

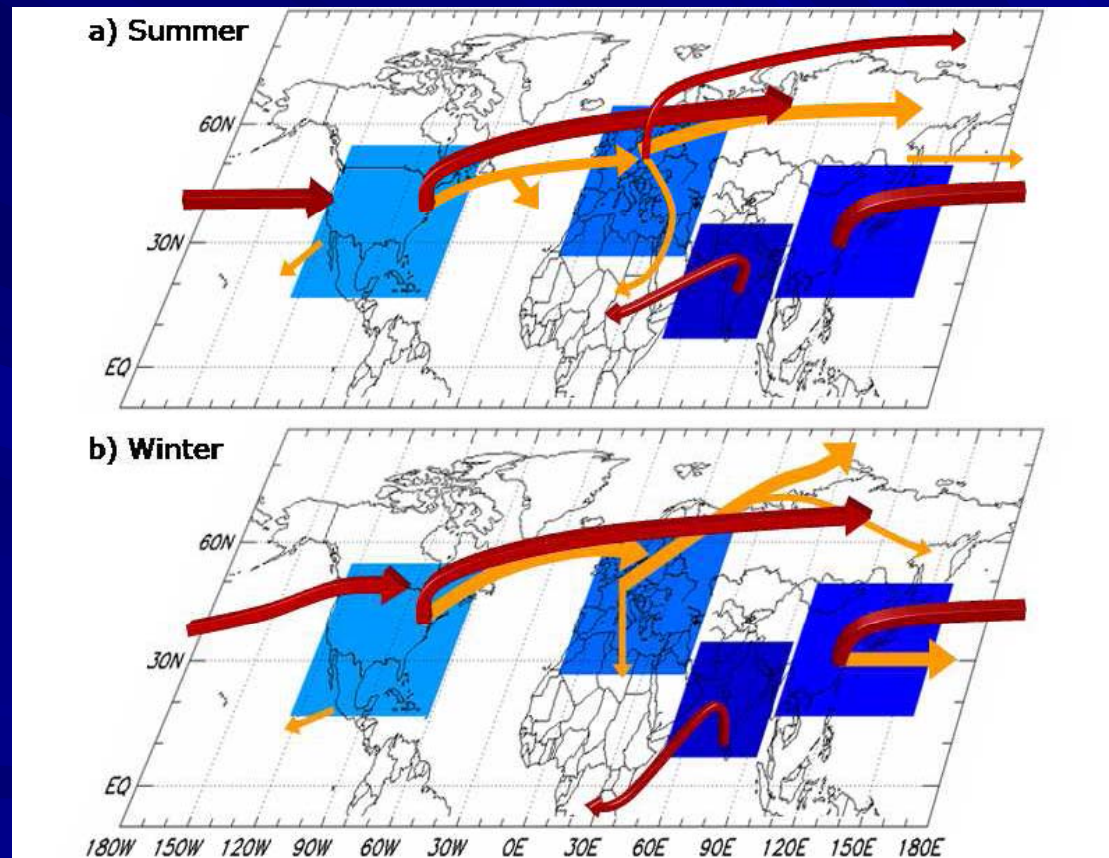
The Impact of Long Range Transport From Asia

SCAQMD Governing Board
Meeting

January 9, 2009

The Issue

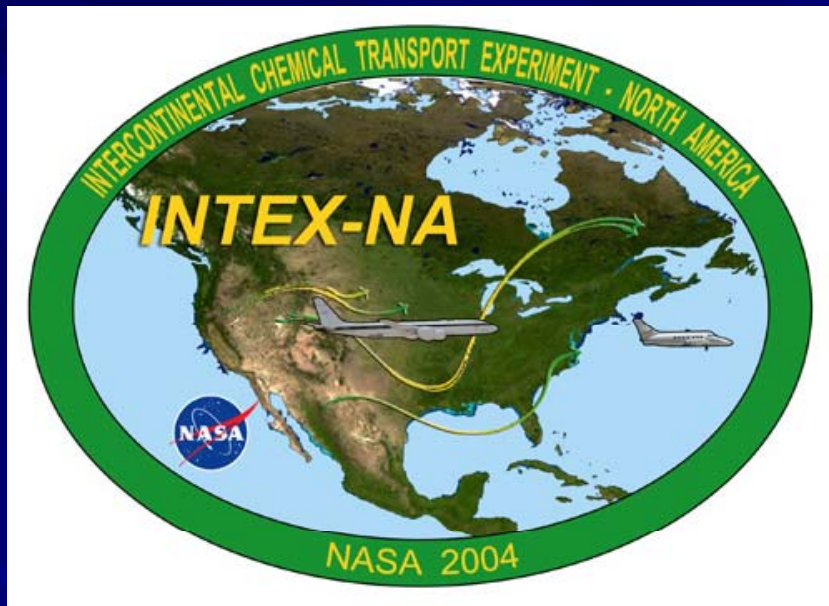
How long-range pollution transport of Asian emissions are affecting air quality in the South Coast Air Basin



Sources of Basin Background Concentrations

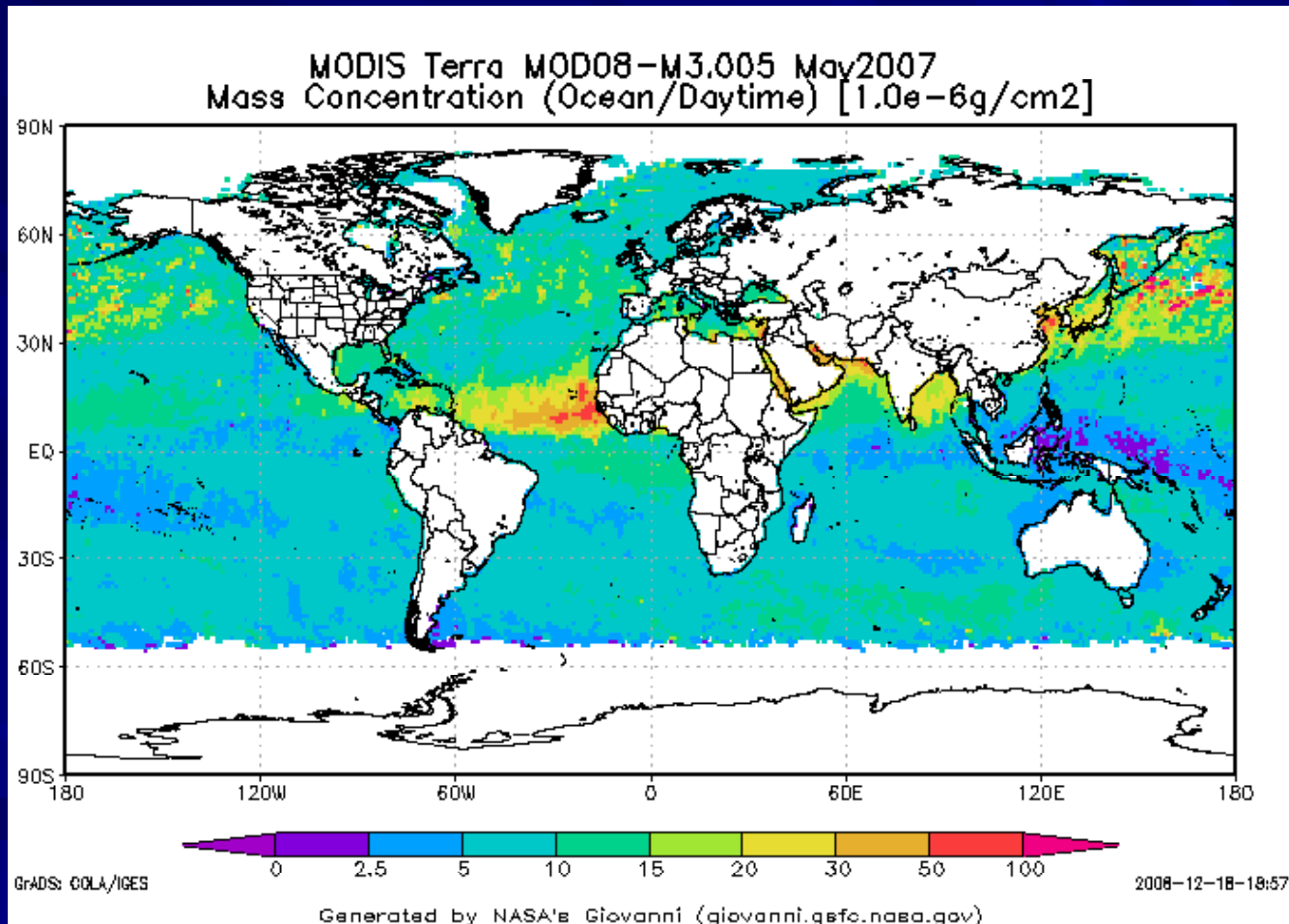
- Natural background
 - (Ozone ~ 40 ppb; PM2.5 ~ < 2 $\mu\text{g}/\text{m}^3$)
- Biogenic emissions (land-based and oceans)
 - organic compounds
 - nitrogen oxides
 - sulfates
- Sea Salts
- Shipping emissions
- Transport from neighboring air basins and Mexico
- Long-range transport (Asia)

Focus on Asian Transport



- Enhanced observing systems ability to track transport
 - High resolution satellite imagery
 - Improvements to remote sensing
 - Field monitoring programs
 - > INTEX-NA, “The Intercontinental Chemical Transport Experiment, 2004 & 2006”
- Enhanced Global Simulation Capability
 - Transport & Weather Prediction
 - Climate Change

MODIS Hi-Resolution Satellite Imagery: May 2007 Monthly Average Particulate Mass



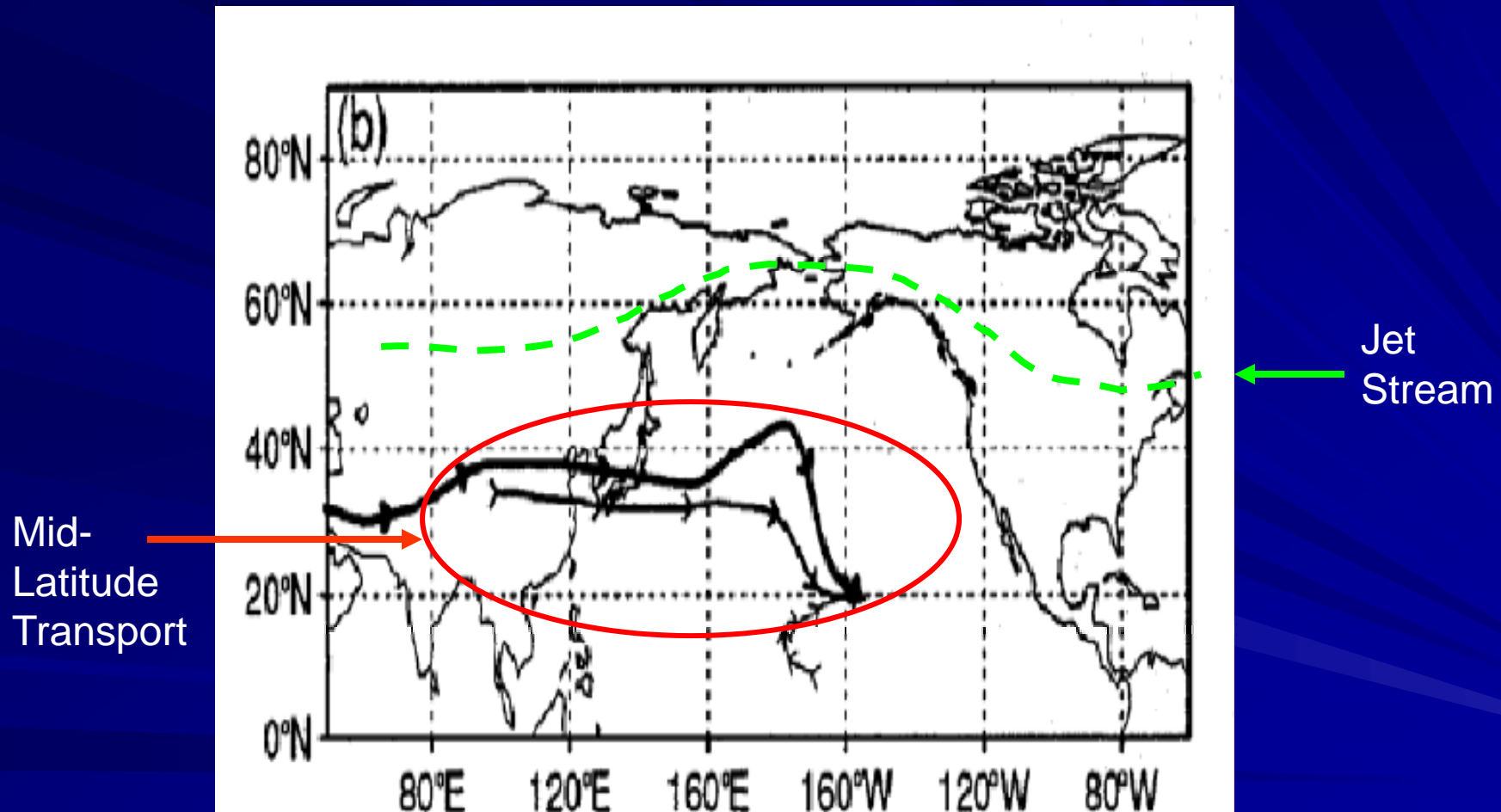
Key Transport Pollutants

- Ozone and ozone precursors (NO_x, CO)
- Airborne particles (dust, secondary aerosols [Sulfate & Nitrate])
- Mercury
- Persistent Organic Pollutants (PCBs, Dioxins, pesticides)

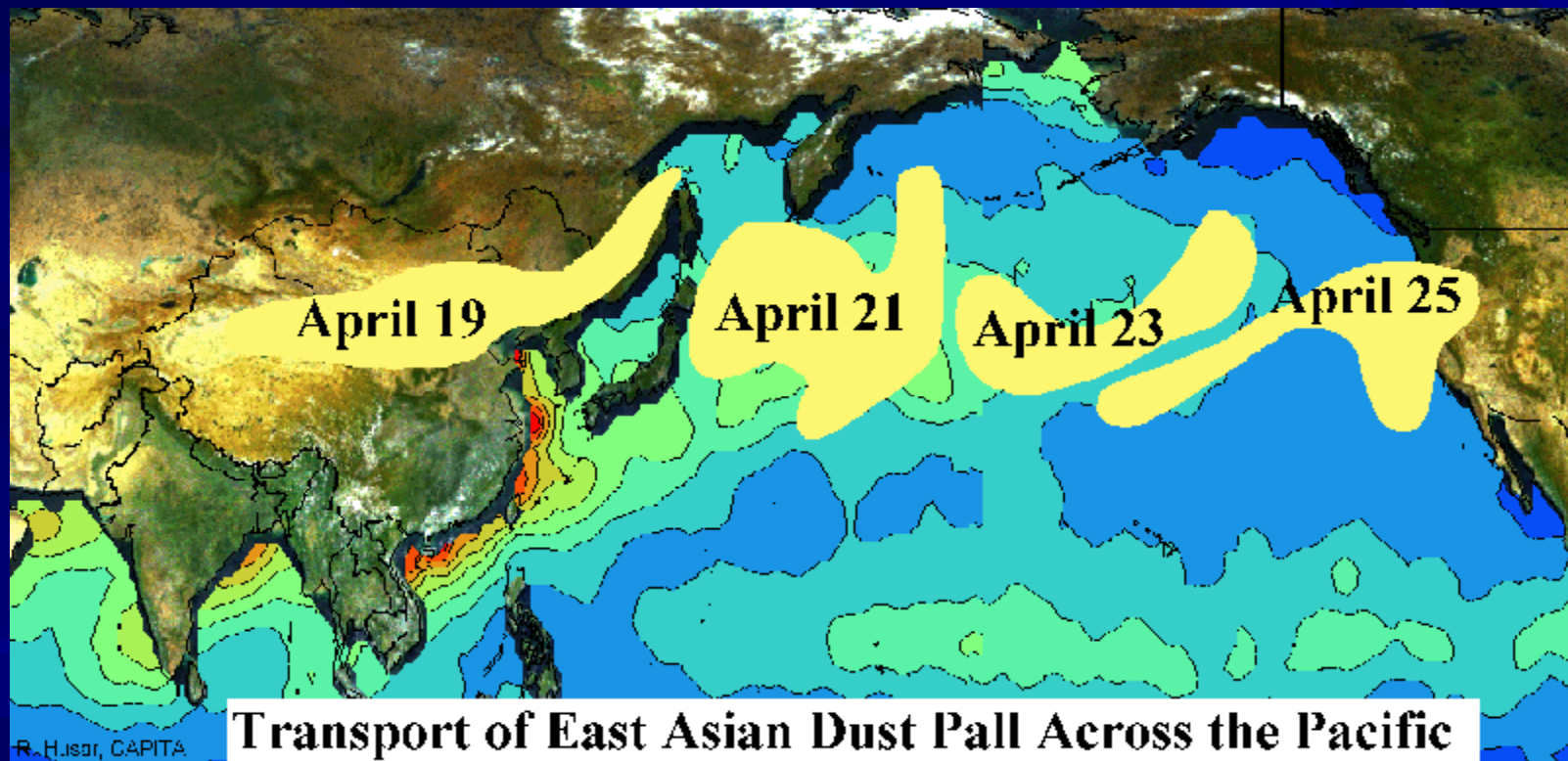
Transport Profile

- Primary impact to Canada and the Pacific Northwest US
- Maximum transport occurs in the Spring (when the jet stream is strongest)
- Transport greatest through mid levels of Troposphere
- Episode events duration: days
- Basin is impacted much less than the Northwest U.S.

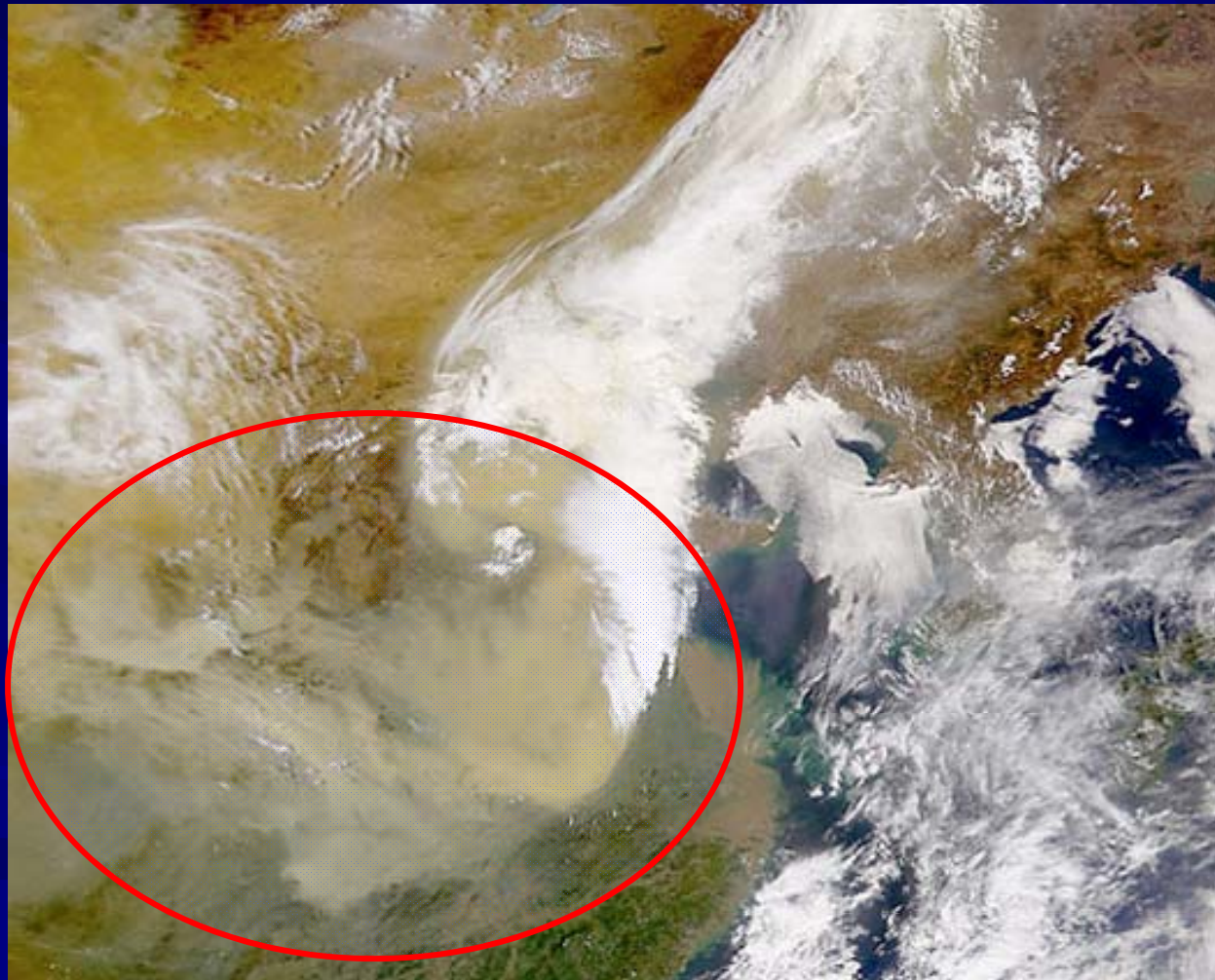
10-Day Back Trajectory Originating at Mauna Loa on 10 May 1996



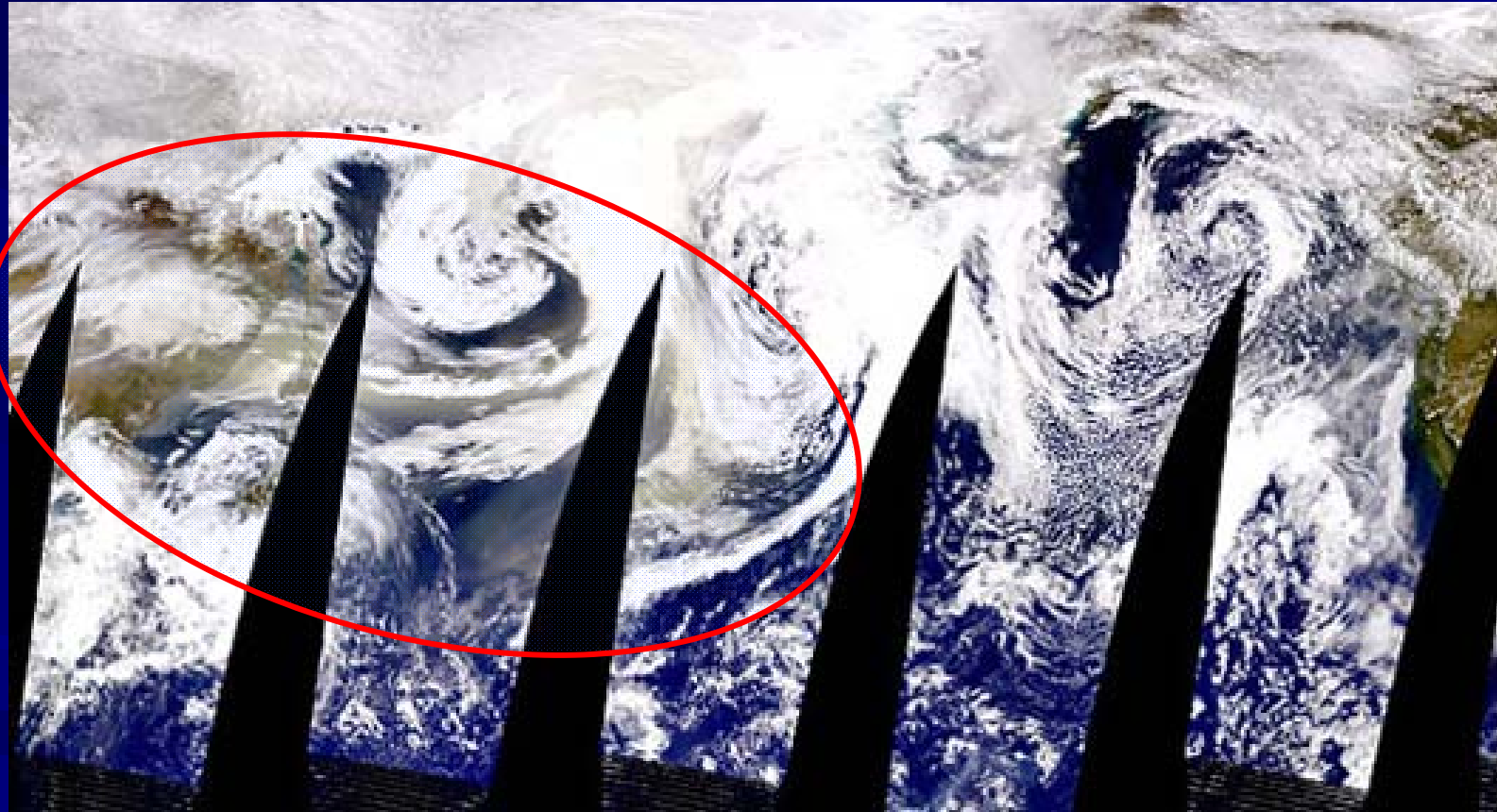
Episodic Particulate Transport Event Dust Storm: April 19-25, 1998



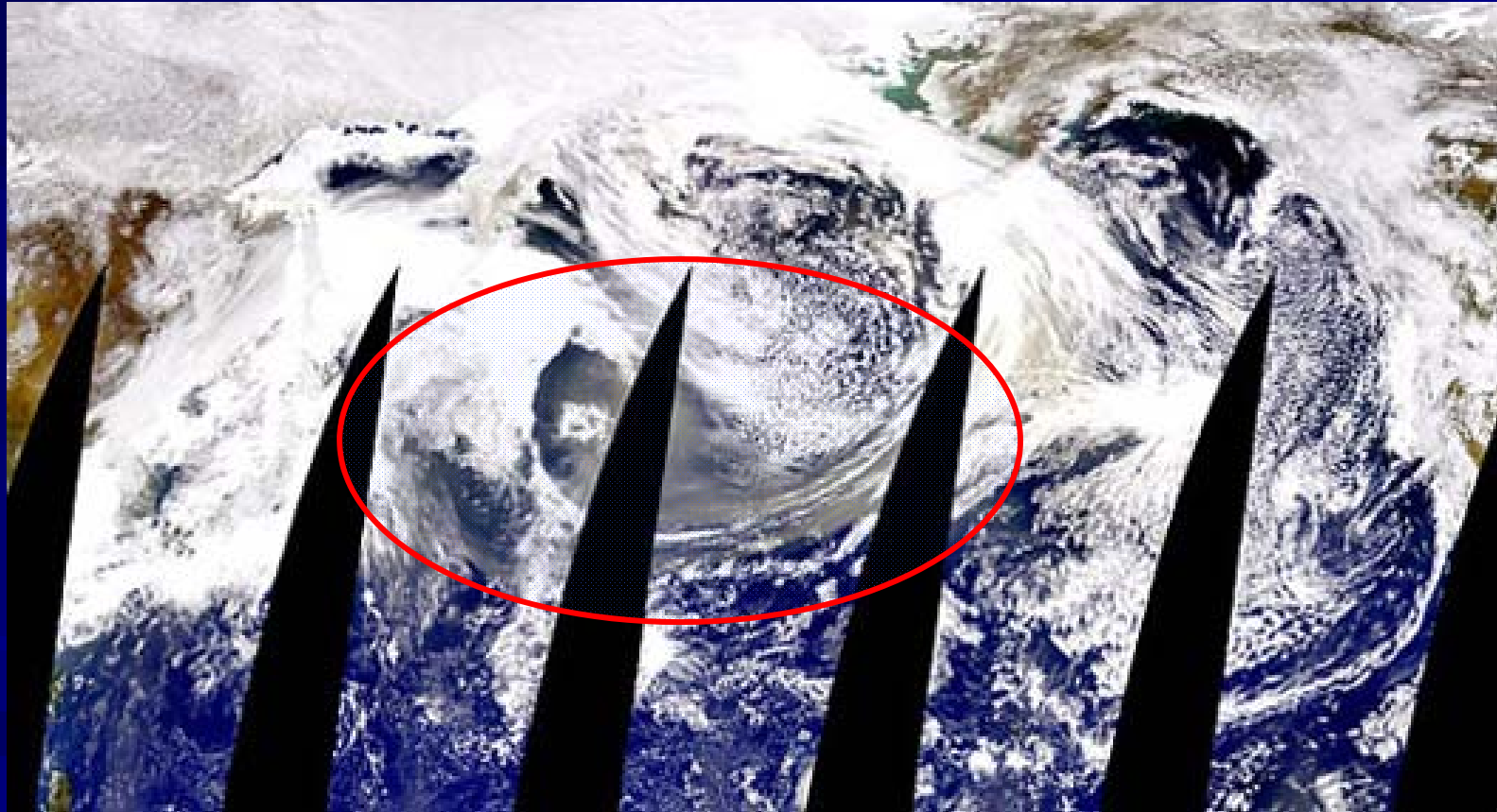
Asian Dust in China: April 16, 1998



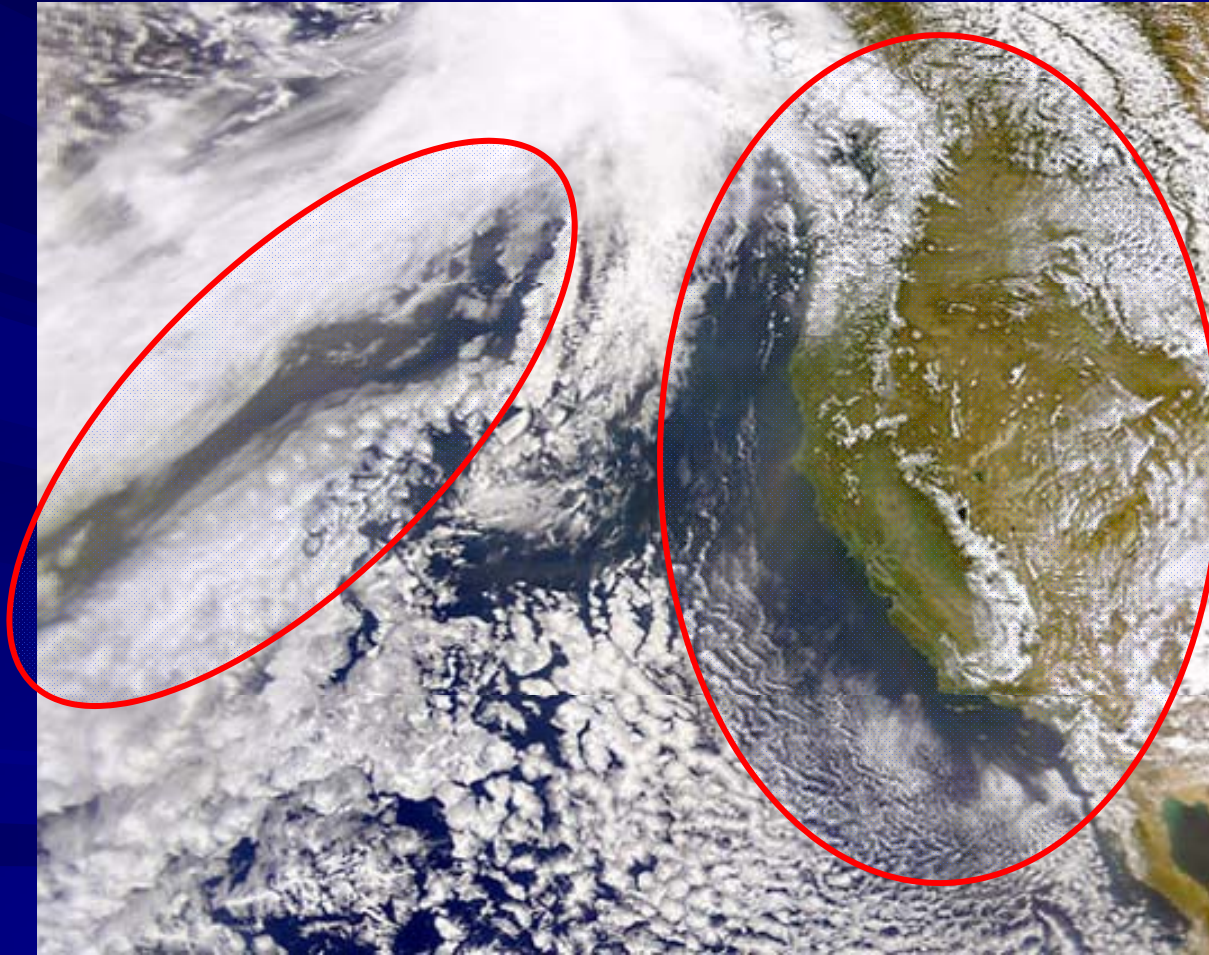
April 21, 1998



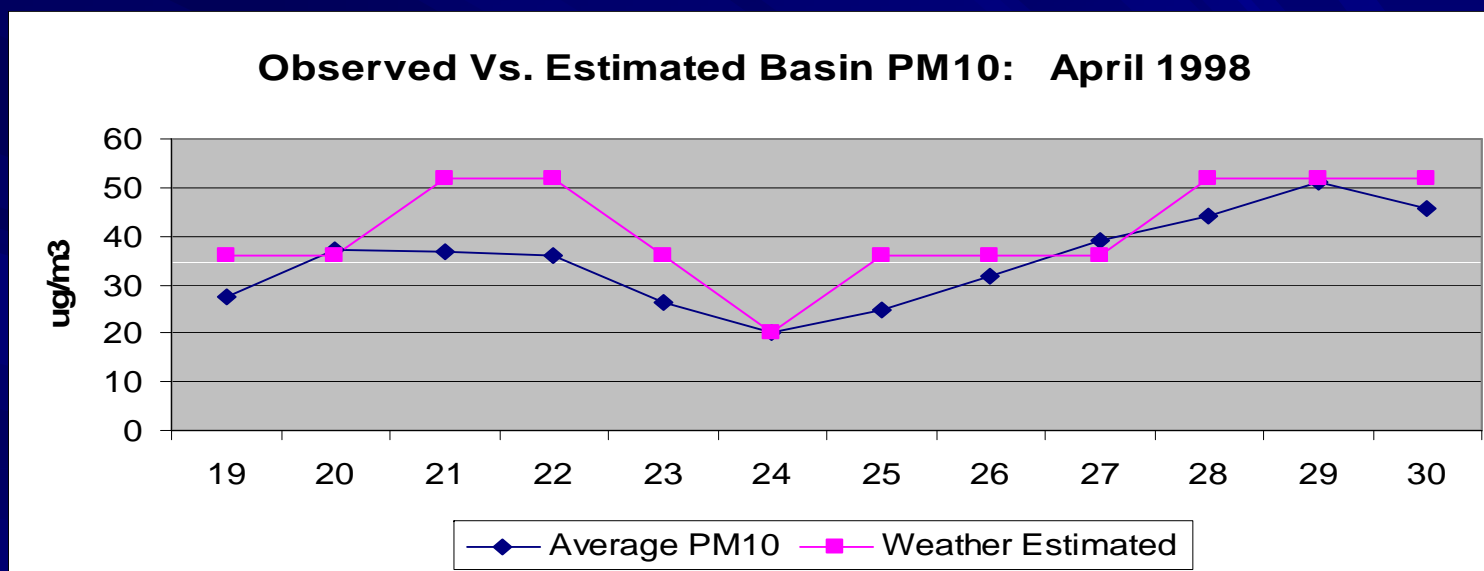
April 23, 1998



April 25 1998: Arrival of Dust Cloud



Basin PM10 Profile During Episodic Particulate Transport Event

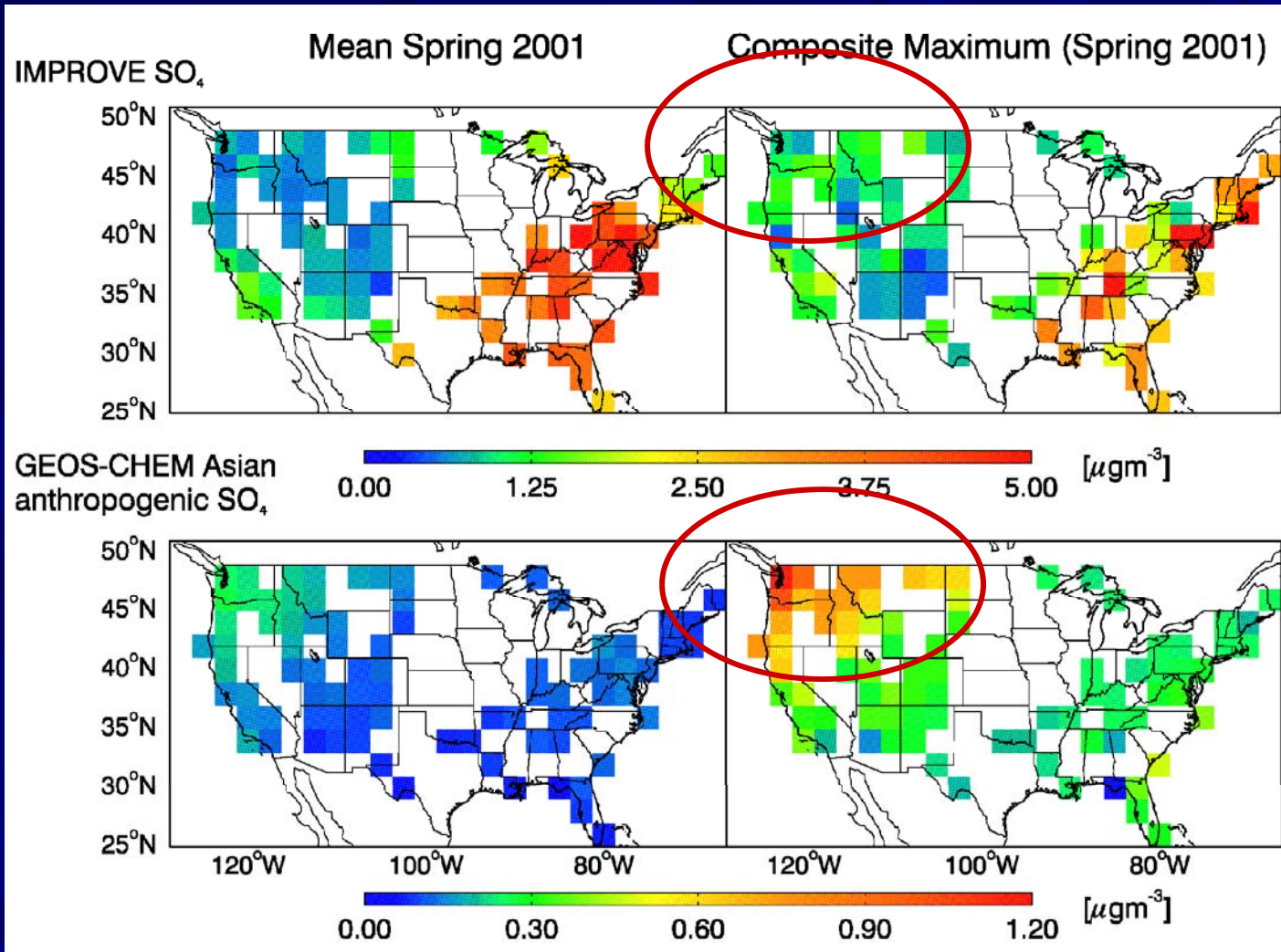


- Impact of dust cloud was observed in Northern California
- Impact to the Basin was within the noise level

Asian Impact to Ambient Sulfate

Observed
NW US:
 $0.72 \mu\text{g m}^{-3}$

Simulated
Asian
Transport
NW US:
 $0.18 \mu\text{g m}^{-3}$



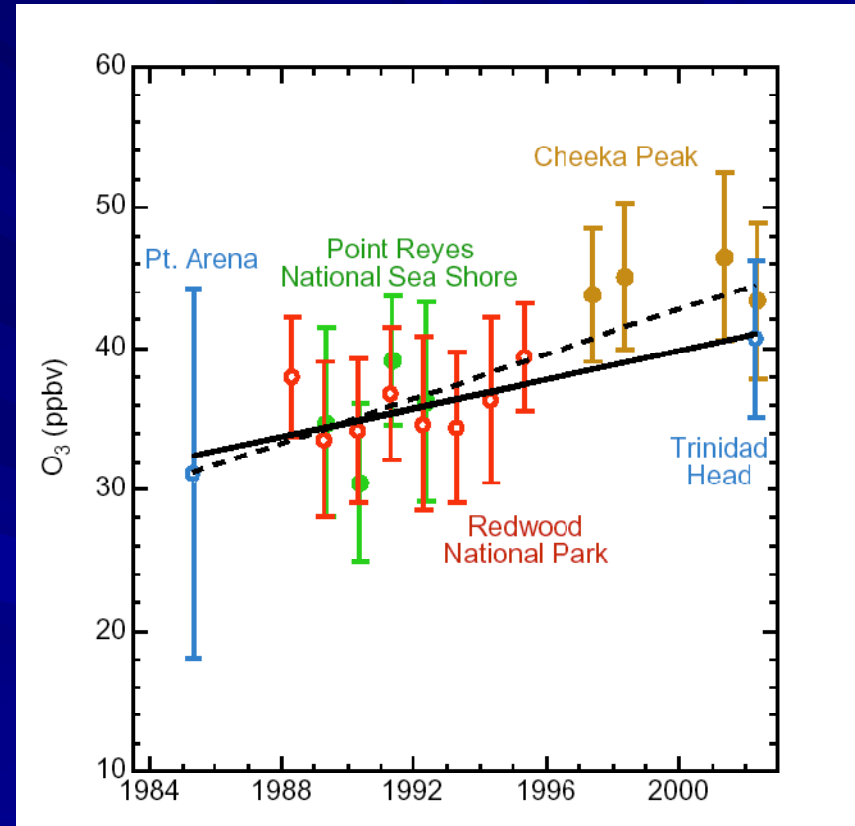
Observed
during
Asian
events
NW US:
 $1.04 \mu\text{g m}^{-3}$

Simulated
Asian
Transport
during
events
NW US:
 $0.60 \mu\text{g m}^{-3}$

Asian aerosols preferentially impact ground sites in the NW US.
Observations at IMPROVE sites are elevated from mean when simulated Asian influence is high
[Heald et al., JGR, 2006]

Transport To Northwest U.S.

- Based on field program measurements and computer simulations
- Current Estimates Episodic :
(Events lasting days)
 - Ozone 4 - 8 ppb
 - Fine Dust 0.2 - >1.0 $\mu\text{g}/\text{m}^3$
 - Sulfates 0.5 - >1.0 $\mu\text{g}/\text{m}^3$
- Projected Long-term Impact
(Measured over years)
 - Ozone 0.5 - 0.4 ppb/year
 - Particulates ~ 3% of Asian dust aerosol reaches US



Surface ozone trends in air flowing into the United States

Analysis Uncertainties

- Paucity of Earth based observations (surface, aircraft and balloon borne monitoring)
- Limited observations to assess long-term-trend
- Satellite imagery improving – data needs evaluation
- Model projections are dependent on:
 - Weather model performance
 - Lack of accurate Asian emissions inventory

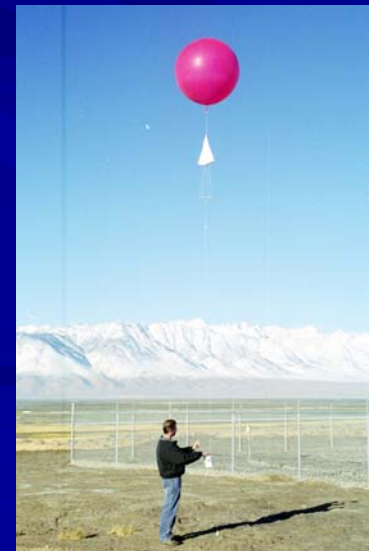
Impacts to the Basin:

Not well defined but research is underway

- Other than winter, the Basin is located south of the main transport route from Asia
- Impacts during episodic events are minor compared to Canada and the Northwest US
- Particulate and ozone transport is strongest in spring – out of phase with peak concentrations observed in the Basin
- Recent and upcoming studies focus on the Basin
 - > NASA's ARCTAS 2008: Arctic Research of the Composition of the Troposphere from Aircraft and Satellites
 - > NOAA's CalNex 2010 Research at the Nexus of Air Quality and Climate Change (Aircraft, Lidar, Ships)

Air Pollution Measurement Aloft Background Monitoring

- Ozone, particulates, sulfur dioxide, nitrogen dioxide
- Boundary Layer & Aloft
- Aircraft & ozone-sondes
- Potential offshore-island fixed site
- Update boundary conditions for regional modeling
- 2008 - 2009



Aircraft Flight Plan



Summary

- Asian emissions do contribute to background concentrations
 - Episodic in nature
 - Extent uncertain
 - Ongoing studies
- Basin is impacted much less than the Northwest U.S.
- Attainment demonstrations need to account for background concentrations including long-range transport
- Research ongoing to update current background concentrations and estimate future impacts