

# **Science Data Products for Public Health Decision Support**

**IGARSS  
Denver, CO  
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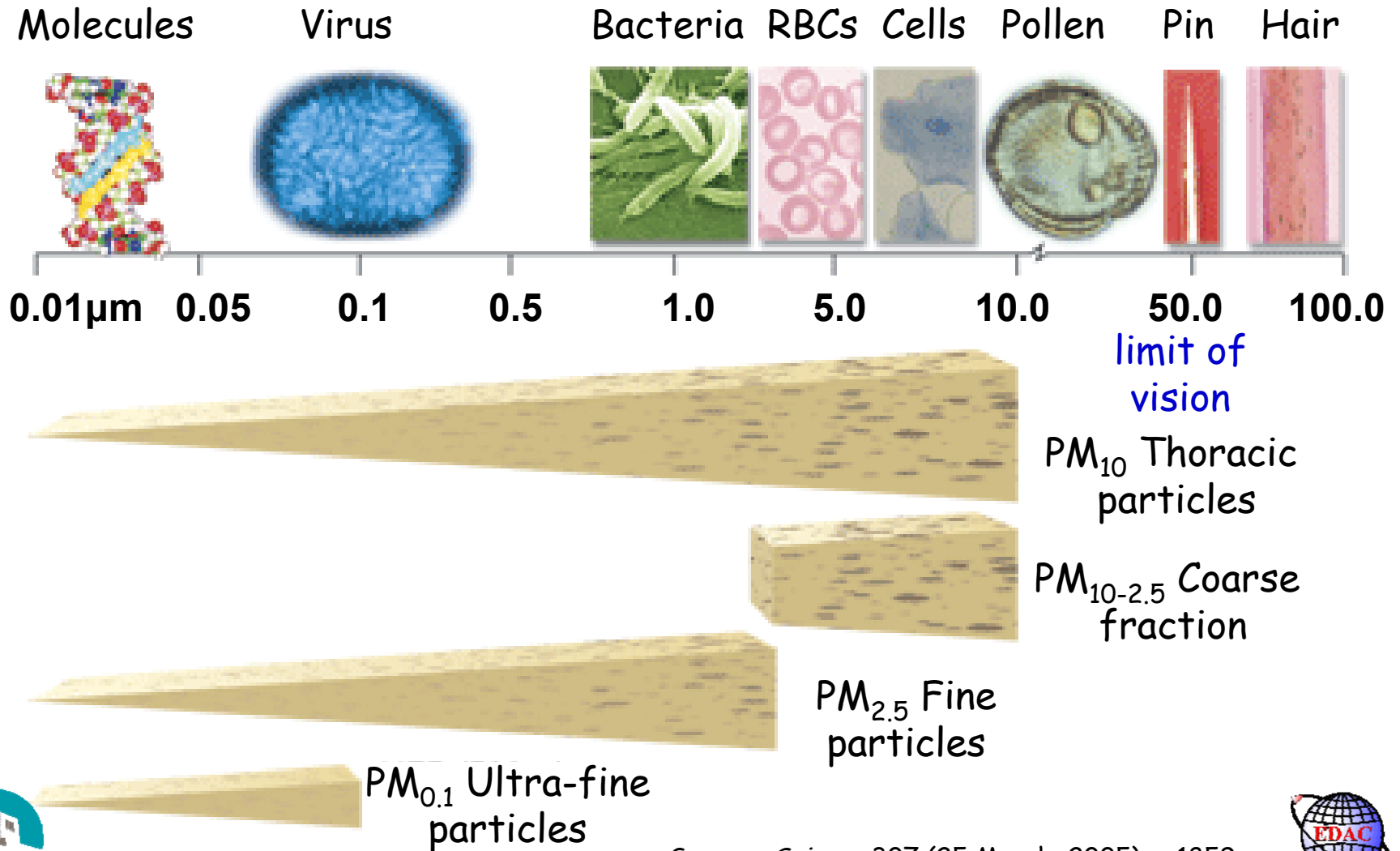
**Earth Data Analysis Center  
University of New Mexico**



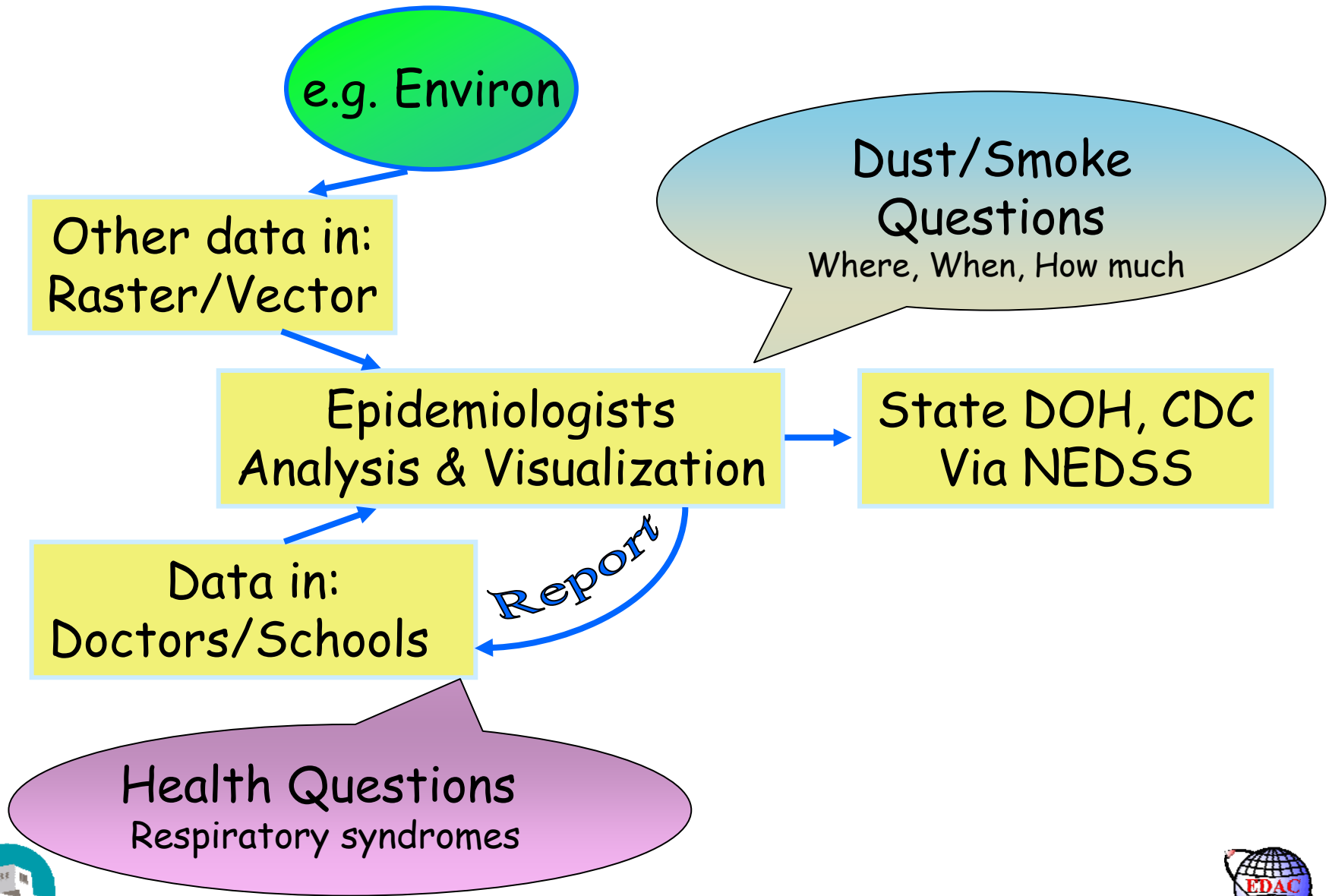
# Presentation Topics

- Why EO and Public Health?
- What is Syndromic Surveillance?
- What is PHAiRS?
- How are Science Data Products Being Used?

# Particulate Matter Size Distribution & Their Related Biophysical Impacts

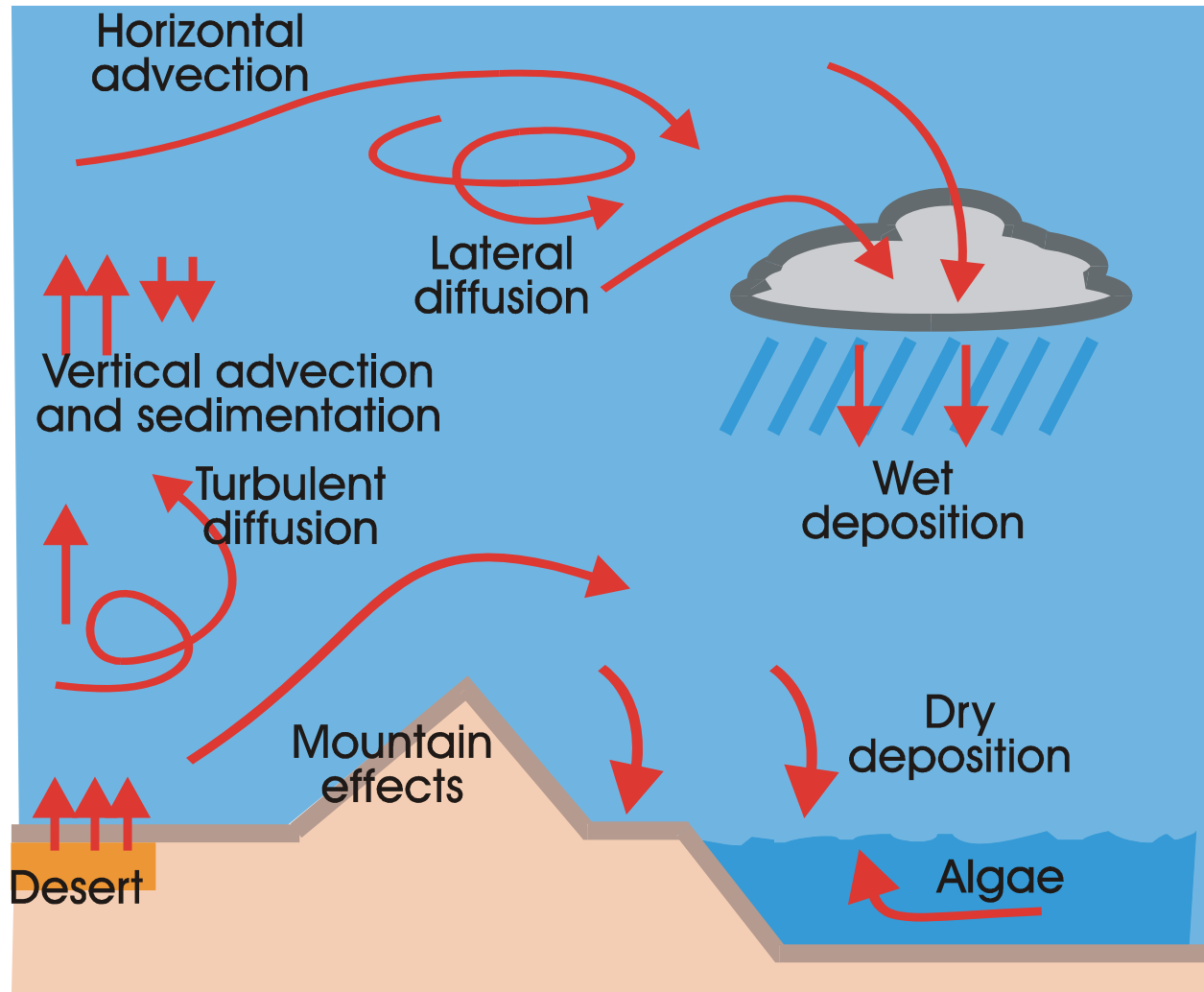


# Data Assimilation Concept

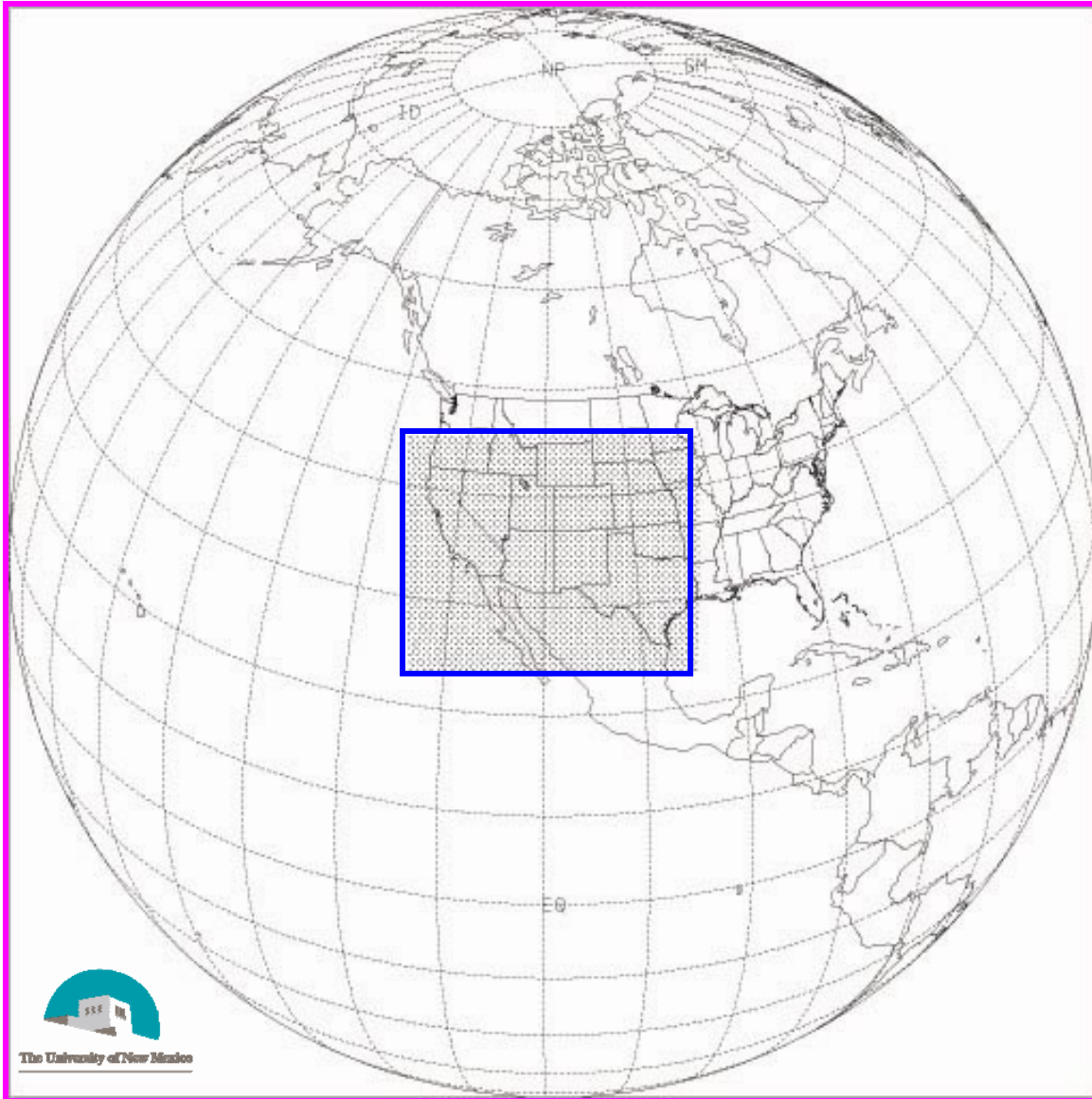


# DREAM's Governing Equation

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



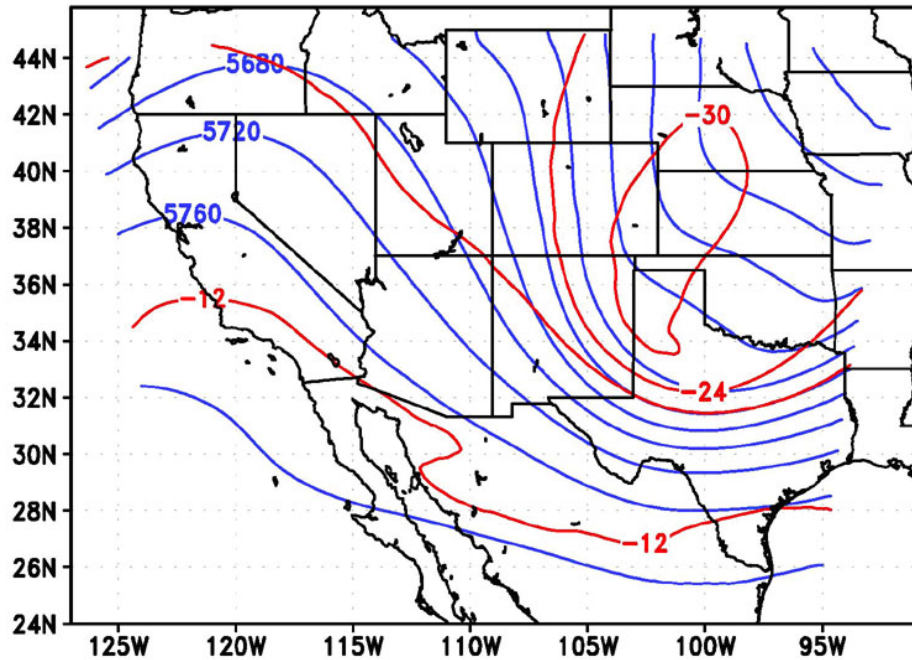
# Model Domain



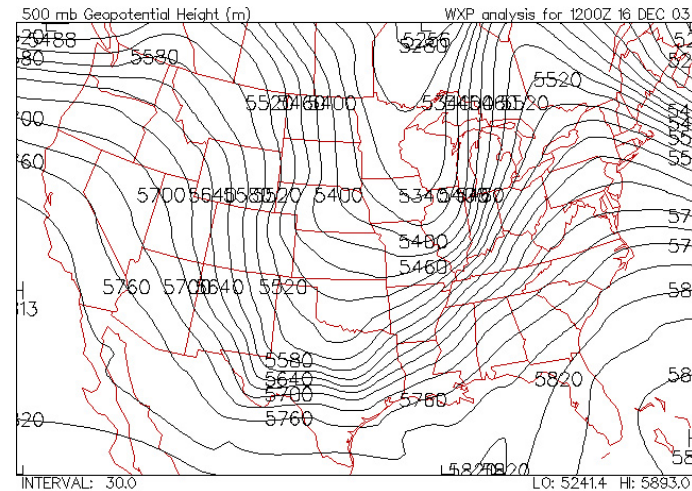
- Domain center at  $(109^\circ\text{W}, 35^\circ\text{N})$
- Horizontal semi-staggered Arakawa E grid
- Horizontal grid spacing  $1/3$  degree



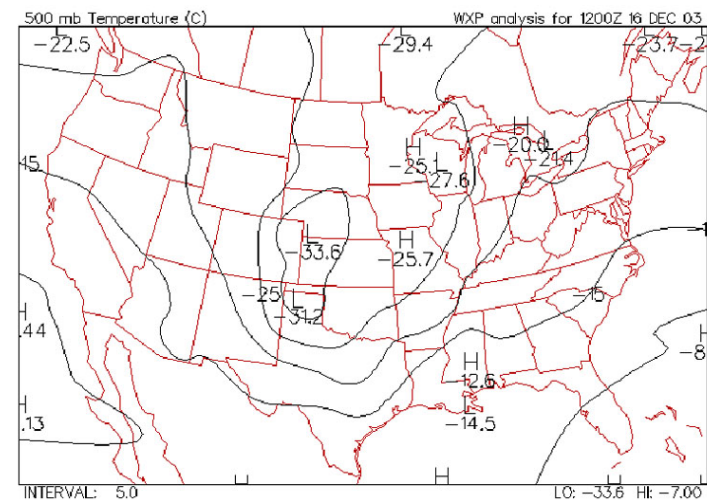
# Modeled vs Observed Synoptic Patterns 12 Z 16 Dec 03



DREAM Simulation



Observed Geopotential Height

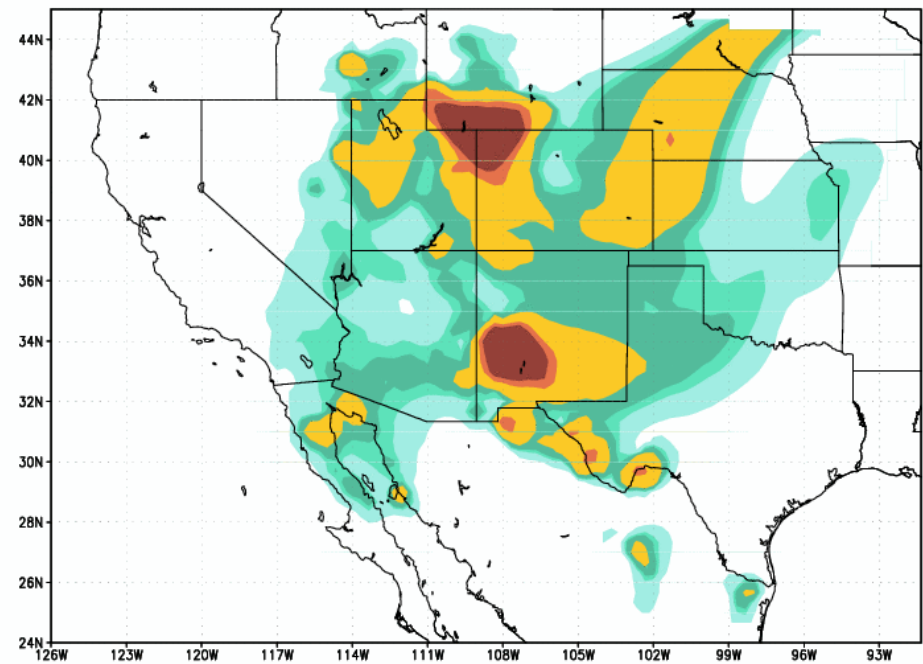
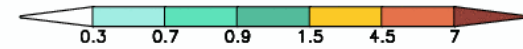


Observed Temperature

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



Texas  
 Continuous Air Monitoring Stations



GRADS: COLA/IGES

2004-09-18-13:06

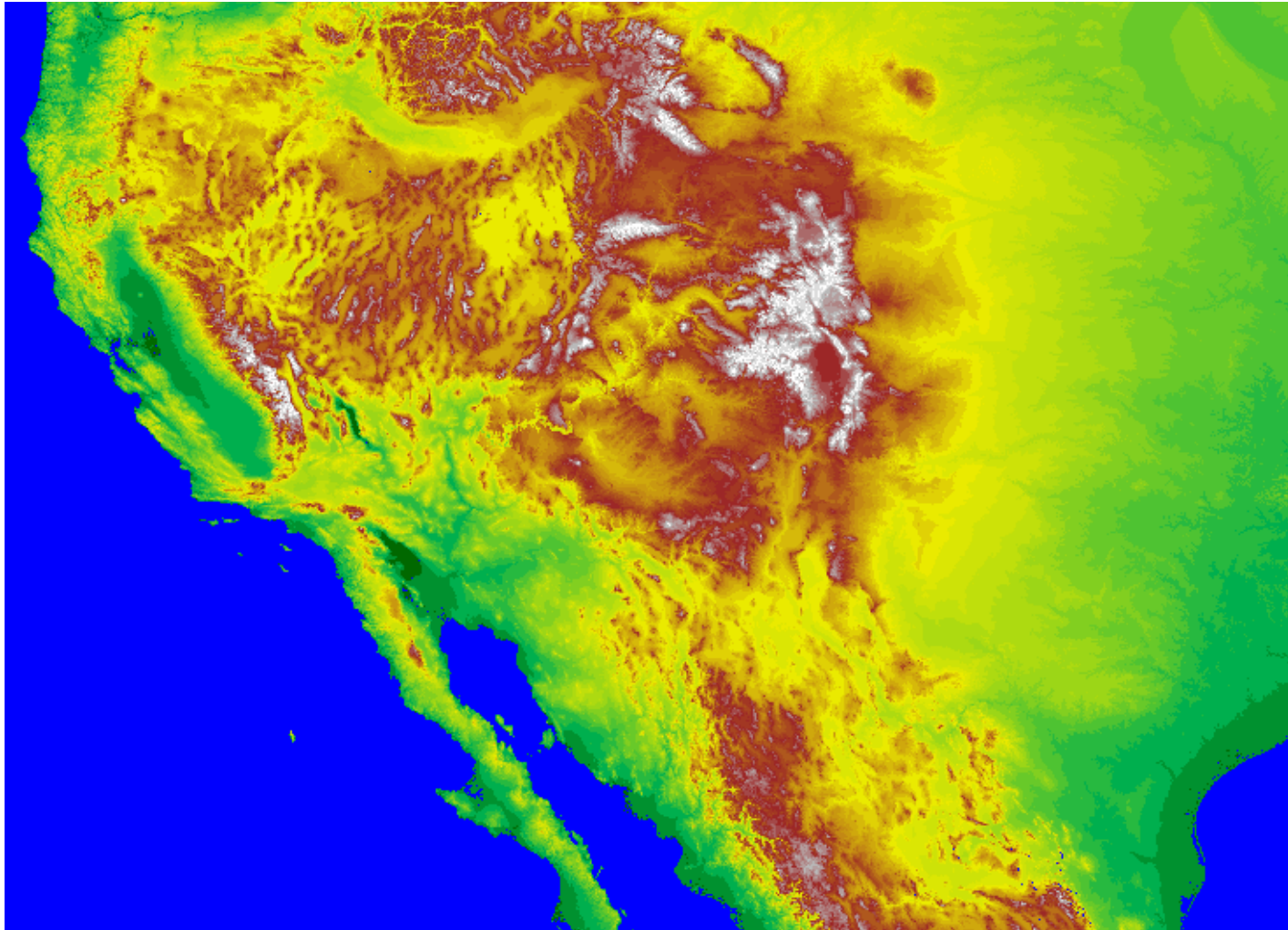
DREAM Baseline (no EO data included)





# Level-1 (90m) SRTM Data for DREAM Domain

Large voids have been filled using GTOPO30 Data; small ones w/ a 5x5 filter



# Assimilation vs. Fusion

**Assimilation**: The process of replacing selected static parameters in an Earth system model with digital pixel values from Earth observation data sets to improve the model's performance and convert it into a more dynamic (forecasting) form without changing the model's intended purpose.

**Fusion**: The process of including EO image products (at any of several levels of processing) into a GIS architecture in such a way that the datasets, both vector and raster, are geospatially registered at a specified scale. This usually requires sub-setting, re-projection and rescaling of fused data.



# DREAM Replacements as of April '06

## Previously used data

- Soil Moisture: simulated using a land surface model
- Elevation: USGS 1 km terrain data
- Vegetation: Olson World Ecosystems 10-minute,  $\pm 19$  km resolution
- Aerodynamic Roughness Length predicted using 12 SSiB land cover types

## Data being evaluated

- AMSR-E soil moisture data
- SRTM 90 meter terrain data
- MOD12 Land Cover 1 km resolution
- Look-up table based on MOD12 land cover, 1 km resolution

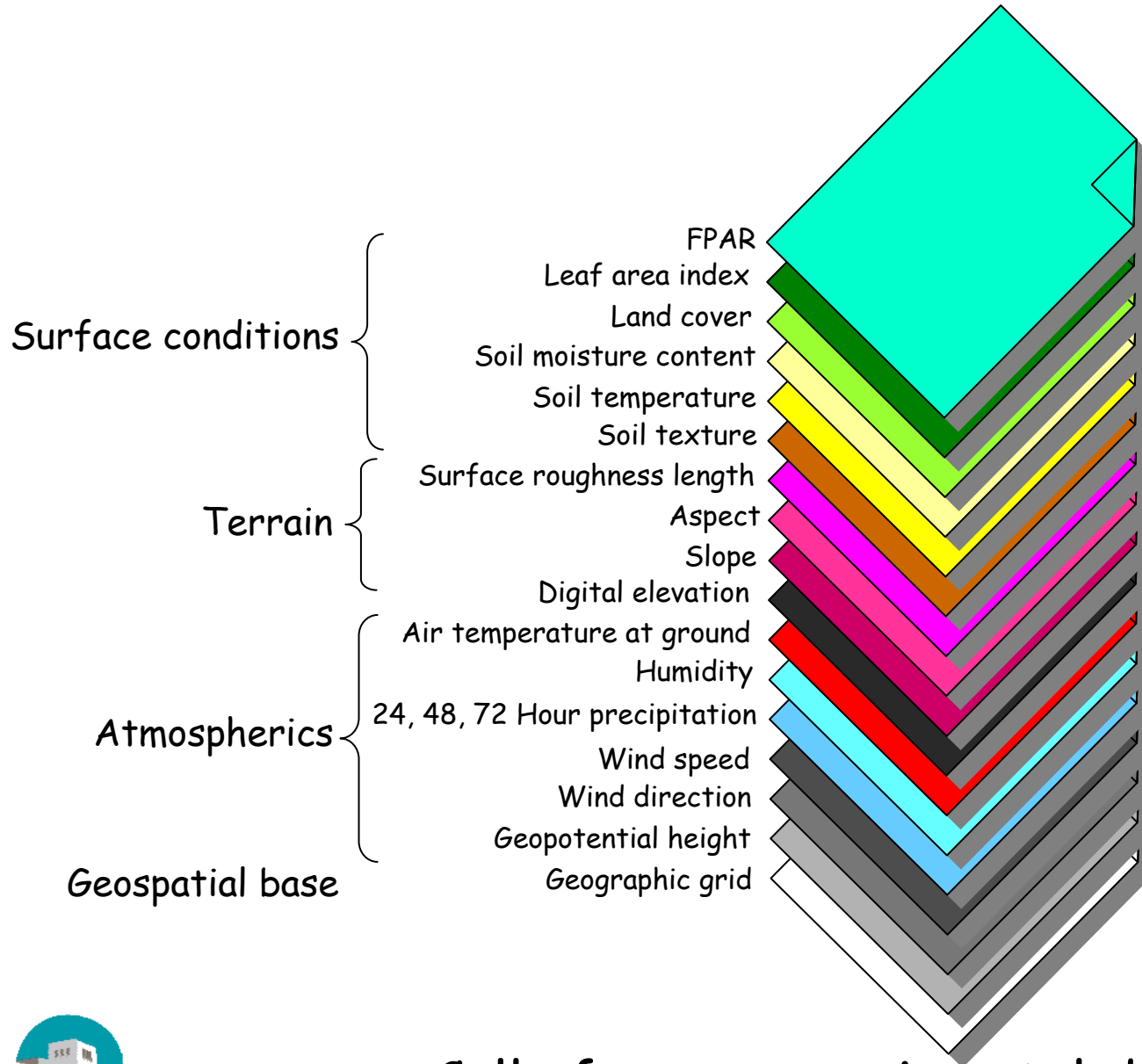


# Steps in Assimilating Data

- **Assess metadata & attributes of current model inputs and of possible EO inputs**
  - Measurement units
  - xyz Resolution
  - Temporal frequency
  - Projection
  - File formats
  - Validity & accuracy
  - Error & error propagation
- **Select EO inputs based on highest perceived benefit for enhancing model output**
- **Replace model input with EO data and compare model outputs**
- **Iterate with successive EO inputs**
- **Measure improvements at each stage and document overall performance improvements**



# 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.



# Planned Replacements & Refinements

## Now

- SRTM Level-1 90m Elev.
- MOD12 Land Cover
- NCEP/ETA Hydrostatic
- NWS Humidity
- Soil Temperature
- NCEP Precipitation
- Aerodynamic Roughness

## Later

- ASTER AST14 Elevation
- MOD15 LAI and FPAR
- NCEP/NMM Non-Hydro
- AMSU-A Humidity
- MOD11 Soil Temp
- TRMM 5-day Rain Map
- ???

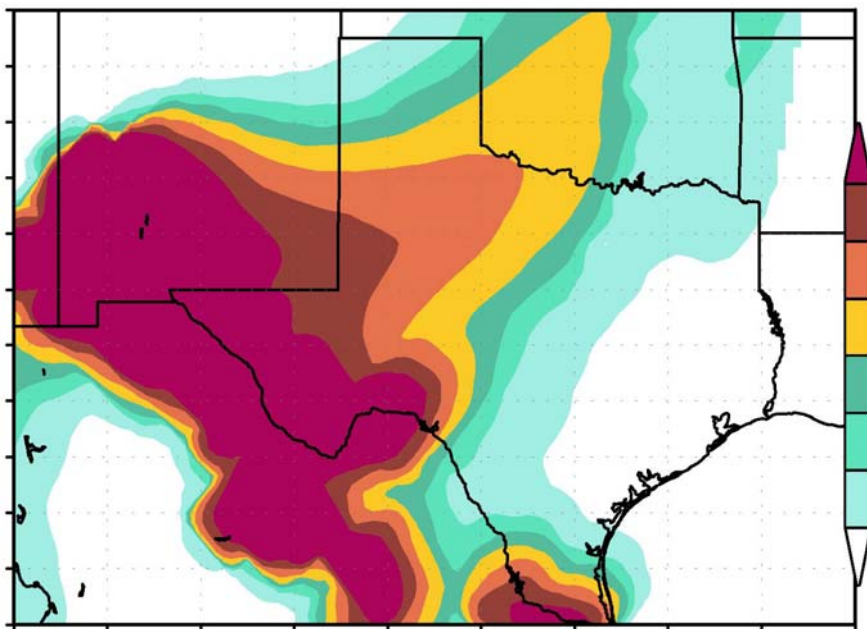


# DREAM Performance Before & After EO Data Assimilation

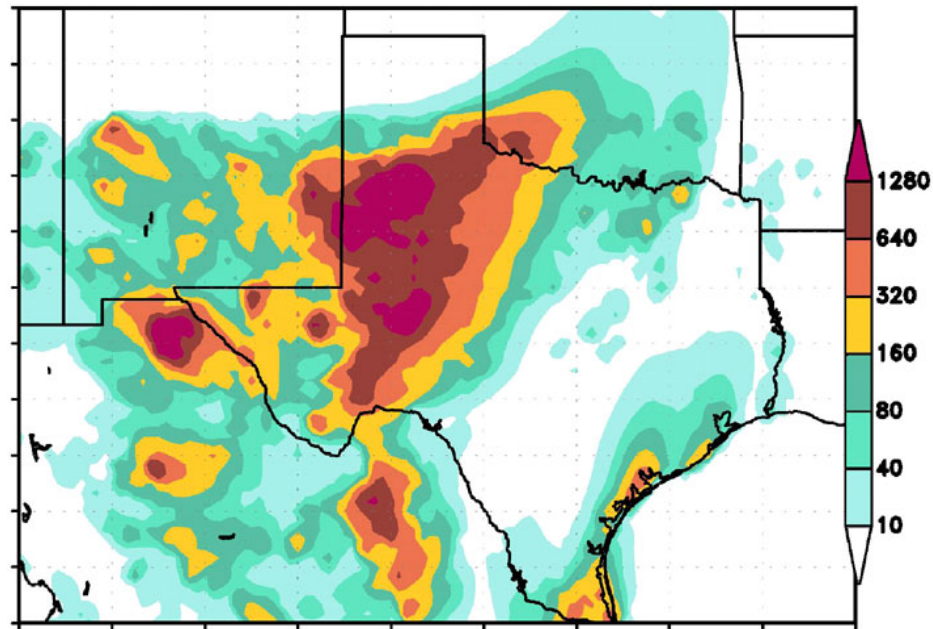
Metrics	Wind Speed (m/s)	Wind Direction (°)	Temp. (K)	Definition (M: modeled; O: observed)
Mean observed	5.53	231.40	276.74	$\frac{1}{N} \sum_{i=1}^N O_i$
Mean modeled	4.65 4.37	226.60 230.38	275.56 277.48	$\frac{1}{N} \sum_{i=1}^N M_i$
Mean bias	-0.88 -1.16	-4.80 -1.02	-1.20 0.72	$\frac{1}{N} \sum_{i=1}^N (M_i - O_i)$
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

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



Static Surface Inputs



EO Surface Inputs

**Thank you.**

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