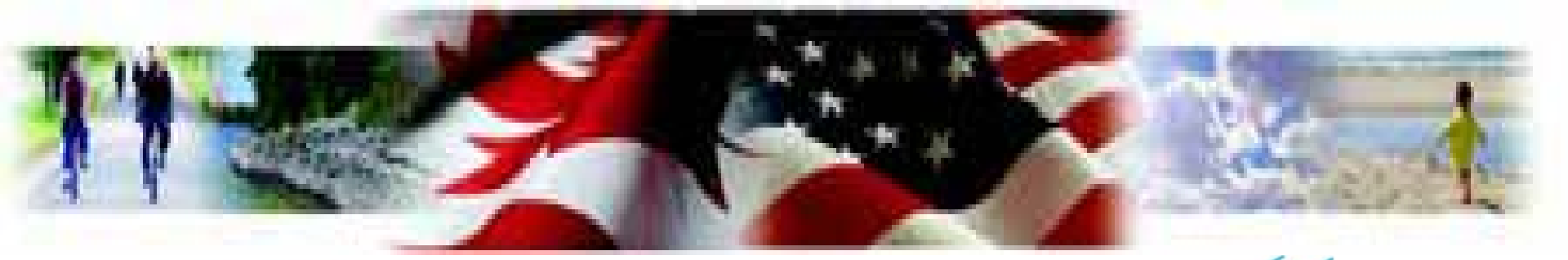

Healthy Environments and Consumer Safety Branch

Air Health Effects Division, Health Canada

BORDER AIR QUALITY STRATEGY (BAQS)

Detroit MI, 21 October 2005

Canada

RESEARCH COLLABORATORS

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Ron Williams – NERL, US EPA

WHY CONDUCT RESEARCH ON HEALTH AND AIR QUALITY IN WINDSOR?

- **To address community concerns regarding:**
  - Sources of air pollution
  - Personal exposure
  - Links between air pollution and public health
- **To further develop air quality policies and address knowledge gaps with respect to:**
  - Exposure misclassification (i.e., ambient vs. indoor air exposure)
  - Susceptible populations (i.e., children, seniors, pregnant women)
  - Long-term health effects
- **To develop accurate air health messaging and tools i.e. the Air Quality Index (AQI)**
- **To assist in facilitating coordinated airshed planning and management amongst different sectors and jurisdictions both domestically and internationally**

HEALTH OUTCOMES

Short- & long-term health effects

- Lung health of children
- Cardiac effects of diabetics
- Mortality
- Cancer
- Birth Outcomes
- Toxicology

Health within/across region

- Regional variation of health impacts

Health impacts quantification (health economics)

COLLABORATIVE PROJECTS WITH UNIVERSITY OF WINDSOR

- LUR models for NO_2, four seasons
- Monitoring of black carbon and PM near the Bridge
- HYSPLIT modeling of regional transport of air pollutants
- Source apportionment of ambient VOCs
  - Use models like Chemical Mass Balance to identify source contribution
  - Results could be useful in pollution control
- Air exposure assessment in Sarnia

BLACK CARBON AND PM MONITORING NEAR THE AMBASSADOR BRIDGE

- Areas with high NO2 concentrations
- A year and half monitoring near the Bridge
  - Temporal variability: seasonal, day of week, and time of day
  - Association with traffic
  - Effect of meteorological conditions
  - Correlation between black carbon, PM and fine PM
  - Changes in dispersive patterns when moving away from the road
- Hot spots in local air quality
- Modification/calibration of air dispersion models: plume in-grid, CAL_LINE, AIRMOD

HYSPLIT – MODELLING REGIONAL TRANSPORT OF AIR POLLUTANTS

- Identify regions that frequently influence Windsor's air quality
- Study the sensitivity of results to modeling resolution: number of runs per week
- *Seasonal variability of regional transport of pollutants
- *Use of monitoring data to ground truth the modeling results

SARNIA EXPOSURE ASSESSMENT AND SURVEY

- SSHRC/NSERC funding
- Surveying self-reported health status and perceived risks
- Monitoring of exposure during the same time as the survey
- Geo-spatial modeling, which one of the following correlates better with the perceived risks, based on:
  - Emissions
  - Long term monitoring
  - Two-week monitoring at time of survey
- Is socio-economic status a factor
- Environmental engineering-social justice-sustainable urban development

PASSIVE SPATIAL MONITORING (2004)

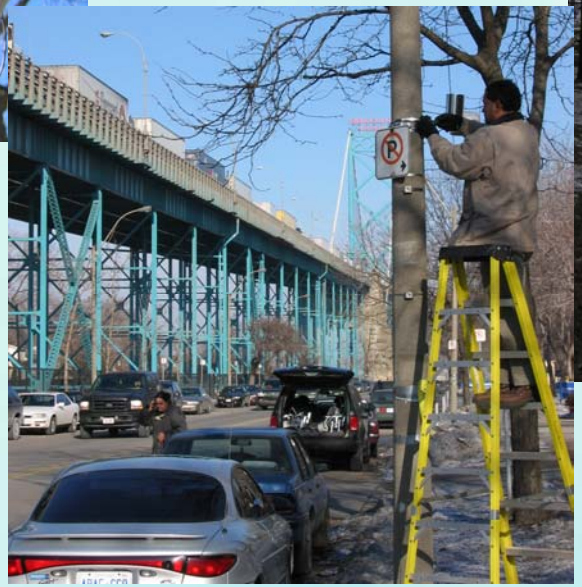
- **Spatial monitoring**
  - 60 sites
  - 8 permanent sites across airshed

- **Phase A – Windsor (2004 – 2007)**
- **Phase B – Windsor – Chatham (2004)**
- **Phase C – Chatham – Sarnia (2004)**

- **Two week integrated sampling using passive monitors**
  - Volatile Organic Compounds
  - Nitrogen Dioxide & Sulfur Dioxide

- **Development of LUR models**
  - Health Canada
  - University of Windsor

SPATIAL MONITORING



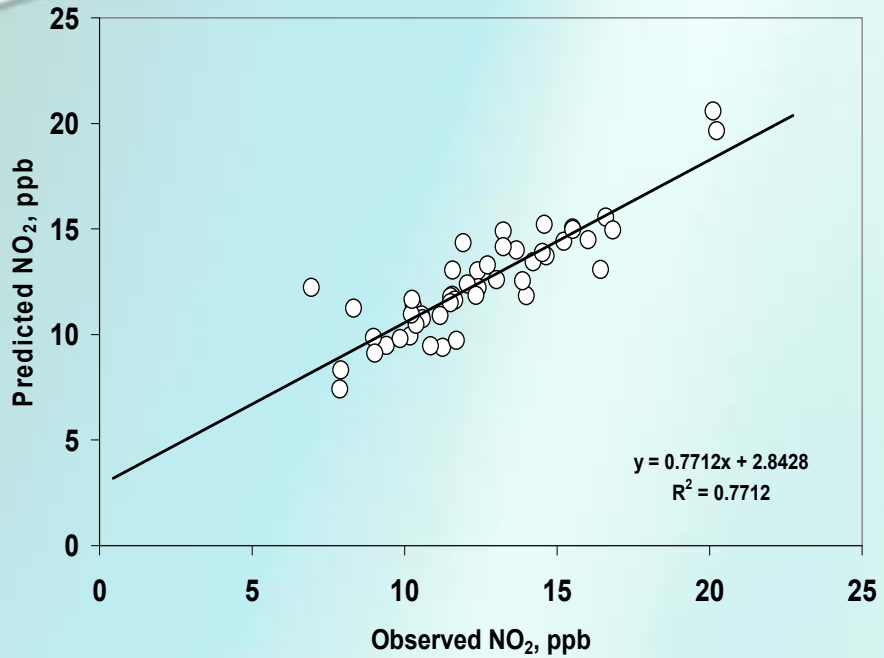
MULTIPLE LINEAR REGRESSION MODELS

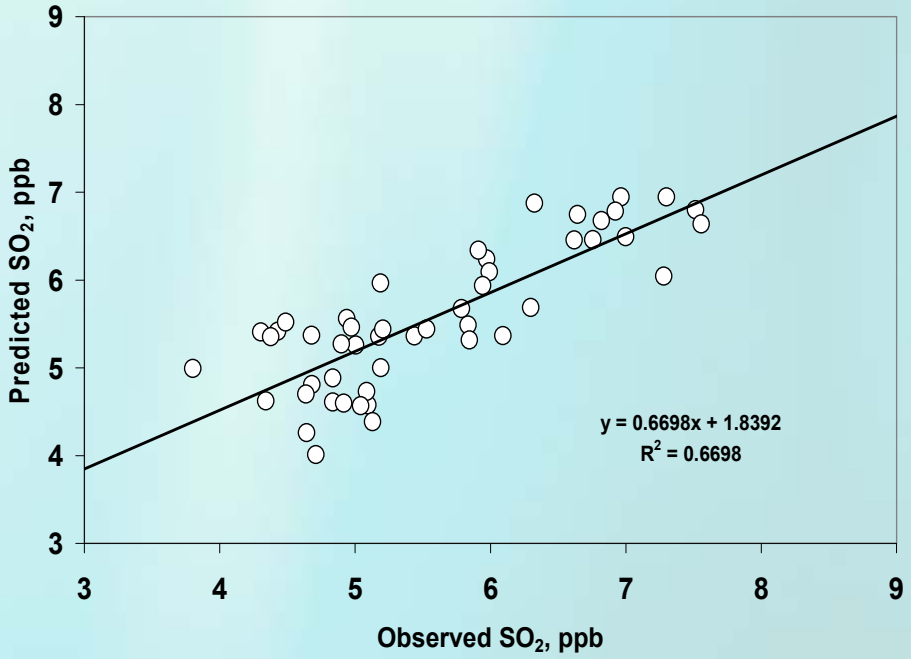
		Variable		
NO_2, R^2 is 0.7738	**Unit**	**ß**	**t-value**	**P-value**
Intercept		14.86	33.75	<.0001
Distance to Ambassador Bridge	km	-0.49	-8.96	<.0001
Length of Expressways and Highways within 50 m	km	38.46	5.63	<.0001
Length of major roads within 100 m	km	5.61	3.47	0.0011
SO_2, R^2 is 0.6853				
Intercept		5.95	16.92	<.0001
Distance to Ambassador Bridge	km	-0.15	-5.13	<.0001
Dwelling density within 1500 m	dwellings/km^2	0.0005	2.29	0.026
Detroit. SO_2 emission point sources within 3000 m		0.61	2.75	0.008

MULTIPLE LINEAR REGRESSION MODELS

		Variable		
Benzene, R^2 is 0.7248	**Unit**	**ß**	**t-value**	**P-value**
Intercept		0.53	13.18	<.0001
Length of major roads within 100 m	km	0.81	4.88	<.0001
Length of expressway & primary highway within 50 m	km	2.46	3.62	0.0007
Detroit VOC emission point sources within 4000 m		0.19	4.35	<.0001
Windsor VOC emission point sources within 3000 m		0.27	6.16	<.0001
Toluene, R^2 is 0.4601				
Intercept		2.97	11.14	<.0001
Distance to Ambassador Bridge	km	-0.96	-3.07	0.0035
Length of major roads within 200 m	km	0.68	1.96	0.0554
Length of primary highways within 100 m	km	2.5	2.19	0.0330
Windsor VOC emission point sources within 1000 m		0.83	2.88	0.0059

OBSERVED VS PREDICTED



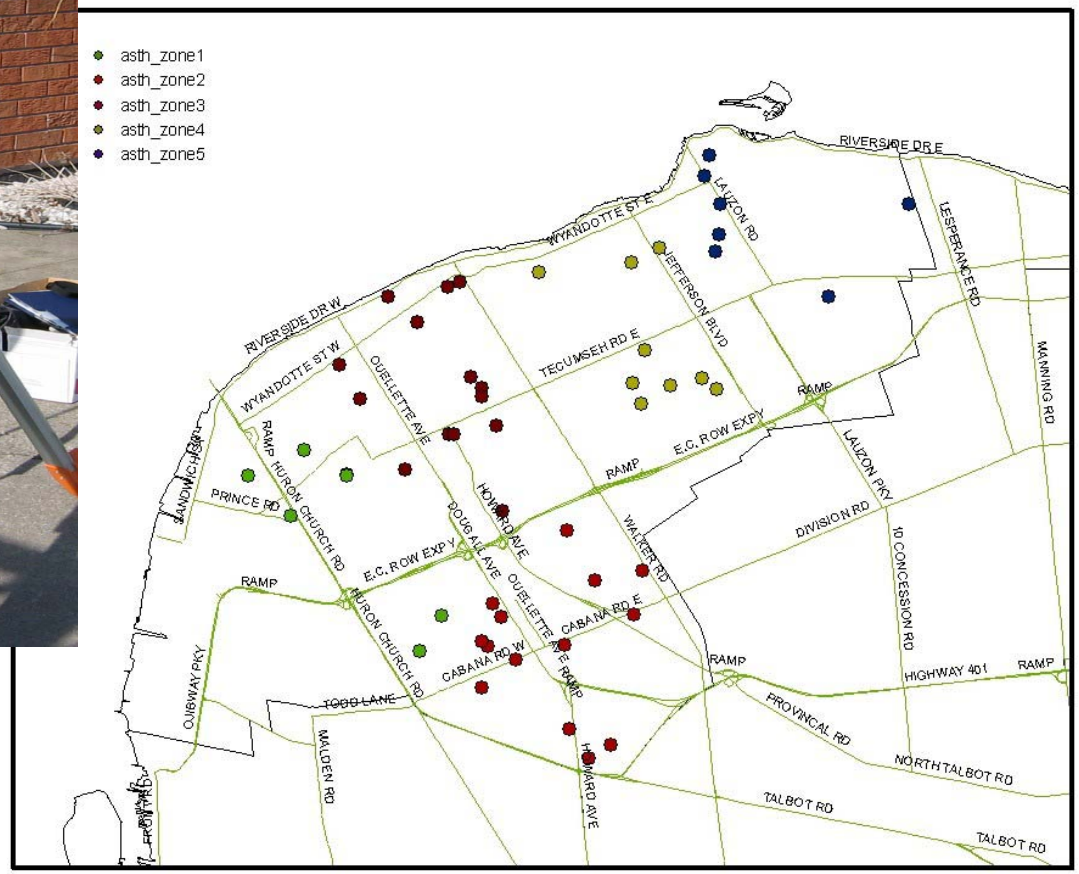


CURRENT SPATIAL MONITORING

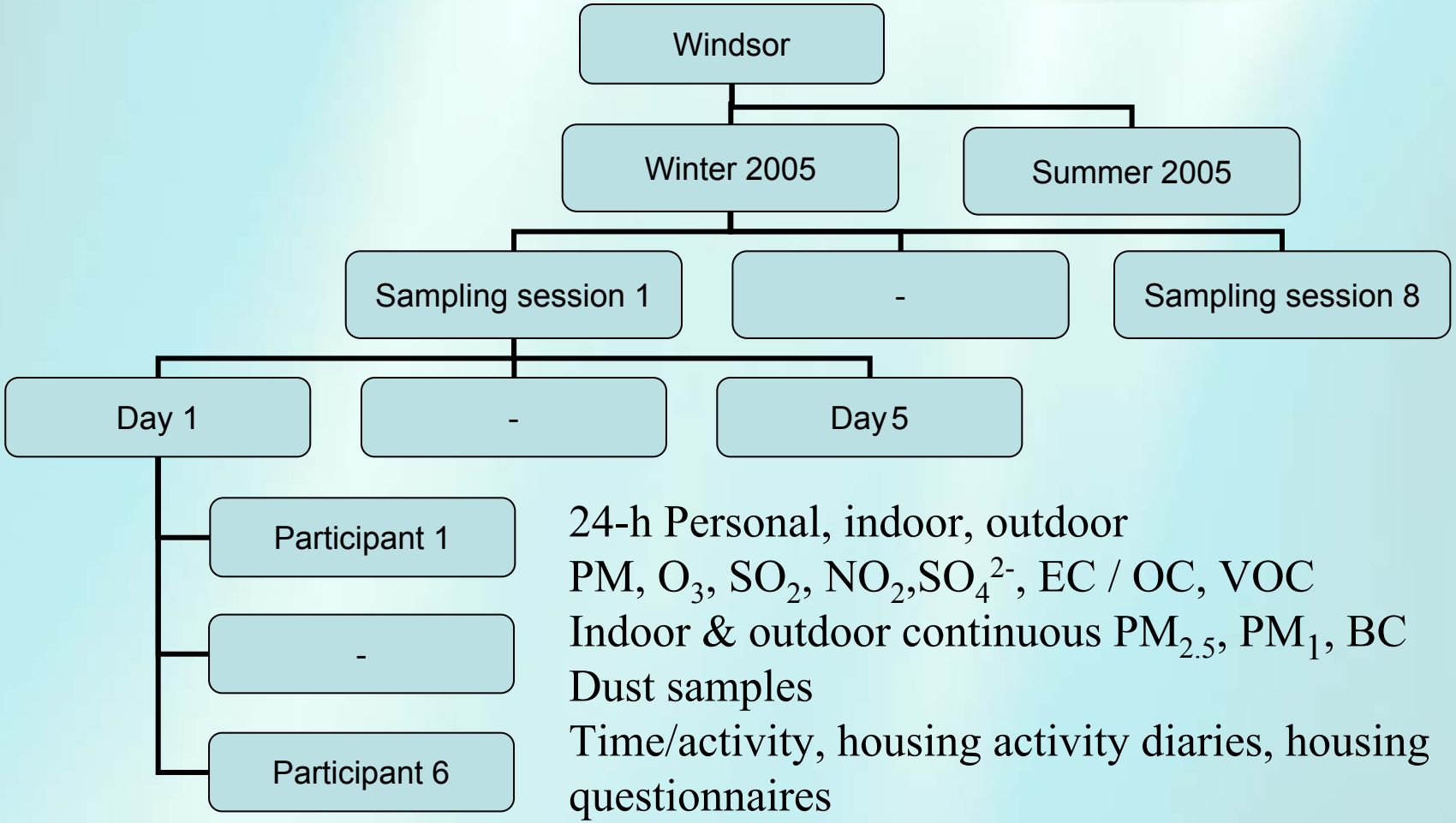
- **Spatial active monitoring**
  - 50 sites located in personal exposure participant's back yard & co-located with National Air Pollution Survey and Detroit's Allen Park site
  - 4 seasons
- **Two week integrated sampling**
  - Particulate Matter ($PM_{2.5}$, $PM_{2.5-10}$)
  - Total Polycyclic Aromatic Hydrocarbons (PAH)
  - Total Acid Vapour (formic, acetic & nitric)
  - Volatile Organic Compounds
  - Nitrogen dioxide and sulfur dioxide

SPATIAL MONITORING

HECS



PERSONAL EXPOSURE ASSESSMENT STUDY – Adults (2005)



24-h Personal, indoor, outdoor
PM, O_3, SO_2, NO_2,SO_4^{2-}, EC / OC, VOC
Indoor & outdoor continuous $PM_{2.5}$, PM_1, BC
Dust samples
Time/activity, housing activity diaries, housing questionnaires

PERSONAL EXPOSURE STUDY - METHODS

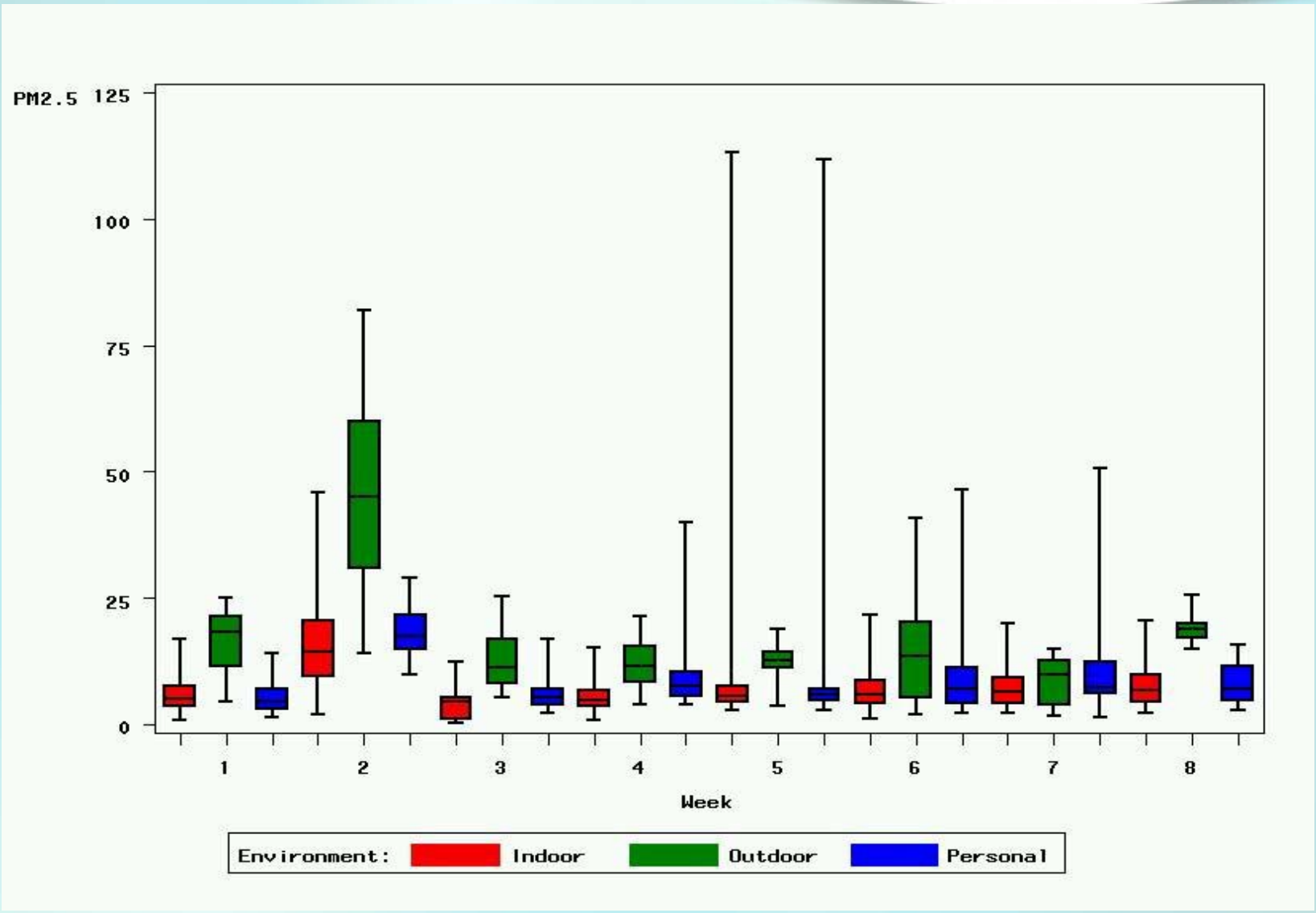
Pollutant	Personal Samples	Indoor Samples	Outdoor Samples
Particulate Matter ($PM_{2.5}$ and PM_{10})	Chempass PEM (4 lpm) Mass, Metals	Chempass PEM (4 lpm) Mass, Metals	Chempass PEM (4 lpm) Mass, Metals
PM_1 Continuous	-	Ptrak	Ptrak
$PM_{2.5}$ Continuous	-	Dustrak	Dustrak
Black Carbon	-	Aethalometer	Aethalometer
Air Exchange Rates	-	PFT	-
Dust samples	-	Floor sample - Vacuum	-
Nitrogen Dioxide / Sulfur Dioxide	Ogawa (passive)	Ogawa (passive)	Ogawa (passive)
Ozone (summer)	Ogawa (passive)	-	Ogawa (passive)
Nitrate	Chempass Mini - Denuder (0.8 lpm)	Chempass Mini - Denuder (0.8 lpm)	Chempass Mini - Denuder (0.8 lpm)
Elemental Carbon / Organic Carbon	Chempass Mini - PEM (0.8 lpm)	Chempass Mini - PEM (0.8 lpm)	Chempass Mini - PEM (0.8 lpm)
Volatile Organic Compounds	Summa Canister (1 litre)	Summa Canister (6 litre)	Summa Canister (6 litre)

PARTICIPANT FEEDBACK MEETING - JUNE 2005

- Timing
  - Preliminary winter results (June 2005)
    - ✓ $PM_{2.5}$
    - ✓ Benzene
  - Winter final data (November 2005)
  - Summer preliminary results (December 2005)
  - Final report for both seasons (March 2006)
  - Scientific publications (On-going)

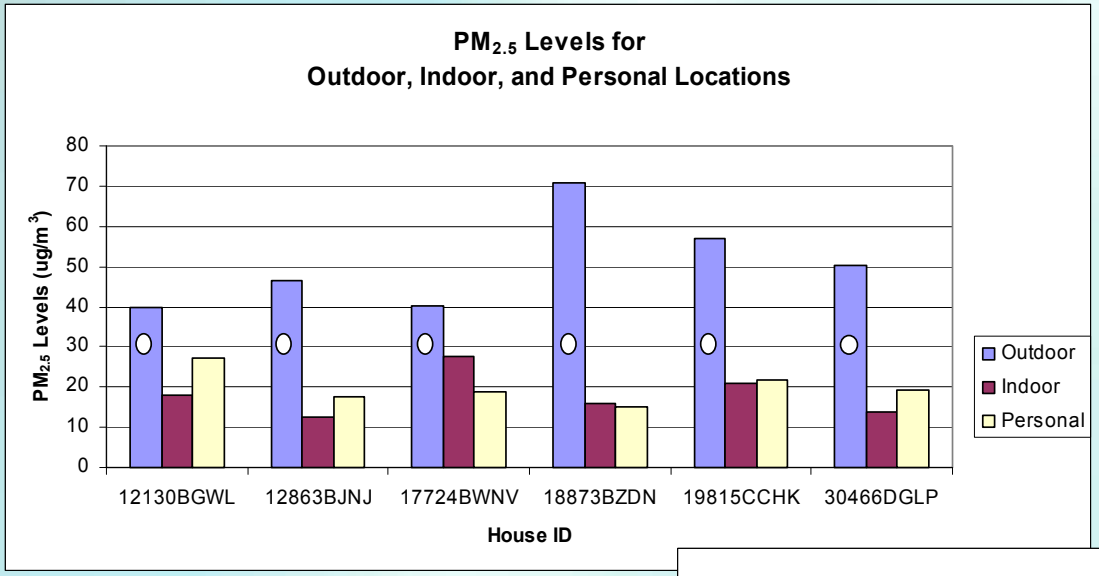
- Summer Recruitment
  - 43 original winter participants + 2 new recruits for 45 total
    - 3 original participants moved from the area
    - 1 home renovation / 1 personal issues / 1 business trip

WINTER $PM_{2.5}$ DESCRIPTIVE STATISTICS



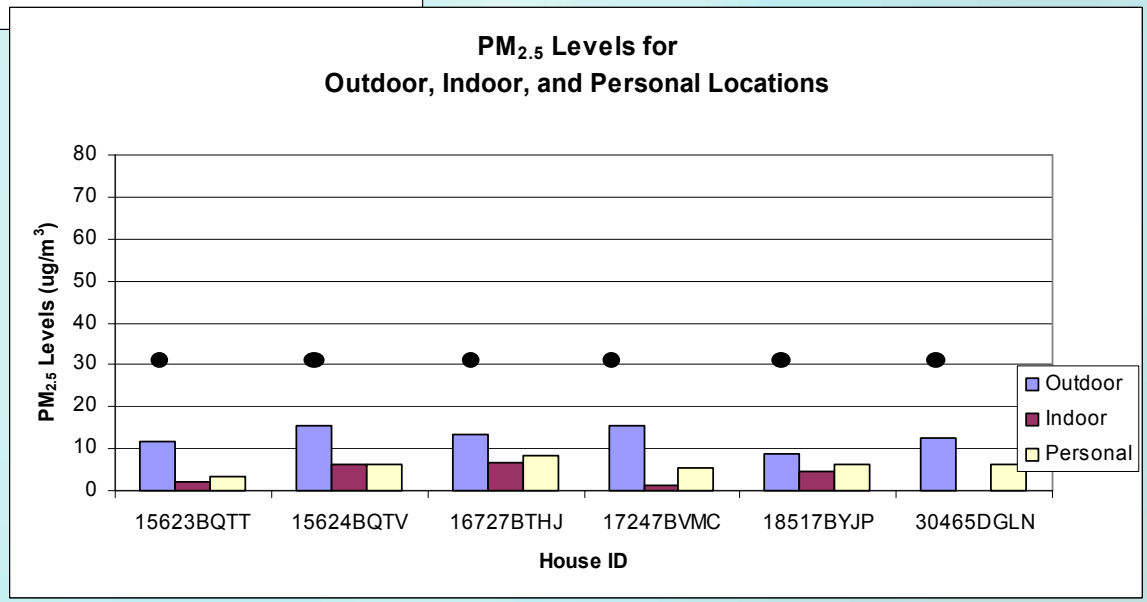
HECS

$PM_{2.5}$ WEEK 2



Week 2

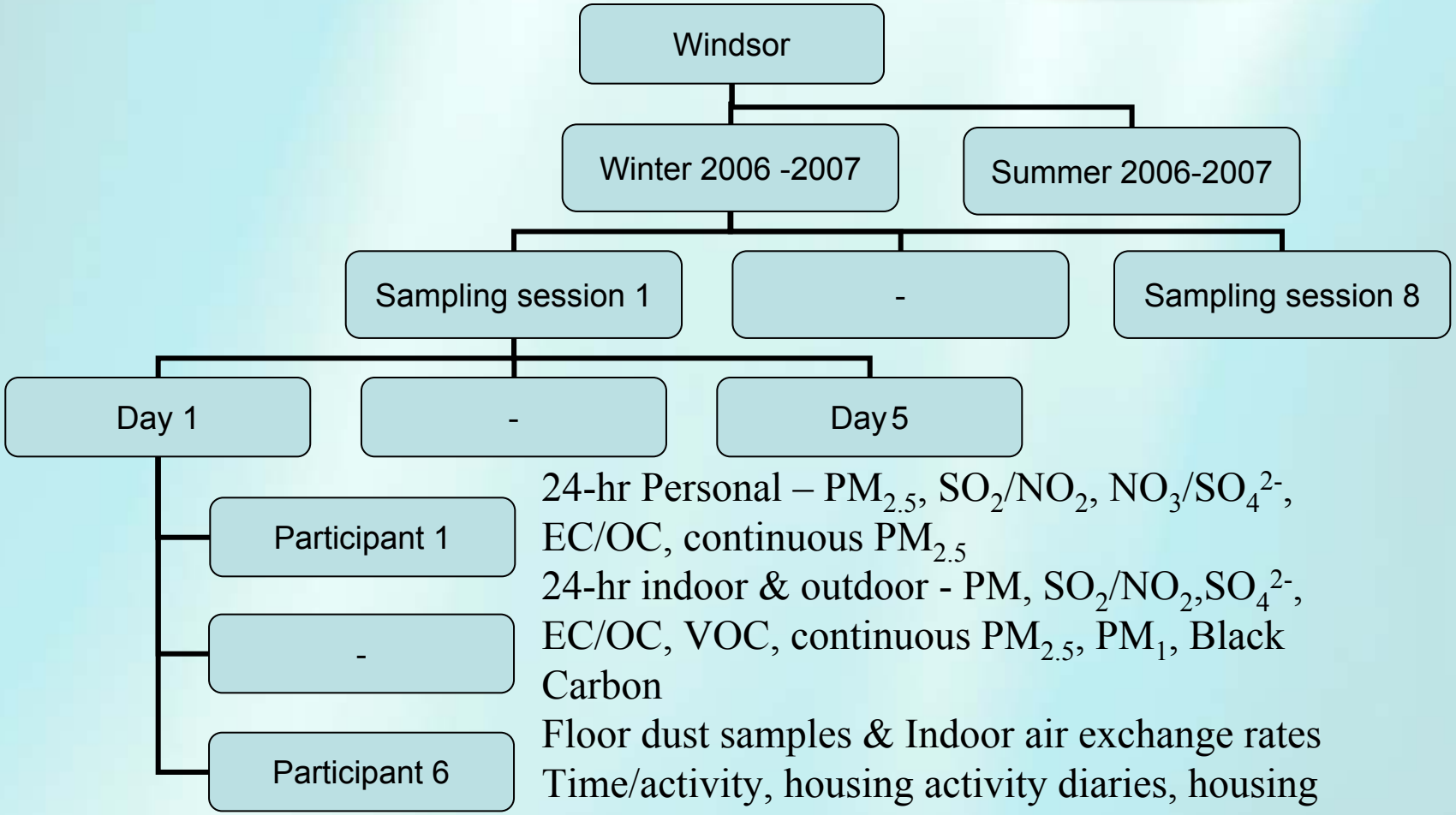
Week 3



PERSONAL EXPOSURE STUDY – ASTHMATIC CHILDREN

- Assess the contribution of ambient sources of air pollution to asthmatic children's personal and indoor exposures.
- Determine the impact of ambient sources of air pollution on asthmatic children's lung health.
- Address the exposure error when using different methods for assigning exposure to asthmatic children and the potential misclassification of health effects.

Personal Exposure Assessment Study Design



24-hr Personal – $PM_{2.5}$, SO_2/NO_2, NO_3/SO_4^{2-}, EC/OC, continuous $PM_{2.5}$

24-hr indoor & outdoor - PM, SO_2/NO_2,SO_4^{2-}, EC/OC, VOC, continuous $PM_{2.5}$, PM_1, Black Carbon

Floor dust samples & Indoor air exchange rates

Time/activity, housing activity diaries, housing questionnaires

Daily morning & evening peak flow measures

Daily evening exhaled breathe condensate

CURRENT STATUS – EXPOSURE ASSESSMENT

- 4 x Seasons of passive spatial monitoring completed (2004)
  - (Paper in progress)
- 2 x Seasons of personal, indoor and outdoor monitoring of healthy adults completed
  - Winter dataset being finalised
  - Summer data entry complete
  - Summer lab analysis almost complete
- 3 x Seasons of active spatial monitoring completed – to be continued
- Ethics approval granted for 4 x seasons of personal, indoor and outdoor exposure and health measures for asthmatic children
- 1 x season of personal, indoor and outdoor NAPS and DEARS intercomparison completed – to be continued
- Intercomparison between Detroit spatial and Windsor methods – 3 weeks