Final Report
Site IN4A
Pork Production Facility

for the

NATIONAL AIR EMISSIONS MONITORING STUDY

to

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1 Overview

1.1 Introduction

The primary goals of the National Air Emissions Monitoring Study (NAEMS) were to: 1) quantify aerial pollutant emissions from dairy, pork, egg, and broiler production facilities, 2) provide reliable data for developing and validating emissions models for livestock and poultry production and for comparison with government regulatory thresholds, and 3) promote a national consensus on methods and procedures for measuring emissions from livestock operations. NAEMS consists of two components: a barn component and an open source component. Open source emissions measurements were conducted at a total of 10 different farms in the continental US. Farms chosen for monitoring were selected based on the location (relative to climate and typical practice), method of manure collection, manure storage and physical configuration of the buildings and lagoons/ basins relative to the surrounding terrain.

The NAEMS was managed by Purdue University, in its role as Independent Research Contractor (IRC) to the Agricultural Air Research Council (AARC). The Purdue Applied Meteorology Laboratory (PAML) maintained and calibrated equipment, collected samples, conducted all other on-site activities, and analyzed the data for all open sources.

The objective of this report is to present the quality-assured measurements of ammonia (NH_3) and hydrogen sulfide (H_2S) emissions from the wastewater lagoon open source at the Midwestern sow facility. Within that objective, this report will:

- Describe the farm and the lagoon/basin monitored for the NAEMS
- Describe the monitoring methods and quality assurance
- Present tabulated daily averages of emissions

1.2 Procedures

To meet these objectives, gaseous emissions of NH_3 and H_2S from open sources were measured at a number of farm operations with a range of characteristics. Emissions were measured at a total of 10 farms over the course of two and one-half years.

The emissions from the lagoon were measured to determine the variation in emissions with time of year, stability of the atmosphere, and facility operation. Emissions were measured using models that rely on concentration and wind flow measurements. Lagoon emissions were measured continuously for about one year. The DQO for completeness stipulates a 75% completeness of 10 d per quarter. Setting aside 21 d per quarter to acquire at least 7.5 d of valid data (75% of 10 d) minimized the risk of not meeting this completeness DQO due to instrumentation problems associated with unfavorable weather conditions.

Atmospheric concentrations of NH_3 around the area sources were measured using narrow-bandwidth open path tunable-diode laser absorption spectroscopy (TDLAS). Atmospheric measurements of H_2S concentrations were made using pulsed fluorescence (PF) technology from air collected from 50 m synthetic open path systems (S-OPS) and sampled from a gas sampling system (GSS) that drew the air through the S-OPS. Emissions of NH_3 were determined from the difference in upwind and downwind concentration measurements from the TDLAS open path systems using two emissions models: a Gaussian plume fit model (Radial Plume Mapping: *RPM*; Arcadis Inc, Denver, CO) and a backward Lagrangian Stochastic (bLS) model (*WindTrax*; Thunder Beach Scientific, http://www.thunderbeachscientific.com). Emissions of H_2S were determined using the concentration measurements from the PF analyzer from air sampled by the air inlets of the S-OPS using two emissions models: a Ratiometric model using the ratio of these concentrations to NH_3 concentrations along the same path with the corresponding *RPM* NH_3 emissions measurement, and the bLS model. The critical measurements needed to make the emissions measurements are described in Table 1-1.

Measurements of the lagoon pH, oxidation-reduction potential, and temperature at 0.3 m depth were also measured from a float located at least 30 m from the lagoon inlet (Table 1-2). Measurements of the atmospheric temperature, relative humidity, barometric pressure, solar radiation and wetness were measured and recorded at an automated weather station established on the lagoon berm.

Table 1-1: Critical measurements

Measurement	Method/ Instrument	Required operating range	MDL	Minimum sample frequency	Final data-aggregation
NH_3	TDLAS/ Boreal Laser, Inc. GasFinder2™	1-800 ppb	5 ppm-m	1.2 s dwell	30 min & 24 h
H_2S	PF/Thermo Environmental 450i analyzer	1-800 ppb	2 ppb	60 s averaging	30 min & 24 h
Wind Speed	3D Sonic anemometer/ RM Young 81000	0-60 ms^{-1}	0.01 ms^{-1}	160 Hz sampling/ 16 Hz averaging	30 min & 24 h
Wind Direction	3D Sonic anemometer/ RM Young 81000	0^{o} -360^{o}	0.1^{o}	160 Hz sampling/ 16 Hz averaging	30 min & 24 h
3D Turbulence wind components	3D Sonic anemometer/ RM Young 81000	0-40 ms^{-1}	0.01 ms^{-1}	160 Hz sampling/ 16 Hz averaging	30 min
Temperature Variability	3D Sonic anemometer/ RM Young 81000	-50 to +50°C	0.01°C	160 Hz sampling/ 16 Hz averaging	30 min
GSS sample flow rate	GSS/S-OPS	10 L min^{-1}	0.1 L min^{-1}	30 s	30 min
GSS sampling manifold pressure	GSS/S-OPS	±60,000 Pa	±500 Pa	30 s	30 min
NH_3 emissions	Radial Plume Mapping Model	N/A	N/A	30 min	30 min, 24 h
H_2S emissions	Backward Lagrangian Stochastic Model	N/A	N/A	30 min	30 min, 24 h
NH_3 emissions	Backward Lagrangian Stochastic Model	N/A	N/A	30 min	30 min, 24 h
H_2S emissions	Ratiometric to *RPM* Model	N/A	N/A	30 min	30 min, 24 h

All measurements from around the lagoon (TDLAS, barometric pressure, air temperature and relative humidity, wetness, solar radiation, lagoon pH, lagoon oxidation-reduction potential, lagoon temperature, and wind) were telemetered to an instrumentation trailer on site via radio communications. The instrumentation trailer also housed the GSS (with associated pressure, flow, temperature and humidity measurements) and PF analyzer for the measurement of H_2S in the S-OPS collected air and two computers that controlled the two TDLAS scanners and collected measurements made by the two TDLAS units. All measurements were then stored on a computer in the trailer that was downloaded daily by file transfer protocol (FTP) via the internet to a computer located at the PAML.

Table 1-2: Non-critical measurements.

Measurement	Method/ Instrument	Required Operating range	MDL	Minimum sample frequency	Final Data-Aggregation
Ambient Temperature	Thermistor/ Campbell Scientific Inc HMP45C (Vaisala)	-40 to 50 ° C	0.1 ° C	5 min	30 min, 24 h
Relative Humidity	Hygrometer/ Campbell Scientific Inc HMP45C (Vaisala)	0-100%	5%	5 min	30 min, 24 h
Barometric Pressure	Aneroid barometer/ Setra 278	600 to 1100 hPa	600 hPa	5 min	30 min, 24 h
Surface wetness	VAC resistance grid/ Campbell Scientific Inc.	(binary)	(binary)	5 min	30 min & 24 h
Solar Radiation	Silicon pyranometer/ LiCOR 190SB	0- 1200 Wm^{-2}	10 Wm^{-2}	5 min	30 min & 24 h
Lagoon solids depth	Sludge level detector/ Sludge Gun 10HD, Markland Specialty Eng.	0-10 m	0.05 m	1/ measurement period	1 time
Lagoon/ basin pH	Campbell Scientific Inc CSIM11 (Innovative Sensors, Inc)	0-14 units	0.2 unit	5 min	30 min & 24 h
Lagoon/ basin Oxidation-reduction potential	Campbell Scientific Inc CSIM11-ORP (Innovative Sensors, Inc)	-800 - +1100 mV	20 mV	5 min	30 min & 24 h
Lagoon/ basin Temperature	Thermistor/ Campbell Scientific Inc 107-L	-35 - +50 °C	0.5 °C	5 min	30 min & 24 h

1.3 Farm description and operation

The Midwestern sow lagoon facility was located in Indiana. The elevation at the farm was 264 m. The farm consisted of nine barns and a lagoon (Fig. 1-1), and had a capacity of 1400 sows. The facility had been added to for many years, starting operations in 1968, while the last building addition was completed in 1992. Eight years ago (1998), the facility was changed from a finisher operation to a farrow-to-wean operation.

Liquid waste from the deep pits of the barns was transferred once every two weeks to the lagoon by a single inlet on the east side of the lagoon (Fig. 1-1). The lagoon was south from the barns. The clay-lined waste lagoon was 112 m by 115 m. The lagoon berm was 2-3 m high and had a slope of 3:1. At maximum capacity, the liquid depth was 4 m with a volume of 34,000 m^3 and surface area of 13,580 m^2. Sludge had never been removed from the lagoon. Since the lagoon was inherently a source of gases emanating from manure and effluent residing in the lagoon for multiple months, it was assumed that the number of animals contributing to the lagoon was the maximum capacity of the farm. During the growing season, corn completely surrounded the lagoon.

Figure 1-1: Configuration of the IN4A farm.

1.4 Measurement layout

The NH_3 emissions from the lagoon were monitored continuously for one year using scanning Tunable Diode Laser Absorption Spectrometer (TDLAS) open-path instruments and 3-dimensional (3D) sonic anemometers, in conjunction with meteorological measurements and the radial plume mapping (*RPM*) and backward Lagrangian Stochastic (bLS) emissions models. The H_2S emissions from the lagoon were monitored using pulsed-florescence (PF) of air sampled through a Synthetic Open Path System (S-OPS) and 3-dimensional (3D) sonic anemometers, in conjunction with meteorological measurements and both the bLS emissions model and the *RPM* emissions model in combination with the ratiometric relationships of measured NH_3 and H_2S concentrations.

The path-integrated concentrations (PICs) of NH_3 were measured by TDLAS along optical paths defined by TDLAS/scanner systems and retro-reflectors. The scanning TDLAS instruments (TDLAS/scanner) were mounted at 1-m height above the lagoon berm (abl) at the northwest and southeast corners (Figure 1-2). Towers for mounting retro-reflectors were located off the northeast and southwest corners of the lagoon (Figure 1-2). A description of the position and path length of the optical paths along each side of the lagoon follows:

- <u>North side</u>: Retro-reflectors were located on anchored tripods at 1 abl at distances of 39 m and 79.5 m from the northwest TDLAS/scanner. Three TDLAS retro-reflectors were mounted on the northeast tower 132 m from the northwest TDLAS/scanner at heights of 1.3 m, 6.4 m, and 14.3 m abl.

- East side: Retro-reflectors were located on anchored tripods at 1 abl at distances of 38 m and 76 m north of the southeast TDLAS/scanner. Three TDLAS retro-reflectors were mounted on the northeast tower 134 m from the southeast TDLAS/scanner at heights of 1.3 m, 6.4 m, and 14.3 m abl.
- South side: Retro-reflectors were located on anchored tripods at 1 abl at distances of 38.5 m and 74.5 m from the southeast TDLAS/scanner. Three TDLAS retro-reflectors are mounted on the southwest tower 129 m from the southeast TDLAS/scanner at heights of 1.4 m, 6.6 m, and 14.5 m abl.
- West side: Retro-reflectors were located on anchored tripods at 1 abl at distances of 38 m and 76.5 m from the northwest TDLAS/scanner. Three retro-reflectors were mounted on the southwest corner tower 129.5-m from the northwest TDLAS/scanner at heights of 1.4 m, 6.6 m, and 14.5 m abl.

Two synthetic PICs of H_2S were measured by PF from air sampled from linear S-OPS positioned at 1-m abl. A 50-m long S-OPS path was parallel to and 2 m north of the north berm and began 12 m east of northwest berm corner and extended east (Figure 1-2). The second 50-m long S-OPS was parallel to and 2 m south of the south lagoon berm and began 12 m east of southeast corner of berm (in the drainage swale) and extended west (Figure 1-2). The flow through the S-OPS was maintained and sampled by a gas sampling system (GSS) located in the on-site instrumentation trailer. The temperature and humidity of the air flowing through the GSS, as well as the flow rate through and the suction in the negative-pressure portion of the GSS were measured and recorded on a data logger (Model CR800, Campbell Scientific, Logan, Utah).

Meteorological measurements, including barometric pressure, air temperature, relative humidity, solar radiation, and surface wetness were made on the berm 15 m to the east of the lagoon's southwest berm corner. The data from these meteorological measurements were collected by a data logger (Model CR1000, Campbell Scientific, Logan UT) and telemetered to the on-site instrumentation trailer. The 3D sonic anemometers were located on the meteorological tower at 2.5 m height, and on the southwest corner tower (Fig. 1-2) at 4.2 m and 16.3 m heights above berm level and also telemetered to the on-site instrumentation trailer.

Lagoon measurements (pH, oxidation-reduction potential, and temperature) were made from a float located in the southwest corner of the lagoon.

Figure 1-2: Locations of instrumentation around the lagoon under measurement.

Retro-reflectors are indicated according to side (north, south, east, and west) with 345 indicating the location of a tower. TDLAS/scanner locations are indicated by TS. The locations of the two S-OPS lines are indicated by the solid yellow lines. The instrumentation trailer was located on the east side of the lagoon.

2 Monitoring activities

2.1 Measurement periods

Measurements were made continuously between 7/1/2007 and 7/14/2008 at this location (Table 2.1-1). The equipment was on site a total of 374 d over five measurement periods. Calibrations reduced the number of measurement days from the total number of days on site. NH_3 emissions were measured 303 d and H_2S emissions were measured 71 d.

Table 2.1-1: Days on site

Period	Start date	End date	# days
1	7/1/2007	8/31/2007	61
2	9/1/2007	11/30/2007	90
3	12/1/2007	2/28/2008	89
4	3/1/2008	5/31/2008	91
5	6/1/2008	7/14/2008	43

2.2 Site visits

The Field operation team visited this farm 55 d (Table 2.2). Since this site was the first-year long-term fixed location site, the site set-up and take-down occurred only once each. Most site visits were either for calibration verifications or equipment replacement.

Table 2.2: Dates of site visits

Year	Spring	Summer	Fall	Winter
2007		Jul 24 Aug 8,10,15,16,17,20,22,23,30	Sep 4,5,12,19,20 Oct 4,17,18,23 Nov 1,13,15	Jan 29,30,31 Feb 12,
2008	Mar 5,12,17,20,21 Apr 7,8,14,15,30 May 1,7,12,20,21,27,28	Jun 5,11,19,20,24 Jul 1,2,3,8,14,15,16		

2.3 Instrumentation QA/QC

Calibration verification checks of the instruments making the critical measurements and some of the non-critical measurements most susceptible to deterioration were generally conducted within 21 d intervals on site. Instruments checked during these visits (with indication of Section documenting the instrument performance and calibration verification check results) included:

- GasFinder2™ NH3-OP TDLAS serial number (s/n) 1026, 1027, 1028, 1029 and 1030 (Section 6.1)
- TEC 450i H_2S Analyzer s/n 0733825130 (Section 6.2)
- RM Young 81000 3D sonic anemometers s/n 1925, 1926, 1927 and 1938 (Section 6.3)
- lagoon pH probes s/n 001 and 003 (Section 6.4)
- lagoon ORP probe s/n 010 and 40 (Section 6.5)

- GSS/ S-OPS s/n 4-0019 (Section 6.6)

In addition, the instruments making the critical measurements were calibrated at least semi-annually. During the semi-annual calibrations, multipoint calibrations were conducted on the TDLAS (Section 6.1) and TEC 450i (Section 6.2) instruments and an inter-comparison conducted on the sonic anemometers (Section 6.3) with three unused 'standard' anemometers.

2.4 Audits

No internal audits were conducted at this location due to the location's close proximity to Purdue University and the diverse individuals maintaining the equipment on the location. There was a Technical Systems Audit conducted by USEPA at this location on 24 September, 2007.

2.5 Repair trips

Numerous repair trips were made to this location: 7/20/2007, 8/16/2007, 8/17/2007, 8/20/2007, 8/22/2007, 8/23/2007, 10/4/2007, 10/17/2007, 10/18/2007, 10/23/2007, 11/1/2007, 11/13/2007, 2/12/2008, 4/15/2008, 5/1/2008, 5/7/2008, 5/12/2008, 6/5/2008, 6/11/2008, 6/24/2008, 7/1/2008, 7/3/2008, and 7/8/2008. In addition many trips were made to this location to swap out equipment needed for the continued operation of the many outlying NAEMS measurement locations.

2.6 Remote site checks

Over the course of measurements, there were 77 remote checks made from PAML through the computer for instruments operating at this location. The limited number of remote site checks is due to the close proximity of the site and the early establishment of the site relative to the establishment of the remote-site check routines

2.7 Measurement data acquisition

Data from the TDLAS units (Model GasFinder2™ NH3-OP, Boreal Laser Inc., Spruce Grove, Alberta, Canada) were acquired using the Boreal Laser *GasView MP* software (Boreal Laser Inc., Spruce Grove, Alberta, Canada) program running on laptops dedicated to this purpose (one laptop per TDLAS unit). The TDLAS units sent back data through 2.4 GHz wireless modems about every 1.2 s. This software also controlled the movements of the scanner (Model PTU-D300, Directed Perception Inc., Burlingame, CA) that aimed the TDLAS units.

Weather and lagoon data were saved to the internal memory of the data logger (Model CR1000, Campbell Scientific Inc, Logan, UT) at 5-min intervals. Optimally, these data were transferred to the trailer through 2.4 GHz wireless modem at intervals of 10 min using *Loggernet* software (Campbell Scientific Inc, Logan, UT). However, communications interference at a number of sites significantly impeded this regular data transfer. Thus, it was sometimes necessary to download data directly to a laptop during site visits. The data were then transferred from the laptop to the trailer computer using a USB thumb-drive. As a backup, all data were also stored on a compact flash memory card that was brought back to Purdue and downloaded after each period.

Data from the gas sampling system (GSS) were saved to a data logger (Model CR800, Campbell Scientific Inc, Logan, UT) located in the trailer at intervals of 30 s. These data included the line currently being sampled and the mass flow rate. The data were transferred through a serial cable to the trailer computer every 10 min using *Loggernet*.

Data from the H_2S analyzer (Model 450i, Thermo Fisher Scientific, Franklin, MA) were downloaded in real-time through a serial cable to the trailer computer using the iPort (Thermo Fisher Scientific, Franklin, MA) software program. The *iPort* software frequently disconnected from the analyzer, so that during our daily status checks from PAML it was frequently necessary to reconnect *iPort* to the analyzer, download data back to the time when *iPort* had crashed and stopped collecting data, and restart real-time data collection

Data from the 3D sonic anemometers (Model 81000, RM Young Inc., Traverse City, MI) were downloaded to the data acquisition computer in the trailer using custom built *Visual Basic* software. Binary data from up to four anemometers were transferred at 16 Hz through 900 MHz wireless modems to a single polling modem connected to the data acquisition computer in the trailer. The software time stamped and stored each 16 Hz data point and calculated 100-s and 300-s averages, variances, and covariances for each component of the wind and the sonic anemometer temperature.

Files were transferred from the instrument trailers to the PAML FTP server using the program *rsync* in the *cygwin* environment (open source programs). This transfer took place every six h, as long as the internet connection was available. The program was set up so that only new or modified files were transferred each time, so that only the updated data were transferred. A log of each file transferred was produced by the *rsync* program. The *rsync* program was used to transfer data daily from the PAML FTP server to the PAML data computer. This transfer was performed early each morning before the automated quality control software runs. Two copies of the data were stored on the Data computer. One copy was placed in the directory “FTP” and was never modified. This copy represents the original data as transferred from the trailers. The other copy of the data was placed in the directory “Data”. The data processing and quality control programs used this copy of the data, and modifications and corrections were made to this copy of the data as needed to allow the data to be processed. These modifications will be described below. It is important to note that no actual data numbers were changed during these modifications.

In addition to the copies of the data transferred over the internet, a copy of the data for each period was produced on a CD and DVD. To ensure complete and accurate data transfer, a data comparison program was used to compare the data on the CD/DVDs with the data in the “FTP” directory.

3 Data processing and analysis

Before final data processing, the data files were examined to ensure that they were ready to be processed. Modifications to the files were required due to human error, issues related to changing from one site or period to another, and bugs in the data collection software. None of the actual data were modified in this file preparation, only filenames and/or the file in which the data appeared were changed. A detailed log was kept of each modification.

Deleting empty files: Data files created but not filled with data occurred as a byproduct of the data collection systems. The sonic anemometer data collection program was set up to start automatically when the trailer LAN server computer (hereafter termed LAN) was started. As a result, when the LAN was started at a new location empty files were often created because the sonic anemometer anemometers were not yet in place. If the location and/or period were not adjusted in the sonic anemometer parameter input file before the computer was shut down at the previous site, these empty files would be present in the directory from this previous location or period. These empty files contain no data and were deleted. Empty files also sometimes occurred for the TDLAS units if the TDLAS laptop was still logging but no data were being transferred from the TDLAS. These empty files were generally deleted, although they were sometimes retained since empty files can be handled by the data analysis and QC software. Even if deleted from the "data" directory, these empty files will still be present in the "FTP" directory, and in some cases these empty files will be useful in determining whether missing TDLAS data are due to problems with the TDLAS unit itself or with the TDLAS data collection laptop computer. Empty files in other data sets were also deleted.

Moving/deleting data from surrounding periods: When moving from one site to another or switching periods during a "back-to-back" site visit, several changes need to be made for the data to be saved in the directories for the new site or period. If these changes were not made when the LAN was first started or before the computer was shut down at the preceding site, data for the new site was often saved in the directory for the preceding site. Data were moved from the file for one site to the file for the correct site. Data to be moved were identified by breaks in the data timestamps corresponding to the period when the equipment was shut down and in transit from one site to the next. Data were most often moved in the files for the CR1000 data logger and GSS (CR800 data logger), as these data files started adding new data immediately when the LAN was turned on, and it was easy to forget to immediately make the directory and file name change in *Loggernet*.

Combining data files: The *iPort* software that was used to collect data from the H_2S analyzer occasionally lost its connection with the analyzer causing the data collection to stop. These events were noticed during the daily site checks from PAML at which time the missing data were filled from the internal memory on the analyzer and a new data file was started to collect the data in real-time. To allow the quality control software to run most efficiently, these multiple data files were combined into a single file at the conclusion of the period. The files that were included in this single file were placed in a subdirectory of the H_2S data folder named "Pieces". On isolated occasions, the CR1000-logged or CR800-logged data for a period were split into more than one file, and these data files were generally combined into a single file for the period, unless a change was made to the data stream in between the files (e.g. adding temperature and relative humidity probe to the gas sampling system output).

Renaming files: On some occasions, files had to be renamed due to human error in naming the files or, in the early days of the project, because of the lack of a finalized file structure in which the field operations staff had been trained. These changes were primarily to the TDLAS data files, when the files on the TDLAS laptops were not named appropriately or else TDLAS1 and TDLAS2 were reversed. Various files for other instruments also had to be renamed for a variety of reasons.

Data Processing and Quality Control Input Files: The data processing and quality control software programs require inputs that describe the data to be analyzed. The input parameters for a given site and period are in a single *Excel* workbook consisting of a separate worksheet for each component of the data processing software. These parameter files were produced and then independently double-checked for errors.

3.1 QA/QC software procedures

The valid data times were produced by examining the data in a preliminary run through the data and finding in the records the times when the instrument was calibrated and times when the instrument was known to be malfunctioning. The data excluded as being from a calibration or period of instrument malfunction were placed in separate columns in the output files and plotted in a different color on the output graphs.

Because measurements were acquired on various data acquisition systems, time synchronization of the various systems was critical. The time synchronization data were obtained from the remote site visits conducted as part of the daily status checks. Time corrections were only included if the instrument time was more than one minute off from the LAN. In the end, corrections were made only to the TEC 450i H_2S analyzer as this instrument would infrequently be out of sync by several minutes due to issues with its automatic time updates. The time synchronization is especially important for the TEC 450i because it samples from lines located on both sides of the lagoon and the time difference could lead to H_2S concentrations being recorded for the wrong S-OPS line (side of source).

One worksheet in the *Excel* parameter workbook for each site contains a list of the times of valid data for each data stream and one worksheet indicates when an instrument was out of time synchronization with the LAN as well as the time correction required to bring the data stream into time synchronization with the LAN.

Once the data files were prepared for final processing and the input parameter files were produced for each site and period, the data were processed through the custom designed software for this purpose. Through the duration of the project, each data stream was processed through a separate program, but in preparation for the final data processing these individual programs were combined into a single program to allow for more efficient data processing and easier debugging, as processes that were previously done multiple times in the earlier software versions are now done only once.

The order in which the various data streams were processed was determined by the dependencies in the data processing and quality control between the various instruments: a given data stream may depend on one or more of the preceding streams, but not on following data streams. For each data stream, the data were first loaded into arrays and any corrections for time synchronization applied. The flags were then assigned based on the QAPP. After this, the data exclusion times were applied and the data appropriately broken up into columns. Finally, the data were loaded into *Excel*, plots were produced, and the final data files were saved.

3.2 Data exclusions

Data were excluded from processing due to equipment failures, calibration failures, and calibration checks in progress. Periods of invalidated measurements associated with the calibration check failures is documented in the calibration reports in Section 6. Significant data exclusions of greater than one-day duration are indicated below by instrument with all time in Coordinated Universal Time (UTC):

TDLAS measurement exclusions: Excluded measurements are summarized in Table 3.2-1.

Table 3.2-1: TDLAS measurement exclusions

Begin		End		Reason
8/21/2007	11:16	8/22/2007	14:16	Program stopped
9/11/2007	17:59	9/12/2007	13:38	TDLAS 1 (SE Scanner; 1026) Power disconnected
10/18/2007	0:51	1/30/2008	20:01	Removed TDLAS 1 (SE Scanner; 1026) to replace East Trailer TDLAS
10/19/2007	2:19	10/23/2007	14:58	TDLAS laptops shut down by power failure caused by strong storms
12/1/2008	0:00	2/12/2008	23:59	TDLAS 2 (NW Scanner) Scanner Failure
2/6/2008	3:54	2/12/2008	19:33	TDLAS 1 (NW Scanner; 1030) covered in ice
3/5/2008	21:41	4/15/2008	14:50	TDLAS 2 (SE Scanner; 1030) out for repair
5/20/2008	15:19	5/27/2008	15:44	TDLAS 1 (NW Scanner; 1030) scanner failure
6/9/2008	5:55	6/11/2008	15:45	TDLAS 1 (NW Scanner; 1029) laptop locked up
6/21/2008	17:55	6/23/2008	13:03	TDLAS 1 (NW Scanner(1029) driving program locked up

TEC 450i measurement exclusions: The 450i was returned to the factory for repair resulting in a loss of measurements between 3/21/2008 and 5/28/2008. Exclusions associated with calibrations are summarized in Table 3.2-2.

Table 3.2-2: TEC 450i measurement exclusions

Begin		End		Reason
2/28/2008	17:00	2/28/2008	19:00	Calibration Check
6/19/2008	15:00	6/21/2008	0:00	Calibration Check

Sonic anemometer measurement exclusions: Sonic anemometers experienced communications interference throughout the study. Excluded measurements are summarized in Table 3.2-3.

Table 3.2-3: Sonic anemometer measurement exclusions

Begin		End		Reason
6/19/2007	20:50	6/20/2007	1:15	Beginning Calibration Check
7/14/2007	4:49	7/14/2007	16:14	Calibration Check
8/8/2007	15:30	8/15/2007	16:00	Removed from tower for calibration check, but program wouldn't run. Calibration check finished week later
9/2/2007	9:38	9/5/2007	14:10	Sonic anemometers not working and taken down for calibration check.
9/19/2007	17:05	9/20/2007	19:20	Calibration Check
10/12/2007	22:00	10/19/2007	12:25	New sonic anemometer program installed. Calibration check.
10/17/2007	16:05	10/19/2007	12:20	Calibration Check
11/13/2007	14:39	11/13/2007	20:10	Calibration Check
12/9/2007	12:05	12/10/2007	19:00	Ice blocking transducers
12/15/2007	23:10	12/18/2007	14:30	Ice blocking transducers
1/5/2008	4:23	1/9/2008	14:35	Sonic anemometer program failure
1/18/2008	17:29	1/30/2008	18:40	6 month calibration check
3/8/2008	13:28	3/10/2008	12:30	Sonic anemometer program failure
3/10/2008	21:35	3/12/2008	21:30	Sonic anemometer program failure
3/21/2008	13:55	3/21/2008	17:05	Calibration Check
4/7/2008	16:15	4/7/2008	19:30	Calibration Check
5/1/2008	13:42	5/1/2008	20:25	Calibration Check
5/27/2008	17:04	5/28/2008	16:00	Calibration Check
6/7/2008	10:50	6/9/2008	12:55	Sonic anemometer program failure
6/19/2008	13:49	6/20/2008	14:40	Calibration Check

Lagoon temperature, pH, and ORP measurement exclusions: Excluded measurements are summarized in Table 3.2-4.

Table 3.2-4: Lagoon temperature, pH, and ORP measurement exclusions

Begin		End		Reason
Lagoon temperature exclusion times				
6/19/2007	20:50	6/21/2007	20:55	Probe not yet installed
6/28/2007	16:55	6/28/2007	17:50	Calibration Check
7/24/2007	17:00	7/24/2007	17:20	Calibration Check
8/8/2007	15:30	8/8/2007	16:25	Calibration Check
8/17/2007	15:00	8/17/2007	15:55	Probe wire was cut by mower. Temporary fix was made
8/22/2007	14:35	8/22/2007	15:00	Installing new probe wire.
9/4/2007	16:05	9/4/2007	17:25	Calibration Check
9/19/2007	13:55	9/19/2007	16:40	Calibration Check
10/18/2007	14:40	10/18/2007	15:45	Calibration Check
11/1/2007	16:20	11/1/2007	16:50	Calibration Check
11/15/2007	15:35	11/15/2007	17:50	Calibration Check
1/26/2008	9:25	5/6/2008	14:55	Wires cut during winter due to freezing/thawing of lagoon. Fixed and reinstalled 4/30/2008. Took several days to come back online to good readings
5/12/2008	16:40	5/14/2008	19:05	Numbers spiked unreasonably, then went back to normal readings
6/20/2008	16:55	6/20/2008	18:10	Calibration Check
7/4/2008	14:55	7/6/2008	11:35	Calibration Check

Begin		End		Reason
pH exclusion times				
6/19/2007	20:50	6/21/2007	20:55	Probe not yet installed
6/28/2007	16:55	6/28/2007	17:50	Calibration Check
7/24/2007	17:00	7/24/2007	17:20	Calibration Check
8/8/2007	15:30	8/8/2007	16:25	Calibration Check
8/17/2007	15:00	8/17/2007	15:55	Probe wire was cut by mower. Temporary fix was made
8/22/2007	14:35	8/22/2007	15:00	Installing new probe wire.
9/4/2007	16:05	9/4/2007	17:25	Calibration Check
9/19/2007	13:55	9/19/2007	16:40	Calibration Check
10/18/2007	14:40	10/18/2007	15:45	Calibration Check
11/1/2007	16:20	11/1/2007	16:50	Calibration Check
11/15/2007	15:35	11/15/2007	17:50	Calibration Check
1/26/2008	9:25	7/14/2008	13:50	Wires cut during winter due to freezing/thawing of lagoon. Discovered on 3/17/2008. Passed calibration on 4/8/2008. Failed calibration on 4/15/2008; wires may be bad. Failed calibration 4/30/2008. Probe not replaced during remainder of IN4A.
ORP exclusion times				
Begin		**End**		**Reason**
6/19/2007	20:50	6/21/2007	20:55	Probe not yet installed
6/28/2007	16:55	6/28/2007	17:50	Calibration Check
7/24/2007	17:00	7/24/2007	17:20	Calibration Check
8/8/2007	15:30	8/8/2007	16:25	Calibration Check
8/17/2007	15:00	8/17/2007	15:55	Probe wire was cut by mower. Temporary fix was made
8/22/2007	14:35	8/22/2007	15:00	Installing new probe wire
9/4/2007	16:05	9/4/2007	17:25	Calibration Check
9/19/2007	13:55	9/19/2007	16:40	Calibration Check
10/18/2007	14:40	10/18/2007	15:45	Calibration Check
11/1/2007	16:20	11/1/2007	16:50	Calibration Check
11/15/2007	15:35	11/15/2007	17:50	Calibration Check
1/26/2008	9:25	5/14/2008	19:05	Wires cut during winter due to freezing/thawing of lagoon. Fixed and reinstalled 4/30/2008. Took several days to come back online to good readings
6/20/2008	16:55	6/20/2008	18:10	Calibration Check
7/4/2008	14:55	7/6/2008	11:35	Calibration Check

GSS/S-OPS measurement exclusions: Excluded measurements are summarized in Table 3.2-5.

Table 3.2-5: GSS/S-OPS measurement exclusions

Begin		End		Reason
3/17/2008	15:15	3/17/2008	17:45	Calibration Check
4/7/2008	16:45	4/7/2008	19:15	Calibration Check
5/1/2008	13:45	5/1/2008	15:15	Calibration Check
5/20/2008	15:45	5/20/2008	19:45	Calibration Check
6/19/2008	14:30	6/19/2008	15:30	Calibration Check

3.3 Data correction procedures

Calibration adjustments based on the multipoint calibrations and calibration verifications were made to the NH_3 and H_2S gas concentration measurements. All concentration measurements were normalized to 101.325 kPa and 20°C (STP) within the instruments. The measured system response corrections used the entire record of calibration verifications and adjusted for a bias associated with the sampling system defined by the EPA Method 301 S-OPS validation by using a correction factor of 0.98. No corrections were required for the sonic anemometer measurements.

3.4 Data validation procedures

3.4.1 NH_3 concentration measurements

Because of the nature of the TDLAS data, the TDLAS routine is the most complicated portion of the data processing and quality control software. It is broken into several subroutines. The first subroutine flags pan/tilt locations that are likely to be in super-saturated "holes" in the retro-reflector array. The TDLAS instrument contains a sensor that detects the intensity of the energy returned from the retro-reflector in arbitrary units. Light levels of between 500 and 12000 are required for data to be considered valid. The light level sensor in the TDLAS instrument has a maximum value of 16368 (arbitrary units). Additional returned energy causes the light level to decrease. This creates a super-saturated condition in which the light levels appear valid, but in reality the returned energy is much greater than the allowable threshold for a valid reading. This leads to erroneous instrument readings, frequently indicated by low r^2 values that are associated with large path integrated concentrations (PICs). The term "hole" refers to a region of light levels that appear valid surrounded by maximized light levels. A hole is a region where the instrument will give faulty data, even though the light levels appear valid. The hole-finding algorithm goes through all the data points defined in "optimize" strings output by the instrument each time the scanner moves to a new location and determines data points that either have maximized light levels (16368) on the current day or else are surrounded above and below or to the left and to the right by points that have maximized light levels on the current day. The routine produces a list of locations (pan and tilt) and days that are probably super-saturated.

The next subroutine inputs all the concentration data and calculates averages over each dwell on a retro-reflector array. A scanner moved the TDLAS from one retro-reflector to another, dwelling for about 15 s on each retro-reflector array. The *GasView MP* program produced a flag that indicated when the scanner was moving. Once this flag indicated that the scanner had stopped its movement, one additional 1-s value was ignored, and then the remaining points were averaged to produce the dwell averages. The additional ignored value helped reduce the occurrence of data from the preceding path leaking into the current path because of communications delays.

On the next pass, concentration data from pan/tilt locations and days that were determined to be super-saturated were flagged as super-saturated. However, it was found that simply using the light levels as the super-saturation criteria resulted in the removal of much data that was clearly not super-saturated. To determine which points truly were super-saturated and which were not, a threshold curve of PIC as a function of r^2 was produced (for valid data, r^2 generally increases as PIC increases). As part of the determination of this PIC vs. r^2 threshold, a record was kept for each retro-reflector array of the ten largest paths integrated concentrations corresponding to each r^2 value from pan/tilt locations that were not determined from the initial hole-finding routine to be super-saturated. Based on this top-ten record, the PIC vs. r^2 threshold was determined by searching for outlying values that might indicate a PIC value that should have been indicated as super-saturated but were not.

Once the PIC vs. r^2 threshold curve was determined, a final pass was made through the data, this time comparing the PIC value for each data point with the threshold value at the current r^2. This resulted in four categories of points depending on whether or not super-saturation was indicated by the hole-finding algorithm and whether or not super-saturation was indicated by the hole-finding routine.

In a final pass through the data, data from the individual dwells was averaged up to the 30-min time intervals required by the *WindTrax* and *RPM* emissions models.

3.4.2 H_2S concentration measurements

The H_2S data processing routine first loaded all the H_2S data into an array. Based on the GSS data array, the data were then sorted by source side and a determination was made whether the GSS had been sampling that side long enough and whether enough time remained until the end of sampling that side for the H_2S data to be considered valid. The data were then sorted and averaged into 30-min intervals for placement into the *WindTrax* input file.

3.4.3 S-OPS sampling

The GSS software routine imported the CR800 data and produced two separate arrays of the data. The time grid for one array was based on when the S-OPSs changed from one line to the other line. This array was later used when separating the H_2S data according to which S-OPSs line was being measured and determining whether enough time had elapsed since the previous line-switch and enough time remained before the next line switch to consider the data valid. The other array was based on a regular 30-min grid. This array was used to produce output over the intervals required as input to *WindTrax*. Output from the GSS were also used to ensure that adequate flow was present for the instruments, that condensation was not a problem inside the GSS, and that there were no major issues with the S-OPS lines (leaks, etc.).

3.4.4 Wind component measurements

The sonic software imported the 300-s sonic anemometer data files and produced the final sonic anemometer QC output file and also arrays of data at 30-min intervals for use by the *WindTrax* and *RPM* emissions models. The *WindTrax* arrays contain the turbulence statistics required as inputs to *WindTrax* and also flags used for characterizing the output from the *WindTrax* or else the reason that sonic anemometer data were not suitable for use by *WindTrax* during a particular data interval. The *RPM* arrays contained the wind direction and wind speed averaged over a 30-min interval and interpolated to 10 levels from the surface to 20 m above the surface.

At some sites and during some periods one or more sonic anemometers experienced intermittent communications interference. This interference reduced the number of 16-Hz data points recorded in the trailer and also led to some spurious data points that resulted in some outlying, unphysical data points. These spurious data had little impact on the mean wind speeds, but did impact the variances, sometimes significantly. It was found that the spurious variances were nearly always associated with sonic anemometer temperature variance of greater than 2.5 K^2, while realistic variances never exceeded this same value. To be considered a valid 300-s period, at least 90% (4320) of the possible 4800 16-Hz values had to be present and the sonic anemometer temperature variance had to be less than 2.5 K^2 To be considered a valid 30-min interval, at least 3 of the 6 possible 300-s intervals were required to be valid. This acceptance scheme caught most of the unacceptable variances.

3.5 Emission calculations

3.5.1 NH_3 emissions by RPM

The *RPM* model was used to estimate the NH_3 emission rates based on the TDLAS and sonic anemometer data. Running the supplied version of *RPM* was very time consuming and inefficient and produced data at short intervals on the order of several minutes (time for a scan through all the paths). To make *RPM* processing much quicker and efficient, the sonic anemometer and TDLAS data processing programs were used to skip the first two stages of *RPM* data processing by producing data in the proper format and with the proper filenames for level 3 processing by the *RPM*. These files were produced at an interval of 30 min with all the data for a site and period contained in a single *RPM* input file. This allowed an entire period of data to be *RPM* processed with just a few clicks of the mouse, instead of with many clicks just for each individual day. The 30-min time interval was appropriate because the focus of the NAEMS study is on the long-term emissions over the course of the day rather than on the minute-by-minute emissions. In addition, the 30-min interval also allowed for a higher percentage of data capture since not all paths were necessarily required to be present for the entire 30-min interval.

3.5.2 NH_3 emissions by bLS

Data input into the *WindTrax* model were produced by combining output from the sonic anemometer and TDLAS portions of the data processing software. The *WindTrax* program was run by a portion of the data processing software that assigned values to the concentrations and wind statistics required by the model and told the model to run depending on whether or not the u_* and L values were acceptable.

GoogleEarth® was used extensively in producing the site maps required by *WindTrax*. By the end of the project, each site had a high-resolution image on *GoogleEarth®* sufficient to see the outline of the source area. A GPS was used to obtain precise latitudes and longitudes for the TDLAS units and each of the retro-reflectors. Labeled location markers were then placed at these coordinate locations. When the locations were obviously wrong (the accuracy indicated by the GPS was generally on the order of 4 m or so), either because the path crossed the lagoon or because it was not correctly placed relative to the corner, the markers were moved slightly to the approximate proper location. The image was then saved and loaded into *WindTrax*, where it was used to define the source areas and measurement paths.

All data required for post-processing the *WindTrax* output were placed into the *WindTrax* output file.

3.5.3 Validation of bLS emissions model

All ½ hourly emissions calculated using the *WindTrax* bLS emissions model in which there was a corresponding *RPM* emissions measurement were compared by pairs using EPA Method 301. The precision of the bLS method for each pair of bLS and *RPM* measurements of emissions was assessed assuming the *RPM* method was the reference. The F-test was used to determine if the precision of the bLS method was significantly different from that of the *RPM* method under a range of meteorological conditions. The experimental *F*-value was calculated according to

$$F = \frac{S_{bLS}^2}{S_{RPM}^2}$$

where S^2_{bLS} is the variance of the bLS measurement method determined from all PICs, and S^2_{RPM} is the variance of the *RPM* measurement method determined from five to ten PICs (depending on the incidence angle) on a given downwind side (and possibly an upwind side) for the paired 30-min measurement periods. The experimental *F*-value was compared to the critical range of *F* at a 95% confidence level for the appropriate degrees of freedom associated with the number of measurements used in the variance calculations in both the numerator and denominator. If the experimental *F* was above the critical range, the precision of the bLS method was significantly greater than the *RPM* method. If the experimental *F* was below the critical range, the precision of the bLS method was accepted as equivalent to the *RPM* method.

The bias of the bLS method was determined from the measurement periods and beam lines used in the precision determination. Bias was determined by t-test of the mean differences in emissions calculations for each meteorological condition evaluated for precision. An 80% confidence interval was used (t=1.397). The correction factor was calculated if the difference was significant. If the correction factor was more than 1.10 or less than 0.90, then the bLS method was considered biased accordingly relative to the *RPM* emissions measurements for the location but not invalidated.

3.5.4 H_2S emissions by Ratiometric

Ratiometric H_2S emissions were determined by first finding 30-min intervals for which all the following conditions were satisfied: the *RPM* calculated a valid emission, one of the S-OPS lines was downwind (angle < 60 degrees) and both S-OPS lines had valid H_2S readings, and the TDLAS path corresponding to the downwind H_2S path had a valid concentration. An upwind TDLAS concentration was not used in the calculations. If the preceding conditions were met, then the H_2S emission was estimated as:

$$Flux_{H2S} = Flux_{RPM-NH3} \frac{34.0818\left([H_2S]_{downwind} - [H_2S]_{upwind}\right)}{17030.4[NH_3]_{downwind}}$$

The yield for the Ratiometric method for determining H_2S emissions was limited significantly by the generally poor yield for the *RPM* emissions method for NH_3.

3.5.5 H2S emissions by bLS

Data input into the *WindTrax* model were produced by combining output from the sonic anemometer, GSS, and H_2S portions of the data processing software. The *WindTrax* program was run by a portion of the data processing software that assigned values to the concentrations and wind statistics required by the model and told the model to run depending on whether or not the u_* and L values were acceptable.

GoogleEarth® was used extensively in producing the site maps required by *WindTrax*. By the end of the project, each site had a high-resolution image on *GoogleEarth*® sufficient to see the outline of the source area. A GPS was used to obtain precise latitudes and longitudes for the ends of the S-OPS lines. Labeled location markers were then placed at these coordinate locations. When the locations were obviously wrong (the accuracy indicated by the GPS was generally on the order of 4 m or so), either because the path crossed the lagoon or because it was not correctly placed relative to the corner, the markers were moved slightly to the approximate proper location. The image was then saved and loaded into *WindTrax*, where it was used to define the source areas and measurement paths. All data required for post-processing the *WindTrax* output were placed into the *WindTrax* output file.

4 Results

4.1 Farm activity

Pertinent activities affecting the lagoon include transfer of waste from barns into the lagoon (Table 4.1-1) and lagoon pump-outs for irrigation. Date of lagoon pump-out activity was not recorded by the producer and consequently not listed.

Table 4.1-1: Producer activities

Period	Activity
1: 7/1 - 8/31/2007	N/A
2: 9/1 - 11/30/2007	10/11/2007 Farrowing Building 92,100 gal pumped to lagoon. 10/17/2007 Gestation Building 72,500 gal pumped to lagoon. 10/22/2007 Gestation Building 102,000 gal pumped to lagoon. 11/14/2007 Farrowing Building 82,800 gal pumped to lagoon. 11/23/2007 Gestation Building 172,800 gal pumped to lagoon
3: 12/1/2007 - 3/5/2008	12/10/2007 Farrowing Building 103,000 gal pumped to lagoon. 1/11/2008 Breeding and Gestation Buildings 200,880 gal pumped to lagoon. 1/18/2008 Farrowing Building 44,000 gal pumped to lagoon. 1/28/2008 Breeding and Gestation Buildings 118,000 gal pumped to lagoon. 2/29/2008 Unknown Buildings 158,000 gal pumped to lagoon
4: 3/6 - 6/6/2008	4/15/2008 Breeding and Gestation Buildings 152,000 gal pumped to lagoon. 5/1/2008 Farrowing Building 41,000 gal pumped to lagoon. 5/7/2008 Farrowing Building 93,100 gal pumped to lagoon. 5/14/2008 Farrowing and Gestation Buildings 190,000 gal pumped to lagoon.
5: 6/7 - 7/14/2008	6/9/2008 Gestation Buildings 57,280 gal pumped to lagoon. 6/18/2008 Farrowing Building 98,000 gal pumped to lagoon.

4.2 Weather conditions

4.2.1 Synoptic weather events

Weather conditions during the measurement periods varied widely as expected for midlatitude climates (Table 4.2-1). Approximately 22% of the days had extra-tropical frontal systems overhead while 78% of the days were under the general influence of extra-tropical high pressure. The Daily Weather Maps for the measurement days are found in Section 6.9.

Table 4.2-1: Synoptic weather events during measurements

Measurement Period	# days	# Warm front passages	# Cold front passages	# days stationary front	# days tropical storms
1	61	3	12	2	0
2	90	3	17	3	0
3	89	7	18	1	0
4	91	4	19	3	0
5	43	1	8	0	0

4.2.2 Variation in barometric pressure, solar radiation, air temperature and wetness

Over the course of the measurement periods, the mean daily air temperature varied from -15.2 °C to 27.9 °C while the barometric pressure varied from 96.4 kPa to 100.7 kPa (Section 6.10). Sky conditions ranged from clear skies with maximum ½ h solar irradiance of 1140 Wm^{-2} to overcast conditions with maximum ½ hr solar irradiance of 83 Wm^{-2} (Section 6.10). The wetness sensor failed frequently due to corrosion issues.

4.2.3 Variation in air temperature and relative humidity

The relationship between the daily mean air temperature and humidity compared to the monthly climatology is indicated in Figure 4-1. Temperatures during the spring and summer measurements were near normal, those during the fall were above normal, while those during the winter ranged from below to above normal. Daily mean relative humidity was greater during the winter than spring, summer and fall.

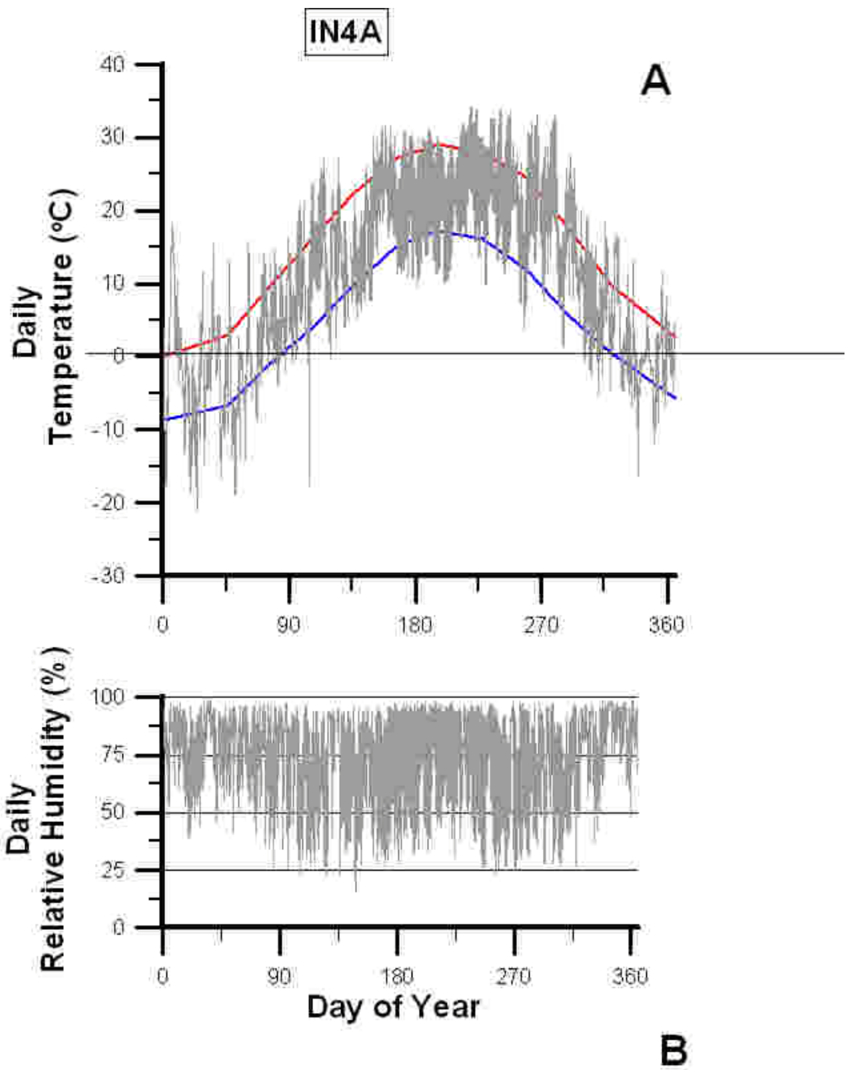
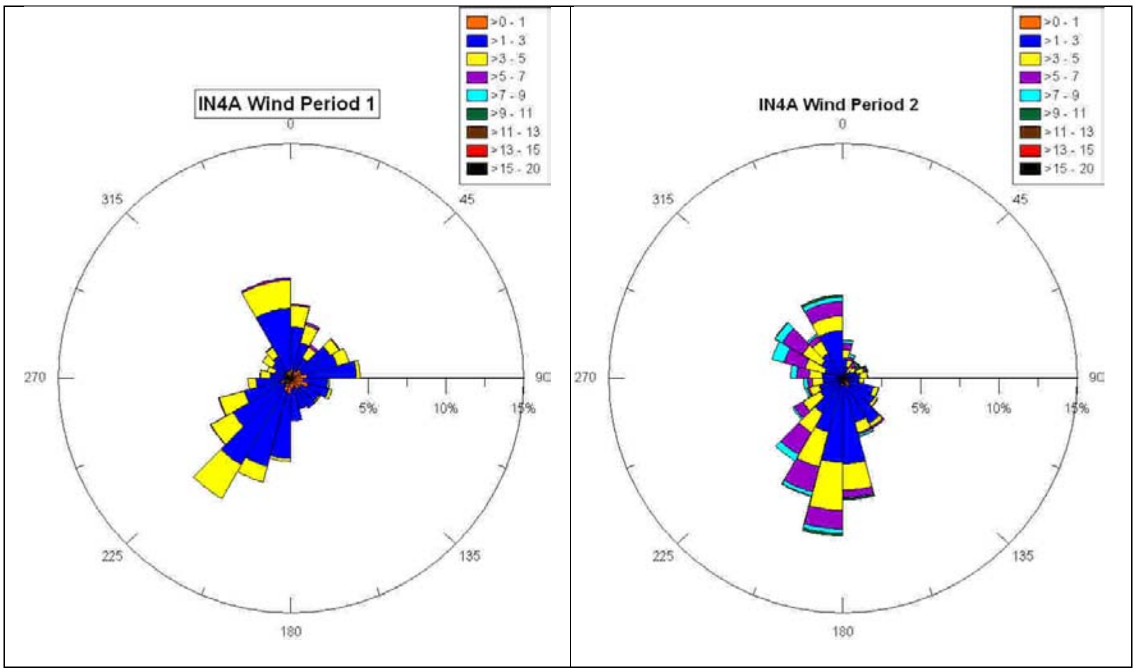


Figure 4-1: Variation in daily temperatures and relative humidity during measurements. The mean monthly climatological maximum (red solid line) and minimum (blue solid line)

temperature are compared against the daily maximum and minimum temperatures for measurement days (grey bars) in panel A. The maximum and minimum relative humidity for measurement days is indicated by the grey bars in panel B.

4.2.4 Wind conditions

Wind conditions for each measurement period are illustrated in Figure 4-2. Winds were largely from the southwest and north-northwest during Period 1, from the south to southwest and northwest during Period 2, from the west during Period 3, from the south or north-northwest during Period 4, and from the south to southwest during Period 5. The frequency of light winds ($\leq 1\ ms^{-1}$) was greatest during the summer (Period 1), with light winds rarely measured during other periods.



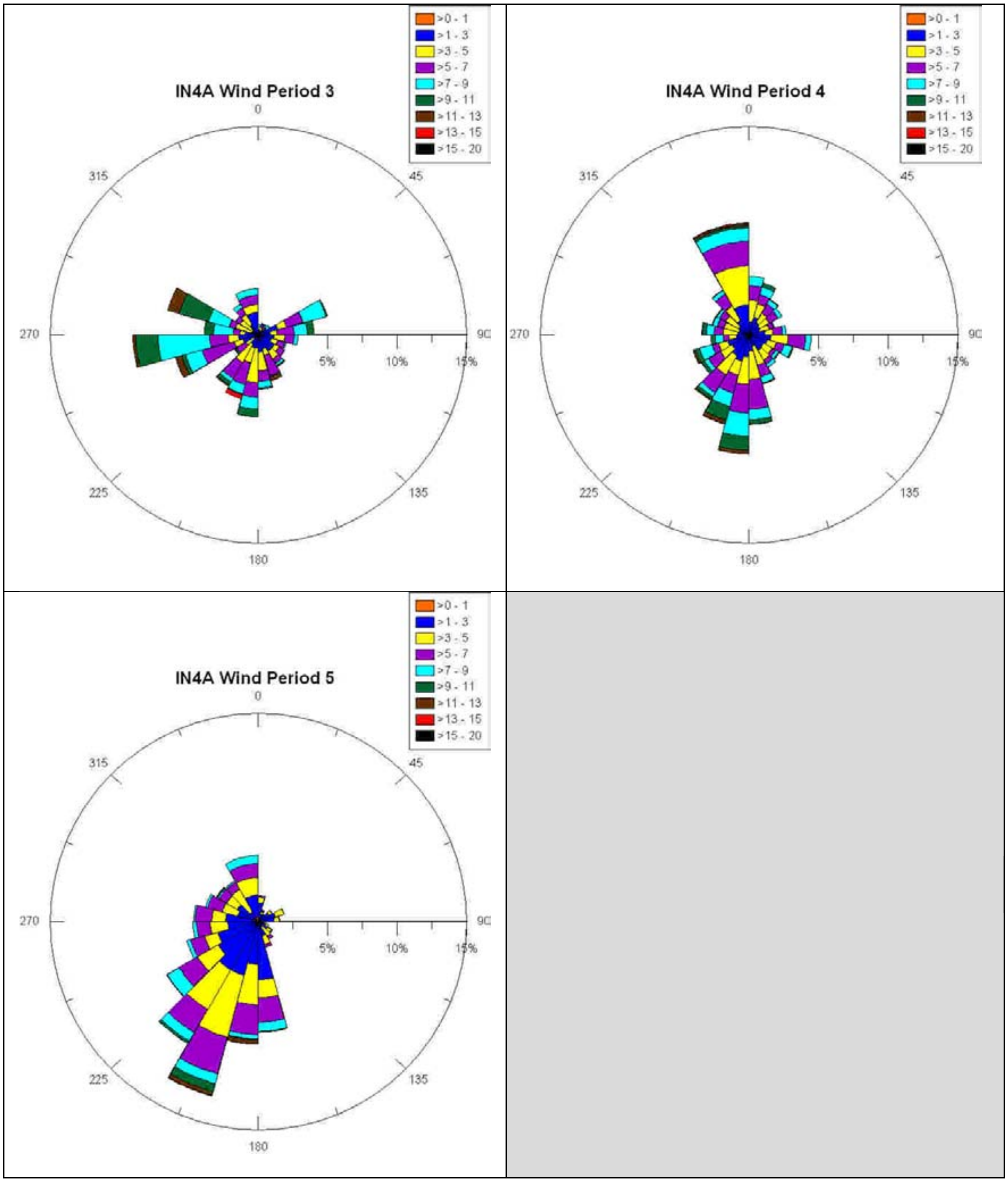


Figure 4-2: Wind roses for ½ hourly wind measurements during the measurement periods. The five periods in which measurements were made are indicated. The relative portion of time in which the wind is from a given direction is indicated by the length of the triangle pointing in that direction. The fraction of time in which the winds were in the binned speed ranges (units of ms^{-1}) is indicated by colors within each triangle.

4.3 Lagoon conditions

4.3.1 Lagoon appearance, liquid depth and sludge depth

The appearance of the lagoon was recorded on almost every site visit (Table 4.3-1). The lagoon generally appeared brown with surface characteristics ranging from frozen during the winter to free of crust during the remainder of the year.

Table 4.3-1: Lagoon physical characteristics

Period	Appearance	Liquid depth	Sludge depth	Source of measure-ment
	Color/Crust	(m)	(m)	
1: 7/1 - 8/31/2007	7/20/2007 - brown/no crust 7/24/2007 - brown/no crust 8/8/2007 - brown/no crust 8/10/2007 - brown/no crust 8/15/2007 - brown/no crust 8/16/2007 - brown/no crust 8/17/2007 - brown/no crust 8/20/2007 - brown/no crust 8/22/2007 - brown/no crust 8/23/2007 - brown/no crust 8/30/2007 - brown/no crust	1.79	0.25	Sludge Gun
2: 9/1 - 11/30/2007	9/4/2007 - brown/no crust 9/5/2007 - brown/no crust 9/12/2007 - brown w/ pink crust/3% crust 9/19/2007 - brown/no crust 9/20/2007 - brown/no crust 10/4/2007 - brown/no crust 10/18/2007 - brown/no crust 10/23/2007 - brown/no crust 11/1/2007 - brown/no crust 11/13/2007 - brown/no crust 11/15/2007 - brown/no crust	1.7	0.3	Sludge Gun
3: 12/1/2007-3/5/2008	1/29/2008 - brown/ 30% frozen 1/30/2008 - brown/100% frozen 1/31/2008 - brown/100% frozen 2/12/2008 - 100% frozen 3/5/2008 - brown/100% frozen	N/A	N/A	N/A

Period	Appearance	Liquid depth	Sludge depth	Source of measure-ment
	Color/Crust	(m)	(m)	
4: 3/6 - 6/6/2008	3/12/2008 - blackish/no crust 3/17/2008 - brown/no crust 3/20/2008 - brown/no crust 3/21/2008 - brown/no crust 4/7/2008 - brown/no crust 4/8/2008 - brown/no crust 4/14/2008 - brown/no crust 4/15/2008 - brown/no crust 4/30/2008 - brown/no crust 5/1/2008 - brown/no crust 5/12/2008 - brown/no crust 5/20/2008 - blackish/no crust 5/21/2008 - blackish/no crust 5/27/2008 - blackish/no crust 5/28/2008 - dark blue/no crust 6/5/2008 - dark brown/no crust	2.25	0.29	Sludge Gun
5: 6/7 - 7/14/2008	6/19/2008 - brown/no crust 6/20/2008 - brown/no crust 6/24/2008 - brown/no crust 7/1/2008 - brown/no crust 7/2/2008 - clear/no crust 7/3/2008 - brown/black/no crust 7/8/2008 - brown/no crust 7/14/2008 - brown/no crust 7/15/2008 - brown/no crust 7/16/2008 - brown/no crust	N/A	N/A	N/A

4.3.2 Temperature, pH and oxidation-reduction potential

The measured daily average lagoon liquid temperature varied from 0 °C to 31 °C. The probe float was not removed during the winter so temperatures of 0 °C were measured for extended periods (Section 6.11). The measured lagoon pH varied from 7.6 during the fall to 8.2 during the winter (Section 6.11). The corresponding oxidation-reduction potentials varied from -483 mV to -248 mV during the summer to -147 mV during the winter (Section 6.11). Significant losses to the record limit the utility of these measurements in relating conditions in the lagoon to the emissions of the lagoon.

4.4 Emissions measurements

Emissions data were calculated on a ½ hour basis since this was the interval over which the S-OPS system sampled both sides of the lagoon and since this interval is in the range over which turbulence statistics are often calculated. To account for the longer term manure storage of the lagoon or basin, emissions reported on a head basis were scaled by the animal population for which the facility was designed and not the animal population at the time of measurements. Emissions reported on an animal unit (AU) basis (1 AU = 500 kg) assumed the typical animal weight values reported by the producer. Piglets were not included in the populations or AU determinations. Emissions reported on an area basis are based on the surface area of the lagoon.

4.4.1.1 Comparison of RPM and bLS emissions models

The comparison between the RPM and bLS emissions models was conducted according to the USEPA Method 301 'Field Validation of Pollutant Measurement Method' using NH_3 emissions measurements. The comparison was based on 530 half- hour measurement periods over the entire measurement time at this location. Results show that the bLS emissions had a significantly difference precision (F=1.16, critical F 1.0) and a significant bias over the *RPM* emissions (t=3.80, $t_{0.2}$=1.29) with a corresponding correction factor for the bLS of 1.08 (Table 4.4.1-1). Consequently the ½ hour bLS emissions measurements are biased high by 8% compared to the *RPM* measurements.

Table 4.4.1-1: Comparison of the bLS and RPM NH_3 emissions

	RPM	bLS	bLS-RPM
Mean emission (gs^{-1})	0.515	0.557	0.042
Standard deviation (gs^{-1})	0.323	0.348	
Variance of the mean (g^2s^{-2})	0.105	0.121	

4.4.2 NH_3 emissions

4.4.2.1 Mean daily NH3 emissions

An annual trend in the daily NH_3 emissions based on the *RPM* model was indicated (Figure 4.4.1-1) with a summer emission of approximately 60 g NH_3 $d^{-1}hd^{-1}$. There was, however, only one day in which 75% of the ½ hour periods within the day had measurable emissions using the *RPM* model. Consequently the high emissions values indicated may be either over or under-representing the mean daily emission depending on the time of day in which the measurable emission occurred. The daily emission during the winter was not measurable using the *RPM* model due to equipment problems. There was a wide variability in emissions from day to day. The daily NH_3 emissions and the number of valid measurements used in the mean daily emissions estimate calculated using the *RPM* model are listed in Section 6.12.1.

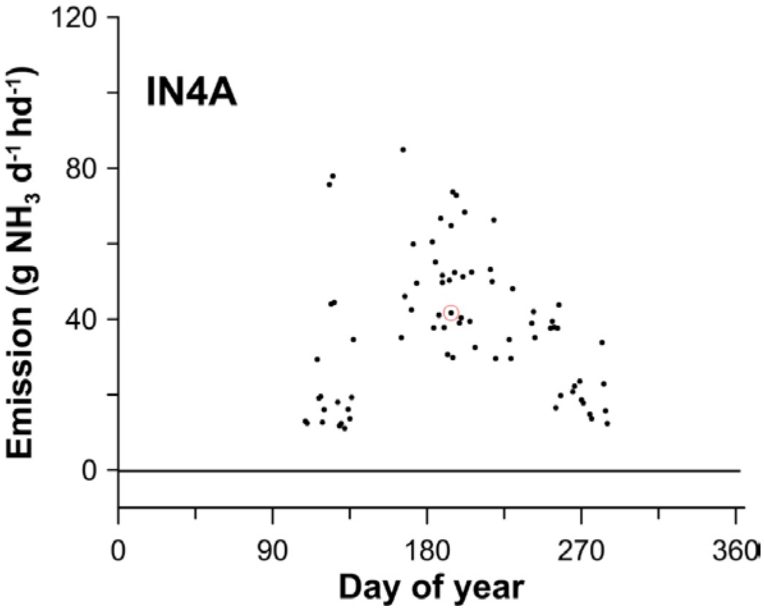


Figure 4.4.1-1: Annual variation in RPM-computed daily NH_3 emissions. Days with a red circle indicate there are measurements for greater than 75% of the continuous day.

A distinct annual trend in NH_3 emissions based on the bLS model was evident (Figure 4.4.1-2). The bLS emissions model provided not only more daily estimates of the NH_3 emissions, but also more days in which more than 75% of the day had valid NH_3 measurements (Table 4.4.1-2). Comparing the standard deviation of the ½ hr emissions estimates of the daily emission rate to the range of partial-day estimates of the daily emission rate shows that the wide range of emission measurements during the summer are due to both day-to-day variability and estimates made on incomplete measurement days (having less than 75% of the possible ½ hrs with valid measurements). There was more variability day to day in the bLS-modeled NH_3 emissions values (Figure 4.4.1-2) than the *RPM*-modeled NH_3 emissions values (Figure 4.4.1-1). This is largely because there were many more partial days of valid emissions measurements. Negative emissions during the fall and winter were likely a result of near MDL concentrations around the lagoon in combination with NH_3 transported to the lagoon from the barns to the North. Emissions during the winter when the lagoon was frozen were not, however, always zero. Maximum NH_3 emissions during the summer are between 40 and 80 g NH_3 $d^{-1}hd^{-1}$. There was wide variability in NH_3 emissions from day to day during the entire year (Figure 4.4.1-2). The daily NH_3 emissions and the number of valid measurements used in the mean daily emissions estimate calculated using the bLS model are listed in Section 6.12.2.

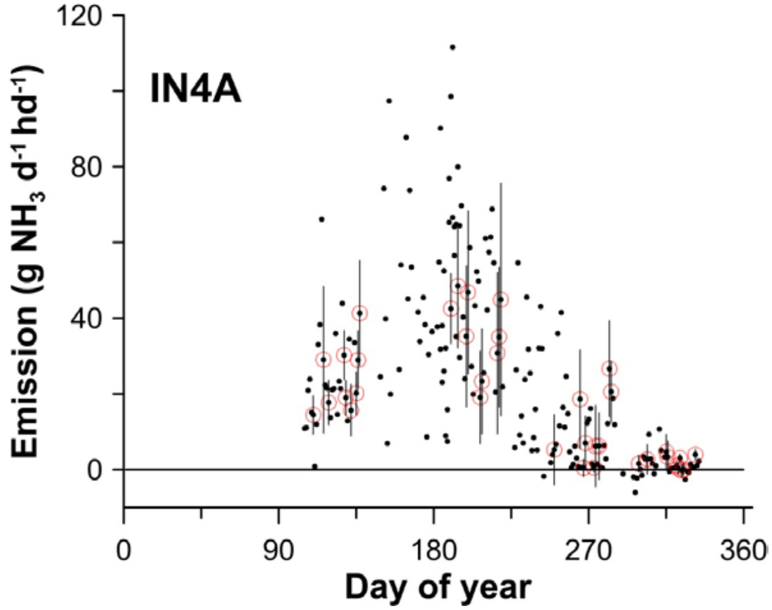


Figure 4.4.1-2: Annual variation in bLS-computed daily NH_3 emissions. Days with a red circle indicate there are measurements for greater than 75% of the continuous day. The bars represent the standard deviation of emissions based on individual ½ hr values when at least 75% of the day had valid measurements.

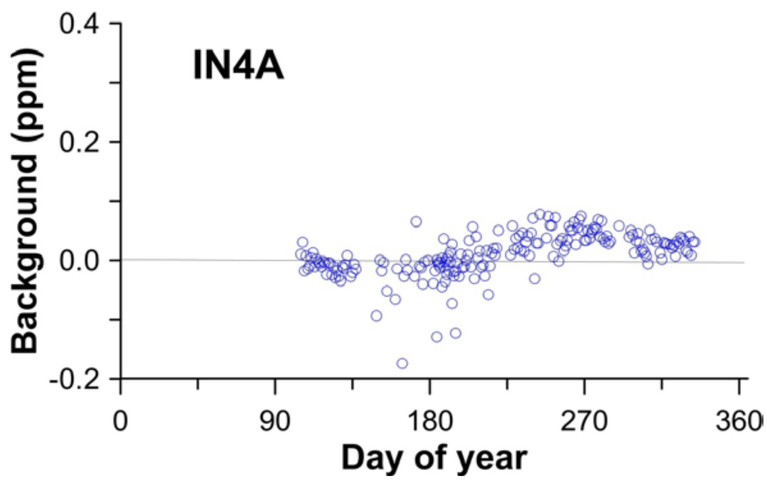


Figure 4.4.1-3: Annual variation in bLS-computed mean daily background concentration of NH_3.

The bLS model was influenced by the calculated background concentrations. Results indicate that the background concentration of NH_3 was generally less than 0.1 ppm (Figure 4.4.1-3). The greatest background concentrations occurred around day of year 270. Given that the typical path length around the lagoon was 50 m to 100 m, this translates to a background concentration for a given PIC of 5 to10 ppm-m. This is above the MDL for the TDLAS instruments (2 ppm-m: Section 6.1) and therefore represents a real background concentration. The negative background concentrations < -0.05 ppm during the summer contributed to some of the very high emissions calculated by the bLS model (Figure 4.4.1-2). These negative values were largely a result of winds shifting within the 5-min time interval for NH_3 measurements.

4.4.2.2 Diurnal variation in NH_3 emissions

The NH_3 emissions were generally higher during the day time than during the night time (Figure 4.4.1-4). During the winter when no significant emissions of NH_3 occurred there was no diurnal variation evident. The greatest diurnal variation occurred during the summer. The wide range of ½ h measurements of the daily emission rate during the summer supports the wide standard deviations of ½ h emission measurements within a single day emission estimate illustrated in Figure 4.4.1-2.

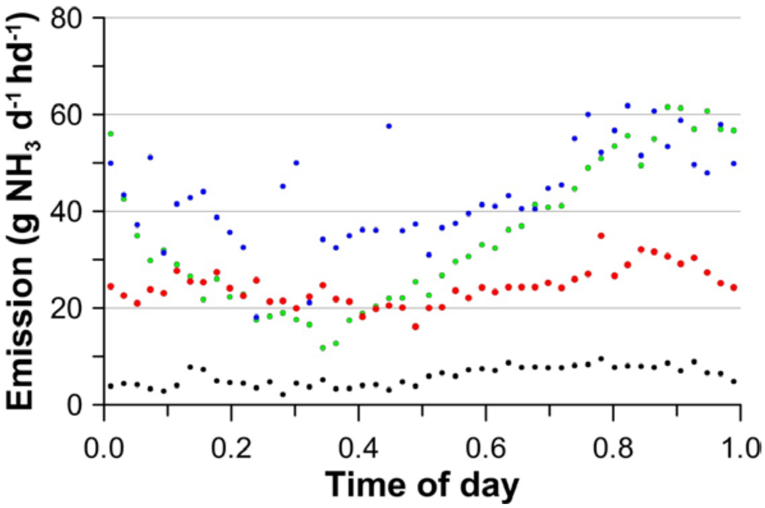


Figure 4.4.1-4: Diurnal variation in bLS-computed NH_3 emissions. Time based on Universal Time Coordinates. The mean emission for each half-hour of the day within a given measurement period (Period 1-Summer (greed), Period 2-Winter (black), Period 4-Summer (red), and Period 5-Spring (blue)) are indicated.

4.4.2.3 NH_3 emissions data completeness

Unless otherwise indicated, emissions completeness and failure totals are given in number of days corresponding to the total number of ½ hour intervals for which the indicated condition was true. This number of days does not indicate the data completeness for any individual day. Therefore, an additional value giving the total number of days with at least 36 valid ½ hour periods (corresponding to 75% completeness on a daily basis) is given. There was no wind direction exclusion region at IN4A, so no data were excluded solely based on wind direction. The completeness statistics are summarized in Table 4.4.1-2.

Table 4.4.1-2: Completeness statistics for NH_3 emissions measurements

Parameter	RPM model	bLS model
Valid ½ h measurements (d)	14.8	89.8
Measurements excluded due to wind direction (d)	0 .0	0.0
Measurements excluded because touchdown fraction < 0.1	—	30.8
Measurements excluded because at least one downwind path is missing or invalid (d)	249.1	—
Measurements excluded because $u_* < 0.15$ ms^{-1} or $\|L\|<2$ m (d):	—	71.8
Number of days with ≥ 36 valid ½ hour periods (d):	1.0	37.0

In total, approximately 15 d of valid NH_3 emissions were determined from the 264 measurement days using the *RPM* model, with only 1 day having at least 36 valid ½ hour NH_3 emissions. The absence or invalidation of at least one downwind path led to 249.1 d for which emissions could not be calculated.

Approximately 90 d of valid NH_3 emissions were determined from the 264 measurement days using the bLS model, with 37 d having at least 36 valid ½ hour NH_3 emissions. Invalid turbulence statistics ($u_* < 0.15$ ms^{-1} or $|L| < 2$ m) led to approximately 72 d in which emissions could not be calculated. These invalid turbulence statistics were most prevalent during the night when light winds were more predominant. A touchdown fraction of less than 0.1 led to the exclusion of 31 d of data. Low touchdown fractions indicated that little, if any, downwind data was available. This corresponded to either when the downwind TDLAS was not present or else the downwind paths were lost because of invalid light levels.

The *RPM* model requires all 5 or 10 (depending on the wind direction) downwind paths to have valid concentration readings for at least a portion of the ½ hour interval. This contrasts with the bLS model which requires only 1 downwind surface path to have valid concentration readings. This difference is largely responsible for the much greater completeness for the bLS model than the *RPM* model. The *RPM* model uses ½ hour mean wind speed and direction, in contrast to the bLS model that requires extensive turbulence statistics over this same period. As a result, there are times that the *RPM* model produces valid emissions that the bLS model does not. However, these times are overwhelmed by the times that the *RPM* model is missing concentration data for one or more paths, while the bLS model is able to run.

4.4.3 H_2S Emissions

4.4.3.1 Mean daily H2S emissions

There were too few daily H_2S emissions based on the Ratiometric emissions model to detect any annual emissions pattern (Figure 4.4.2-1). There were no days at this location that had valid measurements during at least 75% of the day using this calculation method. Consequently, no interpretation of the variability in H_2S emissions is possible. The daily H_2S emissions and the number of valid measurements used in the mean daily emissions estimate calculated using the Ratiometric model are listed in Section 6.12.3.

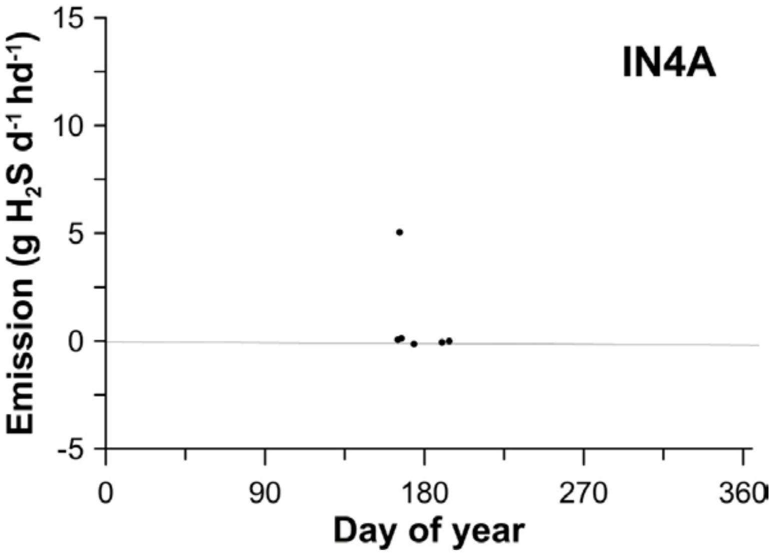


Figure 4.4.2-1: **Annual variation in radiometric-computed daily H_2S emissions.** Days with a red circle indicate there are measurements for greater than 75% of the continuous day.

A peak in H_2S emissions during the spring was suggested based on the bLS emissions model (Figure 4.4.2-2). Although the number of days with H_2S emissions measurements is limited, the bLS emissions model provided not only more daily estimates of the H_2S emissions, but also more days in which more than 75% of the day had valid H_2S measurements (Table 4.4.2-1). There were no H_2S emissions during the winter when the lagoon was frozen or during the summer. A maximum H_2S emission suggested by measurements during the spring could not be determined with any confidence. The daily H_2S emissions and the number of valid measurements used in the mean daily emissions estimate calculated using the bLS model are listed in Section 6.12.4.

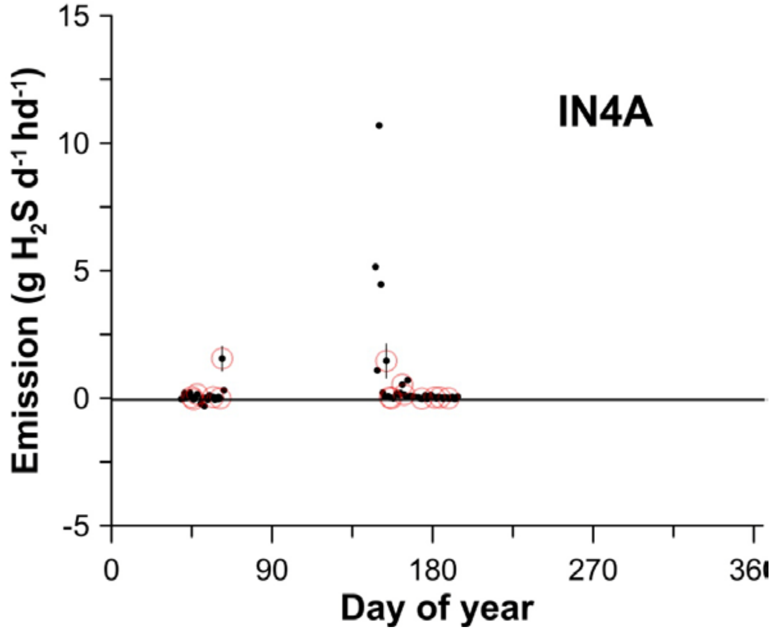


Figure 4.4.2-2: Annual variation in bLS-computed daily H_2S emissions. Days with a red circle indicate there are measurements for greater than 75% of the continuous day. The bars represent the standard deviation of emissions based on individual ½ hr values when at least 75% of the day had valid measurements.

The bLS emission model depends on a good estimate of the background H_2S concentration. Results indicate that the background concentration was generally less than ±2.5 ppb (Figure 4.4.2-3). This background is consistent with an equivalent zero value where the instrument MDL was 3.4 ppb (Section 6.2).

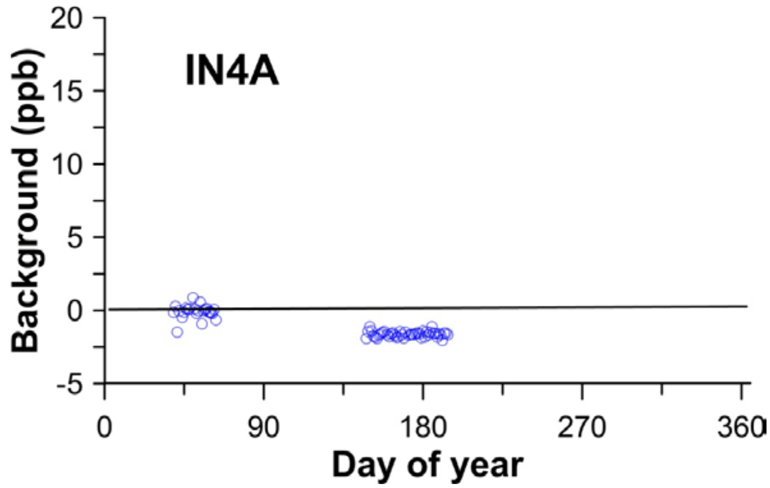


Figure 4.4.2-3: Annual variation in bLS-computed mean daily background concentration of H_2S.

4.4.3.2 Diurnal variation in H_2S emissions
There was no evident diurnal variation in H_2S emissions regardless of season (Figure 4.4.2-4).

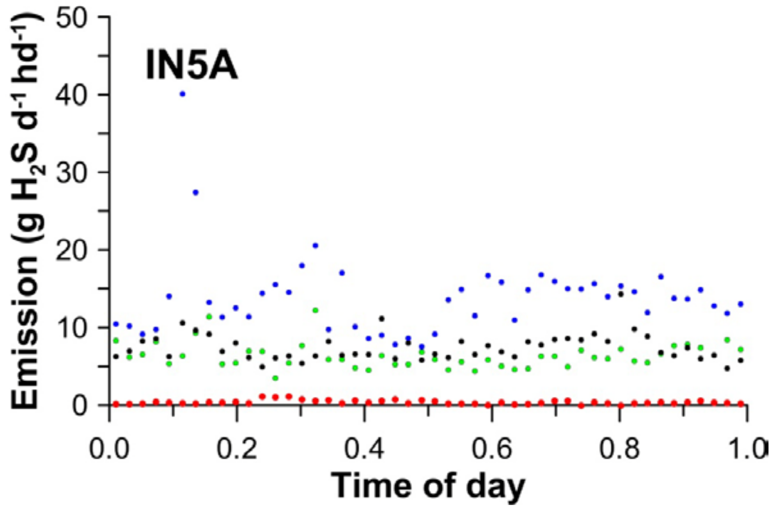


Figure 4.4.2-4: Diurnal variation in bLS-computed H_2S emissions. Time based on Universal Time Coordinates. The mean emission for each half-hour of the day within a given measurement period (Period 3-Winter (black), Period 4-Summer (red), Period 5-Fall (blue)) are indicated.

4.4.3.3 H_2S emissions data completeness
H_2S Measurements were begun in Period 3. Consequently there were no measurements possible for Fall or Winter. As described for the NH_3 emissions, emissions completeness and failure totals are given in number of days corresponding to the total number of ½ hour intervals for which the indicated condition was true. This number of days does not indicate the data completeness for any individual day. The completeness statistics are summarized in Table 4.4.2-1. The completeness statistics are summarized in Table 4.4.2-1.

Table 4.4.2-1: Completeness statistics for H_2S emissions measurements

Parameter	Ratiometric model	bLS model
Valid ½ h measurements (d)	0.4	32.8
Measurements excluded due to wind direction (d)	0.0	0.0
Measurements excluded because angle of attack > 60^o (d)	—	14.8
Measurements excluded because $u_* < 0.15$ ms^{-1} or $\|L\| < 2$ m (d)	—	16.2
Number of days (d) with ≥ 36 valid ½ hour periods:	0.0	15 .0

There was less than one day of valid H_2S emissions that were determined using the Ratiometric emission method, with no days having at least 36 valid ½ hour H_2S emissions. Given the limited period of measurements, there was still a poor yield of valid measurements during the Spring and Summer as a result of three factors. The primary cause for poor yield was the return of the instrument to the manufacturer for repair: no measurements were made between 3/21/2008 and 5/28/2008. Another factor was that this method requires a valid NH_3 emission calculation by the *RPM* model. As indicated, the *RPM* model itself has relatively low completeness as a result of the loss of at least one of the ten needed measurement paths. In addition, that the lack of S-OPS lines on the north and south sides of the lagoon limits the range of wind directions for which the Ratiometric method can be used due to the requirement of a valid downwind H_2S concentration reading.

Approximately 33 d of valid H_2S emissions were determined using the bLS model, with 15 d having at least 36 valid ½ hour H_2S emissions. Invalid turbulence statistics ($u_* < 0.15$ ms^{-1} or $|L| < 2$ m) led to 16 d for which emissions could not be calculated. These invalid turbulence statistics were most prevalent during the night when light winds were more predominant. An angle of attack greater than 60 degrees led to the exclusion of 15 d of data. The absence of S-OPS lines on the east and west sides of the lagoon is largely responsible for these large angles of attack, as winds from the east or west were more or less parallel to the S-OPS lines on the north and south sides, leading to poorly defined inputs to the bLS models and invalid results.

4.4.4 Estimation of emission measurement errors

Errors in the response of the TDLAS due to atmospheric moisture limited the accuracy of the TDLAS serial numbers 1026, 1027, and 1028 prior to July 21, 2008. TDLAS 1026 and 1027 were used at IN4A from 7/1/2007 to 2/28/2008 (Measurement periods 1 through 3). Under the calibration verification checks, the TDLAS error of all units was within a10% accuracy. However due to the short path length of the calibration verification, these checks did not assess water vapor interferences experienced in the long path lengths around the area sources. Inter-comparisons between various TDLAS units experiencing atmospheric moisture interference and units without apparent interference revealed reduced responses with the moisture-affected units of 28%, 68%, 36% and 31% for atmospheric moisture varying from dew point temperatures of -2^oC to 20^oC. A conservative estimate of the bias of all of the above TDLAS units with evident moisture interference was estimated at -40%.

4.4.4.1 Error in RPM-measured NH_3 emissions

Tracer releases studies indicated that the RPM emissions measurement has an error in accuracy of approximately ±15% (Hashmonay et al., 2001; Verma et al., 2005; USEPA, 2007). The TDLAS measurement error was 10% (Section 6.1). Combining errors results in an expected error in the RPM-measurement of NH_3 emissions of ± 18%. In addition, the NH_3 measurements made using the TDLAS units with moisture interference had a bias of -40%.

4.4.4.2 Error in bLS-measured NH_3 and H_2S emission

Tracer studies using TDLAS concentration measurements in combination with the bLS emissions model averaged over roughly two hour periods indicated the bLS method error for a given 15-min period varied with stability: overestimated by 12% under near neutral conditions, underestimated by 13% under unstable conditions, and overestimated by 38% under stable conditions (Flesch et al., 2004). Under conditions when Monin Obukhov similarity theory was valid, the bLS-calculated emission rate was biased 6% high with a standard deviation of 16%. Laubach and Kelliher (2005) evaluated the theoretical errors of the bLS model. The breakdown of their 22% model error included a 12% error for the estimate of the Monin-Obukov Length (L) derived from measurements, a 5% error in turbulence statistics (10% error for the normalized variability statistics in the x and y directions and 5% in the z direction), a 15% error associated with the roughness length (z_o) estimate, and a 10% error due to the stochastic methodology. This was consistent with tracer-estimated errors of the bLS emission calculation method, when constrained by the data quality indicators of the bLS method, of between 5% and 36%.

For this study, we assumed the above theoretical random error of 22% for the bLS emissions measurements. The TDLAS measurement error was 10% (Section 6.1). At this location the daily mean bLS emissions bias from the RPM emissions measurement was +8% (from the RPM/bLS method comparison in Section 4.4). As previously stated, the TDLAS units with moisture interference had a bias of -40%. Combining errors resulted in an expected error in the RPM-measurement of NH_3 emissions of ± 24% with a bias of -32% for TDLAS NH_3 measurements made by units with moisture interference and a bias of +8% for TDLAS NH_3 measurements made by units without moisture interference.

The H_2S PF instrument measurement error was 10% (Section 6.2). Given the expected error in the bLS measurement of emissions of 22%, the H_2S emissions error was estimated as ± 24%

4.4.4.3 Error in Ratiometric-measured H_2S emission

The Ratiometric method of H_2S emissions measurement depends on the RPM measurement of NH_3 emissions. The RPM emissions measurement had an error of approximately ±15%. Since the Ratiometric method ratios the emissions and concentrations of NH_3, there was no affect of the moisture interference in the TDLAS measurement on the H_2S emissions calculation. Given the H_2S PF instrument measurement error of 10% (Section 6.2), the combined error for the Ratiometric measurement of H_2S emissions was ± 18%.

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6 Appendices

6.1 TDLAS NH_3 calibrations

Five TDLAS units (Model GasFinder2™ NH3-OP, Boreal Laser Inc., Spruce Grove, Alberta, Canada) were used for measurements at this location: TDLAS 1026, TDLAS 1027, TDLAS 1028, TDLAS 1029, and TDLAS 1030.

TDLAS 1026 was multipoint calibrated seven times during the study (Figure 6.1-1). The response is non-linear and consequently a third-order polynomial was used to correct the raw data for the instrument response. The multipoint calibration on 1/17/2007 was used for the entire study period. The offset of the equation was determined from a least squares fit of the entire record of calibration verifications made at 50 ppm-m applied to the first, second, and third order terms derived from the multipoint calibration. The regression equation was:

$$\text{ppm-m} = -0.97 + 1.0197 * X - 4.410\text{E-}5 * X^2 + 1.591\text{E-}8 * X^3$$

where X is the instrument response. The response of the sensor was influenced by humidity until 7/21/2008 due to an error in the factory settings for the spectral waveband analysis window. At that time, factory personnel corrected the spectral waveband used for analysis. The effect of this error was to 1) reduce the maximum possible linear correlation with the internal reference cell resulting in unusually low r^2 values under conditions in which the concentration of NH_3 was more than three times of the MDL, and 2) reduce the reported concentration. Adjustments made on the instrument at this time did not appear to affect the calibration (conducted before and after adjustments) but did change the maximum r^2 reached by the instrument when in the field for long path lengths and high humidity.

A zero concentration is not reportable by this instrument because the concentration is based on the correlation of the measured NH_3 absorption to a reference gas. No measured absorption at zero concentration results in no correlation and consequently no reportable measurement. The MDL of the instrument was determined from the mean of the variability (3 times the standard deviation) experienced at the verification concentration during each calibration verification. Since the calibration verifications were conducted in a very short path length, the water vapor effect on the instrument response was generally not detectable. The MDL was calculated to be 2.04 ppm-m prior to the July 2008 modification and 1.77 ppm-m after the modification. The instrument performance was within the MDL DQI that required the MDL to be less than 10 ppm-m. The calibration equation offset was less than the requisite DQI MDL.

Instrument performance calibration checks (Figure 6.1-2) were made at the beginning and end of each measurement period. The majority of calibration checks were made within 21 d (Figure 6.1-3). The large fraction of checks made within 7 d is the result of calibration checks made at the end and beginning of sequential measurement periods. The standard deviation of the verifications about that predicted by the calibration equation was 8.27 ppm-m. The precision DQI was ±10% RSD at 100 ppm-m. All verifications resulted in less than 10% RSD for 50 ppm-m (Figure 6.1-2) and well within the precision DQI. The accuracy DQI was ±10% of the 1000 ppm-m range of the measurements. A positive bias in the calibration verification exceeding the DQI occurred on 4/28/2009 and 11/10/2009 while negative biases exceeding the DQI occurred over the period 4/2/2008 through 7/1/2008 (Figure 6.1-2). The 4/28/2009 and 11/10/2009 bias exceedences were followed the same or next day with a passing verification and were deemed to be a result of operator error. The negative bias over the period 4/2/2008 through 7/1/2008 was not a result of calibration cylinder certification error (three different cylinders were used). During operations the bias was only intermittently evident because to different multipoint calibration was applied to the calibration verification measurements during the progress of the study than finally applied during the analysis. Repeated calibrations within 24 hours often showed biases differing by more than 10 ppm-m suggesting operator errors. Although this instrument had a bias associated with water vapor interference, the instrument was in use in dry climates during this time. The measurements made during this period are considered valid and the error assumed to be due to the calibration verification operator.

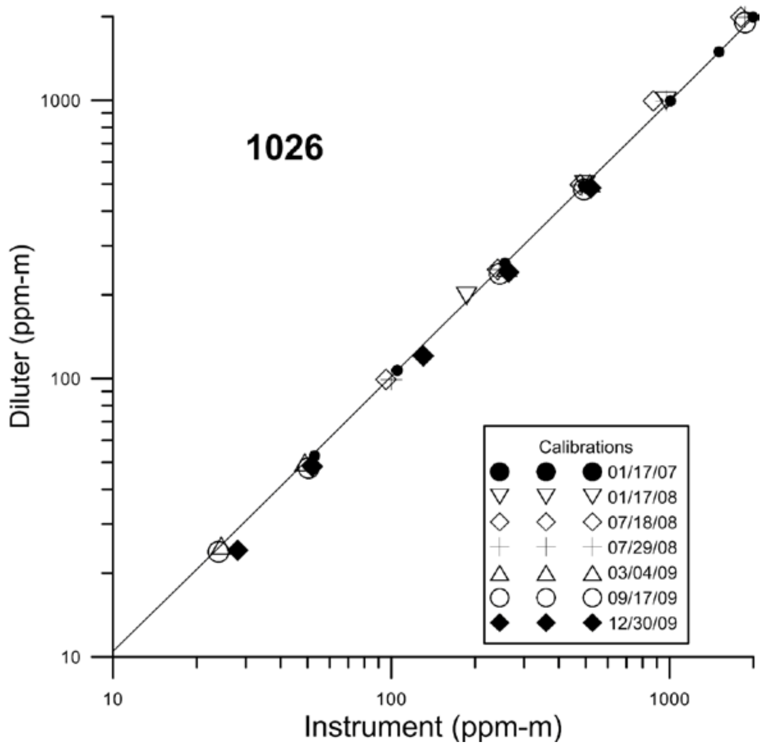


Figure 6.1-1: Multipoint calibrations of the GasFinder2 ™ s/n NH3-OP-1026. The solid line is the 3rd order polynomial regression for the chosen multipoint calibration.

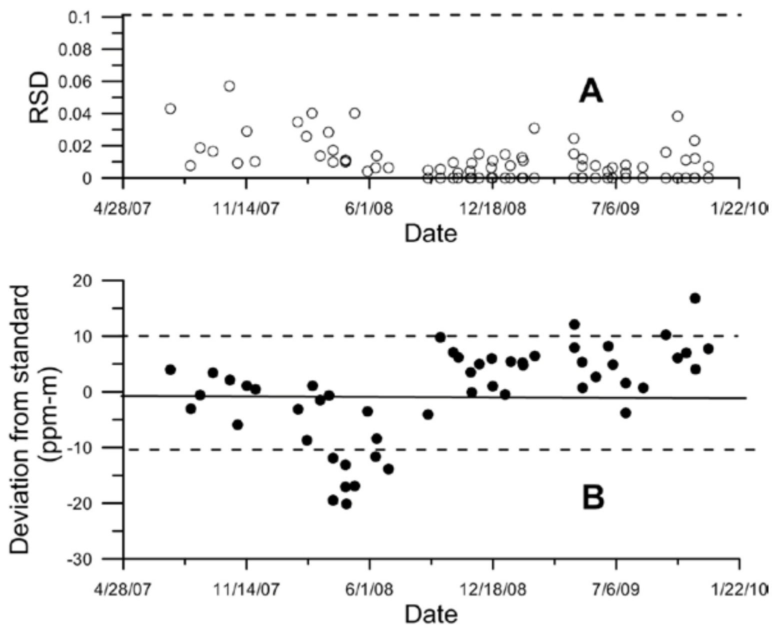


Figure 6.1-2: Control charts of the GasFinder2 TM s/n NH3-OP-1026

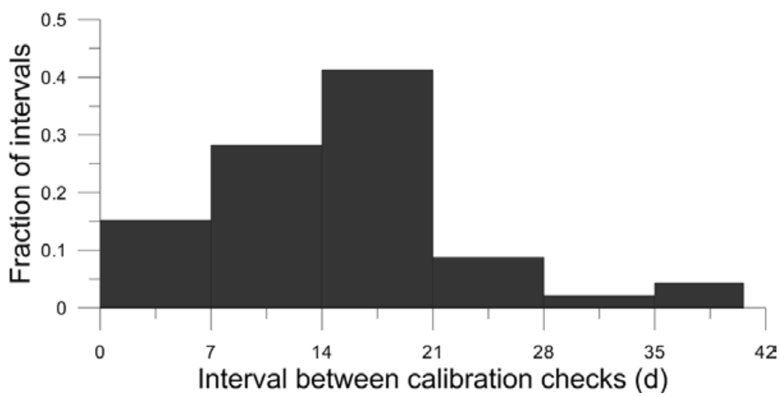


Figure 6.1-3: Calibration check intervals of the GasFinder2 TM s/n NH3-OP-1026

TDLAS 1027 was multipoint calibrated eight times during the study (Figure 6.1-4). The response is non-linear and consequently a third-order polynomial was used to correct the raw data for the instrument response. The multipoint calibration on 6/18/2008 was used for the entire study period. The offset of the equation was determined from a least squares fit of the entire record of calibration verifications made at 50 ppm-m applied to the first, second, and third order terms derived from the multipoint calibration. The regression equation was:

$$\text{ppm-m} = 2.24 + 0.9936 * X - 3.59E\text{-}5 * X^2 + 6.230E\text{-}8 * X^3$$

where X is the instrument response. The response of the sensor was influenced by humidity until 7/21/2008 due to an error in the factory settings for the spectral waveband analysis window. At that time, factory personnel corrected the spectral waveband used for analysis. The effect of this error was to 1) reduce the maximum possible linear correlation with the internal reference cell resulting in unusually low r^2 values under conditions in which the concentration of NH_3 was more than three times of the MDL, and 2) reduce the reported concentration. Adjustments made on the instrument at this time did not appear to affect the calibration (conducted before and after adjustments) but did change the maximum r^2 reached by the instrument when in the field for long path lengths and high humidity.

A zero concentration is not reportable by this instrument because the concentration is based on the correlation of the measured NH_3 absorption to a reference gas. No measured absorption at zero concentration results in no correlation and consequently no reportable measurement. The MDL of the instrument was determined from the mean of the variability (3 times the standard deviation) experienced at the verification concentration during each calibration verification. Since the calibration verifications were conducted in a very short path length, the water vapor effect on the instrument response was generally not detectable. The MDL was calculated to be 2.13 ppm-m prior to the July 2008 modification and 1.83 ppm-m after the modification. The instrument performance was within the MDL DQI that required the MDL to be less than 10 ppm-m. The calibration equation offset was less than the requisite DQI MDL.

Instrument performance calibration checks (Figure 6.1-5) were made at the beginning and end of each measurement period. The majority of calibration checks were made within 21 d (Figure 6.1-6). The large fraction of checks made within 7 d is the result of calibration checks made at the end and beginning of sequential measurement periods. The standard deviation of the verifications about that predicted by the calibration equation was 5.36 ppm-m. The precision DQI was ±10% RSD at 100 ppm-m. All verifications resulted in less than 10% RSD for 50 ppm-m (Figure 2) and well within the precision DQI. The accuracy DQI was ±10% of the 1000 ppm-m range of the measurements. A positive bias in the calibration verification exceeding the DQI occurred on 9/26/2008 and 9/24/2009 (Figure 6.1-4). No negative biases exceeding the DQI occurred during the study. Since both positive bias exceedences were followed by a DQI compliant verification on the subsequent calibration verification without intervention, it is assumed that operator error was the cause for the non-compliance.

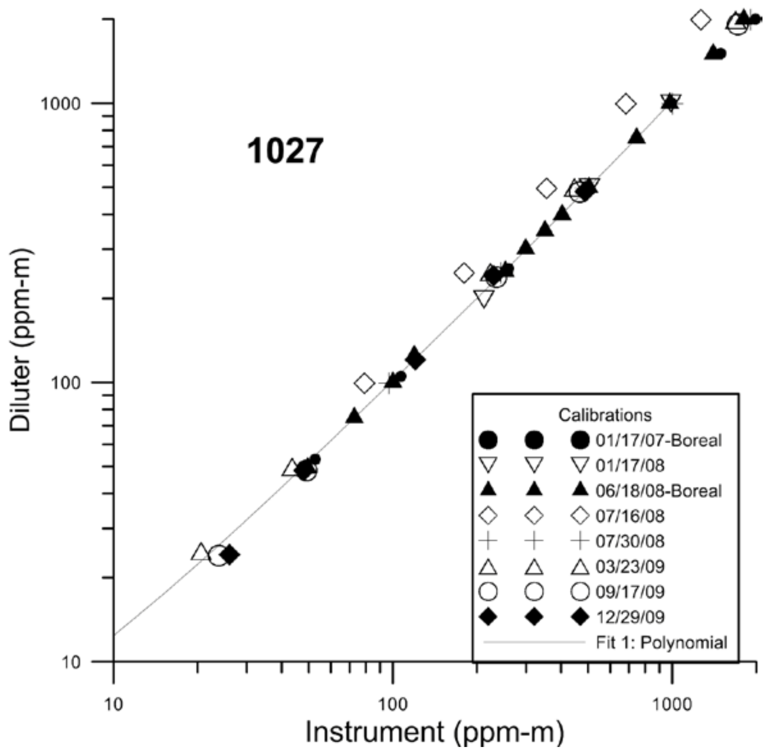


Figure 6.1-4: Multipoint calibrations of the GasFinder2 TM s/n NH3-OP-1027. The solid line is the 3rd order polynomial regression for the chosen multipoint calibration.

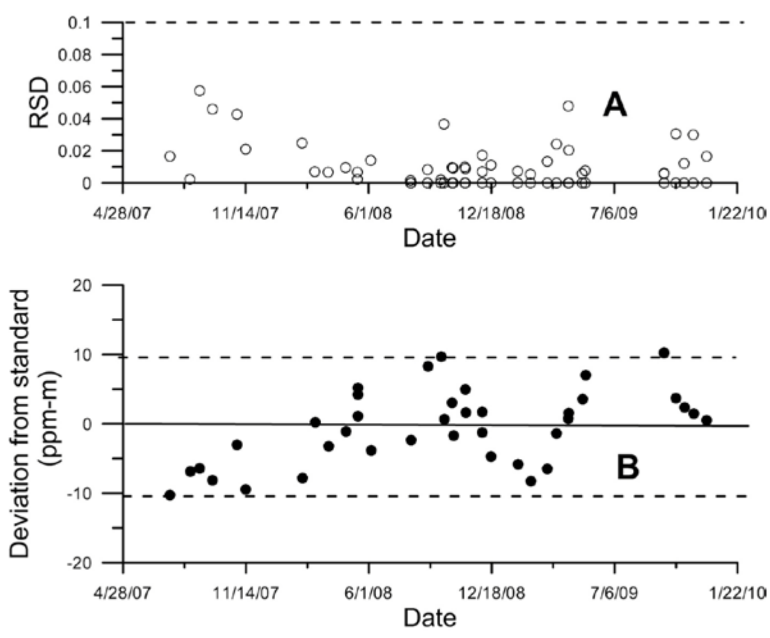


Figure 6.1-5: Control charts of the GasFinder2 TM s/n NH3-OP-1027

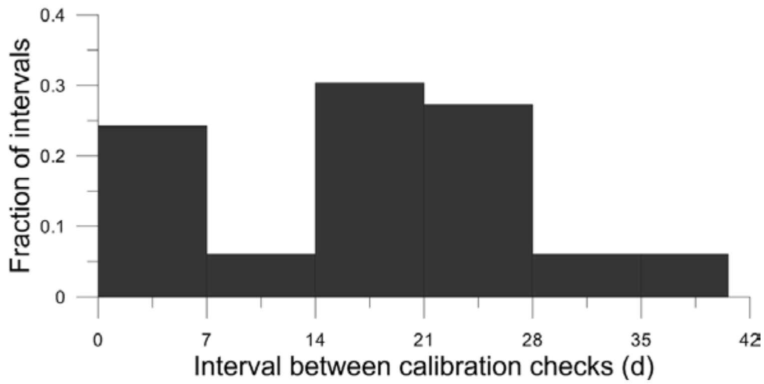


Figure 6.1-6: Calibration check intervals of the GasFinder2 ™ s/n NH3-OP-1027

TDLAS 1029 was multipoint calibrated seven times during the study (Figure 6.1-7). The response is non-linear and consequently a third-order polynomial was used to correct the raw data for the instrument response. Table 6.1-1 indicates the multipoint calibrations used during different periods in the study.

Table 6.1-1: Multipoint calibration application

Period of applicability (mm/dd/yyyy)		
Begin	**End**	**Multipoint calibration**
6/24/2007	03/01/2008	05/24/2007
3/24/2008	07/15/2008	03/24/2008
7/31/2008	08/03/2009	03/04/2009
8/4/2009	12/2/2009	12/29/2009

The offsets of the calibration equations were determined from a least squares fit of the appropriate period (Table 6.1-1) of calibration verifications made at 50 ppm-m applied to the first, second, and third order terms derived from the multipoint calibrations. The regression equations were:

05/24/2007: ppm-m = -1.48 + 0.967 * X + 4.842E-005 * X^2 - 7.312-009 * X^3

03/24/2008: ppm-m = -2.58 + 0.998 * X - 1.611E-004 * X^2 + 7.449E-008 * X^3

03/04/2009: ppm-m = 4.36 + 1.069 * X + 1.128-004 * X^2 - 1.206E-007 * X^3

12/29/2009: ppm-m = 5.48+ 1.268 * X - 6.072E-005 * X^2

where X is the instrument response. In July 2008 factory representatives adjusted the response of this unit. Adjustments made on the instrument at this time did not appear to affect the calibration (conducted before and after adjustments).

A zero concentration is not reportable by this instrument because the concentration is based on the correlation of the measured NH_3 absorption to a reference gas. No measured absorption at zero concentration results in no correlation and consequently no reportable measurement. The MDL of the instrument was determined from the mean of the variability (3 times the standard deviation) experienced at the verification concentration during each calibration verification. Since the calibration verifications were conducted in a very short path length, the water vapor effect on the instrument response was generally not detectable. The MDL was calculated to be 2.74 ppm-m prior to the July 2008 modification and 1.66 ppm-m after the modification. The instrument performance was within the MDL DQI that required the MDL to be less than 10 ppm-m. The MDL prior to the July 2008 modification was greater than the offset in the calibration regression equations but less than the offset in the calibration equations after the modification. The calibration equation offset was less than the requisite DQI MDL.

Instrument performance calibration checks (Figure 6.1-8) were made at the beginning and end of each measurement period. The majority of calibration checks were made within 21 d (Figure 6.1-9). The large fraction of checks made within 7 d is the result of calibration checks made at the end and beginning of sequential measurement periods. The standard deviation of the verifications about that predicted by the calibration equations were 4.65, 4.15, 5.23, and 4.27 ppm-m respectively. The precision DQI was ±10% RSD at 100 ppm-m. All verifications resulted in less than 10% RSD for 50 ppm-m (Figure 6.1-8) and well within the precision DQI. The accuracy DQI was ±10% of the 1000 ppm-m range of the measurements. A negative bias exceeding the DQI threshold occurred on two dates (Figure 6.1-8). No positive bias exceeding the DQI threshold occurred. In all cases subsequent calibration verifications did not indicate the same exceedance bias and it is concluded that operator error resulted in the exceedences rather than instrument failure.

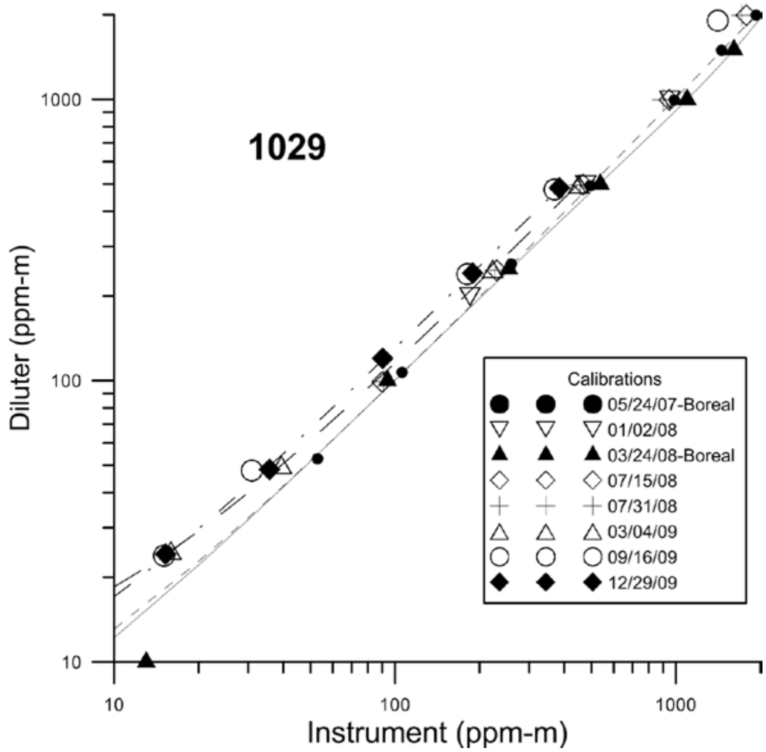


Figure 6.1-7: Multipoint calibrations of the GasFinder2 ™ s/n NH3-OP-1029. The solid (5/24/2007), dotted (3/24/2008), dashed (3/4/2009) and dash-dot (12/29/2009) lines are the 3rd order polynomial regression for the chosen multipoint calibration.

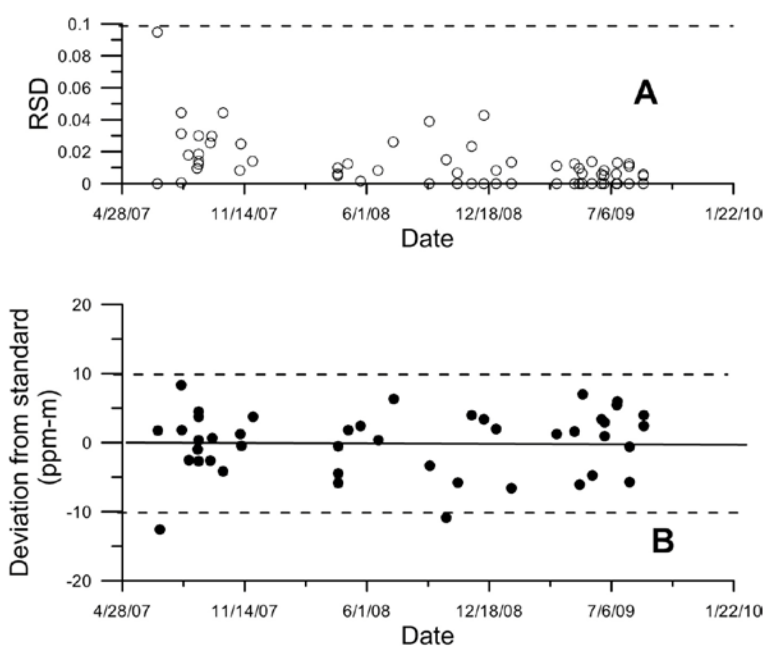


Figure 6.1-8: Control charts of the GasFinder2 ™ s/n NH3-OP-1029

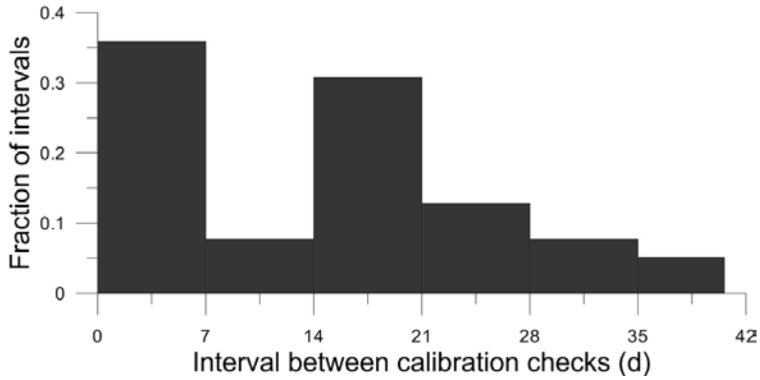


Figure 6.1-9: Calibration check intervals of the GasFinder2 ™ s/n NH3-OP-1029

TDLAS 1030 was multipoint calibrated eight times during the study (Figure 6.1-10). The response is non-linear and consequently a third-order polynomial was used to correct the raw data for the instrument response. The multipoint calibration on 3/26/2008 was used for the entire study period. The offset of the equation was determined from a least squares fit of the entire record of calibration verifications made at 50 ppm-m applied to the first, second, and third order terms derived from the multipoint calibration. The regression equation was:

$$\text{ppm-m} = 0.13 + 0.9974 * X - 2.1056E\text{-}005 * X^2 + 3.050E\text{-}008 * X^3$$

where X is the instrument response. In July 2008 factory representatives adjusted the response of this unit. Adjustments made on the instrument at this time did not appear to affect the calibration (conducted before and after adjustments).

A zero concentration is not reportable by this instrument because the concentration is based on the correlation of the measured NH_3 absorption to a reference gas. No measured absorption at zero concentration results in no correlation and consequently no reportable measurement. The MDL of the instrument was determined from the mean of the variability (3 times the standard deviation) experienced at the verification concentration during each calibration verification. Since the calibration verifications were conducted in a very short path length, the water vapor effect on the instrument response was generally not detectable. The MDL was calculated to be 3.05 ppm-m prior to the July 2008 modification and 0.685 ppm-m after the modification. The instrument performance was within the MDL DQI that required the MDL to be less than 10 ppm-m. The calibration equation offset was less than the requisite DQI MDL.

Instrument performance calibration checks (Figure 6.1-11) were made at the beginning and end of each measurement period. The majority of calibration checks were made within 21 d (Figure 6.1-12). The large fraction of checks made within 7 d is the result of calibration checks made at the end and beginning of sequential measurement periods. The standard deviation of the verifications about that predicted by the calibration equation was 7.27 ppm-m. The precision DQI was ±10% RSD at 100 ppm-m. All verifications resulted in less than 10% RSD for 50 ppm-m except on 8/30/2007 (Figure 6.1-11) and well within the precision DQI. The accuracy

DQI was ±10% of the 1000 ppm-m range of the measurements. A positive bias in the calibration verification exceeding the DQI occurred on 8/14/2008 and 9/23/2008 while negative biases exceeding the DQI occurred on 10/4/2007, 9/23/2008, and 4/28/2009 (Figure 6.1-11). In all cases, subsequent calibration verifications did not indicate the same exceedance bias and it is concluded that operator error resulted in the exceedences rather than instrument failure.

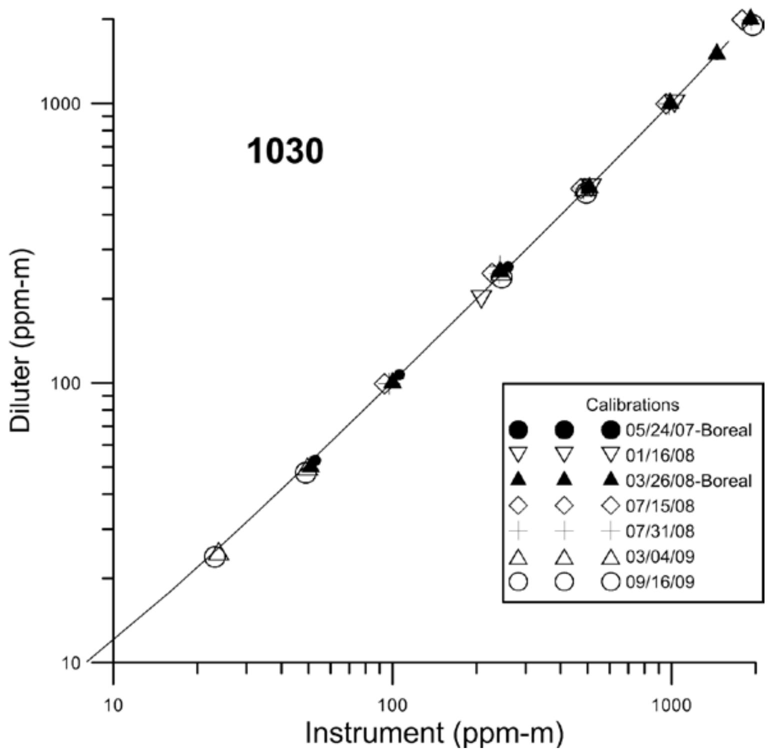


Figure 6.1-10: Multipoint calibrations of the GasFinder2 ™ s/n NH3-OP-1030. The solid line is the 3rd order polynomial regression for the chosen multipoint calibration.

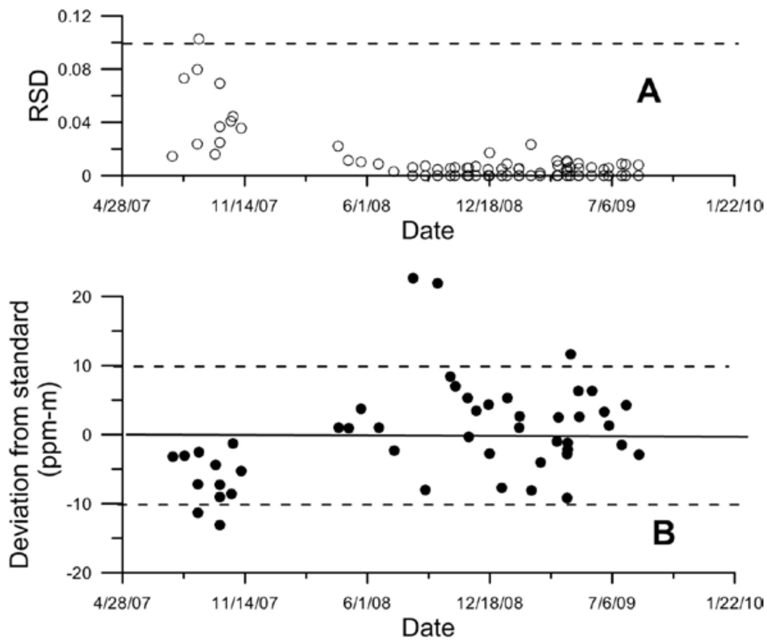


Figure 6.1-11: Control charts of the GasFinder2 TM s/n NH3-OP-1030

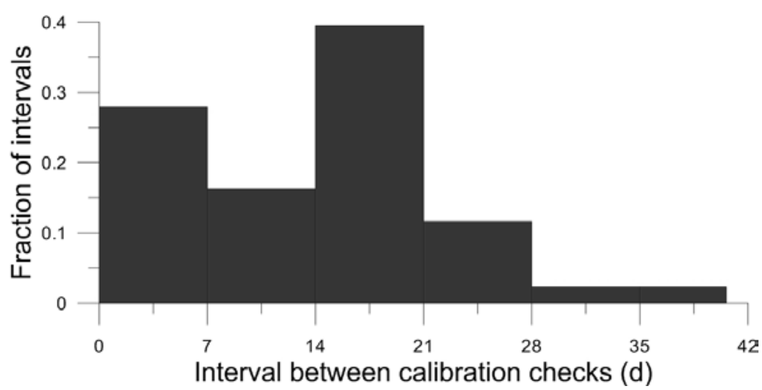


Figure 6.1-12: Calibration check intervals of the GasFinder2 TM s/n NH3-OP-1030

TDLAS 1028 was multipoint calibrated six times during the study (Figure 6.1-13). The response is non-linear and consequently a third-order polynomial was used to correct the raw data for the instrument response. The multipoint calibration on 5/23/2007 was used for the entire study period. The offset of the equation was determined from a least squares fit of the entire record of calibration verifications made at 50 ppm-m applied to the first, second, and third order terms derived from the multipoint calibration. The regression equation was:

$$ppm\text{-}m = 1.46 + 0.985 * X + 8.465E\text{-}6 * X^2 + 3.879E\text{-}8 * X^3$$

where X is the instrument response. The response of the sensor was influenced by humidity until 7/21/2008 due to an error in the factory settings for the spectral waveband analysis window. At that time, factory personnel corrected the spectral waveband used for analysis. The effect of this error was to 1) reduce the maximum possible linear correlation with the internal reference cell resulting in unusually low r^2 values under conditions in which the concentration of NH_3 was more than three times of the MDL, and 2) reduce the reported concentration. Adjustments made on the instrument at this time did not appear to affect the calibration (conducted before and after adjustments) but did change the maximum r^2 reached by the instrument when in the field for long path lengths and high humidity.

A zero concentration is not reportable by this instrument because the concentration is based on the correlation of the measured NH_3 absorption to a reference gas. No measured absorption at zero concentration results in no correlation and consequently no reportable measurement. The MDL of the instrument was determined from the mean of the variability (3 times the standard deviation) experienced at the verification concentration during each calibration verification. Since the calibration verifications were conducted in a very short path length, the water vapor effect on the instrument response was generally not detectable. The MDL was calculated to be 2.48 ppm-m prior to the July 2008 modification and 1.91 ppm-m after the modification. The instrument performance was within the MDL DQI that required the MDL to be less than 10 ppm-m. The MDL was greater than the offset indicated in the calibration regression. The calibration equation offset was less than the requisite DQI MDL.

Instrument performance calibration checks (Figure 6.1-14) were made at the beginning and end of each measurement period. The majority of calibration checks were made within 21 d (Figure 6.1-15). The large fraction of checks made within 7 d is the result of calibration checks made at the end and beginning of sequential measurement periods. The standard deviation of the verifications about that predicted by the calibration equation was 6.46 ppm-m. The precision DQI was ±10% RSD at 100 ppm-m. All verifications resulted in less than 10% RSD for 50 ppm-m (Figure 6.1-14) and well within the precision DQI. The accuracy DQI was ±10% of the 1000 ppm-m range of the measurements. A positive bias in the calibration verification exceeding the DQI occurred on three dates (9/26/2008, 10/1/20008 and 9/24/2009) while negative biases exceeding the DQI occurred on 12/16/2008 (Figure 6.1-14). In all cases except the short 9/24/2008 through 10/1/2008 period, subsequent calibration verifications did not indicate the same exceedance bias and it is concluded that operator error resulted in the exceedences rather than instrument failure.

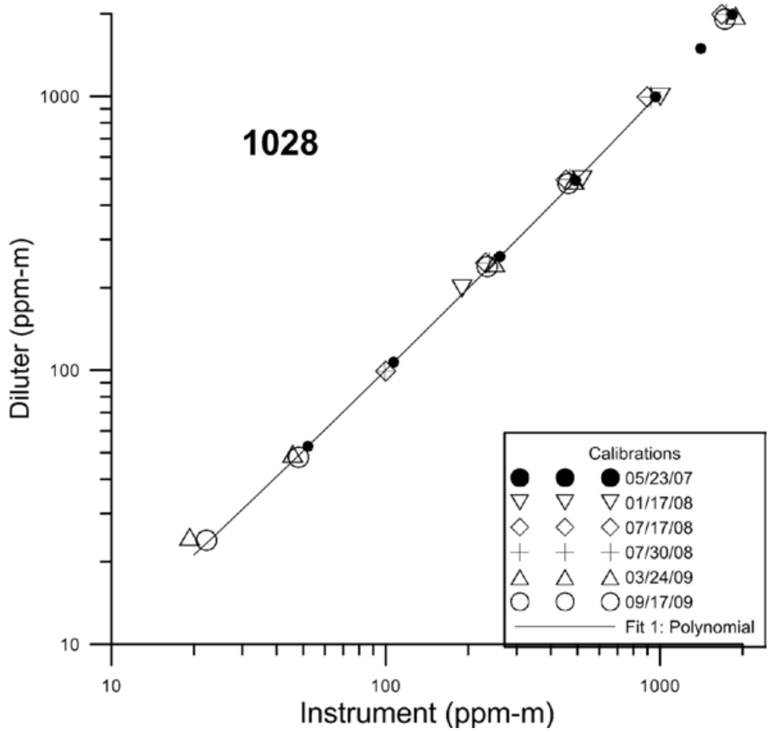


Figure 6.1-13: Multipoint calibrations of the GasFinder2 TM s/n NH3-OP-1028. The solid line is the 3rd order polynomial regression for the chosen multipoint calibration.

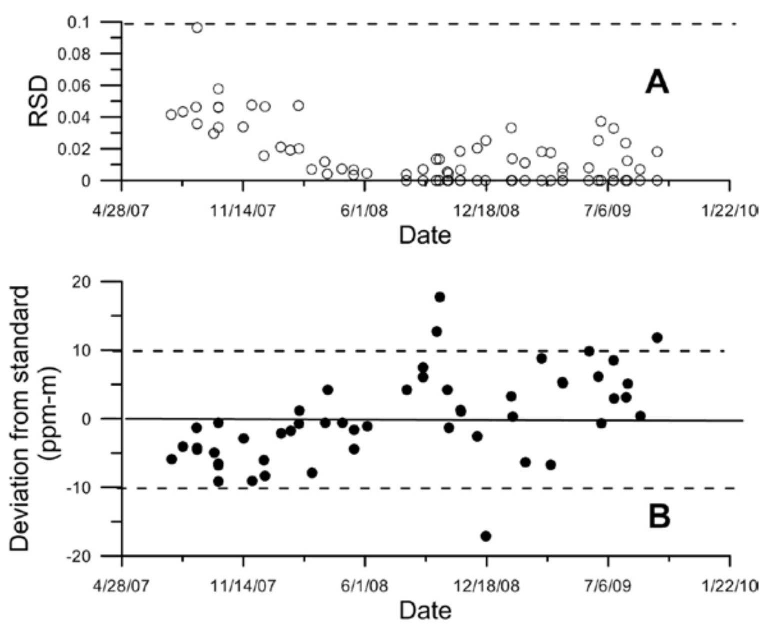


Figure 6.1-14: Control charts of the GasFinder2 TM s/n NH3-OP-1028

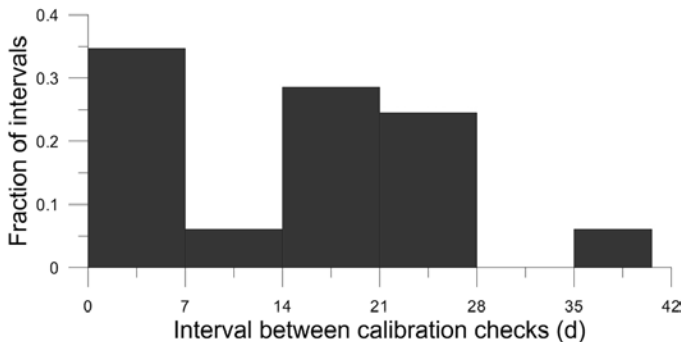


Figure 6.1-15: Calibration check intervals of the GasFinder2™ s/n NH3-OP-1028

6.2 TEC 450i analyzer H_2S calibrations

The H_2S Analyzer (Model TEC 450i, Thermo Fisher Scientific, Franklin, MA) with serial number 0733825130 was multipoint calibrated twelve times during the study (Figure 6.2-1). The coefficient of determination (r^2) for linear fits to the calibration values was never less than 0.990 although the slope of the linear regression equation varied from 0.73 to 1.20 (Table 6.2-1). The initial multipoint calibration was conducted prior to the complete burn-in of the converter and consequently differs greatly from the other calibrations. Part of the variation in slope was a result of the H_2S calibration cylinders used.

Table 6.2-1- Multipoint H_2S calibrations

Date	Slope (ppb/response)	Intercept (ppb)	r^2
12/12/2007	1.20	0.0018	0.999
5/21/2008	0.95	-0.0031	0.999
7/28/2008	0.74	0.0051	0.999
9/24/2008	1.08	-0.0643	0.991
10/28/2008	0.98	0.0049	0.999
10/30/2008	0.98	0.0019	0.999
11/19/2008	0.80	-0.0077	0.999
12/09/2008	0.87	-0.0008	0.999
12/10/2008	0.83	0.0026	0.999
3/11/2009	0.92	0.0112	0.999
4/30/2009	0.80	0.0124	0.999
9/9/2009	0.73	0.0014	0.999

The instrument was returned to the manufacturer for repair on 3/21/2008 and put back into service after a multipoint calibration (Table 6.2-1) on 5/28/2008.

The standard deviation of instrument response with CEM zero air measured over a 1-h period was 1.13 ppb (10/19/2009). The instrument MDL, defined as 3σ was 3.4 ppb and is indicated in Figure 2A with dashed lines. This is much less than the mean absolute value of the multipoint calibration intercept of 10.5 ppb.

Instrument performance calibration checks (Figure 6.2-2, 6.2-3) were made at the beginning and end of each measurement period. The majority of calibration checks were made within 28 d (Figure 6.2-4). Instrument response was converted into measured concentrations by multiplying the instrument response by the long-term mean ratio of diluted calibration gas by instrument reading. The long-term mean ratio for this instrument was 0.819. The mean zero concentration was -1.3 ppb, less than the MDL.

The instrument measurement accuracy DQI was 10% of full scale (FS; 1 ppm). Based on the correlation of instrument performance and the calibration cylinder used, it was determined that the concentration of H_2S in the FF44447 cylinder (expiration date 5/13/2009), which was inter-compared with other H_2S calibration cylinders on 8/28/2009 and found to have been much below the indicated specification. This resulted in unusually high ratios of diluter concentration versus instrument response on 3/11/2009 and a post-study calibration failure.

The instrument measurement precision DQI was 10% of FS. Precision DQI exceedences (Figure 6.2-3) occurred on 1/31/2008 and 10/28/2008. The 1/31/2008 failure is due to the burn-in of the converter and signals changes in the instrument response as the instrument is conditioned. The 10/28/2008 DQI failure was likely due to the use of a different calibration tank for one check. Although it cannot be confirmed, the cylinder (SA15346) was likely either not within certification specifications or at the opposite end of the valid certification bound as the cylinder used before (FF20675) and after (LL34303) the date the cylinder is used resulted in valid calibration verifications.

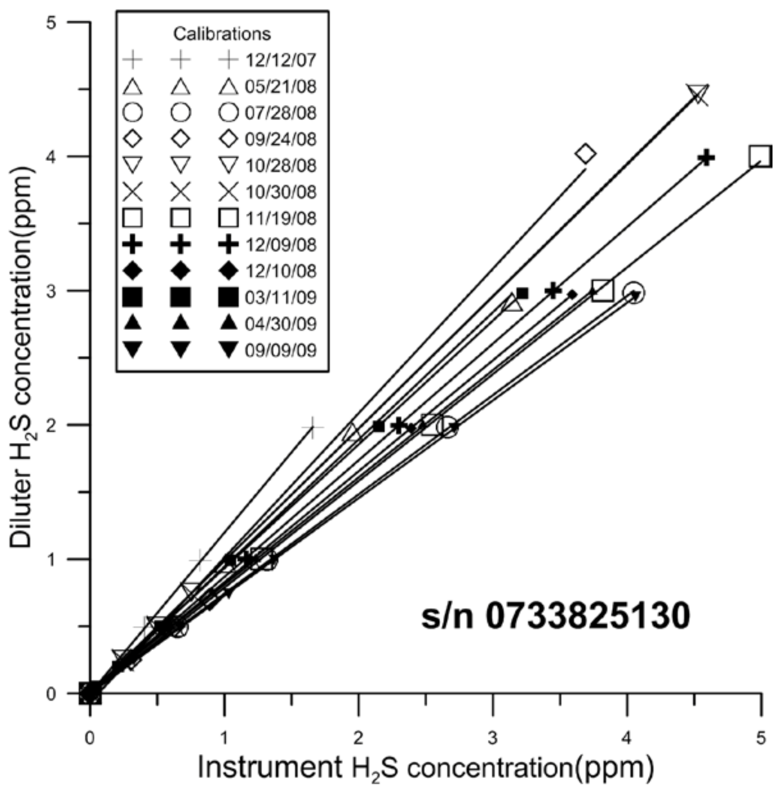


Figure 6.2-1: Multipoint calibrations of the 450i SO_2/ H_2S Analyzer

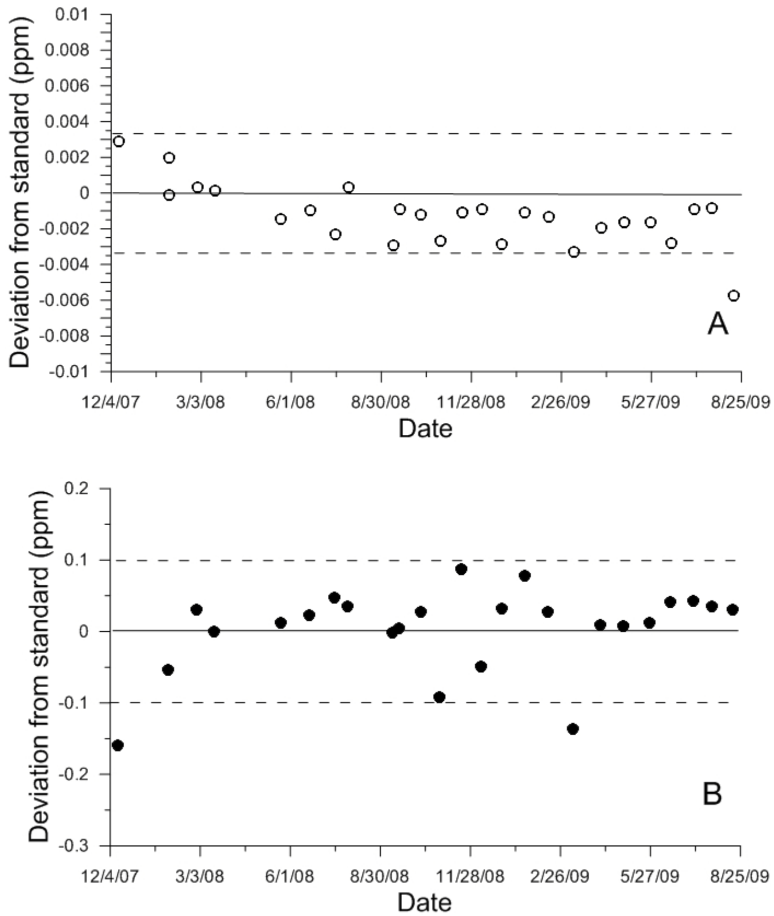


Figure 6.2-2: Instrument control charts

The zero check (panel A) and span check (panel B) are indicated. The dashed lines in panel A represent the MDL. The dashed lines in panel B represent 10% of the Full Scale value (1ppm).

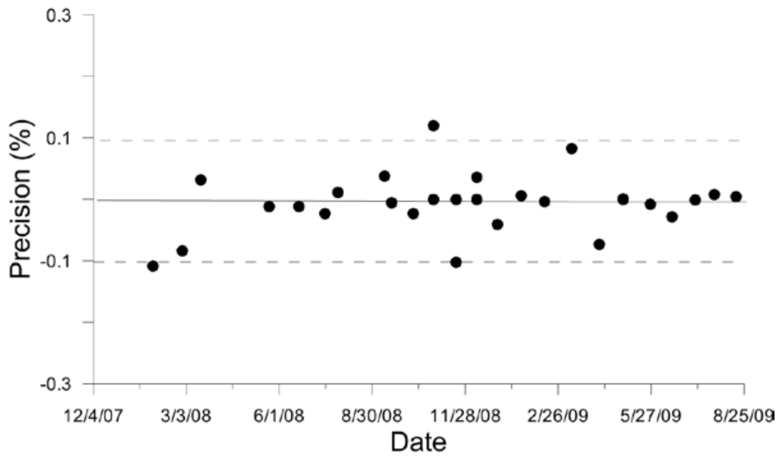


Figure 6.2-3: Instrument precision

The precision of span checks are indicated. The dashed lines in panel A represent the MDL. The dashed lines represent 10% of the Full Scale value (1ppm).

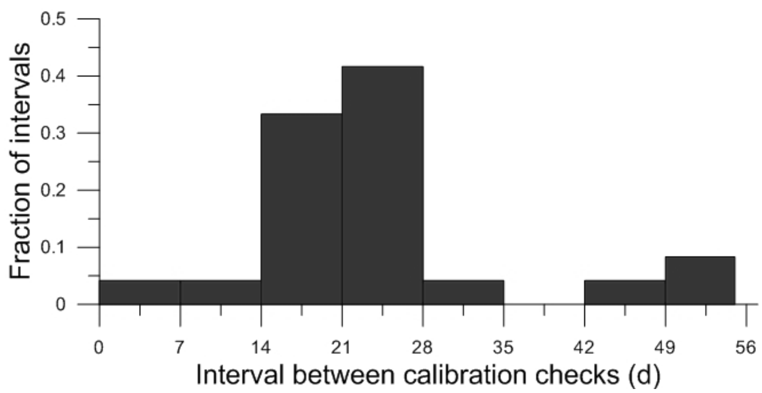


Figure 6.2-4: Calibration check intervals

6.3 Sonic anemometer calibrations

Three sonic anemometers (Model 81000, RM Young Inc, Traverse City, MI) were used at this location: serial numbers 1938, 1927, 1925, and 1926.

Sonic anemometer 1938 was inter-compared with three standard anemometers of identical design eight times during the study (Table 6.3-1). No absolute turbulence calibration is possible with this instrument. To assure proper performance and comparability in the wind measurements, the anemometer was inter-compared on-site with those used during a given measurement period at the beginning and end of a measurement period. This instrument was inter-compared with the co-located anemometer sensors on site26 times (Figure 6.3-1). The majority of calibration checks were made within 21 d (Figure 6.3-2). The large fraction of checks made within 7 d is the result of calibration checks made at the end and beginning of sequential measurement periods.

The accuracy DQI for the on-site inter-comparisons required the individual instruments to have the mean wind speed within 0.2 ms^{-1} of the grand mean value of the three (or four) on-site instruments (Figure 6.3-1B). This instrument passed this check at all times. The last standard inter-comparison (1/2010) failed due to loss of communications.

The precision DQI for the on-site inter-comparisons required each wind component (x, y, and z) of the individual instruments to be within 0.3 ms^{-1} of zero (Figure 6.3-1A). Records of the zero checks made before 12/2007 were recorded as pass/fail- not indicating the actual measurements. The instrument always passed this DQI.

Table 6.3-1: Standards inter-comparisons, s/n 1938

Calibration periods		Mean difference from reference anemometers (ms^{-1})	
Alignment 1	**Alignment 2**	**Alignment 1**	**Alignment 2**
6/8-12/2007	6/12-14/2007	-0.013	+0.011
1/21/2008	1/23/2008	+0.002	-0.036
7/16-17/2008	7/17-18/2008	-0.005	+0.010
3/6-7/2009	3/8-9/2009	-0.007	+0.002
1/7-9/2010	1/21-25/2010	-3.73	-3.94

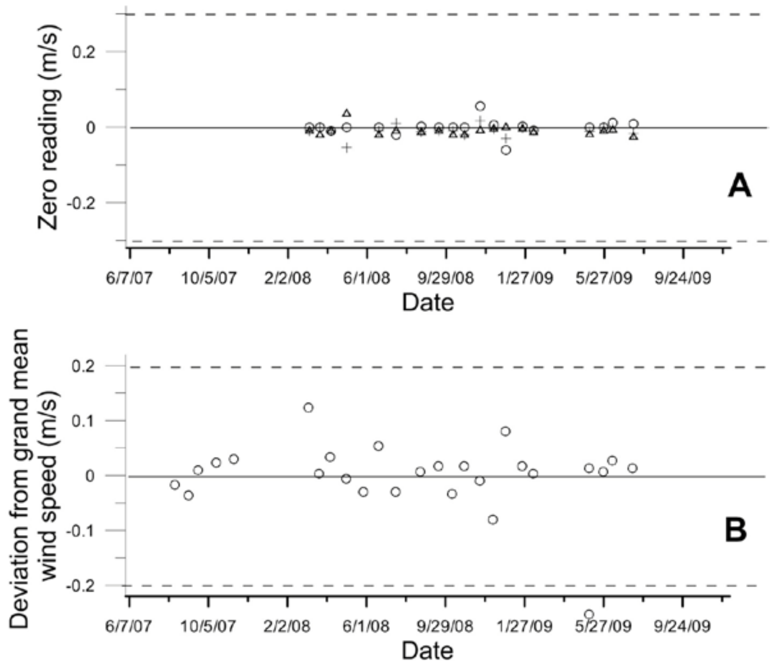


Figure 6.3-1: On-site quality assurance, s/n 1938. The DQI for the zero and inter-comparisons are indicated by the dashed lines. The zero check in the x (open circle), y (open triangle) and z (cross) components are indicated in panel A.

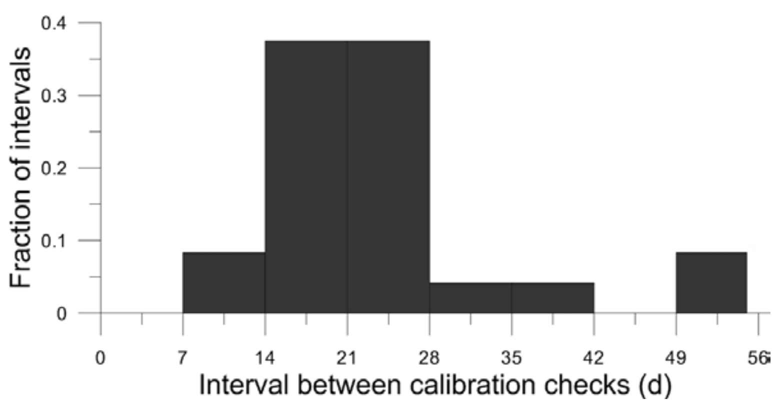


Figure 6.3-2: Inter-comparison check intervals, s/n 1938

Sonic anemometer 1927 was inter-compared with three standard anemometers of identical design five times during the study (Table 6.3-2). No absolute turbulence calibration is possible with this instrument. To assure proper performance and comparability in the wind measurements, the anemometer was inter-compared on-site with those used during a given measurement period at the beginning and end of a measurement period. This instrument was inter-compared with the co-located anemometer sensors on site 35 times (Figure 6.3-3). The majority of calibration checks were made within 21 d (Figure 6.3-4). The large fraction of checks made within 7 d is the result of calibration checks made at the end and beginning of sequential measurement periods.

The accuracy DQI for the on-site inter-comparisons required the individual instruments to have the mean wind speed within 0.2 ms^{-1} of the grand mean value of the three (or four) on-site instruments (Figure 6.3-3B). This instrument passed this check on all checks except 9/23-25/2008 and was taken out of service. Laboratory testing indicated wetness in the sensor. The sensor was dried, tested, and put back in use.

The precision DQI for the on-site inter-comparisons required each wind component (x, y, and z) of the individual instruments to be within 0.3 ms^{-1} of zero (Figure 6.3-3A). Records of the zero checks made before 12/2007 were recorded as pass/fail- not indicating the actual measurements. The instrument always passed this DQI.

Table 6.3-2: Standards inter-comparisons, s/n 1927

Calibration periods		**Mean difference from reference anemometers (ms^{-1})**	
Alignment 1	**Alignment 2**	**Alignment 1**	**Alignment 2**
6/8-12/2007	6/12-14/2007	-0.025	-0.043
1/21/2008	1/23/2008	-0.051	-0.033
7/16-17/2008	7/17-18/2008	+0.042	+0.029
3/23-25/2009	3/25-27/2009	-0.050	-0.028
9/1-2/2009	9/2-3/2009	-0.035	-0.023

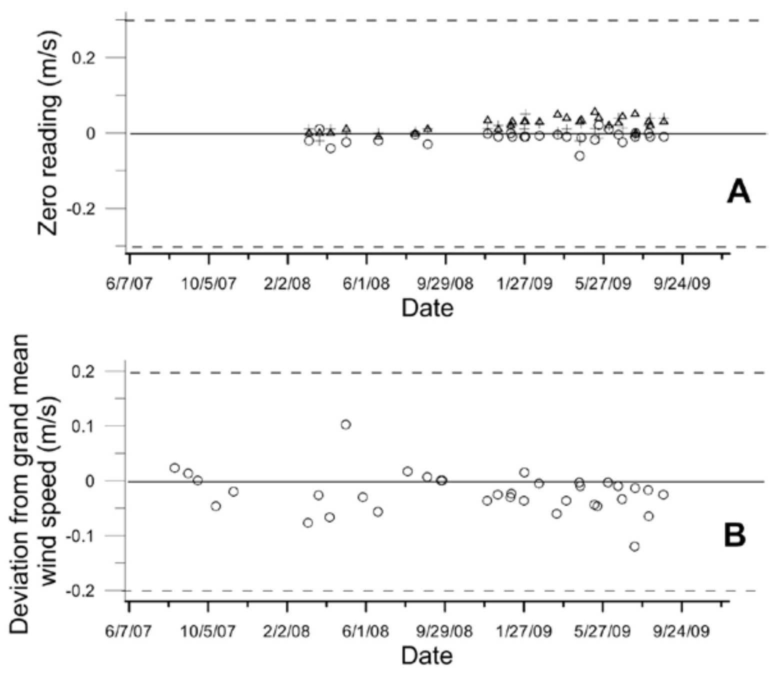


Figure 6.3-3: On-site quality assurance, s/n 1927. The DQI for the zero and inter-comparisons are indicated by the dashed lines. The zero check in the x (open circle), y (open triangle) and z (cross) components are indicated in panel A.

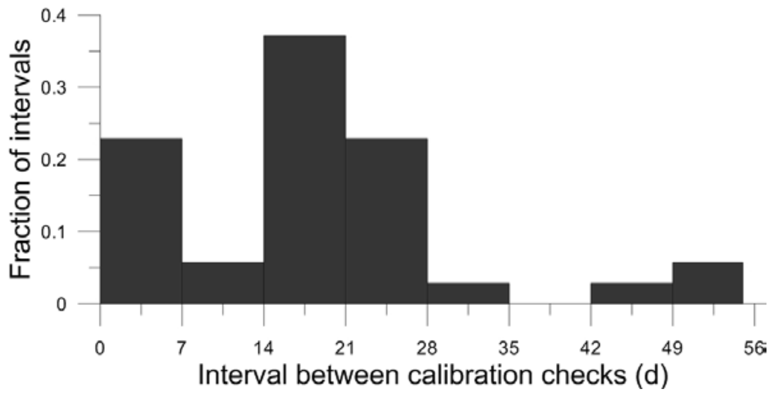


Figure 6.3-4: Inter-comparison check intervals, s/n 1927

Sonic anemometer 1925 was inter-compared with three standard anemometers of identical design six times during the study (Table 6.3-3). No absolute turbulence calibration is possible with this instrument. To assure proper performance and comparability in the wind measurements, the anemometer was inter-compared on-site with those used during a given measurement period at the beginning and end of a measurement period. This instrument was inter-compared with the co-located anemometer sensors on site 26 times (Figure 6.3-5). The majority of calibration checks were made within 21 d (Figure 6.3-6). The large fraction of checks made within 7 d is the result of calibration checks made at the end and beginning of sequential measurement periods.

The accuracy DQI for the on-site inter-comparisons required the individual instruments to have the mean wind speed within 0.2 ms^{-1} of the grand mean value of the three (or four) on-site instruments (Figure 1B). This instrument passed this check at all times.

The precision DQI for the on-site inter-comparisons required each wind component (x, y, and z) of the individual instruments to be within 0.3 ms^{-1} of zero (Figure 6.3-5A). Records of the zero checks made before 12/2007 were recorded as pass/fail- not indicating the actual measurements. The instrument always passed this DQI.

Table 6.3-3: Standards inter-comparisons, s/n 1925

Calibration periods		Mean difference from reference anemometers (ms^{-1})	
Alignment 1	**Alignment 2**	**Alignment 1**	**Alignment 2**
6/8-12/2007	6/12-14/2007	-0.013	-0.022
1/21-22/2008	1/23/2008	-0.053	-0.075
7/16-17/2008	7/17-18/2008	+0.023	+0.004
3/6-7/2009	3/7-9/2009	-0.018	-0.058
9/8-14/2009	9/15-16/2009	-0.013	-0.022
12/18-19/2009	12/21-23/2009	+0.095	-0.084

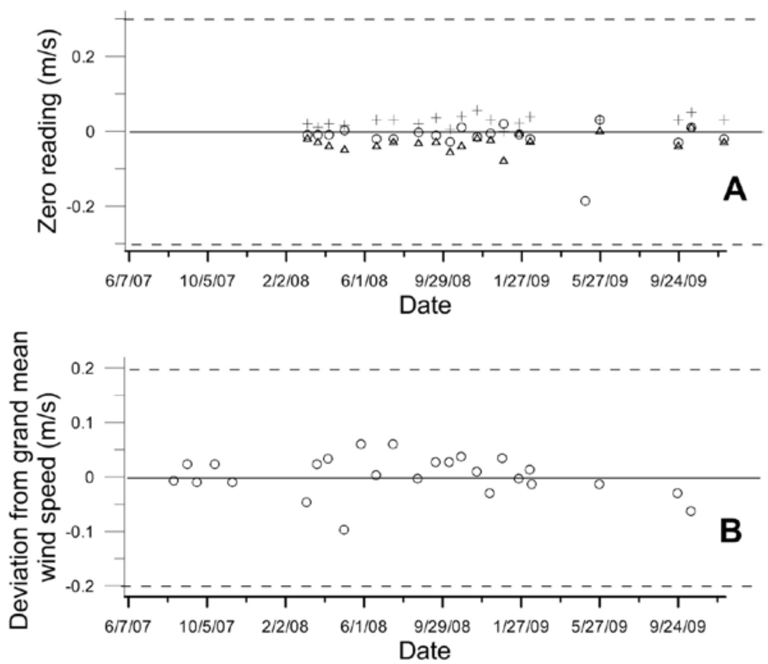


Figure 6.3-5: On-site quality assurance, s/n 1925. The DQI for the zero and inter-comparisons are indicated by the dashed lines. The zero check in the x (open circle), y (open triangle) and z (cross) components are indicated in panel A.

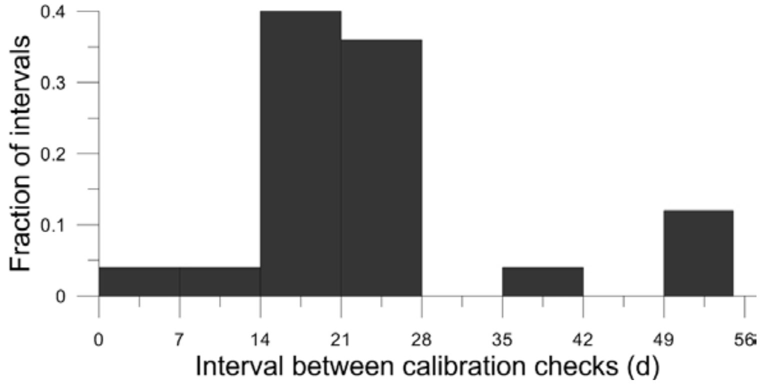


Figure 6.3-6: Inter-comparison check intervals, s/n 1925

Sonic anemometer 1926 was inter-compared with three standard anemometers of identical design five times during the study (Table 6.3-4). No absolute turbulence calibration is possible with this instrument. To assure proper performance and comparability in the wind measurements, the anemometer was inter-compared on-site with those used during a given measurement period at the beginning and end of a measurement period. This instrument was inter-compared with the co-located anemometer sensors on site 35 times (Figure 6.3-7). The majority of calibration checks were made within 21 d (Figure 6.3-8). The large fraction of checks made within 7 d is the result of calibration checks made at the end and beginning of sequential measurement periods.

The accuracy DQI for the on-site inter-comparisons required the individual instruments to have the mean wind speed within 0.2 ms^{-1} of the grand mean value of the three (or four) on-site instruments (Figure 6.3-7B). This instrument passed this check at all times.

The precision DQI for the on-site inter-comparisons required each wind component (x, y, and z) of the individual instruments to be within 0.3 ms^{-1} of zero (Figure 1A). Records of the zero checks made before 12/2007 were recorded as pass/fail- not indicating the actual measurements. The instrument always passed this DQI.

Table 6.3-4: Standards inter-comparisons, s/n 1926

Calibration periods		**Mean difference from reference anemometers (ms^{-1})**	
Alignment 1	**Alignment 2**	**Alignment 1**	**Alignment 2**
6/19-22/2007	6/29-7/2/2007	-0.005	-0.033
1/17-18/2008	1/20-21/2008	-0.013	-0.032
7/16-17/2008	7/17-18/2008	+0.037	+0.059
3/6-7/2009	3/7-9/2009	+0.004	+0.048
9/16-17/2009	9/17-18/2009	+0.059	+0.001

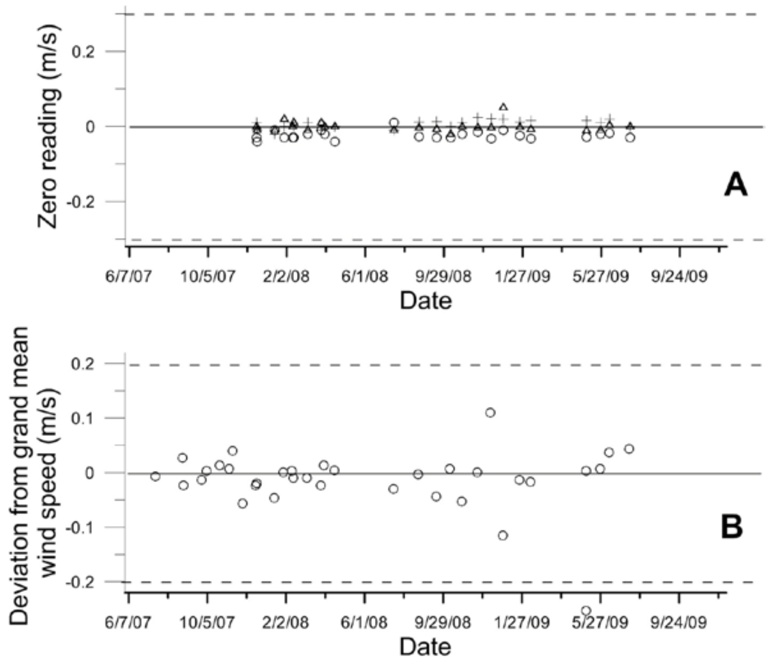


Figure 6.3-7: On-site quality assurance, s/n 1926. The DQI for the zero and inter-comparisons are indicated by the dashed lines. The zero check in the x (open circle), y (open triangle) and z (cross) components are indicated in panel A.

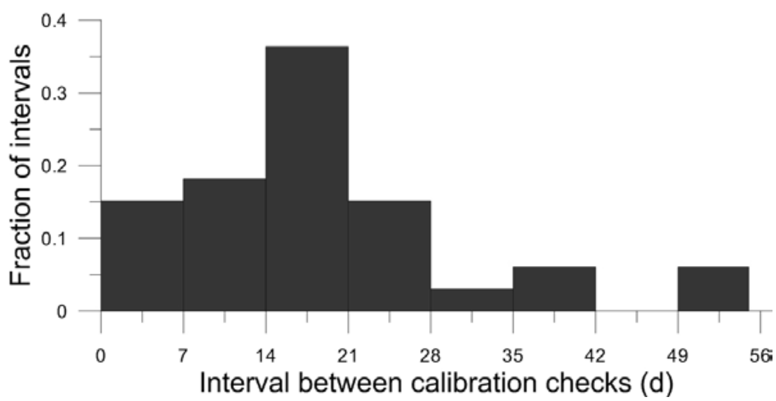


Figure 6.3-8: Inter-comparison check intervals, s/n 1926

6.4 pH probe calibrations

Two pH probes (Model CSIMM-ph, Innovative Sensors Inc., Anaheim, California) were used at this location: serial numbers 001 and 003.

Probe 001 was used between 7/18/2007 and 4/30/2008. The probe was calibrated 17 times. The pH probe DQI specified an accuracy of ±0.3 pH units, corresponding to a difference between the calculated and measured pH of 17.7 mV of signal. Figure 6.4-1A illustrates the control chart for the three pH standards used (pH 4, 7, and 10) relative to the mV error. Each sensor was also checked for stability using QCCS solution, with the requirement that the sensor be within 0.05 pH units, or 3 mV. The history of the probe stability check is illustrated in Figure 6.4-1B. Problems with freezing of the electrolyte in the reference electrode during the winter reduced the frequency of these checks. The probe always passed both the accuracy DQI and the stability checks.

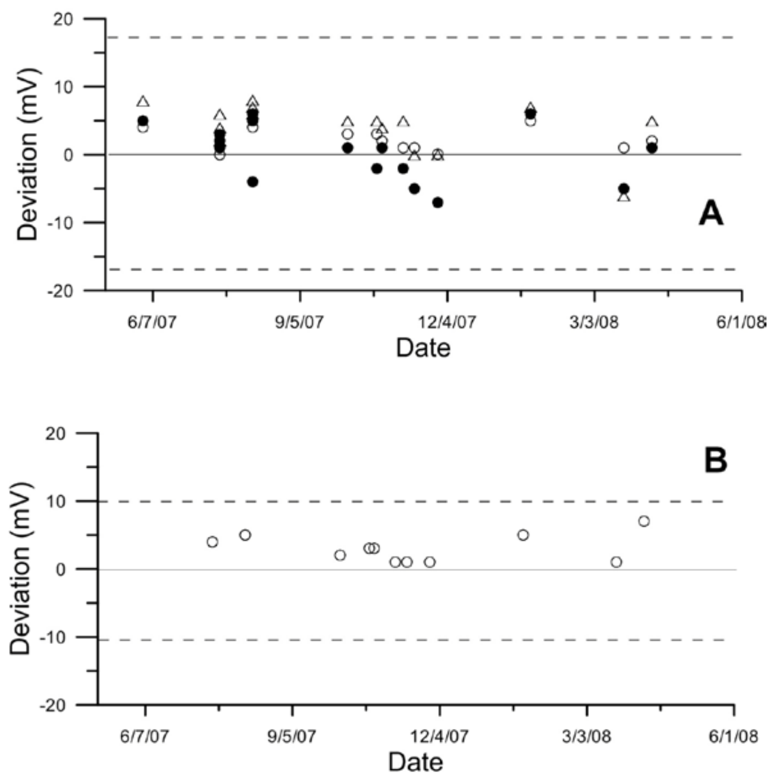


Figure 6.4-1: Accuracy and stability calibration checks of CSIM11 pH probe, s/n 001. The absolute deviation in mV of the pH 4 (closed circle), pH 7 (open circle), and ph 10 (solid triangle) tests are indicated in panel A. The dashed lines define the DQI limits. The time history of the absolute stability is indicated in panel B where the dashed lines indicate the desired bounds of the stability.

Probe 003 was used between 7/24/2007 and 11/15/2007. The probe was calibrated seven times. The pH probe DQI specified an accuracy of ±0.3 pH units, corresponding to a difference between the calculated and measured pH of 17.7 mV of signal. Figure 6.4-2A illustrates the control chart for the three pH standards used (pH 4, 7, and 10) relative to the mV error. Each sensor was also checked for stability using QCCS solution, with the requirement that the sensor be within 0.05 pH units, or 3 mV. The history of the probe stability check is illustrated in Figure 6.4-2B. Problems with freezing of the electrolyte in the reference electrode during the winter reduced the frequency of these checks. The probe always passed both the accuracy DQI and the stability checks.

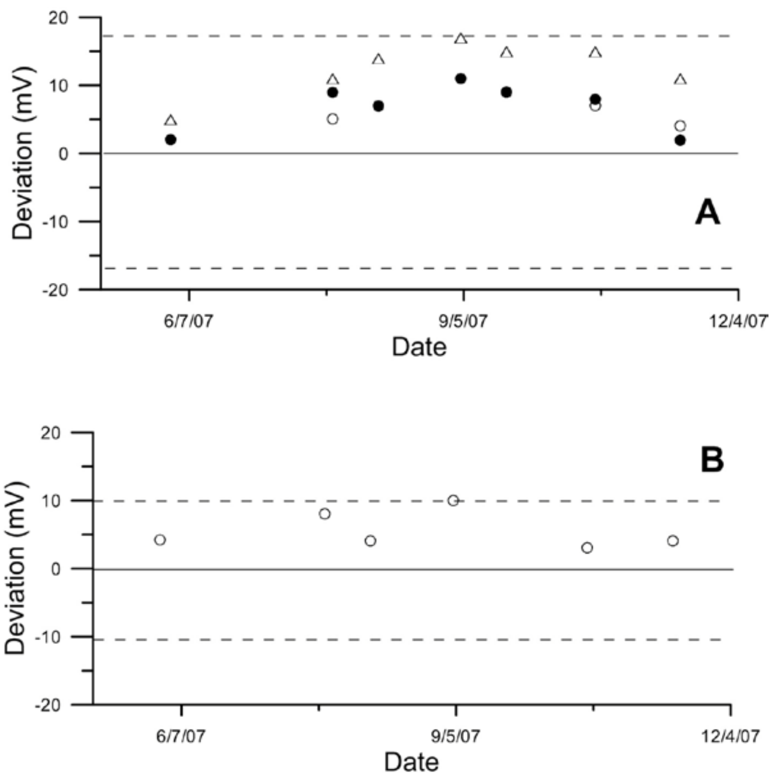


Figure 6.4-2: Accuracy and stability calibration checks of CSIM11 pH probe, s/n 003. The absolute deviation in mV of the pH 4 (closed circle), pH 7 (open circle), and ph 10 (solid triangle) tests are indicated in panel A. The dashed lines define the DQI limits. The time history of the absolute stability is indicated in panel B where the dashed lines indicate the desired bounds of the stability.

In general, the probe calibrations were conducted about every 20 d. Since freezing conditions damage the probe, the probes were not used during the winter.

6.5 ORP probe calibrations

Two oxidation-reduction potential (ORP) probes (Model CSIM11-ORP, Innovative Sensors Inc., Anaheim, California) were used at this location: serial numbers 010 and 040.

Probe 010 was used between 5/31/2007 and 10/15/2007. The probe was calibrated three times. The probe was first checked and the failure to meet the DQI resulted in the probe's return to the manufacturer. On return, the probe was calibrated and installed. This probe was then destroyed during the winter in the frozen lagoon and could not be checked at the end of the winter due to its destruction by the ice. The ORP probe DQI specified an accuracy of ±20 mV (Figure 6.5-1A). Each sensor was also checked for stability using a KCl solution, with the requirement that the sensor be within 1 mV of the reference solution. The history of the probe stability check is illustrated in Figure 6.5-1B.

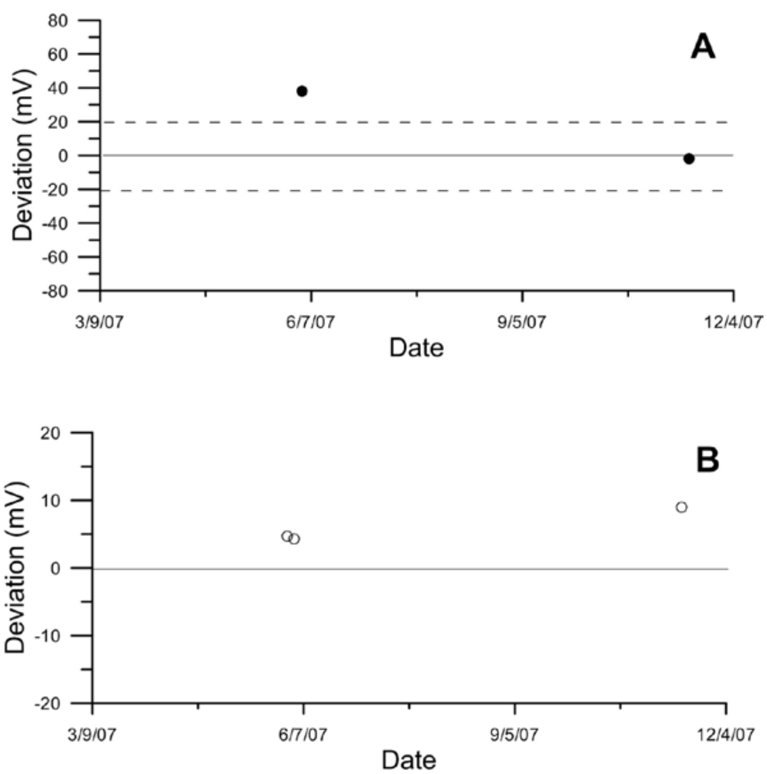


Figure 6.5-1: Accuracy and stability calibration checks of CSIM11 ORP probe, s/n 010. The stability check of the probe (Panel B) and the absolute deviation in mV of the probe (panel A) are indicated. The dashed lines define the DQI limits in panel A.

Probe 040 was used between 7/18/2007 and 4/7/2008. The probe was calibrated six times. The ORP probe DQI specified an accuracy of ±20 mV (Figure 6.5-2A). Each sensor was also checked for stability using a KCl solution, with the requirement that the sensor be within 1 mV of the reference solution. The history of the probe stability check is illustrated in Figure 6.5-2B. Problems with freezing of the electrolyte in the reference electrode during the winter reduced the frequency of these checks. The probe always passed the accuracy check DQI and the stability check indicated excellent probe stability.

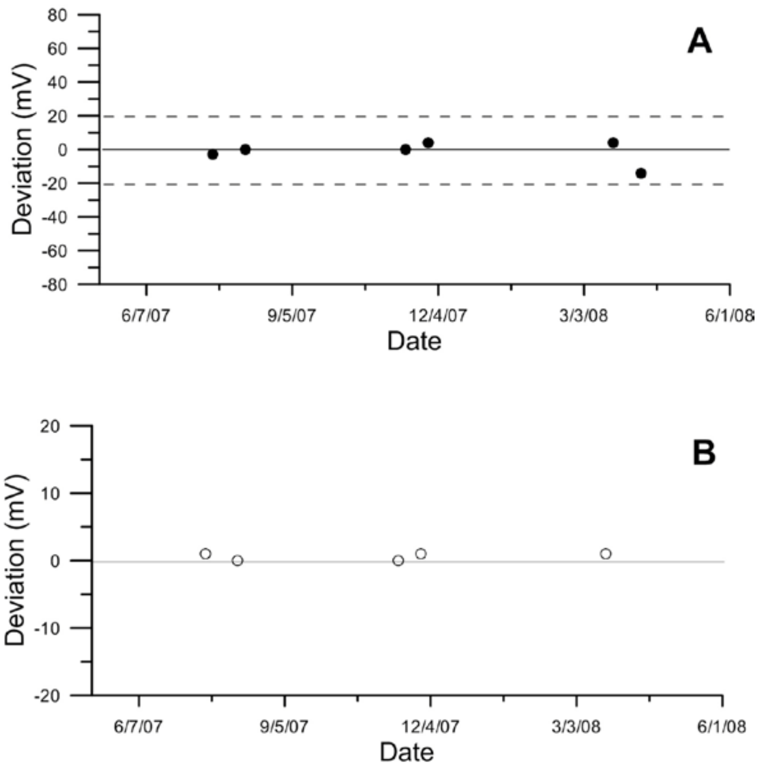


Figure 6.5-2: Accuracy and stability calibration checks of CSIM11 ORP probe, s/n 040. The stability check of the probe (Panel B) and the absolute deviation in mV of the probe (panel A) are indicated. The dashed lines define the DQI limits in panel A.

In general, the probe calibrations were conducted about every 20 d. Since freezing conditions damage the probe, the probes were not used during the winter.

6.6 S-OPS operational checks

The Synthetic Open Path Systems (S-OPS; s/n A and C) and the Gas Sampling System (GSS s/n 4-0019) used at this location were checked about every 20 d. A leak check and maximum flow check were made for both the S-OPS in combination with the GSS and for the GSS alone. In addition, the balance of flow into each inlet in the S-OPS was checked before and after each measurement period.

Results of the leak tests for both the GSS and the Combined GSS/S-OPS are indicated in Table 6.6-1.

Table 6.6-1: Record of leak check for GSS and GSS/S-OPS

Date	Site	GSS solenoid/ S-OPS	GSS mass flow (L min^{-1})	GSS pressure (kPa)	GSS check result	S-OPS max flow (L min^{-1})	S-OPS mass flow (L min^{-1})	S-OPS pressure (kPa)	S-OPS check result
04/07/2008	IN4A	2	0.12	-36.70	Pass	7.6	0.54	-36.46	Pass
		3	0.12	-34.97	Pass	7.6	0.62	-36.34	Pass
05/01/2008	IN4A	2	0.13	-33.98	Pass	9.6	0.52	-35.70	Pass
		3	0.07	-33.68	Pass	9.8	0.64	-37.50	Pass
05/20/2008	IN4A	2	0.05	-34.84	Pass	9.1	0.49	-35.67	Pass
		3	0.03	-34.89	Pass	9.8	0.59	-35.86	Pass
06/19/2008	IN4A	2	0.00	-2.17	Pass	9.6	0.52	-1.09	Pass
		3	0.05	-37.25	Pass	9.8	0.70	-38.28	Pass
07/14/2008	IN4A	2	0.15	2.20	Pass	9.4	0.71	2.20	Pass
		3	0.22	-11.72	Fail	9.6	0.92	-12.11	Pass

The inlet flow balance checks are summarized in Tables 6.6-2A and 6.6-2B. While the inlet flow balance was measured at the beginning and end of each measurement period, results showed that the balance throughout the period was not assured if the balance test indicated an adequate balance. Balance across the inlets at any time during a period or at the beginning or end of a period was limited due to wetness of the inlet filters associated with fog, ice, snow, or rain. In addition dust on the inlet filters contributed to an undetermined rate of flow degradation of individual inlets over a period. Spider webs would also restrict flow across the inlet filters. The allowable tolerance in the inlet balance was that the flow through any inlet was within 10% of the expected flow for the inlet. Inlet flow balance checks were not conducted on 6/19/2008 and 7/14/2008 due to wet conditions.

Condensation or liquid water intrusion into the Teflon tubing of the S-OPS occurred often in the tubing around the area sources. Analysis of the problem revealed that condensation occurred as the air cooled in transit from the inlet to the trailer through tubing under a negative net radiation balance (particularly at night). In addition, water intrusion occurred during the leak testing if any water had accumulated along the junction between the filter/inlet and the S-OPS tubing. The impact of the liquid water in the S-OPS tubing on the measured concentration of H_2S was minimal due to the low solubility of H_2S.

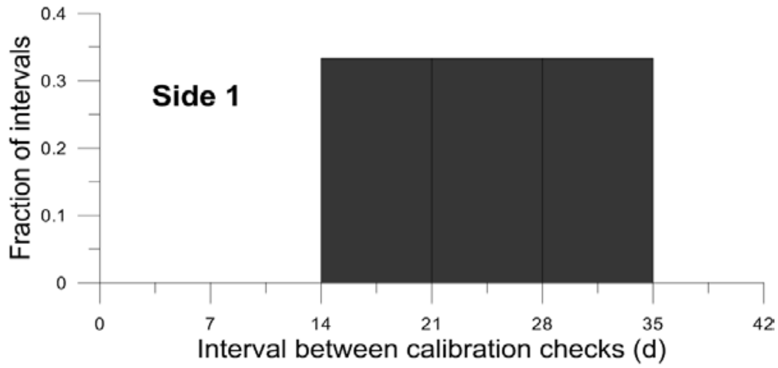
Table 6.6-2A: Change in flow over period, Area source Side 1 (s/n A)

		Delta inlet flow (beginning-end) (L min^{-1})										
Start date	**End date**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**Check results**
4/7/2008	5/1/2008	0.03	0.00	0.03	0.02	0.03	0.00	-0.01	-0.05	-0.02	-0.03	Fail
5/1/2008	5/20/2008	0.08	0.03	0.08	0.09	-0.07	-0.21	0.13	0.05	-0.88	0.05	Fail
5/20/2008	6/19/2008	-0.01	-0.01	-0.07	-0.02	0.00	-0.03	-0.05	-0.02	-0.06	-0.09	Pass

Table 6.6-2B: Change in flow over period, Area source Side 2 (s/n C)

		Delta inlet flow (beginning-end) (L min^{-1})										
Start date	**End date**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**Check results**
4/7/2008	5/1/2008	-0.04	0.05	-0.04	0.05	0.00	-0.02	0.04	0.05	0.00	0.02	Pass
5/1/2008	5/20/2008	0.02	-0.04	0.05	0.00	0.01	0.07	0.08	-0.19	0.06	-0.01	Fail
5/20/2008	6/19/2008	-0.20	-0.11	-0.13	-0.12	-0.13	-0.10	-0.05	-0.11	-0.04	-0.16	Pass

The nominal planned interval between S-OPS checks was 20 d (three weeks). S-OPS checks were conducted at this long-term measurement location a relatively few times with the period of time between checks varying from one to three weeks (Figure 6.6-1). Shorter intervals between checks occurred due to work on the systems.



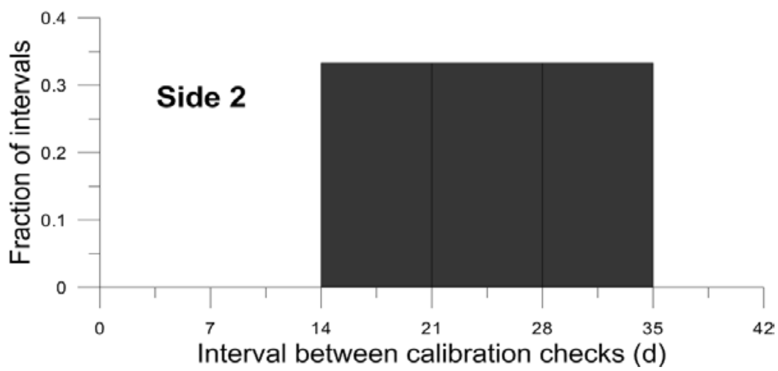


Figure 6.6-1: Intervals between checks

6.7 Miscellaneous meteorological and lagoon calibrations

6.7.1 Air temperature/ humidity

A hygrothermometer (Model HMP45C, Vaisala Inc., Helsinki, Finland) measured both air temperature and relative humidity. Calibration of this sensor was conducted at least annually. Initial calibrations were conducted by the factory. The record of calibration checks are documented in Table 6.7-1.

Table 6.7-1: Calibration record of Vaisala HMP45C, s/n: 4410007

Relative humidity (RH)					
Calibration date	**Expected RH (%)**	**Measured RH (%)**	**Deviation from expected RH (%)**	**Average deviation RH (%)**	**Action**
2/17/2010	21	102	-81		Replace/repair
	50	132	-82		Replace/repair
	95	184	-89		Replace/repair
				-84.0	Replace/repair
7/10/2008	11	11	0		Accept
	50	48	2		Accept
	84	78	6		Accept
				2.5	Accept
Temperature (T)					
Calibration date	**Expected T (°C)**	**Measured T (°C)**	**Deviation from expected T (°C)**		**Action**
2/17/2010	24.3	-81.7	106.0		Replace
7/10/2008	27.1	26.8	0.2		Pass

6.7.2 Barometric pressure

An aneroid barometer (Model 278, Setra Inc, Boxborough, MA.) with serial number 3033745 was used to measure barometric pressure. Calibration of this sensor was conducted at least annually. Initial calibrations were conducted by the factory. The calibration checks are documented in Table 6.7-2.

Table 6.7-2: Calibration record of Setra 278 s/n 3033745

Calibration date	Expected value range (hPa)	Number of comparisons (n)	Mean difference from reference (hPa)	Action
2/11-12/2010	998.4-992.5	6	1.6	Pass
9/16-17/2009	997.4-1000.1	6	0.8	Pass
2/27-3/2/2009	992.3-1010.0	6	2.0	Pass
7/23-27/2008	995.6-996.8	6	1.1	Pass
1/22-23/2008	995.6-998.2	6	1.5	Pass

6.7.3 Solar radiation

A pyranometer (Model 200SB, LiCOR Inc., Lincoln, NE) was used to measure solar radiation. Calibration of this sensor was conducted at least annually. Initial calibrations were conducted by the factory. The calibration checks are documented in Table 6.7-3.

Table 6.7-3: Calibration record of LiCOR 200SB pyranometer, s/n PY554447

Calibration date	Mean difference from reference (Wm^{-2})	Mean difference from reference (%)	Action
3/5-3/8 2010	4.84	0.91	Pass
8/30/2006			Factory calibration

6.7.4 Lagoon water temperature

A thermistor (Model 107-L, Campbell Scientific Inc, Logan, Utah) was used to measure lagoon temperature. Calibration of this sensor was conducted at least annually. Initial calibrations were conducted by the factory. Three thermistor probes were used at this location: serial numbers 0030, 005, and 006. The calibration checks are documented in Table 6.7-4.

Table 6.7-4: Calibration record of thermistor CSI 107-L

Calibration date	Expected value (°C)	Difference from expected (°C)	Action
Thermistor CSI 107-L, s/n 0030 (7777)			
6/18/2007	25.0	-0.0	Accept
	24.5	0.0	Accept
	24.0	0.3	Accept
Thermistor CSI 107-L, s/n 005			
2/1/2008	0.0	0.4	Accept
4/30/2008	20.0	3.3	Replaced
Thermistor CSI 107-L, s/n 006			
4/30/2008	19.5	0.3	New unit

6.7.5 Sludge gun

A sludge gun (Model 10, Marklin Specialty Engineering, Toronto, Ontario, Canada) with serial number 20176A was used to measure sludge depth in the lagoon. Calibration of this sensor was conducted at least annually. Initial calibrations were conducted by the factory. The calibration checks are documented in Table 6.7-5.

Table 6.7-4: Calibration record of Marklin sludge gun s/n 20176A

Calibration date	Mean (mm)	Standard deviation (mm)	Accuracy (mm)	Action
2/23/2010	73.88	0.78	1.88	Accept
7/23/2008	72.06	0.58	1.17	Accept
7/24/2008	77.56	0.72	1.56	Accept
3/23/2007	81.78	0.83	1.78	Accept

6.7.6 CR1000 data logger

The CR1000 data logger (Campbell Scientific Inc., Logan, Utah) was used to log all lagoon measurements (pH, oxidation-reduction potential, and temperature) and air temperature, relative humidity, barometric pressure, and wetness. Calibration check of this unit was conducted at the beginning and end of the study. Initial calibrations were conducted by the factory. The calibration checks are documented in Tables 6.7-6.

Table 6.7-6: Calibration record of Campbell Scientific CR1000 data logger, s/n 7676

Channel	Input (mV)	Tolerance SE|DE (mV)	Measured mV mean value	Error (mV)	Measured (mV)	Error (mV)
Factory Calibration						
Calibration date: 1/18/2007			Single-ended		Differential	
12	5000	± 3	5000.19	-0.19	5001.01	-1.01
12	-5000	± 3	-5002.51	-2.51	-5001.35	-1.35
12	2500	± 1.5	—	—	2500.42	-0.42
12	250	± 0.15	—	—	250.042	-0.042
12	25	± 0.015	—	—	25.005	-0.005
12	7.5	± 0.0045	—	—	7.50015	-0.0015
12	2.5	± 0.0015	—	—	2.49929	0.00071
12	-2.5	± 0.0015	—	—	-2.49967	0.00067
12	5000	± 6	4997.99	2.99	4999.32	0.32
12	5000	± 6	5001.97	-1.97	5003.03	-3.03
12	5000	± 6	—	—	—	—
12	5000	± 6	—	—	—	—
PAML Calibrations						
Calibration date: 2/5/2007			Single-ended		Differential	
1	4950	± 6.96| 4.97	4951.7	-1.7	—	—
2	4950	± 6.96| 4.97	4951.7	-1.7	—	—
3	4950	± 6.96| 4.97	4951.7	-1.7	—	—
4	4950	± 6.96| 4.97	4951.7	-1.7	—	—
5	4950	± 6.96| 4.97	4951.7	-1.7	—	—
6	4950	± 6.96| 4.97	4951.7	-1.7	—	—
7	4950	± 6.96| 4.97	4951.7	-1.7	—	—
8	4950	± 6.96| 4.97	4951.7	-1.7	—	—
9	4950	± 6.96| 4.97	4951.7	-1.7	—	—
10	4950	± 6.96| 4.97	4951.7	-1.7	—	—
12	4950	± 6.96| 4.97	4951.7	-1.7	—	—
13	4950	± 6.96| 4.97	4951.7	-1.7	—	—
14	4950	± 6.96| 4.97	4951.7	-1.7	—	—
15	4950	± 6.96| 4.97	4951.7	-1.7	—	—
16	4950	± 6.96| 4.97	4951.7	-1.7	—	—
Calibration date: 2/24/2010			Single-ended		Differential	
1	100	± 2.06 | 1.06	99.13	0.87	—	—

Channel	Input (mV)	Tolerance SE|DE (mV)	Measured mV mean value	Error (mV)	Measured (mV)	Error (mV)
2	100	± 2.06 | 1.06	99.13	0.87	99.53	0.47
3	100	± 2.06 | 1.06	99.13	0.87	—	—
4	100	± 2.06 | 1.06	99.13	0.87	—	—
5	100	± 2.06 | 1.06	99.13	0.87	99.53	0.47
6	100	± 2.06 | 1.06	99.13	0.87	99.53	0.47
7	100	± 2.06 | 1.06	99.45	0.87	99.53	0.47
8	100	± 2.06 | 1.06	99.13	0.87	99.53	0.47
9	100	± 2.06 | 1.06	99.43	0.87	—	—
10	100	± 2.06 | 1.06	99.13	0.87	—	—
11	100	± 2.06 | 1.06	99.13	0.87	—	—
12	100	± 2.06 | 1.06	99.13	0.87	—	—
13	100	± 2.06 | 1.06	99.13	0.87	—	—
14	100	± 2.06 | 1.06	99.13	0.87	—	—
15	100	± 2.06 | 1.06	99.13	0.87	—	—
16	100	± 2.06 | 1.06	99.13	0.87	—	—
Calibration date: 2/24/2010			**Single-ended**		**Differential**	
1	0	± 2.06 | 1.06	0	0	—	
2	0	± 2.06 | 1.06	0	0	0	0
3	0	± 2.06 | 1.06	0	0	—	—
4	0	± 2.06 | 1.06	0	0	—	—
5	0	± 2.06 | 1.06	0	0	0	0
6	0	± 2.06 | 1.06	0	0	0	0
7	0	± 2.06 | 1.06	0	0	0	0
8	0	± 2.06 | 1.06	0	0	0	0
9	0	± 2.06 | 1.06	0	0	—	—
10	0	± 2.06 | 1.06	0	0	—	—
11	0	± 2.06 | 1.06	0	0	—	—
12	0	± 2.06 | 1.06	0	0	—	—
13	0	± 2.06 | 1.06	0	0	—	—
14	0	± 2.06 | 1.06	0	0	—	—
15	0	± 2.06 | 1.06	0	0	—	—
16	0	± 2.06 | 1.06	0	0	—	—

6.7.7 CR800 data logger

The CR800 data logger (Campbell Scientific Inc., Logan, Utah) was used to log all GSS measurements (air temperature and relative humidity, flow rate, and pressure). Calibration check of this unit was conducted only at end of the study. Initial calibrations were conducted by the factory. The calibration checks are documented in Table 6.7-7.

Table 6.7-7: Calibration record of Campbell Scientific CR800 data logger s/n 3699

Calibration date: 3/22/2010			**Single-ended**	
Channel	**Input (mV)**	**Tolerance SE (mV)**	**Measured (mV)**	**Error (mV)**
1	100	± 2.061	99.40	0.6
2	100	± 2.061	99.40	0.6
3	100	± 2.061	99.41	0.6
4	100	± 2.061	99.41	0.6
5	100	± 2.061	99.41	0.6
6	100	± 2.061	99.41	0.6
Calibration date: 3/22/2010			**Single-ended**	
Channel	**Input (mV)**	**Tolerance SE (mV)**	**Measured (mV)**	**Error (mV)**
1	0	± 2.061	0	0
2	0	± 2.061	0	0
3	0	± 2.061	0	0
4	0	± 2.061	0	0
5	0	± 2.061	0	0
6	0	± 2.061	0	0

6.8 Site Activity

Time HH:MM UTC	Date (dd/mm/yyyy)	Activity (setup, takedown, calibration, repair, remote)	Event
	7/13/2007	Setup	Retro-reflectors and anemometers mounted
16:29-16:42	7/13/2007	Setup	Calibrated TDLAS 1026 - Mean: 45.91 - SD: 2.52
17:55-18:00	7/13/2007	Setup	Calibrated TDLAS 1027 - Mean: 53.55 - SD: 1.75
	7/20/2007	Repair	Purpose of visit was to change plastics on retro-reflectors
	7/24/2007	Calibration	Sludge depth measurements taken. No calculations made.
	7/24/2007	Calibration	pH sensor: calibration done, acceptance done, and QA accepted.
	8/8/2007	Calibration	Took down sonic anemometers for preparation of anemometer inter-comparison on 8/10/2007.
	8/8/2007	Calibration	pH sensor: calibration done, acceptance done, and QA accepted.
14:30	8/8/2007	Calibration	Sludge depth measurements taken. Avg. depth to sludge layer: 1.54m
	8/10/2007	Calibration	Tried to perform sonic anemometer inter-comparison but could not get program to run.
	8/10/2007	Calibration	Tried to re-aim TDLAS 1026 but got a pan-tilt error. Did not have time to re-aim all paths; therefore, TDLAS 1026 was not running upon departure.
	8/15/2007	Calibration	Calibrated TDLAS and sonic anemometers. Re-aimed TDLAS paths that were not aligned.
13:30-14:25	8/15/2007	Calibration	Sonic anemometer inter-comparison performed. Sonic anemometer 1: 1.36 Sonic anemometer 2: 1.33 Sonic anemometer 3: 1.37
15:00-15:05	8/15/2007	Calibration	Calibrated TDLAS 1026: Mean: 51.73 SD: 1.38
15:45-15:50	8/15/2007	Calibration	Calibrated TDLAS 1027: Mean: 50.41 SD: 0.74
16:39	8/15/2007	Calibration	Zero calibration performed on sonic anemometers; all pass.
	8/16/2007	Repair	Tried new polyethylene plastic sheeting in short path ground retro-reflectors to try to diffuse beam. New sheets worked well but may be too thick. Will try thinner plastic sheeting tomorrow.
	8/17/2007	Repair	Changed polyethylene sheeting in ground retro-reflectors to thinner plastic. Also re-aimed some TDLAS paths. TDLAS paths were working well upon departure.
	8/17/2007	Repair	Noticed producer cut wire for pH probe when mowing. Performed temporary repair; will fix properly on Monday.
	8/20/2007	Repair	Cleaned up trailer, organized cables, mounted modems to walls, and copied period 1 data to CD's, DVD's, and memory stick.
	8/22/2007	Repair	Repaired pH probe wire; checked data and works well. Organized trailer. Sealed NE tower retro-reflectors with silicone.
	8/23/2007	Repair	Sealed retro-reflector windows. Re-aimed TDLAS 1 and 2.
	8/30/2007	Calibration	Calibrated TDLAS. Re-aimed TDLAS paths that were not aligned.
18:09-18:14	8/30/2007	Calibration	Calibrated TDLAS 1026: Mean: 49.38 SD: 1.62
19:13-19:18	8/30/2007	Calibration	Calibrated TDLAS 1027: Mean: 50.57 SD: 3.21
	9/4/2007	Calibration	Performed sludge depth measurements. Avg. depth to sludge layer: 1.40m.
	9/4/2007	Calibration	pH sensor: calibration done, acceptance done, and QA accepted.

Time HH:MM UTC	Date (dd/mm/yyyy)	Activity (setup, takedown, calibration, repair, remote)	Event
	9/4/2007	Repair	Sonic anemometer program was not running upon arrival. Bird droppings found on sonic anemometer sensor 3.
	9/5/2007	Repair	Cleaned bird droppings off of sonic anemometer sensor 3. Downloaded sonic anemometer data for period 2 onto disk.
14:10-15:10	9/5/2007	Calibration	Inter-comparison on sonic anemometers: Sonic anemometer 1: 2.02 Sonic anemometer 2: 2.03 Sonic anemometer 3: 2.08
15:35	9/5/2007	Calibration	Zero calibration performed on sonic anemometers; all pass.
	9/12/2007	Repair	Realigned TDLAS. Checked all instruments to see if they are working properly.
	9/19/2007	Repair	Maintenance and Inspection checklist completed.
	9/19/2007	Repair	Switched CR1000 memory card from F2 to F1. Put weatherproof tape over junctions on both TDLAS cables.
	9/19/2007	Calibration	pH sensor: calibration done, acceptance done, and QA accepted.
	9/19/2007	Calibration	Barometer audit: accepted.
	9/19/2007	Calibration	Inter-comparison on sonic anemometers: Sonic anemometer 1: 2.33 Sonic anemometer 2: 2.32 Sonic anemometer 3: 2.31
	9/20/2007	Repair	Re-aimed TDLAS paths.
	9/20/2007	Calibration	Sludge depth measurements taken. Avg. depth to sludge layer: 1.44 m.
	9/20/2007	Calibration	Zero calibration performed on sonic anemometers; all pass.
16:53-16:59	9/20/2007	Calibration	Calibrated TDLAS 1027: Mean: 52.06 SD: 2.30 Note: Attempted to adjust calibration tube position to obtain r^2 in upper 0.90's, but highest I could get was 0.93 or 0.94.
17:22-17:27	9/20/2007	Calibration	Calibrated TDLAS 1026: Mean: 45.71 SD: 1.28
	10/4/2007	Repair	Cleaned and painted wetness sensor with latex paint.
	10/4/2007	Repair	Put power strip at met tower into kitty litter box for water protection.
	10/4/2007	Repair	Noticed that retro-reflectors were not plugged in completely and had dew on outer plastic causing light values to be too low.
	10/4/2007	Repair	External hard drive was not backing up data. It was turned off. Turned it back on and backed up existing data.
	10/4/2007	Repair	Scanner/laptop froze up and restarted automatically after login,
	10/4/2007	Repair	Realigned TDLAS.
	10/17/2007	Repair	Not able to remotely connect in office before arriving. LAN computer looked to be in safe mode. Restarted computer and now can remotely connect.
	10/17/2007	Repair	NH_3 tank expired (10/13/2007), so calibration could not be finished.
	10/17/2007	Repair	Noticed connection problem ("GFOP-xxxx") with TDLAS 1026. It would be in and out of connection. Looked at back of TDLAS when connection was out and the screen said "unlocked." No reading.
	10/17/2007	Repair	Painting wetness sensor may have affected sensor values (got value of 60 instead of expected 100). Noticed during wetness sensor acceptance,
14:10	10/17/2007	Calibration	Wetness sensor calibration: accepted
15:43-15:44	10/17/2007	Calibration	Unable to calibrate either TDLAS because of expired NH_3 gas tank. Also connection was lost with TDLAS 1026 despite

Time HH:MM UTC	Date (dd/mm/yyyy)	Activity (setup, takedown, calibration, repair, remote)	Event
			being in direct connection with laptop
17:35	10/17/2007	Calibration	Sonic anemometer inter-comparison performed: Sonic anemometer 1: 3.64 Sonic anemometer 2: 3.71 Sonic anemometer 3: 3.64
18:20	10/17/2007	Calibration	Barometer audit: accepted.
19:00	10/17/2007	Calibration	Zero calibration performed on sonic anemometers; all pass.
	10/17/2007	Calibration	Maintenance and Inspection checklist completed.
	10/18/2007	Repair	pH cord was damaged in same spot as before. Put new tape (electrical and rubber) around damaged area. Still recording valid data.
	10/18/2007	Repair	Mounted sonic anemometers on tower and met tower.
	10/18/2007	Repair	Removed plastics from NE tower and from S1R7, S2R6/7
	10/18/2007	Repair	Removed TDLAS 1026 and scanner 1 for repair/East team.
	10/18/2007	Repair	Put extension cord on SW tower so we could plug in bottom tower retro-reflector heaters.
	10/18/2007	Repair	Switched out data card in CR1000 and copied period 2 data.
	10/23/2007	Repair	Could not remotely connect from office to check TDLAS 1027. Both Panasonics were turned off upon arrival. Turned on Panasonic for scanner 2. Loaded setup from 10/5/2007 and had to realign most of the paths (moved ~5 steps to the right).
	10/23/2007	Repair	There were storms last Thursday, so it may have lost power during the storms which shut off the computers.
	10/30/2007	Calibration	Calibrated TDLAS 1026 and 1026 with NH_3 (1000 ppm). Forgot to change cylinder tank concentrations from 500 ppm to 1000 ppm. Diluter concentrations 10:1—wanted to dilute tank so concentration was 100 ppm, but forgot to change cylinder concentration; diluter concentration to 200 ppm at 1 meter. TDLAS read 100 ppm instead of expected 50 ppm at 0.5 meter.
17:27-17:32	10/30/2007	Calibration	Calibrated TDLAS 1026: Mean: 101.6 SD: 0.5. Note: Background 1 could not be used because we accidently forgot to change the distance in *GasView MP* to 1.0. Did not change tank concentration on diluter from 500ppm to 1000ppm, so *GasView MP* program/TDLAS will still read ~100ppm at 0.5m. Bumped calibration chamber on "trial 2" calibration gas.
17:58-18:03	10/30/2007	Calibration	Calibrated TDLAS 1027; no measurements recorded. Note: Did not change tank concentration on diluter from 500 ppm to 1000ppm, so *GasView MP* program/TDLAS will still read ~100 ppm at 0.5 m.
	11/1/2007	Calibration	Installed ORP probe onto probe float (checked results of new probe: ~70mV)
	11/1/2007	Calibration	Producer pumping out lagoon and spreading onto nearby fields.
	11/1/2007	Calibration	Installed fence posts every 5 m for GSS.
	11/3/2007	Repair	Tried calibrating TDLAS 1031 but noticed shutter was not clicking like normal. Took TDLAS apart but shutter was not functions properly. Will send back to manufacturer. Could not put instrument into concentration mode because it was stuck "calibrating."
	11/13/2007	Repair	When calibration TDLAS 1027, it took longer than 2 hours to

Time HH:MM UTC	Date (dd/mm/yyyy)	Activity (setup, takedown, calibration, repair, remote)	Event
			calibrate and get valid r^2 and concentrations. Had to excessively bump, wiggle, etc. to get desirable measurements.
15:36	11/13/2007	Calibration	Zero calibration performed on sonic anemometers; all pass.
15:50-16:50	11/13/2007	Calibration	Sonic anemometer inter-comparison performed. Sonic anemometer 1: 2.91 Sonic anemometer 2: 2.98 Sonic anemometer 3: 2.93
16:20	11/15/2007	Calibration	ORP sensor: calibration and acceptance done.
18:29-18:34	11/15/2007	Calibration	Calibrated TDLAS 1027: Mean: 52.8 SD: 2.11% Accuracy: 6.27% - Note: Took longer than 2 hours to calibrate and get valid r^2 and concentrations. Had to bump, wiggle, etc. excessively to get numbers that were desirable.
	11/15/2007	Calibration	Windy conditions both today and Thursday, so no sludge depth measurements taken.
	11/15/2007	Calibration	Switched out scanner/TDLAS connecting cable on scanner 2.
	11/15/2007	Calibration	pH sensor: calibration done, acceptance done, and QA accepted. Notes: Noticed that when calibrating ORP, red and brown wires seemed to be switched. Wired differently when placing probes into lagoon.
18:30	11/15/2007	Calibration	Wetness sensor calibration: accepted
18:40	11/15/2007	Calibration	Barometer audit: accepted.
14:02	1/15/2008	Calibration	TEC 450i reference precision check (done at PAML)
	1/29/2008	Calibration	S-OPS acceptance: Pass
	1/31/2008	Calibration	S-OPS inlet flow verification
	2/12/2008	Repair	TDLAS 1030 (NW corner) was covered in ice; plastic window covered in ice.
	2/12/2008	Repair	Restarted LAN-H_2S analyzer after changing baud rate—found connection.
	2/12/2008	Repair	Installed SO_2 cylinder mount.
	2/12/2008	Repair	Tried using TDLAS 1030 in SE corner on scanner unit 1. Sent "high power" command through *GasView MP* software in Pan/Tilt Options: No response. No response using Hyperterminal. Tried switching COM ports, but still no communication. Power-cycled computer and modems.
	2/28/2008	Calibration	Innova single point calibration
17:20	2/28/2008	Calibration	TEC 450i calibration verification check
	2/29/2008	Calibration	Producer Event/Change Form completed.
	3/5/2008	Calibration	No DVD's in trailer. Could not burn 16 hertz data.
	3/5/2008	Calibration	Barometer audit: accepted.
17:25-18:25	3/5/2008	Calibration	Sonic anemometer inter-comparison performed; all pass. Sonic anemometer 1: 3.89 Sonic anemometer 2: 3.92 Sonic anemometer 3: 3.72
19:21-19:30	3/5/2008	Calibration	Zero calibration performed on sonic anemometers.
19:29-19:34	3/5/2008	Calibration	Calibrated TDLAS 1030: Mean: 72.364 SD: 1.31 RSD: 1.8% Bias: 44.9% - Note: Tried calibrating TDLAS 1030 at 50 ppm; got values ~30-35ppm (expecting ~25). Used new chamber. Moved to field without chamber; with ambient air. New chamber concentrations stable with high r^2 value. Old chamber still acting unstable
20:45	3/5/2008	Calibration	Wetness sensor calibration: accepted
	3/5/2008	Remote	Daily site check from PAML
	3/12/2008	Calibration	Tried to calibrate TDLAS 1030 by using 100 ppm of NH_3.

Time HH:MM UTC	Date (dd/mm/yyyy)	Activity (setup, takedown, calibration, repair, remote)	Event
			However the TDLAS failed during calibration, so it was taken back to Purdue. TDLAS power supply was also found missing. Scott said it was back at Purdue.
19:50	3/12/2008	Calibration	Calibrated TDLAS 1030 — Mean: 61.09 SD: 1.709 - RSD: 2.8% - Bias: 21.8% — Notes: TDLAS power supply (inside trailer) was not there. Unhooked scanner and used it for calibration. Used 100 pmm instead of 50 ppm.
	3/17/2008	Calibration	S-OPS inlet flow verification
	3/17/2008	Calibration	S-OPS acceptance: Pass
	3/17/2008	Calibration	GSS acceptance: Pass
	3/17/2008	Calibration	Innova single point calibration
17:07	3/17/2008	Calibration	Barometer audit: accepted.
	3/17/2008	Check	Lagoon probes (pH, ORP, temperature) all with broken cables. Presumably due to winter ice locking cables then having lagoon height changes stressing the cables.
	3/20/2008	Calibration	TEC 450i multipoint calibration, calibration problems. Discussed problem and troubleshoot with Thermo technician. Problem not resolved.
	3/20/2008	Calibration	Sonic anemometer inter-comparison showed failure of sonic anemometer 1. Will try again tomorrow.
	3/21/2008	Calibration	Sonic anemometer inter-comparison performed.
	3/21/2008	Calibration	Calibrated pH, ORP probes and reinstalled in lagoon with temperature probe.
	3/21/2008	Check	Lagoon temperature probe not working properly.
	3/27/2008	Remote	Daily site check from PAML
	3/28/2008	Remote	Daily site check from PAML
	3/31/2008	Remote	Daily site check from PAML
	4/1/2008	Remote	Daily site check from PAML
	4/7/2008	Calibration	Slurry being pumped into lagoon this morning.
	4/7/2008	Calibration	Need to make new 1M KCl solution.
	4/7/2008	Calibration	Need new temperature probe.
	4/7/2008	Calibration	Added 24 volt power source to relay because there is no H_2S analyzer to power relay.
	4/7/2008	Calibration	Trained Bill Randolph in pH, ORP calibration, wetness, pressure, GSS, S-OPS, sonic anemometers, and TEC 146i.
	4/1/2008	Calibration	Maintenance and inspection checklist completed.
	4/7/2008	Calibration	Did not perform sludge depth measurements because it was too windy.
	4/7/2008	Calibration	GSS was stationary on south side.
	4/7/2008	Calibration	Barometer audit: accepted.
	4/7/2008	Calibration	pH sensor: calibration done, acceptance done, and QA accepted.
	4/7/2008	Calibration	ORP sensor: calibration and acceptance done.
	4/7/2008	Calibration	GSS leak test: Pass
	4/7/2008	Calibration	GSS max flow test: Fail
	4/7/2008	Calibration	S-OPS verification: Pass
14:05	4/7/2008	Calibration	Wetness sensor calibration: accepted
15:10-16:10	4/7/2008	Calibration	Sonic anemometer inter-comparison: all pass.
16:40	4/7/2008	Calibration	Zero sonic anemometer calibration: all pass.
	4/8/2008	Calibration	Performed Innova calibration. Difference in the values between the Innova screen and the program: For NH_3:

Time HH:MM UTC	Date (dd/mm/yyyy)	Activity (setup, takedown, calibration, repair, remote)	Event
			instrument read 34; program read 48. For methane: instrument read 1.3; program read 1.03. For propane: instrument read 5.22; program read 9.31. For water vapor: instrument read 7.3; program read 8.13.
	4/9/2008	Remote	Daily site check from PAML
	4/10/2008	Remote	Daily site check from PAML
	4/11/2008	Remote	Daily site check from PAML
	4/14/2008	Calibration	TDLAS 1031 would not zero; will bring back to PAML to test.
	4/14/2008	Calibration	Calibrated TDLAS 1029 with old gas cylinder first. On second calibration trial, used new cylinder. TDLAS was bumped during calibration; still passed. On third calibration trial, used old cylinder, same position as trial two.
	4/14/2008	Calibration	Calibrated TDLAS 1030 with old gas cylinder first. Performed second calibration with new cylinder. Aligned scanner 1/TDLAS 1030 (NW). Could not align SE scanner/TDLAS because required cords were not in box, scanner case, van, or trailer.
	4/14/2008	Calibration	Lagoon site layout made
15:04-17:48	4/14/2008	Calibration	Calibrated TDLAS 1030 — See site notes for details.
16:03-17:19	4/14/2008	Calibration	Calibrated TDLAS 1029 — See site notes for details.
	4/15/2008	Repair	Producer pumping into lagoon today.
	4/15/2008	Repair	Set up and aimed TDLAS 1 (1029) in SE corner of lagoon.
	4/15/2008	Repair	Copied missing data from periods 1, 2, 3, and 4 to CD's and DVD's.
	4/15/2008	Repair	Checked readings of pH/ORP probes both before and after unhooking RH/temp probe to see if they affect the readings. See site notes for details.
	4/15/2008	Repair	Results confirm problem of pH probe (pH reading is 33.5). Found bad pH started occurring at 21:00 UTC on 4/12/2008. Checked voltage across red and green wires on pH probe and got about 1600 mV, which is the reason for the incorrect pH reading. Checked pH probe connections to CR 1000, and everything looked fine. Unable to pull pH probe from lagoon today, so it will need to be checked another day.
	4/16/2008	Remote	Daily site check from PAML
	4/17/2008	Remote	Daily site check from PAML
	4/18/2008	Remote	Daily site check from PAML
12:00	4/24/2008	Remote	Daily status check from PAML — Note: Very limited data with sonic anemometer flagging. There appears to be communication problems since beginning of period (all 3 sonic anemometers). Total number of data points frequently reduced below normal. Lots of "large variance" flags.
14:20	4/25/2008	Remote	Some sonic anemometer flagged points in all sensors. More spikes in all 3 sonic anemometers than normal.
14:16	4/29/2008	Remote	Sonic anemometer 2 w different from 0 briefly on 482. Sonic anemometer 3 different from 0 at last data points. TDLAS 2 was aligned for almost entire day on 8 paths. TDLAS 1 was not aligned for paths 3 and 5. Loaded previous setup and re-aimed paths—successful. Saved new setup with new pan-tilt values—logged on Daily TDLAS/sonic anemometer log.

Time HH:MM UTC	Date (dd/mm/yyyy)	Activity (setup, takedown, calibration, repair, remote)	Event
	4/30/2008	Calibration	pH sensor: calibration done, acceptance done, and QA accepted.
	4/30/2008	Calibration	Evidence of power failure for 5 s on 2008-4-1. The pH probe not working properly. It always reads ~1700mV, and does not respond to any calibration solutions. Tried changed internal solution of pH probe to 1M KCl, but that did not remedy the problem. Installed and calibrated new temp probe because old one was not working. S/N: 006. Also calibrated ORP.
	4/30/2008	Calibration	ORP sensor: calibration and acceptance done.
	5/1/2008	Calibration	Had to drive back to PAML from IN4A after FTIR. Cylinder #FF44397 was empty when hooked up to diluter—was old East team cylinder. Sonic anemometer inter-comparisons did not pass during first trial. May be caused by high winds. Farm manager attempting to pump into lagoon. Too windy to perform sludge depth measurements.
	5/1/2008	Calibration	No DVD's in trailer. Could not burn 16 hz data.
	5/1/2008	Calibration	Maintenance and Inspection checklist completed.
	5/1/2008	Calibration	Innova single point calibration
	5/1/2008	Calibration	S-OPS/GSS test: Pass
	5/1/2008	Calibration	S-OPS max flow test
	5/1/2008	Calibration	S-OPS inlet flow verification: Pass (North C and South A)
	5/1/2008	Calibration	GSS leak test: Pass
	5/1/2008	Calibration	GSS no flow test
	5/1/2008	Calibration	GSS max flow test: Fail
13:44	5/1/2008	Calibration	Wetness sensor calibration: accepted
15:15-16:15	5/1/2008	Calibration	Sonic anemometer inter-comparison: all pass.
17:16	5/1/2008	Calibration	Sonic anemometer zero calibration: all pass.
17:24-17:39	5/1/2008	Calibration	Calibrated TDLAS 1029: Mean 49.6 SD 0.62 RSD 1.2% Bias -0.7%
18:01-18:06	5/1/2008	Calibration	Calibrated TDLAS 1030: Mean 46.96 SD 0.54 RSD 1.1% Bias -5.8%
12:44	5/2/2008	Remote	Daily Site Check from PAML — Notes: Had to restart sonic anemometer program. Had to re-aim path 2 on TDLAS 1. No pH probe present.
13:50	5/5/2008	Remote	Daily Status Check from PAML — Notes: Sonic anemometer 2 gradually dropped out on day 489 (lost communication?). Restarted sonic anemometer program. Sonic anemometer 2 still missing. H_2S analyzer not present. pH probe not present. ORP giving values of ~+50.
13:15	5/6/2008	Remote	Daily Status Check from PAML — Notes: Sonic anemometer 2 no data. H_2S analyzer not present. pH probe not present
	5/7/2008	Repair	Sonic anemometer 2 was not sending data. Found antenna lying on ground near tower. Placed back in box, and it started sending data.
	5/7/2008	Repair	TDLAS laptops not responding. Unable to connect remotely either. Screens are black except for white mouse cursor. Power-cycled and restored.
	5/7/2008	Repair	TDLAS's were not recording new data. Connected to FTP server at PAML and retrieved most recent good GMP files. Replaced bad pan/tilt values in one of the files. TDLAS systems are now running.

Time HH:MM UTC	Date (dd/mm/yyyy)	Activity (setup, takedown, calibration, repair, remote)	Event
	5/7/2008	Repair	Discovered paths 1 and 2 on TDLAS 1 (1029) were both pointing at retro-reflector 1. Fixed.
14:10	5/7/2008	Remote	Daily Status Check from PAML - Notes: H_2S analyzer not present. Data not transferred last night. TDLAS laptops froze up. pH probe not present. Unable to remotely connect to TDLAS laptops. Last TDLAS2 data on 5-6 at 0615 UTC. Last TDLAS1 data 5-6 at 0620 UTC. TDLAS laptops last checked on 5-6 (yesterday) at 1300 UTC.
12:30	5/8/2008	Remote	Daily status check from PAML - Notes: No pH probe. No H_2S analyzer. TDLAS1 current day scans are less as yesterday it was under repair process.
18:31	5/8/2008	Remote	Checked time issues on LAN and TDLAS PC's. Added timesync batch file to LAN, TDLAS1, and TDLAS2. LAN was about 2 min ahead of TDLAS PC's at check this morning. Generally, the agreement had been much better. The "internet time" tab under "date and time properties" has generally been working.
16:30	5/9/2008	Remote	Daily status check from PAML. Notes: H_2S analyzer not present. pH probe not present. Red checkmark error on DynDNS updater. "Update result: Error with update." Red boxes on TDLAS 1 (1029). Path 2: Replaced corrupt values with 18279, 179. Re-aimed to 18284, 196. Path 5: Replaced corrupt values with 18513, -745. Loaded setup at 1712 UTC.
	5/12/2008	Repair	Tested TDLAS/scanner power/moden box #5 (from west team) to see if it would work. We tested it on TDLAS 1029 (SW corner), and it would not work properly. It was showing the same symptoms as it did at OK3A.
	5/12/2008	Repair	We also took some retro-reflector cubes out of the ground retro-reflectors. Took four cubes out of the 1/3 distance retro-reflectors (leaving one), and took two cubes out of the 2/3 distance retro-reflectors (leaving 3). Started the scanner program up, and it worked very well.
13:38	5/12/2008	Remote	Daily status check from PAML. Notes: Scott and Derrick visited site; could not align paths with low light level. Will visit remotely again in the afternoon.
13:46	5/13/2008	Remote	Daily status check from PAML. Notes: Sonic anemometer 2 "w" values different from 0; back to normal. All sonic anemometer 2 data looked odd during this period; back to normal. No 450i present at site. GSS values are within range but displaying irregular patterns. TDLAS2: centerline duty cycle dropping off; currently normal. Referenced r^2 not at 99; normal now but dropped to 0-20 temporarily. Scott and Derrick were testing new power supply yesterday; could be what affected values temporarily. No working pH probe present at site. Could not see anything but a black screen when logged onto LAN remotely. Restarted computer using task manager—worked successfully. Cannot connect to CR1000; stopped updating files at 2008-5-12 at 1640 UTC. TDLAS 1: Retro-reflectors 9 and 10 were out of range. Loaded previous setup and maximized light values.
13:00	5/13/2008	Remote	Daily status check from PAML - Notes: There is no H_2S analyzer at IN4A. Had to re-aim path 7 on TDLAS 1 because

Time HH:MM UTC	Date (dd/mm/yyyy)	Activity (setup, takedown, calibration, repair, remote)	Event
			the scanner was getting an error with the red boxes on path 7.
16:08	5/15/2008	Remote	Daily status check from PAML — Notes: Last QC data from GSS/ H_2S /Innova was from 2008-5-13. Last QC data from CR1000 was from 2008-5-12.
13:29	5/16/2008	Remote	Daily status check from PAML — Notes: Last QC data from GSS/ H_2S /Innova was from 2008-5-13. Last QC data from CR1000 was from 2008-5-12.
14:31	5/19/2008	Remote	Daily status check from PAML — Notes: Sonic anemometer 1 flagged data and graph of sonic anemometer 1 looks different. Since 2008-5-14 there was a gradual fall in series 2 of the GSS pressure and then increased shortly on 2008-5-16. There is no pH probe. TDLAS 1 showing alarm 10 and pan/tilt error. Solved pan/tilt error, but still not working properly. No light values for all the paths.
	5/20/2008	Calibration	Southeast scanner for TDLAS 1 was not working. It will be returned to Purdue.
	5/20/2008	Calibration	S-OPS south side: orifice #9 had no flow. Changed filter paper, and it's working well.
	5/20/2008	Calibration	S-OPS north side: orifice #8 had water droplets which lowered flow rate. Changed filter paper, and it's now working well.
	5/20/2008	Calibration	S-OPS/GSS test: Pass
	5/20/2008	Calibration	S-OPS max flow test
	5/20/2008	Calibration	S-OPS inlet flow verification: Pass (North C and South A)
	5/20/2008	Calibration	GSS leak test: Pass
	5/20/2008	Calibration	GSS no flow test
	5/20/2008	Calibration	GSS max flow test: Fail
16:05-17:38	5/20/2008	Calibration	Innova single point calibration
	5/21/2008	Calibration	Taking H_2S cylinder, NH_3 cylinders, and TDLAS power supply back to PAML.
21:00	5/21/2008	Calibration	Calibrated TDLAS 1030 — Mean: 46.77 - SD:0.48 - RSD: 1.0% - Bias: -6.5%
21:36	5/21/2008	Calibration	Calibrated TDLAS 1029 — Mean: 50.99 - SD: 0.08 - RSD: 0.2% -Bias: 1.7%
12:45	5/22/2008	Remote	Daily status check from PAML — Notes: H_2S analyzer not present. TDLAS 1 has a broken scanner. TDLAS 2 is in fixed trailer for calibration check. pH probe not present. Back-up error related to sonic anemometer/*iPort*/Innova programs.
	5/27/2008	Calibration	Saw water droplets in the sample inflow tubes for Innova and TEC 450i. There was less water in the Innova tube, but there was much more in the 450i tube. Water droplets were also seen in the exhaust tube for the GSS. After 2 hours the water droplets had disappeared. Reinstalled 450i.
	5/27/2008	Calibration	Did sonic anemometer inter-comparison, but it started to rain before zero/bias test could be done.
18:00-19:00	5/27/2008	Calibration	Sonic anemometer inter-comparison: all pass.
	5/28/2008	Calibration	Too windy to perform sludge depth measurements.
	5/28/2008	Calibration	Finished sonic anemometer calibration by performing zero calibrations.
	5/28/2008	Calibration	Tried to reinstall TDLAS 1029 (without scanner), but could

Time HH:MM UTC	**Date** (dd/mm/yyyy)	**Activity** (setup, takedown, calibration, repair, remote)	**Event**
			not directly communicate with TDLAS laptop.
	5/28/2008	Calibration	Barometer audit: accepted.
	5/28/2008	Calibration	ORP sensor: calibration and acceptance done.
14:15	5/27/2008	Calibration	Sonic anemometer zero calibration: all pass.
15:25	5/28/2008	Calibration	Wetness sensor calibration: accepted
13:30-14:25	5/29/2008	Remote	Daily status check from PAML — Notes: Graph for sonic anemometer 2 looks different. Graph of Innova data points is dropped on current date. TDLAS 1029 has just been aligned for single path (#8) (scanner is not working). No pH probe.
13:15	5/30/2008	Remote	Daily status check from PAML — Notes: Sonic anemometer 2 graph looks different. TDLAS 1 (1029) is only aimed at one path (path 8). No pH probe. Backup error: not enough space to perform backup.
13:14	6/2/2008	Remote	Daily status check from PAML — Notes: Sonic anemometer 2 has not been working since 19:50 UTC on 2005-5-31. Tried restarting sonic anemometer program, but it did not work. TDLAS 1 is aimed at path 8 only. No pH probe present. TDLAS 2 (1030) had no connection ("xxxx") initially when logging in. A few minutes later it reconnected.
12:20	6/3/2008	Remote	Daily status check from PAML — Notes: Sonic anemometer 2 has not been communicating since 0:00 UTC Friday. TDLAS 1029 is currently aimed at path 8 only due to broken scanner. It is still giving vaild light values, but they have dropped from 10000 on Thursday to about 2000 today. pH probe not present in lagoon.
12:18	6/4/2008	Remote	Daily status check from PAML — Notes: Sonic anemometer 2 is still not communicating. There is a noticeable increase in the amount of flagged data in sonic anemometer 3 after day 515. TDLAS 1 (1029) is aimed only at path 8 due to a broken scanner. Light levels have dropped to about 1500 from 2000 yesterday. No pH probe at site.
	6/5/2008	Repair	Found sonic anemometer modems were mounted too low (below berm level) for communication with trailer. Moved modems up to berm level, and now they are working properly.
	6/5/2008	Repair	Installed barometer tube in NEMA box.
	6/5/2008	Repair	Put desiccants and a humidity test strip into NEMA box and the sonic anemometer modem boxes.
	6/5/2008	Repair	Scanner for TDLAS 1029 failed about an hour after installation. Tested power supply, and it was found to be working. Switched with power supply for TDLAS 1030, but it would still not work. Scanners were returned to PAML.
	6/5/2008	Repair	Put 0.25-inch plastics into each retro-reflector on paths 1 and 2 for TDLAS 2 (1030).
	6/5/2008	Repair	Found a very large amount of water in the GSS exhaust tube (~100 mL). The water could not move because of the dips in the tube. Moved exhaust tube back inside of the trailer.
12:20	6/6/2008	Remote	Daily status check from PAML Notes: Sonic anemometer 2 is now working after moving modems higher on tower. Sonic anemometer 1 w graph was showing readings of 0.5 to 1.0 ms^{-1} during yesterday (day 522). No pH probe at site. Replacement scanner for TDLAS 1 (1029) failed after

Time HH:MM UTC	Date (dd/mm/yyyy)	Activity (setup, takedown, calibration, repair, remote)	Event
			installation, so the TDLAS is again aimed at path 8 only. Changed distance on TDLAS from 1 m to 136 m.
12:10	6/9/2008	Remote	Daily status check from PAML — Notes: Overflow error caused sonic anemometer program to stop on day 524.452. Program was restarted on 2008-6-9 at 13:00 UTC. TDLAS QC files are formatted incorrectly and cannot be checked. Air temperature flags have increased to 60 since 06:10 on 2008-6-9 (day 526). Air temperature graph looks normal. No pH probe present. Unable to remotely connect to TDLAS 2 (1030) laptop. TDLAS 1 (1029) is aimed only at path 8 due to broken scanner. Light values are holding around 2500.
12:40	6/10/2008	Remote	Daily status check from PAML — Notes: Sonic anemometer 2 has shown high amounts of flagged data over the last few hours. Sonic anemometer 2 u, v, and T graphs are have changed significantly over the last few hours. Will monitor closely. File name error in TDLAS QC files; cannot access data. No pH probe present. TDLAS 1 is aimed at path 8 only due to a scanner malfunction. TDLAS 1 light values have dropped to around 600. Unable to remotely connect to TDLAS 2 laptop to check TDLAS status.
	6/11/2008	Repair	Found a lot of liquid water in the GSS exhaust tube. Dip in tubing was acting like a trap. Drained about 70 mL from this line. Condensation was also present in input lines for Innova and 450i, but it was a very small amount. Turned up temperature in trailer to prevent further condensation.
	6/11/2008	Repair	TDLAS 2 laptop (192.160.0.10) locked up on arrival. Power-cycled but locked up during startup. Restarted again, and it worked properly. Installed updated on TDLAS laptops (12 on .11 and 10 on.10). Installed update on LAN (1).
	6/11/2008	Repair	TDLAS 2 last stored data on 6/9/2008 at 5:56 UTC.
	6/11/2008	Repair	Stopped TDLAS 1 (1029 on single path) at 15:12 UTC. Replaced scanner bypass with repaired scanner.
	6/11/2008	Repair	On TDLAS 2, the most recent GMP file was in period 4 and was blank. It was last modified (TDL2_NW_IN4A_06052008_running.gmp) on 6/11/2008 at 14:46 UTC. Loaded TDL_NW_IN4A_06052008_bkp.gmp.
	6/11/2008	Repair	New scanner/TDLAS layout in site notes.
12:38	6/11/2008	Remote	Daily status check from PAML — Notes: Sonic anemometer 2 data have improved from yesterday's status check. File name error in TDLAS_QC files. Cannot access data. TDLAS 1 (1029) is aimed only at path 8 due to broken scanner. Light values have risen from 600 yesterday to about 1350 today. TDLAS 2 (1030) laptop is frozen and cannot be accessed remotely. No pH probe present.
13:30	6/12/2008	Remote	Daily status check from PAML — Notes: Sonic anemometer 3 w values slightly, but not uncomfortably, less than zero. No remedial action necessary. Sonic anemometer 1 w values about 0.4 ms^{-1}. Again, no remedial action necessary. TDLAS_QC file name error. Cannot access files. Pan/tilt errors on paths 3 and 4 on TDLAS 1029. Saved new setup with old values for paths 3 and 4. Seems to work. No pH probe present.

Time HH:MM UTC	Date (dd/mm/yyyy)	Activity (setup, takedown, calibration, repair, remote)	Event
12:52	6/13/2008	Remote	Daily status check from PAML — Notes: Sonic anemometer 1 w graph has shown 1.0 ms^{-1} readings for the last day. TDLAS 1030 laptop locked up, causing data to be lost. Red box errors on TDLAS 1029, paths 1, 4, and 8. Loaded previous pan/tilt values for paths 1, 4, and 8. All paths look nice now. Air temperature, relative humidity, and barometric pressure flags have risen 07:00 UTC on day 528. No pH probe present.
12:07	6/16/2008	Remote	Daily status check from PAML — Notes: H_2S analyzer stopped incrementing at 2:19 UTC on day 531. Cannot get program to restart. TDLAS 1029 has a red box error for path 9. Loaded previous setup for path 9. All paths seem to be giving valid data now. No pH probe present.
13:30	6/17/2008	Remote	Daily status check from PAML — Notes: Sonic anemometer 2 has more flagging than sonic anemometers 1 or 3. Sonic anemometer 2 temperature value jumps around more than the other sonic anemometer's temperature graphs. Sonic anemometer 1 has some, but not excessive, spiking above 160. Innova flags 16 and 20. TDLAS 1029 path 4 out of range. All paths for TDLAS 1029 are unaligned and tried for over an hour to aim unsuccessfully using previous setup. Saved pan/tilt values from QC optimize chart. FOS were on site Thursday (day after tomorrow) and will align paths then. No pH probe present.
13:00	6/18/2008	Remote	Daily status check from PAML — Notes: Since yesterday sonic anemometer 1 has excessive sonic anemometer flagging causing data to be lost. Sonic anemometer 1 spike count has increased to over 250 since yesterday. Innova flags 16 and 20. All paths on TDLAS 1029 are not aligned. TDLAS 1029 path 9 has a pan-tilt error. Loaded previous setup but could not align paths. FOS will fix tomorrow during trip to Frankfort. H_2S analyzer is woefully behind LAN (6 min). No pH probe present at site.
16:50	6/18/2008	Remote	Remote login to change power settings on both IN4A scanners. Changed power settings on scanners to "PMR TMR PHL THL"
	6/19/2008	Calibration	Found scanner in SE corner (TDLAS 1029) stuck in one spot. Power-cycled the scanner and it began to work. However, TDLAS 1029 has no power, and scanner seems not to be able to send power to the TDLAS. Will return malfunctioning scanner to PAML, and we will replace scanner. New scanner seems to be working.
	6/19/2008	Calibration	New scanner does not power TDLAS 1029, so a separate power supply for the TDLAS was installed and placed with UPS.
	6/19/2008	Calibration	TEC 450i IP address was incorrect, causing clock to fall over 6 min behind LAN. Entered default IP address, and 450i is now synchronized with LAN.
	6/19/2008	Calibration	Looked for missing temperature probes but was unable to find them.
	6/19/2008	Calibration	S-OPS/GSS test: Pass
	6/19/2008	Calibration	S-OPS max flow test

Time HH:MM UTC	Date (dd/mm/yyyy)	Activity (setup, takedown, calibration, repair, remote)	Event
	6/19/2008	Calibration	S-OPS inlet flow verification: Pass (North C and South A)
	6/19/2008	Calibration	GSS leak test: Pass
	6/19/2008	Calibration	GSS no flow test
	6/19/2008	Calibration	GSS max flow test: Fail
14:55	6/19/2008	Calibration	Sonic anemometer inter-comparison: all pass.
16:09	6/19/2008	Calibration	Calibrated TDLAS 1029 — Mean: 51.35 - SD: 0.43 - RSD: 0.8% - Bias: 2.6%
16:48	6/19/2008	Calibration	Calibrated TDLAS 1030 — Mean: 47.92 - SD: 0.42 - RSD: 0.9% - Bias: -4.2%
17:46	6/19/2008	Calibration	Zero sonic anemometer calibration: all pass.
	6/20/2008	Calibration	Installed new 24 V supply to relay. Copied data and switched CR1000 flash drive.
	6/20/2008	Calibration	Barometer audit: accepted.
	6/20/2008	Calibration	Maintenance and inspection checklist completed.
	6/20/2008	Calibration	Innova single point calibration
12:30	6/20/2008	Remote	Daily status check from PAML — Notes: Sonic anemometers are currently disconnected for calibration. Before calibration, sonic anemometer 1 showed excessive flagging and spike counts; will monitor data after calibration. H_2S analyzer is currently disconnected, due to power cycling and calibration. H_2S PMT voltage dropped to -630 at day 533.615. Innova flags 2, 16, and 18. Supply voltage on TDLAS 1029 dropped from 1340 to 1240 at the start of day 536, probably due to change of power supply.
15:15	6/20/2008	Calibration	TEC 450i instrument operation parameters
15:15	6/20/2008	Calibration	TEC 450i calibration verification check
15:27	6/20/2008	Calibration	TEC 450i reference precision check
17:02	6/20/2008	Calibration	Wetness sensor calibration: accepted
	6/23/2008	Remote	On 2008-5-28 Innova settings were changed accidentally to pre-set monitoring period="yes" and monitoring period="001:00." Added line to InnovaInterface.vbp to set to "No" the option to use a preset monitoring period. "SE M_M1N" & Chr(10)—Checked "backup" file, and preset monitoring period is now "No.)
13:27	6/23/2008	Remote	Daily status check from PAML — Notes: *GasView MP* program on TDLAS 1 laptop had frozen up upon login and had the error: "Boreal Laser has encountered an error and needs to close…." Restarted program and loaded previous setup but had red boxes around pan/tilt values of 21474 and 21474. Also, clicking "stop" button on program did not stop the scanner from moving and getting pan/tilt errors. Loaded backup file of previous setup, and the scanner was aimed correctly at all paths. Sonic anemometer 1 has a day or two with high spike counts. Flags 16 and 18 on Innova data. No pH probe present.
	6/24/2008	Repair	Came out to look at TDLAS 1 (1029) because it would not connect to the *GasView MP* program. By taking the laptop out and directly connecting directly to the scanner with the laptop, no connection with TDLAS could still be established. Tried connecting to TDLAS (by bypassing scanner) and was able to connect to the TDLAS. Therefore, the TDLAS signal

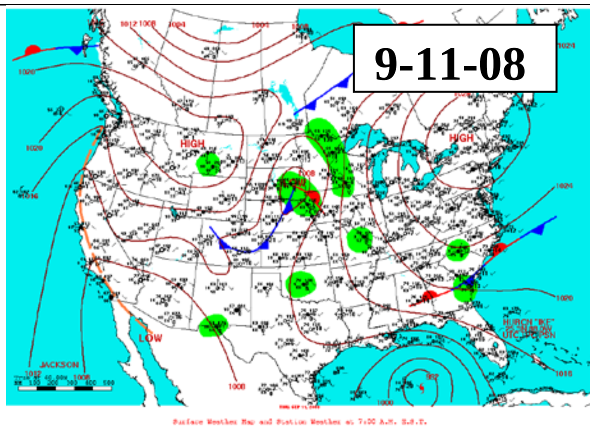
Time HH:MM UTC	Date (dd/mm/yyyy)	Activity (setup, takedown, calibration, repair, remote)	Event
			would not pass through the scanner. Mounted TDLAS 1029 on stationary mount and aimed it at path 8 on the south side of lagoon.
	6/24/2008	Repair	Started to perform 450i multipoint calibration, but later realized that H_2S tank did not have the correct concentration to perform calibration.
12:45	6/24/2008	Remote	Daily status check from PAML — Notes: Innova flags 2, 16, and 18. No pH probe present. FOS on site.
12:13	6/25/2008	Remote	Daily status check from PAML — Notes: Only one path for TDLAS 1 (1029). Flags 16 and 18 in Innova data. No pH probe present.
13:39	6/26/2008	Remote	Daily status check from PAML — Notes: Only one path for TDLAS 1 (1029). Flag 16 in Innova data. No pH probe present.
16:20	6/27/2008	Remote	Daily status check from PAML — Notes: TDLAS 1 (1029) is aimed only at one path. No pH probe.
13:00	6/30/2008	Remote	Daily status check — Notes: Sonic anemometer 2 stopped working at 20:00 UTC on 6/27/2008. TDLAS 1 (1029) is aimed only at one path due to broken scanner. Light values have dropped below valid levels. Innova flag 16. Lagoon pH probe not present.
	7/1/2008	Repair	Tried to repair sonic anemometer 2, which was not communicating. Could not find climbing belt, so we will return tomorrow. Saw no evidence of damage in modem box, or on sonic anemometer itself.
	7/1/2008	Repair	Realigned TDLAS 1 (1029) at path 8. Light levels are now valid (~6000). r^2 values are good (~0.98-0.99)
12:07	7/1/2008	Remote	Daily status check from PAML — Notes: Sonic anemometer 2 is still not communicating. See yesterday's QC for details. FOS were on site today. Sonic anemometer 1 had a few spike counts over 160 yesterday. Innova flag 16. TDLAS 1 (1029) is aimed only at one path due to broken scanner. Light values have dropped below valid limits. FOS were on site today to address problem. TDLAS 2 (1030) is optimizing a lot but is aimed at all 10 paths. No pH probe.
	7/2/2008	Repair	Took sonic anemometer 2 down and checked the modem box; desiccant pouch was stuck between the plug wires. Tightened up the plugs and put the desiccant into the lower part of the modem box. Sonic anemometer 2 is now working.
	7/2/2008	Repair	Readjusted TDLAS 1029; light levels are now around 12,000.
12:17	7/2/2008	Remote	Daily status check from PAML — Notes: TDLAS 1 (1029) is aimed at path 8 only due to broken scanner. FOS adjusted TDLAS yesterday, but light values have already dropped below valid levels. FOS were on site again today. H_2S analyzer lost connection with LAN at 7:18 UTC on 7/2/2008. Reconnected to the program and created fill file to add missing data. Data now incrementing normally. Sonic anemometer 2 still not communicating. FOS will address issue today.
	7/3/2008	Repair	Sonic anemometer 2 failed again this morning at 7:49 UTC. Found modem for sonic anemometer 2 to be working. Took down sonic anemometer 2 and hooked it up to sonic

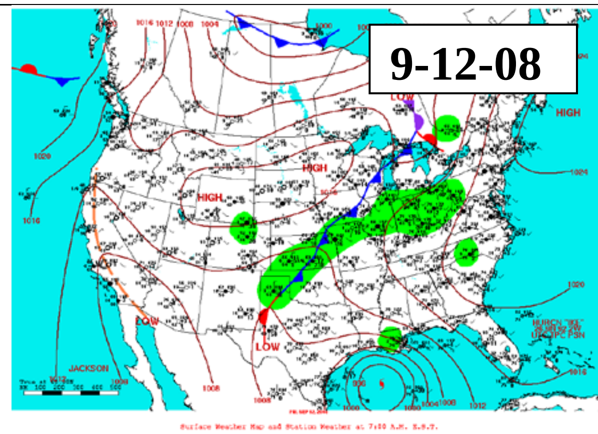
Time HH:MM UTC	Date (dd/mm/yyyy)	Activity (setup, takedown, calibration, repair, remote)	Event
			anemometer 1's modem; sonic anemometer 2 would still not work. Taking sonic anemometer 2 back to PAML for repair. Also, put a thick plastic in retro-reflector 8 for TDLAS 1029. Plastic can only get light values around 3500. The r^2 values are very good (0.97-0.99).
12:07	7/3/2008	Remote	Daily status check from PAML — Notes: Sonic anemometer 2 was repaired yesterday, but stopped communicating this morning at 7:49:59 UTC, after QC data had been loaded. Tomorrow's QC files should show sonic anemometer 2 not working, at least for several hours. Strong winds may have been a factor. TDLAS 1 (1029) is aimed at only one path (path 8) due to a broken scanner. Light values have dropped from 12000 yesterday to below valid levels today. Strong winds may have knocked the TDLAS out of alignment, because light values dropped from about 2000 to 30 at 7:49 UTC, which is the same time sonic anemometer 2 recorded 14 ms^{-1} winds before losing communication. H_2S analyzer flag 1 appeared yesterday, but for a very short period. No pH probe.
12:07	7/7/2008	Remote	Daily status check from PAML — Notes: TDLAS 1 (1029) is aimed only at path 8 because of a broken scanner. TDLAS was re-aimed around 15:00 UTC on 7/4/2008. Light values were valid until 10:00 UTC on 7/7/2008 (caused by heavy rain). Sonic anemometer 3 has a few spike counts over 200 for day 533. Innova flag 16. CR1000 stopped incrementing data around 15:00 UTC on 7/4/2008. Data incrementing restarted around 17:30 UTC on 7/6/2008. Cause of lost power is unknown. Sonic anemometer 1 (plugged into same outlet as CR 1000) did not have any lost data. No pH probe.
	7/8/2008	Repair	Installed PTU #6 in SW corner. Aimed scanner. First file is TDL1_IN4A_2008_07_08_1405.gvl. PTU #6 still has grinding sound but still works ok.
	7/8/2008	Repair	Tested TDLAS 1027 for 5 min on path 3 (east side). The r^2 concentration values much better.
12:08	7/8/2008	Remote	Daily status check from PAML Notes: TDLAS 1 (1029) was aimed only at path 8 due to a broken scanner, but FOS installed new scanner this morning. All paths are aligned as of 16:31 UTC, and the status code is 1. Sonic anemometers 2 and 3 had missing data (about 500 data points) from sonic anemometer flagging. No pH probe.
12:10	7/9/2008	Remote	Daily status check from PAML — Notes: Upon login found TDLAS 1 (1029) to be giving pan/tilt errors for several paths. Stopped program and checked each path in the "aim" program. Light levels were unique for each path, meaning the scanner was moving. Restarted program and scanner seems to be working well. Will monitor closely. Sonic anemometer 2 had a brief period of 1000+ flagged points; occurred yesterday. No pH probe.
12:40	7/10/2008	Remote	Daily status check from PAML — Notes: Unable to connect to TDLAS laptop. No TDLAS data was sent back after 12:45 UTC yesterday. FOS will check problem today. Innova flag 16. No pH probe.
17:27	7/11/2008	Remote	Daily status check from PAML — Notes: "Red Box" error on

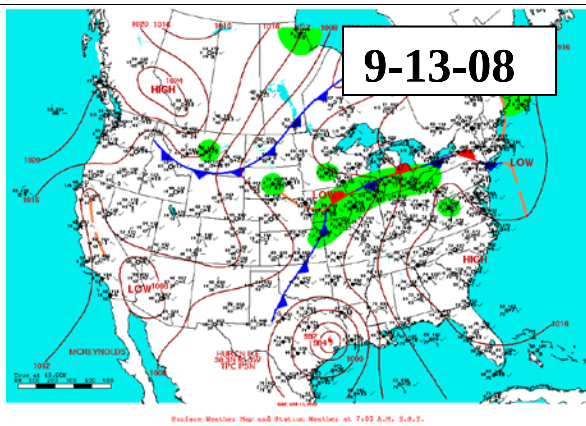
Time HH:MM UTC	Date (dd/mm/yyyy)	Activity (setup, takedown, calibration, repair, remote)	Event
			TDLAS 1 (1029) path 6. Loaded previous setup and all paths are now aligned. Sonic anemometer 3 v had 15 ms^{-1} spikes yesterday. Sonic anemometer 2 had over 3000 flags yesterday. Sonic anemometer 1 had 10 ms^{-1} spikes yesterday. High wind spikes may have been caused by storms overnight. Innova flag 16. Innova data seems to be incrementing but is not showing up on V: drive. No pH probe.
	7/14/2008	Takedown	NH_3 tank #FF44436 had a different concentration reading on the tank (516 ppm) than the certification record (504 ppm).
	7/14/2008	Takedown	Took sludge depth measurements.
	7/14/2008	Takedown	Took down TDLAS's 1029 and 1030 with scanners to be sent back to Purdue. Scanners were sent to DP for maintenance.
	7/14/2008	Takedown	Found mold in S-OPS south inlet #1. Will clean when S-OPS/GSS is returned to Purdue.
	7/14/2008	Takedown	ORP sensor: calibration and acceptance done.
	7/14/2008	Takedown	Innova single point calibration
	7/14/2008	Takedown	S-OPS/GSS test: Pass
	7/14/2008	Takedown	S-OPS max flow test
	7/14/2008	Takedown	S-OPS inlet flow verification: Pass (North C and South A)
	7/14/2008	Takedown	GSS leak test: Pass
	7/14/2008	Takedown	GSS no flow test
	7/14/2008	Takedown	GSS max flow test: Fail
15:27	7/14/2008	Takedown	Calibrated TDLAS 1030 — Mean: 49.40 - SD: 0.15 - RSD: 0.3% - Bias: -1.1%
16:08	7/14/2008	Takedown	Calibrated TDLAS 1029 — Mean: 48.0 - SD: 1.27 - RSD: 2.6% - Bias: -3.8%
	7/15/2008	Takedown	Forgot keys; Scott stayed to take down retro-reflectors and sonic anemometers while Derrick went back to PAML. Took down sonic anemometers and retro-reflectors on SW corner.
	7/15/2008	Takedown	Barometer audit: accepted.
16:05	7/15/2008	Takedown	Wetness sensor calibration: accepted
16:20-17:20	7/15/2008	Takedown	Sonic anemometer inter-comparison: all pass.
16:42	7/15/2008	Takedown	TEC 450i instrument operation parameters
16:42	7/15/2008	Takedown	TEC 450i calibration verification check
16:53	7/15/2008	Takedown	TEC 450i reference precision check
17:10	7/15/2008	Takedown	Sonic anemometer zero calibration: all pass.
	7/16/2008	Takedown	Finished taking down site. Took trailer back to PAML.
	7/16/2008	Takedown	S-OPS installation report made.
	7/16/2008	Takedown	Maintenance and Inspection checklist completed.
	9/2/2008	Takedown	Electronic Data Chain of Custody form completed.

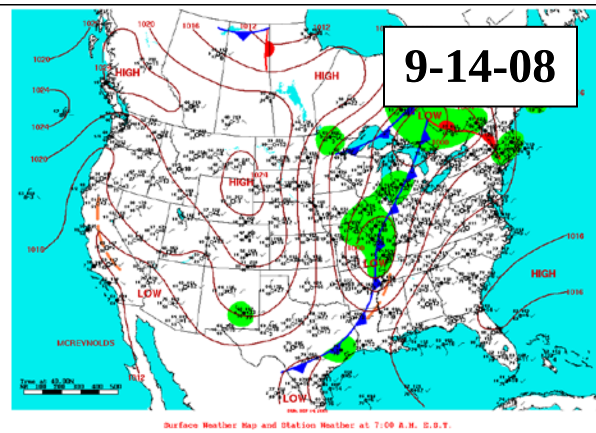
6.9 Site Weather

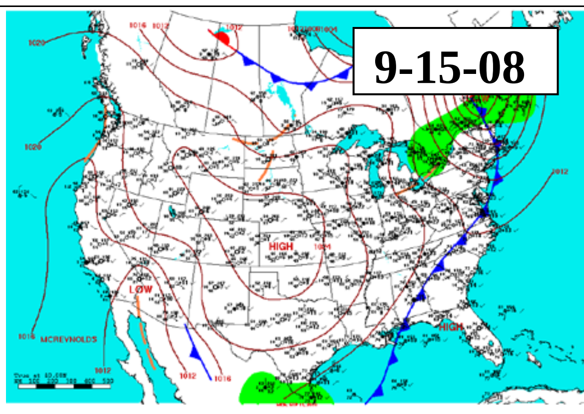
Period 6

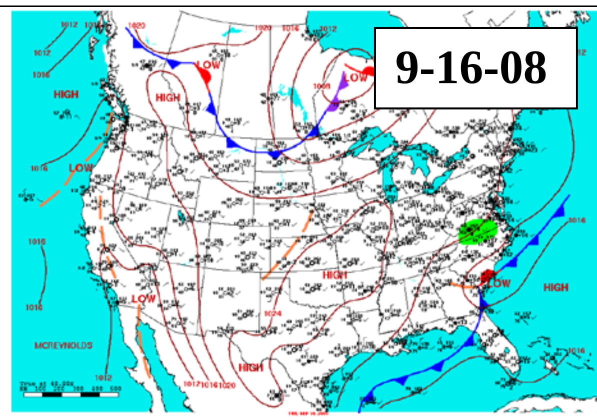


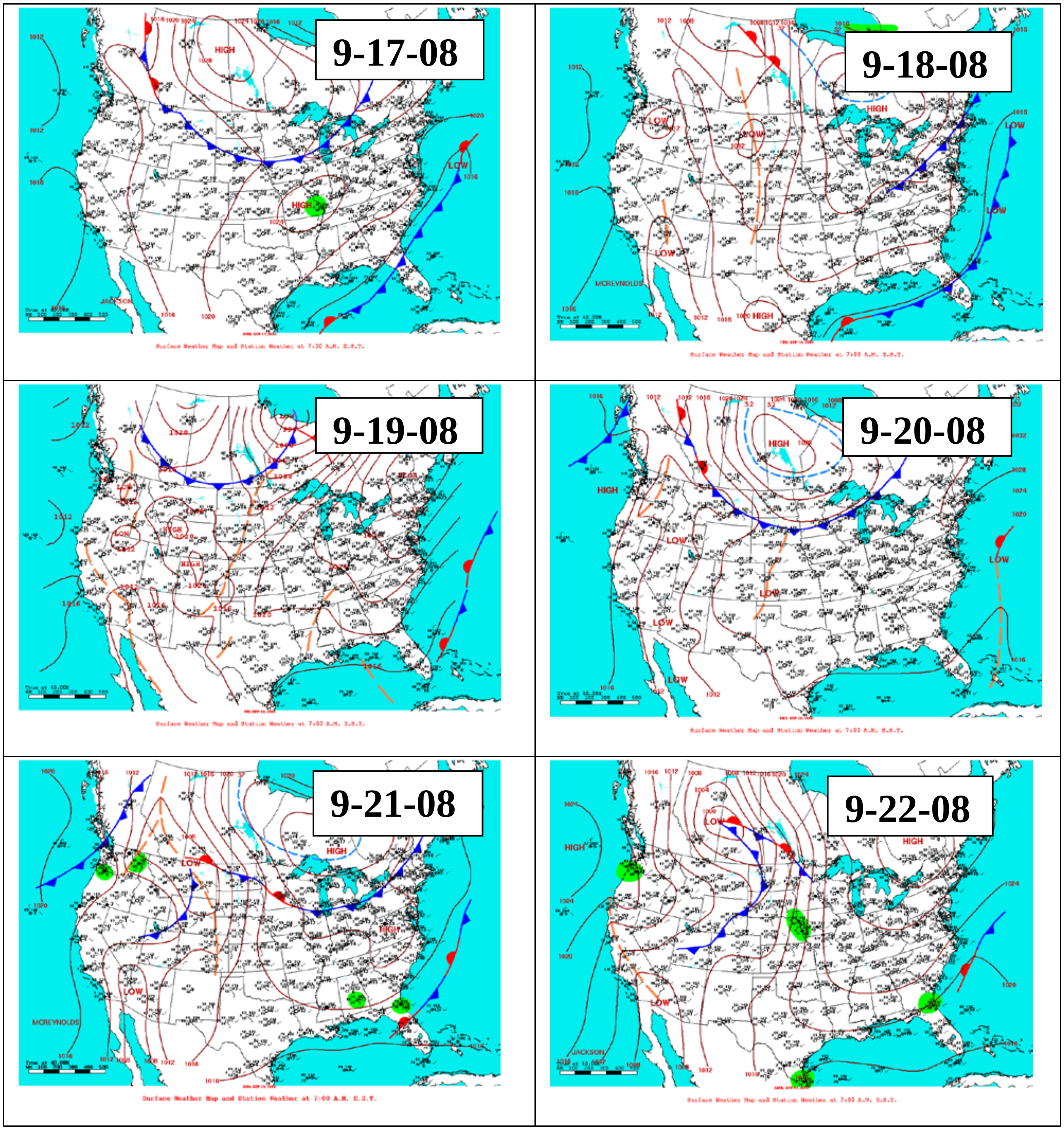








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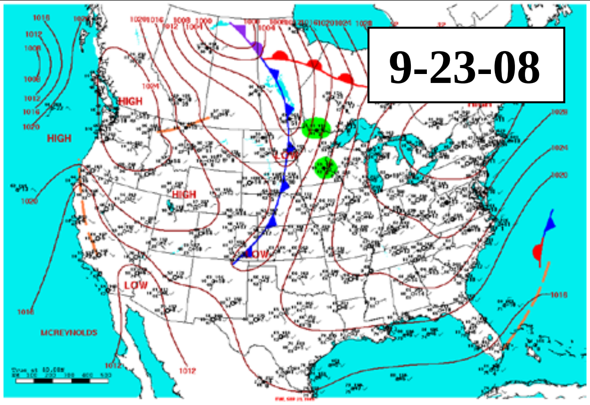
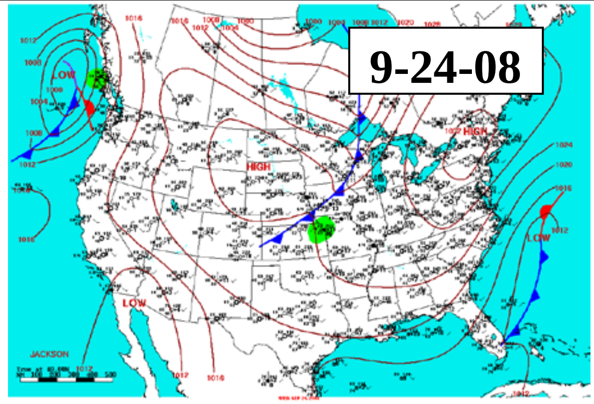
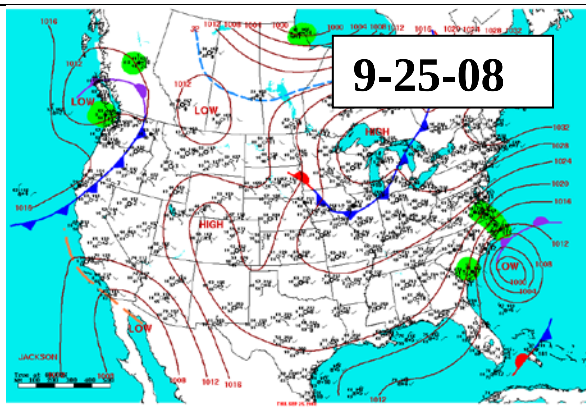
9-22-08



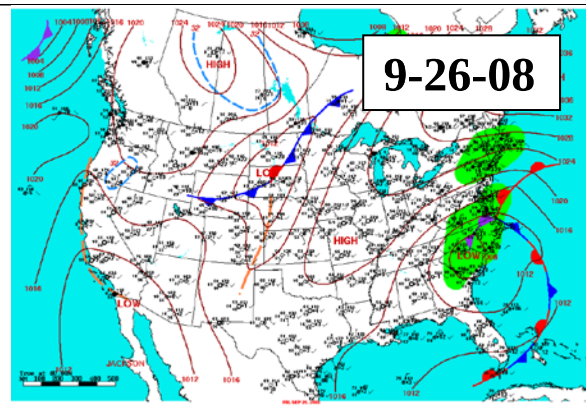
Surface Weather Map and Station Weather at 7:30 A.M. E.S.T.



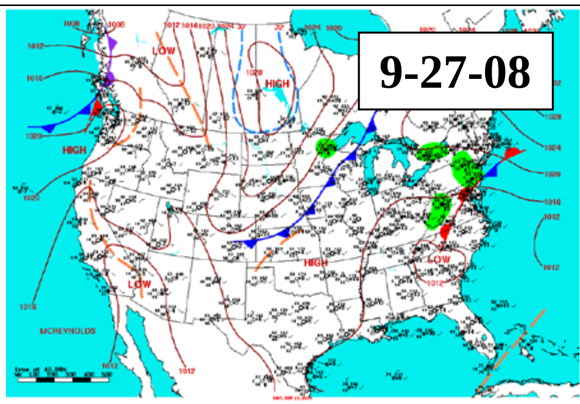
Surface Weather Map and Station Weather at 7:00 A.M. E.S.T.



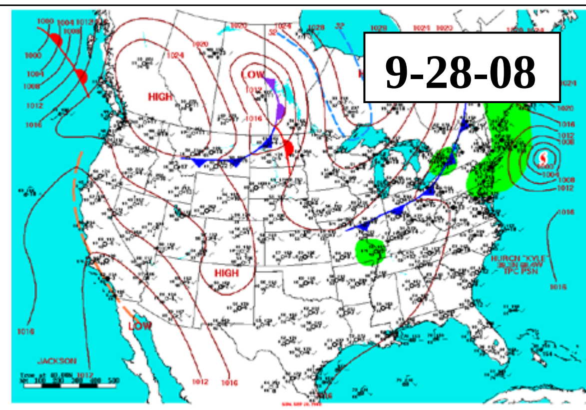
Surface Weather Map and Station Weather at 7:00 A.M. E.S.T.



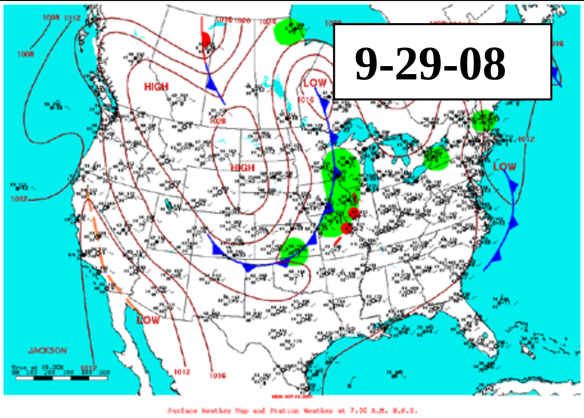
Surface Weather Map and Station Weather at 7:00 A.M. E.S.T.

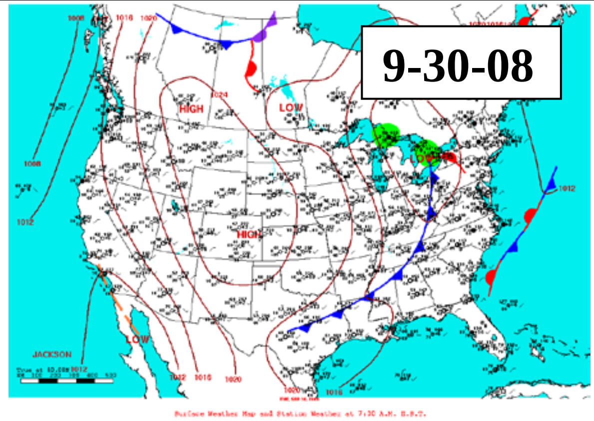


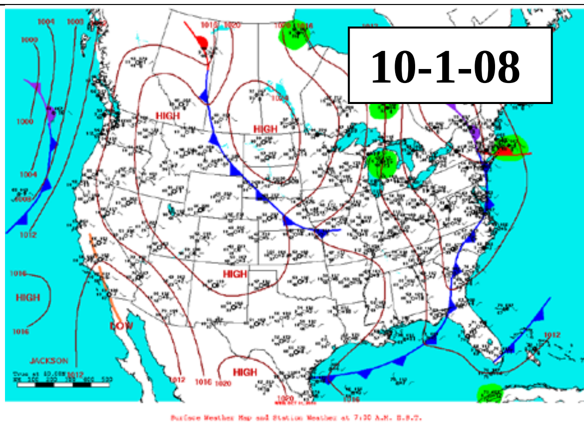
Surface Weather Map and Station Weather at 7:00 A.M. E.S.T.



Surface Weather Map and Station Weather at 7:00 A.M. E.S.T.


9-29-08


9-30-08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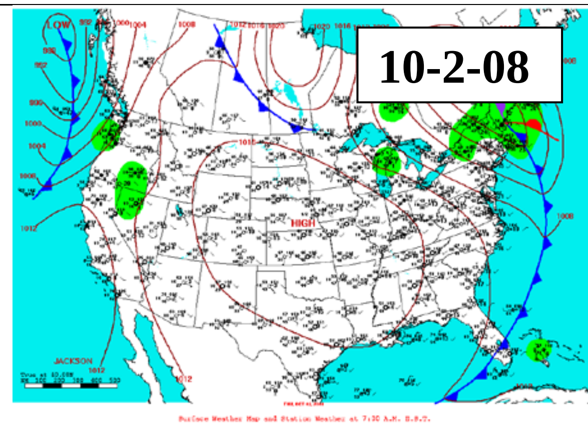
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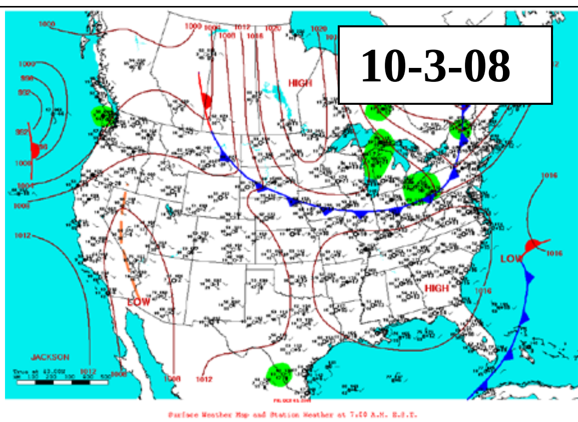
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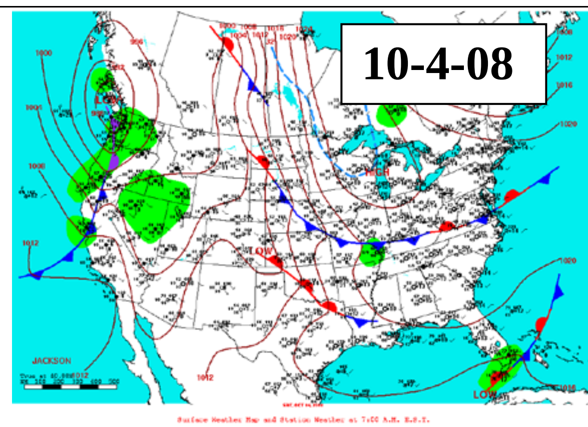
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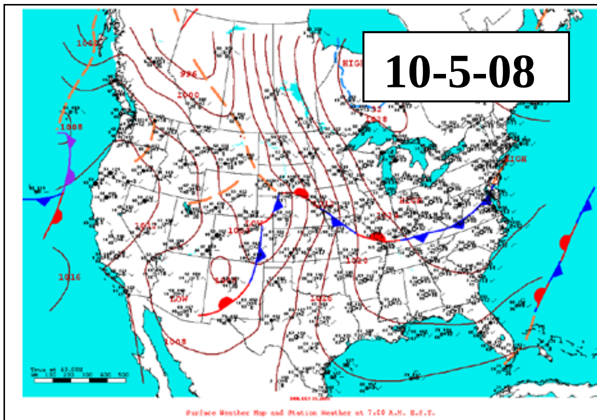
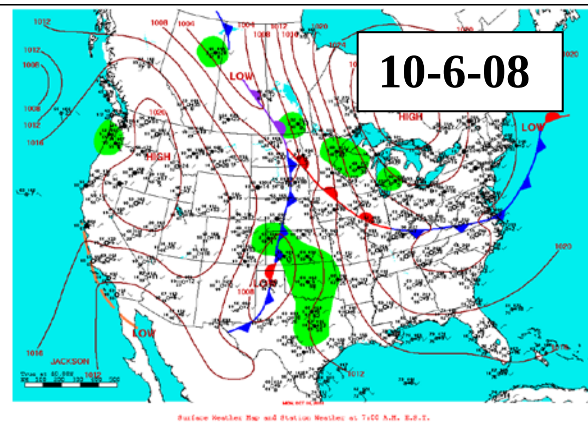

10-5-08
Surface Weather Map and Station Weather at 7:00 A.M. E.S.T.


10-6-08
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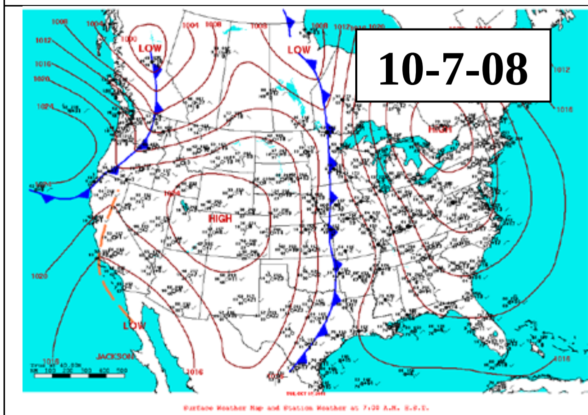
10-7-08
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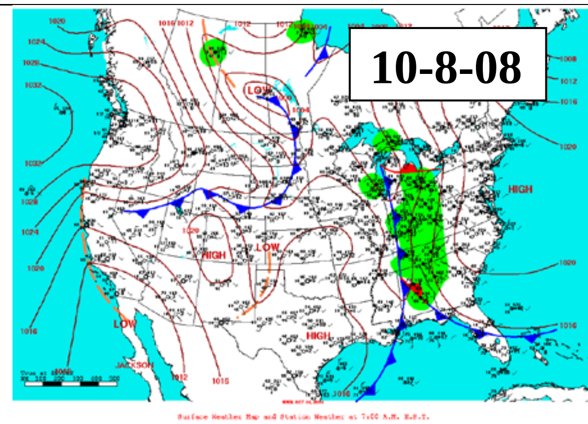
10-8-08
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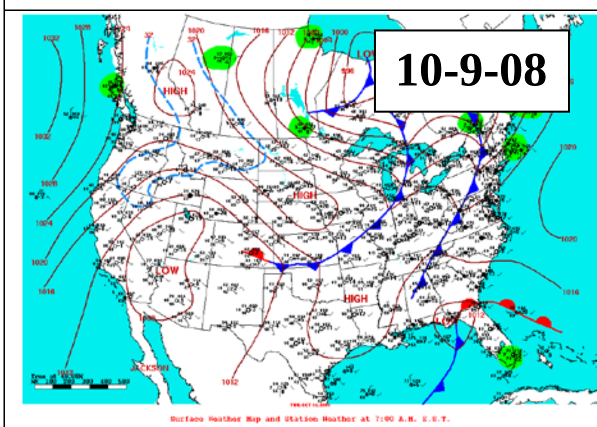
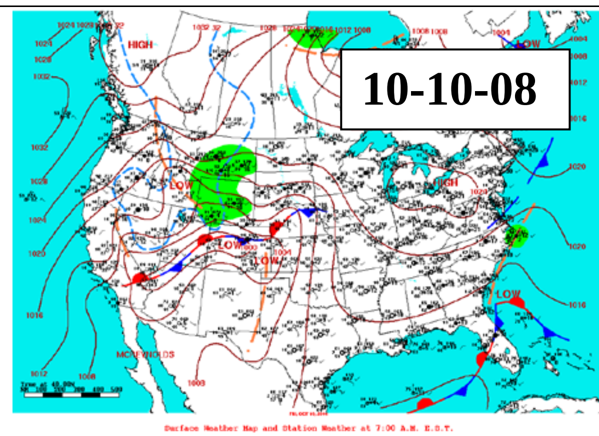

10-9-08
Surface Weather Map and Station Weather at 7:00 A.M. E.S.T.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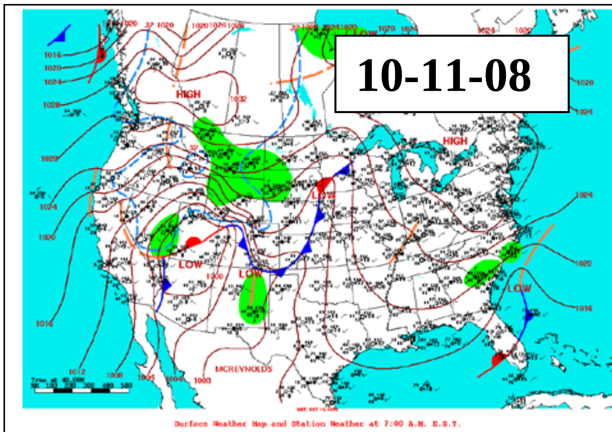
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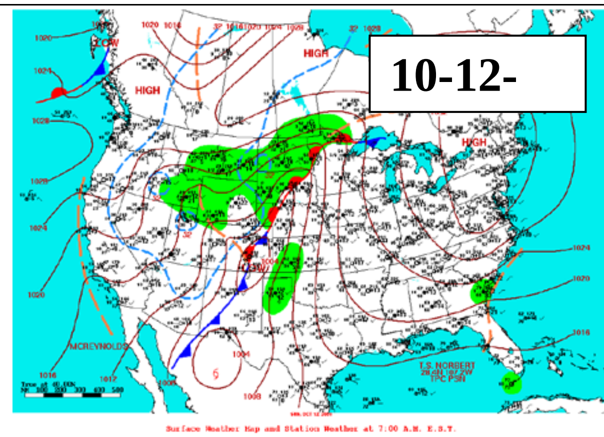
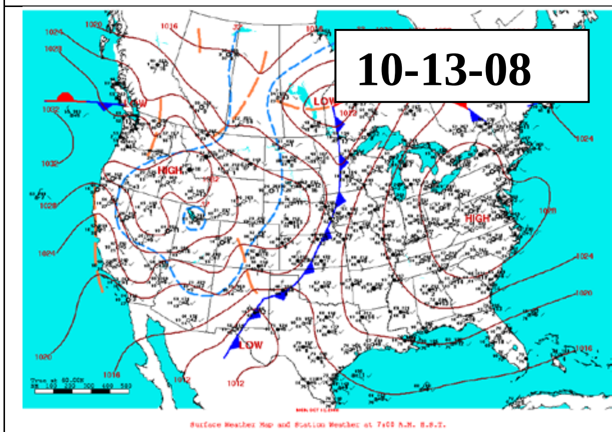

10-12-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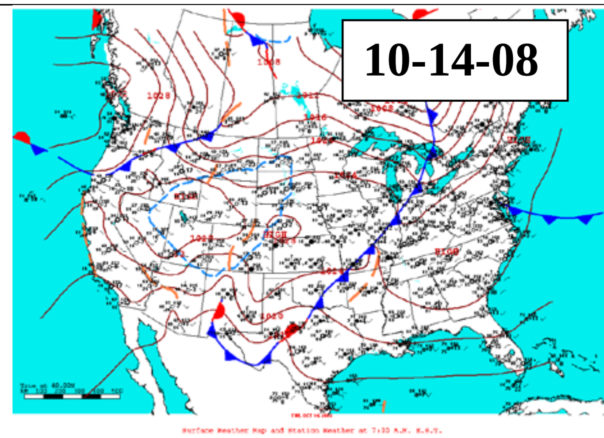
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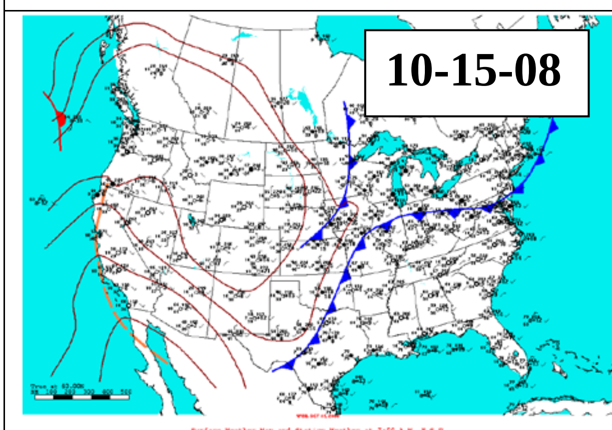
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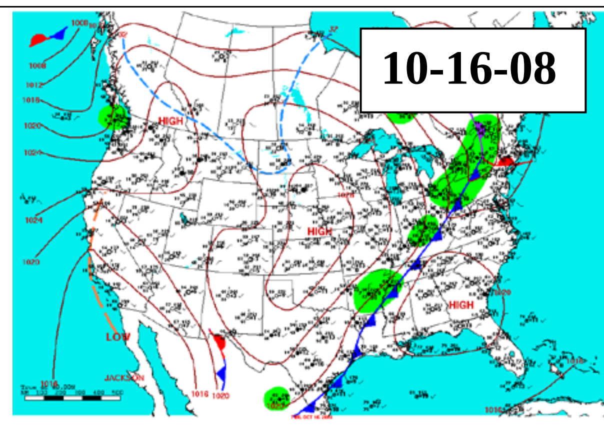
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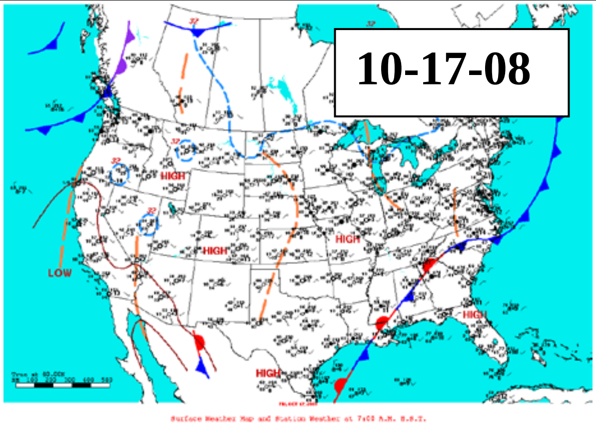
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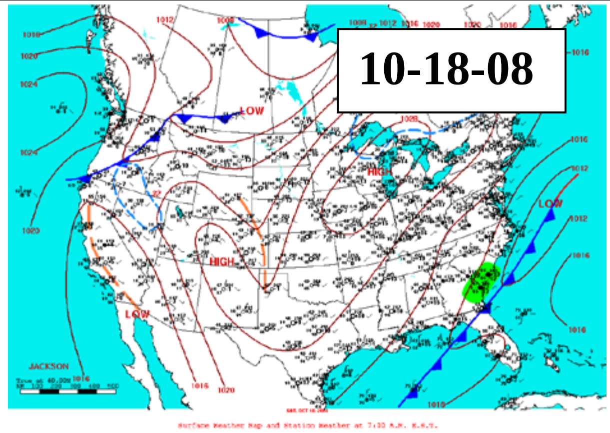
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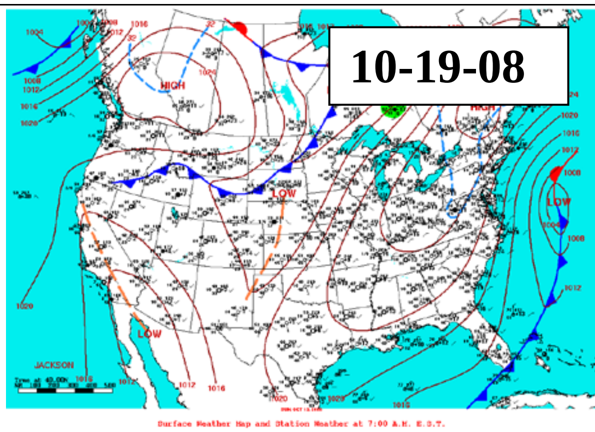
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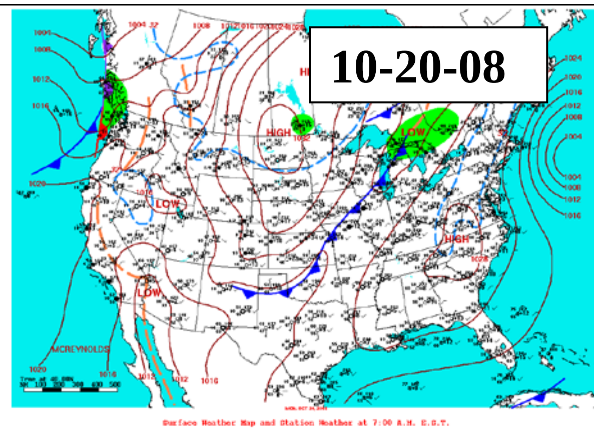
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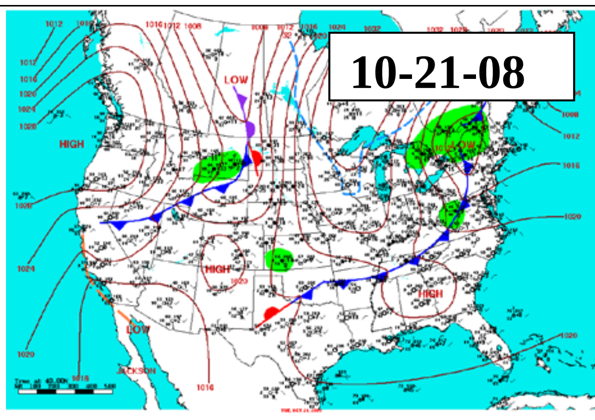
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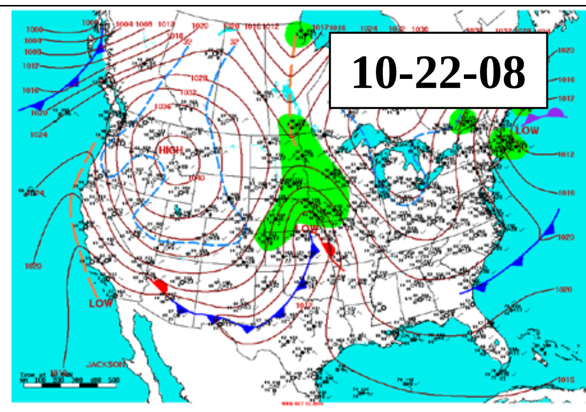
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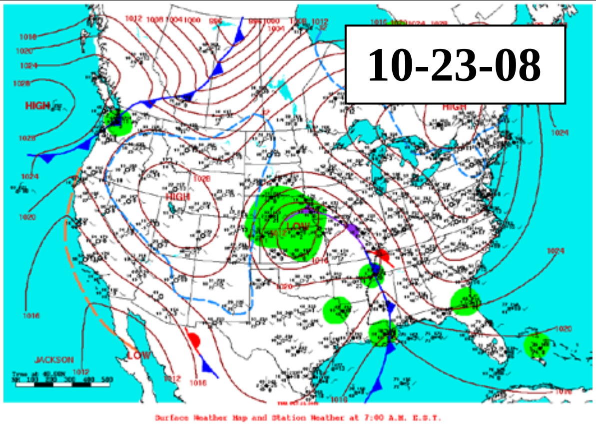
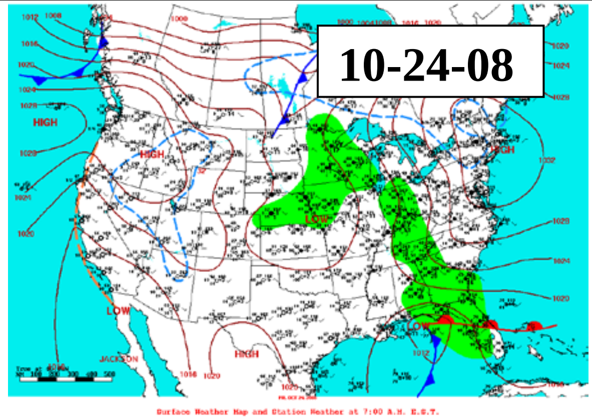

10-23-08
Surface Weather Map and Station Weather at 7:00 A.M. E.S.T.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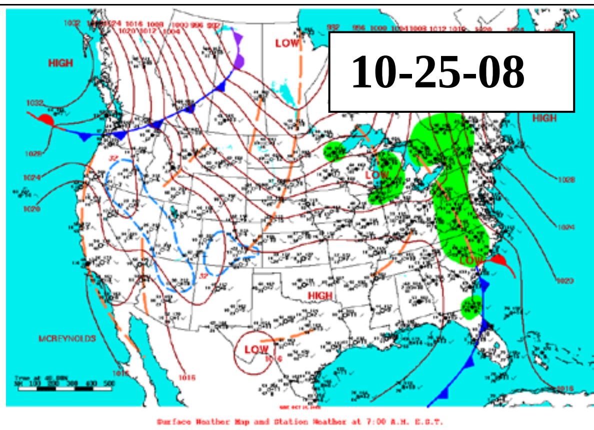
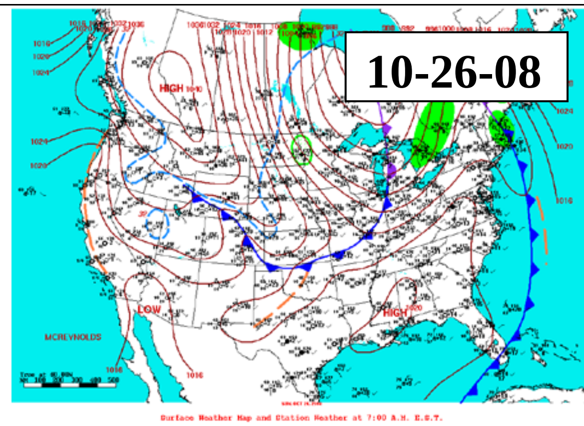
Surface Weather Map and Station Weather at 7:00 A.M. E.S.T.


10-25-08
Surface Weather Map and Station Weather at 7:00 A.M. E.S.T.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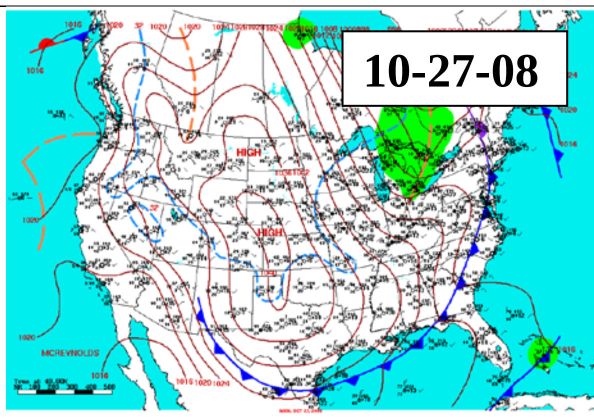
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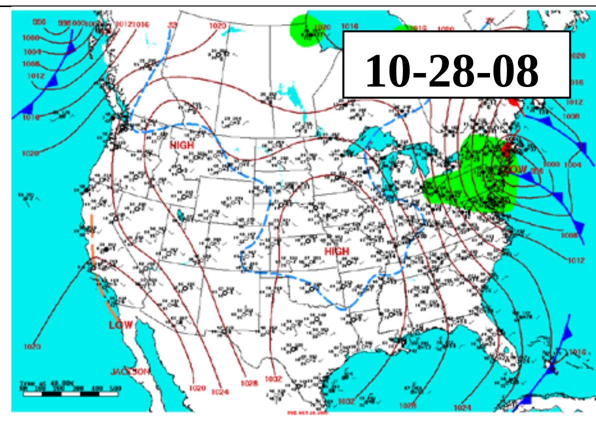
10-28-08
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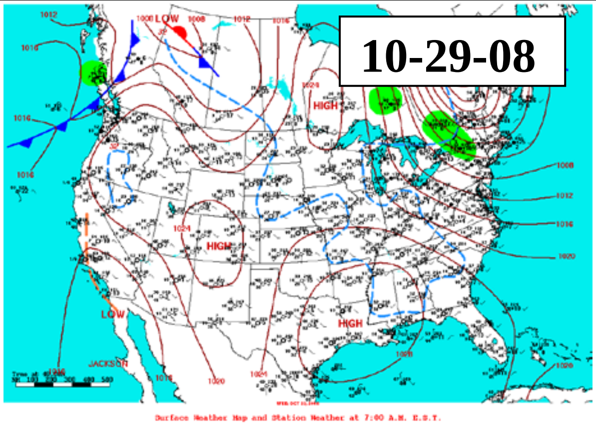
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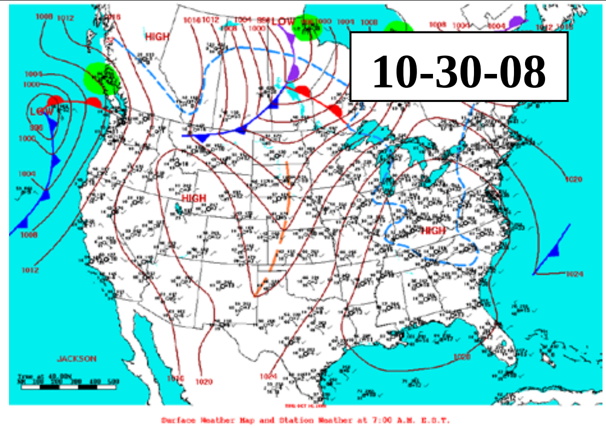
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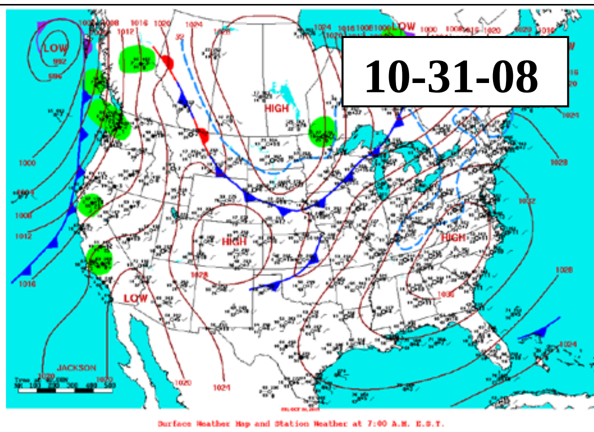
Surface Weather Map and Station Weather at 7:00 A.M. E.S.T.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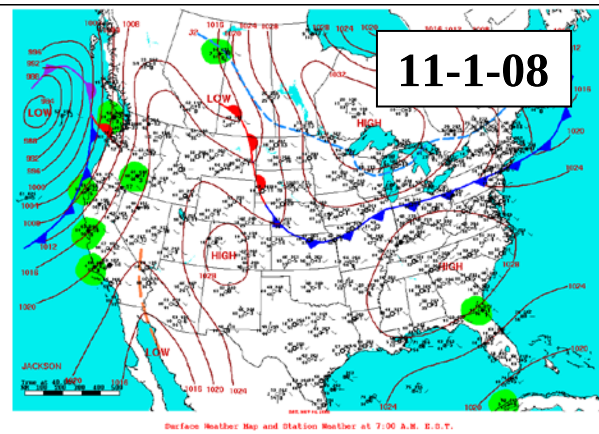
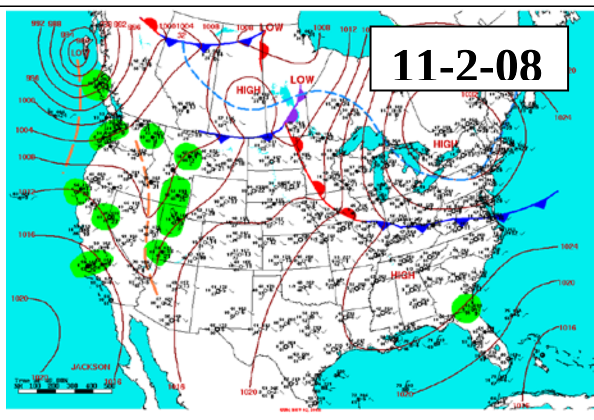
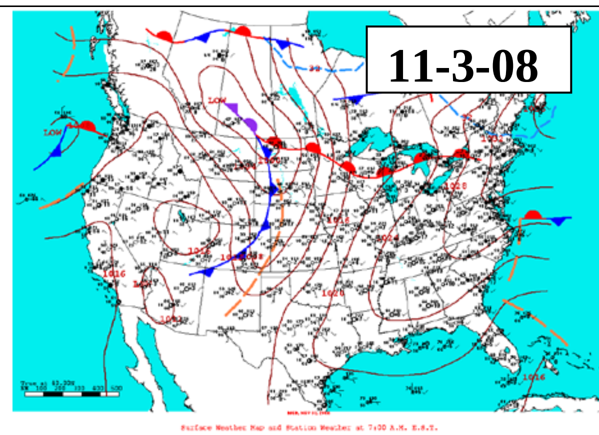
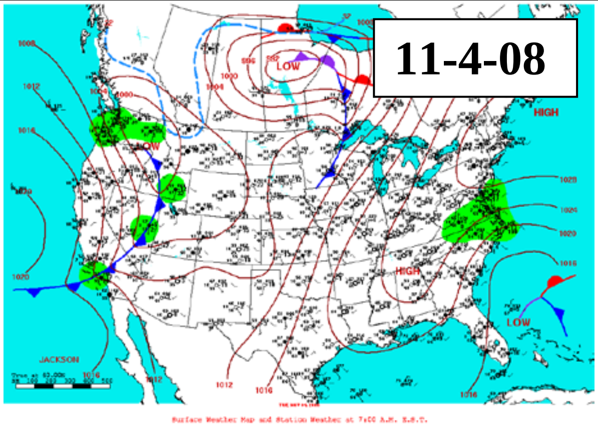
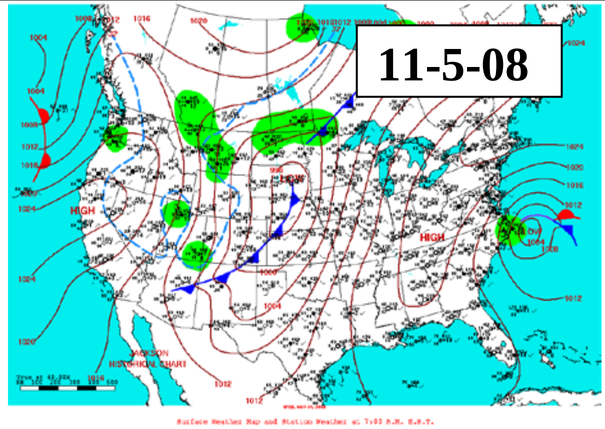

11-1-08
Surface Weather Map and Station Weather at 7:00 A.M. E.S.T.


11-2-08
Surface Weather Map and Station Weather at 7:00 A.M. E.S.T.


11-3-08
Surface Weather Map and Station Weather at 7:00 A.M. E.S.T.


11-4-08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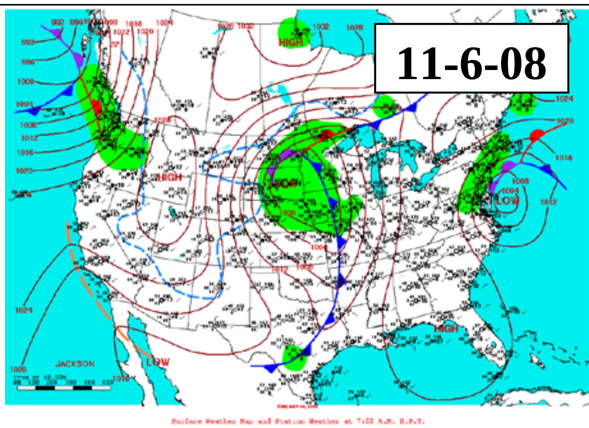
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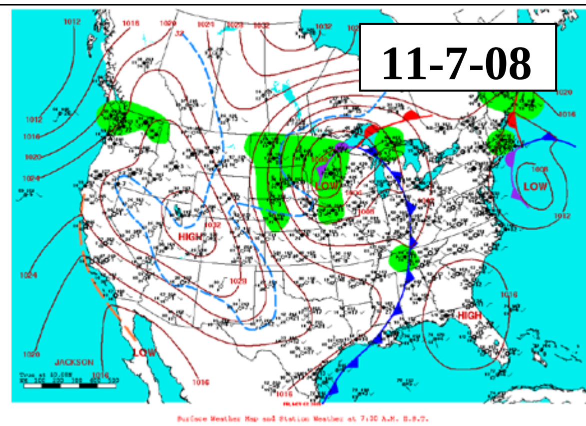
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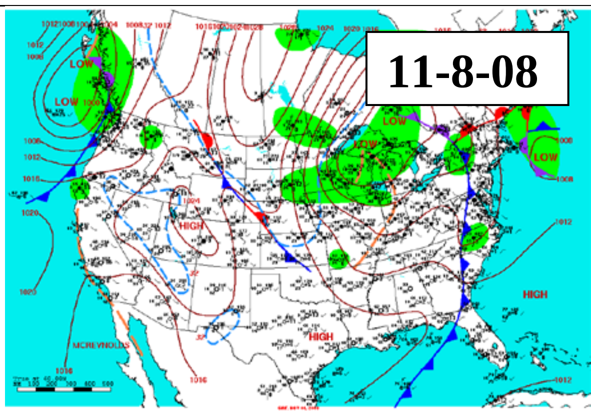
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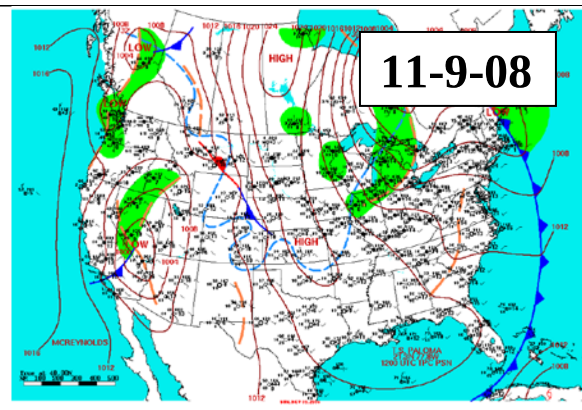
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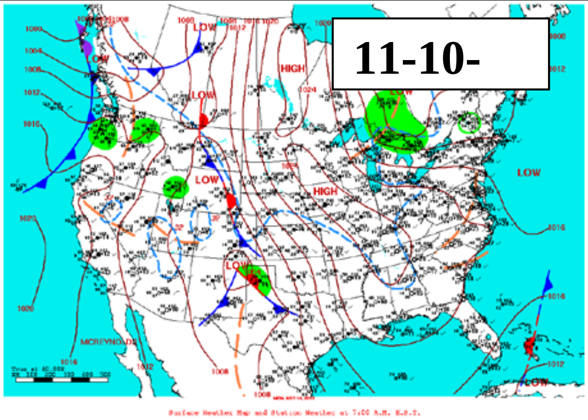
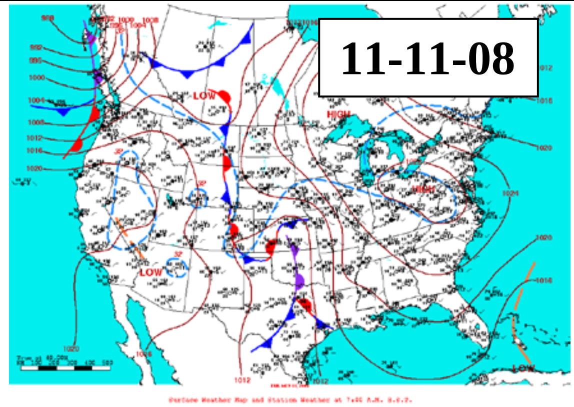

11-10-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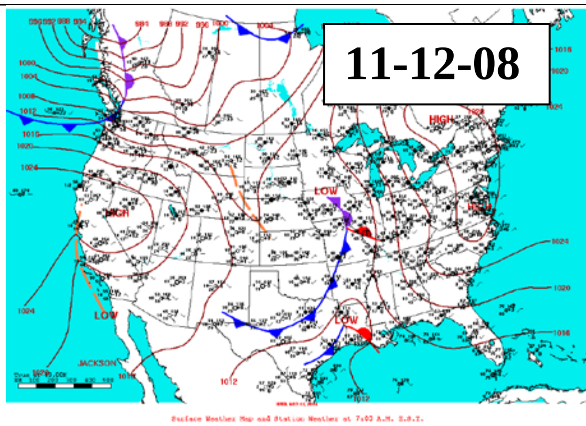
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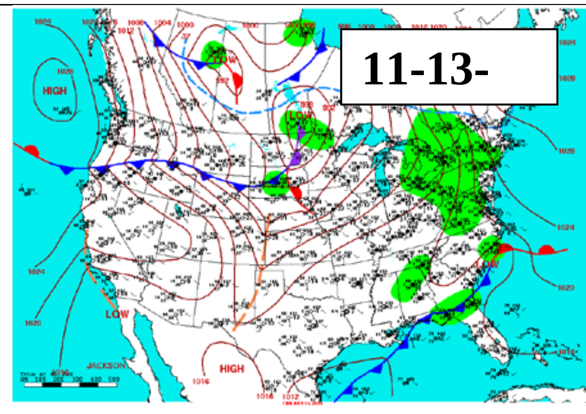
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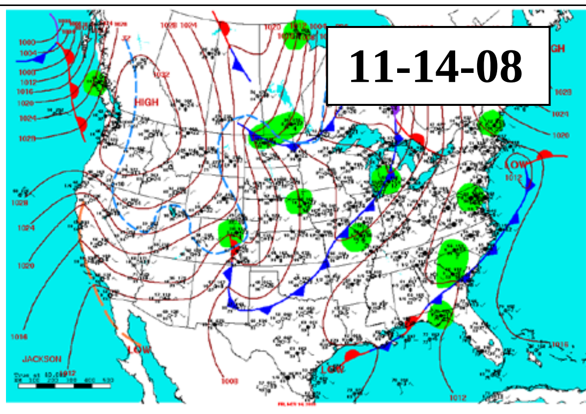
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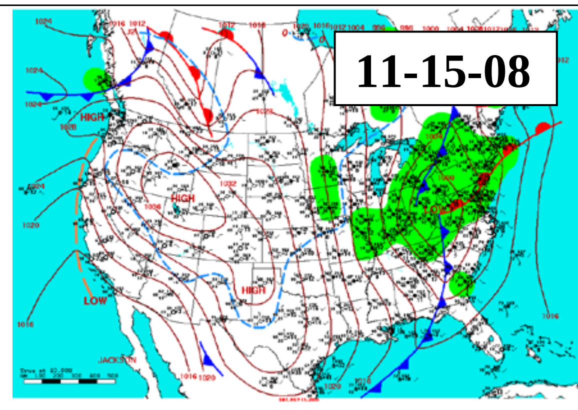
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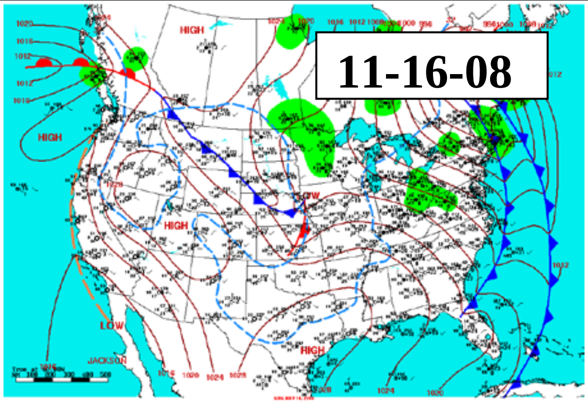
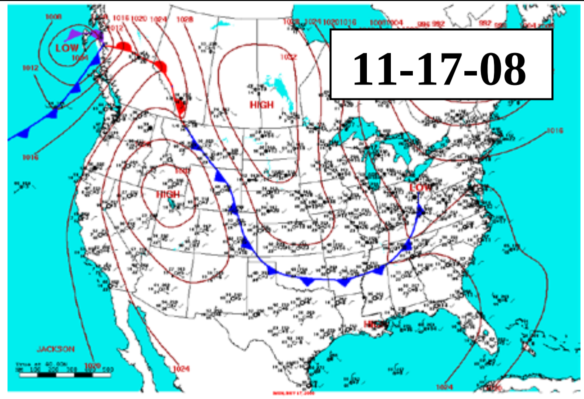
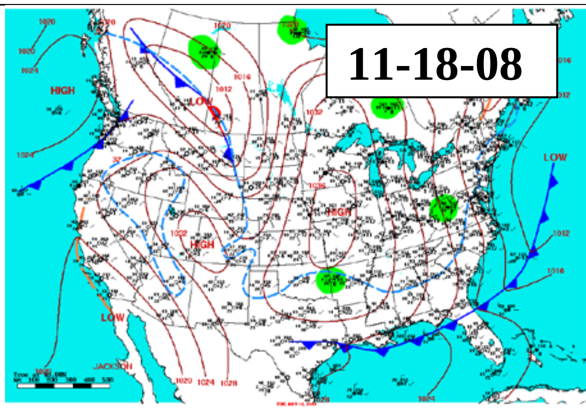


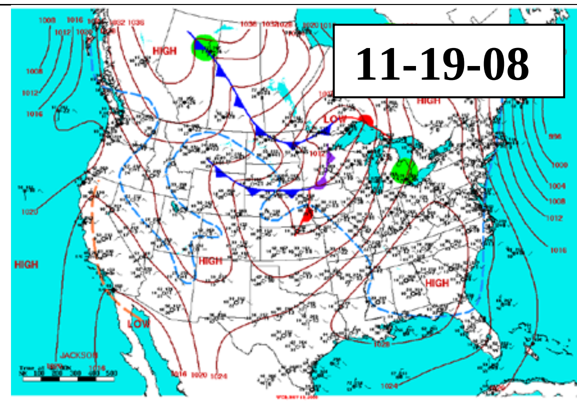
Surface Weather Map and Station Weather at 7:00 A.M. E.S.T.



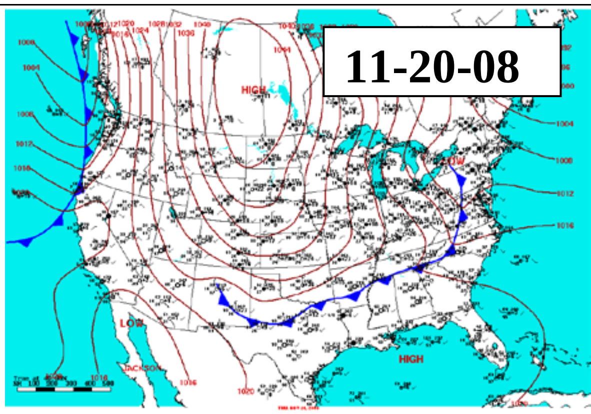
Surface Weather Map and Station Weather at 7:00 A.M. E.S.T.



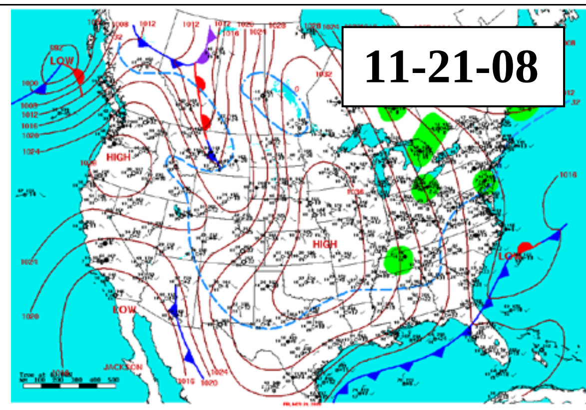
Surface Weather Map and Station Weather at 7:00 A.M. E.S.T.



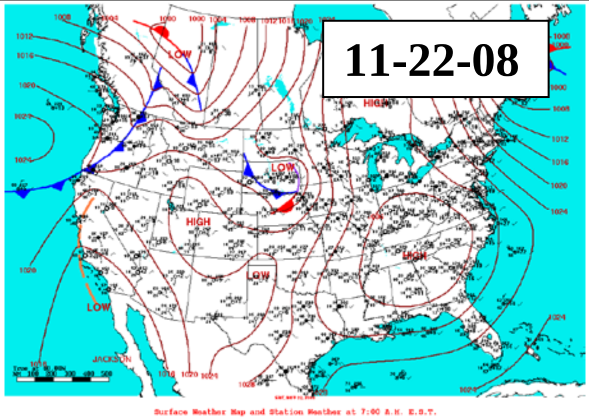
Surface Weather Map and Station Weather at 7:00 A.M. E.S.T.

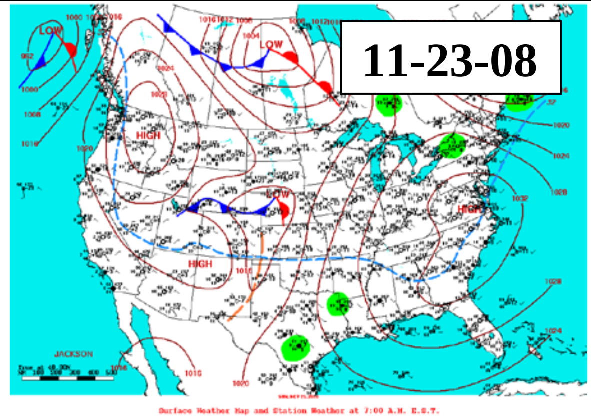


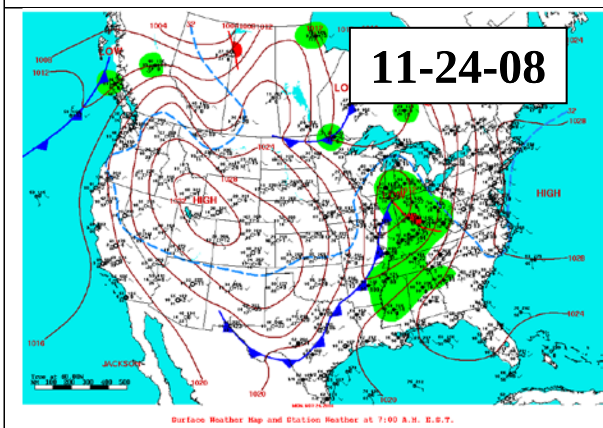
Surface Weather Map and Station Weather at 7:00 A.M. E.S.T.

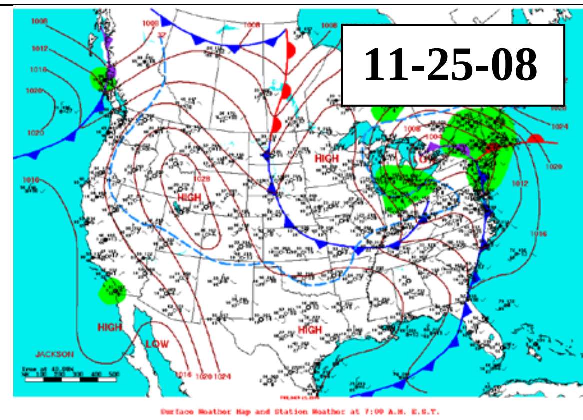


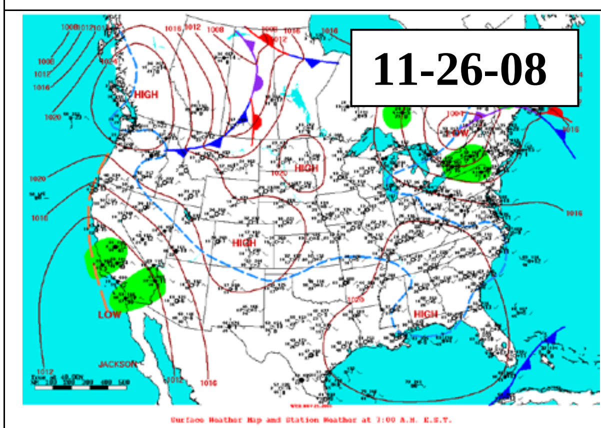
Surface Weather Map and Station Weather at 7:00 A.M. E.S.T.


11-22-08
Surface Weather Map and Station Weather at 7:00 A.M. E.S.T.


11-23-08
Surface Weather Map and Station Weather at 7:00 A.M. E.S.T.


11-24-08
Surface Weather Map and Station Weather at 7:00 A.M. E.S.T.


11-25-08
Surface Weather Map and Station Weather at 7:00 A.M. E.S.T.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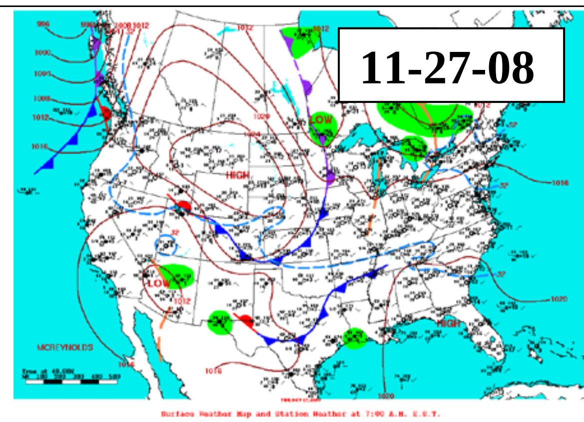
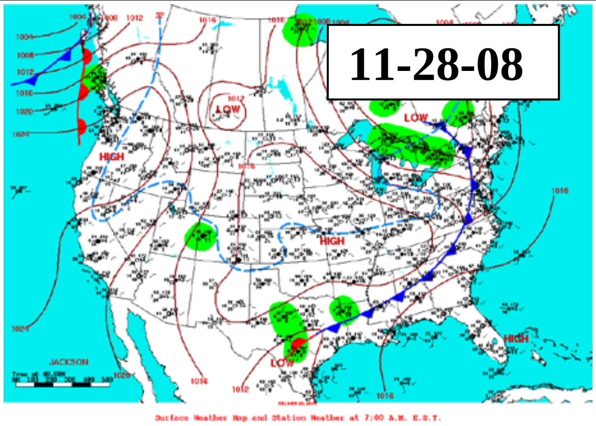
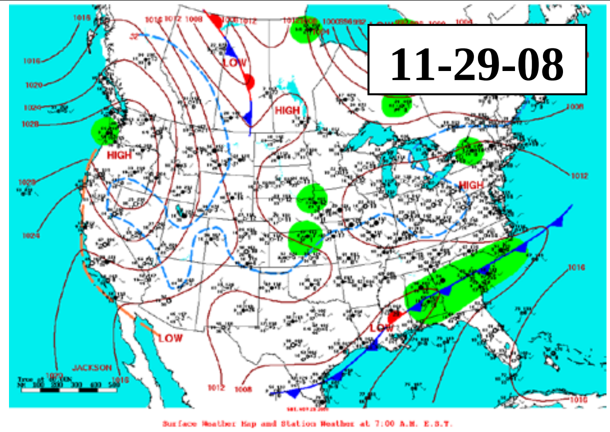
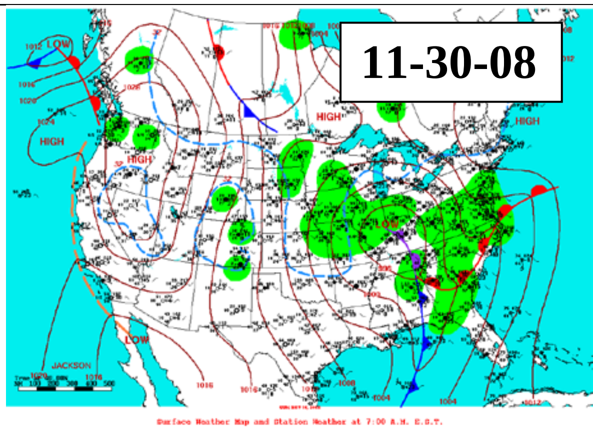
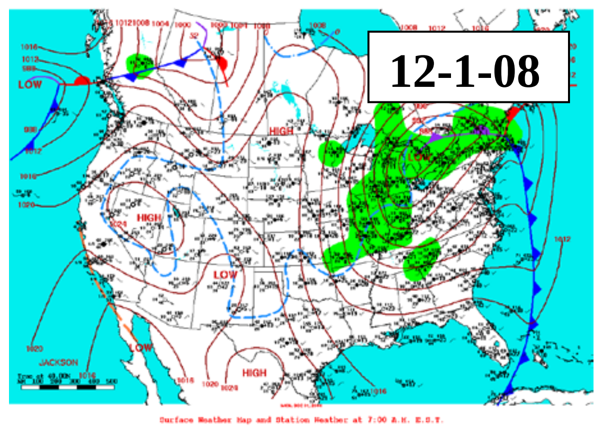

11-27-08
Surface Weather Map and Station Weather at 7:00 A.M. E.S.T.

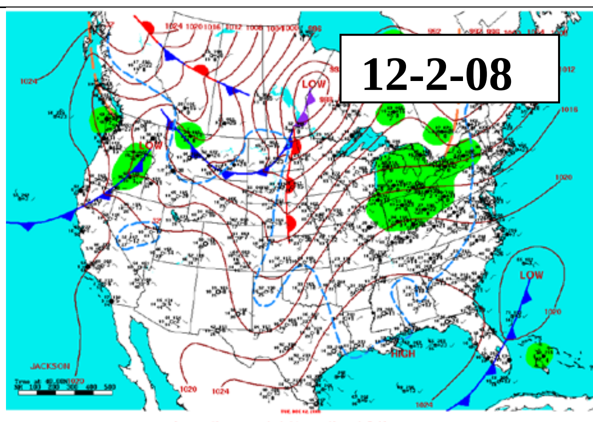


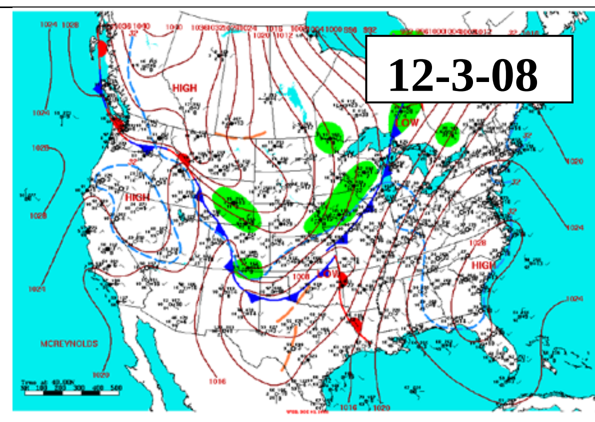


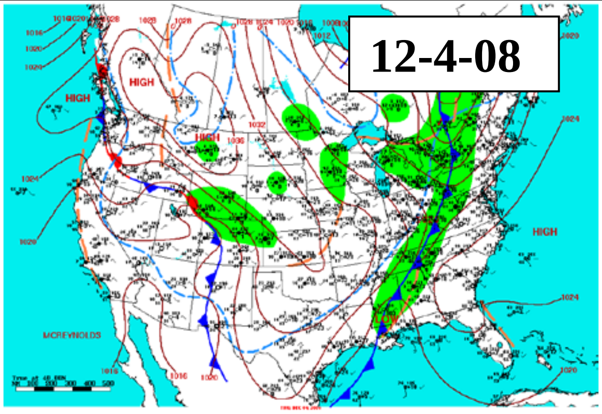


Period 7

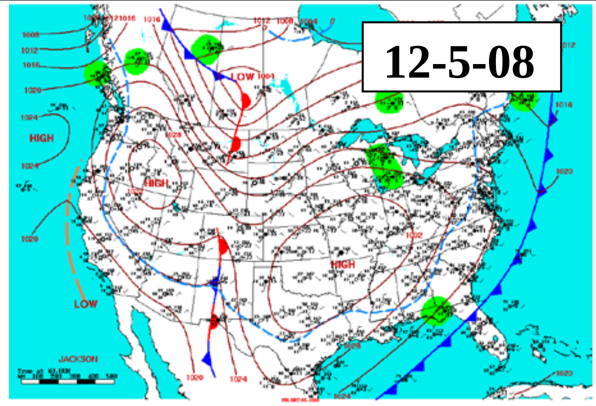




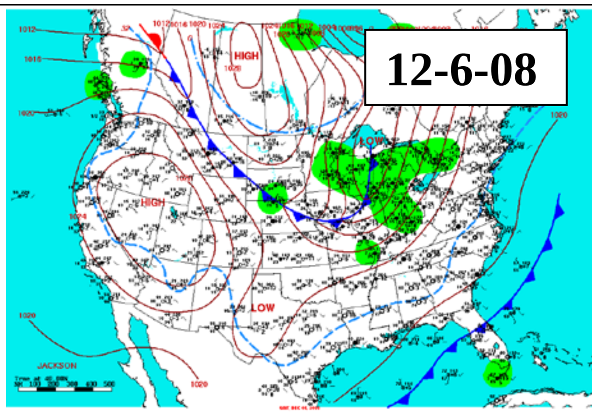




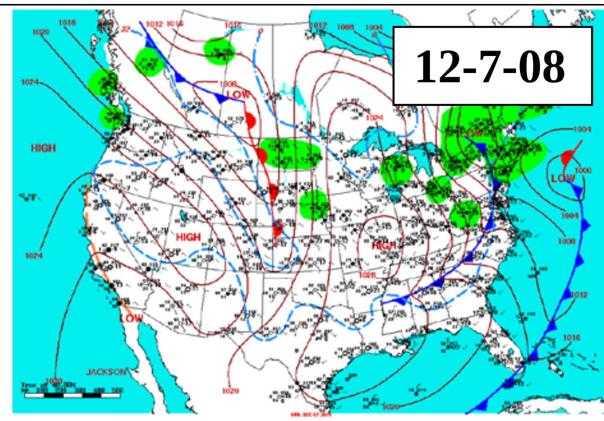
Surface Weather Map and Station Weather at 7:00 A.M. E.S.T.



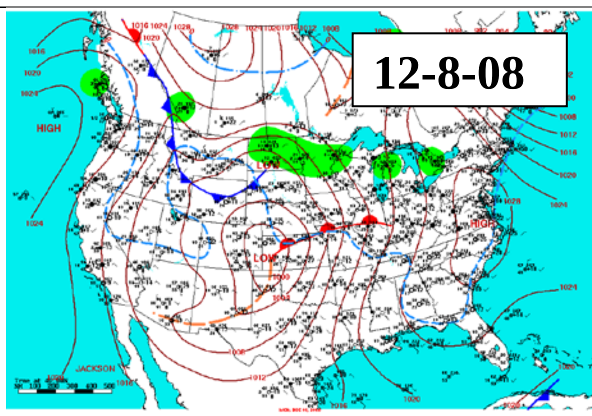
Surface Weather Map and Station Weather at 7:00 A.M. E.S.T.



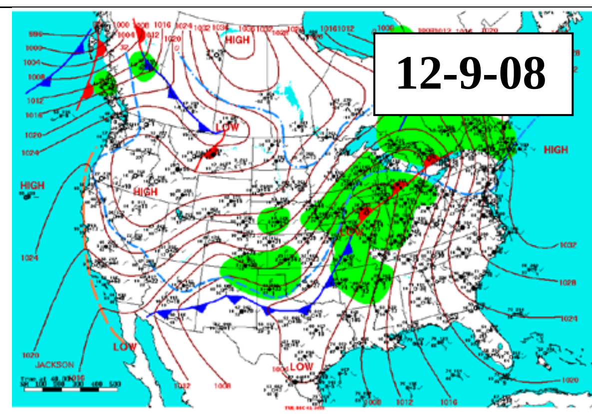
Surface Weather Map and Station Weather at 7:00 A.M. E.S.T.



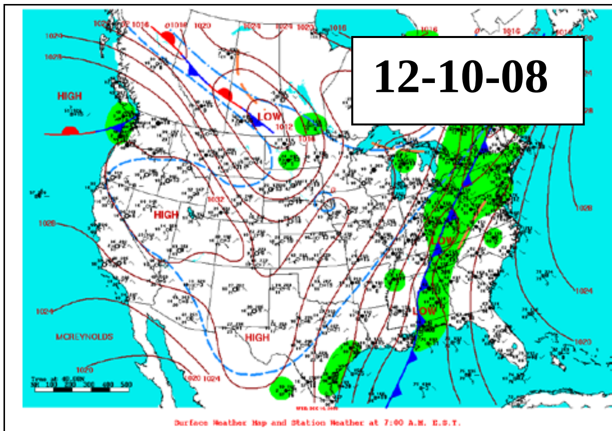
Surface Weather Map and Station Weather at 7:00 A.M. E.S.T.

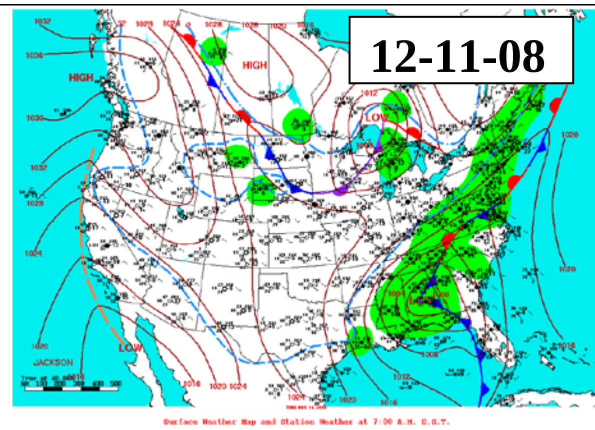


Surface Weather Map and Station Weather at 7:00 A.M. E.S.T.



Surface Weather Map and Station Weather at 7:00 A.M. E.S.T.


12-10-08
HIGH
LOW
Surface Weather Map and Station Weather at 7:00 A.M. E.S.T.


12-11-08
HIGH
LOW
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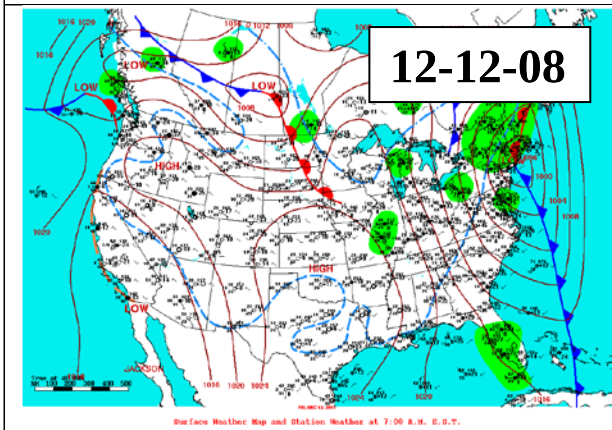
12-12-08
HIGH
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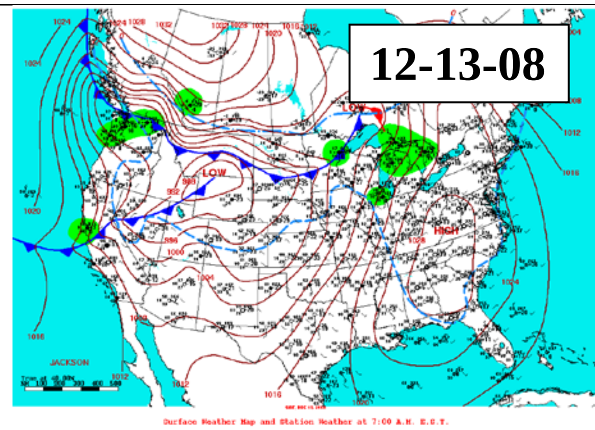
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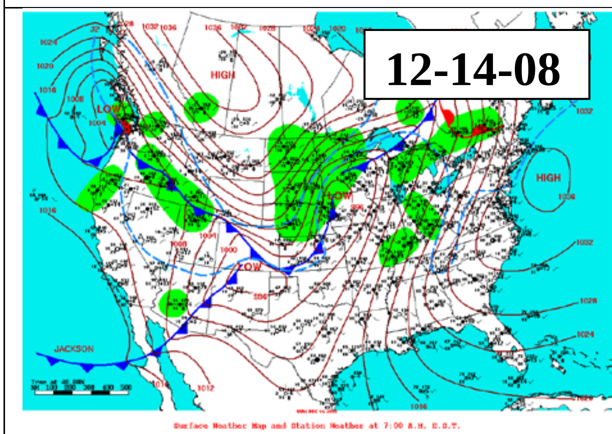
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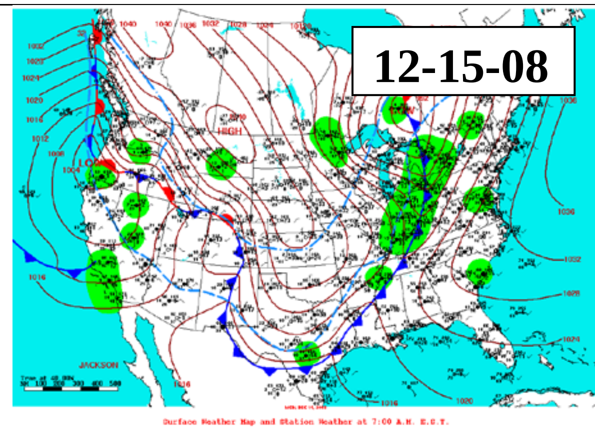
12-15-08
HIGH
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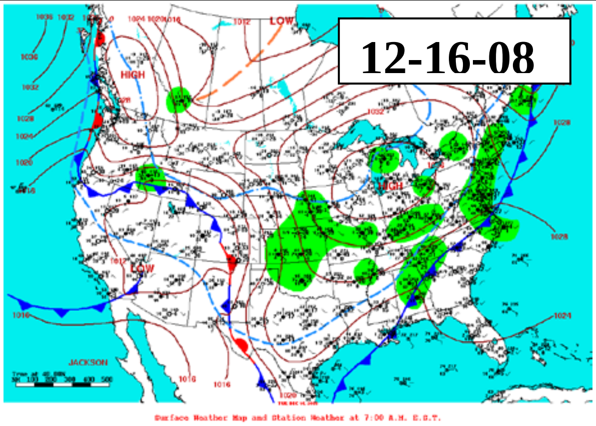
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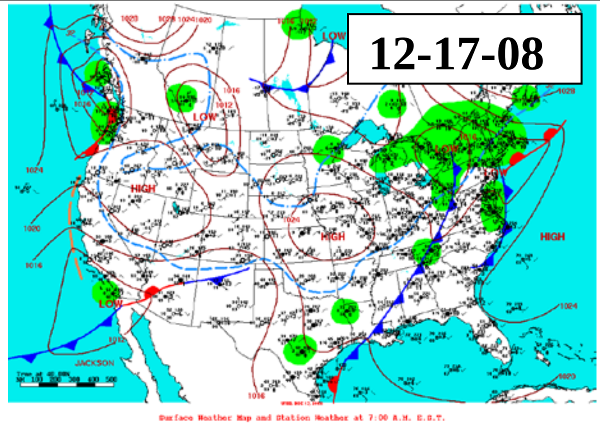
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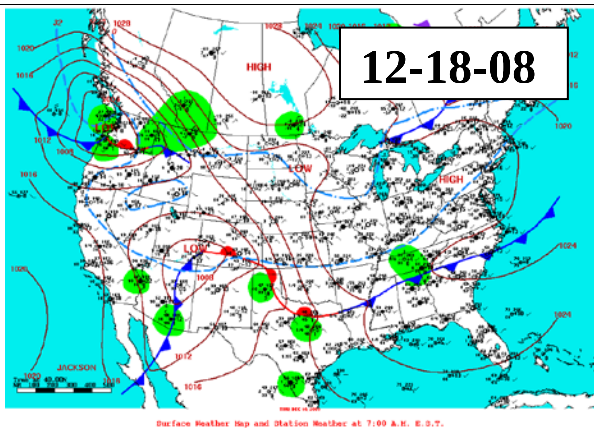
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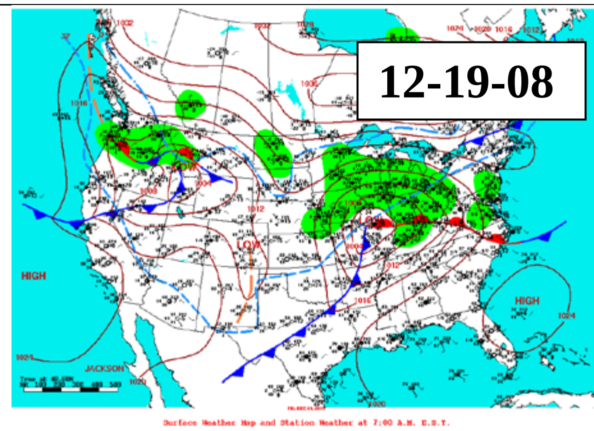
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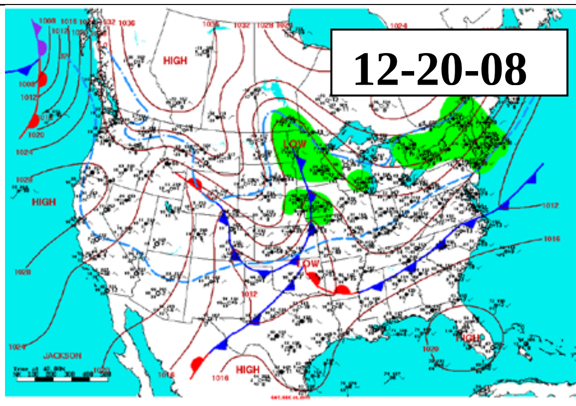
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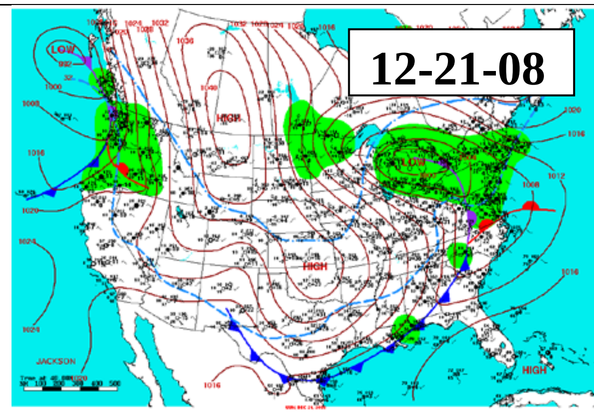
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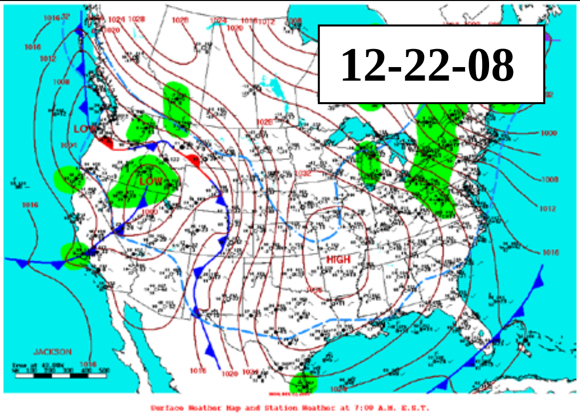
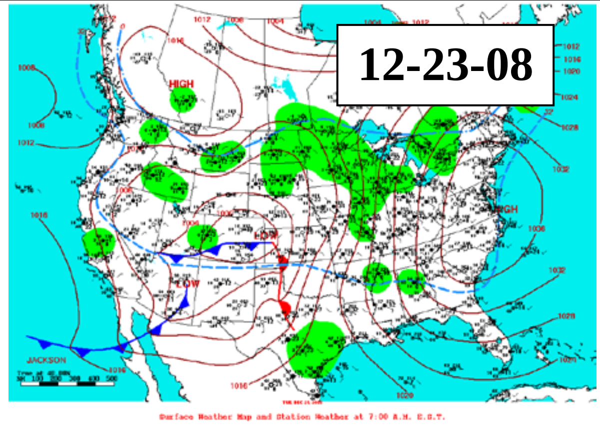

12-22-08
Surface Weather Map and Station Weather at 7:00 A.M. E.S.T.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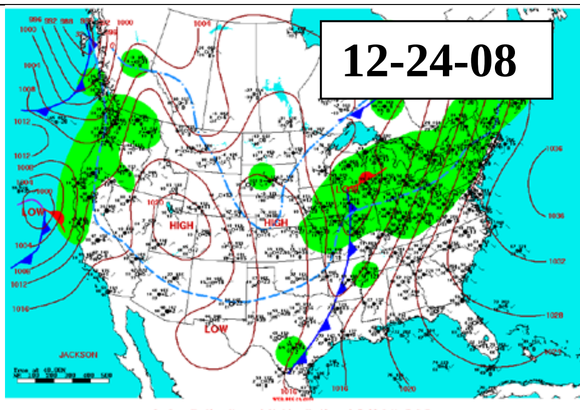
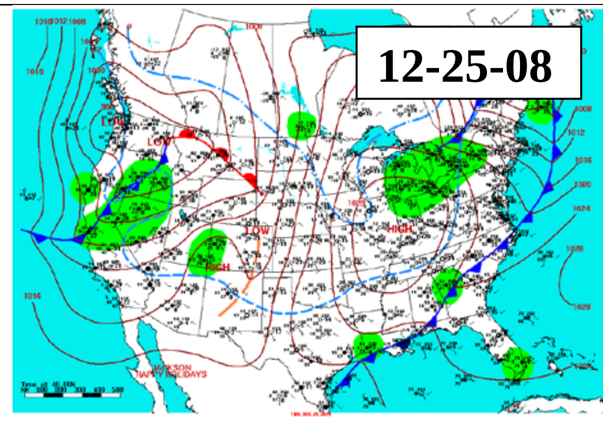
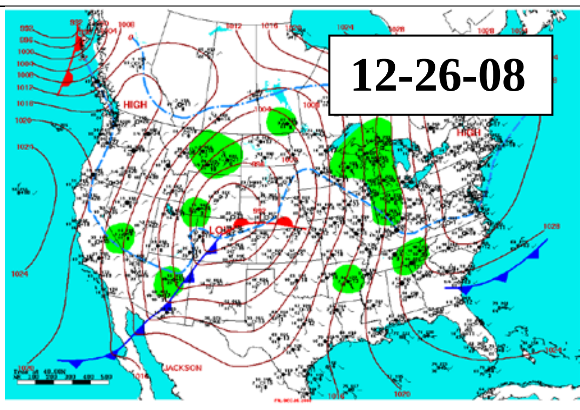
Surface Weather Map and Station Weather at 7:00 A.M. E.S.T.


12-24-08
Surface Weather Map and Station Weather at 7:00 A.M. E.S.T.


12-25-08
Surface Weather Map and Station Weather at 7:00 A.M. E.S.T.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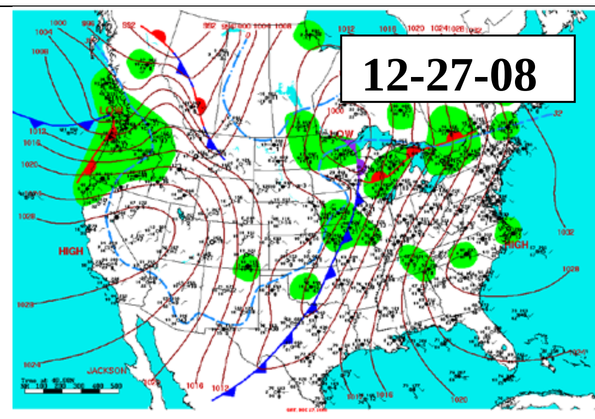
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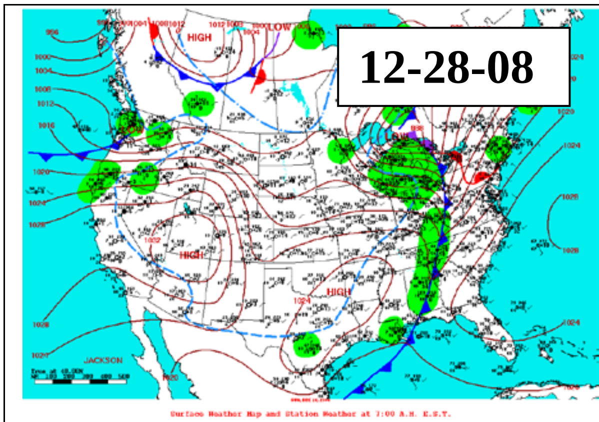
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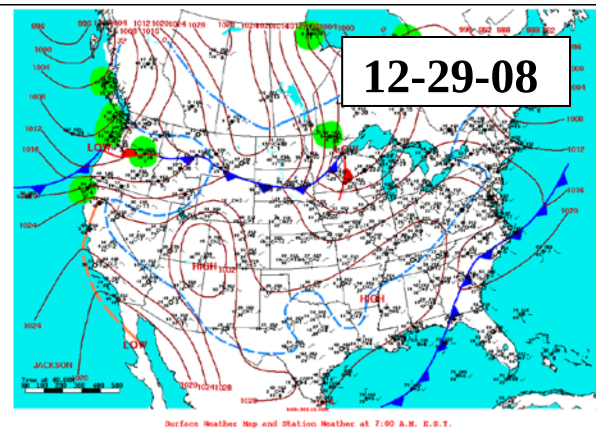
Surface Weather Map and Station Weather at 7:00 A.M. E.S.T.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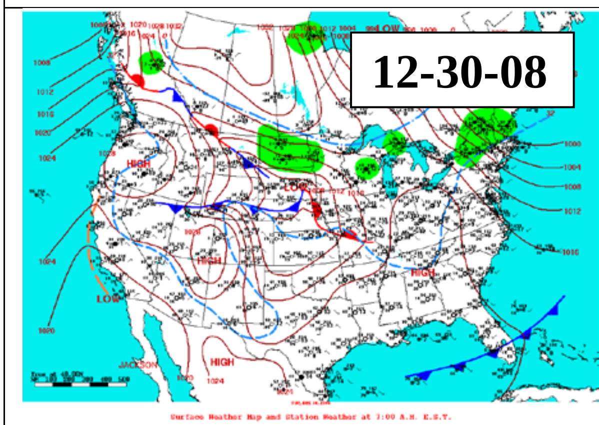
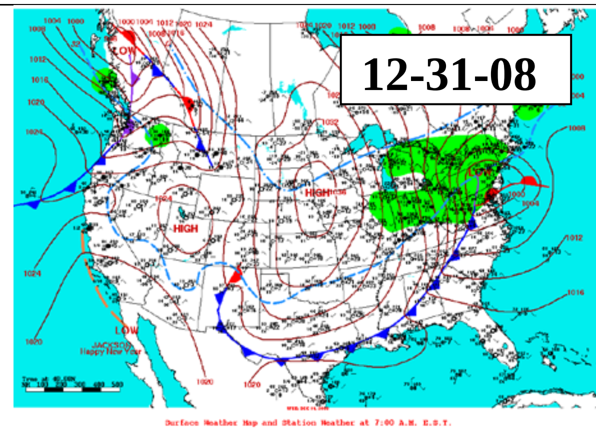

12-30-08
Surface Weather Map and Station Weather at 7:00 A.M. E.S.T.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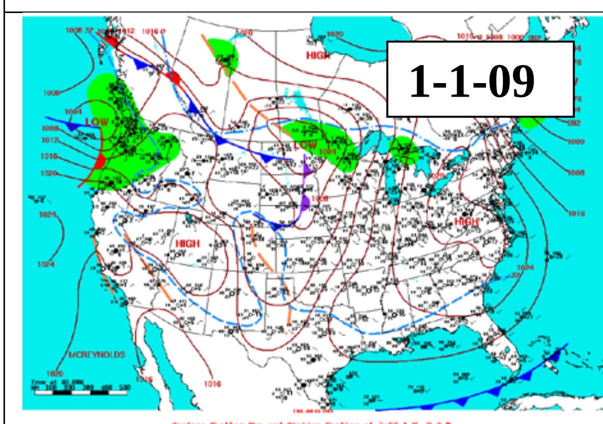
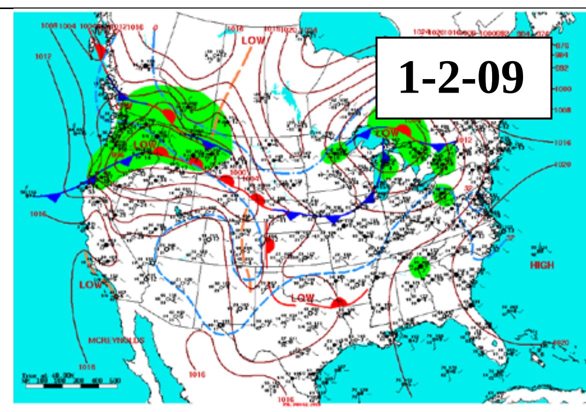
Surface Weather Map and Station Weather at 7:00 A.M. E.S.T.


1-1-09
Surface Weather Map and Station Weather at 7:00 A.M. E.S.T.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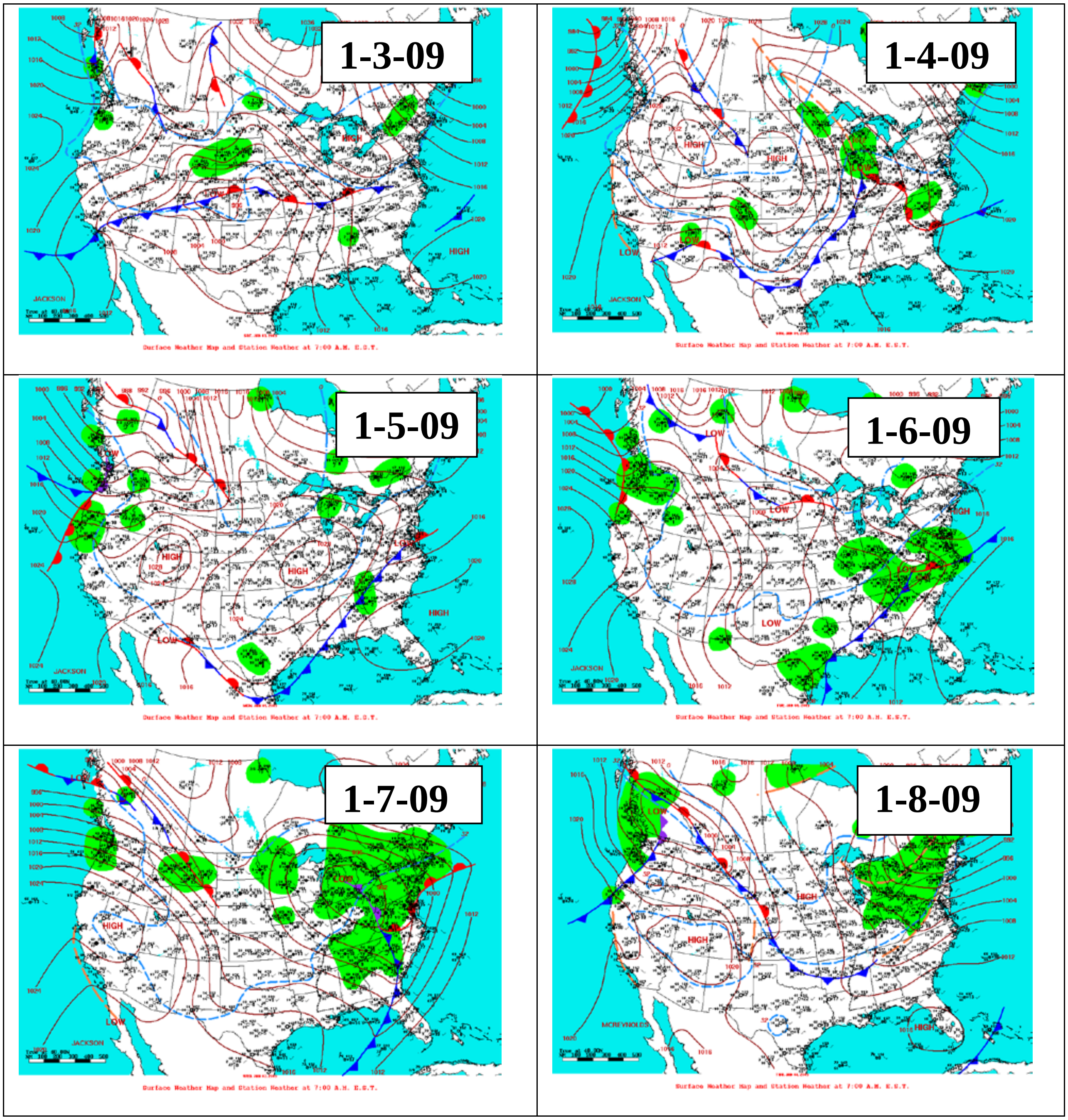
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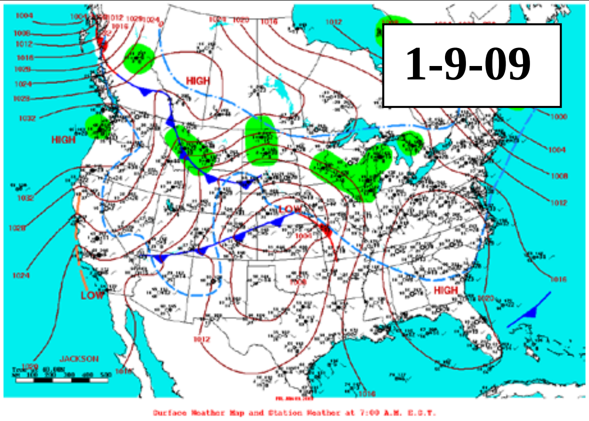
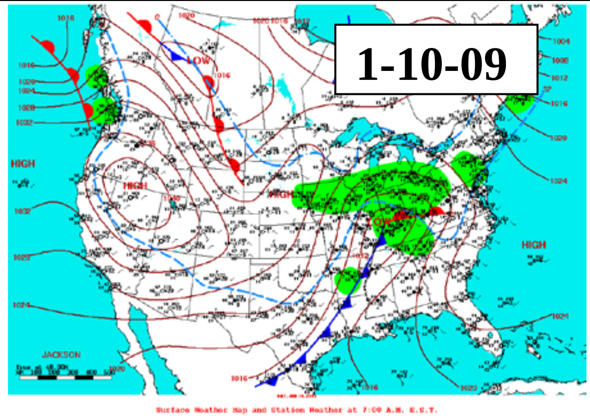
1-8-09


1-9-09
Surface Weather Map and Station Weather at 7:00 A.M. E.S.T.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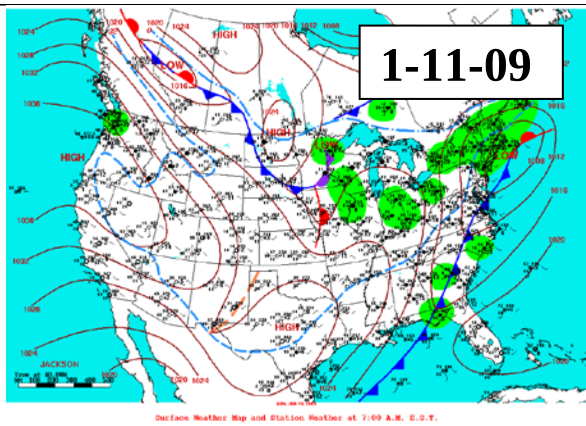
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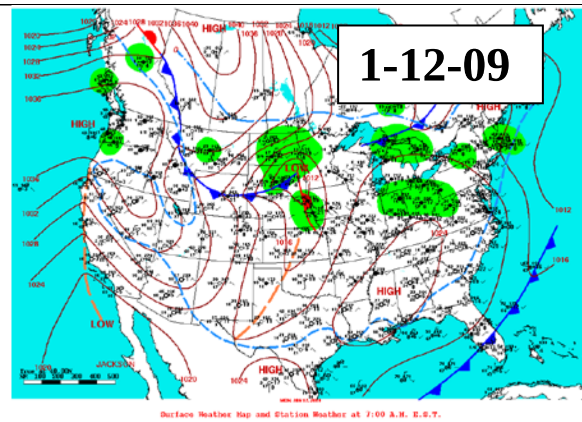
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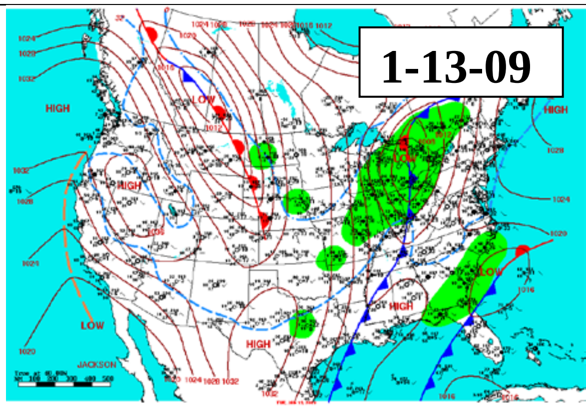
Surface Weather Map and Station Weather at 7:00 A.M. E.S.T.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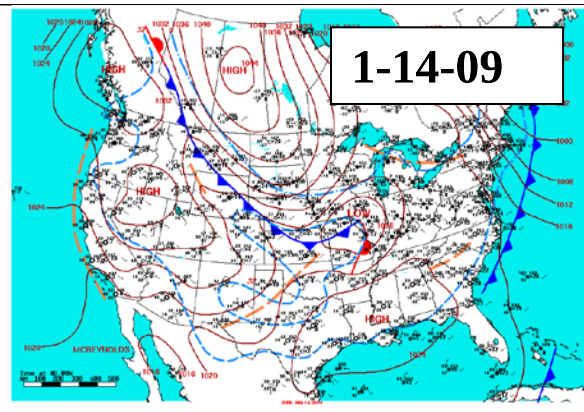
Surface Weather Map and Station Weather at 7:00 A.M. E.S.T.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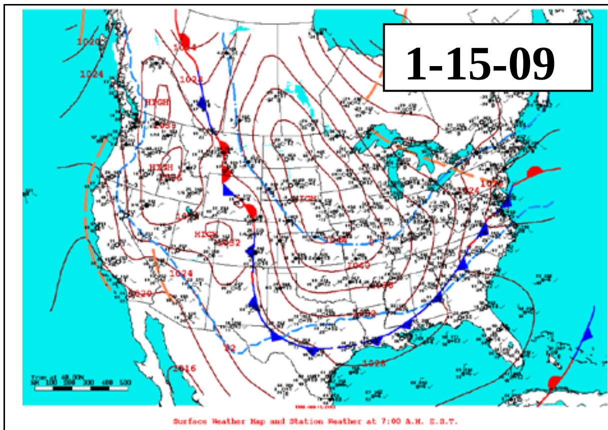
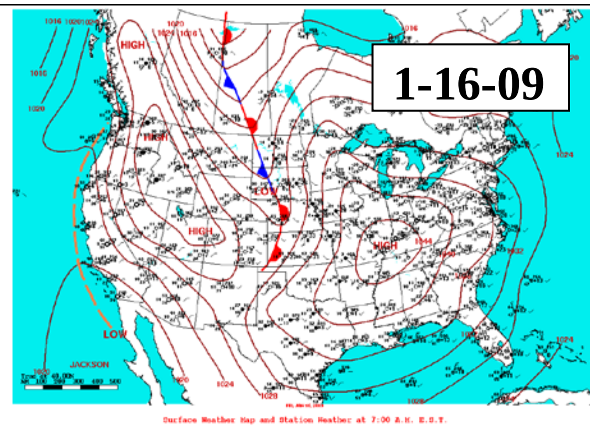
Surface Weather Map and Station Weather at 7:00 A.M. E.S.T.


1-15-09
Surface Weather Map and Station Weather at 7:00 A.M. E.S.T.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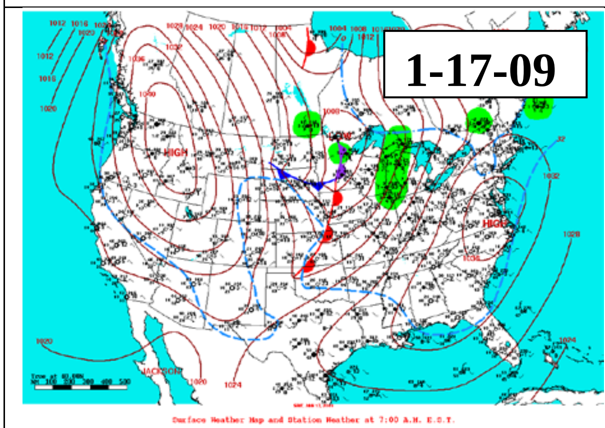
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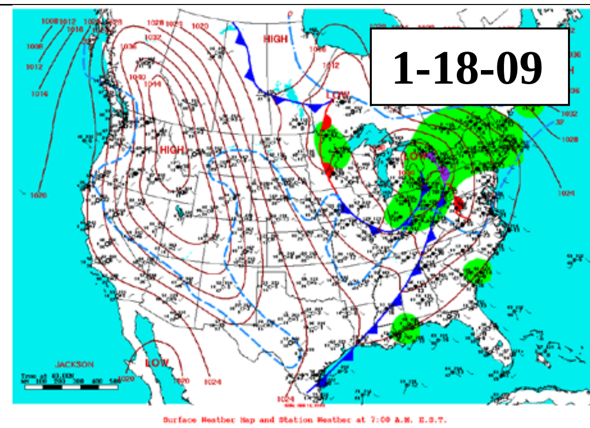
Surface Weather Map and Station Weather at 7:00 A.M. E.S.T.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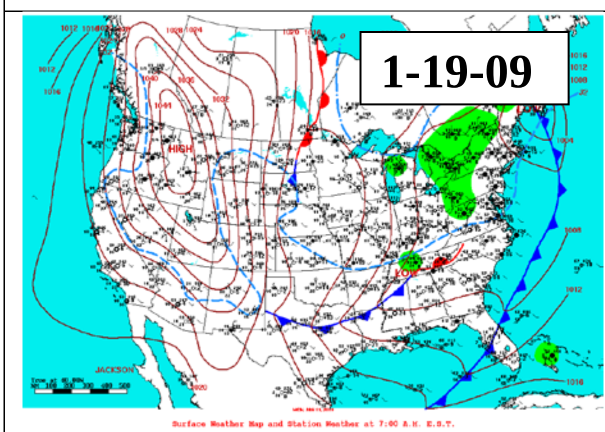
Surface Weather Map and Station Weather at 7:00 A.M. E.S.T.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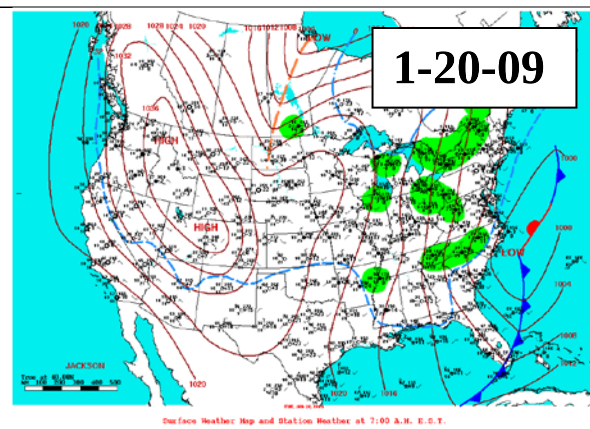
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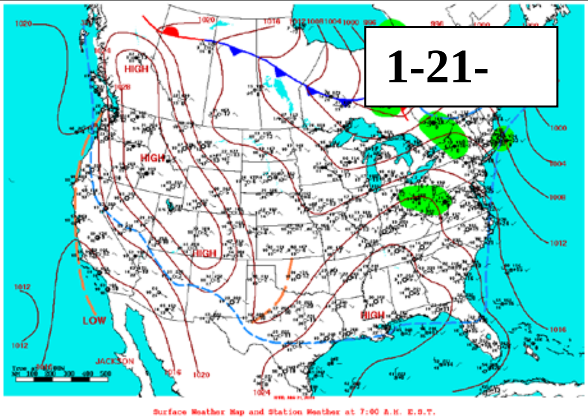
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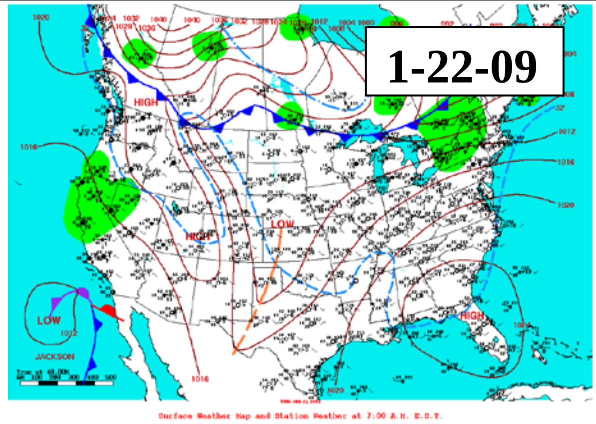
Surface Weather Map and Station Weather at 7:00 A.M. E.S.T.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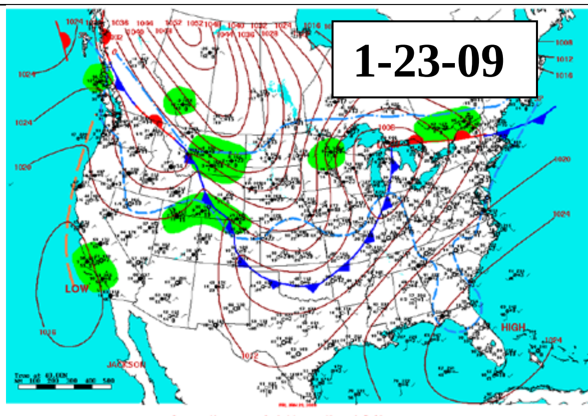
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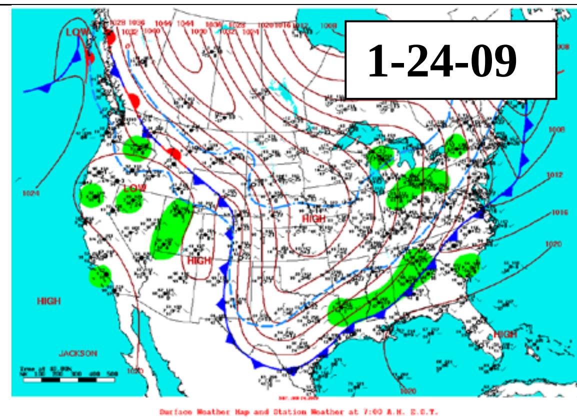
Surface Weather Map and Station Weather at 7:00 A.M. E.S.T.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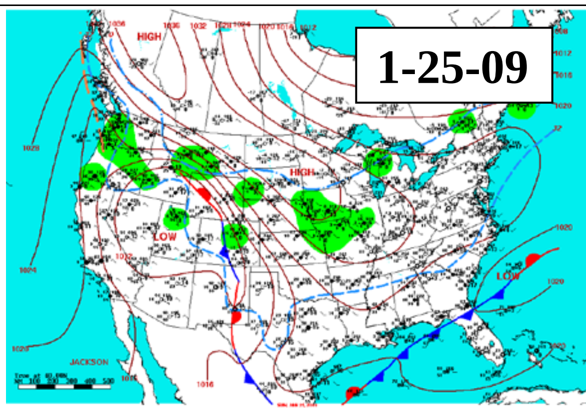
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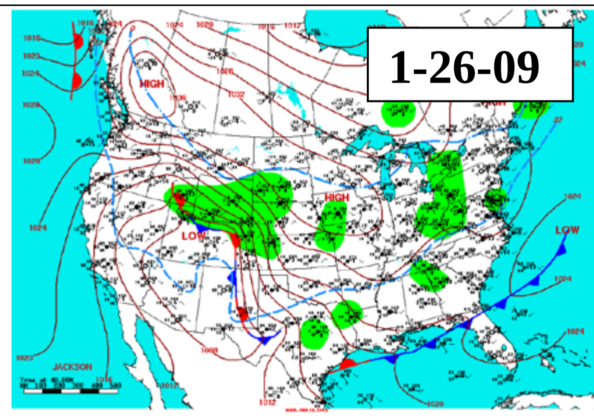
Surface Weather Map and Station Weather at 7:00 A.M. E.S.T.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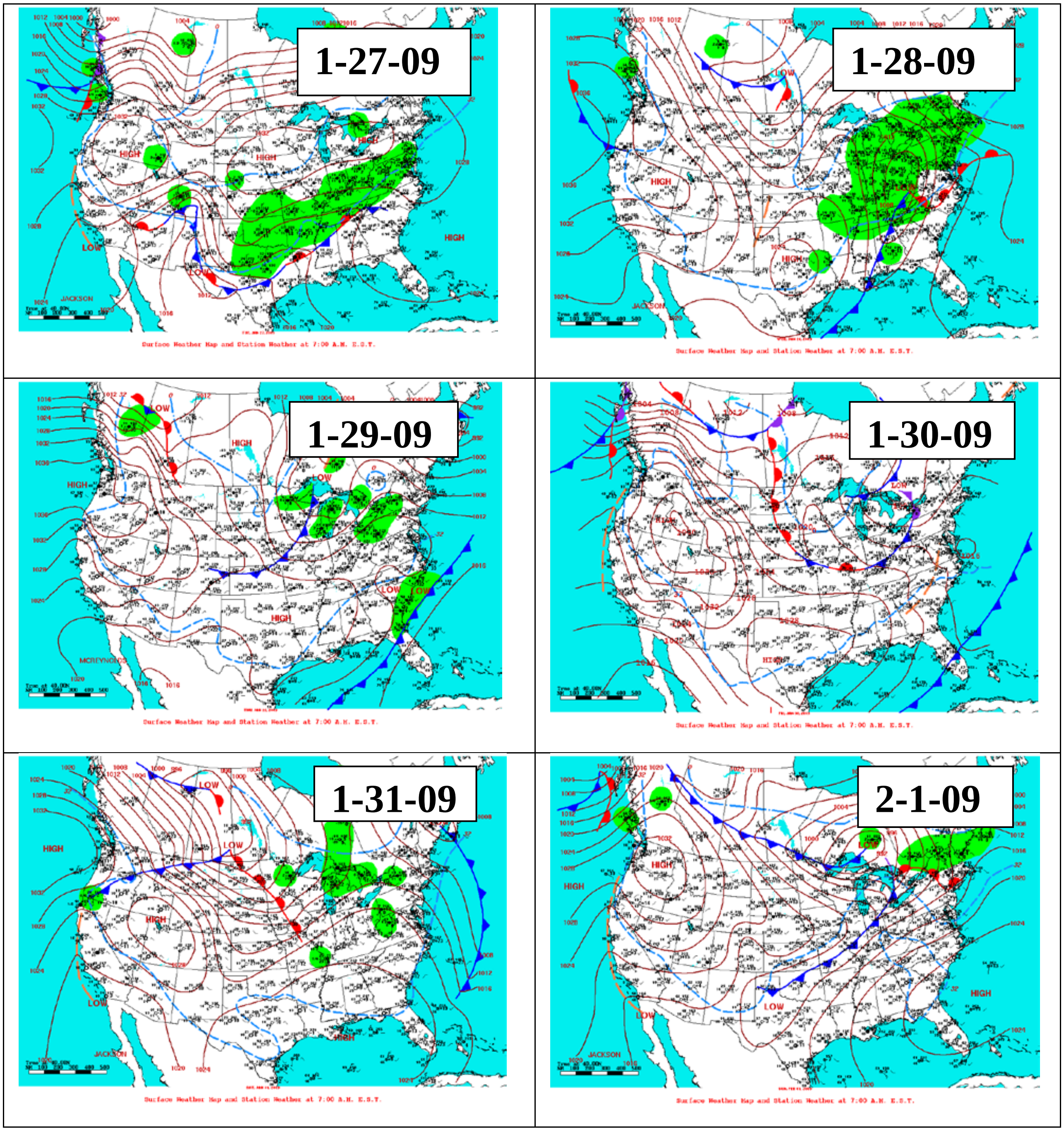
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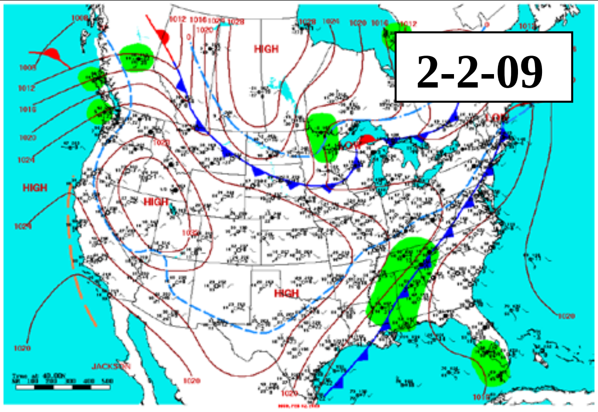
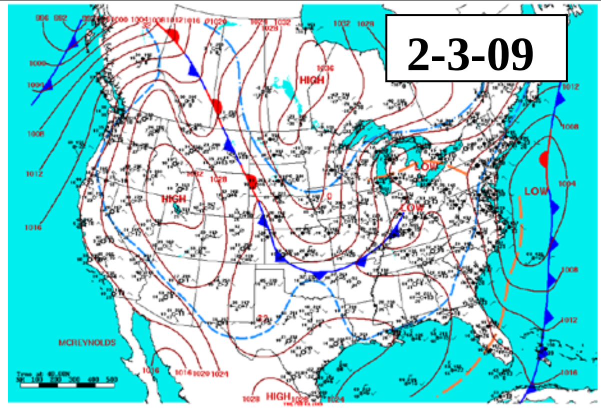
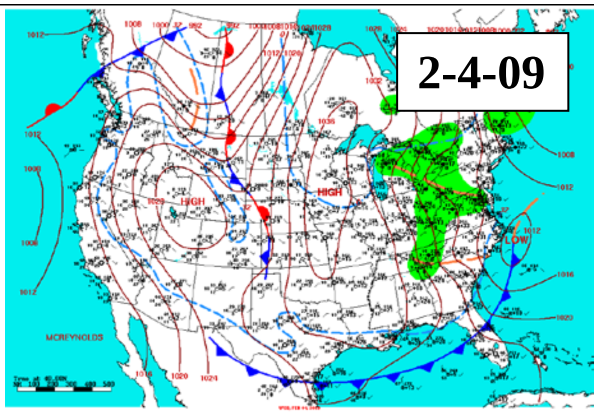
1-31-09
2-1-09



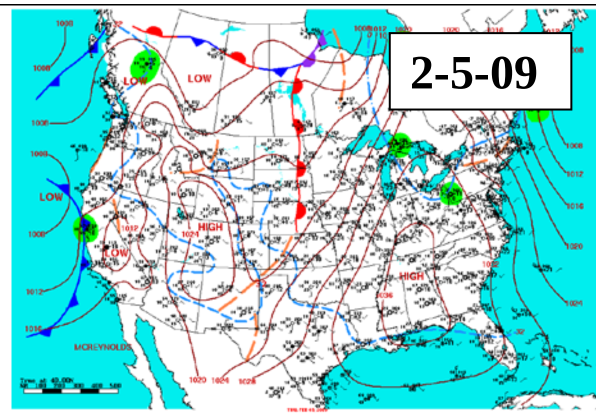
Surface Weather Map and Station Weather at 7:00 A.M. E.S.T.



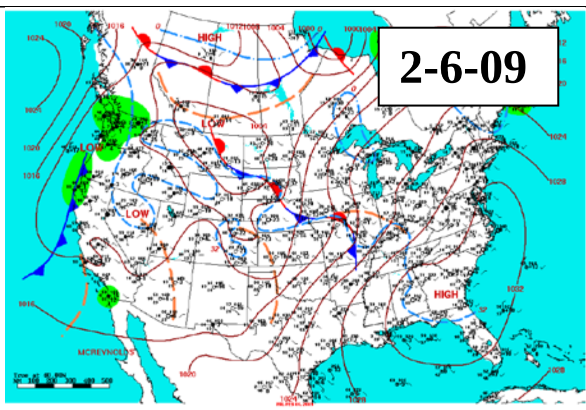
Surface Weather Map and Station Weather at 7:00 A.M. E.S.T.



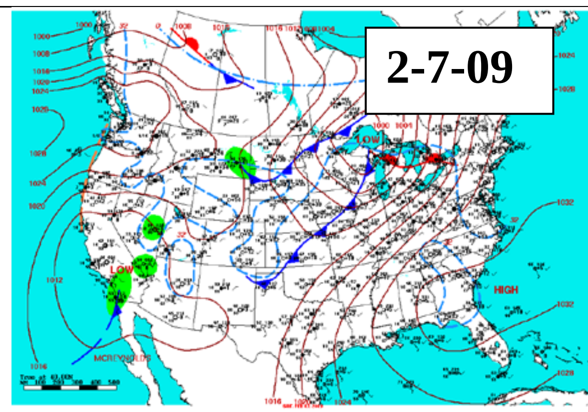
Surface Weather Map and Station Weather at 7:00 A.M. E.S.T.



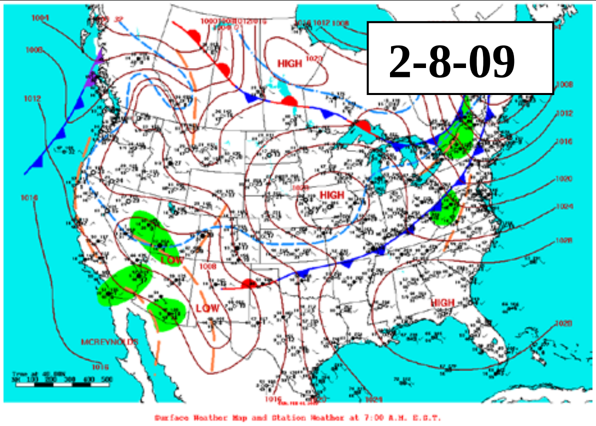
Surface Weather Map and Station Weather at 7:00 A.M. E.S.T.

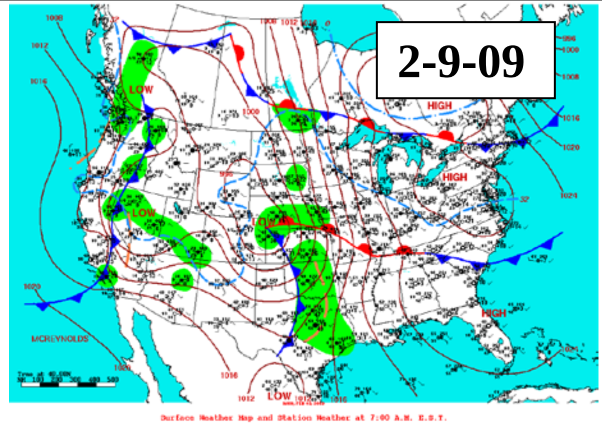


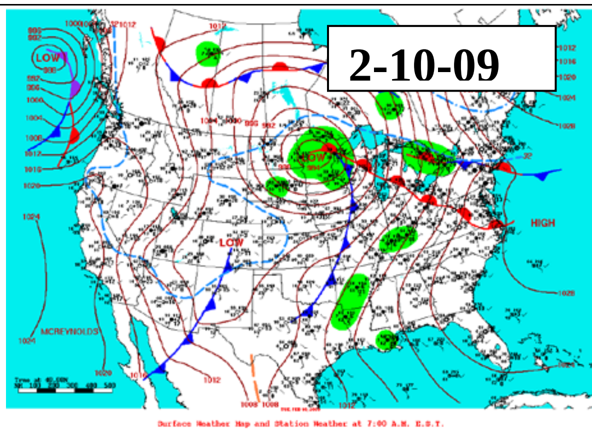
Surface Weather Map and Station Weather at 7:00 A.M. E.S.T.

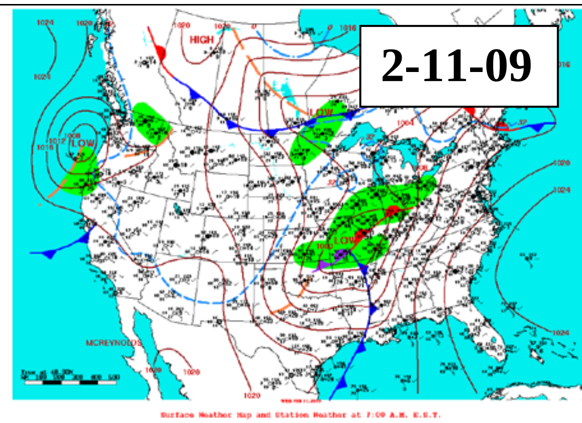


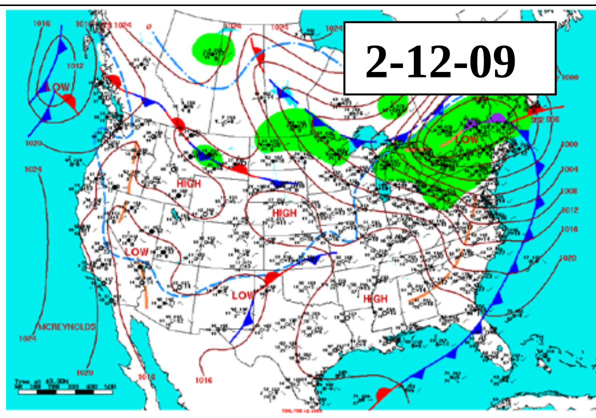
Surface Weather Map and Station Weather at 7:00 A.M. E.S.T.

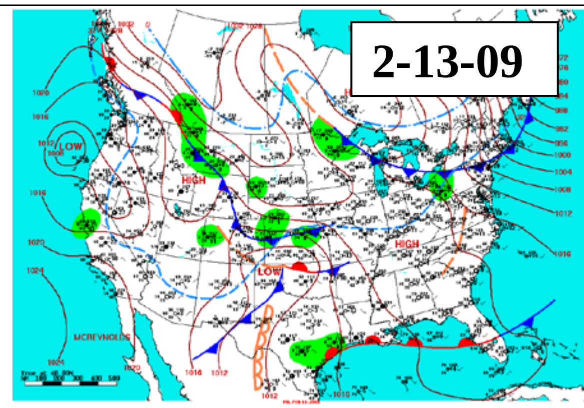

2-8-09
Surface Weather Map and Station Weather at 7:00 A.M. E.S.T.

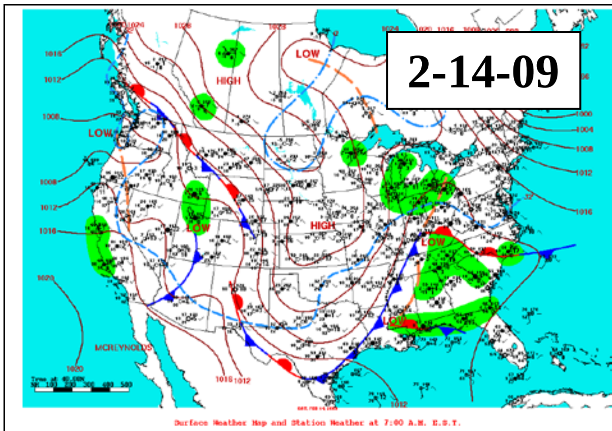

2-9-09
Surface Weather Map and Station Weather at 7:00 A.M. E.S.T.


2-10-09
Surface Weather Map and Station Weather at 7:00 A.M. E.S.T.


2-11-09
Surface Weather Map and Station Weather at 7:00 A.M. E.S.T.


2-12-09
Surface Weather Map and Station Weather at 7:00 A.M. E.S.T.


2-13-09
Surface Weather Map and Station Weather at 7:00 A.M. E.S.T.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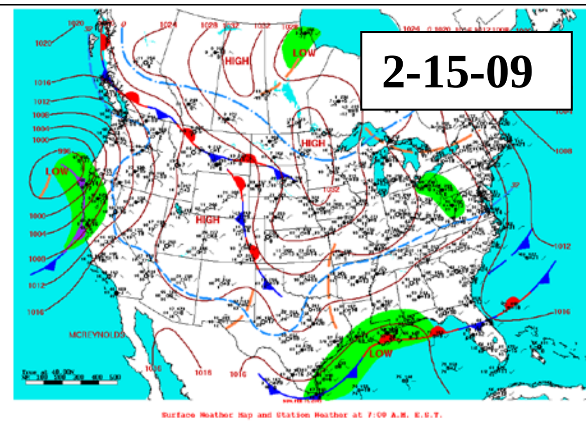
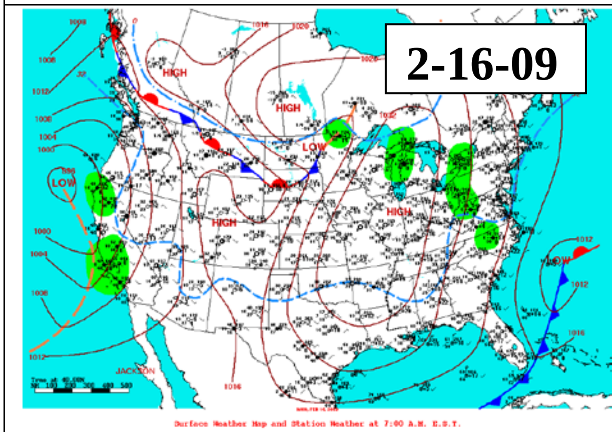
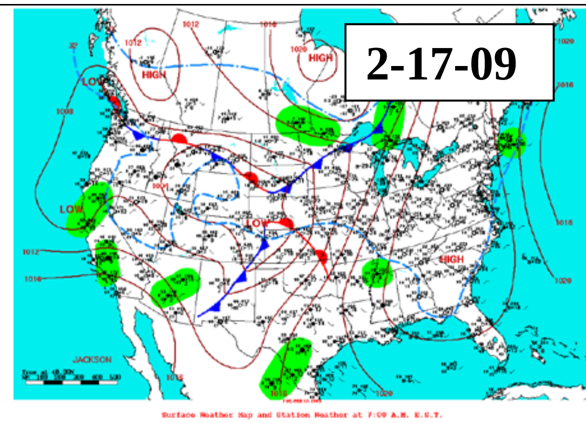
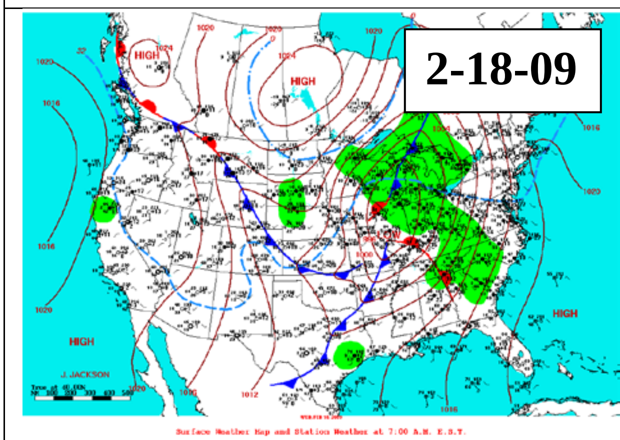
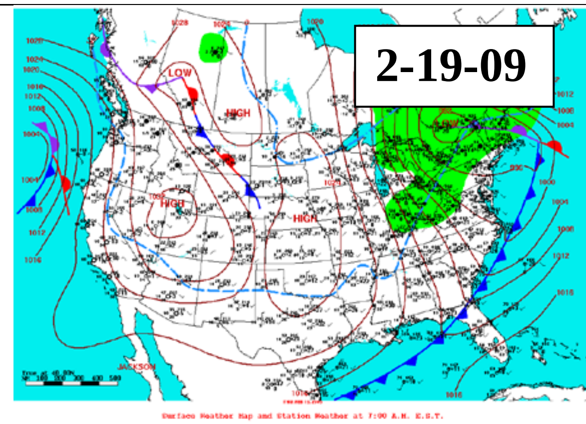
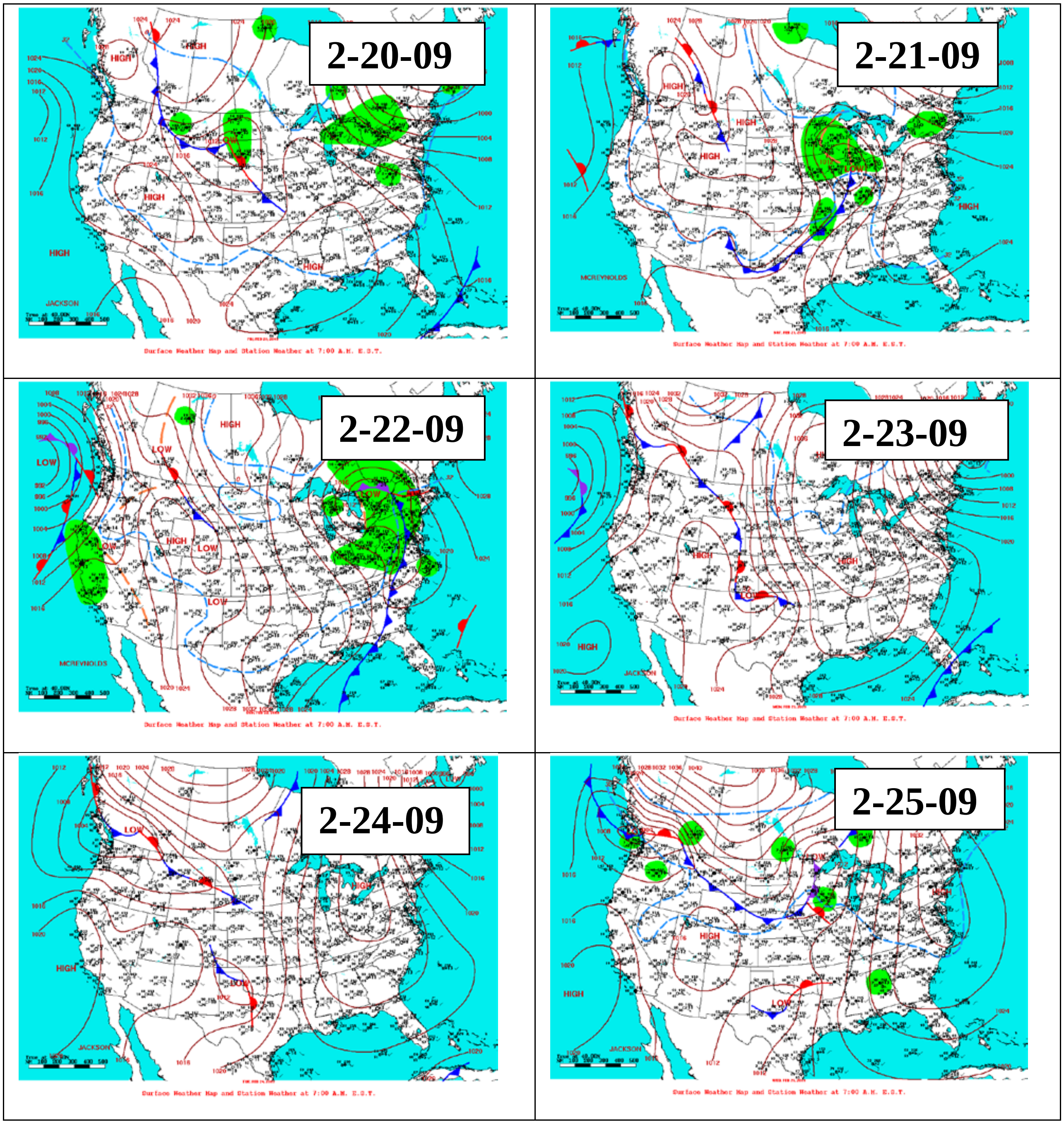

2-15-09
Surface Weather Map and Station Weather at 7:00 A.M. E.S.T.

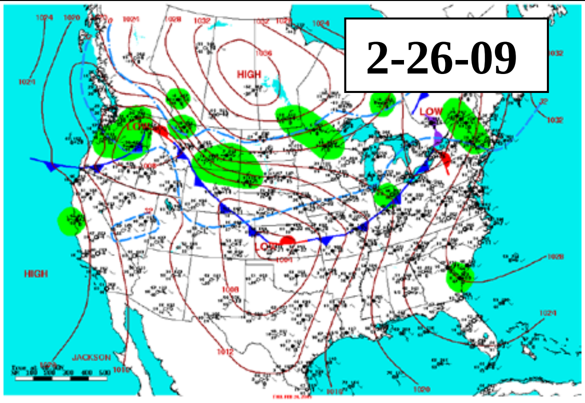

2-16-09
Surface Weather Map and Station Weather at 7:00 A.M. E.S.T.


2-17-09
Surface Weather Map and Station Weather at 7:00 A.M. E.S.T.

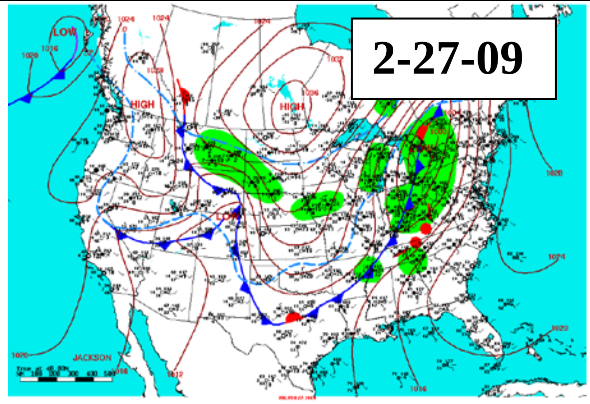

2-18-09
Surface Weather Map and Station Weather at 7:00 A.M. E.S.T.


2-19-09
Surface Weather Map and Station Weather at 7:00 A.M. E.S.T.

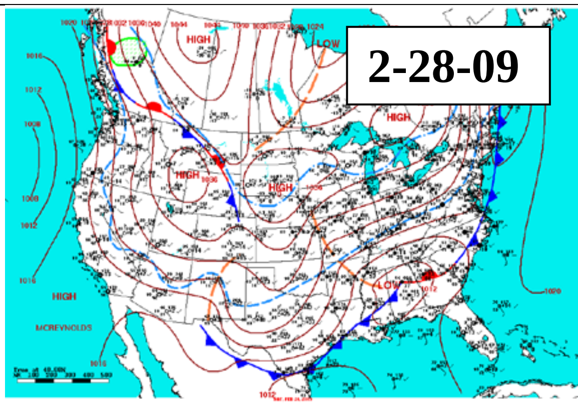

2-20-09
2-21-09
2-22-09
2-23-09
2-24-09
2-25-09



Surface Weather Map and Station Weather at 7:00 A.M. E.S.T.

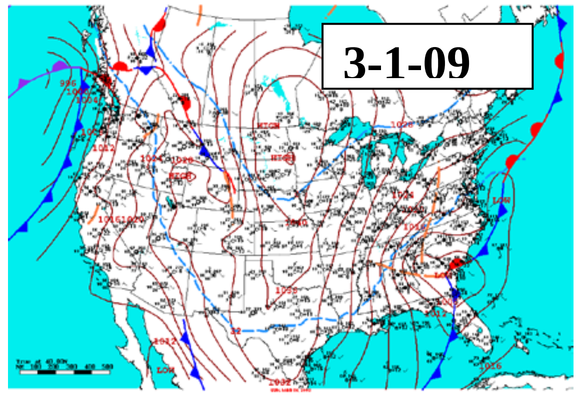


Surface Weather Map and Station Weather at 7:00 A.M. E.S.T.

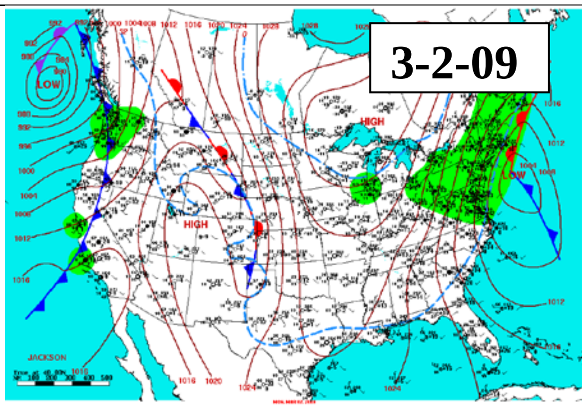


Surface Weather Map and Station Weather at 7:00 A.M. E.S.T.

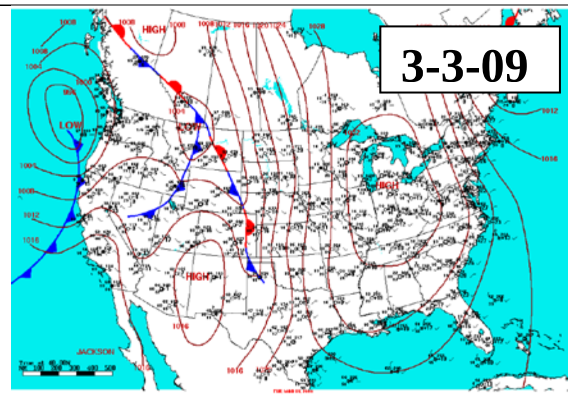
Period 8



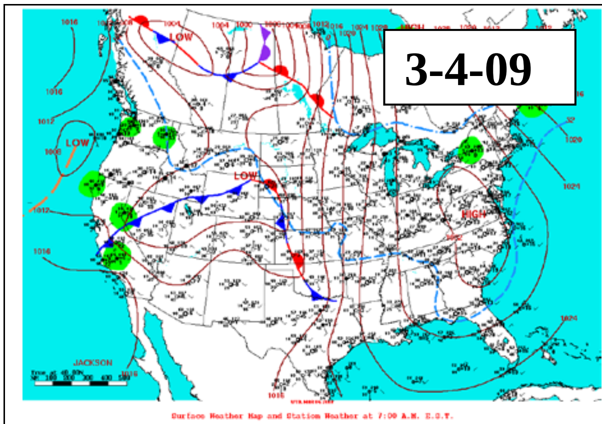
Surface Weather Map and Station Weather at 7:00 A.M. E.S.T.

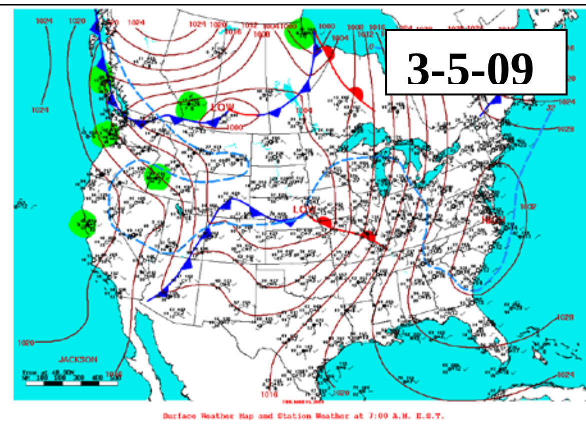


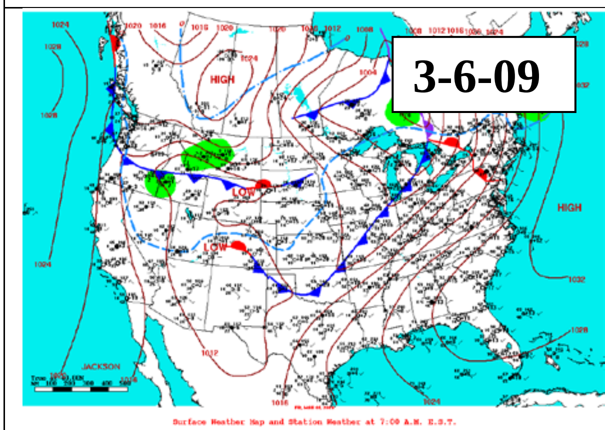
Surface Weather Map and Station Weather at 7:00 A.M. E.S.T.

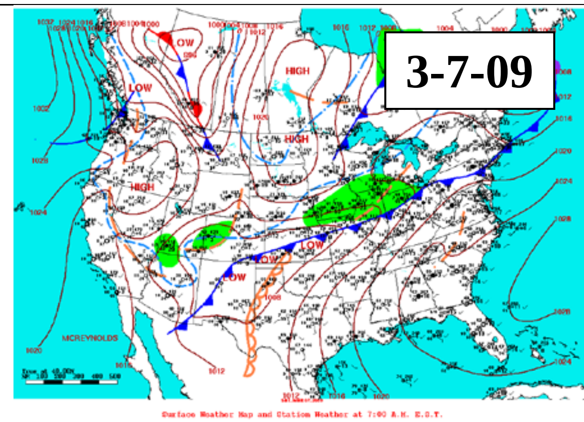


Surface Weather Map and Station Weather at 7:00 A.M. E.S.T.


3-4-09
Surface Weather Map and Station Weather at 7:00 A.M. E.S.T.


3-5-09
Surface Weather Map and Station Weather at 7:00 A.M. E.S.T.


3-6-09
Surface Weather Map and Station Weather at 7:00 A.M. E.S.T.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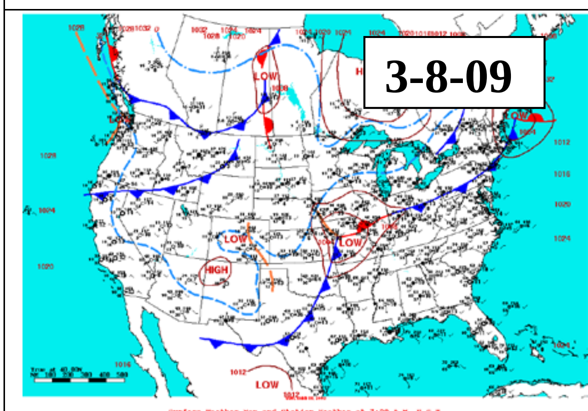
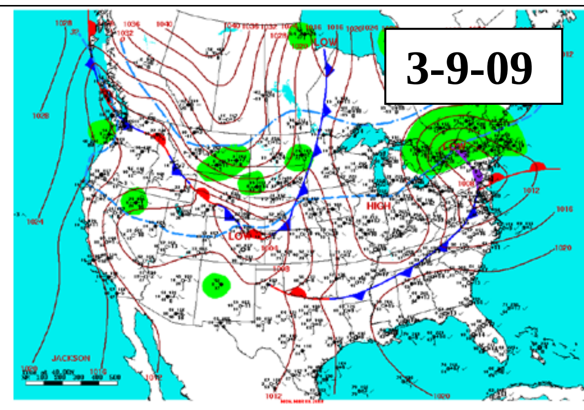
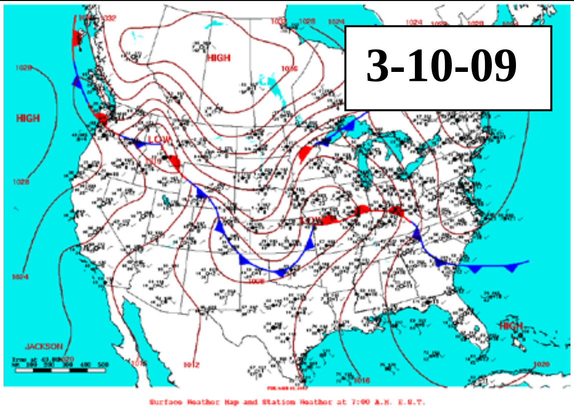
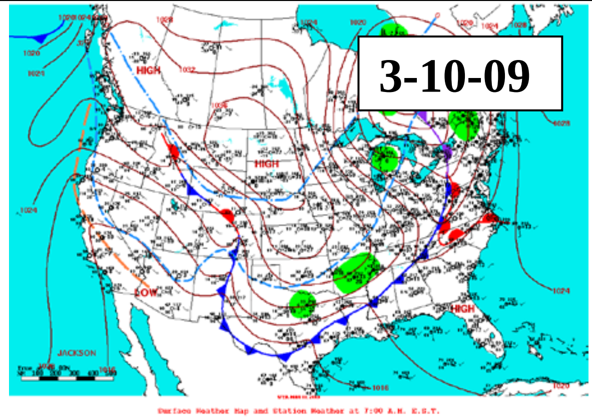
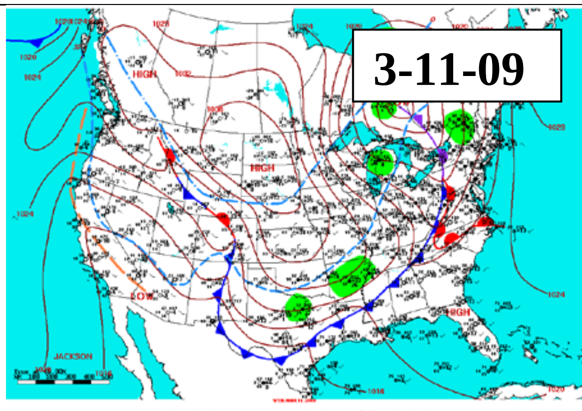
Surface Weather Map and Station Weather at 7:00 A.M. E.S.T.

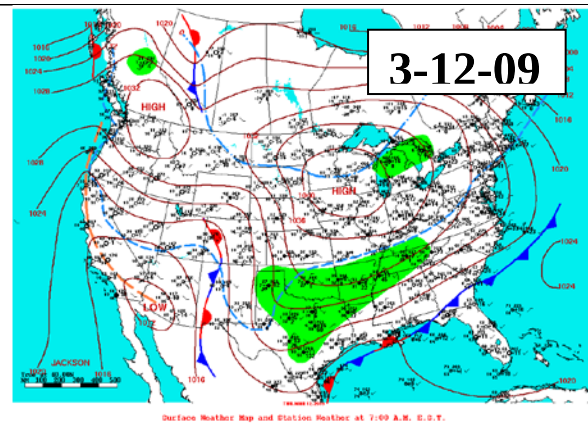

3-8-09
Surface Weather Map and Station Weather at 7:00 A.M. E.S.T.

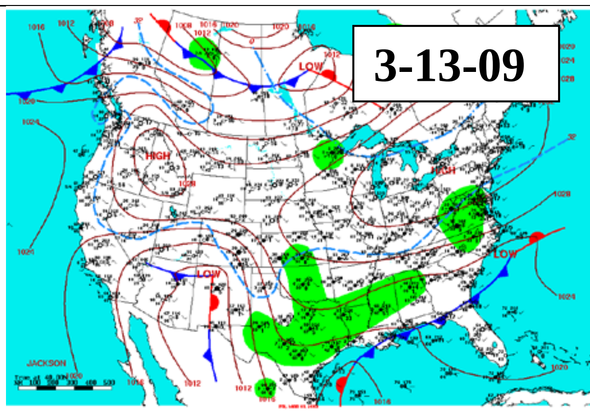

3-9-09
Surface Weather Map and Station Weather at 7:00 A.M. E.S.T.

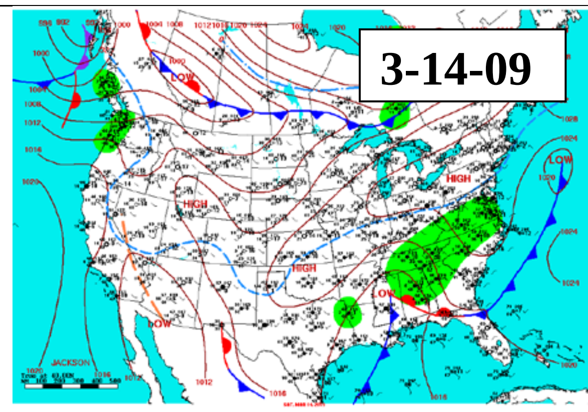

3-10-09
Surface Weather Map and Station Weather at 7:00 A.M. E.S.T.

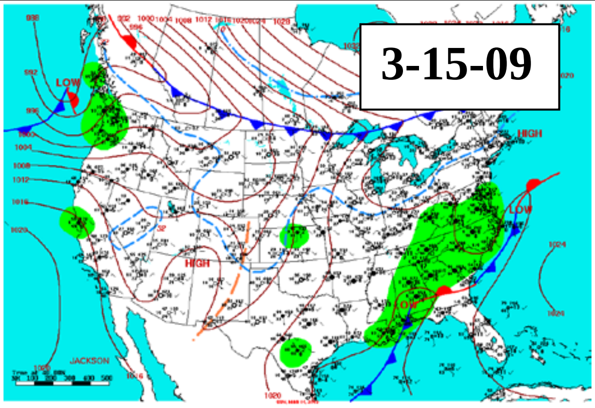

3-10-09
Surface Weather Map and Station Weather at 7:00 A.M. E.S.T.


3-11-09
Surface Weather Map and Station Weather at 7:00 A.M. E.S.T.

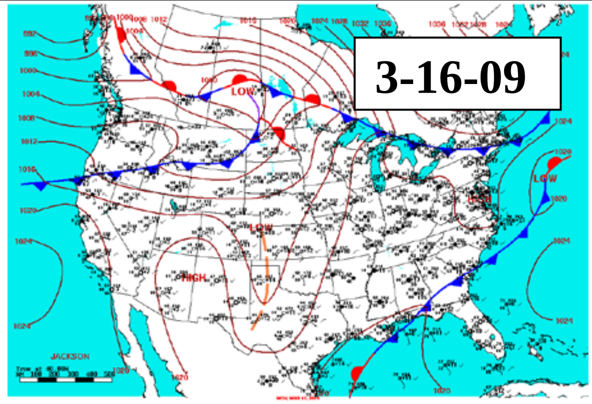

3-12-09
Surface Weather Map and Station Weather at 7:00 A.M. E.S.T.


3-13-09
Surface Weather Map and Station Weather at 7:00 A.M. E.S.T.

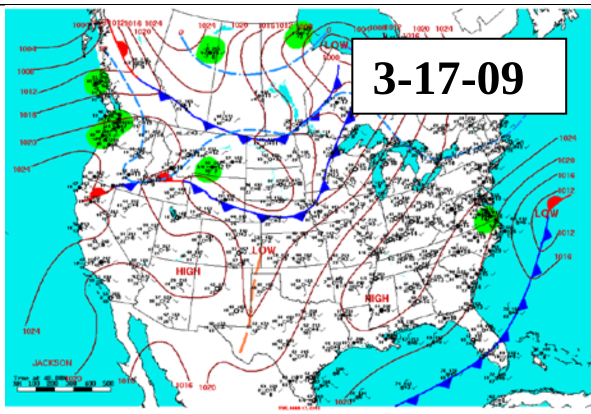

3-14-09
Surface Weather Map and Station Weather at 7:00 A.M. E.S.T.



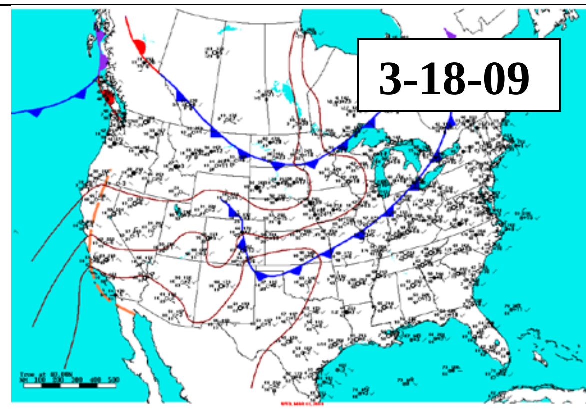
Surface Weather Map and Station Weather at 7:00 A.M. E.S.T.



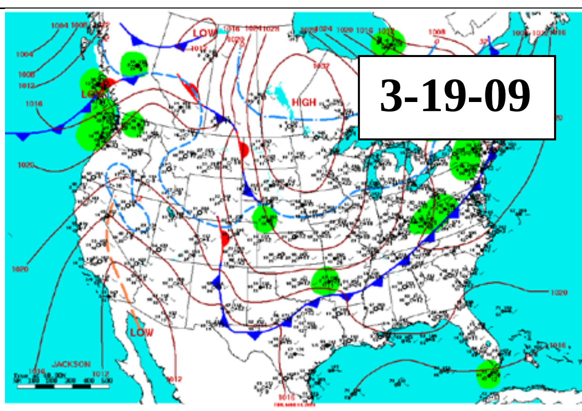
Surface Weather Map and Station Weather at 7:00 A.M. E.S.T.



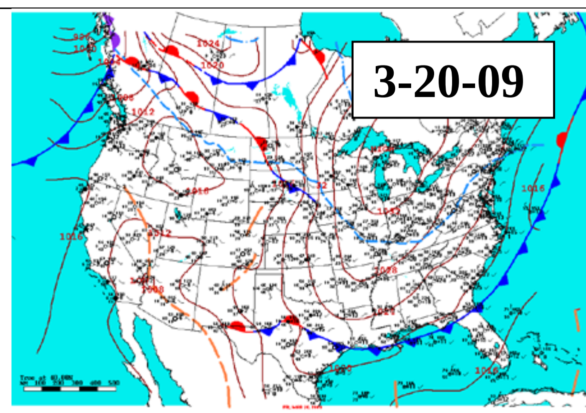
Surface Weather Map and Station Weather at 7:00 A.M. E.S.T.



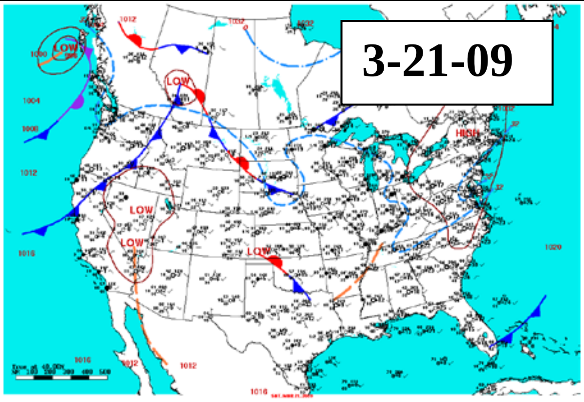
Surface Weather Map and Station Weather at 7:00 A.M. E.S.T.



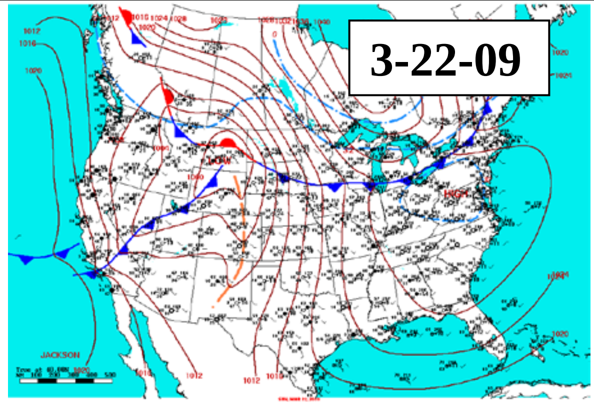
Surface Weather Map and Station Weather at 7:00 A.M. E.S.T.



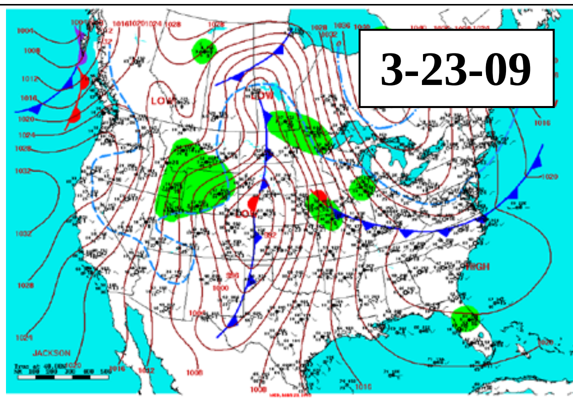
Surface Weather Map and Station Weather at 7:00 A.M. E.S.T.



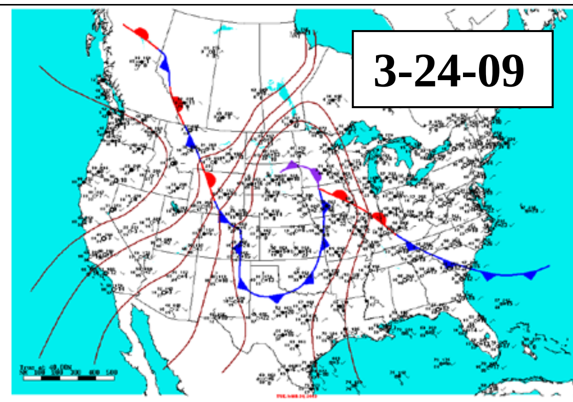
Surface Weather Map and Station Weather at 7:00 A.M. E.S.T.



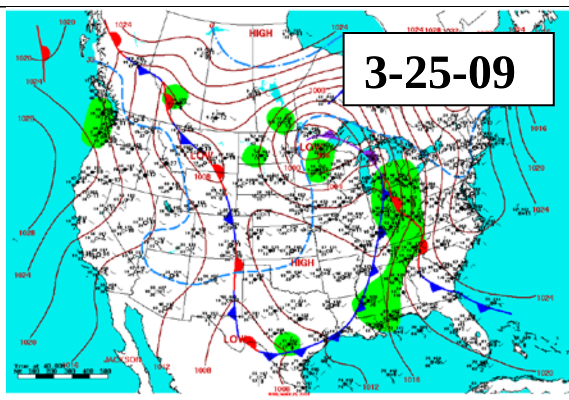
Surface Weather Map and Station Weather at 7:00 A.M. E.S.T.



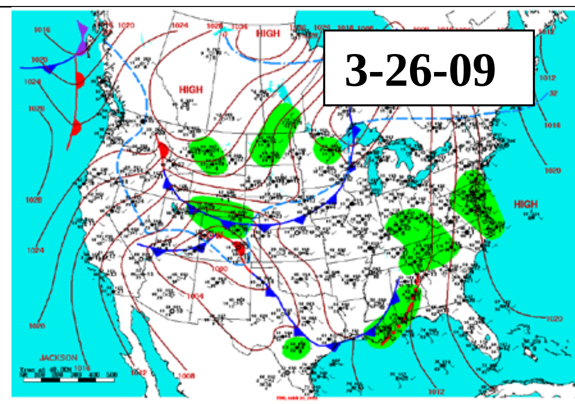
Surface Weather Map and Station Weather at 7:00 A.M. E.S.T.



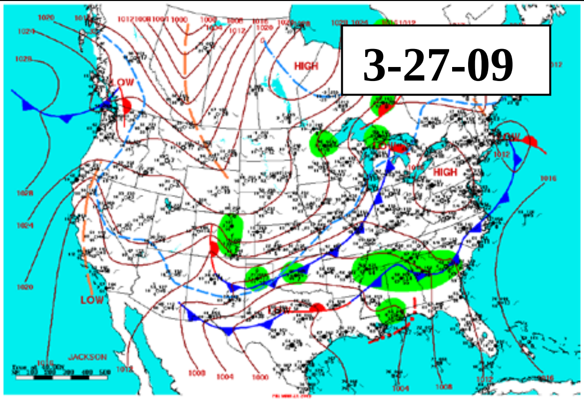
Surface Weather Map and Station Weather at 7:00 A.M. E.S.T.



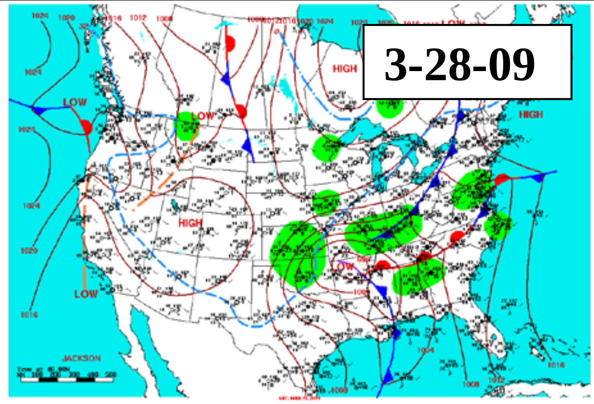
Surface Weather Map and Station Weather at 7:00 A.M. E.S.T.



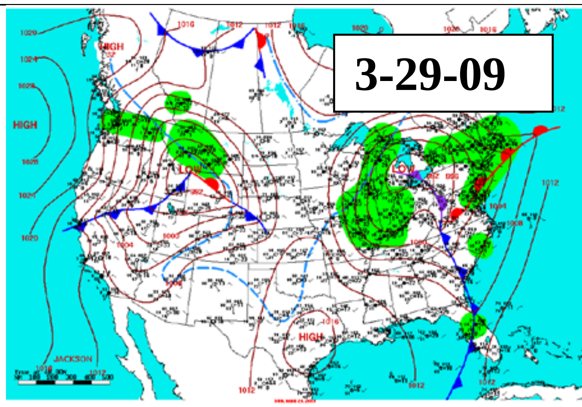
Surface Weather Map and Station Weather at 7:00 A.M. E.S.T.



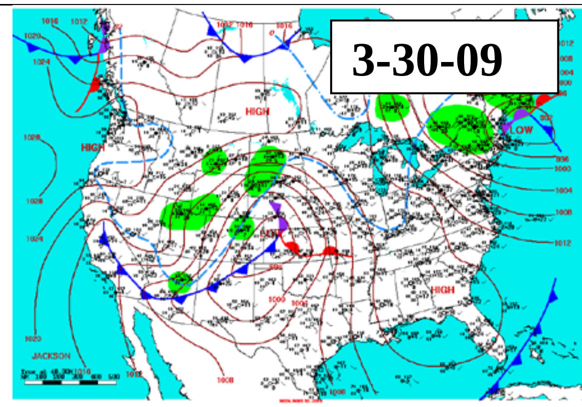
Surface Weather Map and Station Weather at 7:00 A.M. E.S.T.



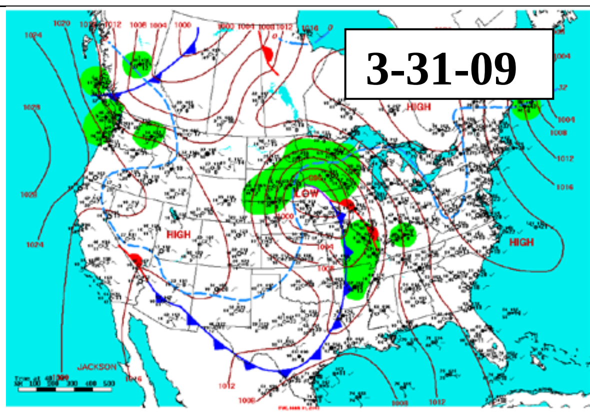
Surface Weather Map and Station Weather at 7:00 A.M. E.S.T.



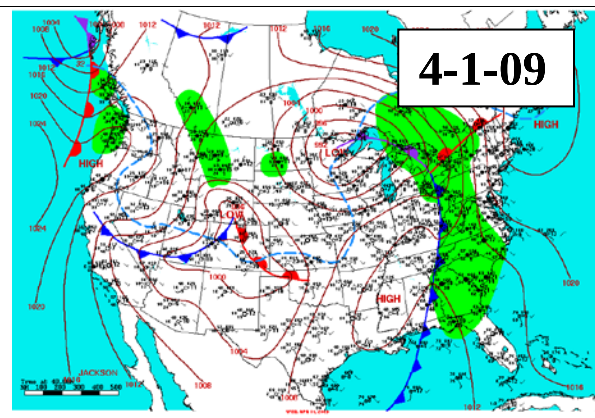
Surface Weather Map and Station Weather at 7:00 A.M. E.S.T.



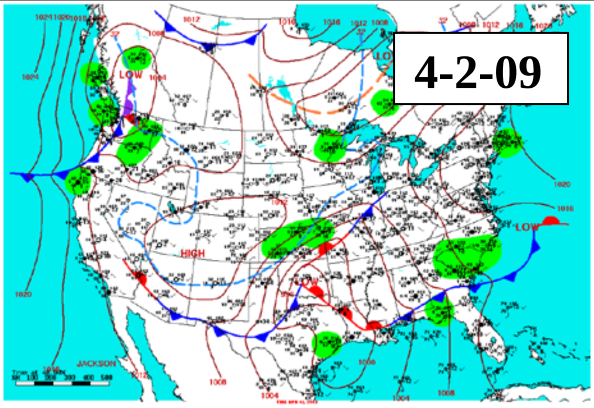
Surface Weather Map and Station Weather at 7:00 A.M. E.S.T.



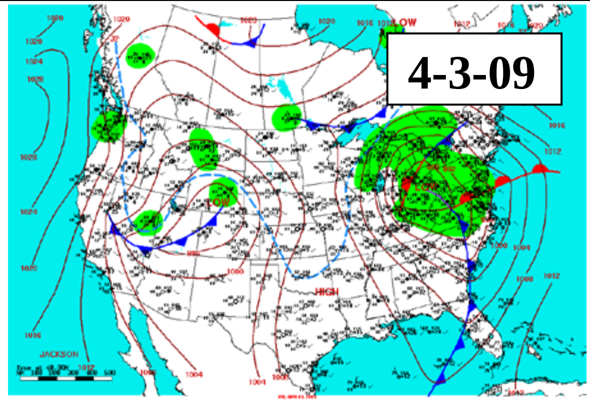
Surface Weather Map and Station Weather at 7:00 A.M. E.S.T.



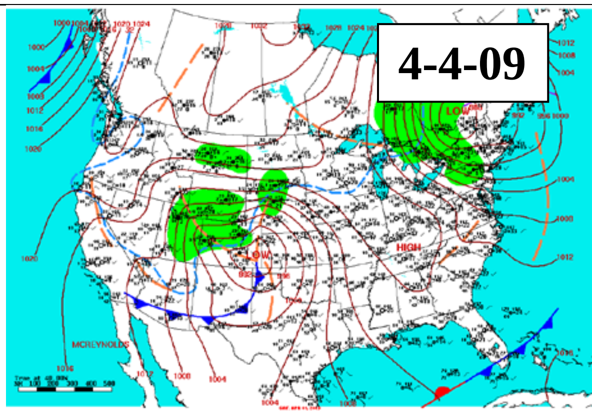
Surface Weather Map and Station Weather at 7:00 A.M. E.S.T.



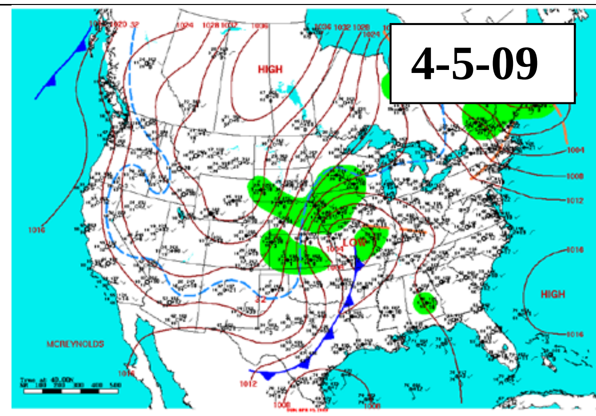
Surface Weather Map and Station Weather at 7:00 A.M. E.S.T.



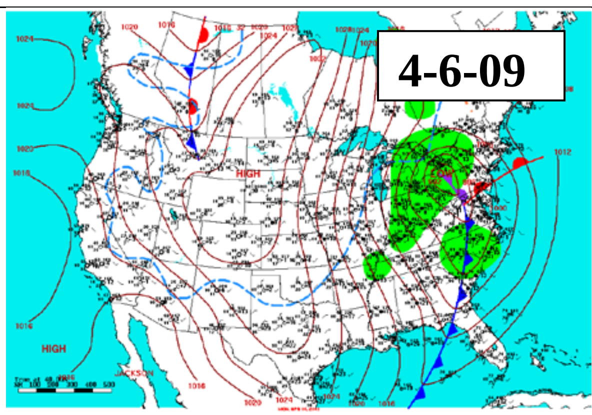
Surface Weather Map and Station Weather at 7:00 A.M. E.S.T.



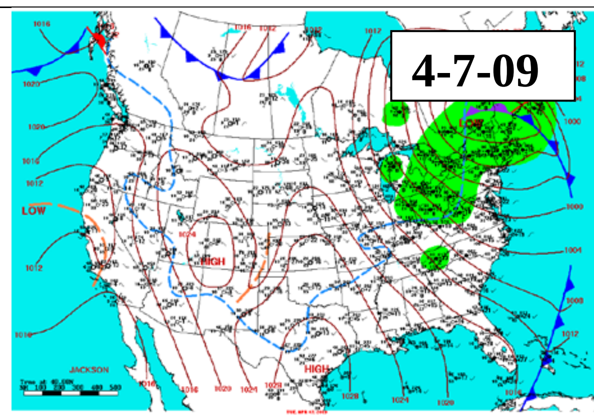
Surface Weather Map and Station Weather at 7:00 A.M. E.S.T.



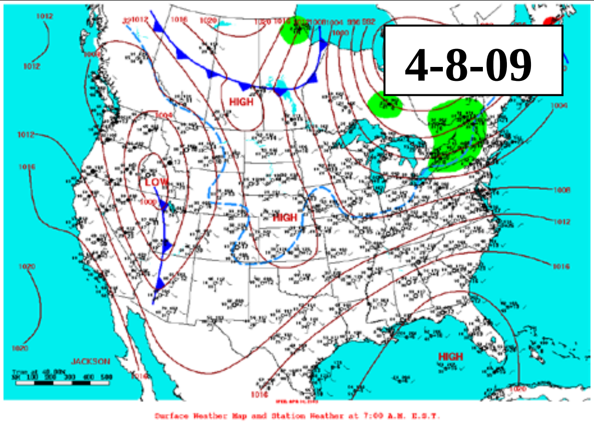
Surface Weather Map and Station Weather at 7:00 A.M. E.S.T.

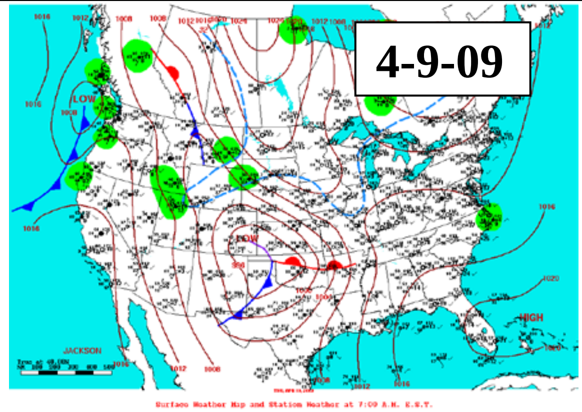


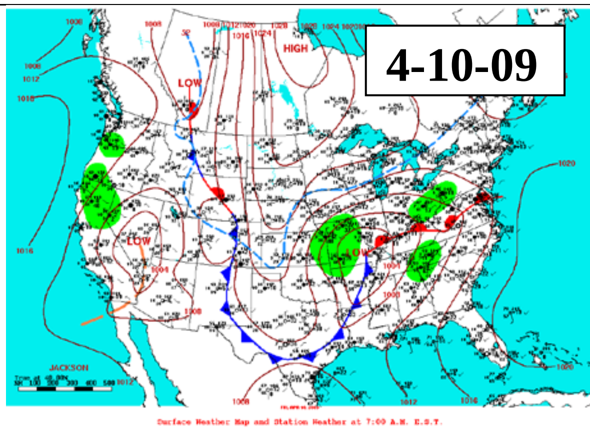
Surface Weather Map and Station Weather at 7:00 A.M. E.S.T.

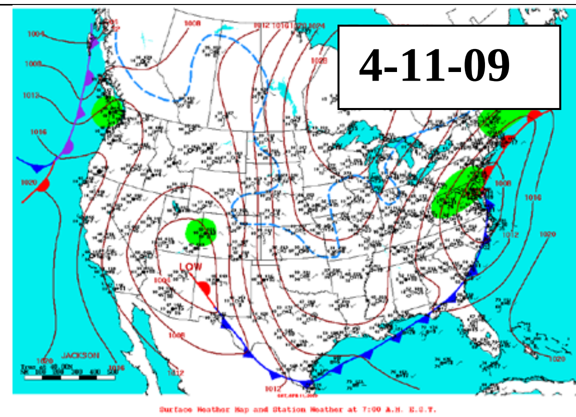


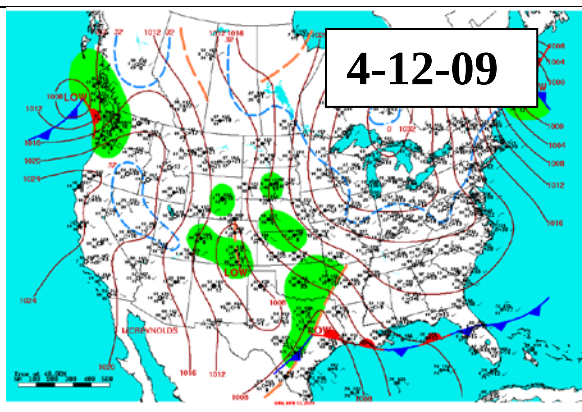
Surface Weather Map and Station Weather at 7:00 A.M. E.S.T.

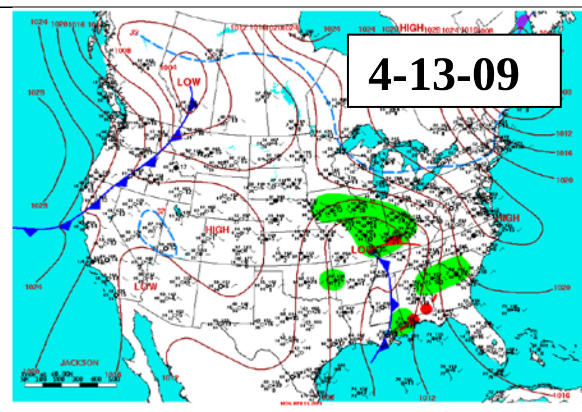

4-8-09
Surface Weather Map and Station Weather at 7:00 A.M. E.S.T.


4-9-09
Surface Weather Map and Station Weather at 7:00 A.M. E.S.T.


4-10-09
Surface Weather Map and Station Weather at 7:00 A.M. E.S.T.


4-11-09
Surface Weather Map and Station Weather at 7:00 A.M. E.S.T.


4-12-09
Surface Weather Map and Station Weather at 7:00 A.M. E.S.T.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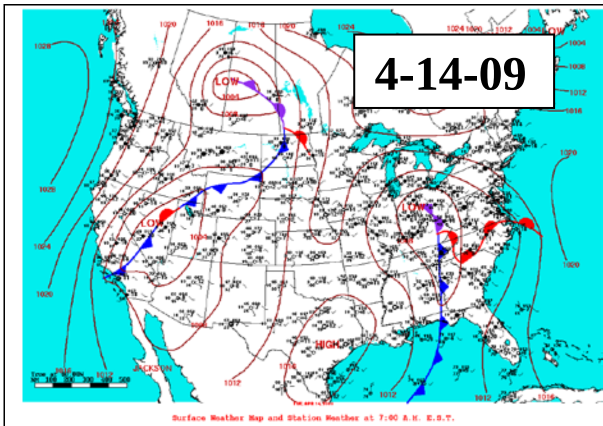
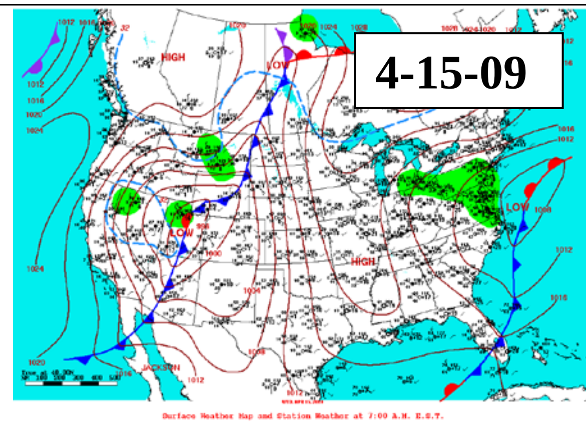
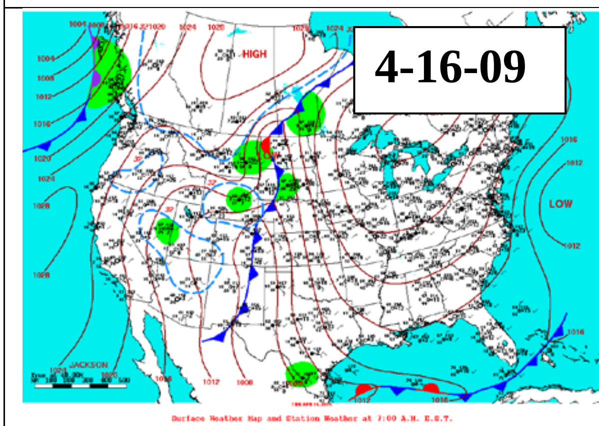
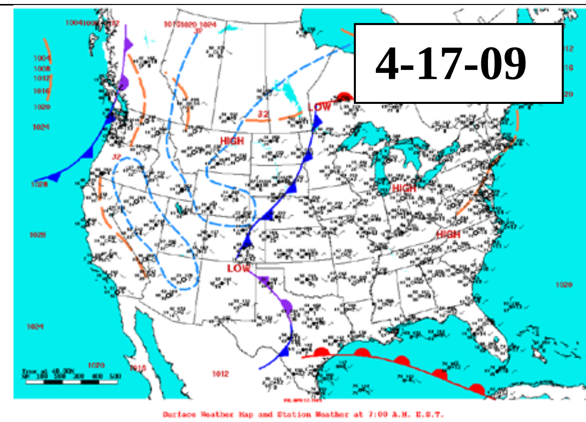
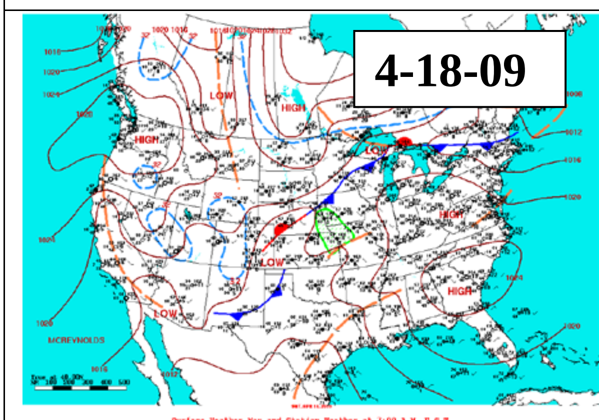
Surface Weather Map and Station Weather at 7:00 A.M. E.S.T.

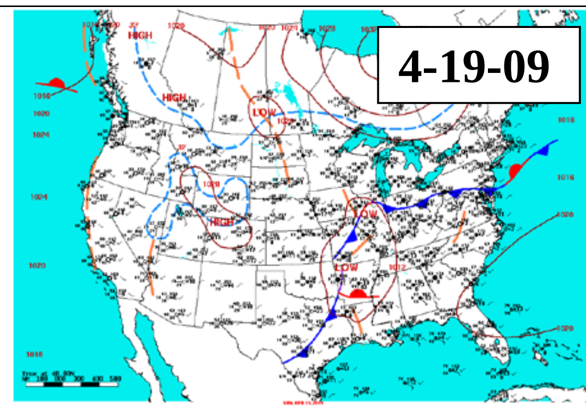

4-14-09
Surface Weather Map and Station Weather at 7:00 A.M. E.S.T.

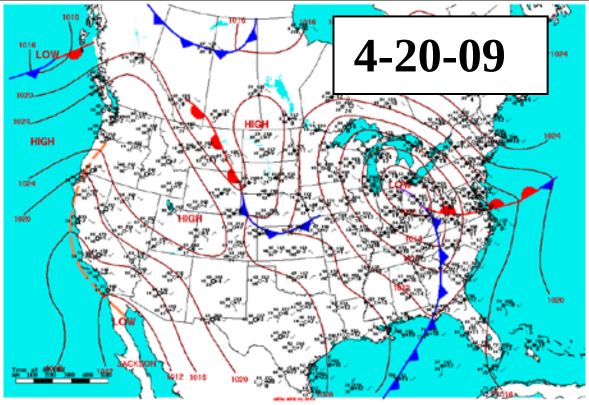

4-15-09
Surface Weather Map and Station Weather at 7:00 A.M. E.S.T.


4-16-09
Surface Weather Map and Station Weather at 7:00 A.M. E.S.T.

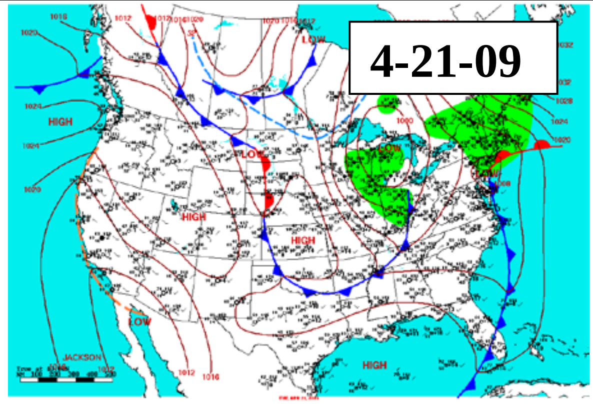

4-17-09
Surface Weather Map and Station Weather at 7:00 A.M. E.S.T.


4-18-09
Surface Weather Map and Station Weather at 7:00 A.M. E.S.T.

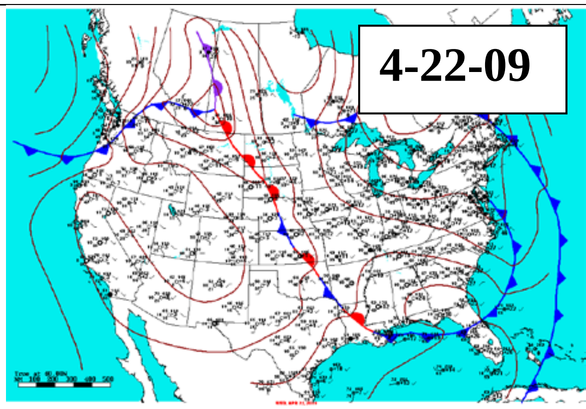

4-19-09
Surface Weather Map and Station Weather at 7:00 A.M. E.S.T.



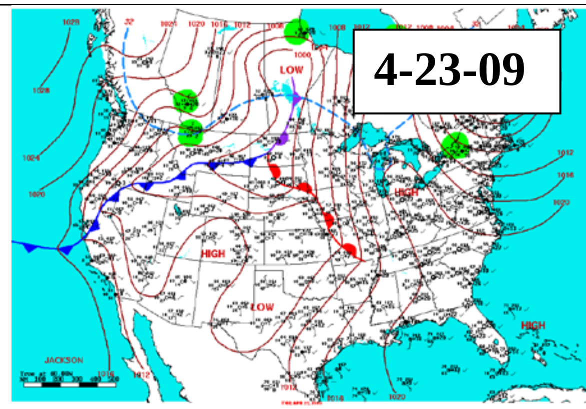
Surface Weather Map and Station Weather at 7:00 A.M. E.S.T.



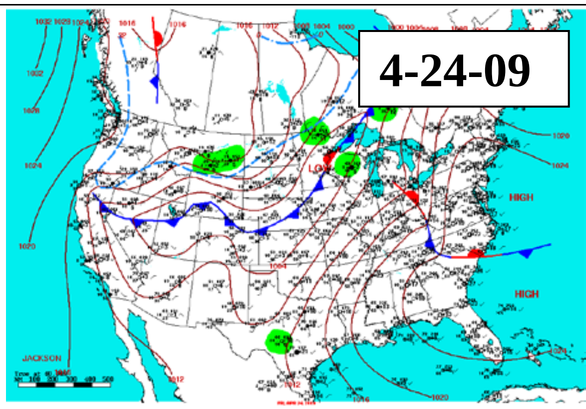
Surface Weather Map and Station Weather at 7:00 A.M. E.S.T.



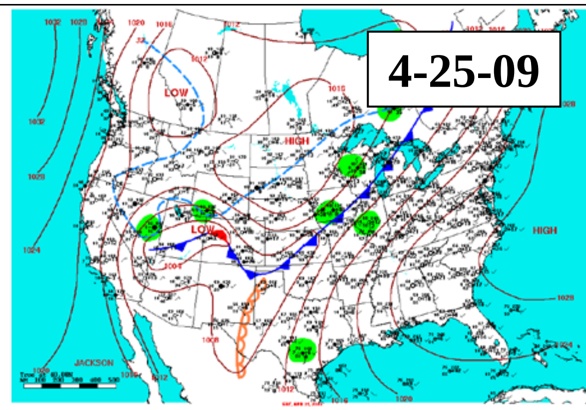
Surface Weather Map and Station Weather at 7:00 A.M. E.S.T.



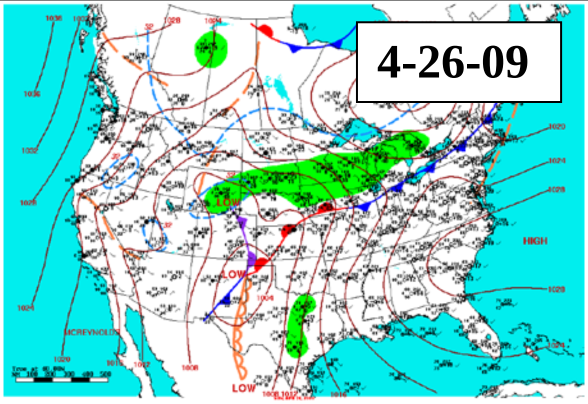
Surface Weather Map and Station Weather at 7:00 A.M. E.S.T.



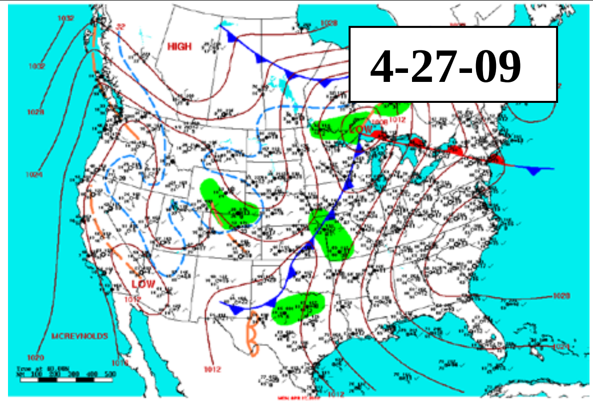
Surface Weather Map and Station Weather at 7:00 A.M. E.S.T.



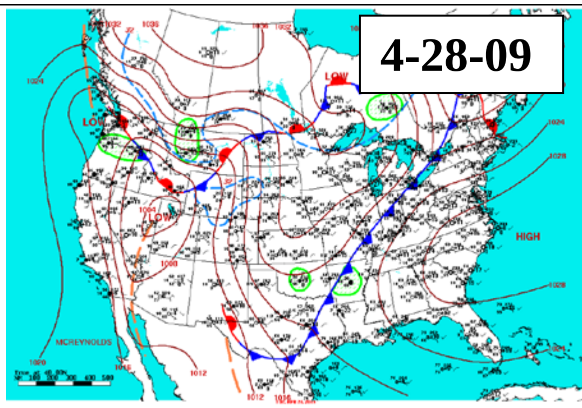
Surface Weather Map and Station Weather at 7:00 A.M. E.S.T.



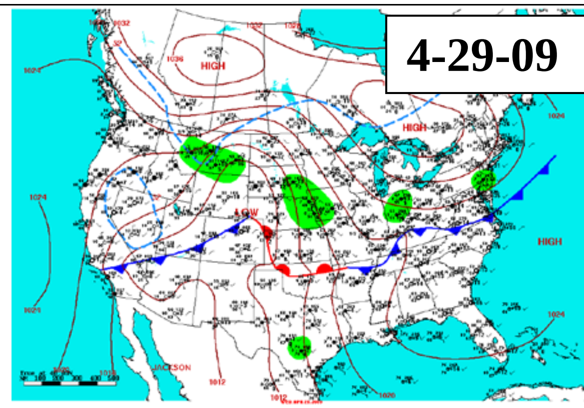
Surface Weather Map and Station Weather at 7:00 A.M. E.S.T.



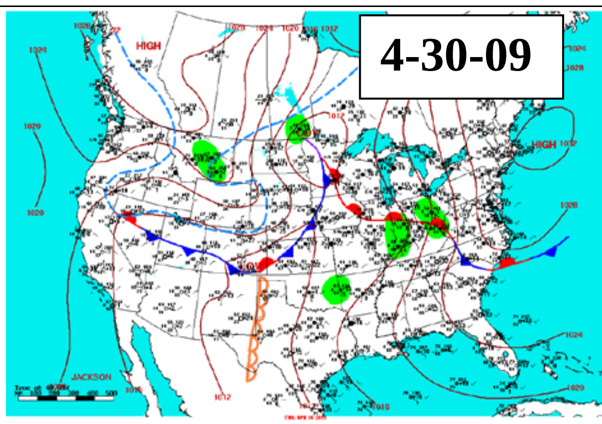
Surface Weather Map and Station Weather at 7:00 A.M. E.S.T.



Surface Weather Map and Station Weather at 7:00 A.M. E.S.T.



Surface Weather Map and Station Weather at 7:00 A.M. E.S.T.



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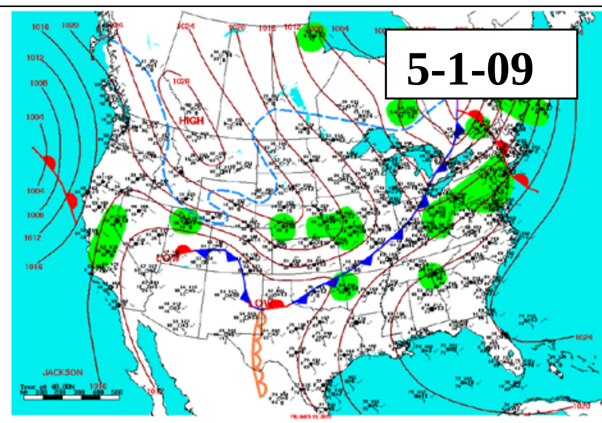
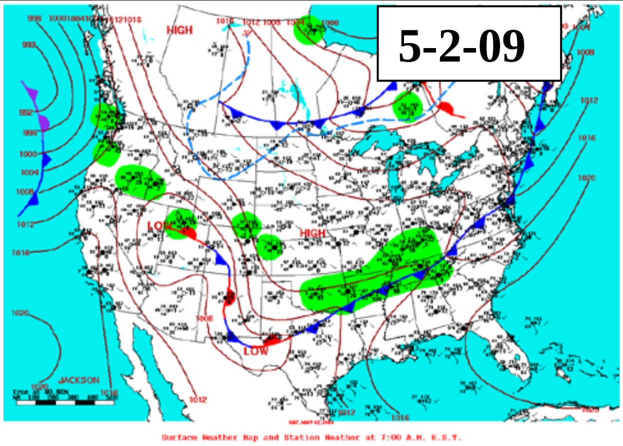
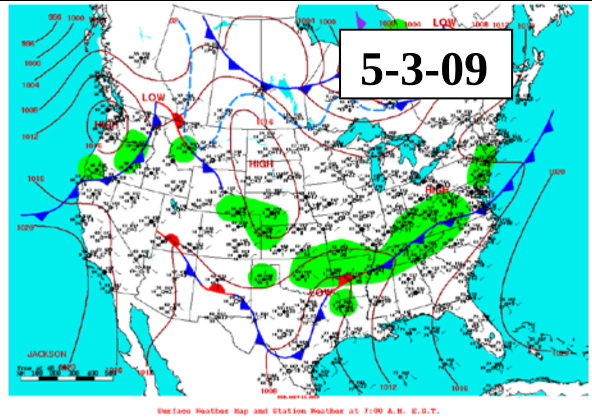
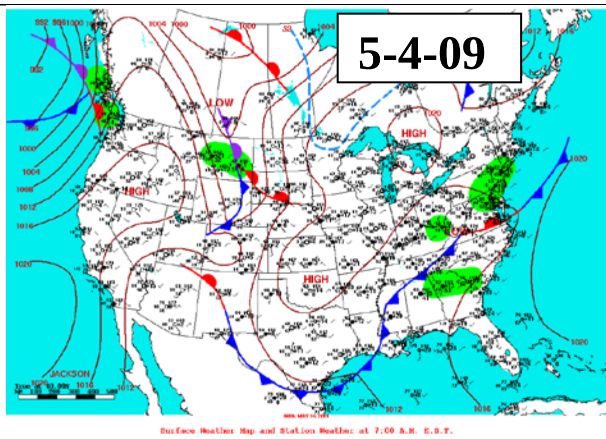
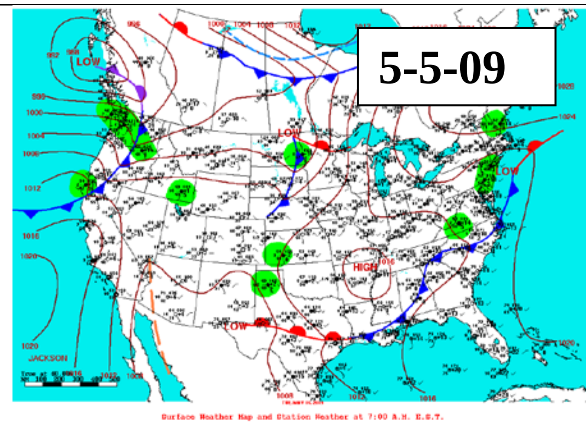


Surface Weather Map and Station Weather at 7:00 A.M. E.S.T.


5-2-09
Surface Weather Map and Station Weather at 7:00 A.M. E.S.T.


5-3-09
Surface Weather Map and Station Weather at 7:00 A.M. E.S.T.


5-4-09
Surface Weather Map and Station Weather at 7:00 A.M. E.S.T.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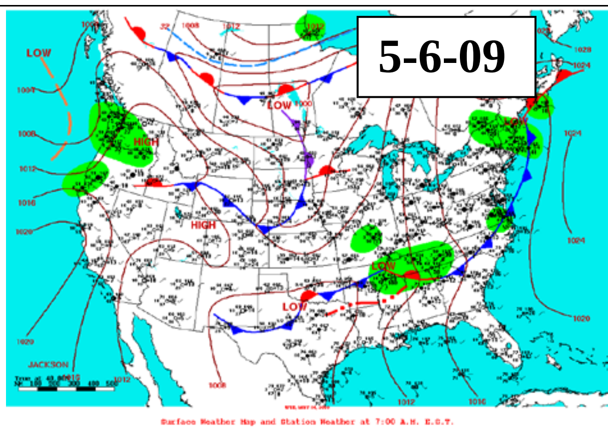
Surface Weather Map and Station Weather at 7:00 A.M. E.S.T.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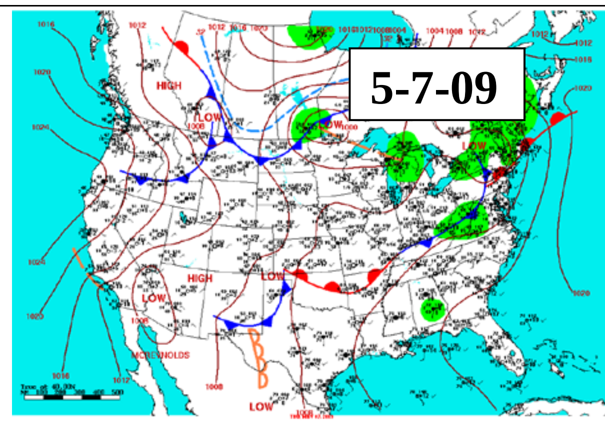
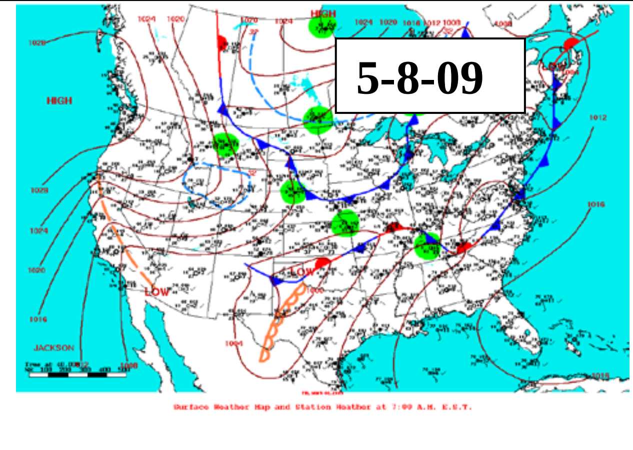
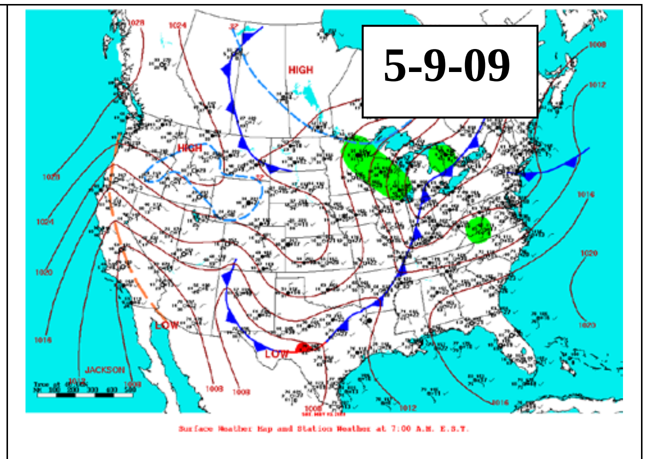
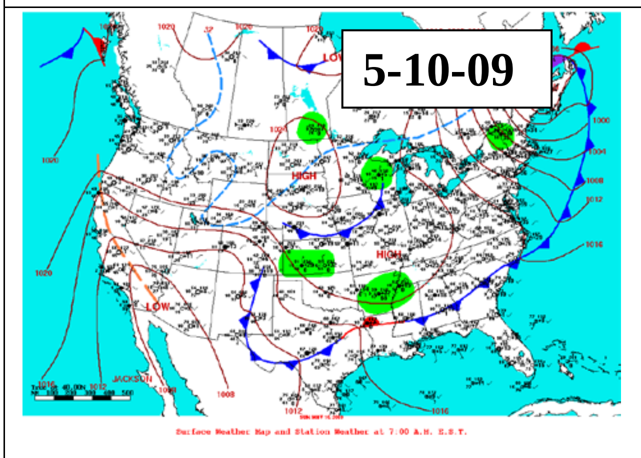
Surface Weather Map and Station Weather at 7:00 A.M. E.S.T.


5-7-09
Surface Weather Map and Station Weather at 7:00 A.M. E.S.T.


5-8-09
Surface Weather Map and Station Weather at 7:00 A.M. E.S.T.


5-9-09
Surface Weather Map and Station Weather at 7:00 A.M. E.S.T.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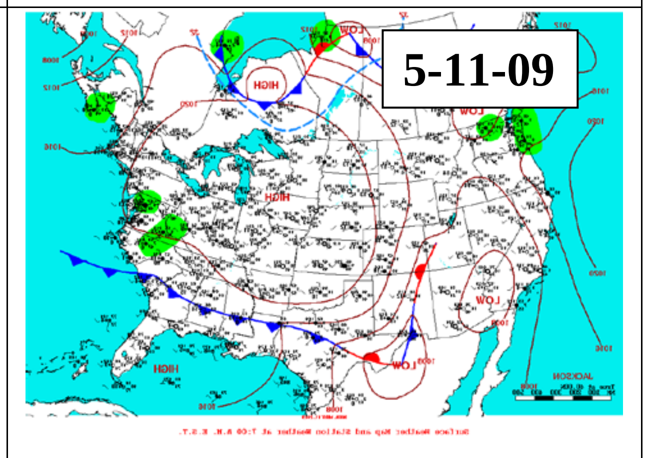
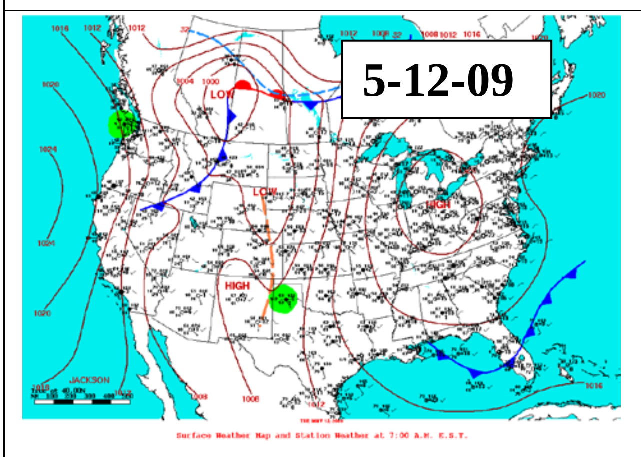
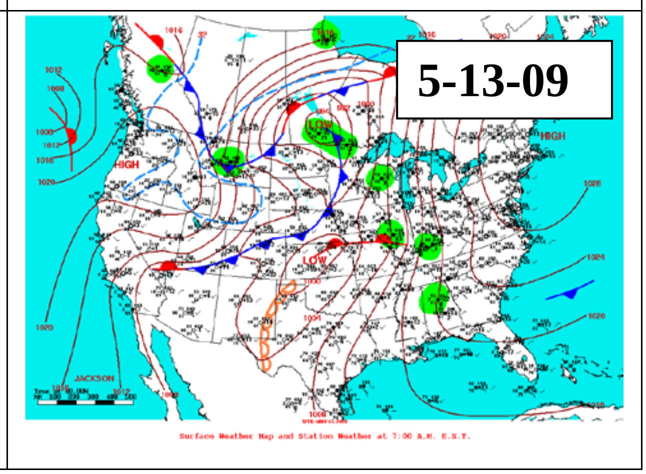
Surface Weather Map and Station Weather at 7:00 A.M. E.S.T.


5-11-09


5-12-09
Surface Weather Map and Station Weather at 7:00 A.M. E.S.T.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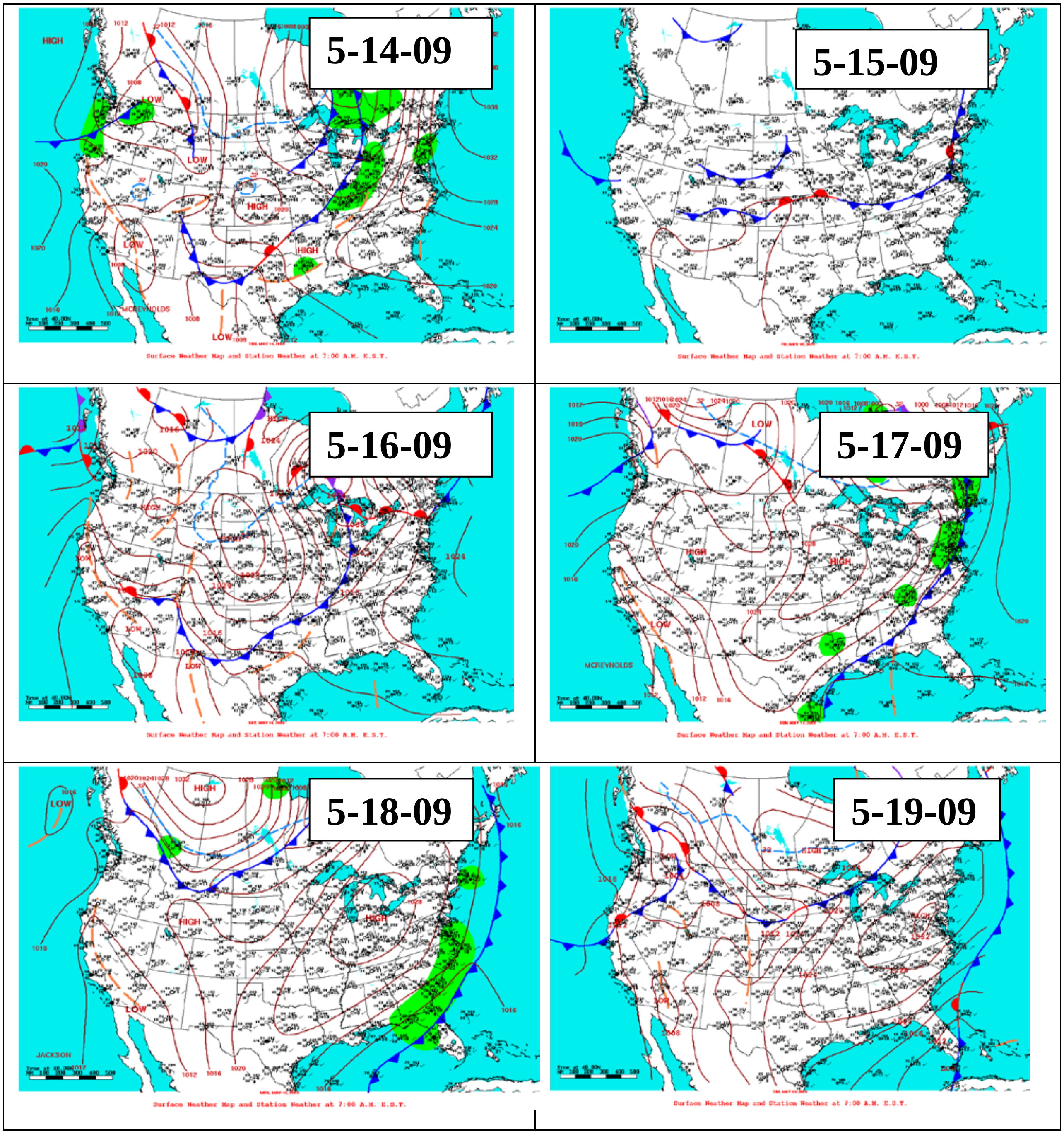
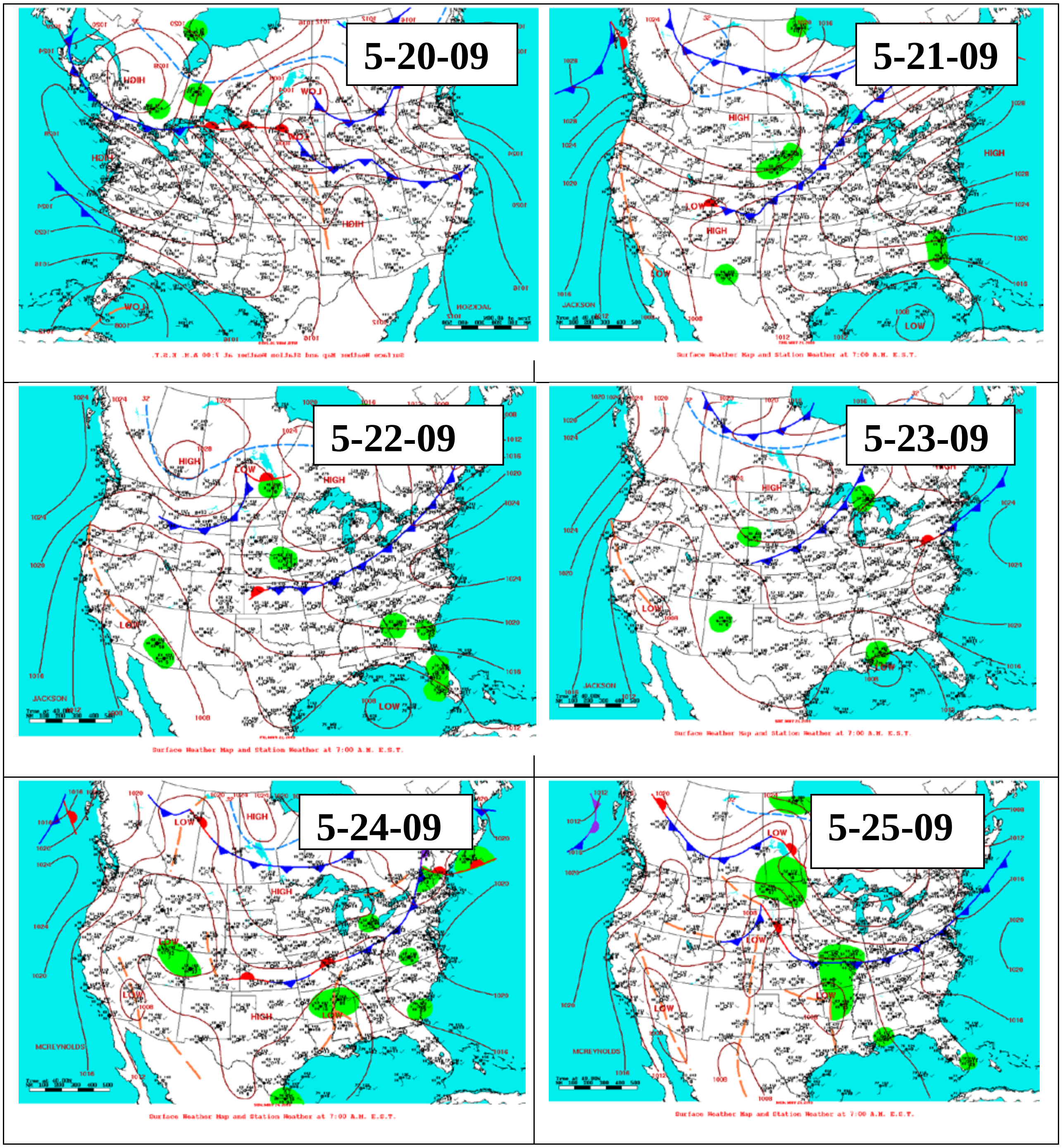
Surface Weather Map and Station Weather at 7:00 A.M. E.S.T.


5-14-09
5-15-09
5-16-09
5-17-09
5-18-09
5-19-09
Surface Weather Map and Station Weather at 7:00 A.M. E.S.T.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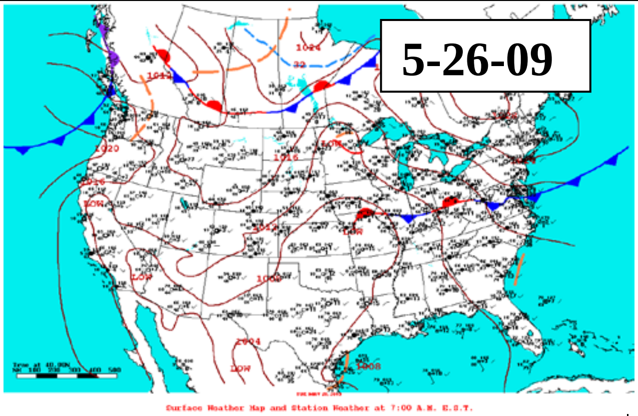
5-22-09
5-23-09
5-24-09
5-25-09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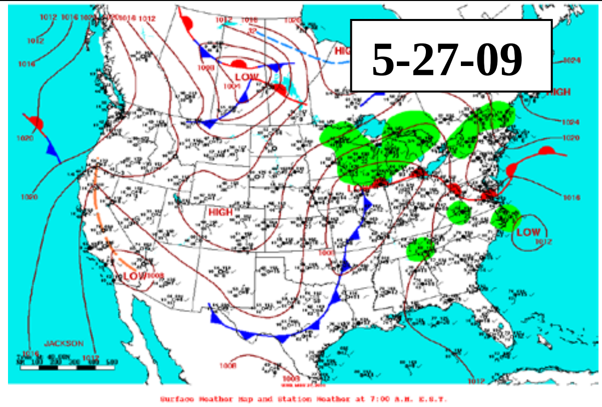
Surface Weather Map and Station Weather at 7:00 A.M. E.S.T.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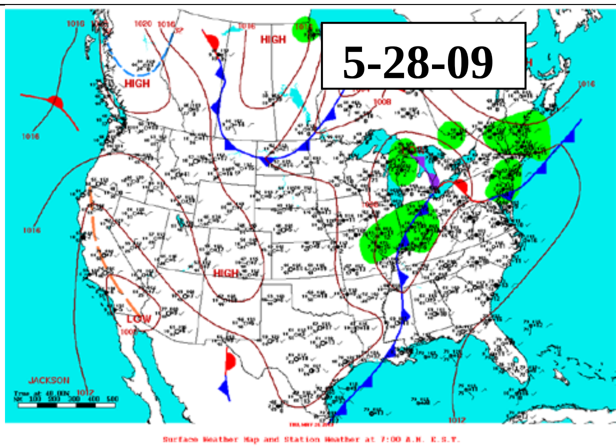
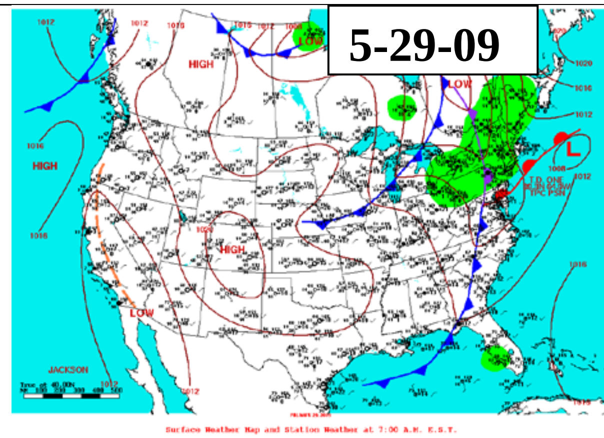
Surface Weather Map and Station Weather at 7:00 A.M. E.S.T.


5-28-09
Surface Weather Map and Station Weather at 7:00 A.M. E.S.T.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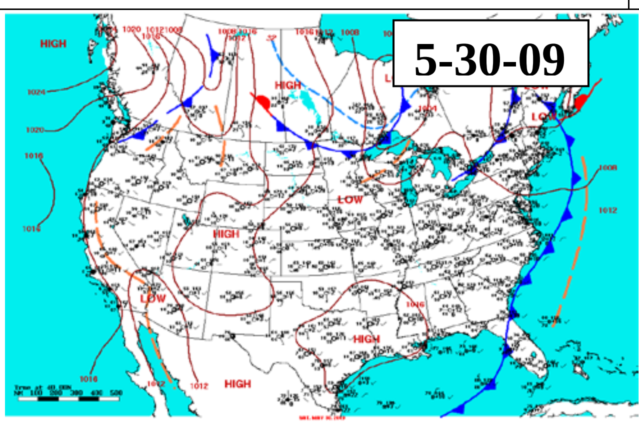
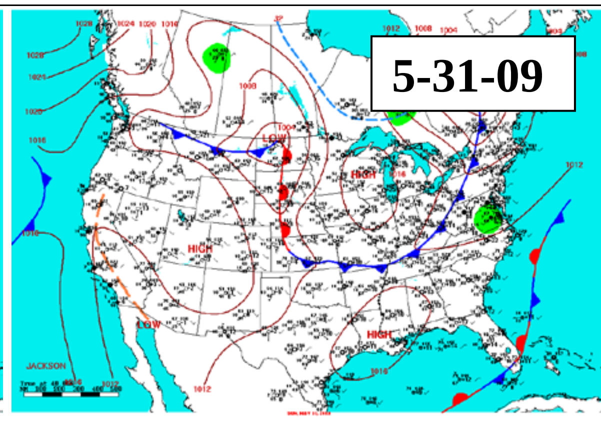
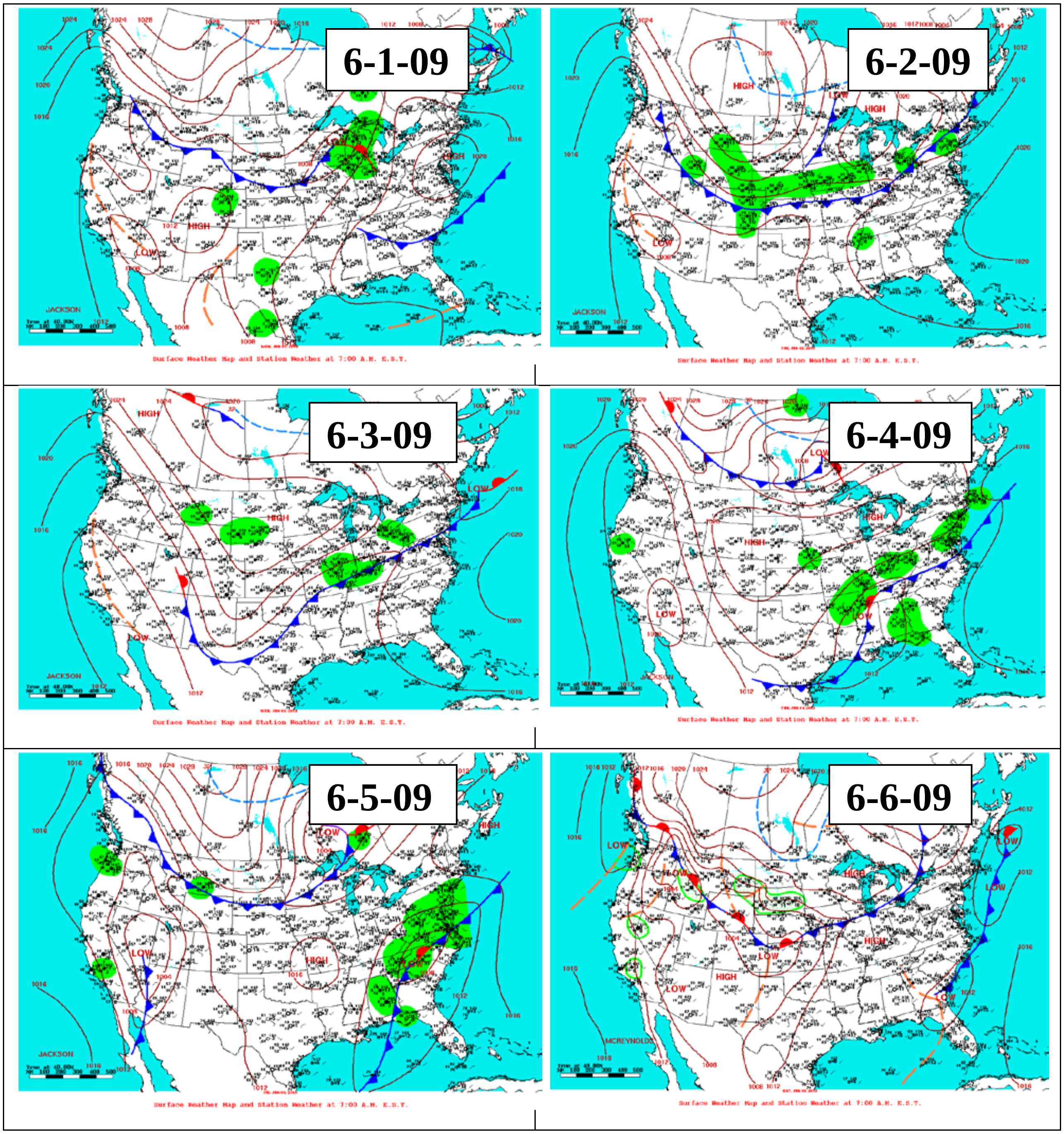
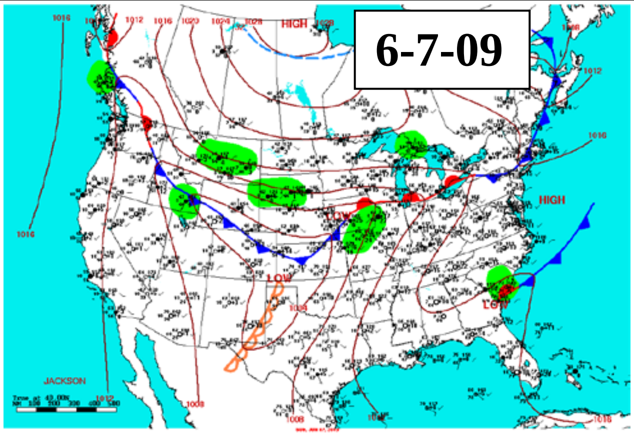
Surface Weather Map and Station Weather at 7:00 A.M. E.S.T.


5-30-09
Surface Weather Map and Station Weather at 7:00 A.M. E.S.T.


5-31-09
Surface Weather Map and Station Weather at 7:00 A.M. E.S.T.

Period 9


6-1-09
Surface Weather Map and Station Weather at 7:00 A.M. E.S.T.
6-2-09
Surface Weather Map and Station Weather at 7:00 A.M. E.S.T.
6-3-09
Surface Weather Map and Station Weather at 7:00 A.M. E.S.T.
6-4-09
Surface Weather Map and Station Weather at 7:00 A.M. E.S.T.
6-5-09
Surface Weather Map and Station Weather at 7:00 A.M. E.S.T.
6-6-09
Surface Weather Map and Station Weather at 7:00 A.M. E.S.T.



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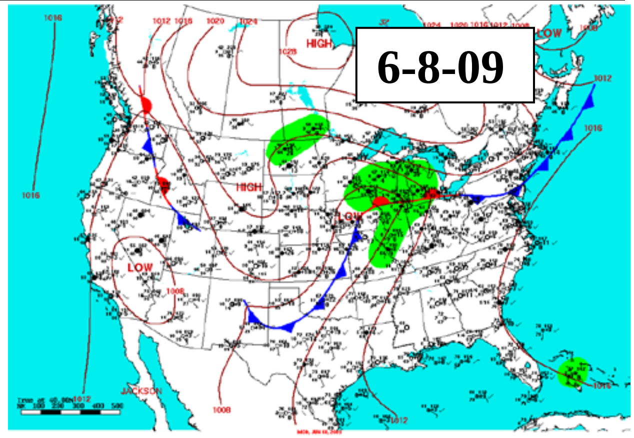
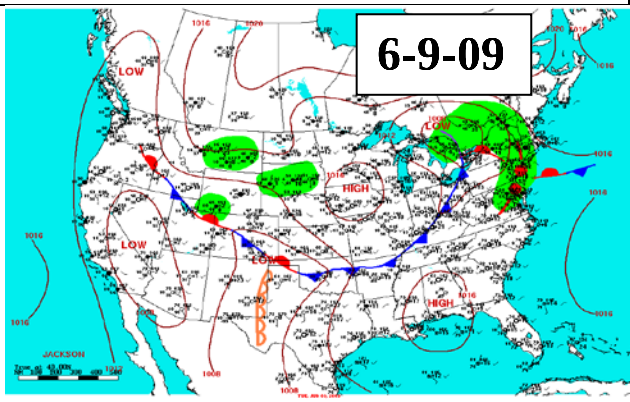
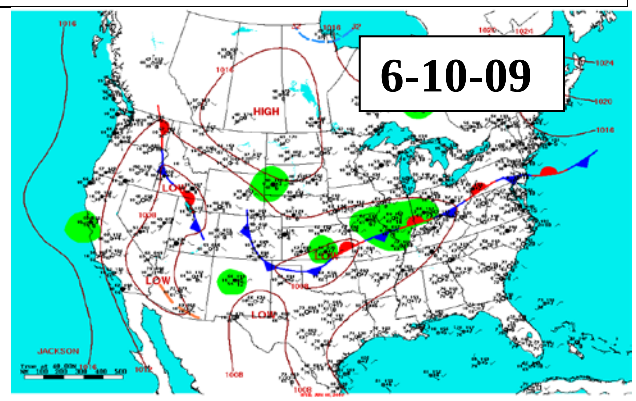


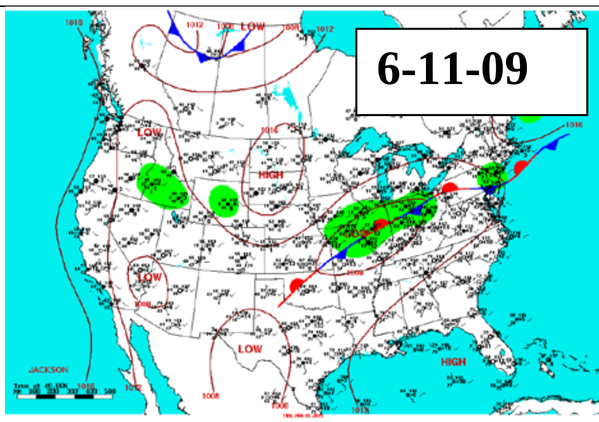
Surface Weather Map and Station Weather at 7:00 A.M. E.S.T.



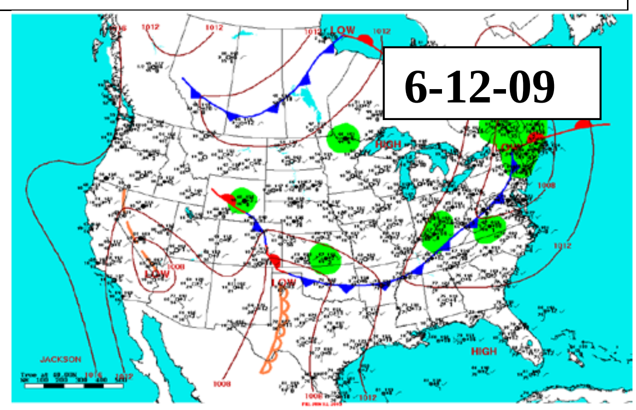
Surface Weather Map and Station Weather at 7:00 A.M. E.S.T.



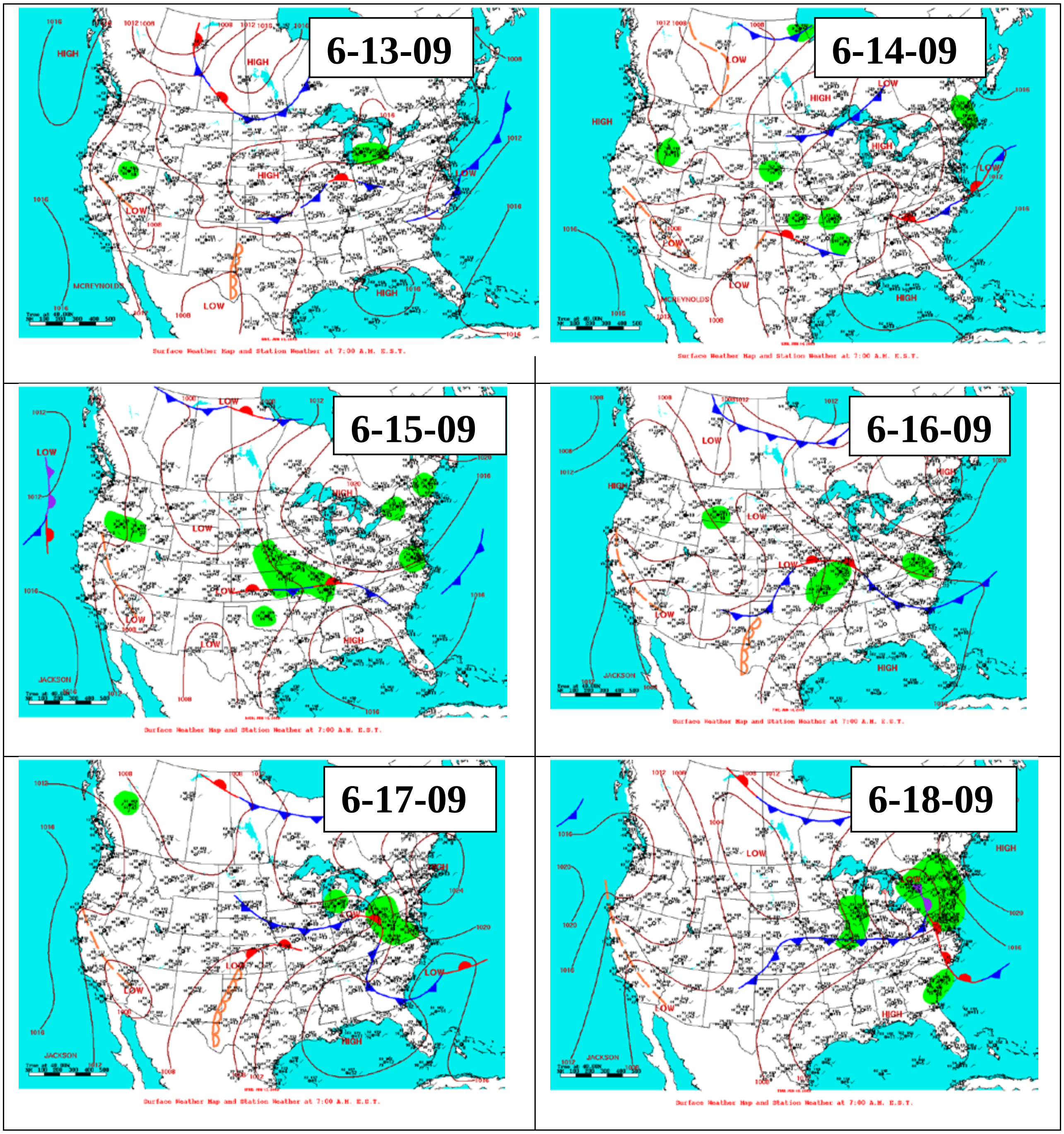
Surface Weather Map and Station Weather at 7:00 A.M. E.S.T.

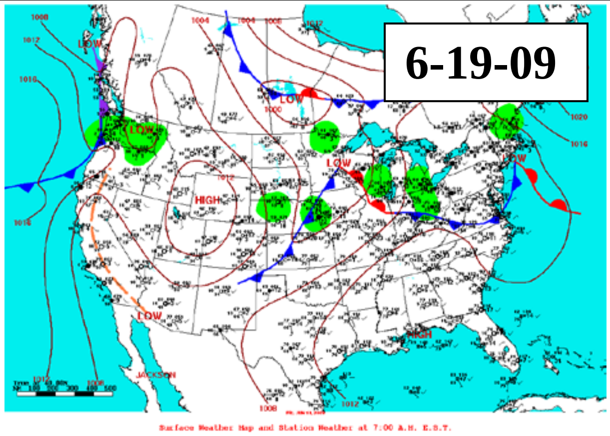


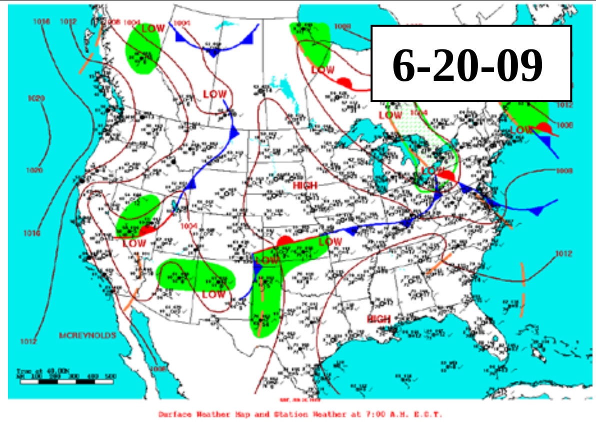
Surface Weather Map and Station Weather at 7:00 A.M. E.S.T.



Surface Weather Map and Station Weather at 7:00 A.M. E.S.T.


6-13-09
Surface Weather Map and Station Weather at 7:00 A.M. E.S.T.
6-14-09
Surface Weather Map and Station Weather at 7:00 A.M. E.S.T.
6-15-09
Surface Weather Map and Station Weather at 7:00 A.M. E.S.T.
6-16-09
Surface Weather Map and Station Weather at 7:00 A.M. E.S.T.
6-17-09
Surface Weather Map and Station Weather at 7:00 A.M. E.S.T.
6-18-09
Surface Weather Map and Station Weather at 7:00 A.M. E.S.T.


6-19-09
Surface Weather Map and Station Weather at 7:00 A.M. E.S.T.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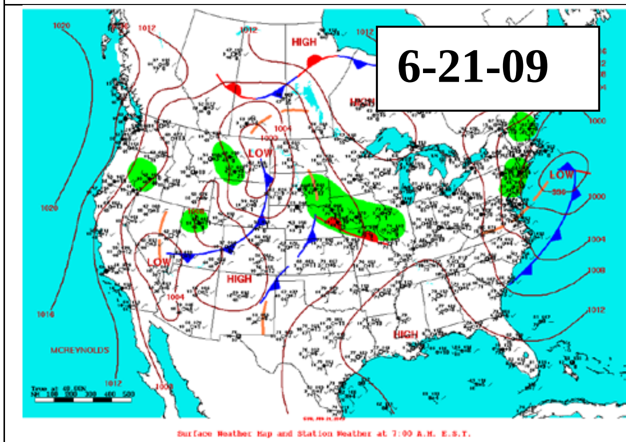
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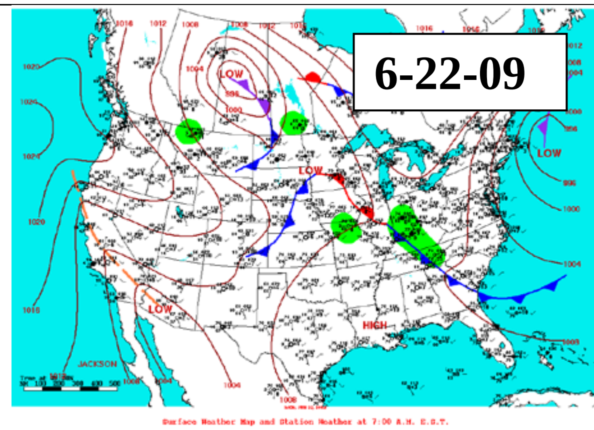
Surface Weather Map and Station Weather at 7:00 A.M. E.S.T.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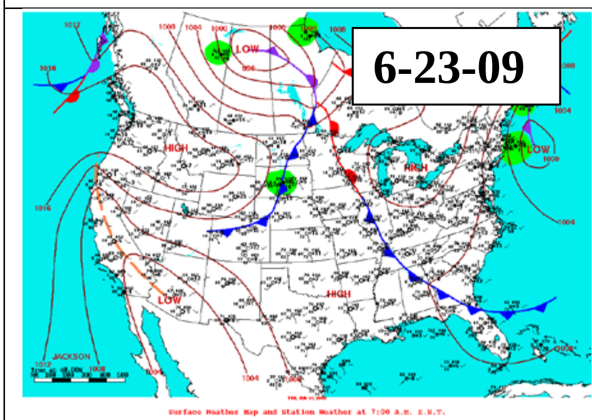
Surface Weather Map and Station Weather at 7:00 A.M. E.S.T.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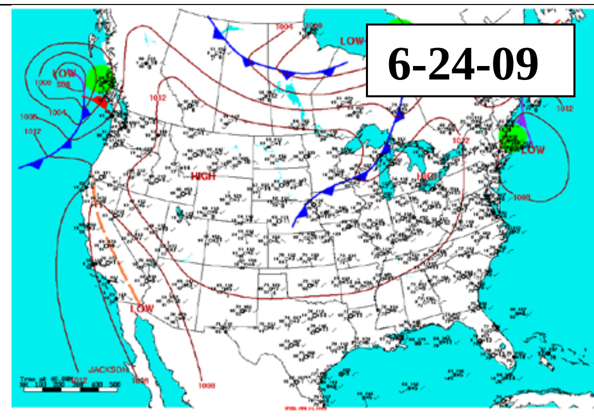
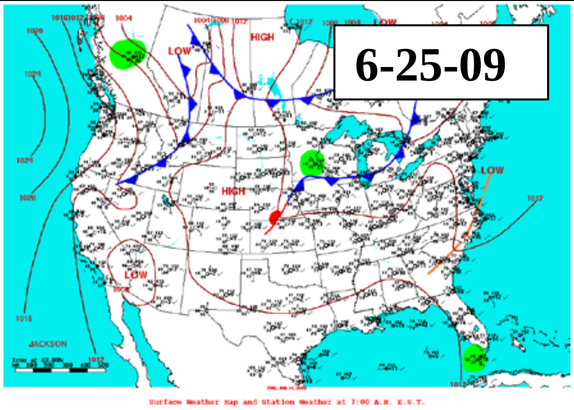
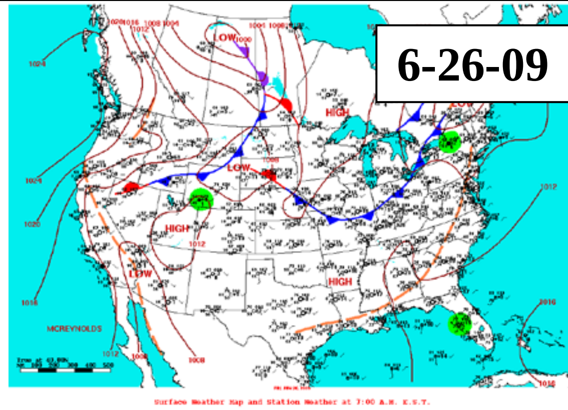
Surface Weather Map and Station Weather at 7:00 A.M. E.S.T.


6-24-09
Surface Weather Map and Station Weather at 7:00 A.M. E.S.T.


6-25-09
Surface Weather Map and Station Weather at 7:00 A.M. E.S.T.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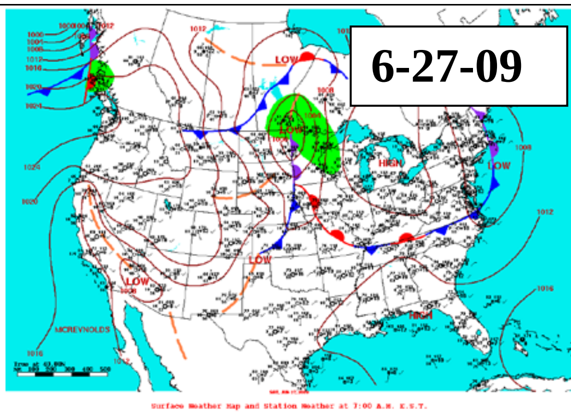
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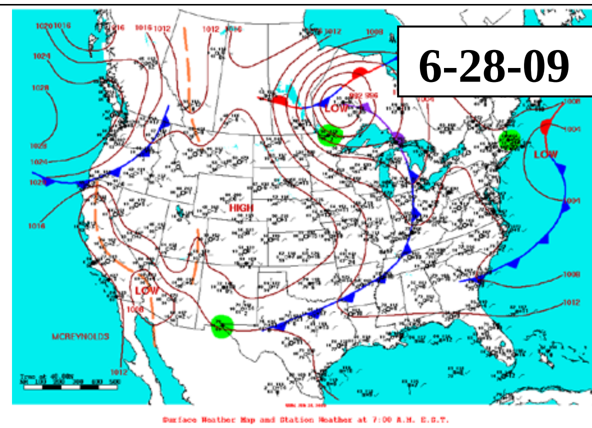
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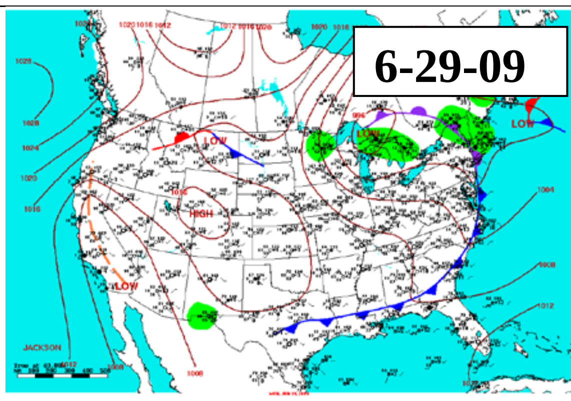
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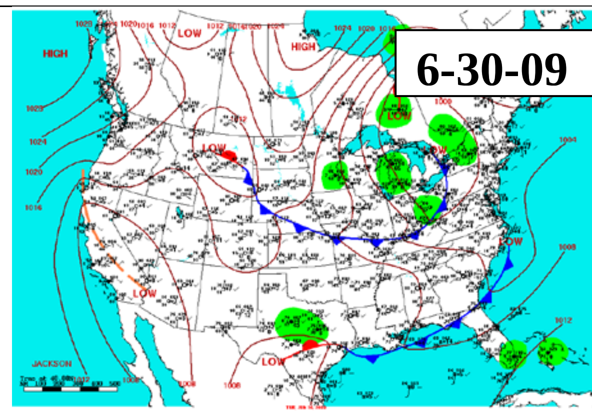
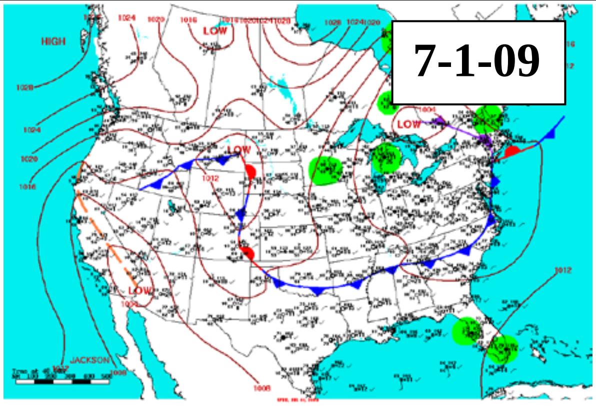
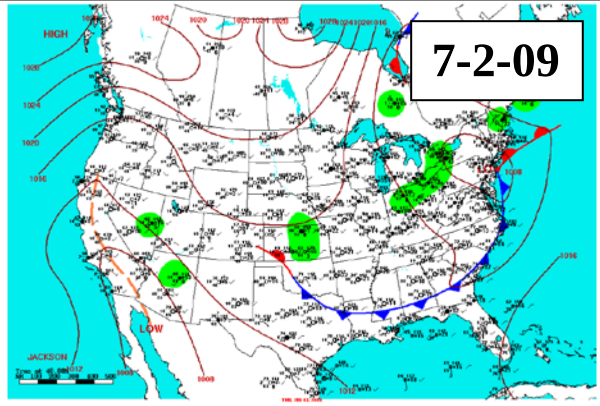
Surface Weather Map and Station Weather at 7:00 A.M. E.S.T.

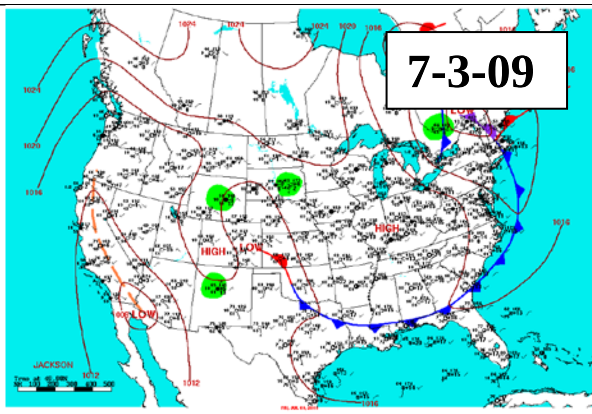

6-30-09
Surface Weather Map and Station Weather at 7:00 A.M. E.S.T.



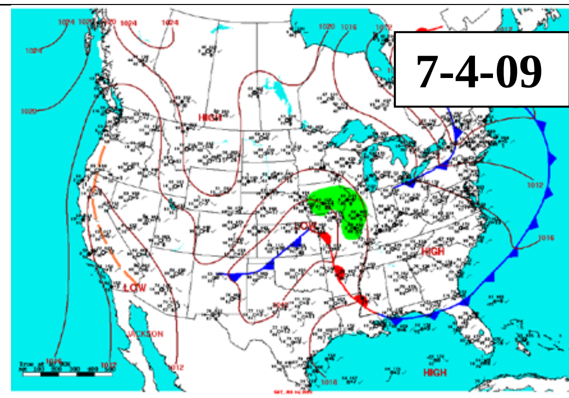
Surface Weather Map and Station Weather at 7:00 A.M. E.S.T.



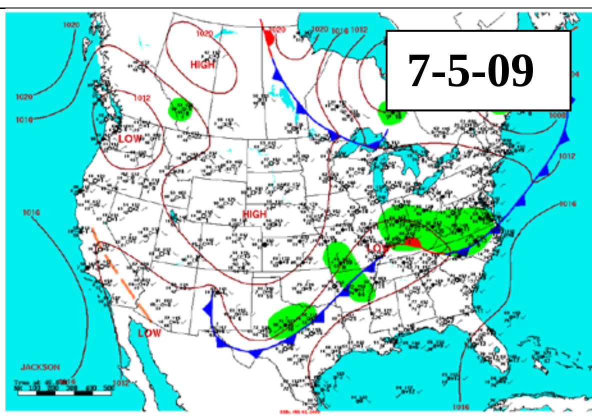
Surface Weather Map and Station Weather at 7:00 A.M. E.S.T.



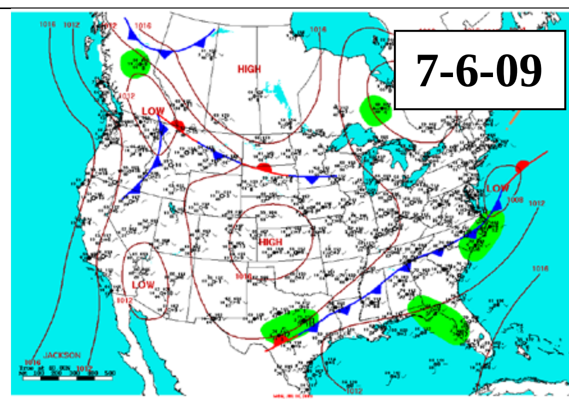
Surface Weather Map and Station Weather at 7:00 A.M. E.S.T.



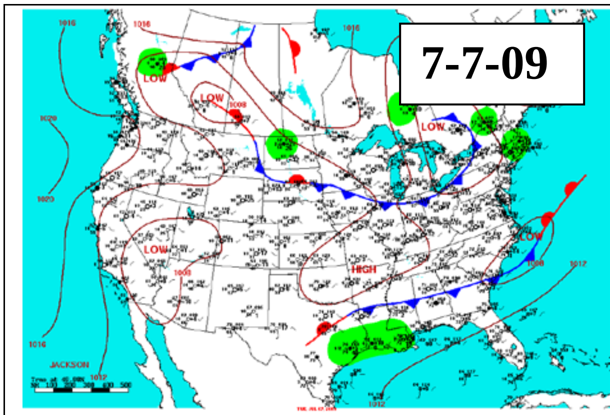
Surface Weather Map and Station Weather at 7:00 A.M. E.S.T.



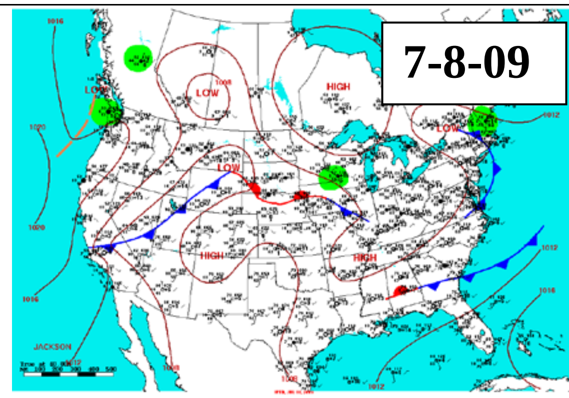
Surface Weather Map and Station Weather at 7:00 A.M. E.S.T.



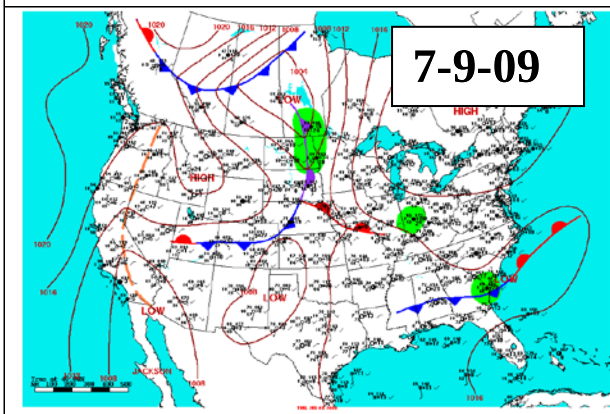
Surface Weather Map and Station Weather at 7:00 A.M. E.S.T.



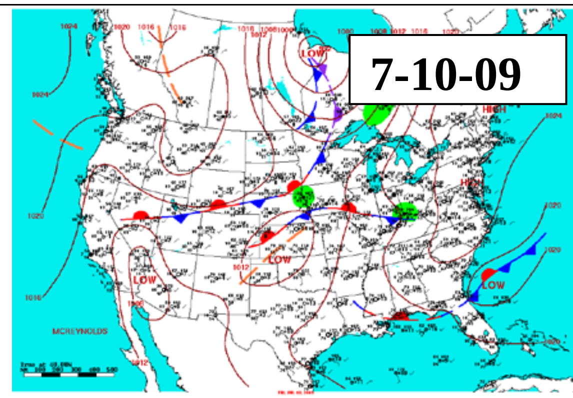
Surface Weather Map and Station Weather at 7:00 A.M. E.S.T.



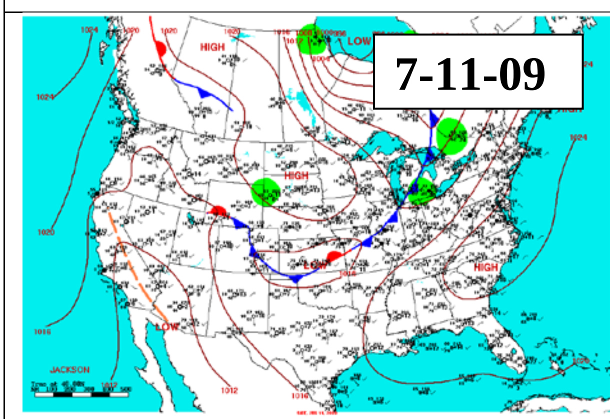
Surface Weather Map and Station Weather at 7:00 A.M. E.S.T.



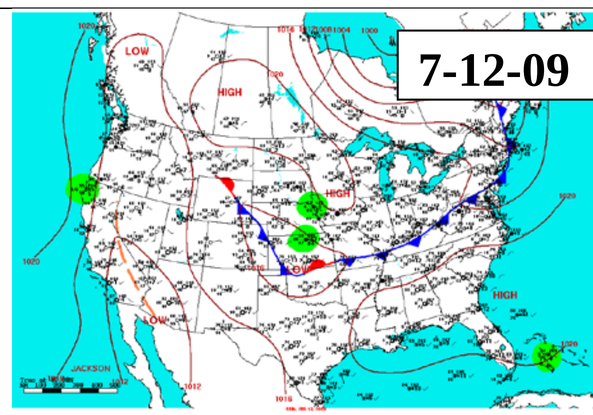
Surface Weather Map and Station Weather at 7:00 A.M. E.S.T.



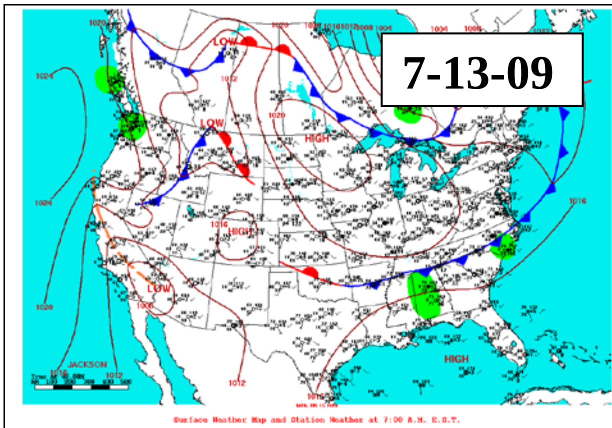
Surface Weather Map and Station Weather at 7:00 A.M. E.S.T.

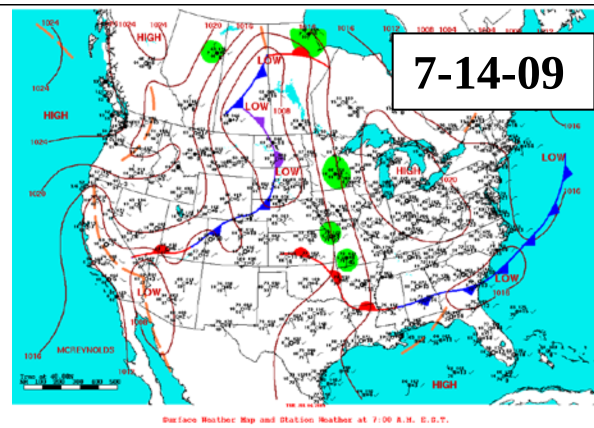


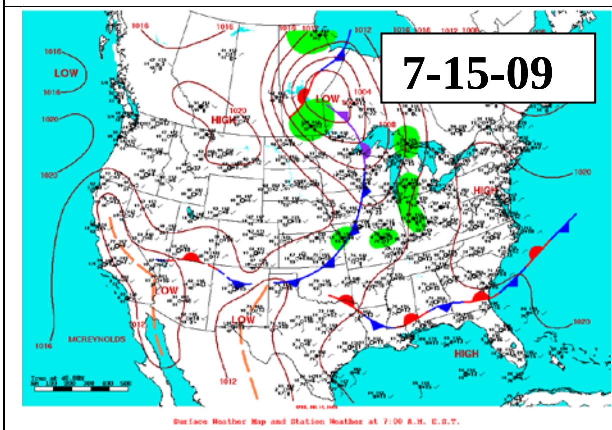
Surface Weather Map and Station Weather at 7:00 A.M. E.S.T.

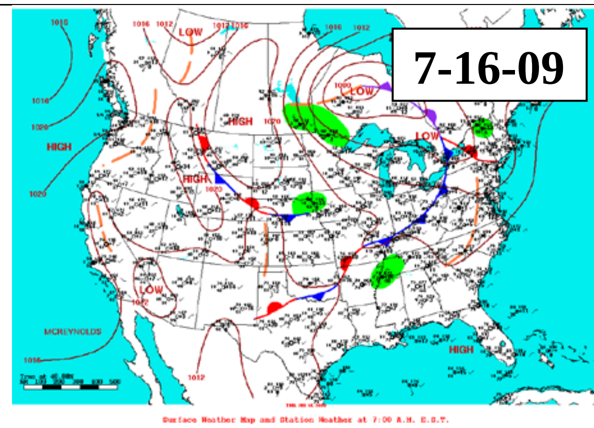


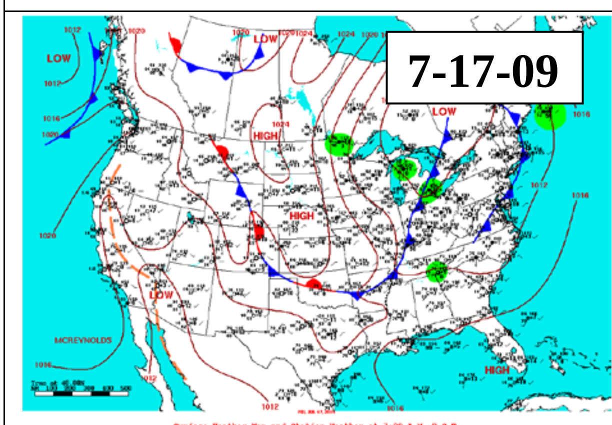
Surface Weather Map and Station Weather at 7:00 A.M. E.S.T.

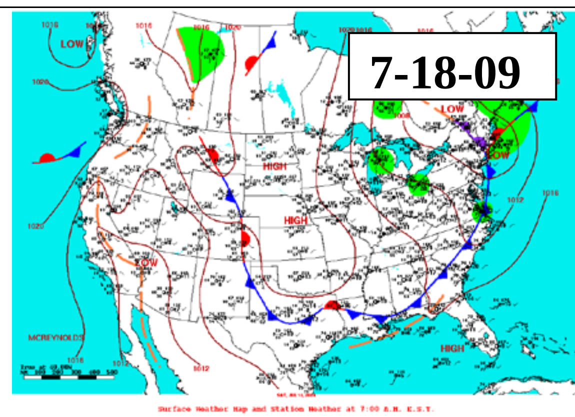

7-13-09
Surface Weather Map and Station Weather at 7:00 A.M. E.S.T.

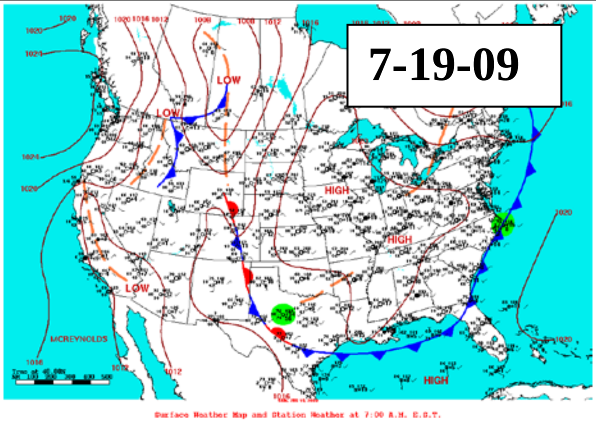

7-14-09
Surface Weather Map and Station Weather at 7:00 A.M. E.S.T.

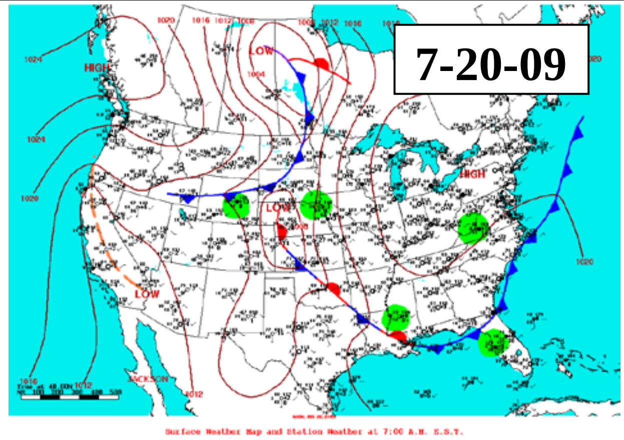

7-15-09
Surface Weather Map and Station Weather at 7:00 A.M. E.S.T.

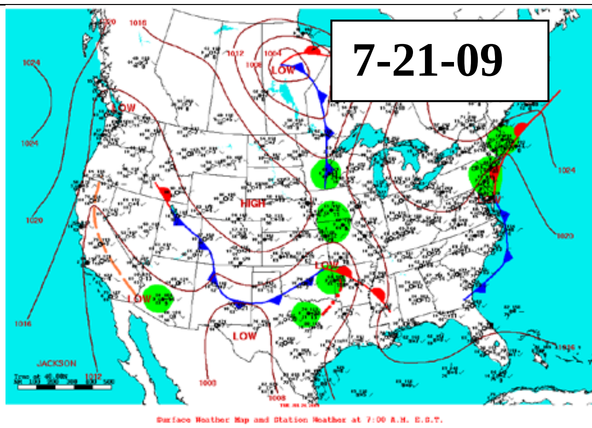

7-16-09
Surface Weather Map and Station Weather at 7:00 A.M. E.S.T.

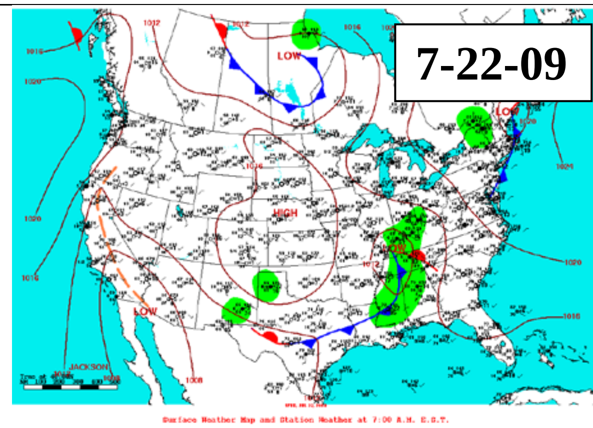

7-17-09
Surface Weather Map and Station Weather at 7:00 A.M. E.S.T.

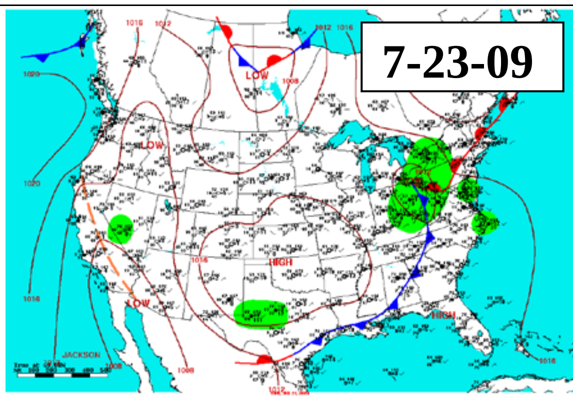

7-18-09
Surface Weather Map and Station Weather at 7:00 A.M. E.S.T.

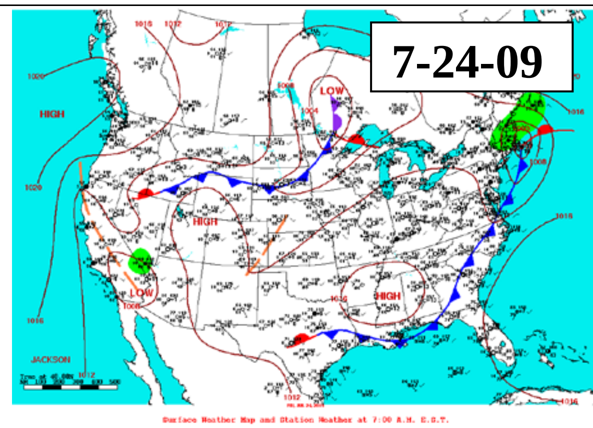

7-19-09
Surface Weather Map and Station Weather at 7:00 A.M. E.S.T.

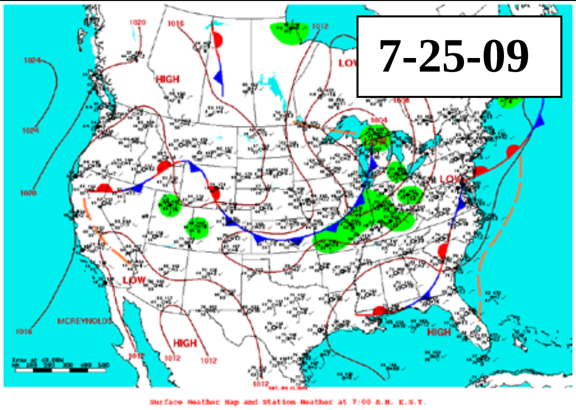

7-20-09
Surface Weather Map and Station Weather at 7:00 A.M. E.S.T.

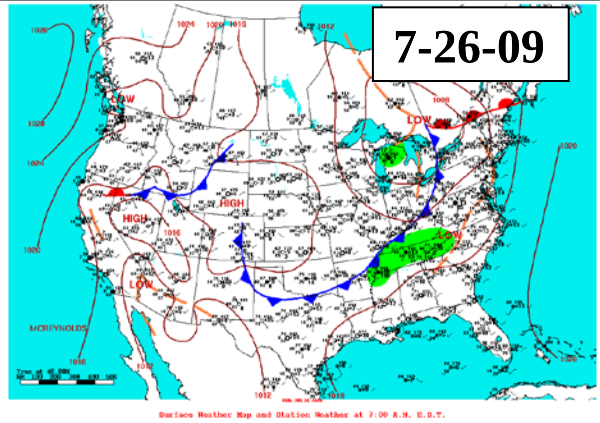

7-21-09
Surface Weather Map and Station Weather at 7:00 A.M. E.S.T.

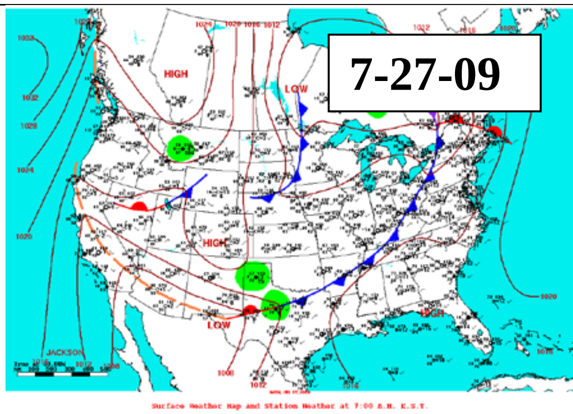

7-22-09
Surface Weather Map and Station Weather at 7:00 A.M. E.S.T.

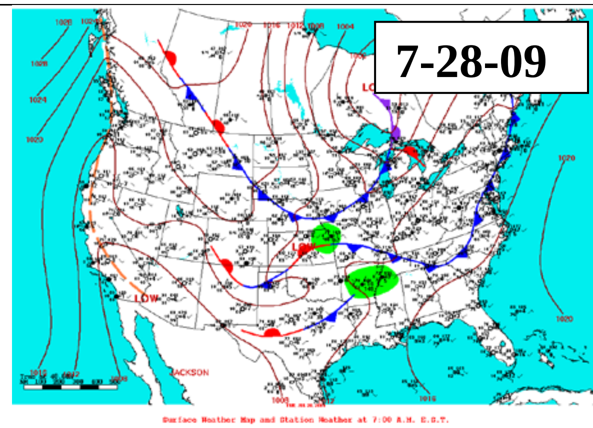

7-23-09
Surface Weather Map and Station Weather at 7:00 A.M. E.S.T.

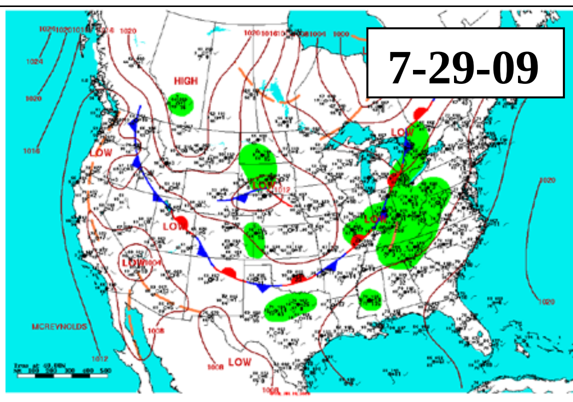

7-24-09
Surface Weather Map and Station Weather at 7:00 A.M. E.S.T.

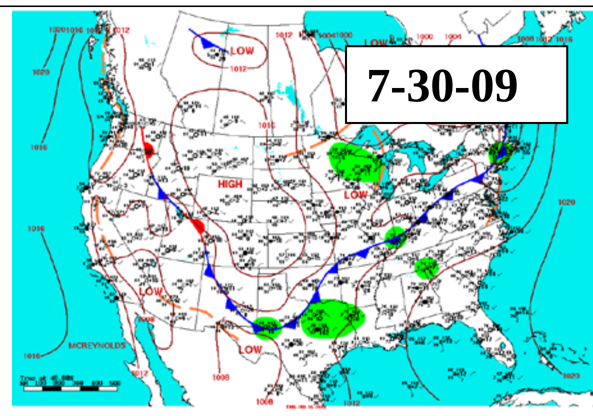

7-25-09

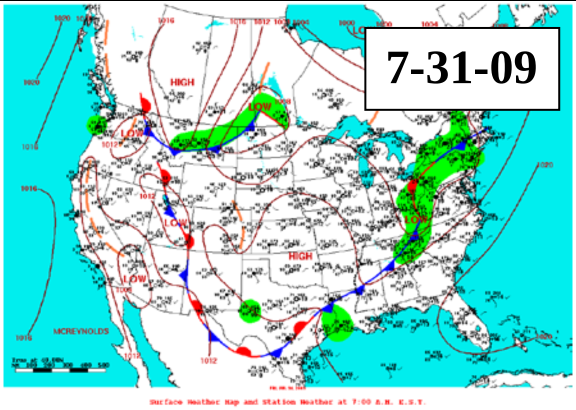

7-26-09

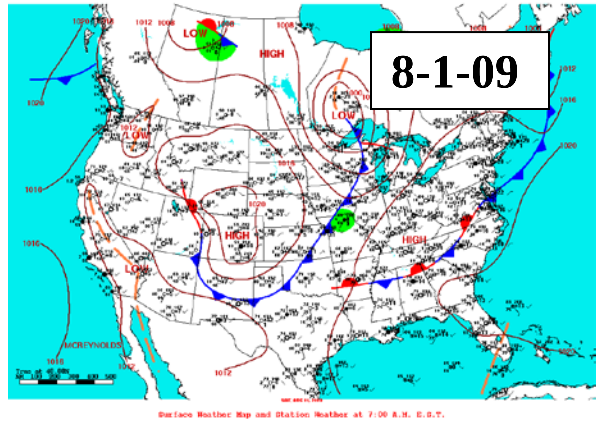

7-27-09

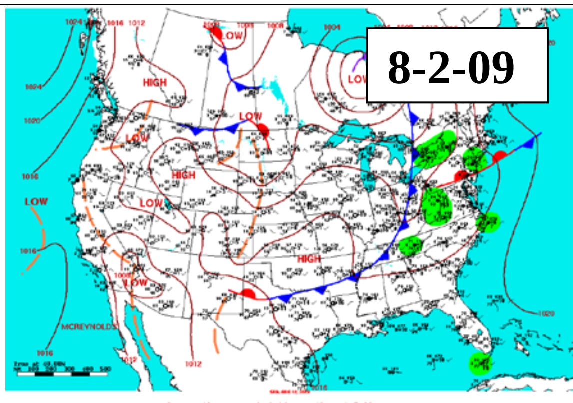

7-28-09

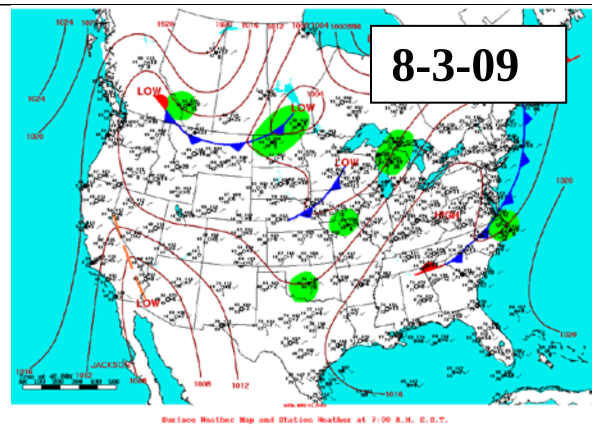

7-29-09

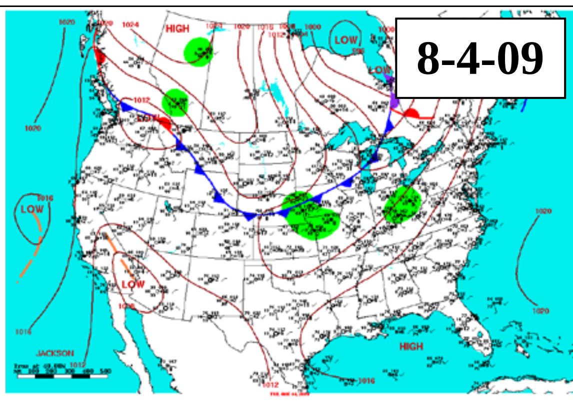

7-30-09

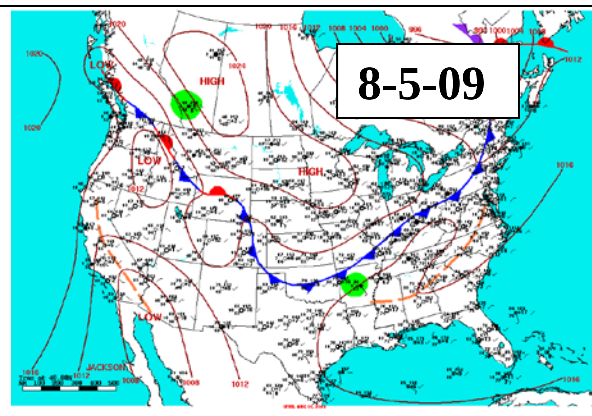

7-31-09

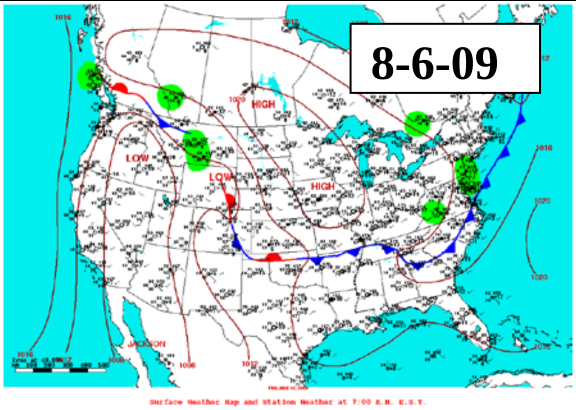

8-1-09

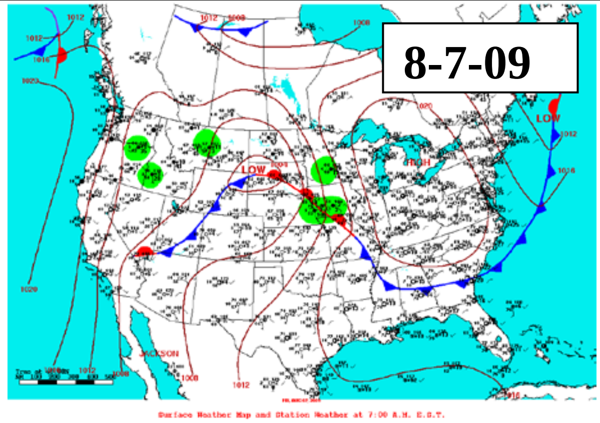

8-2-09

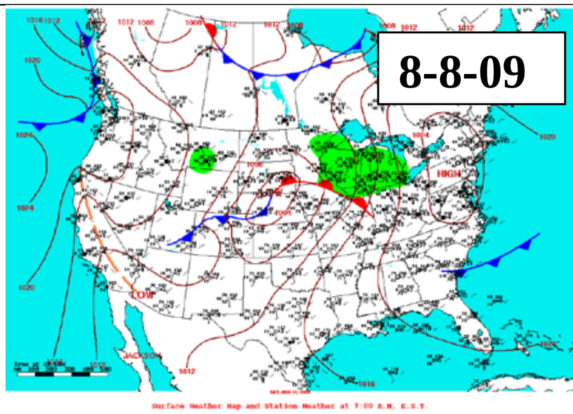

8-3-09

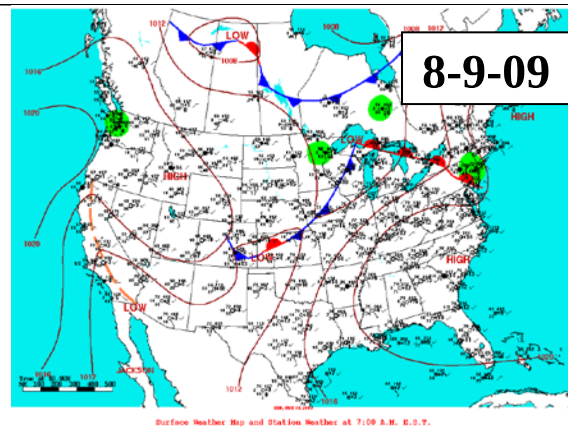

8-4-09

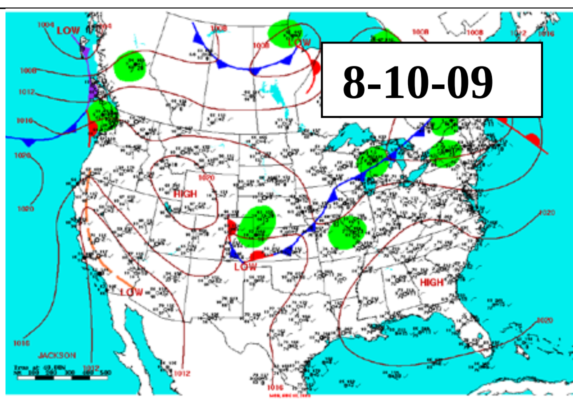

8-5-09

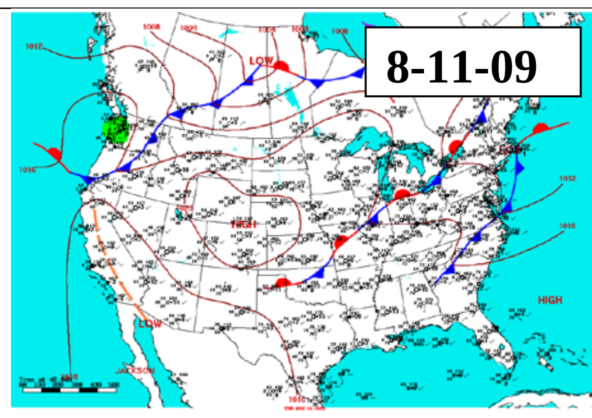

8-6-09
Surface Weather Map and Station Weather at 7:00 A.M. E.S.T.

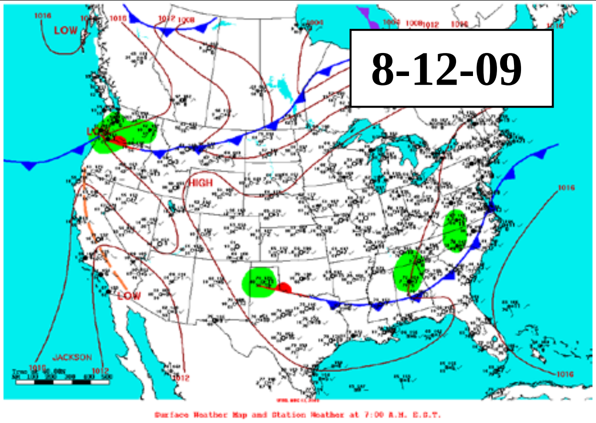

8-7-09
Surface Weather Map and Station Weather at 7:00 A.M. E.S.T.

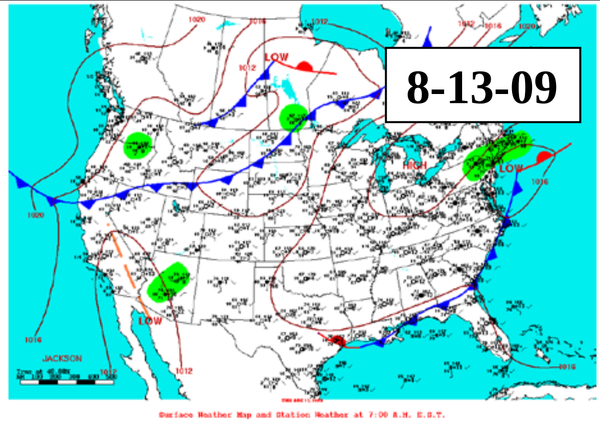

8-8-09
Surface Weather Map and Station Weather at 7:00 A.M. E.S.T.

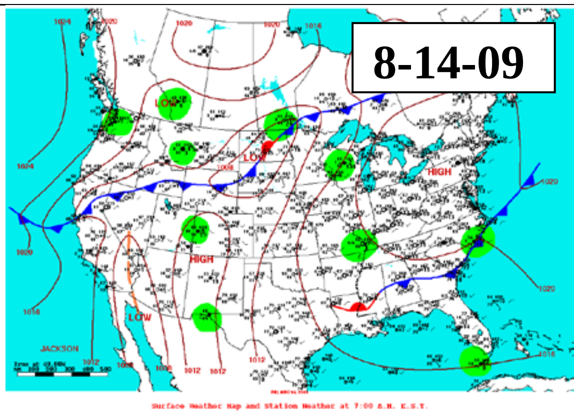

8-9-09
Surface Weather Map and Station Weather at 7:00 A.M. E.S.T.

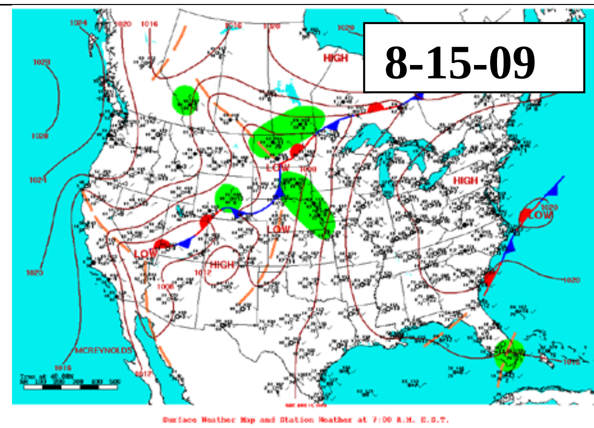

8-10-09
Surface Weather Map and Station Weather at 7:00 A.M. E.S.T.

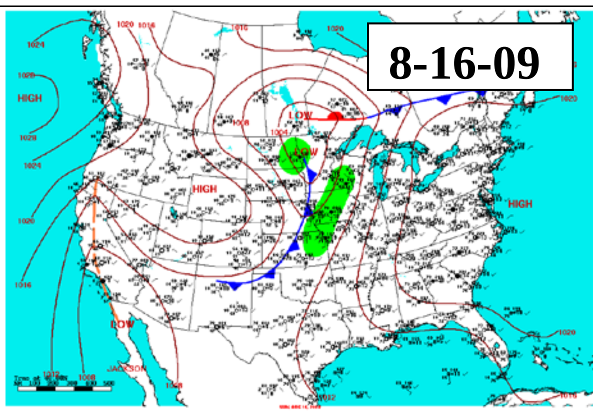

8-11-09
Surface Weather Map and Station Weather at 7:00 A.M. E.S.T.

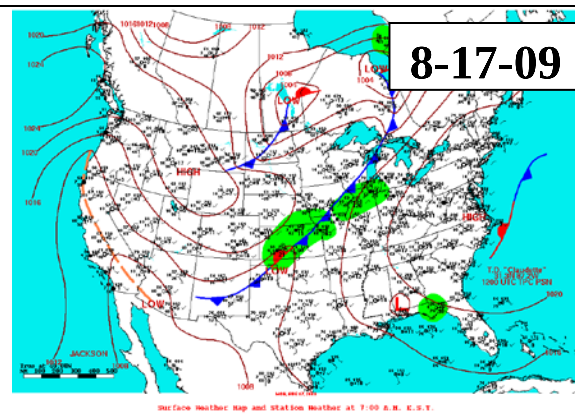

8-12-09
Surface Weather Map and Station Weather at 7:00 A.M. E.S.T.


8-13-09
Surface Weather Map and Station Weather at 7:00 A.M. E.S.T.


8-14-09
Surface Weather Map and Station Weather at 7:00 A.M. E.S.T.


8-15-09
Surface Weather Map and Station Weather at 7:00 A.M. E.S.T.


8-16-09
Surface Weather Map and Station Weather at 7:00 A.M. E.S.T.


8-17-09
Surface Weather Map and Station Weather at 7:00 A.M. E.S.T.

6.10 Daily weather conditions

Date	Barometric pressure (kPA)	Max solar radiation (Wm^{-2})	Wetness (%)	Air temperature (°C)
Period 1				
6/19/2007	98.45	757	0%	26.5
6/20/2007	98.92	985	26%	20.2
6/21/2007	98.83	1043	29%	22.2
6/22/2007	98.69	885	58%	19.7
6/23/2007	98.41	377	47%	17.9
6/24/2007	98.32	686	87%	19.1
6/25/2007	98.75	879	53%	23.2
6/26/2007	99.09	958	66%	24.2
6/27/2007	98.87	846	56%	23.3
6/28/2007	98.66	514	67%	22.2
6/29/2007	98.75	1031	10%	19.7
6/30/2007	98.78	951	33%	20.4
7/1/2007	98.97	1013	39%	20.1
7/2/2007	99.25	977	30%	17.9
7/3/2007	98.97	1056	43%	19.8
7/4/2007	98.38	920	36%	21.6
7/5/2007	98.32	1031	85%	24.1
7/6/2007	98.58	1007	88%	22.3
7/7/2007	98.50	941	61%	22.8
7/8/2007	98.12	920	99%	23.7
7/9/2007	98.08	1001	99%	24.8
7/10/2007	98.07	967	99%	24.4
7/11/2007	98.12	967	63%	22.2
7/12/2007	98.46	1076	56%	19.4
7/13/2007	98.46	1093	58%	20.8
7/14/2007	98.17	994	54%	20.1
7/15/2007	98.02	1054	51%	21.4
7/16/2007	98.45	950	38%	20.8
7/17/2007	98.39	822	31%	21.1
7/18/2007	98.31	982	56%	22.2
7/19/2007	98.02	903	44%	23.2
7/20/2007	98.69	953	14%	17.2
7/21/2007	99.06	1130	30%	18.2
7/22/2007	99.22	945	19%	18.4
7/23/2007	98.92	968	39%	19.7
7/24/2007	98.68	1098	38%	20.2
7/25/2007	98.67	1078	41%	21.7
7/26/2007	98.53	961	54%	21.3
7/27/2007	98.09	485	35%	21.9
7/28/2007	98.06	905	79%	21.8

Date	Barometric pressure (kPA)	Max solar radiation (Wm^{-2})	Wetness (%)	Air temperature (°C)
7/29/2007	98.32	960	47%	22.5
7/30/2007	98.48	974	43%	22.9
7/31/2007	98.64	896	46%	23.5
8/1/2007	98.58	894	44%	25.3
8/2/2007	98.51	912	47%	25.0
8/3/2007	98.55	943	56%	24.1
8/4/2007	98.63	834	1%	22.4
8/5/2007	98.20	1013	51%	24.6
8/6/2007	98.02	877	10%	27.2
8/7/2007	97.99	939	54%	27.9
8/8/2007	97.98	881	46%	27.9
8/9/2007	97.97	967	50%	27.4
8/10/2007	98.27	981	52%	25.2
8/11/2007	98.61	981	49%	24.8
8/12/2007	98.72	906	46%	25.4
8/13/2007	98.79	878	44%	25.1
8/14/2007	98.55	936	67%	19.6
8/15/2007	98.20	837	33%	23.2
8/16/2007	98.21	679	24%	24.3
8/17/2007	98.70	845	55%	23.1
8/18/2007	99.12	904	55%	17.6
8/19/2007	98.55	927	16%	22.1
8/20/2007	98.25	420	91%	22.5
8/21/2007	98.28	804	59%	24.6
8/22/2007	98.52	881	0%	26.5
8/23/2007	98.37	893	8%	26.8
8/24/2007	98.12	999	6%	25.3
8/25/2007	98.17	883	66%	22.6
8/26/2007	98.70	931	38%	20.2
8/27/2007	98.81	895	31%	20.5
8/28/2007	98.72	833	18%	23.8
8/29/2007	98.60	872	28%	25.3
8/30/2007	98.83	881	70%	22.0
8/31/2007	98.95	857	52%	18.7
Period 2				
9/1/2007	99.12	843	54%	18.5
9/2/2007	99.07	845	52%	20.0
9/3/2007	98.91	840	47%	21.8
9/4/2007	98.68	826	43%	23.4
9/5/2007	98.51	840	44%	24.2
9/6/2007	98.61	641	56%	23.2
9/7/2007	98.37	758	10%	23.9

Date	Barometric pressure (kPA)	Max solar radiation (Wm^{-2})	Wetness (%)	Air temperature (°C)
9/8/2007	98.47	335	80%	23.0
9/9/2007	98.44	931	58%	22.5
9/10/2007	98.61	911	29%	20.8
9/11/2007	98.17	821	21%	18.4
9/12/2007	98.68	822	10%	14.5
9/13/2007	98.75	817	25%	16.2
9/14/2007	98.35	801	0%	16.7
9/15/2007	99.28	973	13%	10.7
9/16/2007	99.28	791	14%	12.8
9/17/2007	99.15	790	0%	15.2
9/18/2007	99.03	765	0%	20.5
9/19/2007	98.95	804	4%	22.4
9/20/2007	98.94	777	39%	23.0
9/21/2007	98.51	728	27%	23.4
9/22/2007	98.59	769	0%	21.7
9/23/2007	99.07	733	0%	20.8
9/24/2007	98.83	819	0%	24.5
9/25/2007	98.61	956	11%	25.1
9/26/2007	98.51	244	99%	18.9
9/27/2007	98.45	868	66%	17.8
9/28/2007	98.82	748	24%	16.7
9/29/2007	99.41	789	12%	16.7
9/30/2007	99.28	741	0%	19.1
10/1/2007	98.76	769	4%	20.5
10/2/2007	98.72	790	42%	18.9
10/3/2007	98.36	814	28%	20.6
10/4/2007	98.70	690	31%	20.9
10/5/2007	98.89	886	62%	23.3
10/6/2007	98.87	866	63%	24.6
10/7/2007	98.78	801	58%	24.6
10/8/2007	98.52	740	55%	24.3
10/9/2007	98.43	696	53%	19.5
10/10/2007	98.17	700	0%	11.2
10/11/2007	98.19	679	32%	10.6
10/12/2007	98.43	799	36%	10.5
10/13/2007	98.56	729	56%	8.5
10/14/2007	98.75	497	0%	15.1
10/15/2007	98.53	720	0%	18.1
10/16/2007	98.22	624	47%	18.1
10/17/2007	98.31	760	88%	15.6
10/18/2007	96.98	672	53%	21.6
10/19/2007	96.81	185	38%	15.1

Date	Barometric pressure (kPA)	Max solar radiation (Wm^{-2})	Wetness (%)	Air temperature (°C)
10/20/2007	97.76	645	9%	15.0
10/21/2007	98.17	665	0%	18.2
10/22/2007	98.41	497	21%	15.6
10/23/2007	98.03	327	65%	10.7
10/24/2007	98.44	700	54%	9.4
10/25/2007	98.85	622	48%	8.5
10/26/2007	98.66	486	45%	13.5
10/27/2007	98.89	403	76%	10.8
10/28/2007	100.18	620	57%	6.9
10/29/2007	100.09	606	31%	6.1
10/30/2007	99.56	601	3%	8.7
10/31/2007	98.80	699	32%	11.4
11/1/2007	99.15	602	10%	6.8
11/2/2007	99.28	586	11%	5.6
11/3/2007	98.99	589	9%	6.5
11/4/2007	98.38	572	0%	6.4
11/5/2007	97.89	420	0%	9.1
11/6/2007	98.63	541	0%	3.2
11/7/2007	99.35	565	22%	1.8
11/8/2007	98.56	525	0%	4.5
11/9/2007	98.30	529	26%	5.3
11/10/2007	99.00	550	50%	2.8
11/11/2007	98.66	153	51%	5.9
11/12/2007	98.59	524	69%	12.7
11/13/2007	98.52	547	50%	11.6
11/14/2007	97.71	577	58%	13.1
11/15/2007	98.30	253	2%	3.8
11/16/2007	98.74	557	25%	-0.2
11/17/2007	98.02	534	0%	3.9
11/18/2007	98.98	197	66%	3.3
11/19/2007	98.86	320	80%	7.2
11/20/2007	98.33	244	40%	15.1
11/21/2007	97.90	135	76%	12.9
11/22/2007	98.48	130	84%	2.7
11/23/2007	99.64	522	19%	-2.0
11/24/2007	99.57	638	64%	-1.8
11/25/2007	99.15	417	78%	-1.3
11/26/2007	98.27	184	100%	1.7
11/27/2007	99.13	485	63%	1.1
11/28/2007	99.19	738	25%	2.0
11/29/2007	98.98	494	9%	0.5
11/30/2007	99.45	504	1%	-0.7

Date	Barometric pressure (kPA)	Max solar radiation (Wm^{-2})	Wetness (%)	Air temperature (°C)
Period 3				
12/1/2007	99.74	185	11%	-3.7
12/2/2007	97.94	219	75%	8.1
12/3/2007	98.98	601	13%	-2.7
12/4/2007	98.58	431	59%	-2.2
12/5/2007	97.64	527	69%	-3.2
12/6/2007	99.11	493	80%	-9.4
12/7/2007	98.78	332	96%	-2.1
12/8/2007	99.35	591	100%	-1.2
12/9/2007	99.32	153	100%	-0.8
12/10/2007	99.30	307	100%	-0.4
12/11/2007	98.94	151	100%	1.5
12/12/2007	99.00	485	74%	2.0
12/13/2007	98.64	110	99%	1.3
12/14/2007	99.29	481	72%	-1.3
12/15/2007	98.86	143	98%	-1.7
12/16/2007	97.47	535	100%	-4.3
12/17/2007	99.07	358	100%	-7.6
12/18/2007	98.90	476	83%	-4.0
12/19/2007	98.61	457	60%	-1.5
12/20/2007	98.68	420	87%	-2.8
12/21/2007	98.30	133	92%	1.4
12/22/2007	98.35	175	100%	5.7
12/23/2007	97.48	517	63%	1.8
12/24/2007	98.47	242	7%	-3.5
12/25/2007	99.08	454	74%	-2.1
12/26/2007	98.67	461	63%	0.5
12/27/2007	98.37	126	99%	0.7
12/28/2007	98.44	103	99%	1.5
12/29/2007	98.59	168	39%	-1.0
12/30/2007	98.51	364	81%	-1.8
12/31/2007	97.94	522	77%	0.5
1/1/2008	98.43	326	71%	-4.7
1/2/2008	100.01	364	96%	-14.4
1/3/2008	100.72	476	78%	-12.9
1/4/2008	99.69	472	27%	-3.8
1/5/2008	98.63	86	63%	3.0
1/6/2008	98.15	134	100%	10.0
1/7/2008	98.23	331	86%	15.9
1/8/2008	97.74	125	85%	14.3
1/9/2008	98.35	494	40%	4.0
1/10/2008	98.02	216	77%	2.4

Date	Barometric pressure (kPA)	Max solar radiation (Wm^{-2})	Wetness (%)	Air temperature (°C)
1/11/2008	97.22	212	94%	3.1
1/12/2008	98.39	430	60%	0.2
1/13/2008	98.27	92	69%	0.8
1/14/2008	98.51	234	89%	-3.7
1/15/2008	98.81	508	74%	-8.7
1/16/2008	99.02	529	66%	-6.4
1/17/2008	98.27	203	79%	-0.4
1/18/2008	98.49	512	57%	-5.4
1/19/2008	N/A	555	55%	-11.2
1/20/2008	N/A	522	46%	-15.2
1/21/2008	N/A	515	55%	-9.4
1/22/2008	N/A	722	70%	-3.3
1/23/2008	N/A	533	77%	-10.3
1/24/2008	N/A	546	84%	-11.8
1/25/2008	N/A	592	65%	-14.6
1/26/2008	N/A	184	96%	-4.1
1/27/2008	N/A	532	85%	-3.2
1/28/2008	N/A	313	87%	1.1
1/29/2008	N/A	83	67%	7.9
1/30/2008	N/A	570	15%	-11.1
1/31/2008	N/A	179	10%	-8.2
2/1/2008	N/A	530	68%	-2.8
2/2/2008	N/A	573	70%	-2.0
2/3/2008	N/A	330	99%	-2.1
2/4/2008	N/A	250	100%	3.9
2/5/2008	N/A	142	100%	8.2
2/6/2008	N/A	247	79%	2.1
2/7/2008	N/A	193	30%	-2.0
2/8/2008	N/A	637	59%	0.4
2/9/2008	N/A	669	65%	2.5
2/10/2008	N/A	708	7%	-8.4
2/11/2008	N/A	479	1%	-14.1
2/12/2008	N/A	240	99%	-8.5
2/13/2008	N/A	637	99%	-7.8
2/14/2008	N/A	638	99%	-5.9
2/15/2008	N/A	638	99%	-1.2
2/16/2008	N/A	635	99%	-4.4
2/17/2008	N/A	662	82%	6.6
2/18/2008	N/A	617	36%	-1.2
2/19/2008	N/A	623	0%	-10.4
2/20/2008	N/A	696	66%	-7.7
2/21/2008	N/A	376	90%	-12.2

Date	Barometric pressure (kPA)	Max solar radiation (Wm^{-2})	Wetness (%)	Air temperature (°C)
2/22/2008	N/A	315	100%	-6.1
2/23/2008	N/A	707	69%	-3.9
2/24/2008	N/A	665	99%	-7.0
2/25/2008	N/A	319	100%	-0.6
2/26/2008	N/A	590	97%	-0.7
2/27/2008	N/A	876	37%	-6.4
2/28/2008	N/A	764	66%	-9.2
2/29/2008	N/A	774	98%	-0.3
3/1/2008	N/A	636	70%	-0.3
3/2/2008	N/A	873	98%	5.0
3/3/2008	N/A	113	90%	8.7
3/4/2008	N/A	217	100%	-1.2
3/5/2008	N/A	771	96%	-3.6
Period 4				
3/6/2008	N/A	678	67%	-1.4
3/7/2008	N/A	547	49%	-3.3
3/8/2008	N/A	861	20%	-5.6
3/9/2008	N/A	792	74%	-2.9
3/10/2008	N/A	936	99%	1.3
3/11/2008	N/A	827	98%	-0.1
3/12/2008	N/A	825	83%	3.5
3/13/2008	N/A	794	85%	7.8
3/14/2008	N/A	812	61%	8.1
3/15/2008	N/A	516	93%	4.1
3/16/2008	N/A	657	87%	1.4
3/17/2008	N/A	560	83%	2.0
3/18/2008	N/A	160	93%	7.6
3/19/2008	N/A	233	89%	4.3
3/20/2008	N/A	814	51%	3.9
3/21/2008	97.70	883	62%	4.6
3/22/2008	98.53	792	85%	2.3
3/23/2008	99.26	978	65%	-0.3
3/24/2008	99.45	1065	68%	0.1
3/25/2008	98.60	520	66%	3.5
3/26/2008	98.71	873	73%	6.7
3/27/2008	98.15	194	96%	5.8
3/28/2008	98.49	950	61%	2.7
3/29/2008	99.59	950	66%	1.8
3/30/2008	99.05	618	85%	5.4
3/31/2008	98.42	674	88%	12.9
4/1/2008	98.17	398	79%	8.2
4/2/2008	99.79	897	56%	3.7

Date	Barometric pressure (kPA)	Max solar radiation (Wm^{-2})	Wetness (%)	Air temperature (°C)
4/3/2008	98.93	507	77%	3.9
4/4/2008	97.76	117	100%	5.7
4/5/2008	98.48	878	58%	5.7
4/6/2008	98.41	887	52%	9.2
4/7/2008	98.21	847	54%	12.7
4/8/2008	98.53	544	64%	11.7
4/9/2008	98.54	1005	77%	10.0
4/10/2008	98.45	126	98%	8.6
4/11/2008	96.95	936	54%	16.1
4/12/2008	97.32	271	44%	5.1
4/13/2008	98.13	376	100%	2.7
4/14/2008	99.00	869	62%	3.6
4/15/2008	99.29	715	54%	6.2
4/16/2008	98.70	727	38%	11.0
4/17/2008	98.48	745	30%	15.2
4/18/2008	98.23	821	88%	16.8
4/19/2008	97.83	882	77%	12.9
4/20/2008	98.15	766	64%	12.2
4/21/2008	98.55	949	54%	15.0
4/22/2008	98.56	1055	35%	16.8
4/23/2008	98.80	958	73%	19.4
4/24/2008	98.83	862	63%	19.1
4/25/2008	98.08	910	99%	21.4
4/26/2008	98.30	885	57%	13.3
4/27/2008	98.93	743	23%	9.6
4/28/2008	98.24	793	87%	7.6
4/29/2008	98.60	1001	65%	5.2
4/30/2008	98.59	910	49%	7.7
5/1/2008	97.78	895	26%	15.9
5/2/2008	97.37	696	19%	19.5
5/3/2008	97.40	1016	48%	13.6
5/4/2008	98.60	913	40%	10.4
5/5/2008	98.68	908	6%	14.6
5/6/2008	98.45	996	46%	18.8
5/7/2008	97.73	601	100%	17.9
5/8/2008	97.54	315	100%	13.0
5/9/2008	97.63	566	99%	10.8
5/10/2008	98.07	884	58%	11.7
5/11/2008	96.44	186	98%	11.8
5/12/2008	97.85	925	98%	8.2
5/13/2008	N/A	N/A	N/A	N/A
5/14/2008	98.13	184	100%	14.6

Date	Barometric pressure (kPA)	Max solar radiation (Wm^{-2})	Wetness (%)	Air temperature (°C)
5/15/2008	98.46	461	100%	10.6
5/16/2008	98.23	958	98%	12.0
5/17/2008	97.51	944	79%	16.2
5/18/2008	97.08	1088	99%	13.0
5/19/2008	97.47	756	99%	9.9
5/20/2008	97.30	795	93%	11.0
5/21/2008	97.38	1021	83%	11.9
5/22/2008	97.87	975	85%	13.2
5/23/2008	98.54	493	100%	11.7
5/24/2008	98.95	944	61%	13.9
5/25/2008	98.69	849	79%	16.5
5/26/2008	98.02	1060	100%	21.2
5/27/2008	98.41	1066	100%	16.3
5/28/2008	99.35	962	54%	12.9
5/29/2008	99.17	1041	53%	16.3
5/30/2008	98.32	1002	99%	20.9
5/31/2008	97.86	1001	61%	22.2
6/1/2008	98.20	936	75%	21.0
6/2/2008	98.34	1100	93%	21.9
6/3/2008	97.65	820	95%	21.7
6/4/2008	97.27	1099	83%	22.0
6/5/2008	97.77	994	100%	25.6
6/6/2008	98.18	794	100%	25.2
Period 5				
6/7/2008	98.24	731	87%	21.5
6/8/2008	98.29	932	47%	26.7
6/9/2008	97.98	1021	38%	25.9
6/10/2008	98.19	1020	61%	21.3
6/11/2008	98.64	974	94%	23.2
6/12/2008	98.57	852	100%	24.4
6/13/2008	98.46	494	100%	23.1
6/14/2008	98.46	960	54%	22.2
6/15/2008	98.26	977	49%	22.6
6/16/2008	97.88	1057	62%	20.3
6/17/2008	98.46	1031	61%	17.4
6/18/2008	98.20	998	91%	18.4
6/19/2008	98.25	1048	59%	19.1
6/20/2008	98.36	993	61%	22.0
6/21/2008	98.49	1120	87%	21.2
6/22/2008	98.22	1080	60%	19.9
6/23/2008	98.37	1040	90%	18.8
6/24/2008	99.06	966	70%	19.2

Date	Barometric pressure (kPA)	Max solar radiation (Wm^{-2})	Wetness (%)	Air temperature (°C)
6/25/2008	98.81	971	98%	23.1
6/26/2008	98.26	1005	99%	24.4
6/27/2008	98.02	961	63%	22.9
6/28/2008	97.75	1010	76%	22.7
6/29/2008	97.74	1061	94%	20.2
6/30/2008	98.24	1140	98%	18.7
7/1/2008	98.60	963	56%	19.2
7/2/2008	98.23	981	97%	22.9
7/3/2008	98.23	918	99%	21.7
7/4/2008	98.62	431	100%	18.1
7/5/2008	N/A	N/A	N/A	N/A
7/6/2008	98.44	1042	67%	25.3
7/7/2008	98.42	956	99%	21.7
7/8/2008	98.13	1039	85%	24.5
7/9/2008	98.26	937	90%	22.9
7/10/2008	98.68	936	57%	22.1
7/11/2008	98.60	967	91%	23.4
7/12/2008	98.35	948	89%	24.4
7/13/2008	98.14	936	99%	21.6
7/14/2008	98.27	982	57%	20.4
7/15/2008	98.63	998	6%	23.0
7/16/2008	98.85	152	100%	22.7

6.11 Daily lagoon conditions

Date	Air temperature (°C)	Lagoon temperature (°C)	pH	ORP (mV)
Period 1				
6/19/2007	26.5	N/A	N/A	N/A
6/20/2007	20.2	N/A	N/A	N/A
6/21/2007	22.2	N/A	N/A	N/A
6/22/2007	19.7	25.6	7.86	N/A
6/23/2007	17.9	23.8	7.91	N/A
6/24/2007	19.1	21.9	7.96	N/A
6/25/2007	23.2	23.4	7.94	N/A
6/26/2007	24.2	25.3	7.90	N/A
6/27/2007	23.3	26.2	7.91	N/A
6/28/2007	22.2	25.8	7.90	-156
6/29/2007	19.7	25.3	7.92	-84
6/30/2007	20.4	25.8	7.94	-62
7/1/2007	20.1	25.7	7.95	-56
7/2/2007	17.9	25.4	7.94	-58
7/3/2007	19.8	24.5	7.95	-53
7/4/2007	21.6	23.9	7.94	-52
7/5/2007	24.1	25.8	7.91	-47
7/6/2007	22.3	26.4	7.90	-50
7/7/2007	22.8	25.6	7.95	-51
7/8/2007	23.7	26.0	7.95	-50
7/9/2007	24.8	27.8	7.92	-50
7/10/2007	24.4	27.8	7.90	-49
7/11/2007	22.2	27.6	7.88	-53
7/12/2007	19.4	25.9	7.88	-52
7/13/2007	20.8	25.4	7.87	-54
7/14/2007	20.1	25.0	7.88	-52
7/15/2007	21.4	26.1	7.85	-54
7/16/2007	20.8	25.2	7.88	-51
7/17/2007	21.1	24.5	7.88	-53
7/18/2007	22.2	24.2	7.85	-54
7/19/2007	23.2	25.0	7.82	-52
7/20/2007	17.2	24.8	7.84	-54
7/21/2007	18.2	25.6	7.86	-54
7/22/2007	18.4	25.3	7.88	-57
7/23/2007	19.7	25.5	7.87	-57
7/24/2007	20.2	25.2	7.82	-55
7/25/2007	21.7	24.3	7.86	-53
7/26/2007	21.3	24.2	7.88	-59
7/27/2007	21.9	24.4	7.86	-61
7/28/2007	21.8	24.4	7.90	-51

Date	Air temperature (°C)	Lagoon temperature (°C)	pH	ORP (mV)
7/29/2007	22.5	26.4	7.91	-46
7/30/2007	22.9	27.5	7.90	-49
7/31/2007	23.5	26.6	7.91	-49
8/1/2007	25.3	26.5	7.92	-47
8/2/2007	25.0	26.3	7.96	-47
8/3/2007	24.1	26.8	7.98	-51
8/4/2007	22.4	27.6	7.95	-53
8/5/2007	24.6	26.0	7.92	-48
8/6/2007	27.2	26.5	7.88	-39
8/7/2007	27.9	27.6	7.83	-37
8/8/2007	27.9	29.2	7.79	-37
8/9/2007	27.4	29.3	7.81	-27
8/10/2007	25.2	30.5	7.77	-17
8/11/2007	24.8	28.6	7.82	-34
8/12/2007	25.4	28.0	7.87	-38
8/13/2007	25.1	29.6	7.82	-43
8/14/2007	19.6	26.6	7.86	-47
8/15/2007	23.2	25.7	7.90	-43
8/16/2007	24.3	26.2	7.89	-42
8/17/2007	23.1	26.3	7.86	-41
8/18/2007	17.6	24.8	7.82	-46
8/19/2007	22.1	23.6	7.83	-43
8/20/2007	22.5	23.9	7.79	-47
8/21/2007	24.6	23.7	7.76	-36
8/22/2007	26.5	25.5	7.75	-32
8/23/2007	26.8	27.9	7.74	-31
8/24/2007	25.3	27.8	7.76	-37
8/25/2007	22.6	27.0	7.73	-41
8/26/2007	20.2	26.5	7.74	-41
8/27/2007	20.5	25.4	7.76	-39
8/28/2007	23.8	25.1	7.79	-38
8/29/2007	25.3	26.1	7.80	-39
8/30/2007	22.0	26.1	7.78	-52
8/31/2007	18.7	24.4	7.80	-50
Period 2				
9/1/2007	18.5	24.0	7.76	-46
9/2/2007	20.0	23.4	7.78	-42
9/3/2007	21.8	23.5	7.80	-45
9/4/2007	23.4	24.8	7.79	-49
9/5/2007	24.2	25.4	7.81	-52
9/6/2007	23.2	25.1	7.81	-50
9/7/2007	23.9	23.5	7.75	-50

Date	Air temperature (°C)	Lagoon temperature (°C)	pH	ORP (mV)
9/8/2007	23.0	23.8	7.77	-52
9/9/2007	22.5	24.6	7.75	-53
9/10/2007	20.8	24.3	7.80	-49
9/11/2007	18.4	23.3	7.77	-55
9/12/2007	14.5	22.0	7.76	-46
9/13/2007	16.2	21.3	7.83	-46
9/14/2007	16.7	21.0	7.83	-49
9/15/2007	10.7	19.9	7.85	-48
9/16/2007	12.8	19.3	7.87	-49
9/17/2007	15.2	18.6	7.89	-48
9/18/2007	20.5	19.0	7.89	-48
9/19/2007	22.4	19.1	7.84	-46
9/20/2007	23.0	23.1	7.80	-48
9/21/2007	23.4	22.9	7.82	-46
9/22/2007	21.7	23.2	7.79	-48
9/23/2007	20.8	22.3	7.80	-46
9/24/2007	24.5	22.5	7.83	-46
9/25/2007	25.1	23.4	7.81	-47
9/26/2007	18.9	22.6	7.69	-51
9/27/2007	17.8	21.5	7.70	-54
9/28/2007	16.7	21.3	7.73	-45
9/29/2007	16.7	20.4	7.77	-42
9/30/2007	19.1	19.6	7.76	-42
10/1/2007	20.5	19.4	7.75	-42
10/2/2007	18.9	19.2	7.69	-40
10/3/2007	20.6	20.0	7.67	-43
10/4/2007	20.9	20.4	7.68	-40
10/5/2007	23.3	22.3	7.65	-39
10/6/2007	24.6	23.4	7.65	-40
10/7/2007	24.6	24.1	7.63	-39
10/8/2007	24.3	23.8	7.67	-39
10/9/2007	19.5	22.6	7.67	-41
10/10/2007	11.2	19.1	7.72	-39
10/11/2007	10.6	15.5	7.73	-41
10/12/2007	10.5	14.6	7.77	-44
10/13/2007	8.5	13.8	7.76	-42
10/14/2007	15.1	14.1	7.79	-43
10/15/2007	18.1	14.5	7.79	-44
10/16/2007	18.1	15.6	7.73	-43
10/17/2007	15.6	16.1	7.72	-42
10/18/2007	21.6	17.8	7.70	-44
10/19/2007	15.1	18.0	7.68	-39

Date	Air temperature (°C)	Lagoon temperature (°C)	pH	ORP (mV)
10/20/2007	15.0	15.9	7.71	-39
10/21/2007	18.2	15.5	7.74	-40
10/22/2007	15.6	15.3	7.71	-38
10/23/2007	10.7	14.4	7.83	-43
10/24/2007	9.4	13.3	7.78	-41
10/25/2007	8.5	11.6	7.84	-45
10/26/2007	13.5	11.5	7.83	-45
10/27/2007	10.8	11.8	7.83	-44
10/28/2007	6.9	11.6	7.81	-43
10/29/2007	6.1	10.9	7.79	-42
10/30/2007	8.7	10.7	7.80	-42
10/31/2007	11.4	11.0	7.82	-43
11/1/2007	6.8	11.1	7.83	-52
11/2/2007	5.6	10.0	7.81	-72
11/3/2007	6.5	10.1	7.85	-66
11/4/2007	6.4	9.6	7.87	-64
11/5/2007	9.1	8.9	7.94	-64
11/6/2007	3.2	6.8	8.04	-65
11/7/2007	1.8	5.5	8.03	-65
11/8/2007	4.5	5.5	8.03	-64
11/9/2007	5.3	6.0	8.03	-64
11/10/2007	2.8	5.9	8.02	-64
11/11/2007	5.9	6.0	8.08	-66
11/12/2007	12.7	6.9	8.06	-66
11/13/2007	11.6	9.5	8.00	-67
11/14/2007	13.1	10.7	7.98	-67
11/15/2007	3.8	8.4	8.00	-66
11/16/2007	-0.2	6.1	8.04	-54
11/17/2007	3.9	5.4	8.10	-50
11/18/2007	3.3	5.2	8.11	-55
11/19/2007	7.2	5.2	8.09	-66
11/20/2007	15.1	8.3	8.07	-97
11/21/2007	12.9	10.5	8.05	-105
11/22/2007	2.7	8.8	8.10	-94
11/23/2007	-2.0	5.9	8.16	-106
11/24/2007	-1.8	4.8	8.20	-107
11/25/2007	-1.3	3.8	8.22	-113
11/26/2007	1.7	3.6	8.23	-106
11/27/2007	1.1	3.3	8.20	-112
11/28/2007	2.0	2.9	8.19	-109
11/29/2007	0.5	3.0	8.20	-76
11/30/2007	-0.7	1.9	8.17	-70

Date	Air temperature (°C)	Lagoon temperature (°C)	pH	ORP (mV)
Period 3				
12/1/2007	-3.7	1.2	8.10	-71
12/2/2007	8.1	1.8	8.10	-73
12/3/2007	-2.7	2.2	8.12	-56
12/4/2007	-2.2	1.0	8.13	-54
12/5/2007	-3.2	0.6	8.14	-52
12/6/2007	-9.4	0.1	8.11	-55
12/7/2007	-2.1	0.2	8.08	-60
12/8/2007	-1.2	0.2	8.07	-68
12/9/2007	-0.8	0.4	8.05	-75
12/10/2007	-0.4	0.8	8.03	-78
12/11/2007	1.5	1.3	8.03	-84
12/12/2007	2.0	2.2	8.05	-60
12/13/2007	1.3	2.5	8.00	-68
12/14/2007	-1.3	1.7	8.03	-63
12/15/2007	-1.7	1.0	8.04	-58
12/16/2007	-4.3	-0.2	8.09	-54
12/17/2007	-7.6	-0.4	8.07	-56
12/18/2007	-4.0	-0.3	8.04	-59
12/19/2007	-1.5	-0.2	8.02	-60
12/20/2007	-2.8	-0.2	8.02	-66
12/21/2007	1.4	-0.1	8.02	-71
12/22/2007	5.7	0.1	8.02	-81
12/23/2007	1.8	1.4	8.07	-56
12/24/2007	-3.5	-0.4	8.13	-42
12/25/2007	-2.1	-0.4	8.11	-43
12/26/2007	0.5	-0.1	8.15	-43
12/27/2007	0.7	0.1	8.14	-53
12/28/2007	1.5	0.2	8.14	-56
12/29/2007	-1.0	0.2	8.16	-41
12/30/2007	-1.8	-0.1	8.15	-39
12/31/2007	0.5	0.2	8.13	-41
1/1/2008	-4.7	-0.1	8.18	-33
1/2/2008	-14.4	-0.4	8.15	-31
1/3/2008	-12.9	-0.4	8.16	-29
1/4/2008	-3.8	-0.4	8.15	-28
1/5/2008	3.0	-0.4	8.14	-29
1/6/2008	10.0	-0.1	8.14	-45
1/7/2008	15.9	3.5	8.11	-16
1/8/2008	14.3	8.4	8.07	-8
1/9/2008	4.0	8.6	8.10	-5
1/10/2008	2.4	7.0	8.12	-5

Date	Air temperature (°C)	Lagoon temperature (°C)	pH	ORP (mV)
1/11/2008	3.1	6.1	8.15	-1
1/12/2008	0.2	4.6	8.17	-4
1/13/2008	0.8	4.1	8.17	-6
1/14/2008	-3.7	2.2	8.20	0
1/15/2008	-8.7	0.4	8.21	-3
1/16/2008	-6.4	0.3	8.18	-12
1/17/2008	-0.4	0.6	8.16	-27
1/18/2008	-5.4	0.4	8.15	-24
1/19/2008	-11.2	0.4	8.14	-32
1/20/2008	-15.2	-0.2	8.10	-82
1/21/2008	-9.4	-0.2	8.07	-139
1/22/2008	-3.3	-0.2	8.06	-147
1/23/2008	-10.3	-0.3	8.05	-140
1/24/2008	-11.8	-0.3	8.04	-139
1/25/2008	-14.6	-0.4	8.04	-129
1/26/2008	-4.1	-0.4	8.03	-126
1/27/2008	-3.2	N/A	N/A	N/A
1/28/2008	1.1	N/A	N/A	N/A
1/29/2008	7.9	N/A	N/A	N/A
1/30/2008	-11.1	N/A	N/A	N/A
1/31/2008	-8.2	N/A	N/A	N/A
2/1/2008	-2.8	N/A	N/A	N/A
2/2/2008	-2.0	N/A	N/A	N/A
2/3/2008	-2.1	N/A	N/A	N/A
2/4/2008	3.9	N/A	N/A	N/A
2/5/2008	8.2	N/A	N/A	N/A
2/6/2008	2.1	N/A	N/A	N/A
2/7/2008	-2.0	N/A	N/A	N/A
2/8/2008	0.4	N/A	N/A	N/A
2/9/2008	2.5	N/A	N/A	N/A
2/10/2008	-8.4	N/A	N/A	N/A
2/11/2008	-14.1	N/A	N/A	N/A
2/12/2008	-8.5	N/A	N/A	N/A
2/13/2008	-7.8	N/A	N/A	N/A
2/14/2008	-5.9	N/A	N/A	N/A
2/15/2008	-1.2	N/A	N/A	N/A
2/16/2008	-4.4	N/A	N/A	N/A
2/17/2008	6.6	N/A	N/A	N/A
2/18/2008	-1.2	N/A	N/A	N/A
2/19/2008	-10.4	N/A	N/A	N/A
2/20/2008	-7.7	N/A	N/A	N/A
2/21/2008	-12.2	N/A	N/A	N/A

Date	Air temperature (°C)	Lagoon temperature (°C)	pH	ORP (mV)
2/22/2008	-6.1	N/A	N/A	N/A
2/23/2008	-3.9	N/A	N/A	N/A
2/24/2008	-7.0	N/A	N/A	N/A
2/25/2008	-0.6	N/A	N/A	N/A
2/26/2008	-0.7	N/A	N/A	N/A
2/27/2008	-6.4	N/A	N/A	N/A
2/28/2008	-9.2	N/A	N/A	N/A
2/29/2008	-0.3	N/A	N/A	N/A
3/1/2008	-0.3	N/A	N/A	N/A
3/2/2008	5.0	N/A	N/A	N/A
3/3/2008	8.7	N/A	N/A	N/A
3/4/2008	-1.2	N/A	N/A	N/A
3/5/2008	-3.6	N/A	N/A	N/A
Period 4				
3/6/2008	-1.4	N/A	N/A	N/A
3/7/2008	-3.3	N/A	N/A	N/A
3/8/2008	-5.6	N/A	N/A	N/A
3/9/2008	-2.9	N/A	N/A	N/A
3/10/2008	1.3	N/A	N/A	N/A
3/11/2008	-0.1	N/A	N/A	N/A
3/12/2008	3.5	N/A	N/A	N/A
3/13/2008	7.8	N/A	N/A	N/A
3/14/2008	8.1	N/A	N/A	N/A
3/15/2008	4.1	N/A	N/A	N/A
3/16/2008	1.4	N/A	N/A	N/A
3/17/2008	2.0	N/A	N/A	N/A
3/18/2008	7.6	N/A	N/A	N/A
3/19/2008	4.3	N/A	N/A	N/A
3/20/2008	3.9	N/A	N/A	N/A
3/21/2008	4.6	N/A	N/A	N/A
3/22/2008	2.3	N/A	N/A	N/A
3/23/2008	-0.3	N/A	N/A	N/A
3/24/2008	0.1	N/A	N/A	N/A
3/25/2008	3.5	N/A	N/A	N/A
3/26/2008	6.7	N/A	N/A	N/A
3/27/2008	5.8	N/A	N/A	N/A
3/28/2008	2.7	N/A	N/A	N/A
3/29/2008	1.8	N/A	N/A	N/A
3/30/2008	5.4	N/A	N/A	N/A
3/31/2008	12.9	N/A	N/A	N/A
4/1/2008	8.2	N/A	N/A	N/A
4/2/2008	3.7	N/A	N/A	N/A

Date	Air temperature (°C)	Lagoon temperature (°C)	pH	ORP (mV)
4/3/2008	3.9	N/A	N/A	N/A
4/4/2008	5.7	N/A	N/A	N/A
4/5/2008	5.7	N/A	N/A	N/A
4/6/2008	9.2	N/A	N/A	N/A
4/7/2008	12.7	N/A	N/A	N/A
4/8/2008	11.7	N/A	N/A	N/A
4/9/2008	10.0	N/A	N/A	N/A
4/10/2008	8.6	N/A	N/A	N/A
4/11/2008	16.1	N/A	N/A	N/A
4/12/2008	5.1	N/A	N/A	N/A
4/13/2008	2.7	N/A	N/A	N/A
4/14/2008	3.6	N/A	N/A	N/A
4/15/2008	6.2	N/A	N/A	N/A
4/16/2008	11.0	N/A	N/A	N/A
4/17/2008	15.2	N/A	N/A	N/A
4/18/2008	16.8	N/A	N/A	N/A
4/19/2008	12.9	N/A	N/A	N/A
4/20/2008	12.2	N/A	N/A	N/A
4/21/2008	15.0	N/A	N/A	N/A
4/22/2008	16.8	N/A	N/A	N/A
4/23/2008	19.4	N/A	N/A	N/A
4/24/2008	19.1	N/A	N/A	N/A
4/25/2008	21.4	N/A	N/A	N/A
4/26/2008	13.3	N/A	N/A	N/A
4/27/2008	9.6	N/A	N/A	N/A
4/28/2008	7.6	N/A	N/A	N/A
4/29/2008	5.2	N/A	N/A	N/A
4/30/2008	7.7	N/A	N/A	N/A
5/1/2008	15.9	N/A	N/A	N/A
5/2/2008	19.5	N/A	N/A	N/A
5/3/2008	13.6	N/A	N/A	N/A
5/4/2008	10.4	N/A	N/A	N/A
5/5/2008	14.6	N/A	N/A	N/A
5/6/2008	18.8	16.7	N/A	N/A
5/7/2008	17.9	16.9	N/A	N/A
5/8/2008	13.0	16.3	N/A	N/A
5/9/2008	10.8	15.0	N/A	N/A
5/10/2008	11.7	15.4	N/A	N/A
5/11/2008	11.8	15.1	N/A	N/A
5/12/2008	8.2	12.8	N/A	N/A
5/13/2008	N/A	N/A	N/A	N/A
5/14/2008	14.6	15.3	N/A	-368

Date	Air temperature (°C)	Lagoon temperature (°C)	pH	ORP (mV)
5/15/2008	10.6	14.6	N/A	-353
5/16/2008	12.0	14.2	N/A	-350
5/17/2008	16.2	15.4	N/A	-390
5/18/2008	13.0	16.3	N/A	-390
5/19/2008	9.9	16.1	N/A	-459
5/20/2008	11.0	15.5	N/A	-424
5/21/2008	11.9	15.7	N/A	-376
5/22/2008	13.2	17.9	N/A	-456
5/23/2008	11.7	17.3	N/A	-466
5/24/2008	13.9	16.9	N/A	-450
5/25/2008	16.5	17.5	N/A	-483
5/26/2008	21.2	18.3	N/A	-486
5/27/2008	16.3	19.3	N/A	-434
5/28/2008	12.9	18.2	N/A	-366
5/29/2008	16.3	19.1	N/A	-449
5/30/2008	20.9	19.3	N/A	-470
5/31/2008	22.2	20.8	N/A	-412
6/1/2008	21.0	22.9	N/A	-356
6/2/2008	21.9	23.6	N/A	-440
6/3/2008	21.7	22.9	N/A	-429
6/4/2008	22.0	22.6	N/A	-427
6/5/2008	25.6	23.7	N/A	-407
6/6/2008	25.2	24.6	N/A	-430
Period 5				
6/7/2008	21.5	24.0	N/A	-359
6/8/2008	26.7	24.1	N/A	-401
6/9/2008	25.9	25.7	N/A	-439
6/10/2008	21.3	26.1	N/A	-470
6/11/2008	23.2	26.0	N/A	-480
6/12/2008	24.4	25.7	N/A	-483
6/13/2008	23.1	25.4	N/A	-479
6/14/2008	22.2	24.8	N/A	-470
6/15/2008	22.6	24.9	N/A	-462
6/16/2008	20.3	24.7	N/A	-399
6/17/2008	17.4	24.2	N/A	-357
6/18/2008	18.4	24.0	N/A	-354
6/19/2008	19.1	24.0	N/A	-374
6/20/2008	22.0	25.3	N/A	-349
6/21/2008	21.2	23.6	N/A	-435
6/22/2008	19.9	23.0	N/A	-473
6/23/2008	18.8	23.1	N/A	-318
6/24/2008	19.2	23.4	N/A	-360

Date	Air temperature (°C)	Lagoon temperature (°C)	pH	ORP (mV)
6/25/2008	23.1	23.4	N/A	-426
6/26/2008	24.4	23.8	N/A	-449
6/27/2008	22.9	24.2	N/A	-474
6/28/2008	22.7	24.0	N/A	-469
6/29/2008	20.2	23.9	N/A	-398
6/30/2008	18.7	23.2	N/A	-285
7/1/2008	19.2	23.0	N/A	-383
7/2/2008	22.9	23.4	N/A	-399
7/3/2008	21.7	23.7	N/A	-364
7/4/2008	18.1	23.3	N/A	-351
7/5/2008	N/A	N/A	N/A	N/A
7/6/2008	25.3	24.4	N/A	-389
7/7/2008	21.7	24.7	N/A	-386
7/8/2008	24.5	24.3	N/A	-443
7/9/2008	22.9	26.3	N/A	-299
7/10/2008	22.1	26.6	N/A	-281
7/11/2008	23.4	26.7	N/A	-269
7/12/2008	24.4	27.0	N/A	-248
7/13/2008	21.6	26.5	N/A	-283
7/14/2008	20.4	25.7	N/A	-465
7/15/2008	23.0	N/A	N/A	-465
7/16/2008	22.7	N/A	N/A	N/A

6.12 Daily site emissions and data completeness

6.12.1 Daily NH_3 emission using RPM emissions model

Column headings for the following table are:

Date: Month/Day/Year
Valid values: Number of ½ hour periods with valid emissions data
Direction limited: Number of ½ hour periods invalidated because wind was from an excluded wind direction
Missing downwind NH_3: Number of ½ hour periods invalidated because at least 1 TDLAS path was either missing or else had invalid concentration values
Emission average ($\mu gm^{-2}s^{-1}$): Daily average emission calculated from the valid ½ hour periods
Emissions SD ($\mu gm^{-2}s^{-1}$): Daily emission standard deviation of the valid ½ hour periods
Emission minimum ($\mu gm^{-2}s^{-1}$): Daily minimum emission of the valid ½ hour periods
Emission maximum ($\mu gm^{-2}s^{-1}$): Daily maximum emission of the valid ½ hour periods
Emission average (kgd^{-1}): Daily average emission calculated from the valid ½ hour periods; totaled over the source area
Emission average ($gd^{-1}hd^{-1}$): Daily average emission calculated from the valid ½ hour periods; totaled over the source area on a per head basis
Emission average ($gd^{-1}AU^{-1}$): Daily average emission calculated from the valid ½ hour periods; totaled over the source area on a per animal unit basis

	Valid values	Cause for invalid values		Emission						
Date		Direction limited	Missing downwind NH_3	Emission average ($\mu gm^{-2}s^{-1}$)	Emission SD ($\mu gm^{-2}s^{-1}$)	Emission minimum ($\mu gm^{-2}s^{-1}$)	Emission maximum ($\mu gm^{-2}s^{-1}$)	Emission average (kgd^{-1})	Emission average ($gd^{-1}hd^{-1}$)	Emission average ($gd^{-1}AU^{-1}$)
7/2/2007	1	0	8	72.6	N/A	72.6	72.6	84.7	60.5	111.2
7/3/2007	11	0	37	45.3	29.7	-5.2	86.7	52.8	37.7	69.3
7/4/2007	10	0	37	66.2	26.1	37.0	125.9	77.2	55.2	101.4
7/5/2007	0	0	48	N/A	N/A	N/A	N/A	N/A	N/A	N/A
7/6/2007	2	0	46	49.3	2.6	47.4	51.1	57.5	41.0	75.4
7/7/2007	1	0	46	80.0	N/A	80.0	80.0	93.3	66.7	122.5
7/8/2007	6	0	42	59.6	9.1	46.7	69.6	69.6	49.7	91.3
7/9/2007	0	0	48	N/A	N/A	N/A	N/A	N/A	N/A	N/A
7/10/2007	0	0	48	N/A	N/A	N/A	N/A	N/A	N/A	N/A
7/11/2007	0	0	48	N/A	N/A	N/A	N/A	N/A	N/A	N/A
7/12/2007	0	0	48	N/A	N/A	N/A	N/A	N/A	N/A	N/A
7/13/2007	5	0	43	77.8	15.3	53.3	95.6	90.7	64.8	119.1
7/14/2007	3	0	8	88.4	14.2	75.6	103.7	103.1	73.6	135.4
7/15/2007	9	0	27	62.9	19.0	29.6	88.1	73.3	52.4	96.3
7/16/2007	5	0	34	87.4	34.0	34.8	117.0	102.0	72.8	133.9
7/17/2007	0	0	44	N/A	N/A	N/A	N/A	N/A	N/A	N/A
7/18/2007	6	0	35	46.8	10.7	30.4	60.7	54.6	39.0	71.7
7/19/2007	15	0	29	48.4	12.6	26.7	71.9	56.5	40.4	74.2
7/20/2007	18	0	27	61.6	11.0	43.0	80.7	71.8	51.3	94.3
7/21/2007	3	0	45	82.0	11.6	69.6	92.6	95.6	68.3	125.5
7/22/2007	0	0	48	N/A	N/A	N/A	N/A	N/A	N/A	N/A
7/23/2007	0	0	48	N/A	N/A	N/A	N/A	N/A	N/A	N/A
7/24/2007	1	0	39	47.4	N/A	47.4	47.4	55.3	39.5	72.6
7/25/2007	4	0	43	63.0	16.4	42.2	81.5	73.4	52.5	96.4

Date	Valid values	Cause for invalid values		Emission						
		Direction limited	Missing downwind NH_3	Emission average ($\mu gm^{-2}s^{-1}$)	Emission SD ($\mu gm^{-2}s^{-1}$)	Emission minimum ($\mu gm^{-2}s^{-1}$)	Emission maximum ($\mu gm^{-2}s^{-1}$)	Emission average (kgd^{-1})	Emission average ($gd^{-1}hd^{-1}$)	Emission average ($gd^{-1}AU^{-1}$)
7/26/2007	0	0	48	N/A	N/A	N/A	N/A	N/A	N/A	N/A
7/27/2007	4	0	39	39.1	10.0	26.7	51.1	45.6	32.6	59.8
7/28/2007	0	0	45	N/A	N/A	N/A	N/A	N/A	N/A	N/A
7/29/2007	0	0	48	N/A	N/A	N/A	N/A	N/A	N/A	N/A
7/30/2007	0	0	48	N/A	N/A	N/A	N/A	N/A	N/A	N/A
7/31/2007	0	0	48	N/A	N/A	N/A	N/A	N/A	N/A	N/A
8/1/2007	0	0	48	N/A	N/A	N/A	N/A	N/A	N/A	N/A
8/2/2007	0	0	44	N/A	N/A	N/A	N/A	N/A	N/A	N/A
8/3/2007	0	0	48	N/A	N/A	N/A	N/A	N/A	N/A	N/A
8/4/2007	0	0	48	N/A	N/A	N/A	N/A	N/A	N/A	N/A
8/5/2007	1	0	47	63.7	N/A	63.7	63.7	74.3	53.1	97.6
8/6/2007	2	0	42	60.0	19.9	45.9	74.1	70.0	50.0	91.9
8/7/2007	5	0	38	79.6	31.8	34.1	118.5	92.8	66.3	121.8
8/8/2007	3	0	31	35.6	8.7	28.1	45.2	41.5	29.6	54.4
8/9/2007	0	0	0	N/A	N/A	N/A	N/A	N/A	N/A	N/A
8/10/2007	0	0	0	N/A	N/A	N/A	N/A	N/A	N/A	N/A
8/11/2007	0	0	0	N/A	N/A	N/A	N/A	N/A	N/A	N/A
8/12/2007	0	0	0	N/A	N/A	N/A	N/A	N/A	N/A	N/A
8/13/2007	0	0	0	N/A	N/A	N/A	N/A	N/A	N/A	N/A
8/14/2007	0	0	0	N/A	N/A	N/A	N/A	N/A	N/A	N/A
8/15/2007	0	0	16	N/A	N/A	N/A	N/A	N/A	N/A	N/A
8/16/2007	1	0	41	41.5	N/A	41.5	41.5	48.4	34.6	63.5
8/17/2007	6	0	39	35.6	8.5	27.4	49.6	41.5	29.6	54.4
8/18/2007	5	0	43	57.6	6.9	48.1	67.4	67.2	48.0	88.3
8/19/2007	0	0	48	N/A	N/A	N/A	N/A	N/A	N/A	N/A
8/20/2007	0	0	48	N/A	N/A	N/A	N/A	N/A	N/A	N/A
8/21/2007	0	0	48	N/A	N/A	N/A	N/A	N/A	N/A	N/A
8/22/2007	0	0	48	N/A	N/A	N/A	N/A	N/A	N/A	N/A
8/23/2007	0	0	48	N/A	N/A	N/A	N/A	N/A	N/A	N/A
8/24/2007	0	0	47	N/A	N/A	N/A	N/A	N/A	N/A	N/A
8/25/2007	0	0	46	N/A	N/A	N/A	N/A	N/A	N/A	N/A
8/26/2007	0	0	47	N/A	N/A	N/A	N/A	N/A	N/A	N/A
8/27/2007	0	0	48	N/A	N/A	N/A	N/A	N/A	N/A	N/A
8/28/2007	0	0	48	N/A	N/A	N/A	N/A	N/A	N/A	N/A
8/29/2007	4	0	38	46.7	14.3	32.6	63.0	54.4	38.9	71.5
8/30/2007	1	0	47	50.4	N/A	50.4	50.4	58.8	42.0	77.1
8/31/2007	7	0	39	42.1	7.3	32.6	52.6	49.1	35.1	64.5
9/1/2007	0	0	41	N/A	N/A	N/A	N/A	N/A	N/A	N/A
9/2/2007	0	0	20	N/A	N/A	N/A	N/A	N/A	N/A	N/A
9/3/2007	0	0	0	N/A	N/A	N/A	N/A	N/A	N/A	N/A
9/4/2007	0	0	0	N/A	N/A	N/A	N/A	N/A	N/A	N/A
9/5/2007	0	0	15	N/A	N/A	N/A	N/A	N/A	N/A	N/A
9/6/2007	0	0	48	N/A	N/A	N/A	N/A	N/A	N/A	N/A
9/7/2007	0	0	48	N/A	N/A	N/A	N/A	N/A	N/A	N/A

	Valid values	Cause for invalid values		Emission						
Date		Direction limited	Missing downwind NH_3	Emission average ($\mu gm^{-2}s^{-1}$)	Emission SD ($\mu gm^{-2}s^{-1}$)	Emission minimum ($\mu gm^{-2}s^{-1}$)	Emission maximum ($\mu gm^{-2}s^{-1}$)	Emission average (kgd^{-1})	Emission average ($gd^{-1}hd^{-1}$)	Emission average ($gd^{-1}AU^{-1}$)
9/8/2007	0	0	46	N/A	N/A	N/A	N/A	N/A	N/A	N/A
9/9/2007	4	0	32	45.2	5.6	39.3	51.9	52.7	37.6	69.2
9/10/2007	12	0	36	47.4	3.3	43.0	53.3	55.3	39.5	72.6
9/11/2007	28	0	17	45.5	11.4	27.4	70.4	53.1	37.9	69.7
9/12/2007	11	0	32	19.9	9.1	8.1	38.5	23.2	16.6	30.4
9/13/2007	2	0	46	45.2	4.2	42.2	48.1	52.7	37.6	69.2
9/14/2007	11	0	26	52.5	10.7	31.9	68.9	61.2	43.7	80.3
9/15/2007	24	0	22	23.7	9.2	12.6	43.7	27.6	19.7	36.3
9/16/2007	0	0	48	N/A	N/A	N/A	N/A	N/A	N/A	N/A
9/17/2007	0	0	48	N/A	N/A	N/A	N/A	N/A	N/A	N/A
9/18/2007	0	0	48	N/A	N/A	N/A	N/A	N/A	N/A	N/A
9/19/2007	0	0	35	N/A	N/A	N/A	N/A	N/A	N/A	N/A
9/20/2007	0	0	10	N/A	N/A	N/A	N/A	N/A	N/A	N/A
9/21/2007	0	0	48	N/A	N/A	N/A	N/A	N/A	N/A	N/A
9/22/2007	15	0	22	24.9	6.7	17.0	40.0	29.0	20.7	38.1
9/23/2007	1	0	47	26.7	N/A	26.7	26.7	31.1	22.2	40.8
9/24/2007	0	0	48	N/A	N/A	N/A	N/A	N/A	N/A	N/A
9/25/2007	0	0	48	N/A	N/A	N/A	N/A	N/A	N/A	N/A
9/26/2007	20	0	19	28.3	4.7	18.5	37.8	33.0	23.5	43.3
9/27/2007	7	0	29	22.3	7.0	13.3	32.6	26.0	18.6	34.2
9/28/2007	18	0	17	21.4	5.1	14.8	31.9	24.9	17.8	32.7
9/29/2007	0	0	48	N/A	N/A	N/A	N/A	N/A	N/A	N/A
9/30/2007	0	0	48	N/A	N/A	N/A	N/A	N/A	N/A	N/A
10/1/2007	0	0	45	N/A	N/A	N/A	N/A	N/A	N/A	N/A
10/2/2007	1	0	46	17.8	N/A	17.8	17.8	20.7	14.8	27.2
10/3/2007	7	0	29	16.4	11.1	6.7	39.3	19.1	13.7	25.1
10/4/2007	0	0	48	N/A	N/A	N/A	N/A	N/A	N/A	N/A
10/5/2007	0	0	48	N/A	N/A	N/A	N/A	N/A	N/A	N/A
10/6/2007	0	0	46	N/A	N/A	N/A	N/A	N/A	N/A	N/A
10/7/2007	0	0	47	N/A	N/A	N/A	N/A	N/A	N/A	N/A
10/8/2007	0	0	47	N/A	N/A	N/A	N/A	N/A	N/A	N/A
10/9/2007	22	0	15	40.6	17.5	14.8	78.5	47.3	33.8	62.1
10/10/2007	21	0	14	27.5	5.4	13.3	34.8	32.1	22.9	42.1
10/11/2007	7	0	11	18.8	5.8	13.3	30.4	22.0	15.7	28.8
10/12/2007	9	0	22	14.8	2.8	11.1	18.5	17.3	12.3	22.7
10/13/2007	0	0	0	N/A	N/A	N/A	N/A	N/A	N/A	N/A
10/14/2007	0	0	0	N/A	N/A	N/A	N/A	N/A	N/A	N/A
10/15/2007	0	0	0	N/A	N/A	N/A	N/A	N/A	N/A	N/A
10/16/2007	0	0	0	N/A	N/A	N/A	N/A	N/A	N/A	N/A
10/17/2007	0	0	6	N/A	N/A	N/A	N/A	N/A	N/A	N/A
10/18/2007	0	0	0	N/A	N/A	N/A	N/A	N/A	N/A	N/A
10/19/2007	0	0	24	N/A	N/A	N/A	N/A	N/A	N/A	N/A
10/20/2007	0	0	48	N/A	N/A	N/A	N/A	N/A	N/A	N/A
10/21/2007	0	0	46	N/A	N/A	N/A	N/A	N/A	N/A	N/A

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Date		Direction limited	Missing downwind NH_3	Emission average ($\mu gm^{-2}s^{-1}$)	Emission SD ($\mu gm^{-2}s^{-1}$)	Emission minimum ($\mu gm^{-2}s^{-1}$)	Emission maximum ($\mu gm^{-2}s^{-1}$)	Emission average (kgd^{-1})	Emission average ($gd^{-1}hd^{-1}$)	Emission average ($gd^{-1}AU^{-1}$)
10/22/2007	0	0	19	N/A	N/A	N/A	N/A	N/A	N/A	N/A
10/23/2007	0	0	48	N/A	N/A	N/A	N/A	N/A	N/A	N/A
10/24/2007	0	0	48	N/A	N/A	N/A	N/A	N/A	N/A	N/A
10/25/2007	0	0	48	N/A	N/A	N/A	N/A	N/A	N/A	N/A
10/26/2007	0	0	48	N/A	N/A	N/A	N/A	N/A	N/A	N/A
10/27/2007	0	0	48	N/A	N/A	N/A	N/A	N/A	N/A	N/A
10/28/2007	0	0	48	N/A	N/A	N/A	N/A	N/A	N/A	N/A
10/29/2007	0	0	48	N/A	N/A	N/A	N/A	N/A	N/A	N/A
10/30/2007	0	0	48	N/A	N/A	N/A	N/A	N/A	N/A	N/A
10/31/2007	0	0	48	N/A	N/A	N/A	N/A	N/A	N/A	N/A
11/1/2007	0	0	48	N/A	N/A	N/A	N/A	N/A	N/A	N/A
11/2/2007	0	0	48	N/A	N/A	N/A	N/A	N/A	N/A	N/A
11/3/2007	0	0	48	N/A	N/A	N/A	N/A	N/A	N/A	N/A
11/4/2007	0	0	48	N/A	N/A	N/A	N/A	N/A	N/A	N/A
11/5/2007	0	0	48	N/A	N/A	N/A	N/A	N/A	N/A	N/A
11/6/2007	0	0	48	N/A	N/A	N/A	N/A	N/A	N/A	N/A
11/7/2007	0	0	48	N/A	N/A	N/A	N/A	N/A	N/A	N/A
11/8/2007	0	0	48	N/A	N/A	N/A	N/A	N/A	N/A	N/A
11/9/2007	0	0	48	N/A	N/A	N/A	N/A	N/A	N/A	N/A
11/10/2007	0	0	48	N/A	N/A	N/A	N/A	N/A	N/A	N/A
11/11/2007	0	0	48	N/A	N/A	N/A	N/A	N/A	N/A	N/A
11/12/2007	0	0	48	N/A	N/A	N/A	N/A	N/A	N/A	N/A
11/13/2007	0	0	38	N/A	N/A	N/A	N/A	N/A	N/A	N/A
11/14/2007	0	0	48	N/A	N/A	N/A	N/A	N/A	N/A	N/A
11/15/2007	0	0	48	N/A	N/A	N/A	N/A	N/A	N/A	N/A
11/16/2007	0	0	39	N/A	N/A	N/A	N/A	N/A	N/A	N/A
11/17/2007	0	0	48	N/A	N/A	N/A	N/A	N/A	N/A	N/A
11/18/2007	0	0	48	N/A	N/A	N/A	N/A	N/A	N/A	N/A
11/19/2007	0	0	48	N/A	N/A	N/A	N/A	N/A	N/A	N/A
11/20/2007	0	0	48	N/A	N/A	N/A	N/A	N/A	N/A	N/A
11/21/2007	0	0	48	N/A	N/A	N/A	N/A	N/A	N/A	N/A
11/22/2007	0	0	48	N/A	N/A	N/A	N/A	N/A	N/A	N/A
11/23/2007	0	0	48	N/A	N/A	N/A	N/A	N/A	N/A	N/A
11/24/2007	0	0	48	N/A	N/A	N/A	N/A	N/A	N/A	N/A
11/25/2007	0	0	48	N/A	N/A	N/A	N/A	N/A	N/A	N/A
11/26/2007	0	0	48	N/A	N/A	N/A	N/A	N/A	N/A	N/A
11/27/2007	0	0	48	N/A	N/A	N/A	N/A	N/A	N/A	N/A
11/28/2007	0	0	48	N/A	N/A	N/A	N/A	N/A	N/A	N/A
11/29/2007	0	0	48	N/A	N/A	N/A	N/A	N/A	N/A	N/A
11/30/2007	0	0	48	N/A	N/A	N/A	N/A	N/A	N/A	N/A
1/30/2008	0	0	9	N/A	N/A	N/A	N/A	N/A	N/A	N/A
1/31/2008	0	0	48	N/A	N/A	N/A	N/A	N/A	N/A	N/A
2/1/2008	0	0	34	N/A	N/A	N/A	N/A	N/A	N/A	N/A
2/2/2008	0	0	48	N/A	N/A	N/A	N/A	N/A	N/A	N/A

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2/3/2008	0	0	48	N/A	N/A	N/A	N/A	N/A	N/A	N/A
2/4/2008	0	0	32	N/A	N/A	N/A	N/A	N/A	N/A	N/A
2/5/2008	0	0	14	N/A	N/A	N/A	N/A	N/A	N/A	N/A
2/6/2008	0	0	7	N/A	N/A	N/A	N/A	N/A	N/A	N/A
2/7/2008	0	0	7	N/A	N/A	N/A	N/A	N/A	N/A	N/A
2/8/2008	0	0	48	N/A	N/A	N/A	N/A	N/A	N/A	N/A
2/9/2008	0	0	48	N/A	N/A	N/A	N/A	N/A	N/A	N/A
2/10/2008	0	0	48	N/A	N/A	N/A	N/A	N/A	N/A	N/A
2/11/2008	0	0	48	N/A	N/A	N/A	N/A	N/A	N/A	N/A
2/12/2008	0	0	24	N/A	N/A	N/A	N/A	N/A	N/A	N/A
2/13/2008	0	0	15	N/A	N/A	N/A	N/A	N/A	N/A	N/A
2/14/2008	0	0	48	N/A	N/A	N/A	N/A	N/A	N/A	N/A
2/15/2008	0	0	48	N/A	N/A	N/A	N/A	N/A	N/A	N/A
2/16/2008	0	0	48	N/A	N/A	N/A	N/A	N/A	N/A	N/A
2/17/2008	0	0	48	N/A	N/A	N/A	N/A	N/A	N/A	N/A
2/18/2008	0	0	48	N/A	N/A	N/A	N/A	N/A	N/A	N/A
2/19/2008	0	0	48	N/A	N/A	N/A	N/A	N/A	N/A	N/A
2/20/2008	0	0	48	N/A	N/A	N/A	N/A	N/A	N/A	N/A
2/21/2008	0	0	34	N/A	N/A	N/A	N/A	N/A	N/A	N/A
3/5/2008	0	0	5	N/A	N/A	N/A	N/A	N/A	N/A	N/A
3/6/2008	0	0	48	N/A	N/A	N/A	N/A	N/A	N/A	N/A
3/7/2008	0	0	48	N/A	N/A	N/A	N/A	N/A	N/A	N/A
3/8/2008	0	0	27	N/A	N/A	N/A	N/A	N/A	N/A	N/A
3/9/2008	0	0	0	N/A	N/A	N/A	N/A	N/A	N/A	N/A
3/10/2008	0	0	20	N/A	N/A	N/A	N/A	N/A	N/A	N/A
3/11/2008	0	0	0	N/A	N/A	N/A	N/A	N/A	N/A	N/A
3/12/2008	0	0	5	N/A	N/A	N/A	N/A	N/A	N/A	N/A
3/13/2008	0	0	48	N/A	N/A	N/A	N/A	N/A	N/A	N/A
3/14/2008	0	0	48	N/A	N/A	N/A	N/A	N/A	N/A	N/A
3/15/2008	0	0	48	N/A	N/A	N/A	N/A	N/A	N/A	N/A
3/16/2008	0	0	48	N/A	N/A	N/A	N/A	N/A	N/A	N/A
3/17/2008	0	0	47	N/A	N/A	N/A	N/A	N/A	N/A	N/A
3/18/2008	0	0	48	N/A	N/A	N/A	N/A	N/A	N/A	N/A
3/19/2008	0	0	48	N/A	N/A	N/A	N/A	N/A	N/A	N/A
3/20/2008	0	0	43	N/A	N/A	N/A	N/A	N/A	N/A	N/A
3/21/2008	0	0	42	N/A	N/A	N/A	N/A	N/A	N/A	N/A
3/22/2008	0	0	48	N/A	N/A	N/A	N/A	N/A	N/A	N/A
3/23/2008	0	0	48	N/A	N/A	N/A	N/A	N/A	N/A	N/A
3/24/2008	0	0	47	N/A	N/A	N/A	N/A	N/A	N/A	N/A
3/25/2008	0	0	48	N/A	N/A	N/A	N/A	N/A	N/A	N/A
3/26/2008	0	0	48	N/A	N/A	N/A	N/A	N/A	N/A	N/A
3/27/2008	0	0	48	N/A	N/A	N/A	N/A	N/A	N/A	N/A
3/28/2008	0	0	48	N/A	N/A	N/A	N/A	N/A	N/A	N/A
3/29/2008	0	0	48	N/A	N/A	N/A	N/A	N/A	N/A	N/A

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3/30/2008	0	0	48	N/A	N/A	N/A	N/A	N/A	N/A	N/A
3/31/2008	0	0	48	N/A	N/A	N/A	N/A	N/A	N/A	N/A
4/1/2008	0	0	48	N/A	N/A	N/A	N/A	N/A	N/A	N/A
4/2/2008	0	0	48	N/A	N/A	N/A	N/A	N/A	N/A	N/A
4/3/2008	0	0	48	N/A	N/A	N/A	N/A	N/A	N/A	N/A
4/4/2008	0	0	48	N/A	N/A	N/A	N/A	N/A	N/A	N/A
4/5/2008	0	0	48	N/A	N/A	N/A	N/A	N/A	N/A	N/A
4/6/2008	0	0	48	N/A	N/A	N/A	N/A	N/A	N/A	N/A
4/7/2008	0	0	42	N/A	N/A	N/A	N/A	N/A	N/A	N/A
4/8/2008	0	0	48	N/A	N/A	N/A	N/A	N/A	N/A	N/A
4/9/2008	0	0	48	N/A	N/A	N/A	N/A	N/A	N/A	N/A
4/10/2008	0	0	48	N/A	N/A	N/A	N/A	N/A	N/A	N/A
4/11/2008	0	0	48	N/A	N/A	N/A	N/A	N/A	N/A	N/A
4/12/2008	0	0	48	N/A	N/A	N/A	N/A	N/A	N/A	N/A
4/13/2008	0	0	48	N/A	N/A	N/A	N/A	N/A	N/A	N/A
4/14/2008	0	0	48	N/A	N/A	N/A	N/A	N/A	N/A	N/A
4/15/2008	0	0	48	N/A	N/A	N/A	N/A	N/A	N/A	N/A
4/16/2008	0	0	48	N/A	N/A	N/A	N/A	N/A	N/A	N/A
4/17/2008	0	0	48	N/A	N/A	N/A	N/A	N/A	N/A	N/A
4/18/2008	0	0	48	N/A	N/A	N/A	N/A	N/A	N/A	N/A
4/19/2008	9	0	35	15.5	3.5	10.4	22.2	18.0	12.9	23.7
4/20/2008	20	0	19	15.0	6.9	4.4	31.1	17.5	12.5	22.9
4/21/2008	0	0	48	N/A	N/A	N/A	N/A	N/A	N/A	N/A
4/22/2008	0	0	48	N/A	N/A	N/A	N/A	N/A	N/A	N/A
4/23/2008	0	0	45	N/A	N/A	N/A	N/A	N/A	N/A	N/A
4/24/2008	0	0	48	N/A	N/A	N/A	N/A	N/A	N/A	N/A
4/25/2008	0	0	48	N/A	N/A	N/A	N/A	N/A	N/A	N/A
4/26/2008	14	0	30	35.2	6.0	23.7	45.2	41.0	29.3	53.9
4/27/2008	18	0	30	22.9	7.5	11.1	40.0	26.7	19.1	35.1
4/28/2008	16	0	22	23.4	9.8	7.4	40.0	27.3	19.5	35.8
4/29/2008	12	0	24	15.1	6.0	5.2	24.4	17.6	12.6	23.2
4/30/2008	1	0	47	19.3	N/A	19.3	19.3	22.5	16.0	29.5
5/1/2008	0	0	36	N/A	N/A	N/A	N/A	N/A	N/A	N/A
5/2/2008	0	0	45	N/A	N/A	N/A	N/A	N/A	N/A	N/A
5/3/2008	16	0	28	90.8	18.8	63.7	132.6	105.9	75.7	139.1
5/4/2008	5	0	32	52.7	21.7	24.4	77.8	61.5	43.9	80.8
5/5/2008	4	0	42	93.5	21.0	72.6	122.2	109.1	77.9	143.2
5/6/2008	1	0	46	53.3	N/A	53.3	53.3	62.2	44.4	81.7
5/7/2008	0	0	48	N/A	N/A	N/A	N/A	N/A	N/A	N/A
5/8/2008	7	0	40	21.6	4.0	17.0	28.9	25.2	18.0	33.1
5/9/2008	16	0	28	14.1	3.7	7.4	20.7	16.4	11.7	21.6
5/10/2008	15	0	33	14.9	3.6	8.9	20.7	17.3	12.4	22.8
5/11/2008	0	0	48	N/A	N/A	N/A	N/A	N/A	N/A	N/A
5/12/2008	13	0	32	13.3	4.0	8.1	20.0	15.5	11.1	20.3

	Valid values	Cause for invalid values		Emission						
Date		Direction limited	Missing downwind NH_3	Emission average ($\mu gm^{-2}s^{-1}$)	Emission SD ($\mu gm^{-2}s^{-1}$)	Emission minimum ($\mu gm^{-2}s^{-1}$)	Emission maximum ($\mu gm^{-2}s^{-1}$)	Emission average (kgd^{-1})	Emission average ($gd^{-1}hd^{-1}$)	Emission average ($gd^{-1}AU^{-1}$)
5/13/2008	0	0	48	N/A	N/A	N/A	N/A	N/A	N/A	N/A
5/14/2008	8	0	39	19.4	3.2	14.1	23.7	22.6	16.1	29.6
5/15/2008	11	0	33	16.4	2.4	12.6	20.0	19.2	13.7	25.2
5/16/2008	34	0	12	23.2	7.8	14.8	46.7	27.0	19.3	35.5
5/17/2008	1	0	47	41.5	N/A	41.5	41.5	48.4	34.6	63.5
5/18/2008	0	0	48	N/A	N/A	N/A	N/A	N/A	N/A	N/A
5/19/2008	0	0	48	N/A	N/A	N/A	N/A	N/A	N/A	N/A
5/20/2008	0	0	48	N/A	N/A	N/A	N/A	N/A	N/A	N/A
5/21/2008	0	0	48	N/A	N/A	N/A	N/A	N/A	N/A	N/A
5/22/2008	0	0	48	N/A	N/A	N/A	N/A	N/A	N/A	N/A
5/23/2008	0	0	48	N/A	N/A	N/A	N/A	N/A	N/A	N/A
5/24/2008	0	0	48	N/A	N/A	N/A	N/A	N/A	N/A	N/A
5/25/2008	0	0	48	N/A	N/A	N/A	N/A	N/A	N/A	N/A
5/26/2008	0	0	48	N/A	N/A	N/A	N/A	N/A	N/A	N/A
5/27/2008	0	0	35	N/A	N/A	N/A	N/A	N/A	N/A	N/A
5/28/2008	0	0	16	N/A	N/A	N/A	N/A	N/A	N/A	N/A
5/29/2008	0	0	48	N/A	N/A	N/A	N/A	N/A	N/A	N/A
5/30/2008	0	0	48	N/A	N/A	N/A	N/A	N/A	N/A	N/A
5/31/2008	0	0	48	N/A	N/A	N/A	N/A	N/A	N/A	N/A
6/1/2008	0	0	48	N/A	N/A	N/A	N/A	N/A	N/A	N/A
6/2/2008	0	0	48	N/A	N/A	N/A	N/A	N/A	N/A	N/A
6/3/2008	0	0	48	N/A	N/A	N/A	N/A	N/A	N/A	N/A
6/4/2008	0	0	48	N/A	N/A	N/A	N/A	N/A	N/A	N/A
6/5/2008	0	0	48	N/A	N/A	N/A	N/A	N/A	N/A	N/A
6/6/2008	0	0	47	N/A	N/A	N/A	N/A	N/A	N/A	N/A
6/7/2008	0	0	22	N/A	N/A	N/A	N/A	N/A	N/A	N/A
6/8/2008	0	0	0	N/A	N/A	N/A	N/A	N/A	N/A	N/A
6/9/2008	0	0	23	N/A	N/A	N/A	N/A	N/A	N/A	N/A
6/10/2008	0	0	48	N/A	N/A	N/A	N/A	N/A	N/A	N/A
6/11/2008	0	0	48	N/A	N/A	N/A	N/A	N/A	N/A	N/A
6/12/2008	0	0	48	N/A	N/A	N/A	N/A	N/A	N/A	N/A
6/13/2008	0	0	48	N/A	N/A	N/A	N/A	N/A	N/A	N/A
6/14/2008	18	0	26	42.1	17.4	13.3	80.7	49.2	35.1	64.5
6/15/2008	3	0	44	102.0	57.0	63.0	167.4	118.9	85.0	156.2
6/16/2008	15	0	28	55.3	33.0	26.7	151.1	64.5	46.0	84.6
6/17/2008	0	0	48	N/A	N/A	N/A	N/A	N/A	N/A	N/A
6/18/2008	0	0	48	N/A	N/A	N/A	N/A	N/A	N/A	N/A
6/19/2008	0	0	28	N/A	N/A	N/A	N/A	N/A	N/A	N/A
6/20/2008	8	0	10	50.9	28.9	17.0	97.8	59.4	42.4	78.0
6/21/2008	1	0	47	71.9	N/A	71.9	71.9	83.8	59.9	110.0
6/22/2008	0	0	48	N/A	N/A	N/A	N/A	N/A	N/A	N/A
6/23/2008	4	0	44	59.4	12.6	49.6	77.0	69.3	49.5	91.0
6/24/2008	0	0	48	N/A	N/A	N/A	N/A	N/A	N/A	N/A
6/25/2008	0	0	48	N/A	N/A	N/A	N/A	N/A	N/A	N/A

	Valid values	Cause for invalid values		Emission						
Date		Direction limited	Missing downwind NH_3	Emission average ($\mu gm^{-2}s^{-1}$)	Emission SD ($\mu gm^{-2}s^{-1}$)	Emission minimum ($\mu gm^{-2}s^{-1}$)	Emission maximum ($\mu gm^{-2}s^{-1}$)	Emission average (kgd^{-1})	Emission average ($gd^{-1}hd^{-1}$)	Emission average ($gd^{-1}AU^{-1}$)
6/26/2008	0	0	48	N/A	N/A	N/A	N/A	N/A	N/A	N/A
6/27/2008	0	0	48	N/A	N/A	N/A	N/A	N/A	N/A	N/A
6/28/2008	0	0	48	N/A	N/A	N/A	N/A	N/A	N/A	N/A
6/29/2008	0	0	48	N/A	N/A	N/A	N/A	N/A	N/A	N/A
6/30/2008	0	0	48	N/A	N/A	N/A	N/A	N/A	N/A	N/A
7/1/2008	0	0	48	N/A	N/A	N/A	N/A	N/A	N/A	N/A
7/2/2008	0	0	48	N/A	N/A	N/A	N/A	N/A	N/A	N/A
7/3/2008	0	0	48	N/A	N/A	N/A	N/A	N/A	N/A	N/A
7/4/2008	0	0	48	N/A	N/A	N/A	N/A	N/A	N/A	N/A
7/5/2008	0	0	48	N/A	N/A	N/A	N/A	N/A	N/A	N/A
7/6/2008	0	0	48	N/A	N/A	N/A	N/A	N/A	N/A	N/A
7/7/2008	0	0	48	N/A	N/A	N/A	N/A	N/A	N/A	N/A
7/8/2008	7	0	40	61.9	14.4	48.1	87.4	72.2	51.6	94.8
7/9/2008	13	0	33	45.4	15.0	23.0	77.8	53.0	37.8	69.5
7/10/2008	0	0	48	N/A	N/A	N/A	N/A	N/A	N/A	N/A
7/11/2008	5	0	43	36.7	4.8	28.9	40.7	42.9	30.6	56.3
7/12/2008	8	0	40	60.4	18.2	28.1	77.8	70.4	50.3	92.4
7/13/2008	37	0	11	50.0	10.6	31.1	68.9	58.4	41.7	76.6
7/14/2008	13	0	16	35.8	9.1	23.7	50.4	41.8	29.9	54.9

6.12.2 Daily NH_3 emission using bLS emissions model

Column headings for the following table are:

Date: Month/Day/Year

Valid: Number of ½ hour periods with valid emissions data

Direction limited: Number of ½ hour periods invalidated because wind was from an excluded wind direction

Touchdown limited: Number of ½ hour periods invalidated because fraction of source area surface covered by particle touchdowns was less than 0.1

Turbulence limited: Number of ½ hour periods that the bLS model was not run because either $u_* < 0.15$ ms^{-1} or $|L| < 2$ m

Background (ppm): bLS model calculated daily average background concentration (ppm); average is over the ½ hour periods included in the valid column

Emission average (μgm^{-2}s^{-1}): Daily average emission calculated from the valid ½ hour periods

Emissions SD (μgm^{-2}s^{-1}): Daily emission standard deviation of the valid ½ hour periods

Emission minimum (μgm^{-2}s^{-1}): Daily minimum emission of the valid ½ hour periods

Emission maximum (μgm^{-2}s^{-1}): Daily maximum emission of the valid ½ hour periods

Emission average (kgd^{-1}): Daily average emission calculated from the valid ½ hour periods; totaled over the source area

Emission average (gd^{-1}hd^{-1}): Daily average emission calculated from the valid ½ hour periods; totaled over the source area on a per head basis

Emission average (gd^{-1}AU^{-1}): Daily average emission calculated from the valid ½ hour periods; totaled over the source area on a per animal unit basis

Date	Valid	Direction limited	Touch-down limited	Turbulence limited	Back-ground (ppm)	Emission average (μgm^{-2}s^{-1})	Emission SD (μgm^{-2}s^{-1})	Emission minimum (μgm^{-2}s^{-1})	Emission maximum (μgm^{-2}s^{-1})	Emission average (kgd^{-1})	Emission average (gd^{-1}hd^{-1})	Emission average (gd^{-1}AU^{-1})
7/2/2007	5	0	1	1	-0.02	65.4	9.4	54.4	75.8	76.7	54.8	100.7
7/3/2007	21	0	0	25	-0.13	107.5	62.5	0.3	268.7	126.2	90.1	165.7
7/4/2007	28	0	5	14	-0.01	45.4	27.9	6.0	96.6	53.2	38.0	69.9
7/5/2007	17	0	20	2	-0.01	62.5	28.9	7.6	113.2	73.4	52.4	96.4
7/6/2007	5	0	12	30	0.00	38.3	24.0	13.4	67.7	45.0	32.1	59.0
7/7/2007	2	0	5	27	0.04	8.9	15.1	-1.8	19.6	10.4	7.4	13.7
7/8/2007	25	0	0	20	0.00	91.8	25.1	43.3	148.8	107.7	76.9	141.4
7/9/2007	29	0	0	19	0.00	117.6	37.3	41.4	191.0	138.0	98.6	181.2
7/10/2007	32	0	0	16	0.01	133.1	40.5	50.5	202.1	156.2	111.6	205.0
7/11/2007	12	0	19	1	0.01	76.6	25.1	41.8	123.1	89.8	64.2	117.9
7/12/2007	10	0	19	11	0.03	41.9	19.4	6.7	75.8	49.1	35.1	64.5
7/13/2007	5	0	33	8	-0.02	95.4	11.5	79.4	110.4	112.0	80.0	147.0
7/14/2007	2	0	0	7	-0.12	76.9	54.2	38.6	115.2	90.3	64.5	118.5
7/15/2007	20	0	0	17	-0.01	83.2	49.0	2.7	193.2	97.6	69.7	128.1
7/16/2007	12	0	3	29	-0.03	48.0	39.9	10.0	136.9	56.4	40.3	74.0
7/17/2007	29	0	2	16	0.01	28.6	23.6	-2.2	73.1	33.5	23.9	44.0
7/18/2007	36	0	1	11	-0.01	42.0	22.3	5.4	88.4	49.3	35.2	64.7
7/19/2007	44	0	2	2	-0.01	55.9	25.7	-0.3	123.8	65.6	46.8	86.1
7/20/2007	28	0	0	20	0.00	70.0	18.6	34.7	121.4	82.1	58.7	107.8
7/21/2007	22	0	0	26	0.01	32.5	22.3	-1.5	93.7	38.1	27.2	50.0
7/22/2007	23	0	0	25	0.03	23.8	13.0	6.1	43.1	27.9	19.9	36.6
7/23/2007	25	0	0	23	-0.01	51.6	31.7	10.9	105.6	60.5	43.2	79.5

Date	Valid	Direction limited	Touch-down limited	Turbulence limited	Back-ground (ppm)	Emission average ($\mu gm^{-2}s^{-1}$)	Emission SD ($\mu gm^{-2}s^{-1}$)	Emission minimum ($\mu gm^{-2}s^{-1}$)	Emission maximum ($\mu gm^{-2}s^{-1}$)	Emission average (kgd^{-1})	Emission average ($gd^{-1}hd^{-1}$)	Emission average ($gd^{-1}AU^{-1}$)
7/24/2007	8	0	0	27	0.06	62.4	25.6	11.9	85.2	73.2	52.3	96.2
7/25/2007	10	0	0	34	-0.03	59.4	29.1	4.5	89.7	69.7	49.8	91.5
7/26/2007	42	0	2	2	0.04	22.8	14.7	-1.5	53.6	26.8	19.1	35.2
7/27/2007	44	0	1	3	0.00	27.8	16.5	-7.8	57.8	32.6	23.3	42.8
7/28/2007	13	0	1	32	0.02	30.5	14.7	-5.8	55.5	35.7	25.5	46.9
7/29/2007	20	0	0	28	-0.01	72.8	16.3	36.8	101.3	85.5	61.0	112.2
7/30/2007	20	0	0	28	-0.01	50.2	24.9	22.2	90.9	58.9	42.1	77.4
7/31/2007	11	0	0	34	-0.03	68.6	39.3	28.2	154.7	80.4	57.5	105.6
8/1/2007	12	0	0	36	0.02	73.3	36.7	10.2	147.9	86.0	61.4	112.9
8/2/2007	20	0	0	27	-0.06	82.0	52.3	19.1	186.8	96.3	68.8	126.4
8/3/2007	22	0	0	20	-0.01	65.2	41.4	-3.3	153.5	76.5	54.6	100.4
8/4/2007	16	0	0	32	0.01	24.4	10.4	12.2	49.4	28.6	20.4	37.6
8/5/2007	41	0	0	7	0.02	36.7	25.4	2.5	82.0	43.1	30.8	56.6
8/6/2007	47	0	0	1	0.01	41.8	22.0	-3.8	90.7	49.0	35.0	64.3
8/7/2007	38	0	0	8	0.02	53.6	36.7	-2.9	130.2	62.9	44.9	82.6
8/8/2007	15	0	0	18	0.05	26.1	13.4	5.1	56.8	30.7	21.9	40.2
8/9/2007	0	0	0	0	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
8/10/2007	0	0	0	0	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
8/11/2007	0	0	0	0	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
8/12/2007	0	0	0	0	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
8/13/2007	0	0	0	0	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
8/14/2007	0	0	0	0	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
8/15/2007	9	0	2	3	0.01	7.0	5.7	0.9	16.1	8.2	5.8	10.7
8/16/2007	30	0	1	14	0.06	31.5	31.5	-9.0	76.3	36.9	26.4	48.5
8/17/2007	23	0	0	25	0.02	65.1	21.6	31.9	103.3	76.4	54.5	100.3
8/18/2007	21	0	6	20	0.04	10.9	27.4	-8.5	72.5	12.8	9.2	16.9
8/19/2007	33	0	9	6	0.02	17.0	22.4	-8.9	60.2	19.9	14.2	26.1
8/20/2007	34	0	11	2	0.04	8.4	22.7	-65.1	48.2	9.8	7.0	12.9
8/21/2007	18	0	24	5	0.02	28.3	27.4	0.4	85.6	33.2	23.7	43.6
8/22/2007	32	0	10	5	0.05	54.3	22.5	27.6	104.0	63.8	45.6	83.7
8/23/2007	26	0	6	15	0.01	37.9	32.1	-10.5	95.7	44.5	31.8	58.4
8/24/2007	35	0	0	8	0.03	30.4	36.5	0.3	138.8	35.7	25.5	46.9
8/25/2007	30	0	2	8	0.04	6.1	15.6	-3.6	64.4	7.2	5.1	9.4
8/26/2007	7	0	10	28	0.01	10.1	5.4	1.5	16.4	11.9	8.5	15.6
8/27/2007	20	0	0	26	0.05	19.0	25.1	-9.9	100.3	22.3	15.9	29.3
8/28/2007	30	0	0	18	0.07	6.2	8.0	-0.6	33.4	7.3	5.2	9.5
8/29/2007	24	0	0	22	-0.03	38.3	24.8	-9.9	75.0	44.9	32.1	59.0
8/30/2007	19	0	6	15	0.03	51.3	26.1	-3.7	76.6	60.2	43.0	79.1
8/31/2007	22	0	0	26	0.03	38.2	11.2	19.1	59.8	44.8	32.0	58.9
9/1/2007	22	0	0	19	0.08	-2.0	4.5	-9.8	5.4	-2.4	-1.7	-3.1
9/2/2007	0	0	0	19	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
9/3/2007	0	0	0	0	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
9/4/2007	0	0	0	0	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
9/5/2007	9	0	0	4	0.04	2.2	2.8	-0.2	6.9	2.6	1.9	3.4
9/6/2007	29	0	0	19	0.07	4.8	9.1	-2.7	36.8	5.6	4.0	7.3
9/7/2007	48	0	0	0	0.06	6.3	11.1	-6.9	31.4	7.3	5.2	9.6

Date	Valid	Direction limited	Touch-down limited	Turbulence limited	Back-ground (ppm)	Emission average ($\mu gm^{-2}s^{-1}$)	Emission SD ($\mu gm^{-2}s^{-1}$)	Emission minimum ($\mu gm^{-2}s^{-1}$)	Emission maximum ($\mu gm^{-2}s^{-1}$)	Emission average (kgd^{-1})	Emission average ($gd^{-1}hd^{-1}$)	Emission average ($gd^{-1}AU^{-1}$)
9/8/2007	33	0	1	14	0.06	8.0	9.8	-1.9	31.2	9.4	6.7	12.3
9/9/2007	24	0	0	20	0.01	42.9	21.5	1.5	70.6	50.3	36.0	66.1
9/10/2007	19	0	0	29	0.07	13.7	12.0	0.9	45.9	16.1	11.5	21.1
9/11/2007	24	0	12	10	0.03	49.5	16.4	28.4	113.1	58.1	41.5	76.3
9/12/2007	15	0	6	24	0.00	19.6	13.2	-0.9	45.1	23.0	16.4	30.2
9/13/2007	21	0	0	25	0.03	13.3	9.4	-1.2	26.1	15.7	11.2	20.6
9/14/2007	34	0	0	14	0.04	29.3	19.5	0.1	55.3	34.4	24.6	45.2
9/15/2007	23	0	0	25	0.02	17.6	8.1	5.6	35.8	20.6	14.7	27.1
9/16/2007	34	0	0	13	0.02	5.6	6.9	-0.7	20.7	6.6	4.7	8.7
9/17/2007	33	0	0	15	0.03	0.5	1.2	-1.8	3.3	0.6	0.4	0.8
9/18/2007	32	0	0	16	0.06	1.7	5.6	-6.8	15.7	2.0	1.4	2.6
9/19/2007	20	0	0	14	0.05	7.3	8.7	-1.2	23.1	8.6	6.2	11.3
9/20/2007	5	0	0	3	0.05	3.6	5.1	-1.5	12.1	4.2	3.0	5.5
9/21/2007	27	0	0	21	0.06	0.9	4.4	-8.5	10.7	1.1	0.8	1.4
9/22/2007	38	0	0	10	0.03	22.2	15.5	2.7	50.6	26.0	18.6	34.2
9/23/2007	23	0	0	25	0.05	0.7	3.0	-3.7	6.7	0.8	0.6	1.0
9/24/2007	39	0	0	9	0.07	0.6	2.7	-2.7	8.1	0.7	0.5	0.9
9/25/2007	48	0	0	0	0.07	8.4	8.5	-3.9	28.3	9.9	7.0	12.9
9/26/2007	32	0	0	15	0.05	14.6	10.7	-4.1	33.3	17.2	12.3	22.5
9/27/2007	25	0	2	17	0.03	15.9	11.7	-2.4	38.1	18.6	13.3	24.4
9/28/2007	20	0	0	24	0.03	19.2	6.4	10.3	33.7	22.6	16.1	29.6
9/29/2007	24	0	0	24	0.05	1.7	4.2	-4.0	13.4	2.0	1.4	2.7
9/30/2007	42	0	0	6	0.04	0.7	1.5	-0.9	7.2	0.8	0.6	1.1
10/1/2007	48	0	0	0	0.05	7.4	12.8	-6.1	36.7	8.7	6.2	11.4
10/2/2007	29	0	0	19	0.05	1.6	4.2	-6.4	10.1	1.9	1.4	2.5
10/3/2007	44	0	1	3	0.06	7.4	10.6	-7.3	27.1	8.7	6.2	11.5
10/4/2007	17	0	6	22	0.05	0.7	2.9	-4.8	7.0	0.8	0.6	1.1
10/5/2007	22	0	0	25	0.07	0.4	4.8	-6.2	14.5	0.5	0.3	0.6
10/6/2007	34	0	0	14	0.04	7.6	9.0	-1.9	26.7	8.9	6.4	11.7
10/7/2007	18	0	0	26	0.07	3.4	4.9	-3.1	15.2	3.9	2.8	5.2
10/8/2007	22	0	0	24	0.04	14.5	13.0	-3.0	41.6	17.1	12.2	22.4
10/9/2007	37	0	1	10	0.03	31.8	15.1	-2.1	62.9	37.3	26.6	49.0
10/10/2007	47	0	0	1	0.04	24.5	9.6	4.1	43.0	28.8	20.6	37.8
10/11/2007	26	0	0	1	0.03	22.4	9.1	7.1	34.8	26.3	18.8	34.5
10/12/2007	30	0	0	14	0.03	14.1	7.1	1.9	37.7	16.6	11.9	21.8
10/13/2007	0	0	0	0	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
10/14/2007	0	0	0	0	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
10/15/2007	0	0	0	0	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
10/16/2007	0	0	0	0	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
10/17/2007	1	0	3	0	0.06	-1.4	N/A	-1.4	-1.4	-1.6	-1.1	-2.1
10/18/2007	0	0	0	0	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
10/19/2007	0	0	22	0	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
10/20/2007	0	0	45	0	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
10/21/2007	0	0	46	0	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
10/22/2007	0	0	14	3	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
10/23/2007	7	0	4	7	0.04	-2.3	1.1	-3.8	-0.9	-2.7	-1.9	-3.6

Date	Valid	Direction limited	Touch-down limited	Turbulence limited	Back-ground (ppm)	Emission average ($\mu gm^{-2}s^{-1}$)	Emission SD ($\mu gm^{-2}s^{-1}$)	Emission minimum ($\mu gm^{-2}s^{-1}$)	Emission maximum ($\mu gm^{-2}s^{-1}$)	Emission average (kgd^{-1})	Emission average ($gd^{-1}hd^{-1}$)	Emission average ($gd^{-1}AU^{-1}$)
10/24/2007	19	0	14	10	0.05	-7.2	19.8	-88.5	1.6	-8.4	-6.0	-11.1
10/25/2007	34	0	13	1	0.04	-2.7	7.0	-20.5	9.2	-3.2	-2.3	-4.1
10/26/2007	46	0	0	2	0.01	1.9	2.7	-8.7	4.7	2.3	1.6	3.0
10/27/2007	23	0	9	5	0.03	0.1	1.7	-1.3	4.3	0.1	0.1	0.1
10/28/2007	6	0	9	30	0.05	-1.8	15.0	-19.5	19.9	-2.1	-1.5	-2.7
10/29/2007	20	0	0	22	0.03	4.1	5.0	-0.9	13.1	4.8	3.4	6.2
10/30/2007	16	0	4	24	0.01	3.3	1.4	1.6	6.8	3.9	2.8	5.1
10/31/2007	41	0	4	2	0.02	3.3	4.7	-3.1	16.4	3.8	2.7	5.0
11/1/2007	1	0	16	11	0.01	11.1	N/A	11.1	11.1	13.0	9.3	17.1
11/2/2007	16	0	0	27	0.01	3.4	3.0	0.3	12.6	4.0	2.8	5.2
11/3/2007	1	0	9	24	-0.01	1.8	N/A	1.8	1.8	2.2	1.5	2.8
11/4/2007	10	0	17	19	0.05	-1.4	11.3	-26.2	14.2	-1.6	-1.1	-2.1
11/5/2007	19	0	8	14	0.04	1.2	3.4	-6.5	8.3	1.4	1.0	1.8
11/6/2007	0	0	23	0	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
11/7/2007	9	0	8	27	0.04	12.8	18.3	-2.3	57.8	15.0	10.7	19.7
11/8/2007	31	0	0	15	0.03	6.1	8.4	-10.8	24.3	7.1	5.1	9.4
11/9/2007	0	0	16	18	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
11/10/2007	8	0	1	34	0.01	4.0	8.8	-1.0	25.5	4.7	3.3	6.1
11/11/2007	42	0	0	4	0.00	5.6	5.6	1.8	27.9	6.5	4.7	8.6
11/12/2007	42	0	1	3	0.03	3.9	5.2	-2.9	15.4	4.6	3.3	6.0
11/13/2007	11	0	3	18	0.03	-0.5	1.9	-2.4	2.7	-0.6	-0.4	-0.8
11/14/2007	22	0	7	0	0.03	0.3	2.9	-3.0	6.2	0.4	0.3	0.5
11/15/2007	0	0	4	0	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
11/16/2007	15	0	2	18	0.03	0.6	1.9	-2.7	3.9	0.7	0.5	0.9
11/17/2007	41	0	4	3	0.02	1.2	1.4	-1.7	4.3	1.4	1.0	1.9
11/18/2007	36	0	4	8	0.02	0.5	1.8	-2.6	3.9	0.6	0.4	0.8
11/19/2007	47	0	0	1	0.01	3.7	1.4	1.8	8.0	4.3	3.1	5.6
11/20/2007	48	0	0	0	0.03	-0.3	2.1	-3.1	3.7	-0.4	-0.3	-0.5
11/21/2007	36	0	8	0	0.03	0.1	1.8	-3.3	2.2	0.1	0.1	0.1
11/22/2007	3	0	5	0	0.04	-3.0	0.9	-3.7	-2.0	-3.6	-2.6	-4.7
11/23/2007	3	0	6	3	0.04	-0.4	0.6	-1.1	0.1	-0.5	-0.4	-0.7
11/24/2007	17	0	0	30	0.03	-0.8	1.8	-4.2	1.4	-1.0	-0.7	-1.3
11/25/2007	9	0	0	36	0.02	1.6	1.3	-0.5	2.9	1.9	1.4	2.5
11/26/2007	11	0	16	11	0.01	1.0	1.9	-1.7	2.9	1.2	0.9	1.6
11/27/2007	11	0	19	2	0.04	0.7	3.5	-2.5	7.6	0.8	0.6	1.1
11/28/2007	37	0	0	11	0.01	4.7	1.7	1.9	9.5	5.5	3.9	7.2
11/29/2007	10	0	23	0	0.03	1.3	2.8	-2.1	4.7	1.6	1.1	2.1
11/30/2007	19	0	5	11	0.03	2.6	7.6	-2.3	24.4	3.1	2.2	4.0
1/30/2008	0	0	1	1	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
1/31/2008	0	0	0	17	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
2/1/2008	0	0	0	0	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
2/2/2008	0	0	1	2	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
2/3/2008	0	0	3	24	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
2/4/2008	0	0	3	12	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
2/5/2008	0	0	1	2	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
2/6/2008	0	0	1	0	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A

Date	Valid	Direction limited	Touch-down limited	Turbulence limited	Back-ground (ppm)	Emission average ($\mu g m^{-2} s^{-1}$)	Emission SD ($\mu g m^{-2} s^{-1}$)	Emission minimum ($\mu g m^{-2} s^{-1}$)	Emission maximum ($\mu g m^{-2} s^{-1}$)	Emission average ($kg d^{-1}$)	Emission average ($g d^{-1} hd^{-1}$)	Emission average ($g d^{-1} AU^{-1}$)
2/7/2008	0	0	1	4	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
2/8/2008	0	0	2	16	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
2/9/2008	0	0	5	4	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
2/10/2008	0	0	0	0	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
2/11/2008	0	0	12	4	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
2/12/2008	0	0	0	0	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
2/13/2008	0	0	0	3	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
2/14/2008	0	0	0	10	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
2/15/2008	0	0	3	1	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
2/16/2008	0	0	4	29	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
2/17/2008	0	0	4	3	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
2/18/2008	0	0	0	0	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
2/19/2008	0	0	1	0	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
2/20/2008	0	0	4	14	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
2/21/2008	0	0	0	25	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
3/5/2008	0	0	0	2	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
3/6/2008	0	0	2	18	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
3/7/2008	0	0	0	11	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
3/8/2008	0	0	0	0	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
3/9/2008	0	0	0	0	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
3/10/2008	0	0	1	1	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
3/11/2008	0	0	0	0	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
3/12/2008	0	0	2	2	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
3/13/2008	0	0	1	6	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
3/14/2008	0	0	10	23	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
3/15/2008	0	0	1	22	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
3/16/2008	0	0	9	12	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
3/17/2008	0	0	6	7	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
3/18/2008	0	0	4	3	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
3/19/2008	0	0	0	5	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
3/20/2008	0	0	4	22	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
3/21/2008	0	0	3	11	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
3/22/2008	0	0	5	4	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
3/23/2008	0	0	13	26	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
3/24/2008	0	0	9	27	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
3/25/2008	0	0	2	6	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
3/26/2008	0	0	6	16	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
3/27/2008	0	0	5	10	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
3/28/2008	0	0	0	0	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
3/29/2008	0	0	0	0	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
3/30/2008	0	0	1	0	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
3/31/2008	0	0	0	0	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
4/1/2008	0	0	0	0	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
4/2/2008	0	0	1	21	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
4/3/2008	0	0	0	24	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
4/4/2008	0	0	0	10	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A

Date	Valid	Direction limited	Touch-down limited	Turbulence limited	Back-ground (ppm)	Emission average ($\mu gm^{-2}s^{-1}$)	Emission SD ($\mu gm^{-2}s^{-1}$)	Emission minimum ($\mu gm^{-2}s^{-1}$)	Emission maximum ($\mu gm^{-2}s^{-1}$)	Emission average (kgd^{-1})	Emission average ($gd^{-1}hd^{-1}$)	Emission average ($gd^{-1}AU^{-1}$)
4/5/2008	0	0	12	25	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
4/6/2008	0	0	16	18	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
4/7/2008	0	0	4	14	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
4/8/2008	0	0	2	7	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
4/9/2008	0	0	11	0	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
4/10/2008	0	0	0	0	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
4/11/2008	0	0	2	0	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
4/12/2008	0	0	11	0	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
4/13/2008	0	0	1	0	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
4/14/2008	0	0	4	1	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
4/15/2008	16	0	2	22	0.01	13.0	10.1	-6.2	27.6	15.3	10.9	20.0
4/16/2008	10	0	28	9	0.03	13.2	13.0	-13.2	31.9	15.5	11.1	20.3
4/17/2008	23	0	18	6	-0.02	25.0	9.7	6.1	39.3	29.3	20.9	38.4
4/18/2008	7	0	21	10	0.01	28.5	11.8	13.5	43.4	33.4	23.9	43.9
4/19/2008	26	0	7	7	-0.01	18.0	4.7	6.5	27.8	21.1	15.1	27.8
4/20/2008	39	0	0	9	-0.01	17.2	6.1	5.6	35.0	20.2	14.4	26.5
4/21/2008	3	0	17	23	0.00	1.0	27.1	-29.9	21.1	1.1	0.8	1.5
4/22/2008	12	0	10	17	0.01	14.3	9.7	-3.3	30.9	16.7	12.0	22.0
4/23/2008	18	0	5	22	-0.01	39.4	9.8	20.6	58.0	46.2	33.0	60.7
4/24/2008	1	0	19	3	0.00	45.7	N/A	45.7	45.7	53.6	38.3	70.3
4/25/2008	9	0	38	0	0.00	78.9	22.8	34.1	115.3	92.5	66.1	121.5
4/26/2008	40	0	5	0	-0.01	34.6	23.1	-0.2	77.2	40.7	29.0	53.4
4/27/2008	28	0	0	19	-0.01	26.7	10.5	4.7	43.8	31.3	22.3	41.1
4/28/2008	29	0	2	11	0.00	25.7	12.6	5.3	48.5	30.1	21.5	39.6
4/29/2008	48	0	0	0	0.00	21.1	7.1	9.6	38.4	24.8	17.7	32.5
4/30/2008	4	0	13	22	-0.02	16.4	2.6	13.7	20.0	19.3	13.8	25.3
5/1/2008	2	0	12	3	0.00	25.2	0.5	24.8	25.5	29.5	21.1	38.8
5/2/2008	6	0	39	0	-0.01	25.5	4.0	22.0	31.8	29.9	21.4	39.3
5/3/2008	27	0	17	4	-0.02	42.9	11.8	14.9	63.8	50.3	36.0	66.1
5/4/2008	32	0	1	15	-0.01	17.4	9.5	3.1	43.0	20.4	14.5	26.7
5/5/2008	24	0	0	17	-0.03	27.9	5.3	18.6	36.8	32.7	23.3	42.9
5/6/2008	31	0	4	13	-0.02	25.5	13.0	3.2	55.0	30.0	21.4	39.3
5/7/2008	18	0	1	6	-0.03	52.4	10.7	32.6	66.1	61.5	43.9	80.7
5/8/2008	44	0	0	1	-0.04	36.1	7.8	22.0	54.5	42.4	30.3	55.6
5/9/2008	37	0	0	6	-0.01	22.7	5.5	9.8	30.6	26.6	19.0	34.9
5/10/2008	11	0	16	18	-0.01	15.4	7.4	2.3	24.2	18.1	12.9	23.8
5/11/2008	12	0	9	3	-0.01	41.1	15.5	23.3	81.5	48.3	34.5	63.4
5/12/2008	43	0	0	1	0.01	18.7	8.1	5.2	35.8	22.0	15.7	28.9
5/13/2008	0	0	23	18	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
5/14/2008	24	0	14	2	-0.03	40.1	9.8	25.5	57.8	47.0	33.6	61.7
5/15/2008	36	0	2	10	-0.02	24.1	6.7	4.3	32.7	28.3	20.2	37.1
5/16/2008	47	0	0	0	-0.01	34.5	9.3	13.7	54.6	40.5	28.9	53.2
5/17/2008	45	0	0	2	-0.02	49.3	16.6	18.6	87.9	57.8	41.3	75.9
5/18/2008	0	0	8	3	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
5/19/2008	0	0	9	22	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
5/20/2008	0	0	5	12	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A

Date	Valid	Direction limited	Touch-down limited	Turbulence limited	Back-ground (ppm)	Emission average ($\mu gm^{-2}s^{-1}$)	Emission SD ($\mu gm^{-2}s^{-1}$)	Emission minimum ($\mu gm^{-2}s^{-1}$)	Emission maximum ($\mu gm^{-2}s^{-1}$)	Emission average (kgd^{-1})	Emission average ($gd^{-1}hd^{-1}$)	Emission average ($gd^{-1}AU^{-1}$)
5/21/2008	0	0	12	9	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
5/22/2008	0	0	14	19	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
5/23/2008	0	0	14	3	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
5/24/2008	0	0	11	8	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
5/25/2008	0	0	2	17	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
5/26/2008	0	0	9	0	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
5/27/2008	0	0	1	11	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
5/28/2008	0	0	10	0	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
5/29/2008	7	0	3	27	-0.09	29.3	21.8	15.7	76.1	34.4	24.6	45.2
5/30/2008	0	0	0	16	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
5/31/2008	9	0	14	0	0.00	88.6	12.1	58.8	97.0	103.9	74.2	136.4
6/1/2008	20	0	4	19	-0.02	47.5	15.1	12.8	77.7	55.8	39.9	73.3
6/2/2008	1	0	0	20	0.00	8.2	N/A	8.2	8.2	9.6	6.9	12.6
6/3/2008	1	0	1	8	-0.98	116.1	N/A	116.1	116.1	136.3	97.3	178.9
6/4/2008	6	0	0	6	-0.05	23.7	12.5	7.4	43.1	27.9	19.9	36.6
6/5/2008	0	0	0	0	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
6/6/2008	0	0	0	0	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
6/7/2008	0	0	0	0	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
6/8/2008	0	0	0	0	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
6/9/2008	1	0	1	0	-0.07	31.5	N/A	31.5	31.5	37.0	26.4	48.6
6/10/2008	14	0	14	10	-0.01	64.5	37.8	16.4	140.5	75.6	54.0	99.3
6/11/2008	0	0	11	21	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
6/12/2008	0	0	19	11	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
6/13/2008	3	0	26	2	-0.17	104.7	42.8	55.7	134.8	122.9	87.8	161.3
6/14/2008	26	0	5	17	-0.03	53.8	28.0	7.7	109.6	63.1	45.1	82.8
6/15/2008	19	0	3	22	0.00	88.0	30.9	32.5	146.5	103.3	73.8	135.6
6/16/2008	22	0	6	8	-0.02	63.8	37.1	0.7	159.1	74.9	53.5	98.3
6/17/2008	0	0	11	15	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
6/18/2008	0	0	8	18	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
6/19/2008	0	0	2	21	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
6/20/2008	19	0	0	0	-0.03	49.6	36.8	5.9	153.8	58.2	41.6	76.4
6/21/2008	23	0	4	11	0.07	40.4	30.8	-54.4	76.6	47.4	33.9	62.3
6/22/2008	0	0	14	18	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
6/23/2008	10	0	9	6	-0.01	54.2	15.9	36.5	75.7	63.6	45.5	83.5
6/24/2008	13	0	2	25	-0.01	45.7	17.2	20.2	74.4	53.6	38.3	70.4
6/25/2008	3	0	0	18	-0.04	10.3	6.0	5.2	16.9	12.1	8.6	15.9
6/26/2008	8	0	6	9	0.00	36.3	8.1	24.6	48.7	42.6	30.4	55.9
6/27/2008	0	0	0	19	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
6/28/2008	1	0	3	0	0.00	43.4	N/A	43.4	43.4	50.9	36.4	66.9
6/29/2008	0	0	5	9	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
6/30/2008	0	0	3	0	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
7/1/2008	5	0	8	22	-0.04	45.0	24.6	21.6	75.0	52.8	37.7	69.3
7/2/2008	0	0	0	14	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
7/3/2008	10	0	4	6	0.00	38.0	3.8	32.5	43.3	44.6	31.9	58.5
7/4/2008	25	0	10	10	0.00	27.5	5.2	15.6	36.6	32.3	23.1	42.4
7/5/2008	23	0	1	23	0.00	31.1	7.1	20.7	45.9	36.5	26.0	47.9

Date	Valid	Direction limited	Touch-down limited	Turbulence limited	Back-ground (ppm)	Emission average ($\mu gm^{-2}s^{-1}$)	Emission SD ($\mu gm^{-2}s^{-1}$)	Emission minimum ($\mu gm^{-2}s^{-1}$)	Emission maximum ($\mu gm^{-2}s^{-1}$)	Emission average (kgd^{-1})	Emission average ($gd^{-1}hd^{-1}$)	Emission average ($gd^{-1}AU^{-1}$)
7/6/2008	1	0	2	25	-0.04	10.7	N/A	10.7	10.7	12.6	9.0	16.5
7/7/2008	2	0	5	19	-0.01	18.9	25.0	1.2	36.6	22.2	15.8	29.1
7/8/2008	19	0	0	4	-0.04	77.8	13.6	40.4	97.0	91.3	65.2	119.9
7/9/2008	43	0	3	1	-0.02	50.8	11.0	26.7	80.2	59.6	42.5	78.2
7/10/2008	11	0	8	25	-0.02	79.4	19.3	38.6	100.4	93.2	66.6	122.4
7/11/2008	31	0	3	10	0.00	67.4	26.7	21.1	115.2	79.1	56.5	103.8
7/12/2008	21	0	14	3	-0.07	77.4	28.8	13.0	144.6	90.8	64.9	119.2
7/13/2008	46	0	1	1	-0.03	57.8	19.5	23.0	97.8	67.9	48.5	89.1
7/14/2008	8	0	0	20	-0.02	35.3	3.4	30.0	40.2	41.4	29.6	54.4

6.12.3 Daily H_2S emission using Ratiometric emissions model

Column headings for the following table are:

Date: Month/Day/Year
Valid: Number of ½ hour periods with valid emissions data
Emission average ($\mu gm^{-2}s^{-1}$): Daily average emission calculated from the valid ½ hour periods
Emissions SD ($\mu gm^{-2}s^{-1}$): Daily emission standard deviation of the valid ½ hour periods
Emission minimum ($\mu gm^{-2}s^{-1}$): Daily minimum emission of the valid ½ hour periods
Emission maximum ($\mu gm^{-2}s^{-1}$): Daily maximum emission of the valid ½ hour periods
Emission average (kgd^{-1}): Daily average emission calculated from the valid ½ hour periods; totaled over the source area
Emission average ($gd^{-1}hd^{-1}$): Daily average emission calculated from the valid ½ hour periods; totaled over the source area on a per head basis
Emission average ($gd^{-1}AU^{-1}$): Daily average emission calculated from the valid ½ hour periods; totaled over the source area on a per animal unit basis

Date	Count	Average ratioH_2S ($\mu gm^{-2}s^{-1}$)	SD ratioH_2S ($\mu gm^{-2}s^{-1}$)	Min ratioH_2S ($\mu gm^{-2}s^{-1}$)	Max ratioH_2S ($gm^{-2}s^{-1}$)	Area emissions average (kgd^{-1})	Area emissions average ($gd^{-1}hd^{-1}$)	Area emissions average ($gd^{-1}AU^{-1}$)
1/30/2008	0	N/A	N/A	N/A	N/A	N/A	N/A	N/A
1/31/2008	0	N/A	N/A	N/A	N/A	N/A	N/A	N/A
2/1/2008	0	N/A	N/A	N/A	N/A	N/A	N/A	N/A
2/2/2008	0	N/A	N/A	N/A	N/A	N/A	N/A	N/A
2/3/2008	0	N/A	N/A	N/A	N/A	N/A	N/A	N/A
2/4/2008	0	N/A	N/A	N/A	N/A	N/A	N/A	N/A
2/5/2008	0	N/A	N/A	N/A	N/A	N/A	N/A	N/A
2/6/2008	0	N/A	N/A	N/A	N/A	N/A	N/A	N/A
2/7/2008	0	N/A	N/A	N/A	N/A	N/A	N/A	N/A
2/8/2008	0	N/A	N/A	N/A	N/A	N/A	N/A	N/A
2/9/2008	0	N/A	N/A	N/A	N/A	N/A	N/A	N/A
2/10/2008	0	N/A	N/A	N/A	N/A	N/A	N/A	N/A
2/11/2008	0	N/A	N/A	N/A	N/A	N/A	N/A	N/A
2/12/2008	0	N/A	N/A	N/A	N/A	N/A	N/A	N/A
2/13/2008	0	N/A	N/A	N/A	N/A	N/A	N/A	N/A
2/14/2008	0	N/A	N/A	N/A	N/A	N/A	N/A	N/A
2/15/2008	0	N/A	N/A	N/A	N/A	N/A	N/A	N/A
2/16/2008	0	N/A	N/A	N/A	N/A	N/A	N/A	N/A
2/17/2008	0	N/A	N/A	N/A	N/A	N/A	N/A	N/A
2/18/2008	0	N/A	N/A	N/A	N/A	N/A	N/A	N/A
2/19/2008	0	N/A	N/A	N/A	N/A	N/A	N/A	N/A
2/20/2008	0	N/A	N/A	N/A	N/A	N/A	N/A	N/A
2/21/2008	0	N/A	N/A	N/A	N/A	N/A	N/A	N/A
2/22/2008	0	N/A	N/A	N/A	N/A	N/A	N/A	N/A
2/23/2008	0	N/A	N/A	N/A	N/A	N/A	N/A	N/A
2/24/2008	0	N/A	N/A	N/A	N/A	N/A	N/A	N/A
2/25/2008	0	N/A	N/A	N/A	N/A	N/A	N/A	N/A
2/26/2008	0	N/A	N/A	N/A	N/A	N/A	N/A	N/A
2/27/2008	0	N/A	N/A	N/A	N/A	N/A	N/A	N/A

Date	Count	Average ratioH_2S ($\mu gm^{-2}s^{-1}$)	SD ratioH_2S ($\mu gm^{-2}s^{-1}$)	Min ratioH_2S ($\mu gm^{-2}s^{-1}$)	Max ratioH_2S ($gm^{-2}s^{-1}$)	Area emissions average (kgd^{-1})	Area emissions average ($gd^{-1}hd^{-1}$)	Area emissions average ($gd^{-1}AU^{-1}$)
2/28/2008	0	N/A	N/A	N/A	N/A	N/A	N/A	N/A
2/29/2008	0	N/A	N/A	N/A	N/A	N/A	N/A	N/A
3/1/2008	0	N/A	N/A	N/A	N/A	N/A	N/A	N/A
3/2/2008	0	N/A	N/A	N/A	N/A	N/A	N/A	N/A
3/3/2008	0	N/A	N/A	N/A	N/A	N/A	N/A	N/A
3/4/2008	0	N/A	N/A	N/A	N/A	N/A	N/A	N/A
3/5/2008	0	N/A	N/A	N/A	N/A	N/A	N/A	N/A
3/6/2008	0	N/A	N/A	N/A	N/A	N/A	N/A	N/A
3/7/2008	0	N/A	N/A	N/A	N/A	N/A	N/A	N/A
3/8/2008	0	N/A	N/A	N/A	N/A	N/A	N/A	N/A
3/9/2008	0	N/A	N/A	N/A	N/A	N/A	N/A	N/A
3/10/2008	0	N/A	N/A	N/A	N/A	N/A	N/A	N/A
3/11/2008	0	N/A	N/A	N/A	N/A	N/A	N/A	N/A
3/12/2008	0	N/A	N/A	N/A	N/A	N/A	N/A	N/A
3/13/2008	0	N/A	N/A	N/A	N/A	N/A	N/A	N/A
3/14/2008	0	N/A	N/A	N/A	N/A	N/A	N/A	N/A
3/15/2008	0	N/A	N/A	N/A	N/A	N/A	N/A	N/A
3/16/2008	0	N/A	N/A	N/A	N/A	N/A	N/A	N/A
3/17/2008	0	N/A	N/A	N/A	N/A	N/A	N/A	N/A
3/18/2008	0	N/A	N/A	N/A	N/A	N/A	N/A	N/A
3/19/2008	0	N/A	N/A	N/A	N/A	N/A	N/A	N/A
3/20/2008	0	N/A	N/A	N/A	N/A	N/A	N/A	N/A
3/21/2008	0	N/A	N/A	N/A	N/A	N/A	N/A	N/A
3/22/2008	0	N/A	N/A	N/A	N/A	N/A	N/A	N/A
3/23/2008	0	N/A	N/A	N/A	N/A	N/A	N/A	N/A
3/24/2008	0	N/A	N/A	N/A	N/A	N/A	N/A	N/A
3/25/2008	0	N/A	N/A	N/A	N/A	N/A	N/A	N/A
3/26/2008	0	N/A	N/A	N/A	N/A	N/A	N/A	N/A
3/27/2008	0	N/A	N/A	N/A	N/A	N/A	N/A	N/A
3/28/2008	0	N/A	N/A	N/A	N/A	N/A	N/A	N/A
3/29/2008	0	N/A	N/A	N/A	N/A	N/A	N/A	N/A
3/30/2008	0	N/A	N/A	N/A	N/A	N/A	N/A	N/A
3/31/2008	0	N/A	N/A	N/A	N/A	N/A	N/A	N/A
4/1/2008	0	N/A	N/A	N/A	N/A	N/A	N/A	N/A
4/2/2008	0	N/A	N/A	N/A	N/A	N/A	N/A	N/A
4/3/2008	0	N/A	N/A	N/A	N/A	N/A	N/A	N/A
4/4/2008	0	N/A	N/A	N/A	N/A	N/A	N/A	N/A
4/5/2008	0	N/A	N/A	N/A	N/A	N/A	N/A	N/A
4/6/2008	0	N/A	N/A	N/A	N/A	N/A	N/A	N/A
4/7/2008	0	N/A	N/A	N/A	N/A	N/A	N/A	N/A
4/8/2008	0	N/A	N/A	N/A	N/A	N/A	N/A	N/A
4/9/2008	0	N/A	N/A	N/A	N/A	N/A	N/A	N/A
4/10/2008	0	N/A	N/A	N/A	N/A	N/A	N/A	N/A
4/11/2008	0	N/A	N/A	N/A	N/A	N/A	N/A	N/A
4/12/2008	0	N/A	N/A	N/A	N/A	N/A	N/A	N/A

Date	Count	Average ratioH_2S ($\mu gm^{-2}s^{-1}$)	SD ratioH_2S ($\mu gm^{-2}s^{-1}$)	Min ratioH_2S ($\mu gm^{-2}s^{-1}$)	Max ratioH_2S ($gm^{-2}s^{-1}$)	Area emissions average (kgd^{-1})	Area emissions average ($gd^{-1}hd^{-1}$)	Area emissions average ($gd^{-1}AU^{-1}$)
4/13/2008	0	N/A	N/A	N/A	N/A	N/A	N/A	N/A
4/14/2008	0	N/A	N/A	N/A	N/A	N/A	N/A	N/A
4/15/2008	0	N/A	N/A	N/A	N/A	N/A	N/A	N/A
4/16/2008	0	N/A	N/A	N/A	N/A	N/A	N/A	N/A
4/17/2008	0	N/A	N/A	N/A	N/A	N/A	N/A	N/A
4/18/2008	0	N/A	N/A	N/A	N/A	N/A	N/A	N/A
4/19/2008	0	N/A	N/A	N/A	N/A	N/A	N/A	N/A
4/20/2008	0	N/A	N/A	N/A	N/A	N/A	N/A	N/A
4/21/2008	0	N/A	N/A	N/A	N/A	N/A	N/A	N/A
4/22/2008	0	N/A	N/A	N/A	N/A	N/A	N/A	N/A
4/23/2008	0	N/A	N/A	N/A	N/A	N/A	N/A	N/A
4/24/2008	0	N/A	N/A	N/A	N/A	N/A	N/A	N/A
4/25/2008	0	N/A	N/A	N/A	N/A	N/A	N/A	N/A
4/26/2008	0	N/A	N/A	N/A	N/A	N/A	N/A	N/A
4/27/2008	0	N/A	N/A	N/A	N/A	N/A	N/A	N/A
4/28/2008	0	N/A	N/A	N/A	N/A	N/A	N/A	N/A
4/29/2008	0	N/A	N/A	N/A	N/A	N/A	N/A	N/A
4/30/2008	0	N/A	N/A	N/A	N/A	N/A	N/A	N/A
5/1/2008	0	N/A	N/A	N/A	N/A	N/A	N/A	N/A
5/2/2008	0	N/A	N/A	N/A	N/A	N/A	N/A	N/A
5/3/2008	0	N/A	N/A	N/A	N/A	N/A	N/A	N/A
5/4/2008	0	N/A	N/A	N/A	N/A	N/A	N/A	N/A
5/5/2008	0	N/A	N/A	N/A	N/A	N/A	N/A	N/A
5/6/2008	0	N/A	N/A	N/A	N/A	N/A	N/A	N/A
5/7/2008	0	N/A	N/A	N/A	N/A	N/A	N/A	N/A
5/8/2008	0	N/A	N/A	N/A	N/A	N/A	N/A	N/A
5/9/2008	0	N/A	N/A	N/A	N/A	N/A	N/A	N/A
5/10/2008	0	N/A	N/A	N/A	N/A	N/A	N/A	N/A
5/11/2008	0	N/A	N/A	N/A	N/A	N/A	N/A	N/A
5/12/2008	0	N/A	N/A	N/A	N/A	N/A	N/A	N/A
5/13/2008	0	N/A	N/A	N/A	N/A	N/A	N/A	N/A
5/14/2008	0	N/A	N/A	N/A	N/A	N/A	N/A	N/A
5/15/2008	0	N/A	N/A	N/A	N/A	N/A	N/A	N/A
5/16/2008	0	N/A	N/A	N/A	N/A	N/A	N/A	N/A
5/17/2008	0	N/A	N/A	N/A	N/A	N/A	N/A	N/A
5/18/2008	0	N/A	N/A	N/A	N/A	N/A	N/A	N/A
5/19/2008	0	N/A	N/A	N/A	N/A	N/A	N/A	N/A
5/20/2008	0	N/A	N/A	N/A	N/A	N/A	N/A	N/A
5/21/2008	0	N/A	N/A	N/A	N/A	N/A	N/A	N/A
5/22/2008	0	N/A	N/A	N/A	N/A	N/A	N/A	N/A
5/23/2008	0	N/A	N/A	N/A	N/A	N/A	N/A	N/A
5/24/2008	0	N/A	N/A	N/A	N/A	N/A	N/A	N/A
5/25/2008	0	N/A	N/A	N/A	N/A	N/A	N/A	N/A
5/26/2008	0	N/A	N/A	N/A	N/A	N/A	N/A	N/A
5/27/2008	0	N/A	N/A	N/A	N/A	N/A	N/A	N/A

Date	Count	Average ratioH_2S ($\mu gm^{-2}s^{-1}$)	SD ratioH_2S ($\mu gm^{-2}s^{-1}$)	Min ratioH_2S ($\mu gm^{-2}s^{-1}$)	Max ratioH_2S ($gm^{-2}s^{-1}$)	Area emissions average (kgd^{-1})	Area emissions average ($gd^{-1}hd^{-1}$)	Area emissions average ($gd^{-1}AU^{-1}$)
5/28/2008	0	N/A	N/A	N/A	N/A	N/A	N/A	N/A
5/29/2008	0	N/A	N/A	N/A	N/A	N/A	N/A	N/A
5/30/2008	0	N/A	N/A	N/A	N/A	N/A	N/A	N/A
5/31/2008	0	N/A	N/A	N/A	N/A	N/A	N/A	N/A
6/1/2008	0	N/A	N/A	N/A	N/A	N/A	N/A	N/A
6/2/2008	0	N/A	N/A	N/A	N/A	N/A	N/A	N/A
6/3/2008	0	N/A	N/A	N/A	N/A	N/A	N/A	N/A
6/4/2008	0	N/A	N/A	N/A	N/A	N/A	N/A	N/A
6/5/2008	0	N/A	N/A	N/A	N/A	N/A	N/A	N/A
6/6/2008	0	N/A	N/A	N/A	N/A	N/A	N/A	N/A
6/6/2008	0	N/A	N/A	N/A	N/A	N/A	N/A	N/A
6/7/2008	0	N/A	N/A	N/A	N/A	N/A	N/A	N/A
6/8/2008	0	N/A	N/A	N/A	N/A	N/A	N/A	N/A
6/9/2008	0	N/A	N/A	N/A	N/A	N/A	N/A	N/A
6/10/2008	0	N/A	N/A	N/A	N/A	N/A	N/A	N/A
6/11/2008	0	N/A	N/A	N/A	N/A	N/A	N/A	N/A
6/12/2008	0	N/A	N/A	N/A	N/A	N/A	N/A	N/A
6/13/2008	0	N/A	N/A	N/A	N/A	N/A	N/A	N/A
6/14/2008	4	0.1	2.6	0.0	0.1	0.1	0.1	0.1
6/15/2008	1	6.0	0.0	6.0	6.0	7.1	5.0	9.3
6/16/2008	6	0.1	3.5	-0.1	0.3	0.2	0.1	0.2
6/17/2008	0	N/A	N/A	N/A	N/A	N/A	N/A	N/A
6/18/2008	0	N/A	N/A	N/A	N/A	N/A	N/A	N/A
6/19/2008	0	N/A	N/A	N/A	N/A	N/A	N/A	N/A
6/20/2008	0	N/A	N/A	N/A	N/A	N/A	N/A	N/A
6/21/2008	0	N/A	N/A	N/A	N/A	N/A	N/A	N/A
6/22/2008	0	N/A	N/A	N/A	N/A	N/A	N/A	N/A
6/23/2008	4	-0.2	0.0	-0.3	0.0	-0.2	-0.1	-0.3
6/24/2008	0	N/A	N/A	N/A	N/A	N/A	N/A	N/A
6/25/2008	0	N/A	N/A	N/A	N/A	N/A	N/A	N/A
6/26/2008	0	N/A	N/A	N/A	N/A	N/A	N/A	N/A
6/27/2008	0	N/A	N/A	N/A	N/A	N/A	N/A	N/A
6/28/2008	0	N/A	N/A	N/A	N/A	N/A	N/A	N/A
6/29/2008	0	N/A	N/A	N/A	N/A	N/A	N/A	N/A
6/30/2008	0	N/A	N/A	N/A	N/A	N/A	N/A	N/A
7/1/2008	0	N/A	N/A	N/A	N/A	N/A	N/A	N/A
7/2/2008	0	N/A	N/A	N/A	N/A	N/A	N/A	N/A
7/3/2008	0	N/A	N/A	N/A	N/A	N/A	N/A	N/A
7/4/2008	0	N/A	N/A	N/A	N/A	N/A	N/A	N/A
7/5/2008	0	N/A	N/A	N/A	N/A	N/A	N/A	N/A
7/6/2008	0	N/A	N/A	N/A	N/A	N/A	N/A	N/A
7/7/2008	0	N/A	N/A	N/A	N/A	N/A	N/A	N/A
7/8/2008	0	N/A	N/A	N/A	N/A	N/A	N/A	N/A
7/9/2008	1	-0.1	0.0	-0.1	-0.1	-0.1	-0.1	-0.1
7/10/2008	0	N/A	N/A	N/A	N/A	N/A	N/A	N/A

Date	Count	Average ratioH_2S ($\mu g m^{-2} s^{-1}$)	SD ratioH_2S ($\mu g m^{-2} s^{-1}$)	Min ratioH_2S ($\mu g m^{-2} s^{-1}$)	Max ratioH_2S ($g m^{-2} s^{-1}$)	Area emissions average ($kg d^{-1}$)	Area emissions average ($g d^{-1} hd^{-1}$)	Area emissions average ($g d^{-1} AU^{-1}$)
7/11/2008	0	N/A	N/A	N/A	N/A	N/A	N/A	N/A
7/12/2008	0	N/A	N/A	N/A	N/A	N/A	N/A	N/A
7/13/2008	2	0.0	0.0	-0.2	0.1	0.0	0.0	0.0
7/14/2008	0	N/A	N/A	N/A	N/A	N/A	N/A	N/A

6.12.4 Daily H_2S emission using bLS emissions model

Column headings for the following table are:

Date: Month/Day/Year

Valid: Number of ½ hour periods with valid emissions data

Direction Limited: Number of ½ hour periods invalidated because wind was from an excluded wind direction

Angle limited: Number of ½ hour periods invalidated because angle of attack to the downwind side was greater than 60 degrees

Turbulence limited: Number of ½ hour periods that the bLS model was not run because either $u_* < 0.15$ ms^{-1} or $|L| < 2$ m

Background (ppb): bLS model calculated daily average background concentration (ppb); average is over the ½ hour periods included in the valid column

Emission average (µgm^{-2}s^{-1}): Daily average emission calculated from the valid ½ hour periods

Emissions SD (µgm^{-2}s^{-1}): Daily emission standard deviation of the valid ½ hour periods

Emission minimum (µgm^{-2}s^{-1}): Daily minimum emission of the valid ½ hour periods

Emission maximum (µgm^{-2}s^{-1}): Daily maximum emission of the valid ½ hour periods

Emission average (kgd^{-1}): Daily average emission calculated from the valid ½ hour periods; totaled over the source area

Emission average (gd^{-1}hd^{-1}): Daily average emission calculated from the valid ½ hour periods; totaled over the source area on a per head basis

Emission average (gd^{-1}AU^{-1}): Daily average emission calculated from the valid ½ hour periods; totaled over the source area on a per animal unit basis

Date	Valid	Direction limited	Angle limited	Turbulence limited	Background (ppb)	Emission average (µgm^{-2}s^{-1})	Emission SD (µgm^{-2}s^{-1})	Emission minimum (µgm^{-2}s^{-1})	Emission maximum (µgm^{-2}s^{-1})	Emission average (kgd^{-1})	Emission average (gd^{-1}hd^{-1})	Emission average (gd^{-1}AU^{-1})
2/8/2008	26	0	0	3	-0.1	0.0	0.2	-0.4	0.2	0.0	0.0	-0.1
2/9/2008	23	0	21	4	0.3	0.0	0.2	-0.6	0.5	0.0	0.0	0.0
2/10/2008	2	0	46	0	-1.5	0.2	0.0	0.2	0.3	0.3	0.2	0.4
2/11/2008	13	0	31	4	0.0	0.0	0.1	-0.3	0.2	0.0	0.0	0.0
2/12/2008	0	0	23	0	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
2/13/2008	3	0	9	3	-0.5	0.2	0.3	-0.1	0.4	0.3	0.2	0.4
2/14/2008	36	0	0	12	-0.1	0.1	0.3	-1.3	0.8	0.1	0.0	0.1
2/15/2008	41	0	6	1	0.2	-0.1	0.2	-0.4	0.6	-0.1	0.0	-0.1
2/16/2008	16	0	1	30	0.1	0.0	0.2	-0.5	0.4	0.0	0.0	0.0
2/17/2008	43	0	2	3	0.1	0.2	0.6	-0.8	3.1	0.2	0.1	0.3
2/18/2008	0	0	48	0	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
2/19/2008	1	0	47	0	0.9	-0.3	N/A	-0.3	-0.3	-0.3	-0.2	-0.4
2/20/2008	22	0	12	14	0.1	0.0	0.2	-0.3	0.3	0.0	0.0	0.0
2/21/2008	1	0	16	25	-0.2	-0.4	N/A	-0.4	-0.4	-0.4	-0.3	-0.6
2/22/2008	34	0	14	0	0.0	0.0	0.2	-0.3	0.5	0.0	0.0	0.0
2/23/2008	3	0	0	45	0.6	-0.1	0.1	-0.1	0.0	-0.1	-0.1	-0.1
2/24/2008	2	0	1	43	-0.9	0.1	0.2	0.0	0.3	0.2	0.1	0.2
2/25/2008	27	0	0	8	0.0	0.0	0.2	-0.4	0.6	0.0	0.0	0.1
2/26/2008	42	0	2	4	0.1	0.0	0.2	-0.5	0.5	0.0	0.0	0.1
2/27/2008	28	0	0	0	0.1	-0.1	0.3	-0.5	0.4	-0.1	-0.1	-0.1
2/28/2008	2	0	0	9	-0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2/29/2008	26	0	20	2	-0.1	0.0	0.3	-0.3	0.7	0.0	0.0	0.1

Date	Valid	Direction limited	Angle limited	Turbulence limited	Background (ppb)	Emission average ($\mu gm^{-2}s^{-1}$)	Emission SD ($\mu gm^{-2}s^{-1}$)	Emission minimum ($\mu gm^{-2}s^{-1}$)	Emission maximum ($\mu gm^{-2}s^{-1}$)	Emission average (kgd^{-1})	Emission average ($gd^{-1}hd^{-1}$)	Emission average ($gd^{-1}AU^{-1}$)
3/1/2008	4	0	34	10	-0.2	0.0	0.2	-0.2	0.1	0.0	0.0	-0.1
3/2/2008	42	0	4	2	-0.2	0.0	0.2	-0.5	0.4	0.0	0.0	0.0
3/3/2008	42	0	5	1	0.1	1.9	3.7	-0.3	14.4	2.2	1.6	2.9
3/4/2008	1	0	0	0	-0.6	0.4	N/A	0.4	0.4	0.4	0.3	0.6
5/28/2008	14	0	0	0	-1.9	6.2	2.8	1.0	11.1	7.2	5.1	9.5
5/29/2008	12	0	6	29	-1.4	1.3	1.5	-0.2	4.0	1.5	1.1	2.0
5/30/2008	31	0	0	17	-1.1	12.8	6.5	0.4	23.2	15.0	10.7	19.6
5/31/2008	20	0	26	0	-1.4	5.3	4.6	0.0	23.6	6.2	4.4	8.2
6/1/2008	19	0	8	19	-1.7	0.2	0.5	-0.1	1.7	0.3	0.2	0.4
6/2/2008	23	0	1	22	-1.8	0.0	0.2	-0.4	0.5	0.1	0.0	0.1
6/3/2008	36	0	2	8	-1.9	1.7	3.5	-0.4	17.4	2.0	1.5	2.7
6/4/2008	34	0	5	6	-1.7	0.1	0.3	-0.4	1.0	0.1	0.1	0.1
6/5/2008	47	0	0	0	-1.6	0.0	0.3	-0.6	0.6	0.0	0.0	0.1
6/6/2008	44	0	0	0	-1.5	0.2	0.3	-0.5	1.0	0.0	0.0	0.0
6/7/2008	21	0	0	0	-1.4	0.0	0.2	-0.2	0.3	0.0	0.0	0.0
6/8/2008	0	0	0	0	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
6/9/2008	20	0	1	0	-1.7	0.2	0.9	-0.7	3.7	0.3	0.2	0.3
6/10/2008	11	0	24	10	-1.8	0.2	0.2	0.0	0.6	0.2	0.1	0.2
6/11/2008	25	0	1	22	-1.6	0.2	0.3	-0.4	0.8	0.3	0.2	0.4
6/12/2008	36	0	0	12	-1.5	0.6	1.0	-0.4	3.1	0.7	0.5	1.0
6/13/2008	45	0	0	2	-1.7	0.2	0.3	-0.4	1.1	0.2	0.1	0.3
6/14/2008	16	0	14	17	-1.9	0.1	0.1	-0.1	0.3	0.1	0.1	0.1
6/15/2008	22	0	2	23	-1.8	0.8	1.6	-0.3	6.3	1.0	0.7	1.3
6/16/2008	20	0	13	8	-1.4	0.1	0.2	-0.3	0.4	0.1	0.1	0.1
6/17/2008	19	0	13	16	-1.6	0.1	0.3	-0.4	0.5	0.1	0.1	0.2
6/18/2008	16	0	14	18	-1.9	0.0	0.2	-0.3	0.5	0.0	0.0	0.0
6/19/2008	4	0	1	22	-1.5	0.0	0.2	-0.1	0.3	0.1	0.0	0.1
6/20/2008	0	0	0	0	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
6/21/2008	21	0	15	11	-1.7	0.0	0.2	-0.5	0.4	0.0	0.0	0.1
6/22/2008	16	0	11	19	-1.7	0.0	0.2	-0.4	0.4	0.0	0.0	0.0
6/23/2008	40	0	2	6	-1.6	0.0	0.2	-0.5	0.3	0.0	0.0	0.0
6/24/2008	11	0	9	26	-1.6	0.0	0.1	-0.2	0.2	0.0	0.0	0.0
6/25/2008	24	0	2	18	-1.6	0.1	0.3	-0.4	0.7	0.2	0.1	0.2
6/26/2008	28	0	9	10	-1.5	0.0	0.1	-0.3	0.3	0.0	0.0	0.0
6/27/2008	29	0	0	19	-1.6	0.0	0.2	-0.2	0.4	0.0	0.0	0.1
6/28/2008	28	0	20	0	-1.9	0.2	0.2	-0.2	0.6	0.2	0.1	0.2
6/29/2008	17	0	20	9	-1.4	0.0	0.4	-0.7	0.8	0.0	0.0	0.0
6/30/2008	36	0	12	0	-1.8	0.0	0.2	-0.6	0.7	0.0	0.0	0.0
7/1/2008	16	0	8	24	-1.5	0.0	0.2	-0.3	0.5	0.0	0.0	0.0
7/2/2008	33	0	0	14	-1.7	0.0	0.3	-0.5	1.3	0.0	0.0	0.1
7/3/2008	37	0	3	6	-1.5	0.0	0.2	-0.2	0.5	0.0	0.0	0.1
7/4/2008	6	0	32	10	-1.1	0.0	0.1	-0.1	0.3	0.0	0.0	0.0
7/5/2008	16	0	9	23	-1.6	0.0	0.1	-0.2	0.2	0.0	0.0	0.0
7/6/2008	17	0	3	26	-1.6	0.0	0.2	-0.2	0.5	0.0	0.0	0.0
7/7/2008	22	0	3	19	-1.8	0.0	0.2	-0.3	0.4	0.0	0.0	0.0
7/8/2008	36	0	8	4	-1.6	0.0	0.2	-0.4	0.5	0.0	0.0	0.0

Date	Valid	Direction limited	Angle limited	Turbulence limited	Background (ppb)	Emission average ($\mu gm^{-2}s^{-1}$)	Emission SD ($\mu gm^{-2}s^{-1}$)	Emission minimum ($\mu gm^{-2}s^{-1}$)	Emission maximum ($\mu gm^{-2}s^{-1}$)	Emission average (kgd^{-1})	Emission average ($gd^{-1}hd^{-1}$)	Emission average ($gd^{-1}AU^{-1}$)
7/9/2008	34	0	13	1	-1.6	0.0	0.2	-0.4	0.4	0.0	0.0	0.0
7/10/2008	23	0	0	25	-2.0	0.0	0.2	-0.4	0.4	0.0	0.0	0.1
7/11/2008	30	0	5	10	-1.5	0.0	0.2	-0.5	0.3	0.0	0.0	0.0
7/12/2008	33	0	9	3	-1.6	0.0	0.2	-0.3	0.3	0.0	0.0	0.0
7/13/2008	8	0	39	1	-1.7	0.1	0.1	-0.2	0.2	0.1	0.0	0.1