

# **Climate Modeling Using Earth Observation Data to Improve Public Health Decisions**

**PHAiRS Team  
CCSP Workshop  
Climate Science in Support of  
Decision Making**

**14-16 November, 2005  
Arlington, VA**

# The PHAiRS Team

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## •Research Assistants

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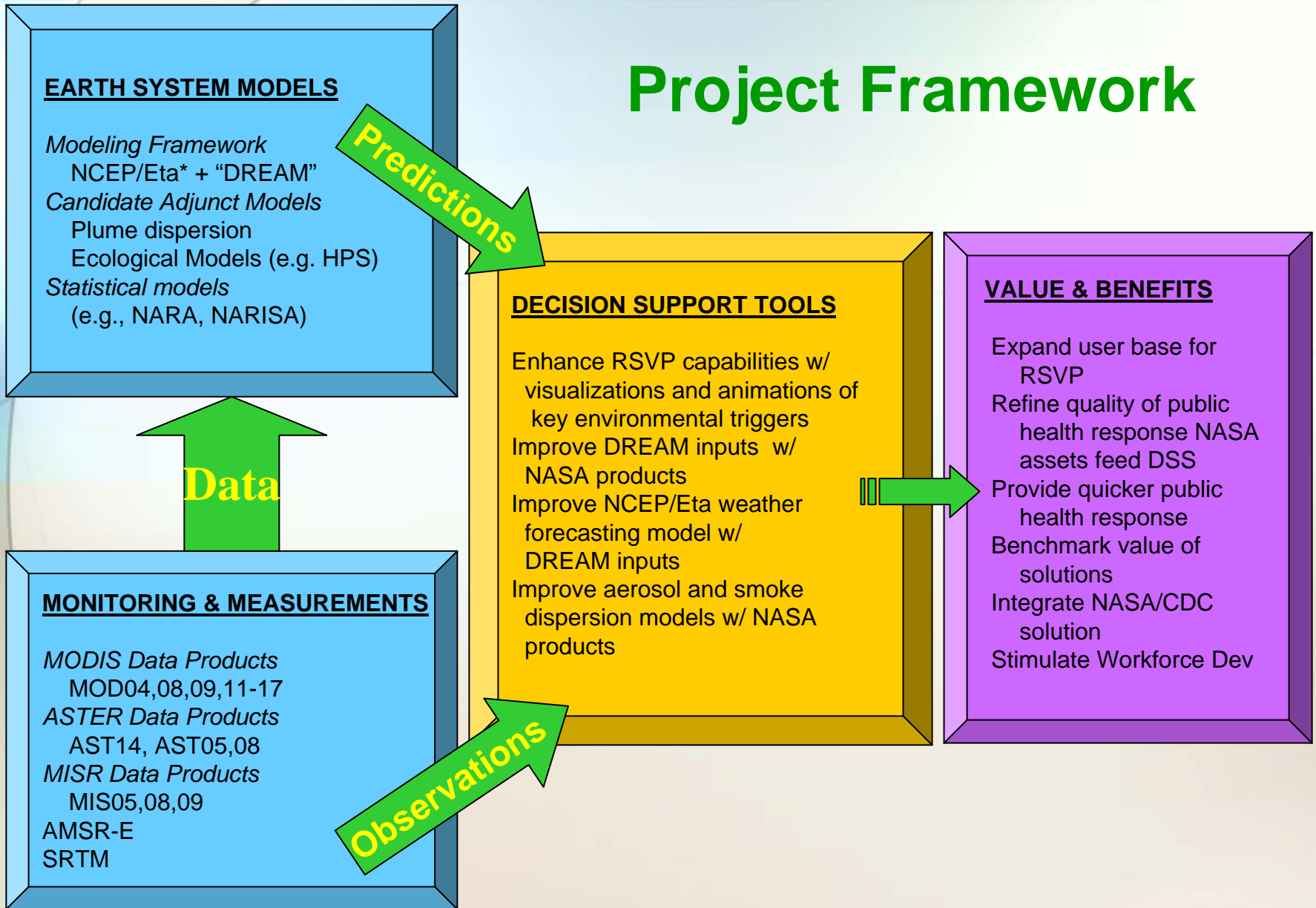
## •Public Health Partners

- City of Lubbock Dept of Health
- Pima County Dept of Environmental Quality
- Arizona Dept of Health Services
- NM Dept of Health
- ARES Corporation

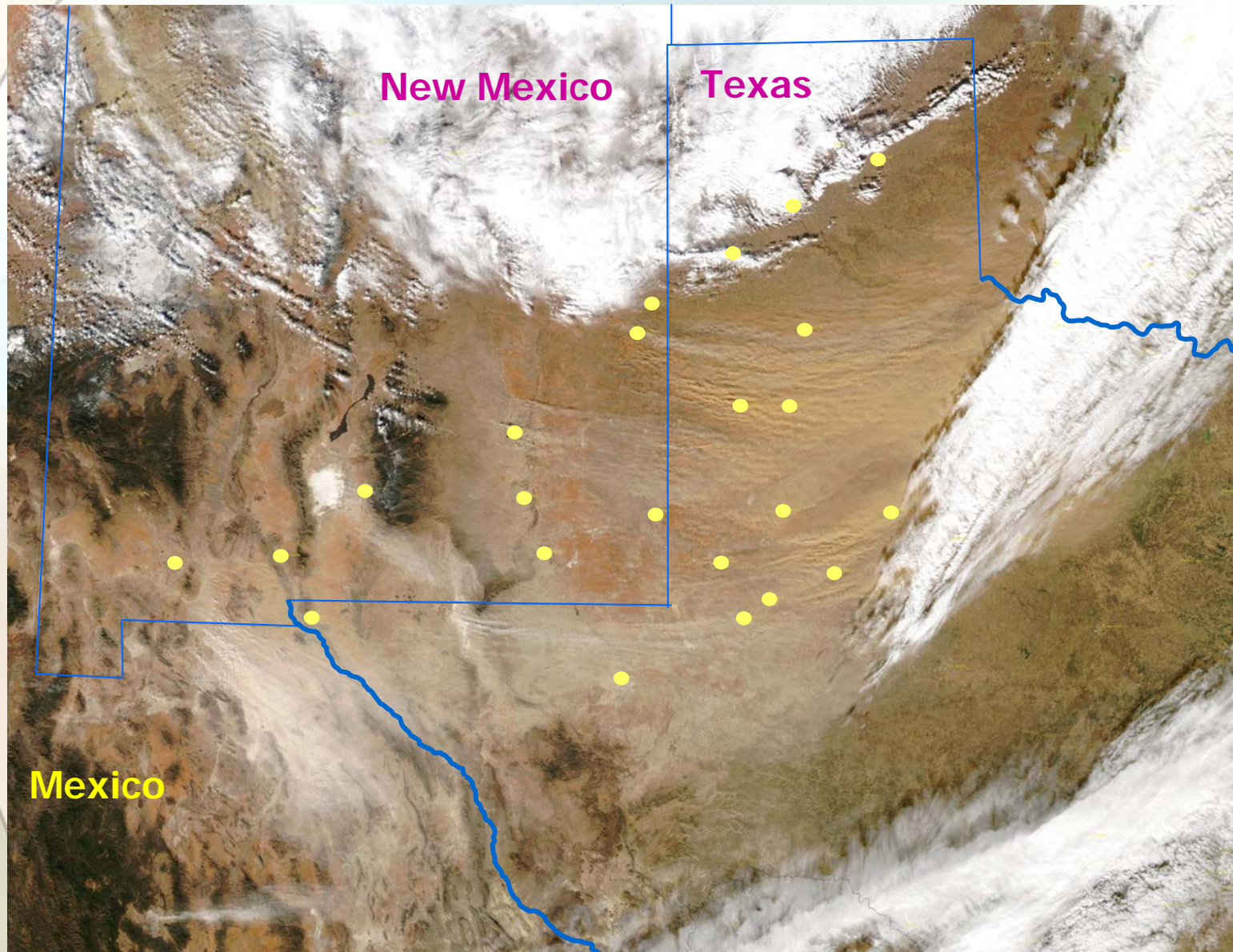
# Public Health Applications in Remote Sensing (PHAIRS)

- Focus on SW, dust storms, respiratory diseases, and syndromic surveillance
- 3 thrusts
  - Assimilate EO data into DREAM as part of NCEP/Eta forecasting system
  - Measure incremental improvements to DREAM outputs as inputs to RSVP/SYRIS
  - Create collaborations with public health authorities to validate relationships between dust episodes and respiratory complaints

# Project Framework

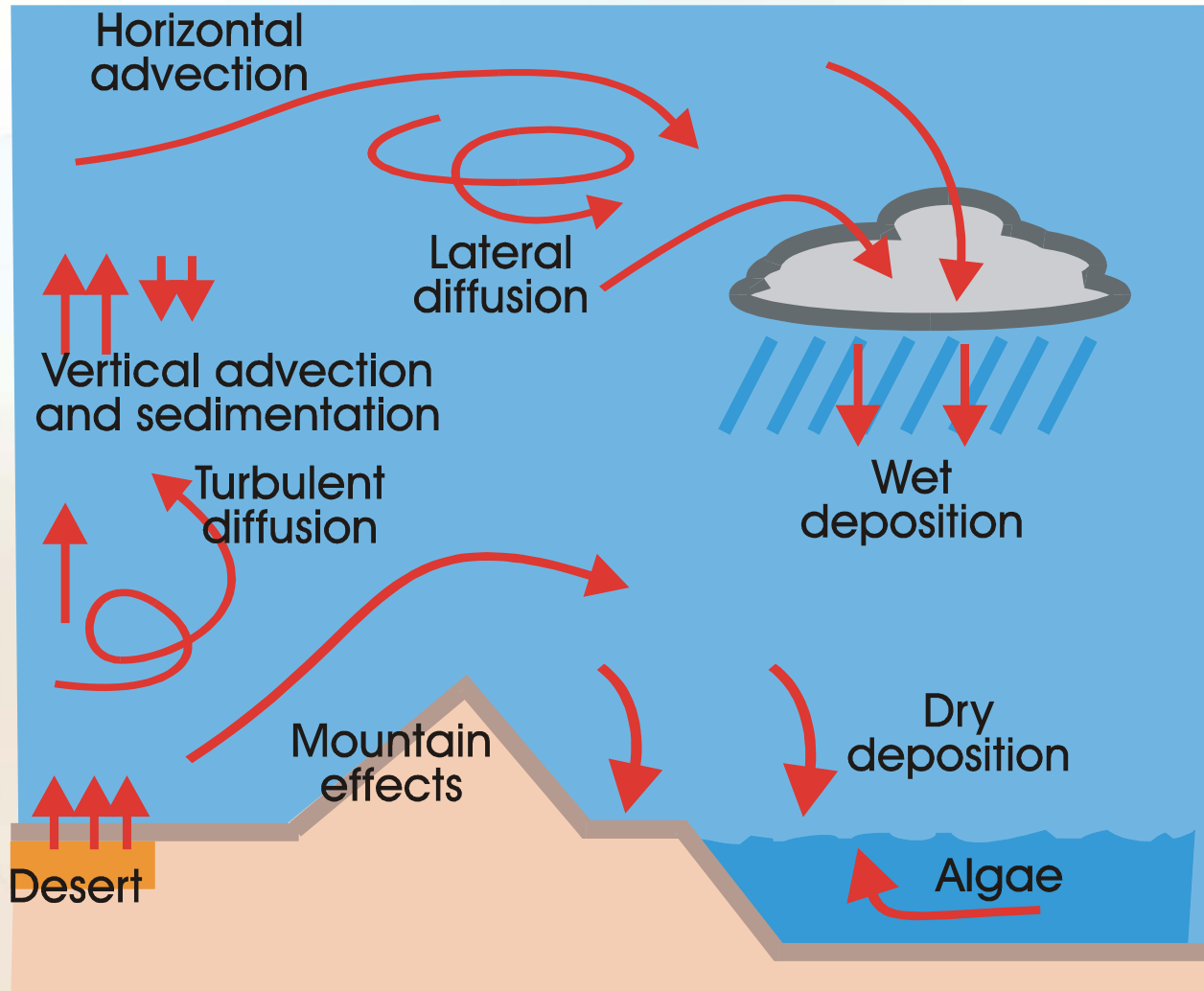


# New Mexico/Texas Dust Storm – Dec 2003



# DREAM's Governing Equation

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

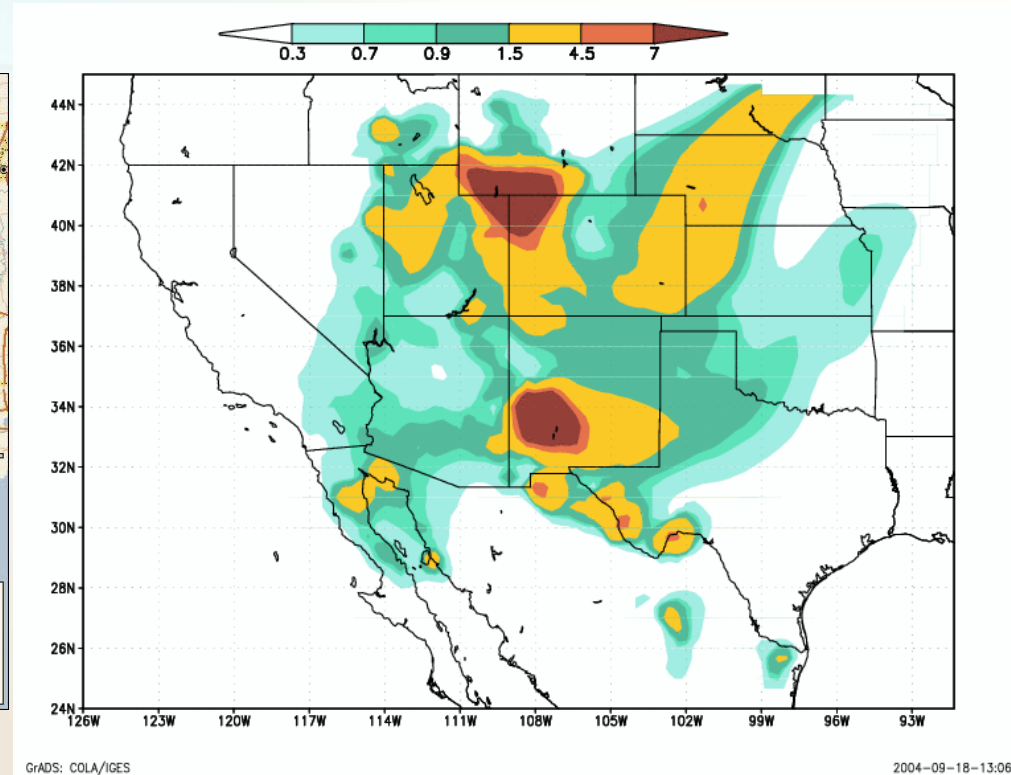


# Observed Visibility vs Modeled Dust Concentrations Dec. 15-16, 2003



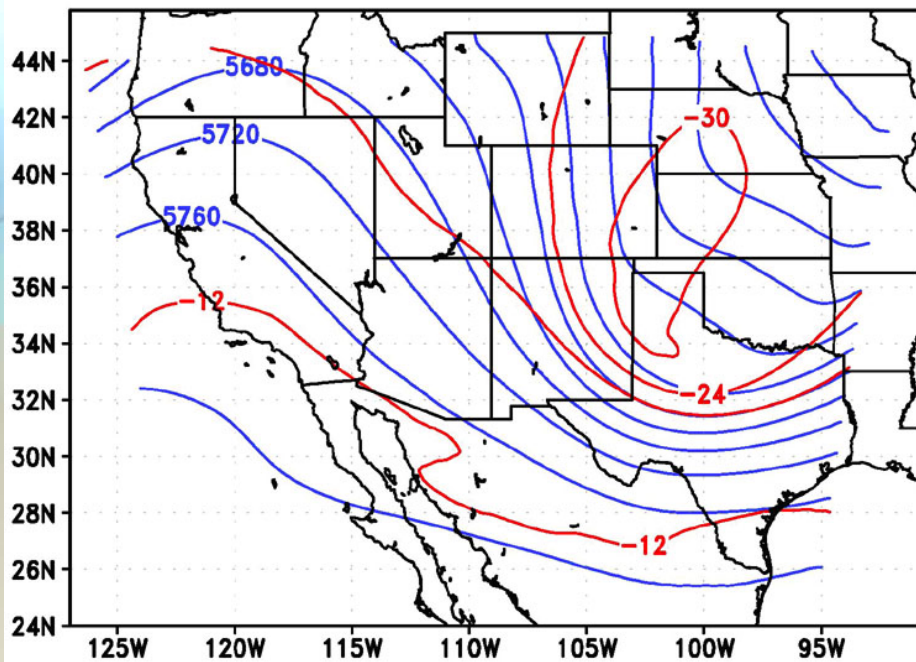
**Texas**

**Continuous Air Monitoring Stations**

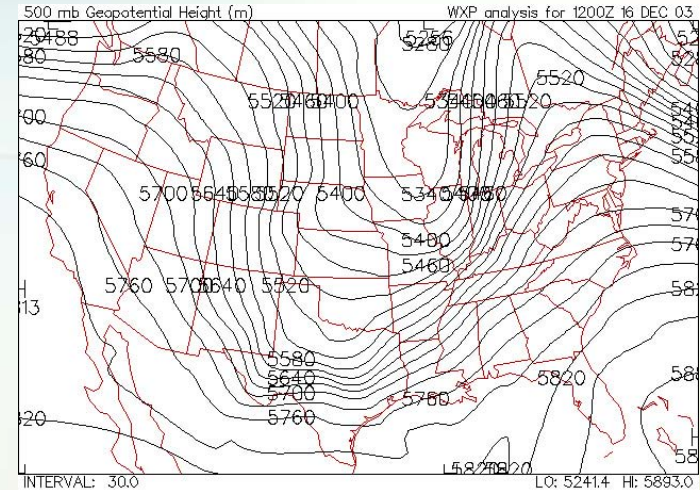


**DREAM Baseline (no EO data included)**

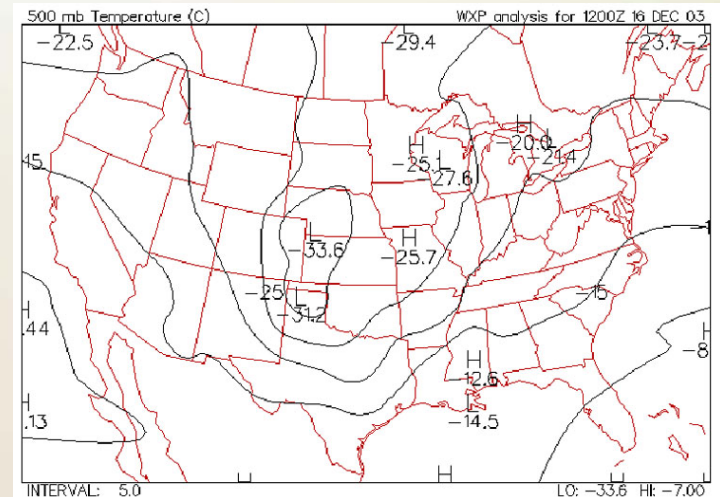
# Modeled vs Observed Synoptic Patterns 12Z 16 Dec 03



**DREAM Simulation**

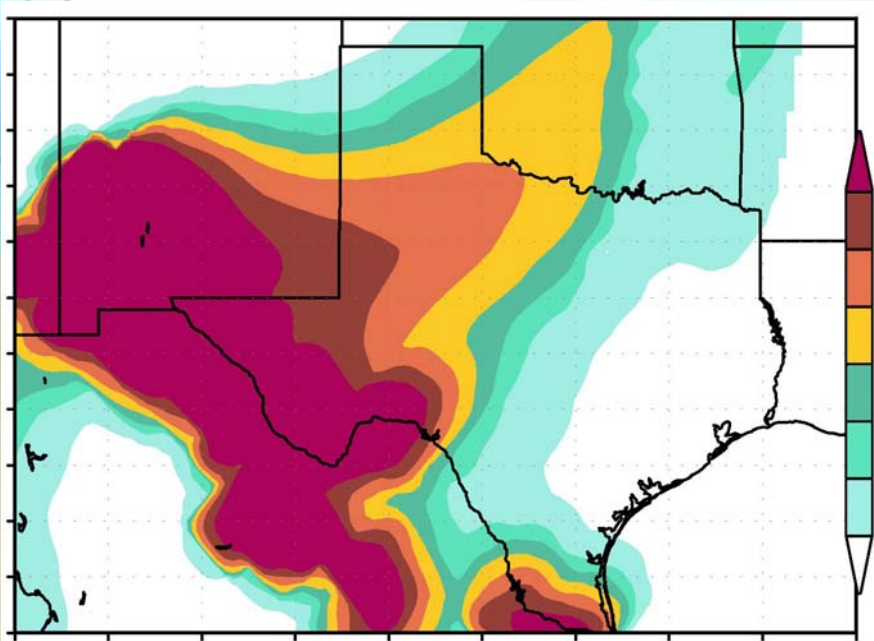


**Observed Geopotential Height**

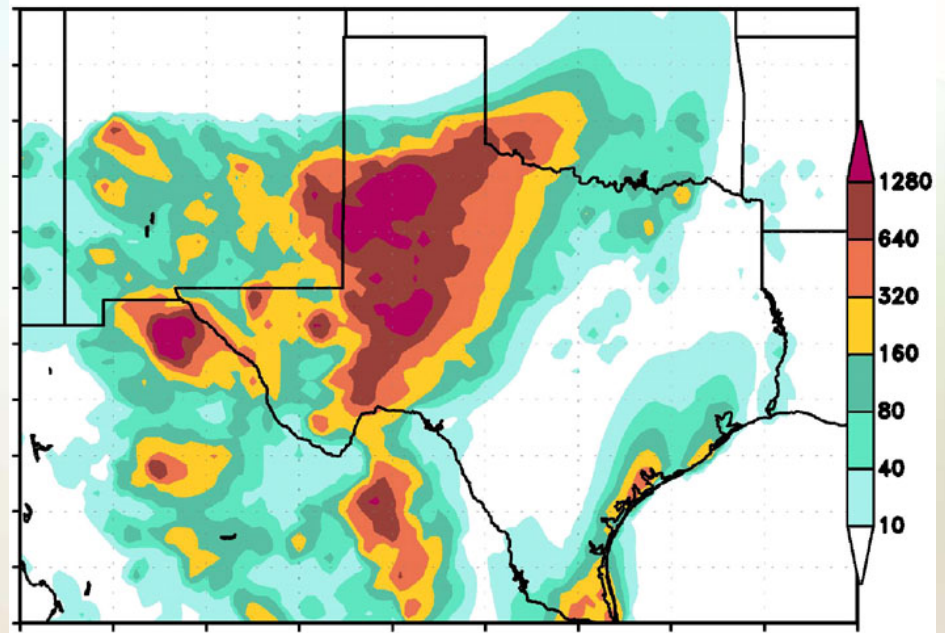




# Comparison of DREAM Dust Concentrations at 20Z 15 Dec 03



**Static Surface Inputs**



**EO Surface Inputs**

# DREAM Performance

## Before & After EO Data Assimilation

Metrics	Wind Speed (m/s)	Wind Direction (°)	Temp. (K)	Definition (M: modeled; O: observed)
Mean observed	5.53	231.40	276.74	$\frac{1}{N} \sum_{i=1}^N O_i$
Mean modeled	4.65 4.37	226.60 230.38	275.56 277.48	$\frac{1}{N} \sum_{i=1}^N M_i$
Mean bias	-0.88 -1.16	-4.80 -1.02	-1.20 0.72	$\frac{1}{N} \sum_{i=1}^N (M_i - O_i)$
Mean error	1.97 2.03	51.76 47.85	4.09 2.67	$\frac{1}{N} \sum_{i=1}^N  M_i - O_i $
Agreement index	0.74 0.75	0.74 0.76	0.71 0.95	$1 - \frac{\sum_{i=1}^N (M_i - O_i)^2}{\sum_{i=1}^N ( M_i - \bar{O}  +  O_i - \bar{O} )}$

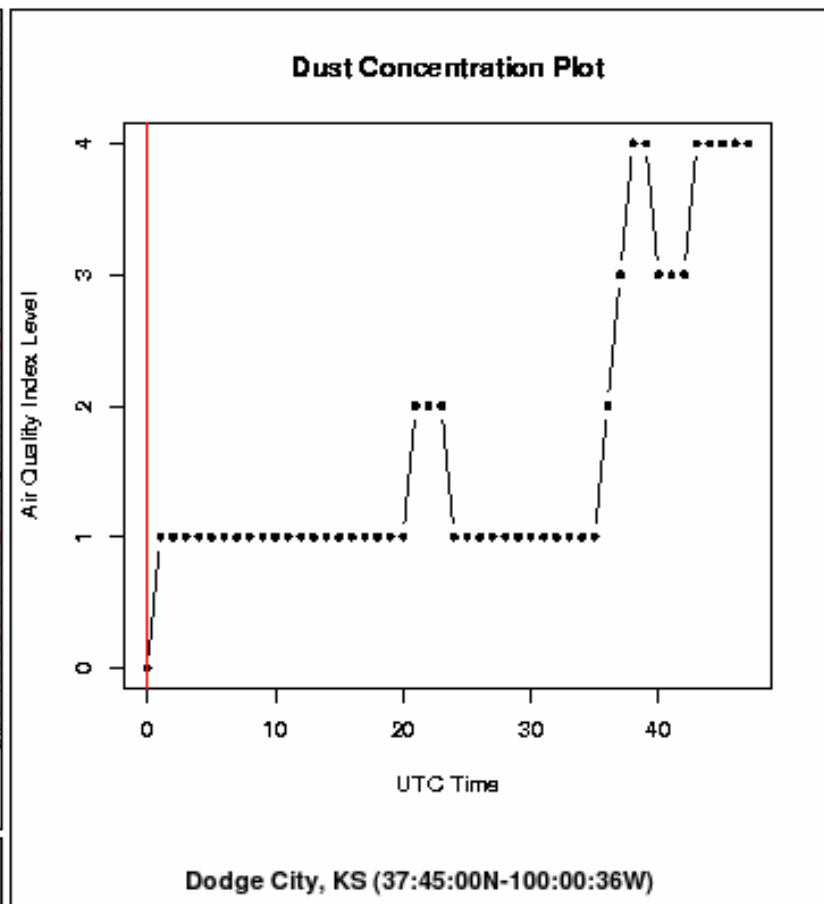
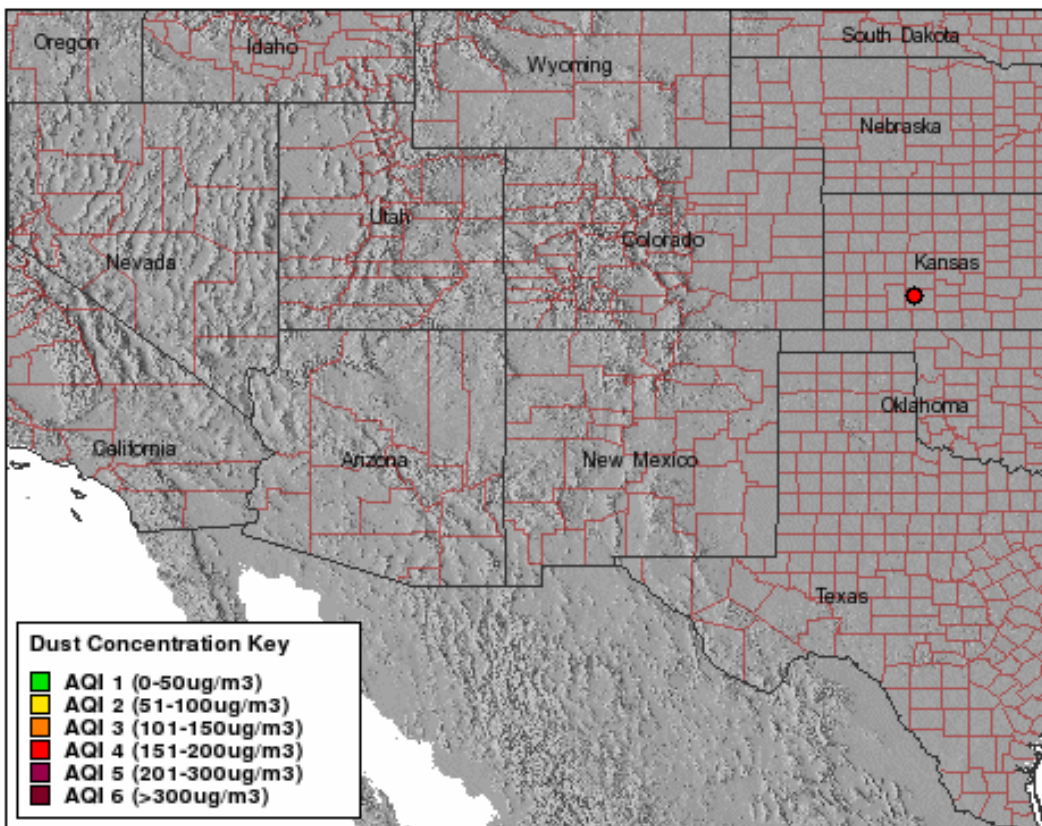
**Blue values** = before EO Data Assimilation

**Red values** = after EO Data Assimilation

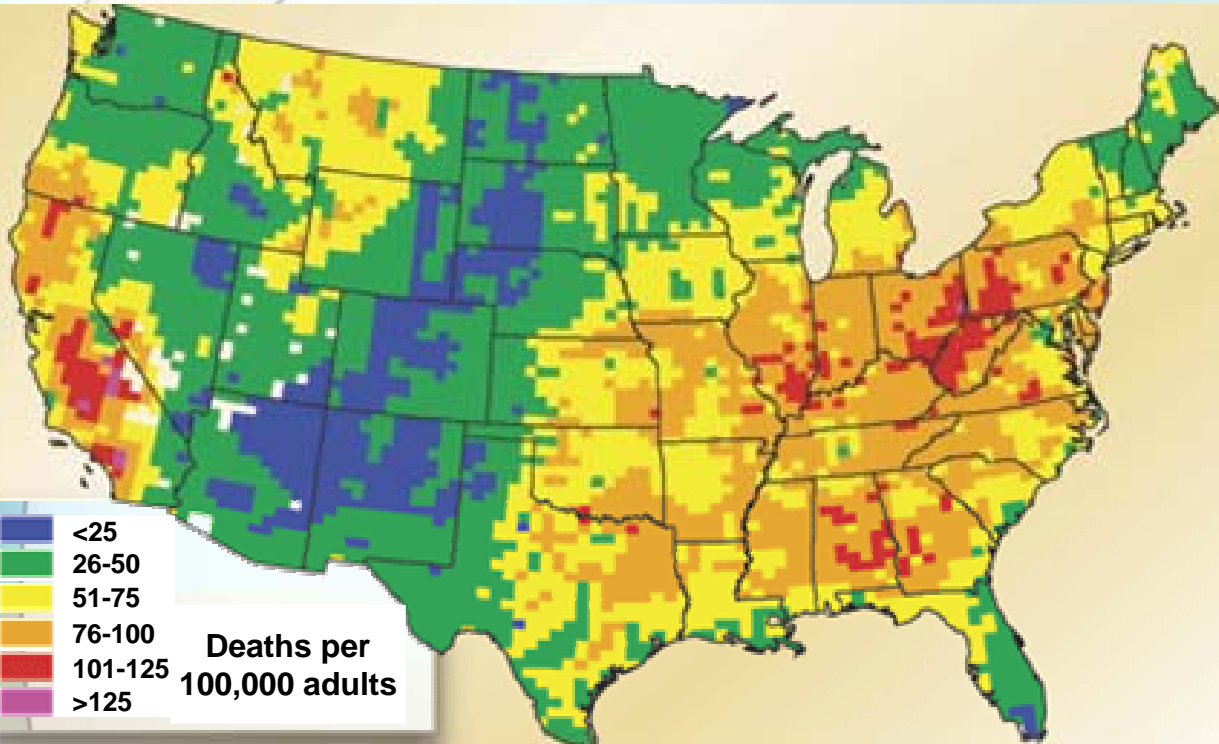
# Enhancing Decision Support Tools

## PHAiRS Dust Modeling Client

48 hr Dust Forecast for Dodge City, KS



# Relevance to CCSP



**Premature  
Mortality Risk  
Attributable to  
PM2.5**



**Locations of  
Emerging  
Infectious  
Diseases**

