Linking Climate Change and Air Quality

*Science to Support **Synergistic** Environmental Policies and Mitigation Strategies*

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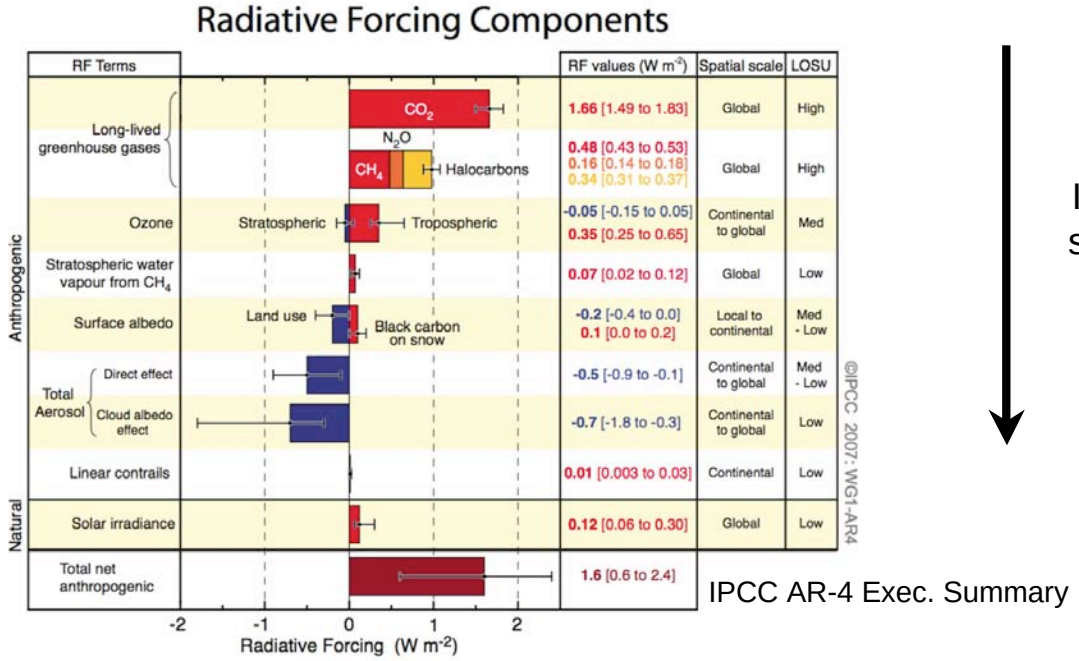
Climate Forcing and Air Quality



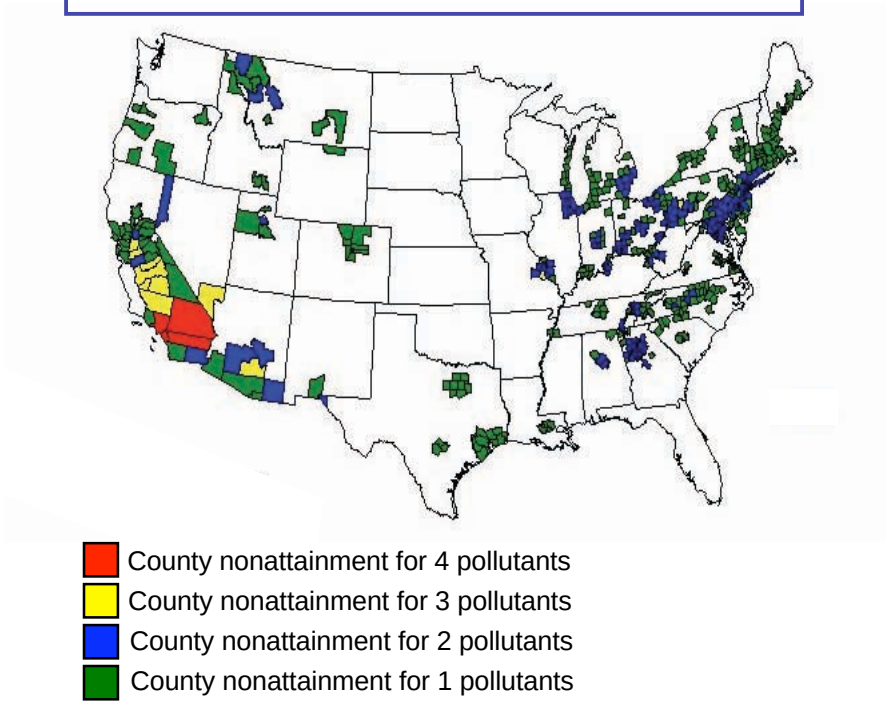
Increasing spatial and temporal variability

IPCC AR-4 Exec. Summary

- Quantification of “anthropogenic” forcings is the simplest way to evaluate climate influence of an emission (caution: global versus regional/local).
- Uncertainty in total forcing is due to chemically active species (now!).
- Chemically active agents have larger regional forcing than their global values.
- Future forcing by CO_2 (climate-carbon cycle interactions) and aerosols are key uncertainties (for the future).
- Ozone and aerosols are also “pollutants.” The common “target” for both Air Quality and Climate.

Air Quality

474 Counties That Violate US Clean Air Regulations



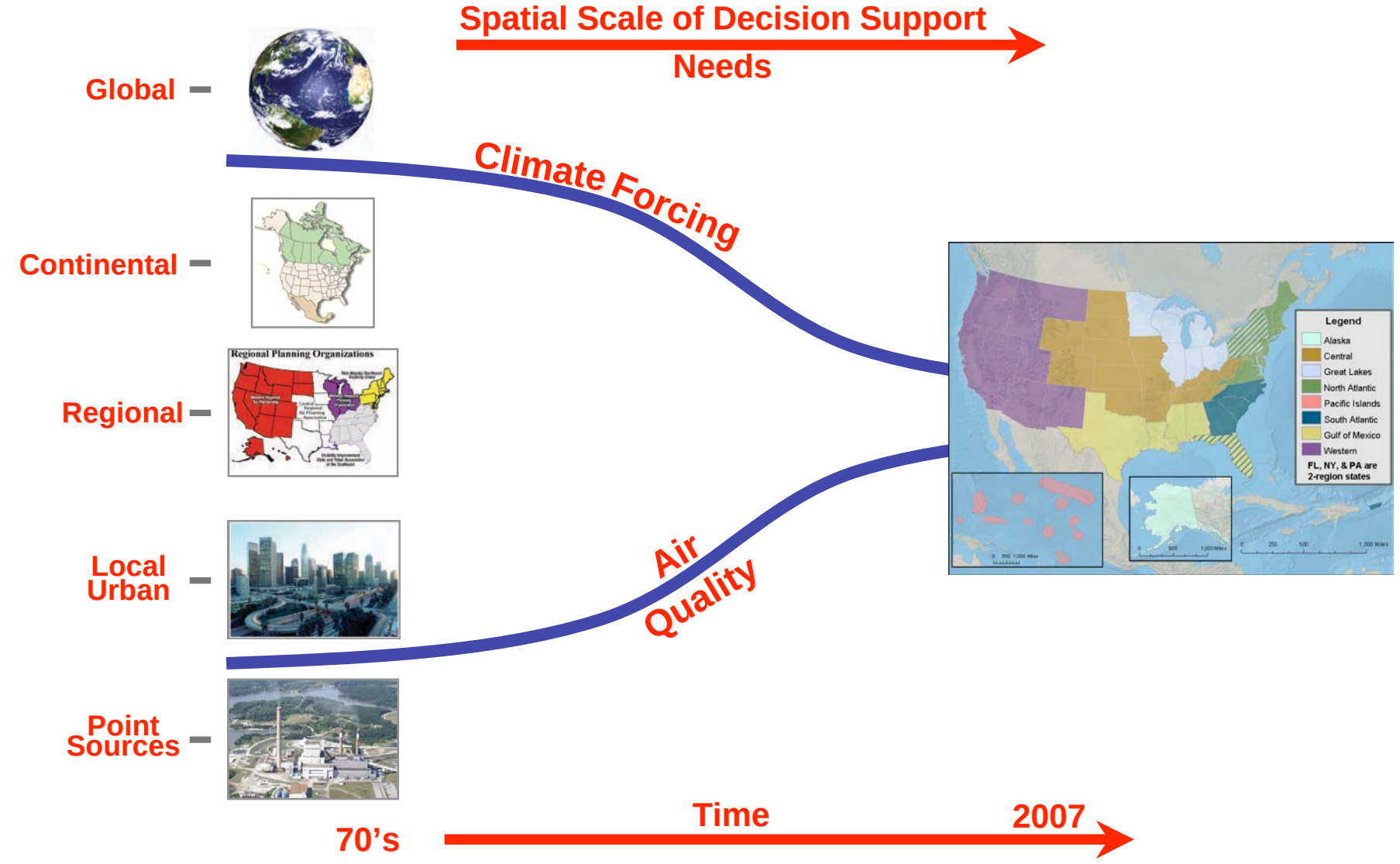
Air Quality is a key issue for states and regions

- More effective national policies
- More efficient local/regional management strategies

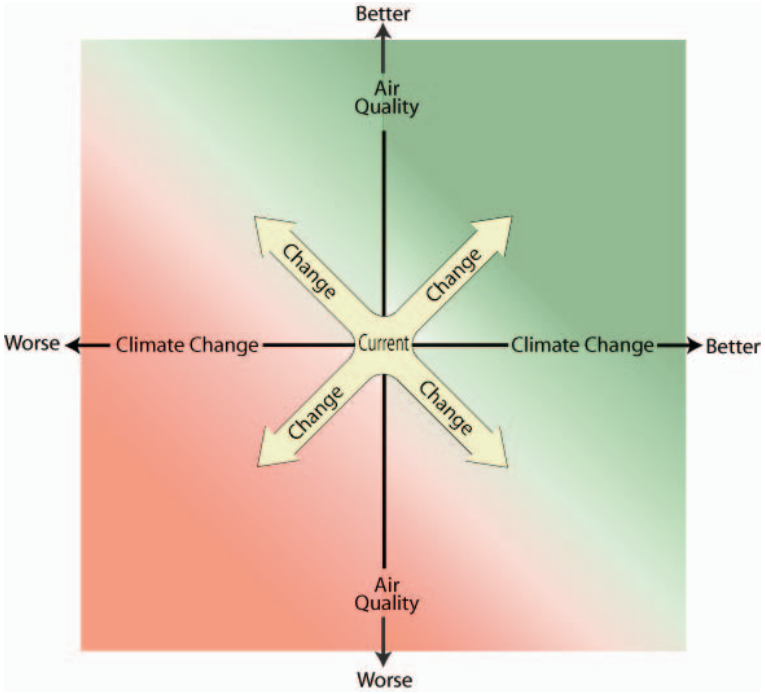
More than half of the people in the US live where the air quality does not meet EPA's health-based standards

Emissions important to Air Quality and Climate
BOTH come mostly from same regions

Changing Needs of Climate and Air Quality: Convergence of Scales



Decision to Maximize Benefits: Air Quality and Climate



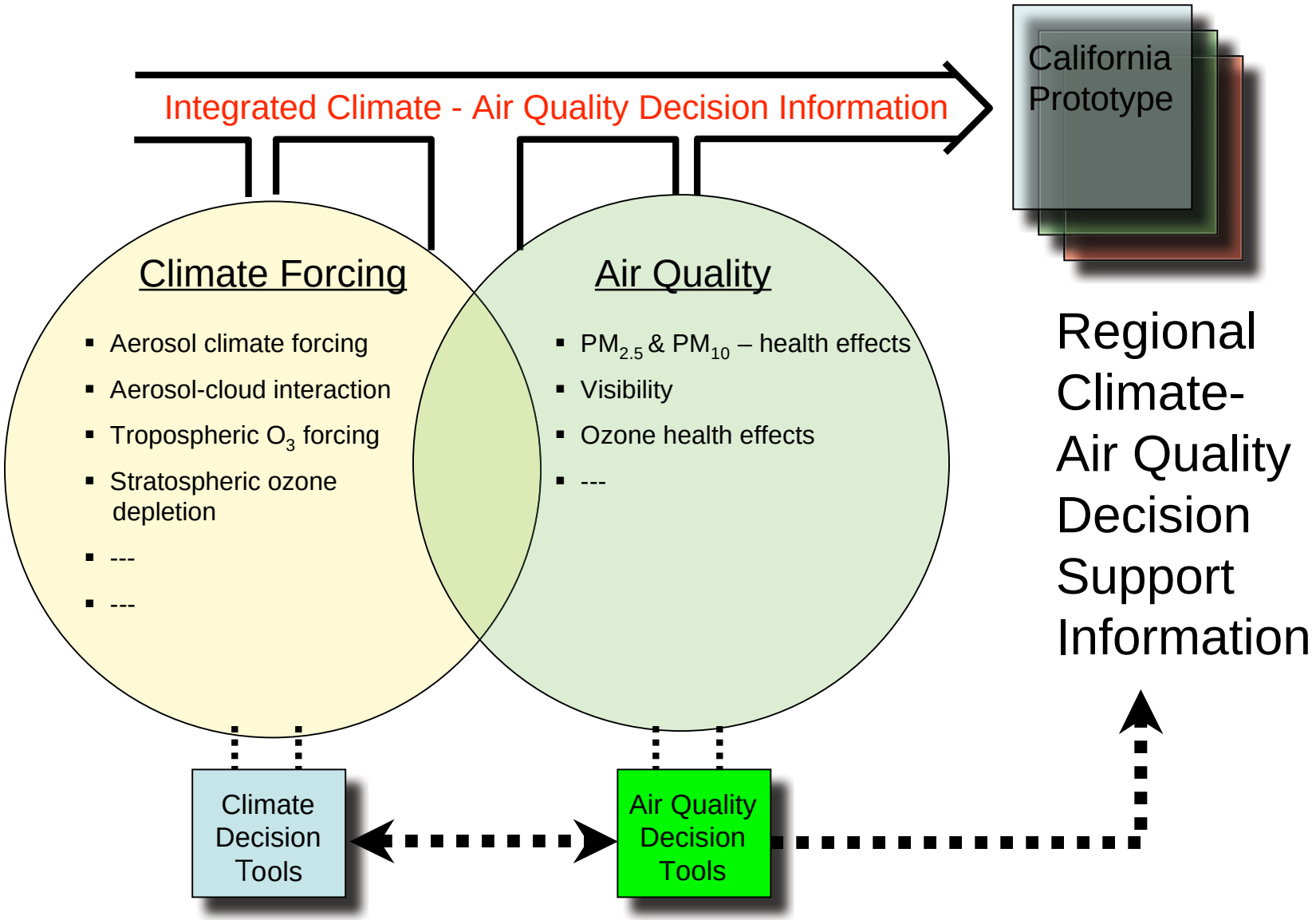
Strategies / Scenarios

Examples

1. Remove CO_2 from fossil-fueled power plants?
2. Reduce in SO_2 from fossil-fueled power plants?
3. Reduce black carbon emissions from heavy-duty vehicles?
4. Switch from gasoline to ethanol fuel for cars and light-duty vehicles?

Decision-makers need information / tools to support integrated strategies.

The New NOAA Initiative

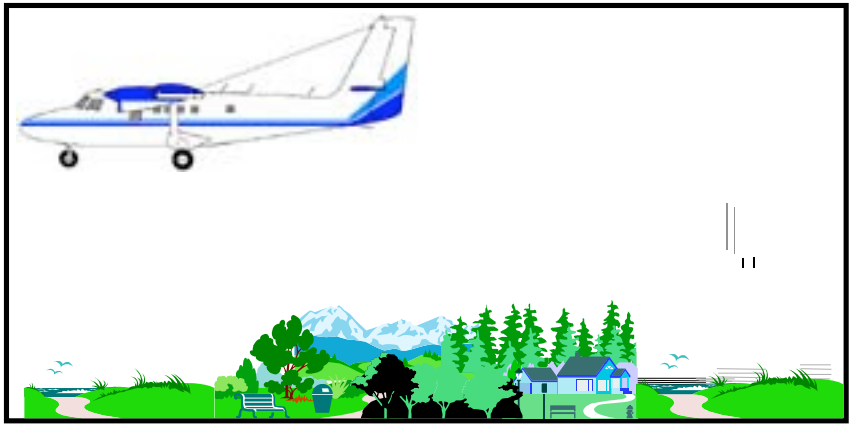


What NOAA Plans for FY 2010

NOAA WP-3D Aircraft – Urban and power plant plume studies, emissions verification, regional and inter-regional transport, day/night O_3/PM chemistry, aerosol characterization and quantification (size, composition, optical properties, growth, etc.).

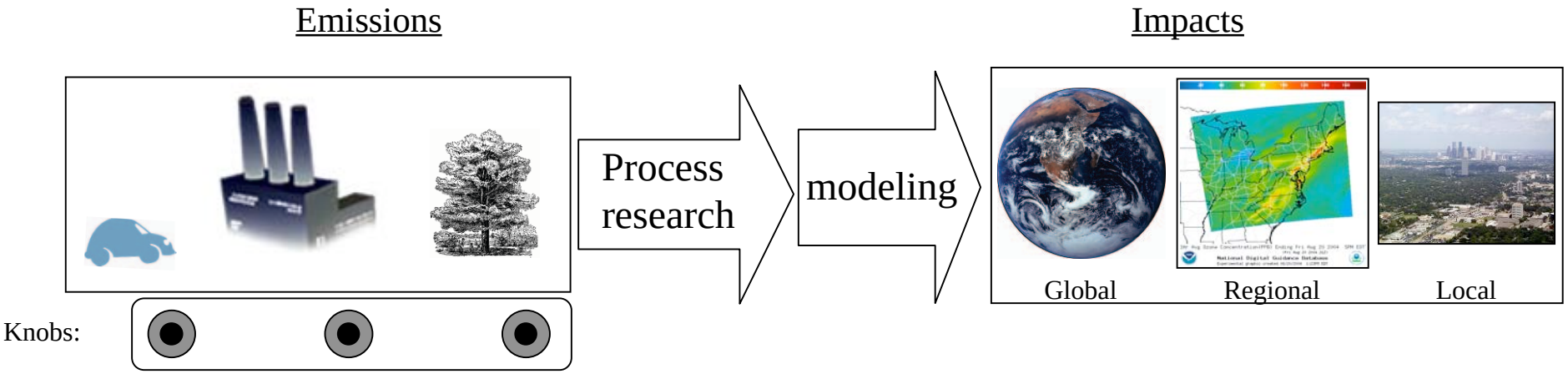
NOAA R/V Ronald H. Brown – Marine chemistry, marine emissions, coastal emissions, chemistry in the land/bay/sea breeze recirculation, aerosol characterization and quantification (size, composition, optical properties, growth, etc.).

NOAA LIDAR Aircraft – Regional distribution of O_3 and PM, urban and power plant plume studies, regional and inter-regional transport, boundary layer evolution and variability.



Other instrumentation?

Emissions: The key need



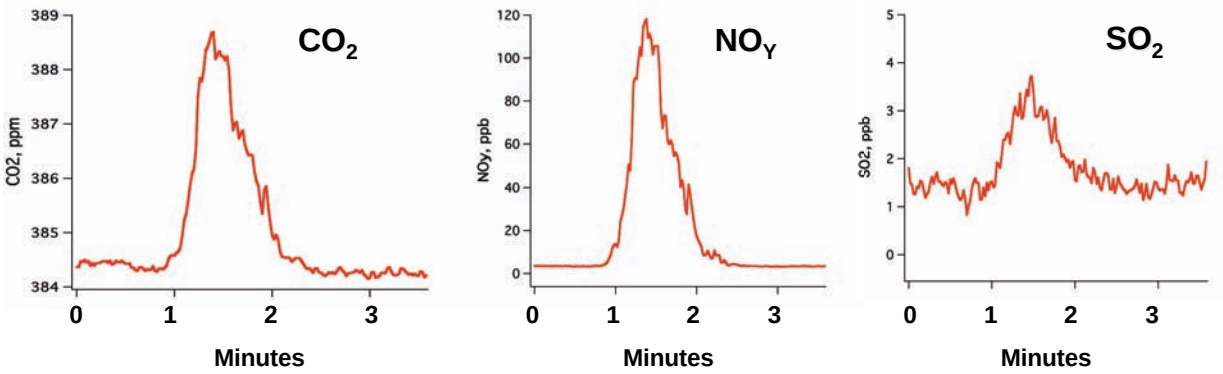
Quantification of emissions is essential for any mitigation strategy

- Quantify emissions different sources.
- Measure ambient levels outside of plumes.
- Measure constituents together to evaluate relative emissions.
- Quantify processes on time and spatial scales needed for air quality and for climate forcing.

Multiple goals- but highlighting one here.

Emissions Quantification: A Big Issue

Ship Emissions



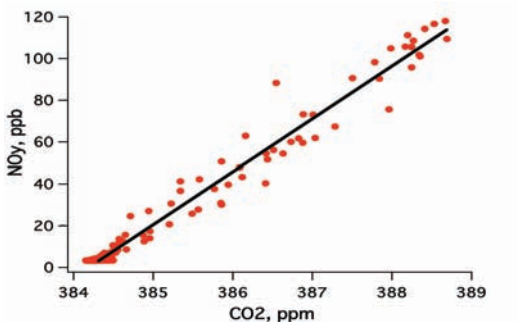
Slope = 25.3 ppb/ppm
R^2 = 0.98

Slope = 0.417 ppb/ppm
R^2 = 0.94

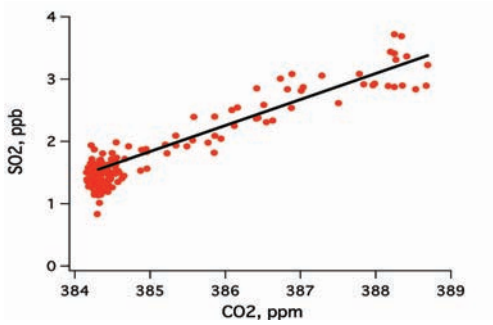
Ship emissions can be significant in ports and coastal areas and for global air quality

NOAA ship emission measurements:

- Gases (CO, CO_2, NO_X, SO_2, VOCs)
- Aerosols (size, number, speciation)



83.7 gm. NO_2 / kg. fuel burned



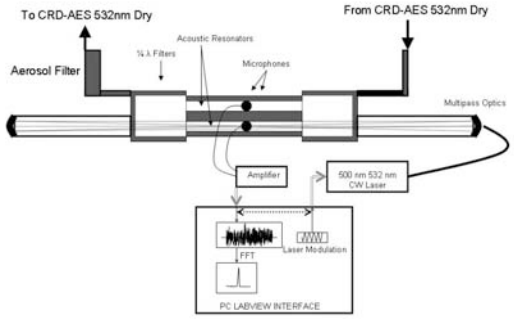
1.9 gm. SO_2 / kg. fuel burned

2010: Test emission inventories for Los Angeles and Long Beach Ports
Investigate transport of offshore ship emissions to land

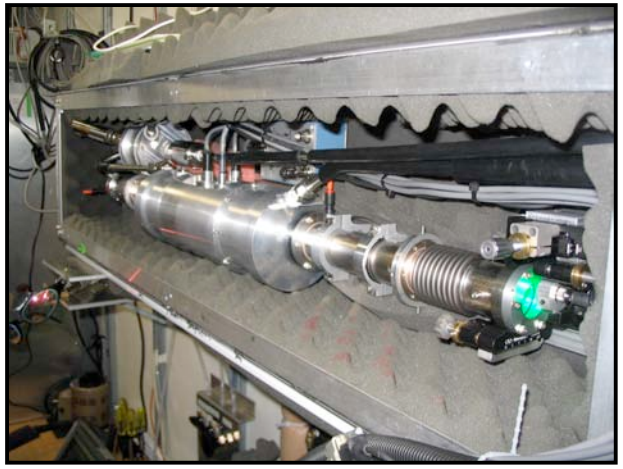
Measurements from NOAA R/V Ronald H. Brown - E. Williams

Ship Emissions of Black Carbon During TexAQS/GoMACCS

- Measured using Photoacoustic Absorption Spectrometer and CO_2 sensor
- Over 1,100 individual plumes

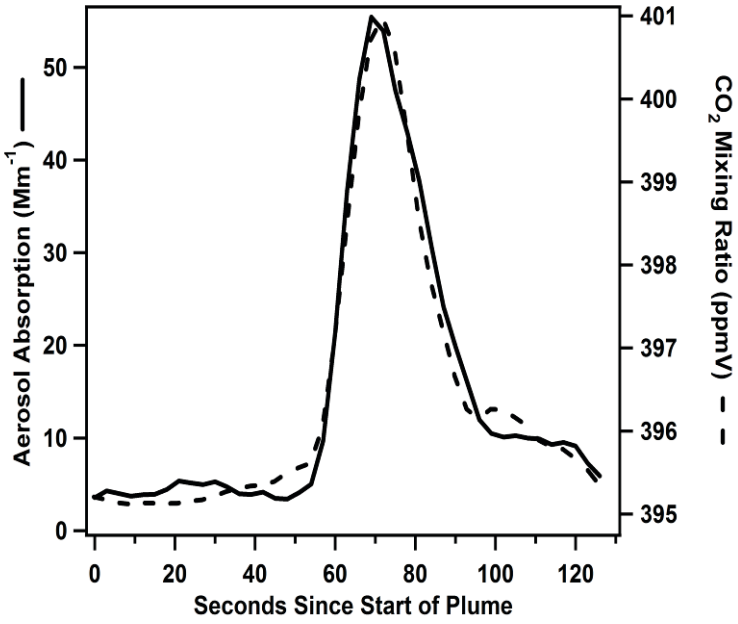


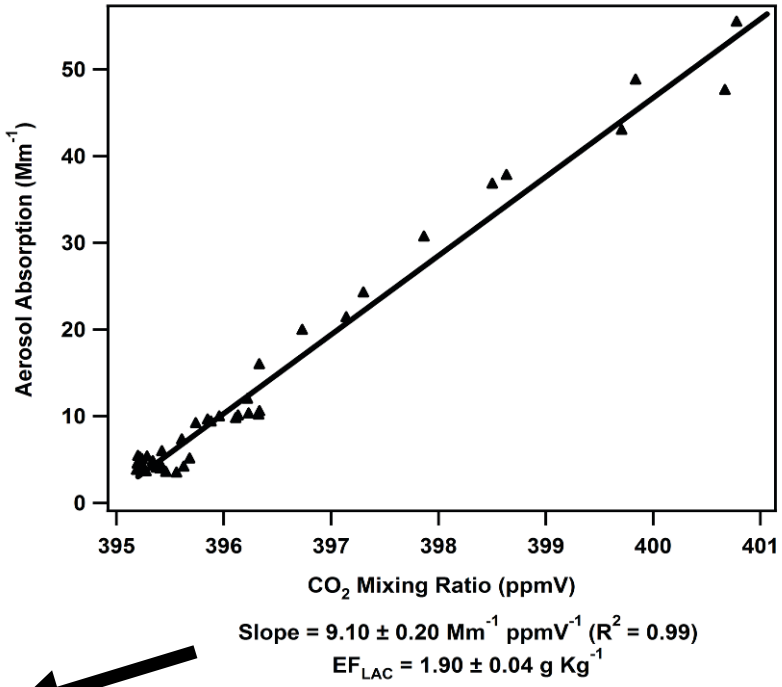
- Direct method
- Accurate calibrations (<1%)
- Overall uncertainty = <5%
- Designed and built for aerosols
- Validated using aerosols



Photos: Richard Marchbanks & Dan Welsh-Bon

Calculating Emission Factors





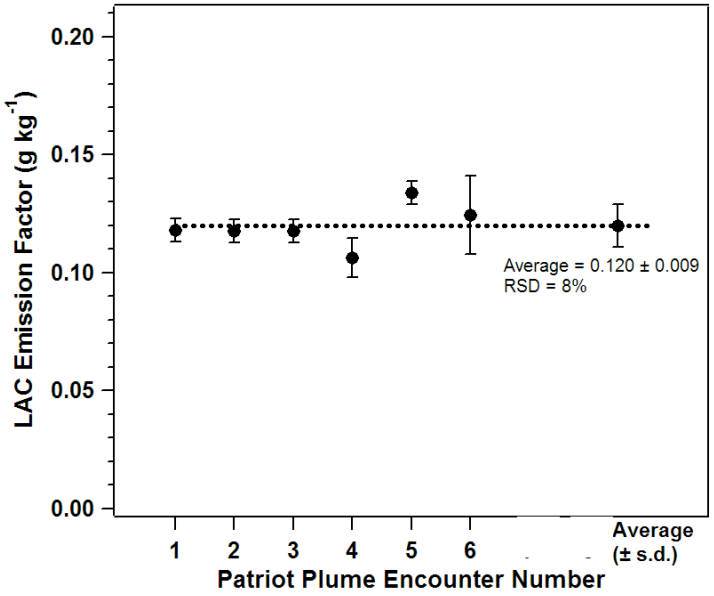
$$EF_{LAC}(gkg^{-1}) = \frac{Absorption(Mm^{-1})}{CO_2(ppmV)} \times \frac{1}{MAC(m^2g^{-1})} \times f_{fuel}$$

Emission factors can be in absorption per CO_2…

but comparison with previous data requires MAC

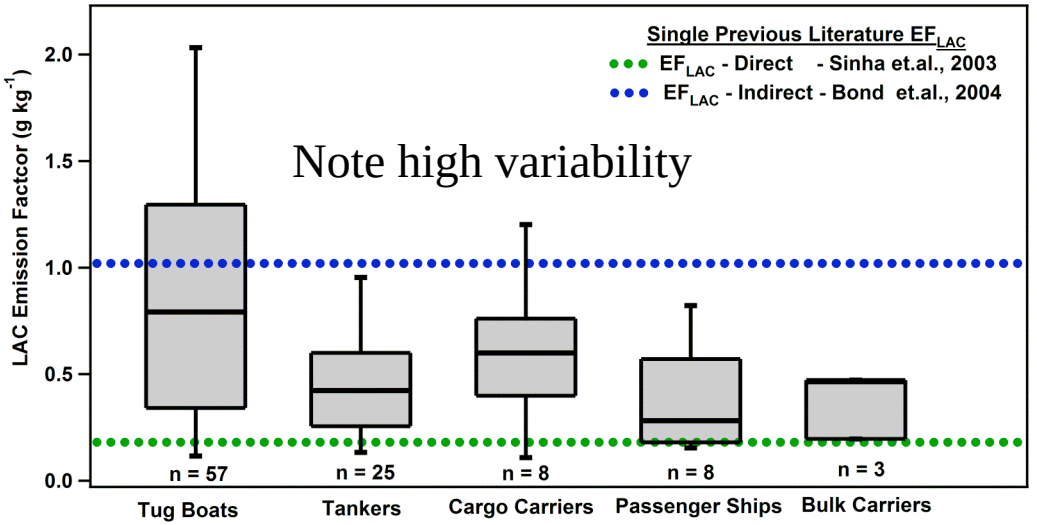
Emission Factors for Absorbing Aerosols

Patriot Encounter



116 individual vessel plumes

(15 yet to be identified)



- Can quantify emissions different sources – from ship and aircraft.
- Can measure ambient levels outside of plumes – for long periods of time.
- Co-measurement of composition, size, etc. will enable better quantification of absorbing aerosols.
- Real quantification of absorbing aerosols.

Thank you

for your attention!