Environmental Factors Affecting Asthma and Allergies

Predicting & Simulating Downwind Exposure To Airborne Pollen

A NASA Project with:

- Jeffrey Luvall & Sue Estes [MSFC]
- William A. Sprigg, Slobodan Nickovic, Alfredo Huete, Ramon Solano, Piyachat Ratana, & Zhangyan Jiang [University of Arizona]
- Len Flowers [New Mexico Department of Health]
- Alan Zelicoff [ARES Corporation]
Phenology and Pollen Transport

NASA Remote Sensing

UofA Models DREAM/eta + DREAM/NMM NASA Remote Sensing
Modified to PREAM (Phenology):
http://www.atmo.arizona.edu/research/dust/dust

Currently – MODIS-derived dust source regions
Future – pollen sources derived from phenological studies & MODIS + NPOES

New Product – predicted concentrations of pollen in time and space displayed on PHAiRS-like client server at UNM: http://phairs.unm.edu
DREAM 4-8 particle bins

- **Model predictions (72-h):**
  - Horizontal distribution
    - Surface concentration
    - Total column mass (dust load)
    - Wet, dry, total deposition
    - Meteorological variables
  - Vertical distribution
    - Concentration
    - Cross sections
    - Fixed point/time profiles
  - Fixed point (selected sites/cities)
Pollen Strategy

- Select Pollen of Interest
- Map Pollen Source
- Estimate Emission on Test Date
- Prepare Model
  - Insert Terrain & Pollen Aerodynamic Characteristics
  - Insert Source Emission
  - Insert Meteorology
- Simulate Downwind Pollen Dispersal
- Evaluate
Juniper Pollen

Good News for Modeling

- Pollination Feb-March, little confusion with other pollinating plants
- *Juniperus* pollens are (mostly) spherical
- Distinct, large, 2-week pollination events: 2006 & 2007
Juniper Pollen

“Dust” Particle

Juniperus virginiana
LAND COVER SOURCE
Southwest Regional Gap Analysis Project

Biodiversity for AZ, CO, NV, NM, UT
Preparing Source for Model

- Model requires juniper density (pixel fraction): percent juniper pixels (30m resolution) present in 2-km cell
  - Each 2km cell has 66 x 66 (4,356) pixels
  - Count juniper pixels
  - \((\#\text{Juniper Pixels})/4,356 = \text{juniper pixel fraction} = \text{juniper density}\)
Juniper Density

Class S039, Colorado Plateau, Piñon-Juniper Woodland

Juniper Density value was estimated from the aggregation of 30-m pixels into 2-km pixels. This value indicates what percentage of the original 30-m pixels corresponds to the new 2-km pixel labeling class.
MODerate-resolution Imaging Spectroradiometer (MODIS)

- Seasonal sampling of Juniper Land cover
- Surface measurements on a near-daily basis – corrected for atmospheric aerosols, clouds etc.
MODIS Juniper Time Series

Enhanced Vegetation Index

70-90% density
Pre-PREAM Test

- Single-particle (size) Pre-PREAM
- Simultaneous transport from 4 sources
- Result: sum of transported particles coming from the 4 sources
Juniper Pollen
Near-surface concentration (Nm3)

Pre-PREAM

6 March 2006  9 March 2006  11 March 2006
Albuquerque:
Pollen concentration: 24 Feb – 19 March 2006

Model integration time

# spores/m³
Los Alamos:
Pollinosis concentration: 24 Feb – 19 March 2006

Model integration time
Santa Fe:
Pollen concentration: 24 Feb – 19 March 2006

Model integration time
‘Predicting’ Climate-Scale Pollination using MODIS and Phenology?

Juniper Site 2

Pollinating period

Historical Reflectance & Weather + Weather/Climate Outlook → Predicted VI & Pollen
Applications Have Included:

- Dust Storms & Airborne Mineral Dust Concentrations in the Middle East, Africa and the Southwest US
- Pollen in Colorado, New Mexico & Texas
- Volcanic Ash in the Mediterranean
- Soybean Rust in South America

A new test: Forest fire ash and smoke plumes
A proposed test: mold spores
THANK YOU

Prof. William A. Sprigg
Institute of Atmospheric Physics
The University of Arizona, Tucson
520-626-8945
wsprigg@u.arizona.edu