EPA: Requirements for AQ Monitoring and Regulation

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Air pollution has been recognized for a long time ....

1661 article…

FUMIFUGIUM:

Or

the Inconvenience of the Aer

and

Smoake of London Dissipated

by

JOHN EVELYN

First Published in 1661 and Reprinted

by the

NATIONAL SOCIETY FOR CLEAN AIR

1961


Health effects…
Look at conditions in New York …..
Thanksgiving of 1966

National Mandates related to Air Quality

Regulatory NAAQS (Assessment/Monitoring):

Clean Air Act - EPA Administrator required to periodically review and revise National Ambient Air Quality Standards in accordance with latest state of the science

Air Quality Forecast:

H.R. 4 Energy Policy Act of 2002 (Senate Amendment)

EPA-NOAA Agreements: EPA Administrator and Dept. of Commerce Deputy Secretary signed MOU/MOA for AQ forecasting May 6, 2003

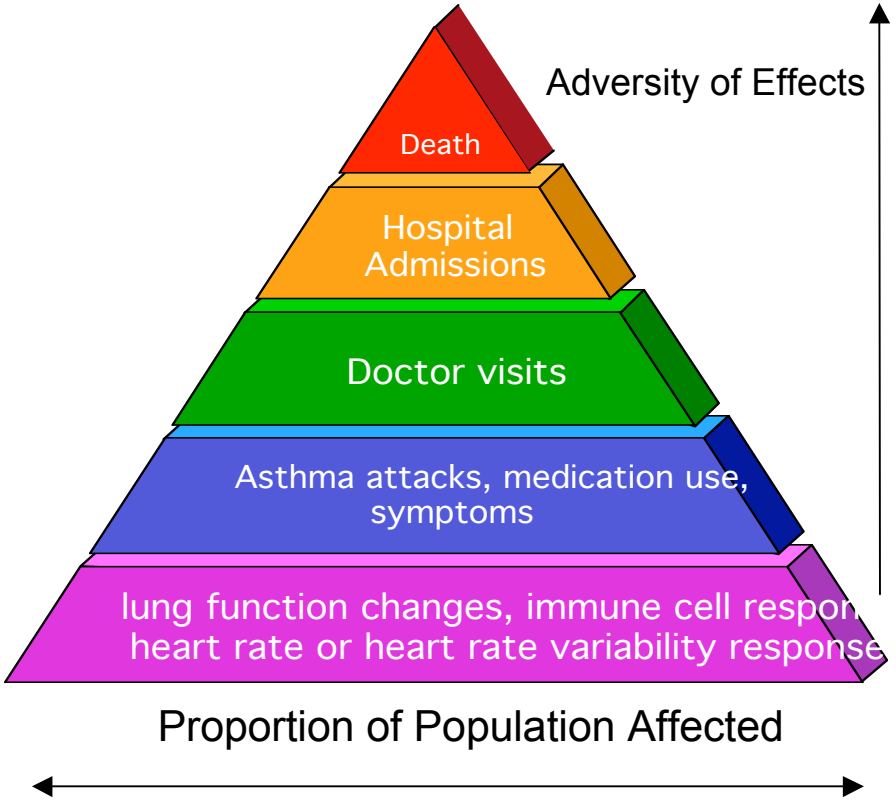
Public Health Tracking:

Nationwide Health Tracking Bills originally introduced in S.2054 and H.R.4061 in 2002, re-introduced in 2005.

EPA-CDC Agreement: EPA Administrator and Dept. of HHS Secretary signed MOU related to EPHTN September 30, 2002

Science Driver for Ozone and Aerosols are the Health Based Standards

- Annual PM2.5 (1997)
  - Form: Annual Arithmetic Mean
  - Level: 15.0 ug/m3
- 24-hr PM2.5 (1997)
  - Form: 98th percentile
  - Level= 65 ug/m3
- 8-hr O3 (1997)
  - Form: 4th daily max
  - Level =0.08 ppm
- 24-hr PM2.5 (proposed 2005)
  - Form: 98th percentile
  - Level= 35 ug/m3



U.S. Contribution to GEOSS

Vision Statement

Enable a healthy public, economy, and planet through an integrated, comprehensive, and sustained Earth observation system.

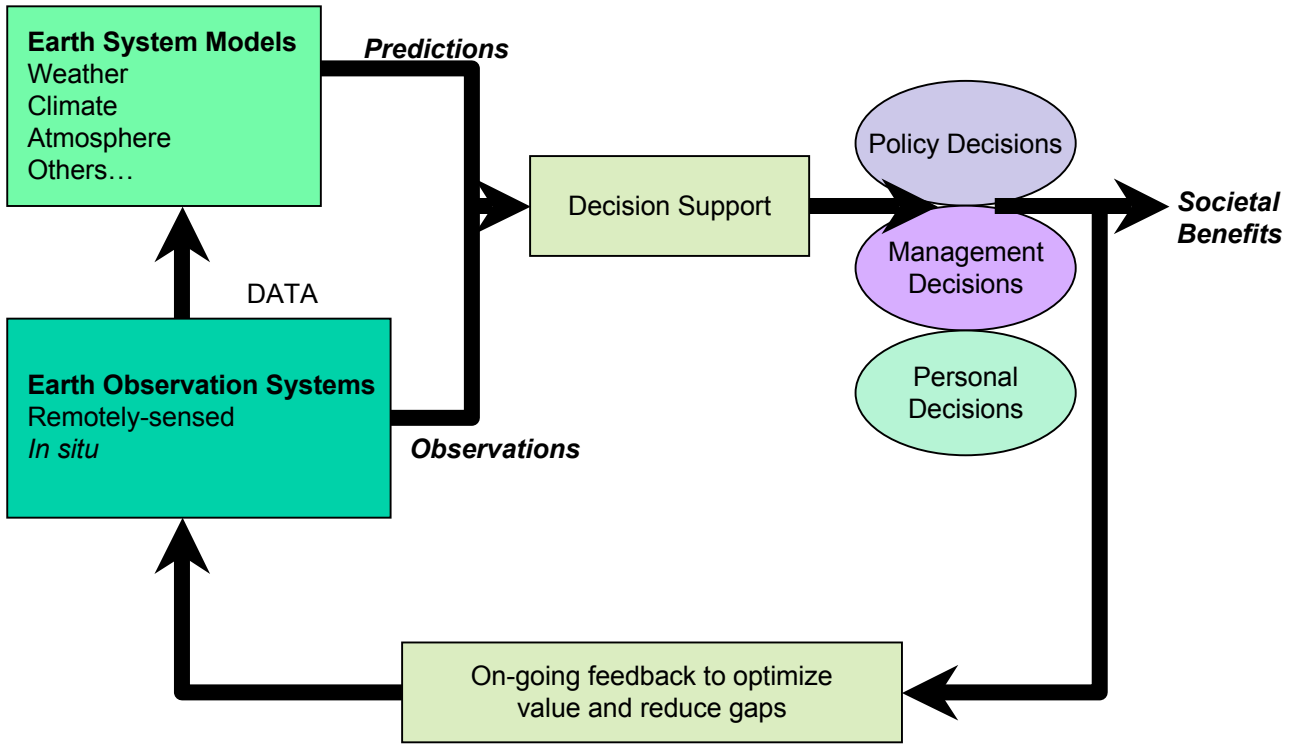
17 federal agencies/groups

USGEO.gov

Linking Earth Observations to Societal Benefits

The Challenge:

- To combine existing and future data at various temporal and spatial scales in a meaningful way;
- Transform data into new knowledge;
- Map new knowledge into agency decision support systems;
- Thereby, improving the science foundation of environmental decisions.



Application of Trace Gas and Aerosol Satellite Measurements

- **Assessment/Monitoring** - Enhance Traditional Focus on Regulatory Policy
  - Identify, characterize, and track pollution
    - Model forecasts evaluation/verification.
    - Data will help to develop pollution reduction strategies and characterize emission sources.
    - Data will help assess existing pollution control strategies Criteria Pollutant NAAQS.

Application of Trace Gas and Aerosol Satellite Measurements

- **Air Quality Forecasting** - EPA/NOAA Partnership
  - Assimilation of data to improve air quality forecast
  - Model forecasts evaluation/verification
- **Connecting to other Science Areas**
  - Global and Region Climate-Air Quality Connections
  - Public Health Tracking - Human Exposure

"Applications require balanced approach of measurements and models"

Tropospheric Satellite Data to Date Are from Low-Earth Orbit (LEO)

- Current EOS Research Satellites (MODIS, MISR, MOPITT, AIRS) are LEO and have demonstrated the measurements.
- Newer Generation Research Satellites (SCIAMACHY, TES, OMI, CALIPSO) are also LEO and Will Provide Asynoptic Global Coverage.
- The measurement capability has been demonstrated from LEO and these provide extremely valuable data for AQ research.

EPA Expert Community Panel Workshop: 9-10 March 2004

- 14 invited experts from Public-Private-Academic sectors

The charge:

- Provide EPA with expert recommendations and guidance concerning EPA participation in a Global Earth Observing System of Systems (GEOSS).
- Make recommendations focused on:
  - domestic and international needs and challenges, and
  - chemical and meteorological monitoring and modeling,
  - emissions inventorying, urban air quality,
  - communications,
  - information archiving,
  - training and outreach
  - Covered the gamut of resolution and other parameters.

Henry and Dabberdt report available

Panel Members

- Gregory Carmichael -- Univ. Iowa
- Mary Anne Carroll -- Univ. Michigan
- Jason Ching -- NOAA (assign. to EPA)
- Walter Dabberdt -- Vaisala (Co-Convener)
- Jack Fishman -- NASA LaRC
- Alex Guenther -- NCAR
- Jeremy Hales -- ENVAIR
- Robert Imhoff -- BAMS
- Sharon LeDuc -- NOAA NCDC
- John McHenry -- BAMS (Co-Convener)
- Richard McNider -- Univ. Alabama - Huntsville
- Nelson Seaman -- Penn State Univ. (assign. To NOAA/NWS)
- James Szykman – USEPA ORD (assign. to NASA LaRC)
- Anne Thompson – Penn. State Univ.
- Gary Foley, S.T. Rao, Ellen Cooter and John Lyon – EPA (Sponsors)

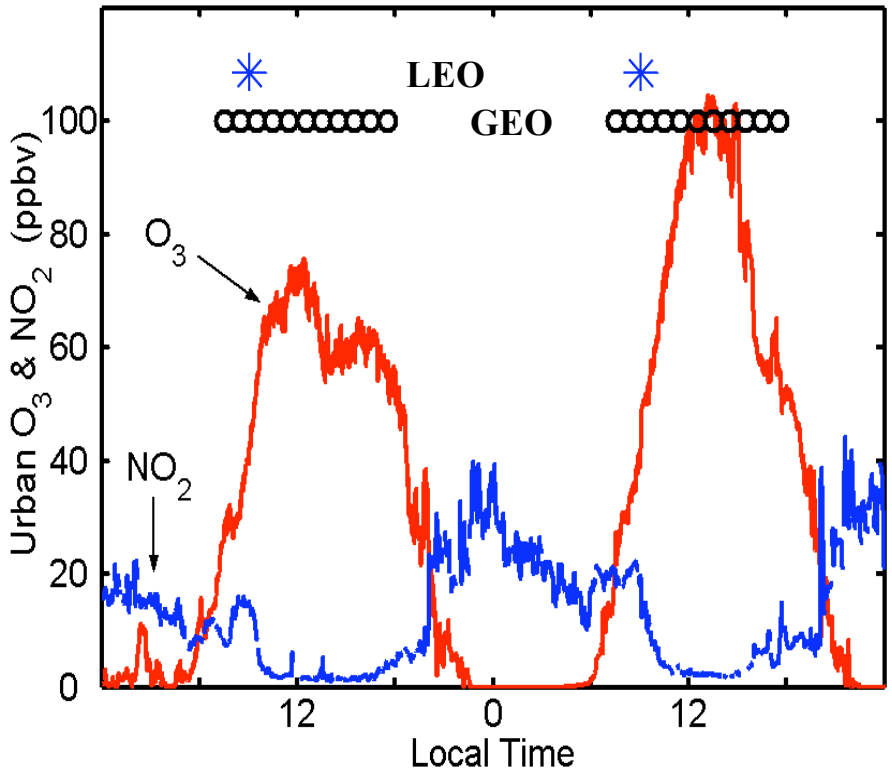
"Ideal" Observation of Chemical Parameters Needed for Air Quality

- Key Chemical species directly related to NAAQS
  - Ozone, NO2, HCHO, CO, SO2, NH3
  - Other trace gases of opportunity within spectrum
  - PM species: AOD at a minimum
    - Chemical composition and size distribution of aerosols (PM10 - PM2.5)

- Resolution:
  - Vertical – multiple layers in troposphere with resolution of PBL
  - Horizontal – Spatial resolution needs to be in with high resolution regional AQ models (i.e., 4 km x 4 km or finer)
  - Temporal – Hourly to capture **rapid changes of *O3, aerosols, & precursors during the day,*** *and night for IR measurements*

- Information used for :
  - Data assimilation during air quality model simulation
  - Operational and diagnostic model evaluation
  - Emissions inventory verification
  - Evaluation of Policy issues

GEO provides the appropriate time resolution for air quality



O_3, aerosols, & precursors change rapidly during the day.

Urban area AQ

Stars indicate typical times for Low Earth Orbit (LEO) measurements

Circles indicate individual GEO hourly measurements

U.S. EPA Participating in GOES-R Program as a User

- GOES-R will provide improved operational AQ related products.
  - MODIS like aerosol and fire products.
  - Traces gases CO, CH4 and O3, primarily for corrections on physical parameter retrievals.
- GOES-R will help with temporal resolution for air quality aerosol needs, but trace gas products will provide limited information and are not optimal for air quality.

GOES-R Sensor	Bands	Product
ABI	0.47μm, 0.86μm, 2.1μm	Aerosol optical depth, type (dust vs non dust), and particle size (effective radius) Fraction of fine mode vs coarse mode
ABI	9.6μm	Total column ozone
ABI	3.9μm, 11μm	Fire location, size and intensity Carbon consumption Aerosol and trace gas emissions
ABI	11μm, 12μm	Dust detection
HES	800 – 1000 cm^{-1}	Dust loading and height Volcanic ash detection and amount Volcanic ash height Smoke plume height
HES	1650 – 2250 cm^{-1}	Carbon monoxide Methane
HES	950 – 1050 cm^{-1}	Ozone profile
HES	600 – 800 cm^{-1}	Ash cloud height Smoke plume height
HES	1100 – 1200 cm^{-1}	Sulfur dioxide

Considerations for Air Quality Derived Tropospheric Satellite Data

Ideal air quality observations match temporal and spatial scales of assessment/forecast models and complement operational surface monitoring network

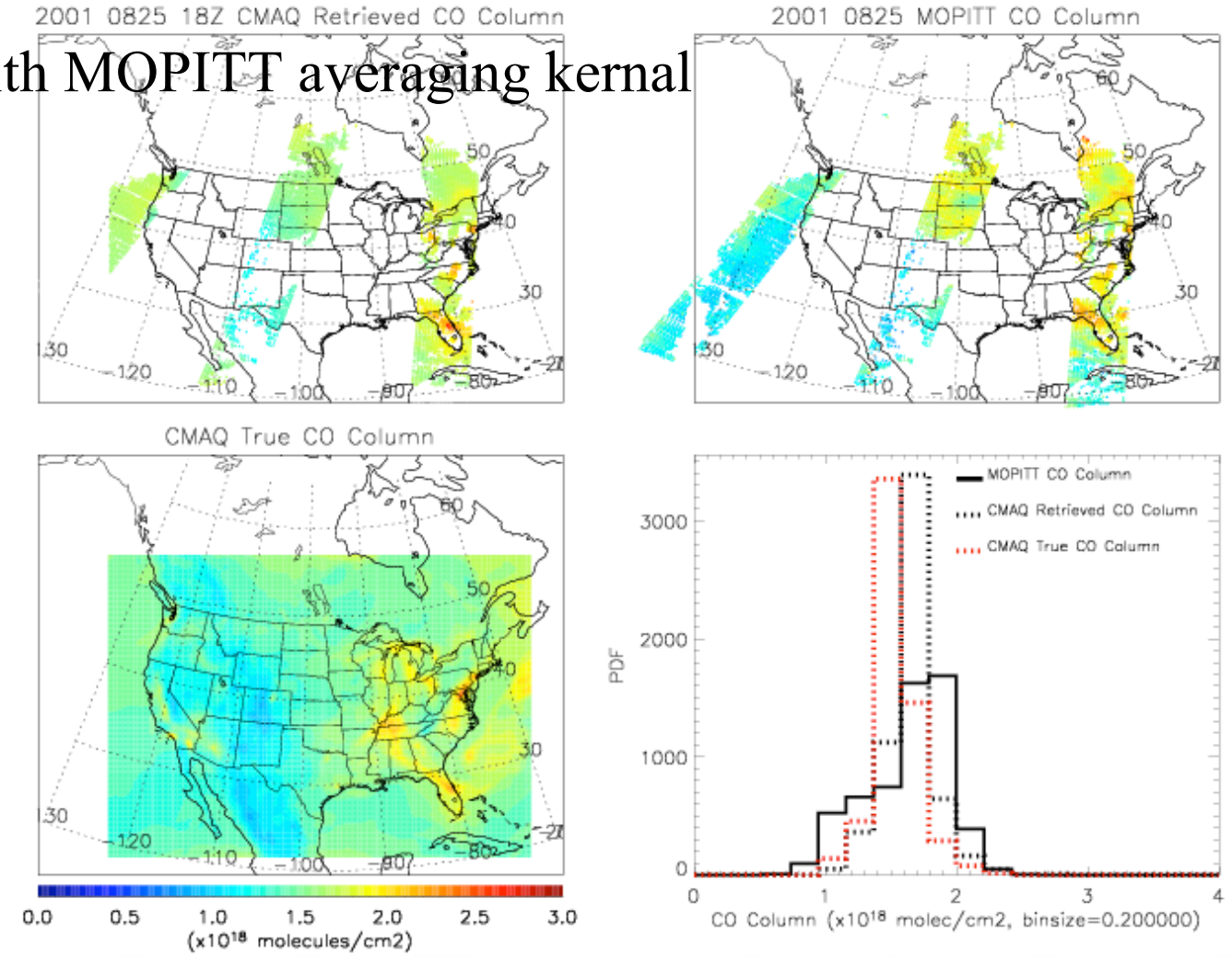
LEO, with global coverage and daily sampling, is good for climate and global monitoring.

GEO, with regional coverage and hourly sampling, is appropriate for regional scale modeling and assessments.

- Primary region of interest is US, and areas of transport to US (Mexico, Canada).
- Pollution is episodic, can be regional or local, but most importantly has large diurnal variability

Model Evaluation
CMAQ (retrieved) CO vs. MOPITT CO

CMAQ with MOPITT averaging kernal

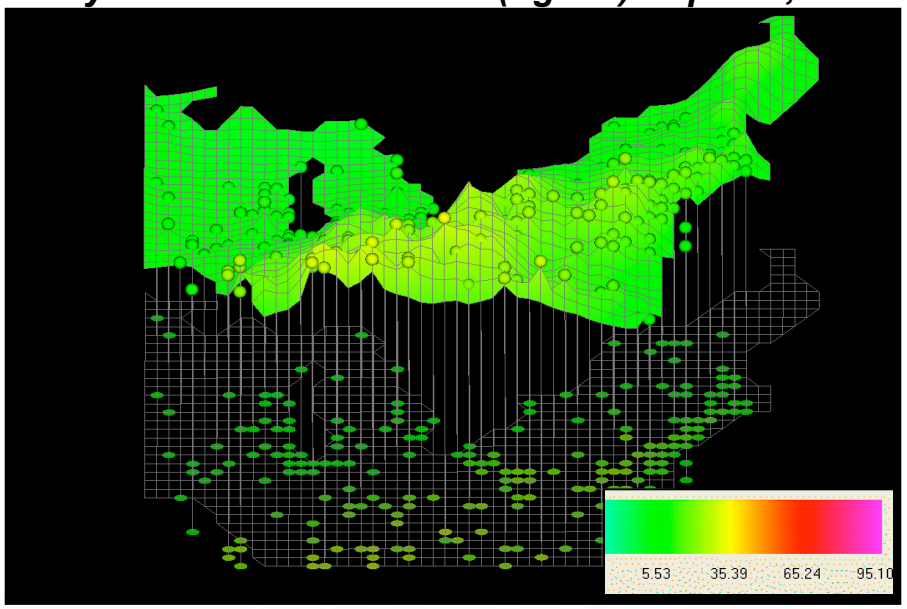


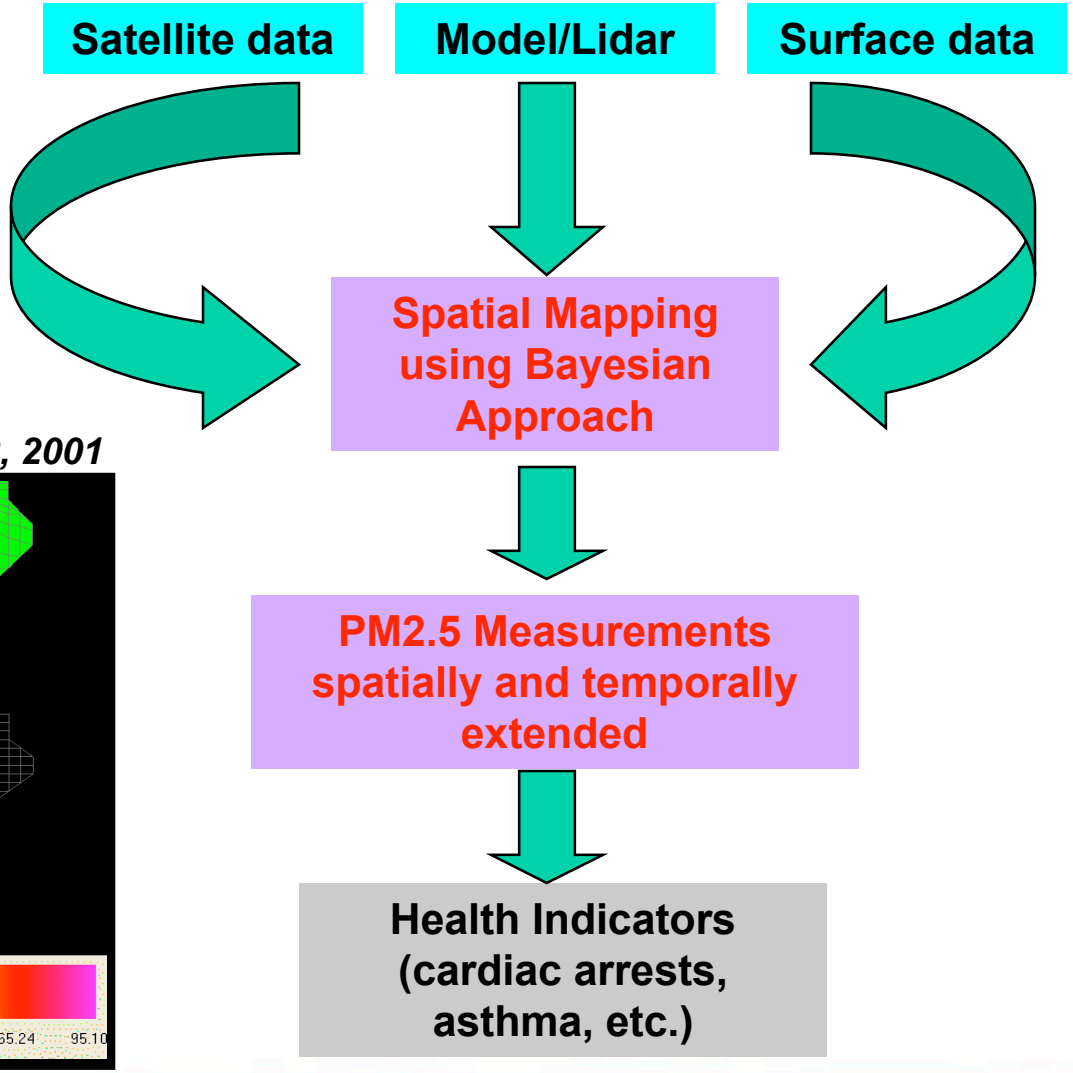
Spatial Prediction Using Combined Sources of Data

Understand the mechanisms behind AOD/PM2.5 correlations.

Fill temporal and spatial gaps to study the linkages between poor air quality and human health.

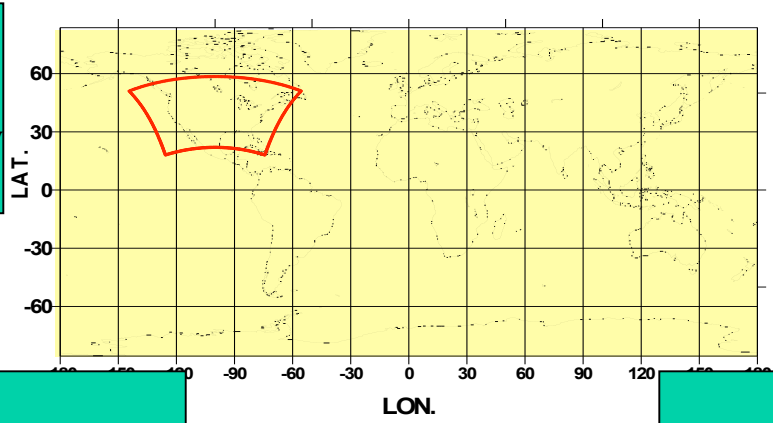
Daily PM2.5 Concentration (ug/m3) Sept. 12, 2001





Impact of Lateral Ozone Boundary Conditions on Predicted Ozone, linking global models to regional

GFS
Meteorology : NCEP
Chemical Mech. : Climatology
(zonal mean strat. P-L)

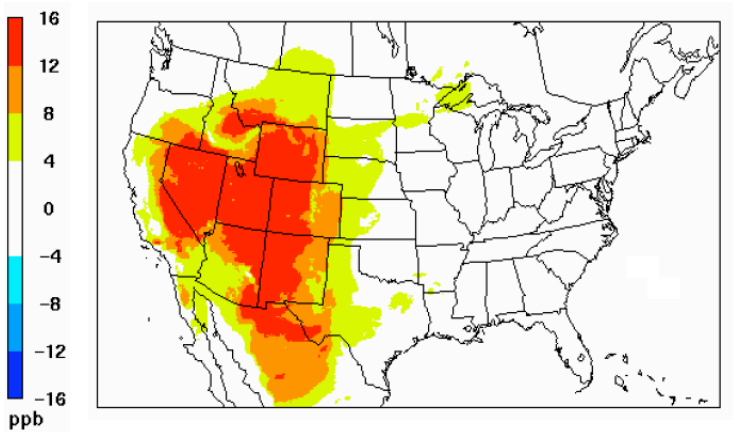


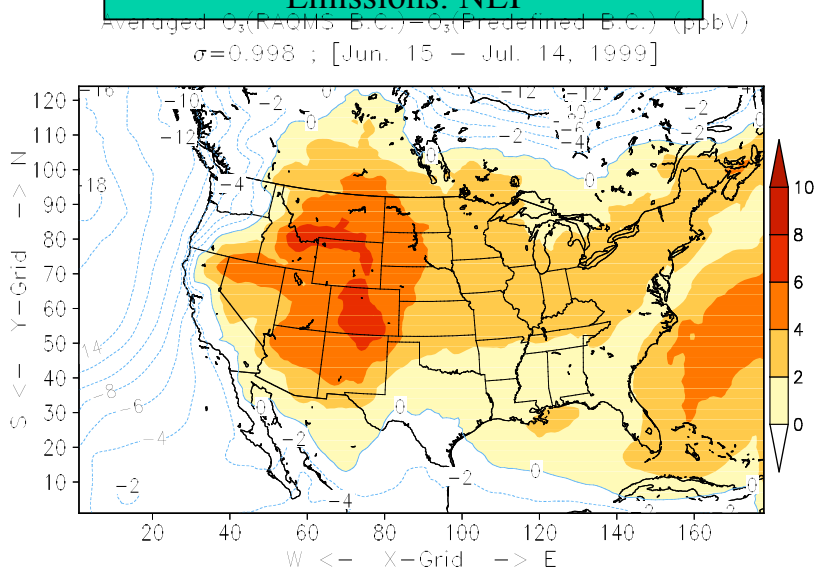
RAQMS
Meteorology : U. of Wisconsin
Chemical Mech. : NASA LaRC
unified trop/strat.

CMAQ
Meteorology : NCEP Eta-12 (NAM)
Chemical Mech. : CB4
Emissions: modified NEI

CMAQ
Meteorology : MM5
Chemical Mech. : CB4
Emissions: NEI

Predicted O3 Difference: GFS-derived – Static (ppb)
[15 July 2005]





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