



Respiratory Health Applications Using New Satellite Air Quality Sensors

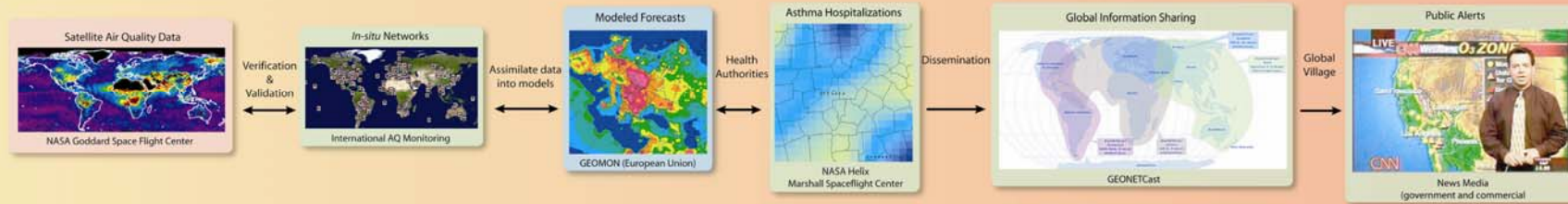
Prof. Stanley Morain
Earth Data Analysis Center
University of New Mexico, USA

ISPRS Presentation at SCANEX, Annual Meeting, Moscow
Dec. 2007

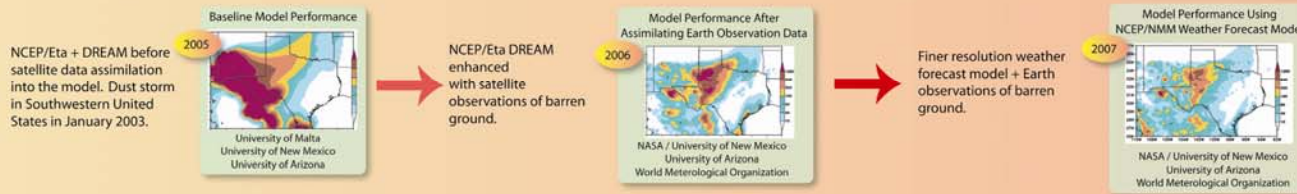


International Society for Photogrammetry and Remote Sensing
 Internationale Gesellschaft für Photogrammetrie und Fernerkundung
 Societe Internationale de Photogrammetrie et de Teledetection

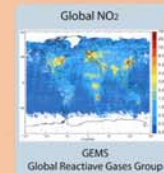
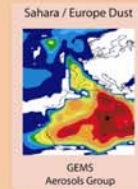
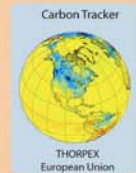
Early Achievements in Air Quality and Health



Progress in dust forecasting and early warning for populations at risk for cardiovascular and chronic respiratory diseases like asthma and myocardial infarction.



These are examples of air quality and health models based on geospatial techniques, satellite data assimilation techniques, and biostatistical techniques from air quality centers and laboratories in the United States and European Union. They all are produced by GEO members and participating organizations to facilitate decisions concerning human health.



- Emerging Products
- Developmental
- Collaborations

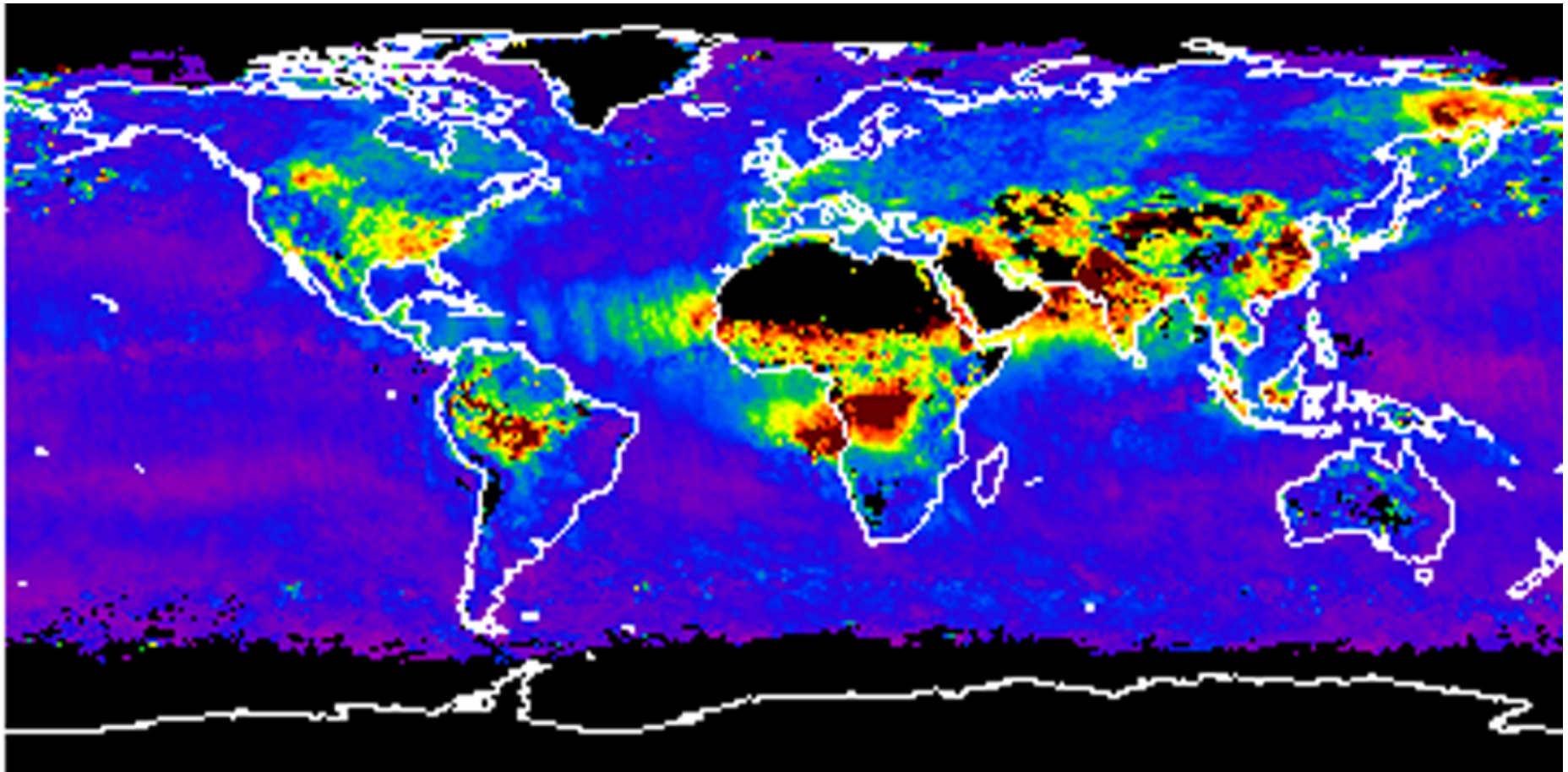
Global Statistics 2002	
Causes of Death	Estimated # (%) of Deaths
Cardiovascular	16.7 M (29%)
Infectious and Parasitic	14.9 M (26%)
Chronic Lung	3.0 M (6%)

Centers of Disease Control & Prevention, United States

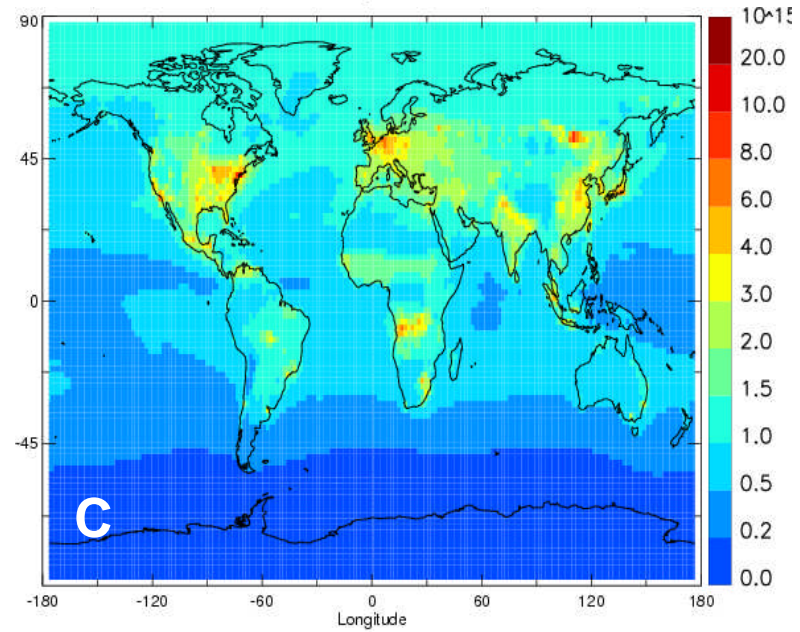
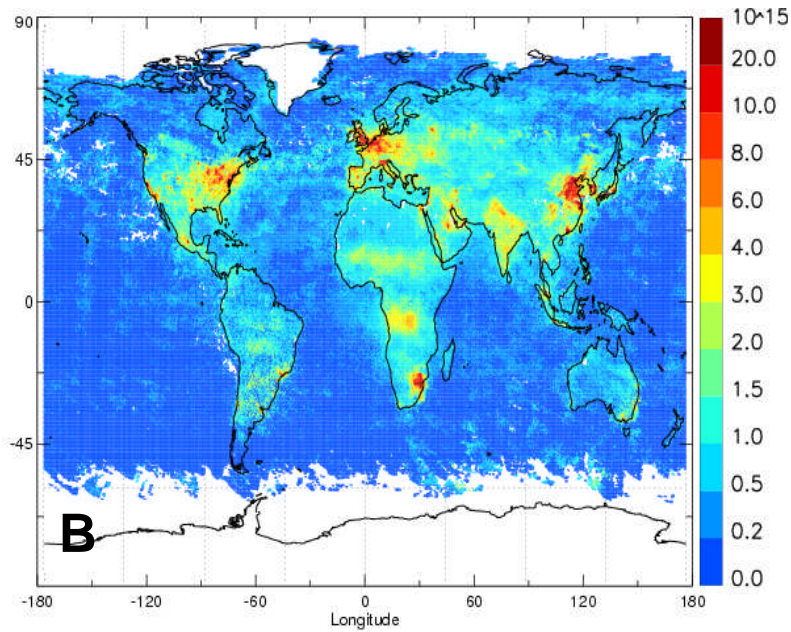
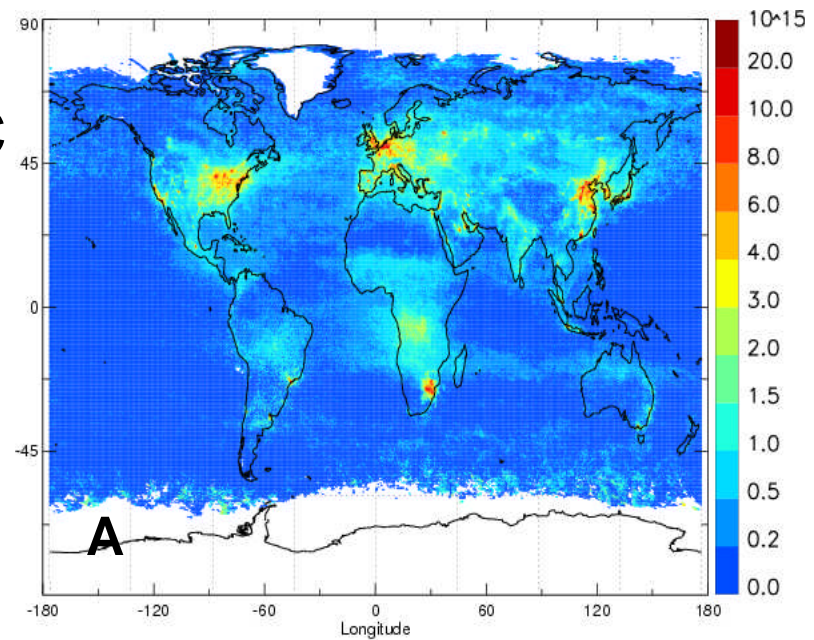
Prepared by the Earth Data Analysis Center, University of New Mexico for the GEO Ministerial Summit on behalf of ISPRS Commission VIII, Working Group 2



Global Aerosol Optical Depth-MODIS

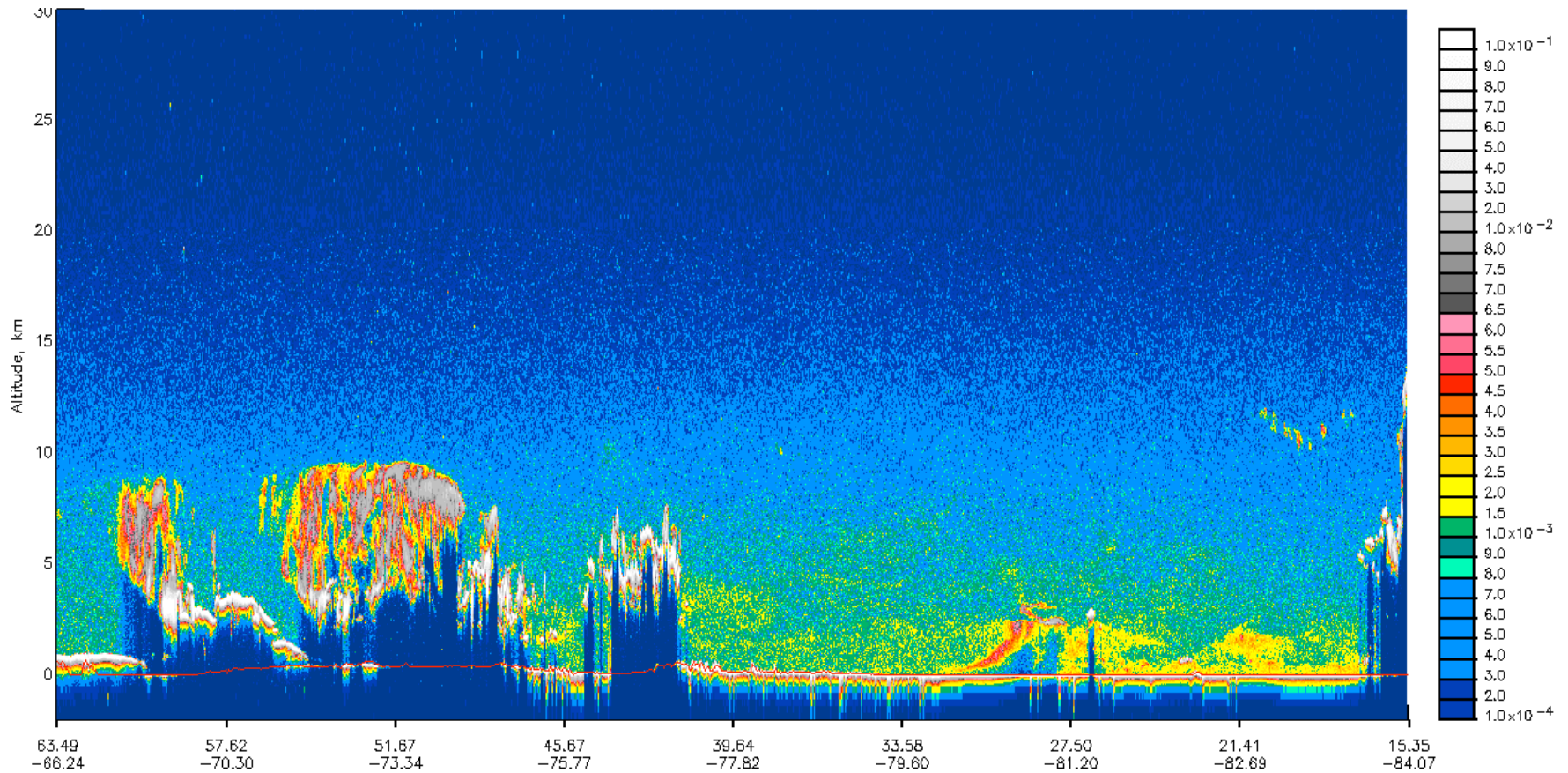


Global Tropospheric NO₂ as viewed by SCIAMACHY (A&B), and as modeled by Mozart (C)

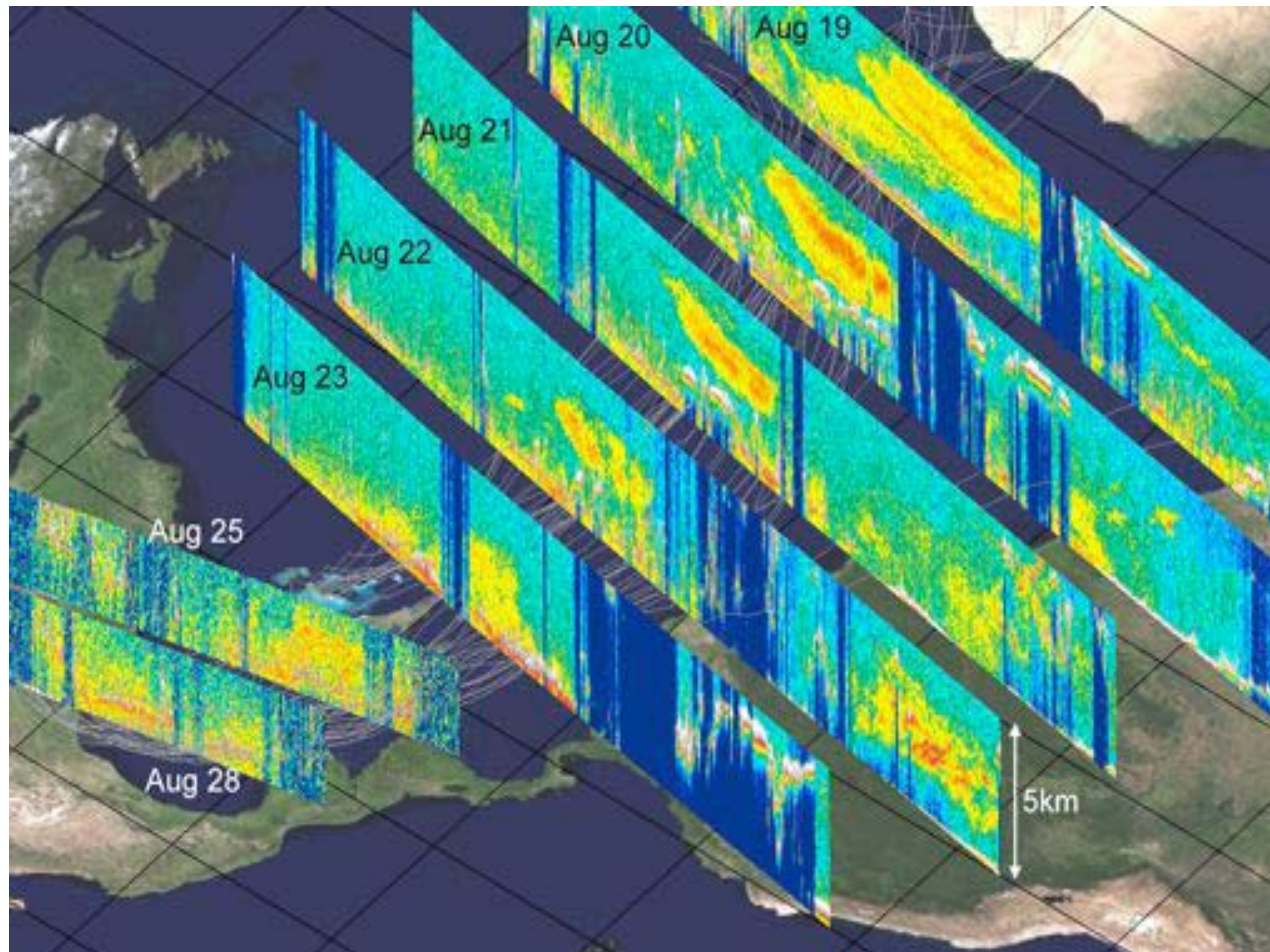


CALIOP Vertical Profile

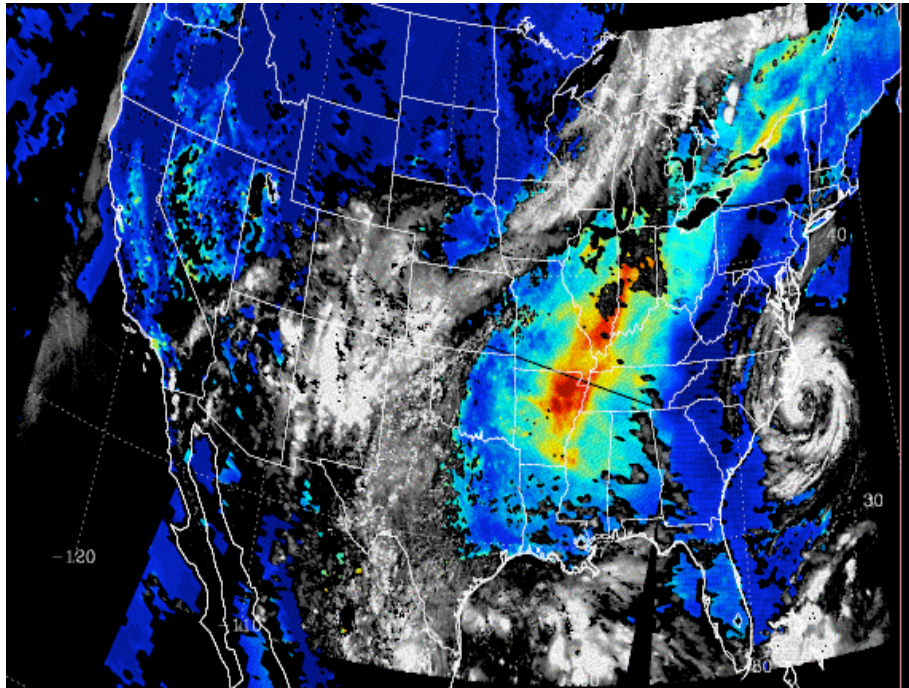
532nm Total attenuated backscatter /km/sr



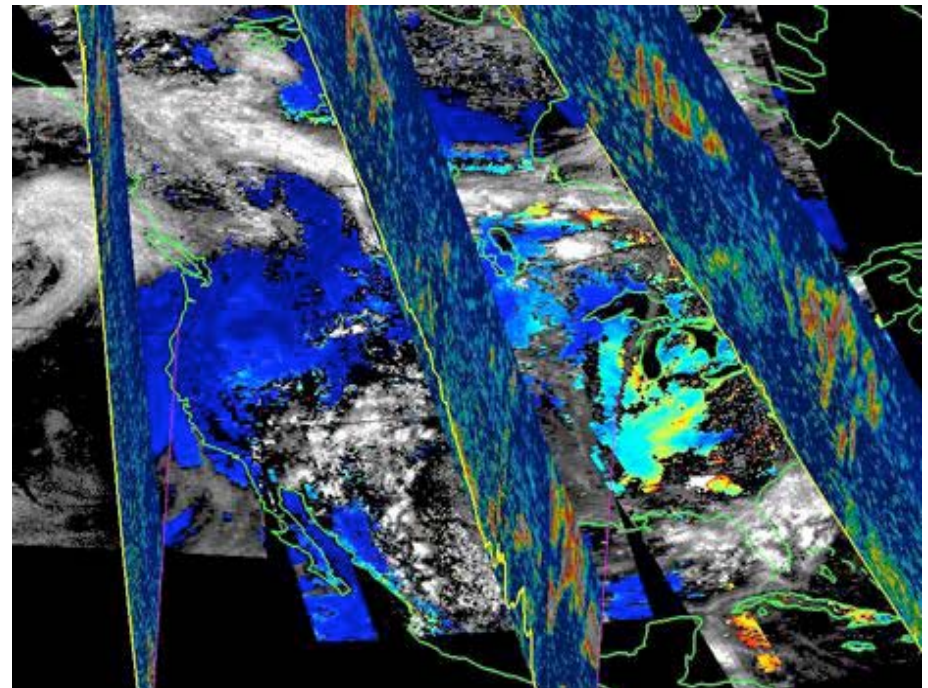
Monitoring African Dust Across the Atlantic



New Dimensions in Air Quality Monitoring



MODIS Aerosol Optical Depth



MODIS AOD fused with CALIOP

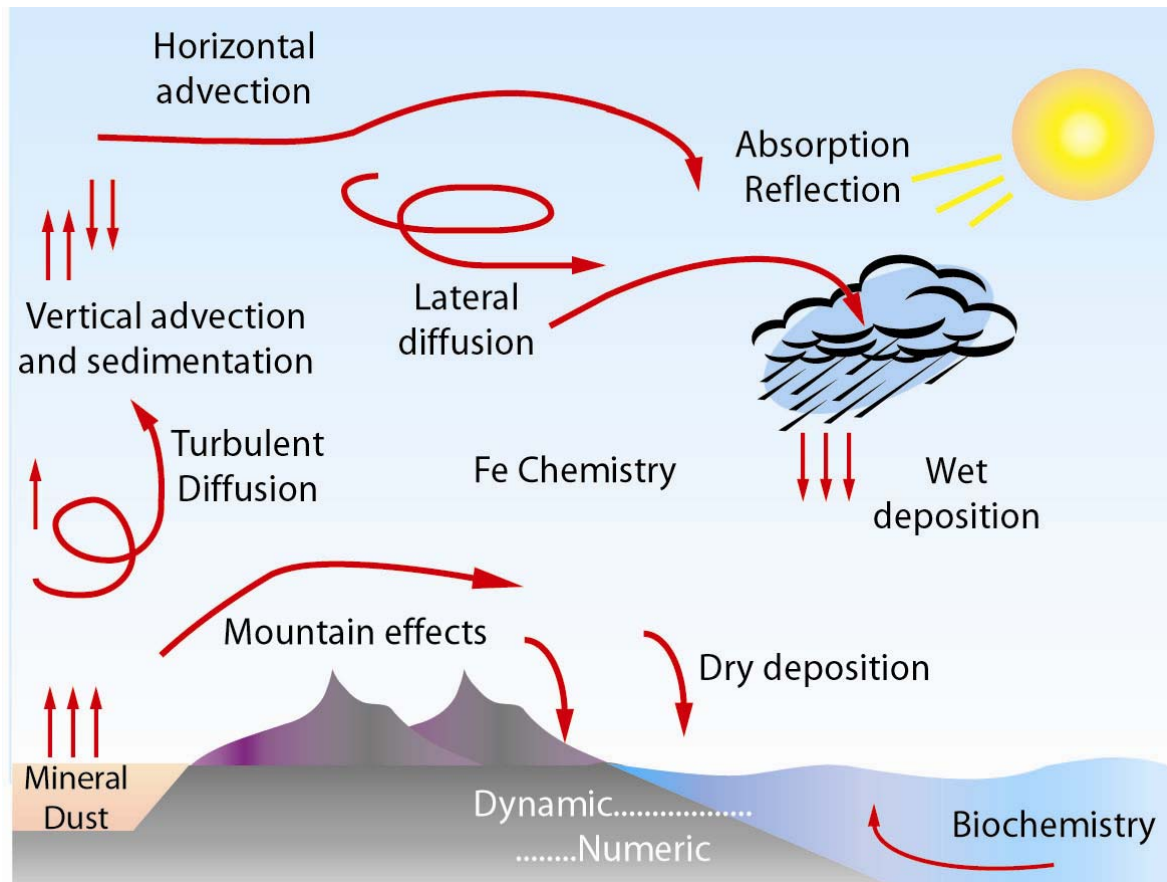
Current capability



Future capability

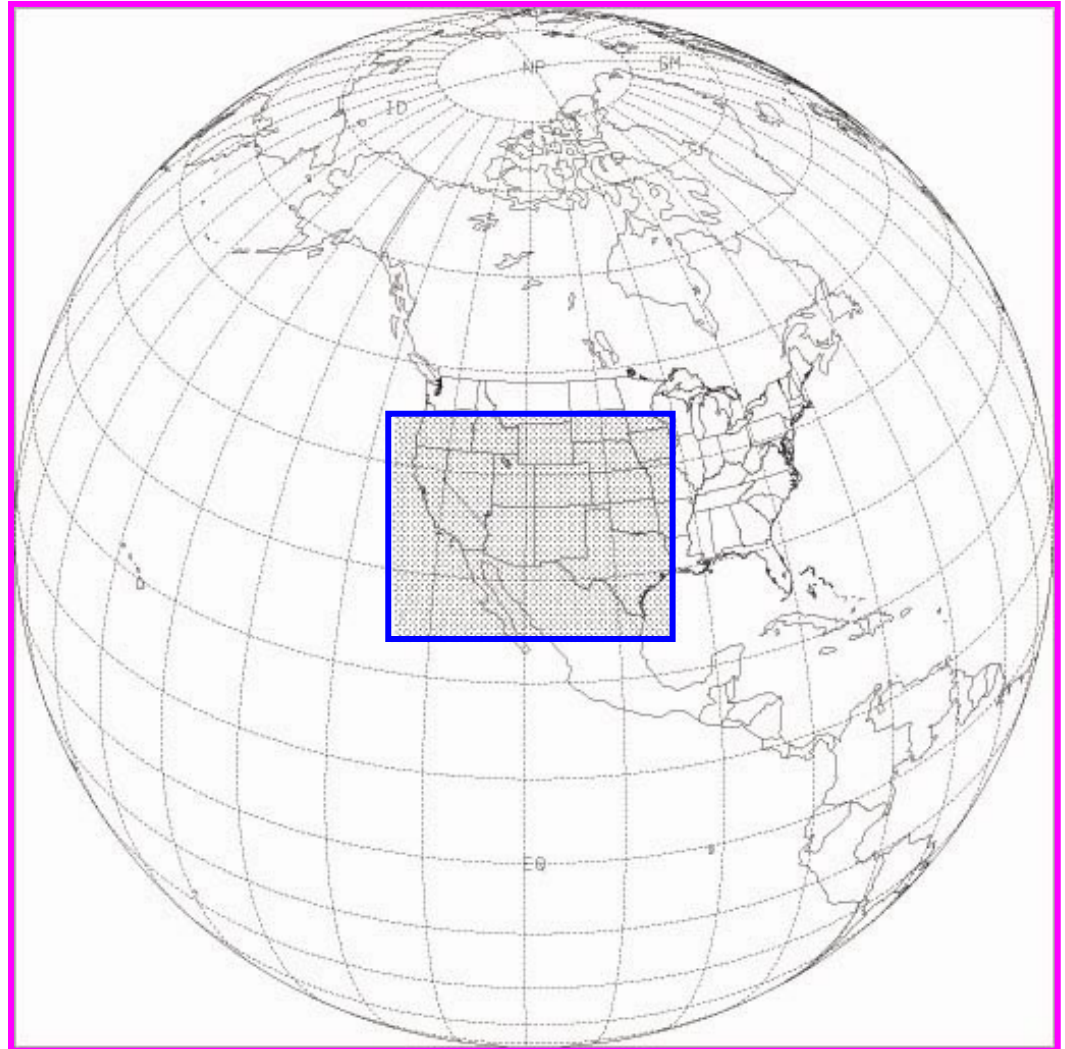
Dust Regional Atmospheric Model (DREAM)

$$\frac{\partial C_k}{\partial t} = -u \frac{\partial C_k}{\partial x} - v \frac{\partial C_k}{\partial y} - (w - v_{gk}) \frac{\partial C_k}{\partial z} - \nabla \cdot (K_H \nabla C_k) - \frac{\partial}{\partial z} \left(K_Z \frac{\partial C_k}{\partial z} \right) + \left(\frac{\partial C_k}{\partial t} \right)_{SOURCE} - \left(\frac{\partial C_k}{\partial t} \right)_{SINK}$$



PHAiRS DREAM Domain

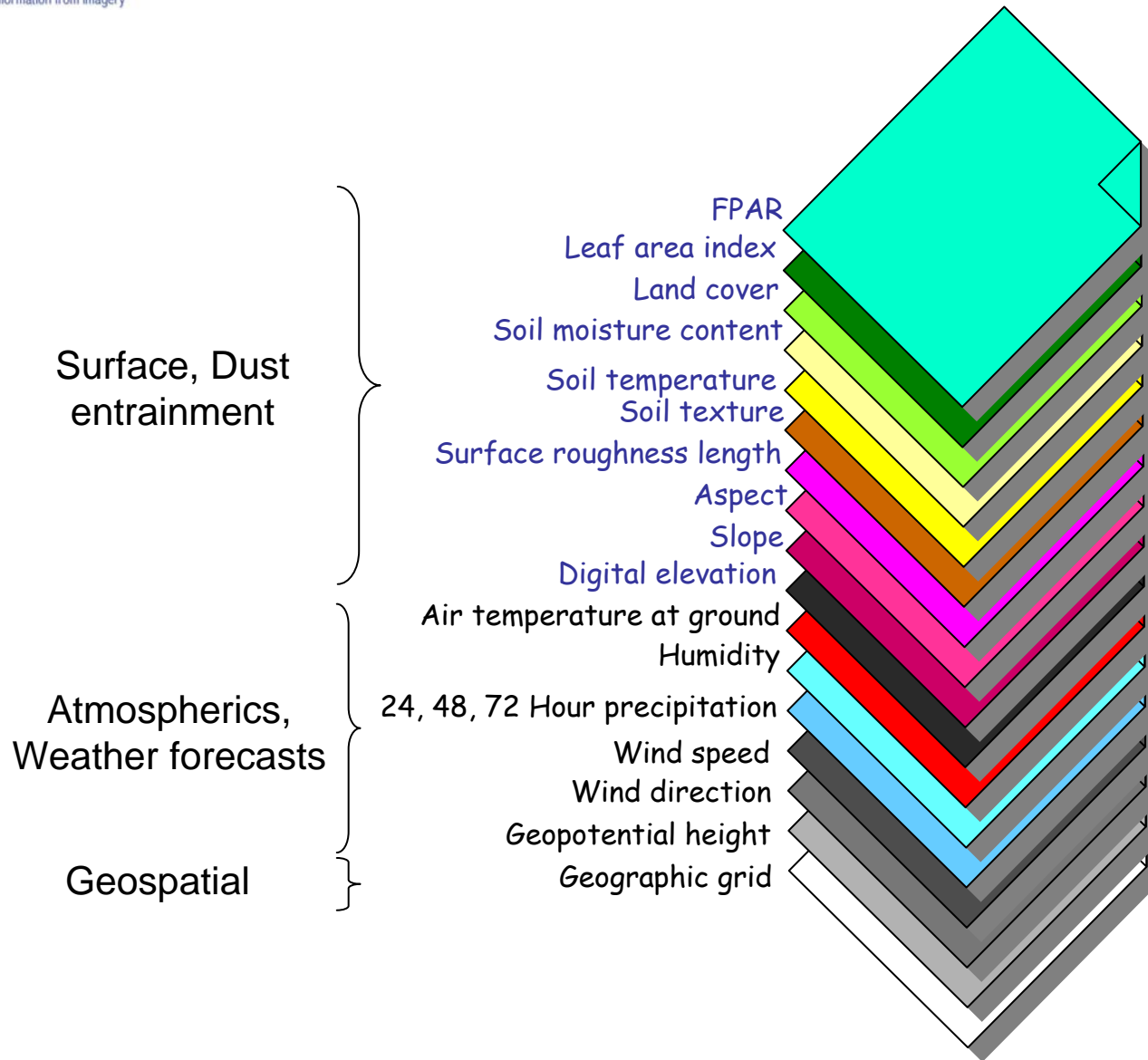
- Domain center at (109°W, 35°N)
- Horizontal semi-staggered Arakawa E grid
- Horizontal grid spacing 1/3 degree



PHAiRS Approach

- Assimilate NASA Earth observations data into a regional dust model (DREAM) nested in the NCEP/Eta weather forecasting model to
 - simulate dust entrainment and dispersion patterns
 - replace traditional model parameters with actual measurements
 - improve dust forecasts by combining atmospheric and land surface measurements that influence health outcomes.
- Use air quality data to
 - verify & validate model outputs of dust episodes
 - transition modeled dust concentrations with air quality standards
- Develop **integrated** forecast products for users
 - model output 24-36 hour *animated* regional forecasts
 - provide fully interoperable **SOAP and SOA interfaces and web-based services** for health care communities and authorities

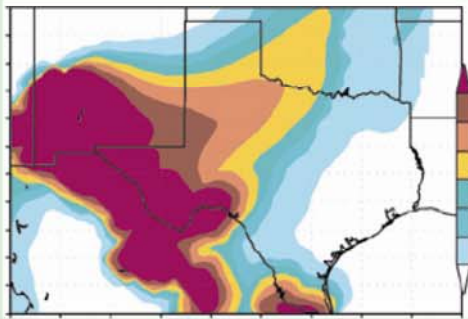
The Baker's Rack



Aims are to: (1) replace selected trays in the rack with regularly refreshed EO digital data from the "terrain." "surface conditions," and "atmospheric" parameters that drive DREAM; (2) improve model output without altering the validity of the model's original function; and (3) convert the model to a more dynamic forecast.

Three Generations of DREAM Model Improvements

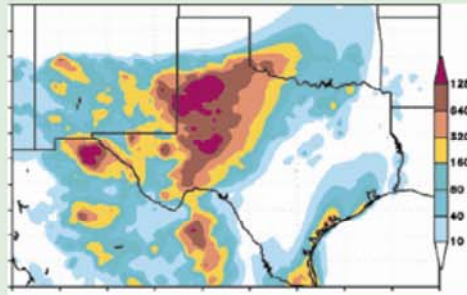
Baseline Model Performance



University of Malta
University of New Mexico
University of Arizona

2005

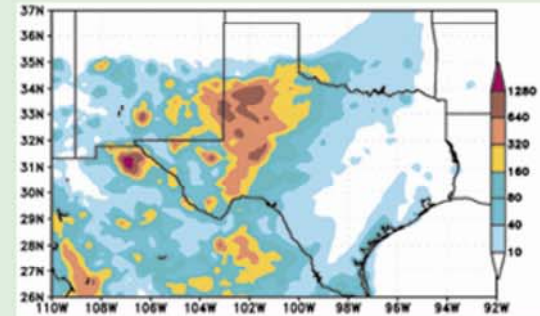
Model Performance After
Assimilating Earth Observation Data



NASA / University of New Mexico
University of Arizona
World Meteorological Organization

2006

Model Performance Using
NCEP/NMM Weather Forecast Model

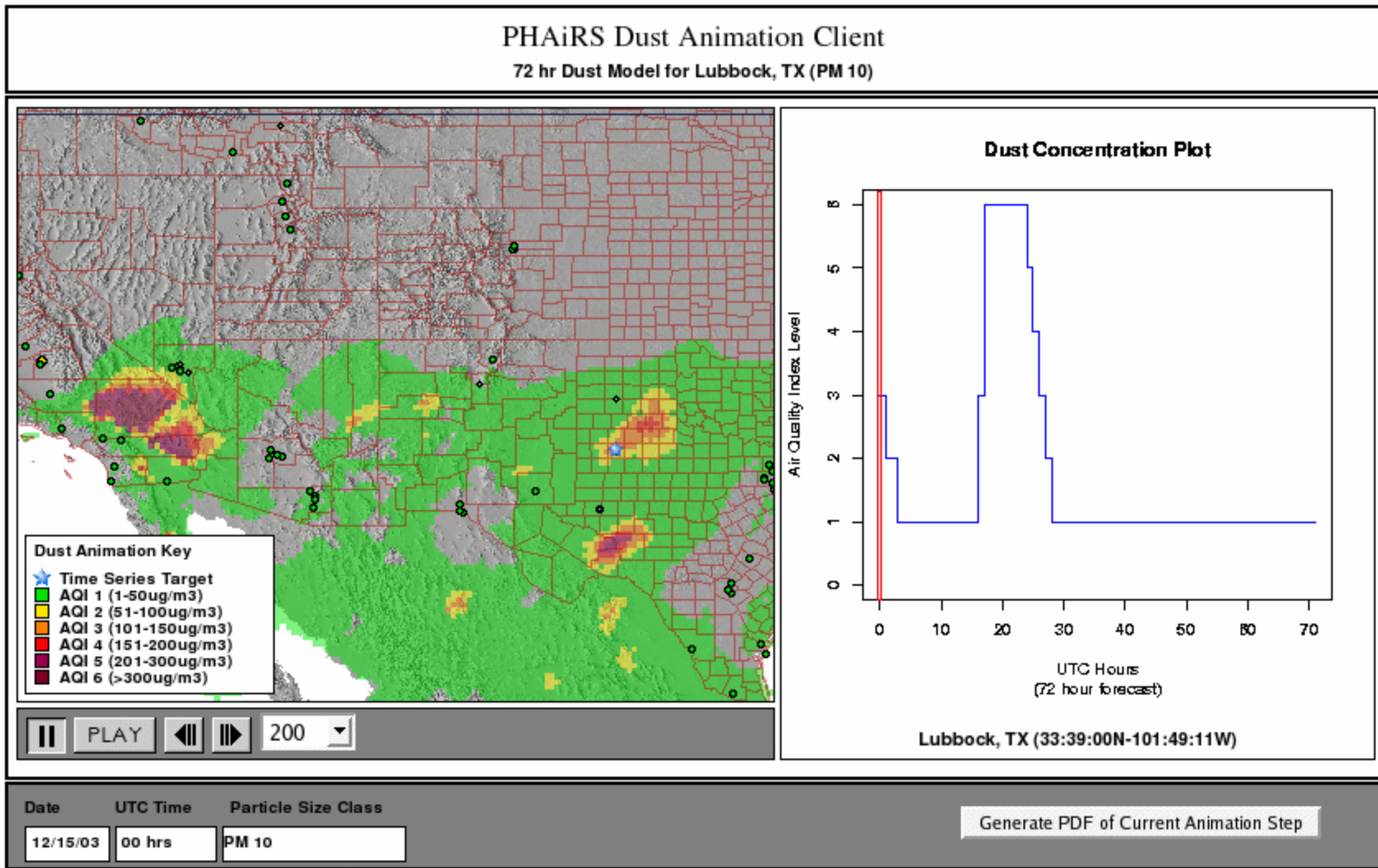


NASA / University of New Mexico
University of Arizona
World Meteorological Organization

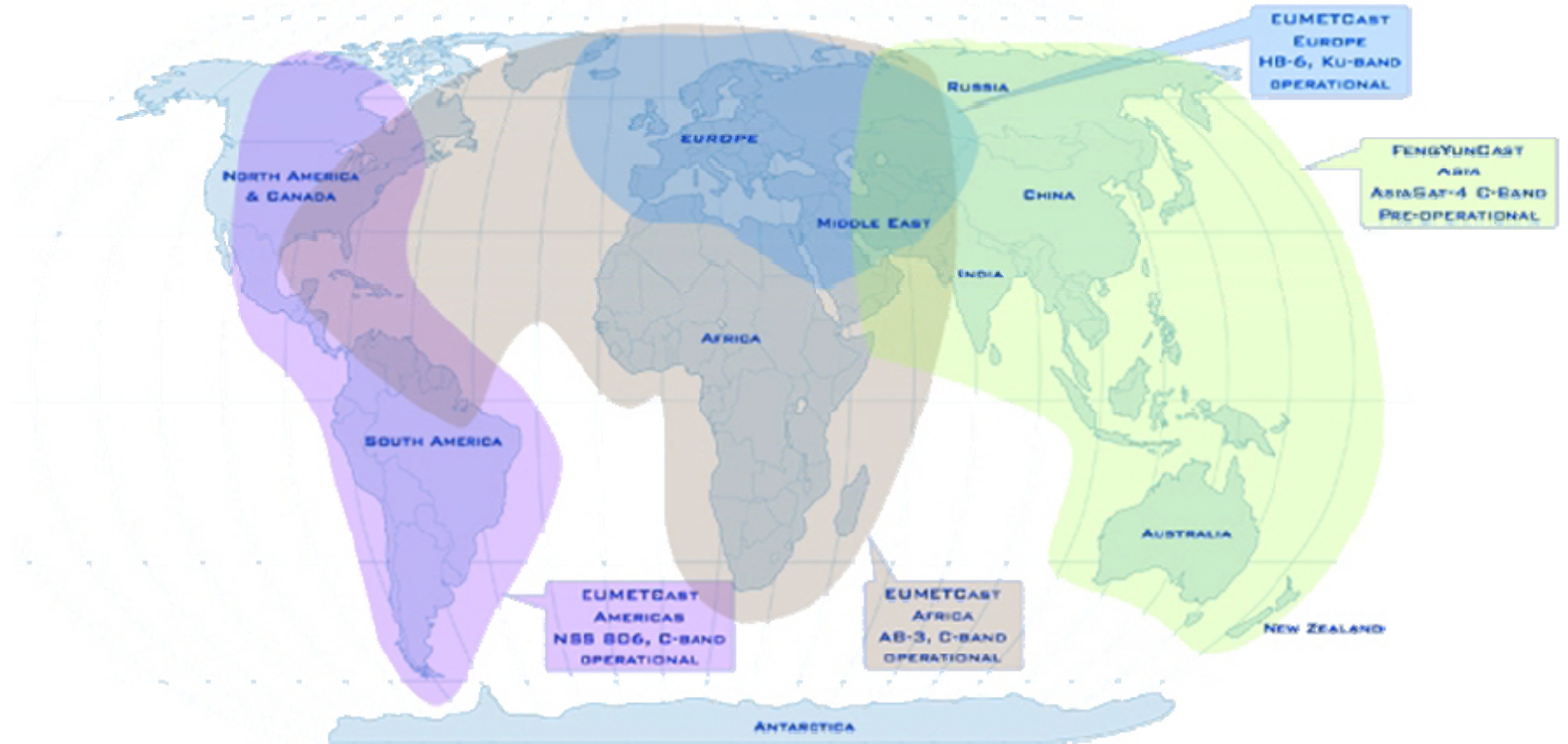
2007

PHAiRS Dust Animation

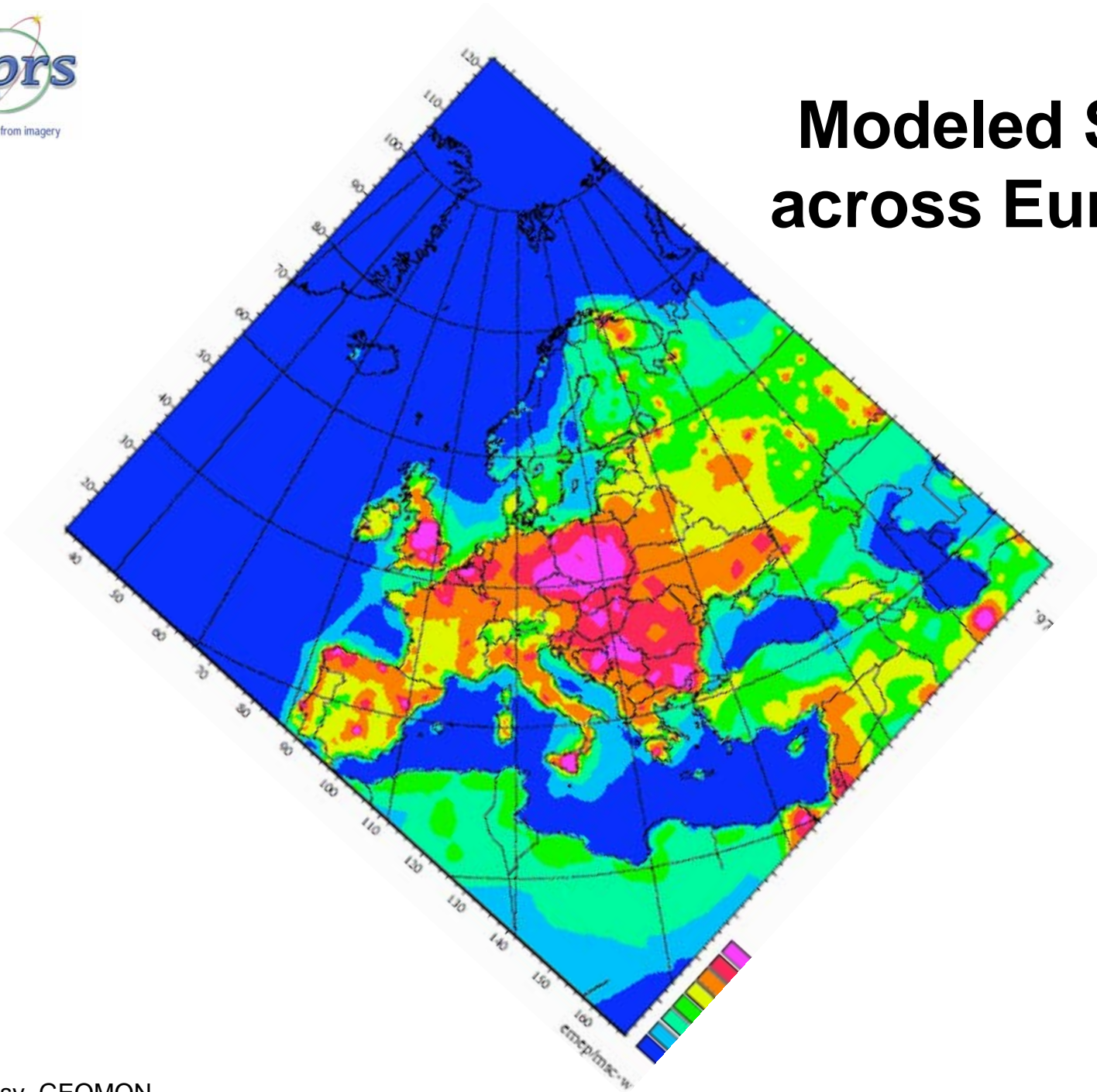
72 Hr Dust Outlook for Lubbock, TX (PM-10)



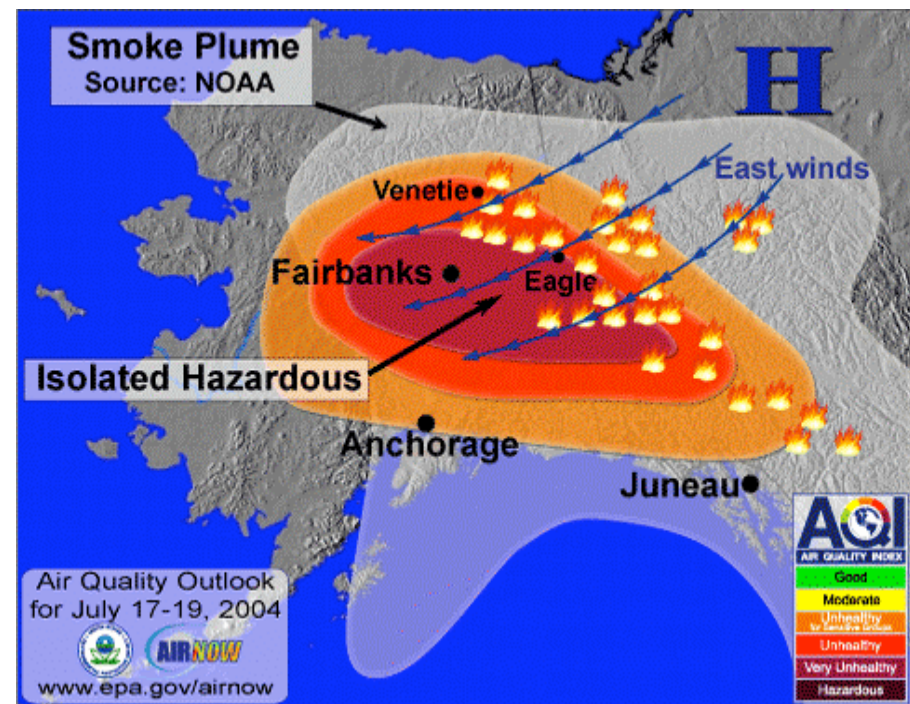
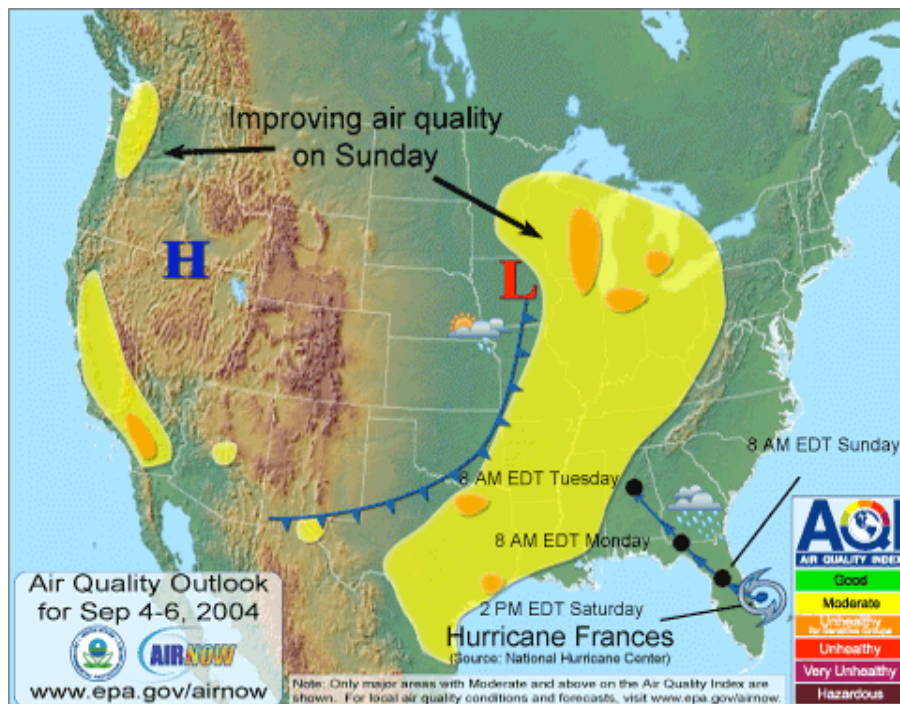
GEONETCast



Modeled SO₂ across Europe

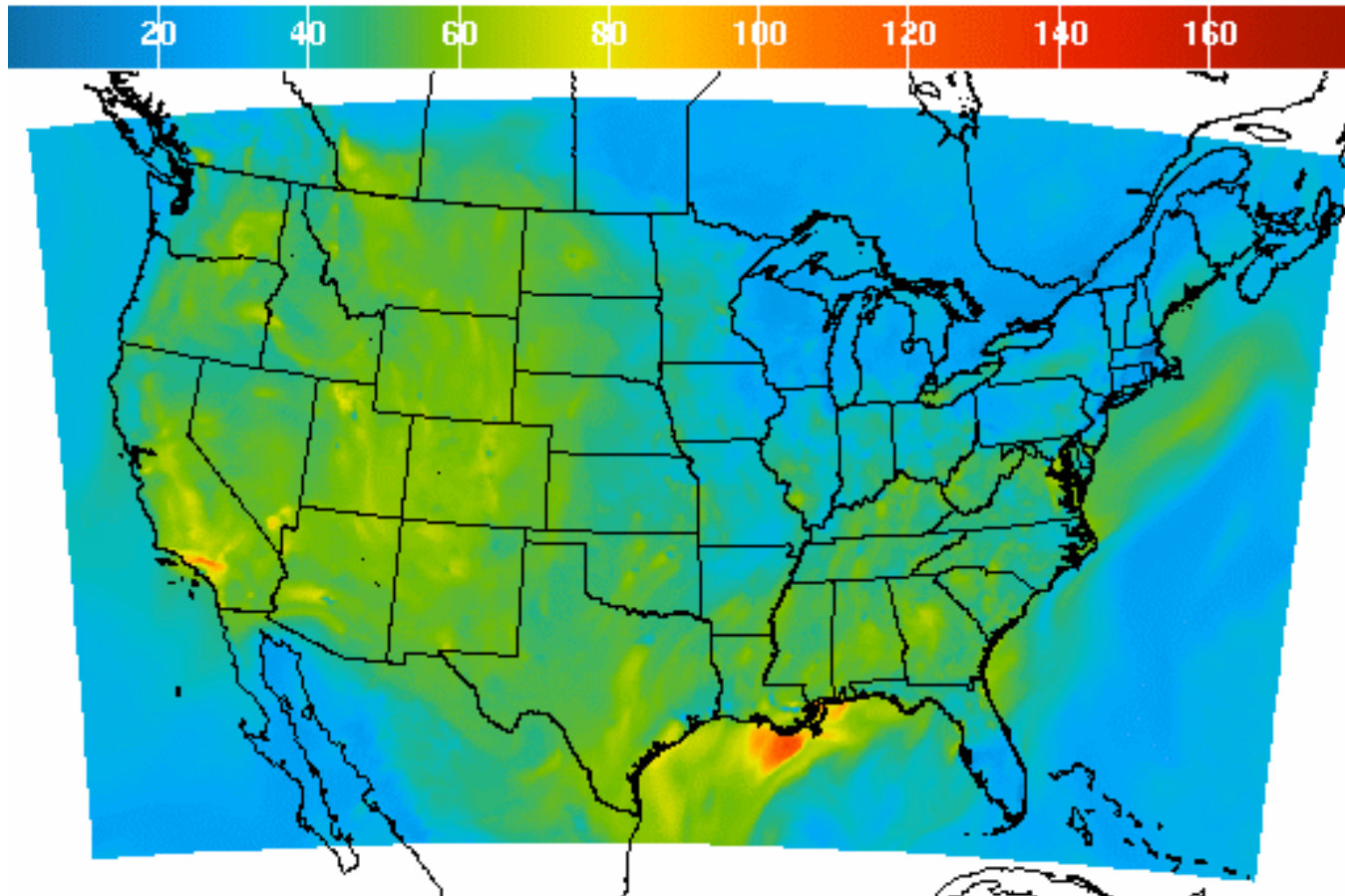


User-ready Air-Quality and Smoke Hazards Products



Based on weather forecast models using geostationary satellite data and ground station networks

Experimental Product Coast to Coast Ozone



8Hr Avg Ozone Concentration(PPB) Ending Wed Sep 06 2006 10PM EDT

Experimental

(Thu Sep 07 2006 02Z)



National Digital Guidance Database

12z model run

Graphic created-Sep 05 2:35PM EDT





Thank You

Contact

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