Current NASA Earth Remote Sensing Observatories
The Public Health application area focuses on Earth science applications to public health and safety, particularly regarding *infectious disease, emergency preparedness and response*, and *environmental health* issues. The application explores issues of toxic and pathogenic exposure, as well as natural and man-made hazards and their effects, for risk characterization/mitigation and improvements to health and safety.
Integration of Airborne Aerosol Prediction Systems and Vegetation Phenology to Track Pollen for Asthma Alerts in Public Health Decision Support Systems

Jeffrey C Luvall  Marshall Space Flight Center

William A. Sprigg, Alfredo Huete, Goran Pejanovic, Slobodan Nickovic, Guillermo Ponce-Campos, University of Arizona,

Heide Krapfl
Environmental Health Epidemiology Bureau, NM Department of Health

Amy Budge  Earth Data Analysis Center, Alan Zelicoff, Dept of Family & Community Medicine, Orrin Myers University of New Mexico

ARES Corporation

Peter K. Van de water  California State University, Fresno

Estelle Levetin Dept. Biology University of Tulsa

Theresa Crimmins & Jake Weltzin USGS National Phenology Network
Tracking Pollen for Asthma Alerts in Public Health DSS (Luvall)

Earth System Models
- DREAM/NMM
- Dust model
- PREAM/NMM
- Pollen transport

Predictions/Forecasts
- Identification of pollen source, timing and transport

Value and Benefits to citizens and society
- Early Warnings
  - Reduced medical costs
  - Fewer inpatients
  - More accurate diagnoses

Decision Support Systems
- Enhanced NM EPHTS & CDC EPHTN
  - SYRIS

Asthma/MI health data
- OGC Web Map Services
  - Apache Web Server

Data
- Earth Observations
  - MODIS & NPOESS-VIIRS
    - MOD9, MOD09GA, MOD09 SPA, NDVI/EVI SPA, MODLST SPA, ASTER
  - Burkard pollen samplers
    - ASD-FR spectroradiometer

Inputs
- NASA and UNM, UA Partners

Outputs
- NMDOH and CDC EPHT Systems: SYRIS
  - Practicing Allergists

Outcomes
- Issue public health alerts
- Optimize hospital staffing
- Allergists alerted to pollen timing

Impacts
Top pollen-producing species

Los Alamos
- juniper
- sagebrush
- pine
- Alternaria*
- oak
- grass
- ragweed
- goosefoot
- Cladosporium*
- Myxomycete*
- cottonwood
- mulberry
- aster
- elm

Albuquerque
- mulberry
- juniper
- ash
- goosefoot
- cottonwood
- grass
- sagebrush
- pine
- elm
- aster
- ragweed
- sycamore
- oak
- willow

*fungal / slime mold spores
Burkard Spore Trap
PolluCast for Tucson, Arizona

Reported Levels

Tree pollen count for today, 03/31/08:
Moderate

See past pollen counts for Tucson, Arizona

Forecasted Levels

- Very High
- High
- Medium
- Low
- No Activity

Forecast not available
Limitations of Pollen Sampling

- Lack of stations
- Count frequency & reporting lag time
- Different sampling instruments Rotorod Sampler/Burkard Spore Trap
- Only identifiable pollen “grains”
- Expertise in counting/indentification
- Refusal to release sampling information—”We do not reveal the sources for our data for privacy and proprietary, competitive reasons. Some pollen counts are conducted privately, and are not meant to be broadcast to the public”
Pollen Timing

- *Growing Degree Days* - the average of the daily maximum and minimum temperatures compared to a base temperature, $T_{\text{base}}$, (usually 10 °C)
- Response to length of day
- Species differences
- Climate – Variability in Precipitation
- Weather
Airborne Dust Simulations and Forecasts
University of Arizona
With NASA Earth System Science & University of New Mexico

Phoenix dust storm – 7 June 2006
Photo by Robb Schumacher Arizona Republic

http://www.atmo.arizona.edu/faculty/research/dust/dust.html
Phenology and Pollen Transport

Pollen sources derived from phenological maps

NASA MODIS data

DREAM – UofA numerical meteorological particulate transport model

Final Product – predicted concentrations of pollen in time and space

http://www.atmo.arizona.edu/research/dust/dust.html
LAND COVER SOURCE
Southwest Regional Gap Analysis Project

Biodiversity for AZ, CO, NV, NM, UT
2003 Los Alamos daily pollen counts

date
2/18/03  3/4/03  3/18/03  4/1/03  4/15/03  4/29/03  5/13/03  5/27/03  6/10/03  6/24/03  7/8/03  7/22/03  8/5/03  8/19/03  8/23/03  9/16/03  9/20/03  10/14/03  10/28/03  11/1/03  11/15/03  11/29/03  12/9/03

pollen
0  1,000  2,000  3,000  4,000  5,000  6,000  7,000

daily pollen counts (grains/m$^3$)

juniper
Cladosporum
sagebrush
juniper

sagebrush
Pollen Strategy

- Select *Juniperus* spp. 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 Dec-March, little confusion with other pollinating plants
- *Juniperus* pollens are (mostly) spherical, 20μm size
Spectral characteristics of male juniper canopies at different bud density levels

<table>
<thead>
<tr>
<th>Density level</th>
<th>Bud density (g/m²)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>204.2</td>
</tr>
<tr>
<td>2</td>
<td>190.0</td>
</tr>
<tr>
<td>3</td>
<td>176.9</td>
</tr>
<tr>
<td>4</td>
<td>164.9</td>
</tr>
<tr>
<td>5</td>
<td>151.1</td>
</tr>
<tr>
<td>6</td>
<td>136.2</td>
</tr>
<tr>
<td>7</td>
<td>115.8</td>
</tr>
<tr>
<td>8</td>
<td>92.9</td>
</tr>
<tr>
<td>9</td>
<td>45.9</td>
</tr>
<tr>
<td>10</td>
<td>0.0</td>
</tr>
</tbody>
</table>
MODIS Juniper Time Series

Enhanced Vegetation

70-90% density
Juniper Pollen
Near-surface concentration (Nm3)

PREAM

6 March 2006
9 March 2006
11 March 2006
Welcome to the New Mexico EPHT Mapping Applications Page

How to use this map

The layers that you have requested to map are listed below. To add them to the map click 'add to map'. When you first add your EPHT query layer it will appear above the other layers in your map. You can use the arrowed buttons beside each layer in the table of contents to move layers up and down in the list for viewing. Navigation controls for the map are just below the map. Hovering over any of the controls gives you directions for their use. You must have popups enabled in your web browser in order to be able to query features in the map. You can use the small locator map above to zoom on the map in addition to using the zoom button below the map, just click and drag.

Map Layers from: your EPHT data search

DREAM dust output PM2.5 - Classified 24-Hr Mean 2009-04-11 00:00:00Z - add to map

Table of Contents

- Excellent
- Good
- Moderate
- Unhealthy for Sensitive Groups
- Unhealthy
- Very Unhealthy
- Hazardous
- Water System Boundaries

All content © Earth Data Analysis Center 2001-2007.
Send comments to the EDAC Webmaster

This portal was supported by Cooperative Agreement Number 5 U01 DE001083 from the Centers for Disease Control and Prevention. Its contents are solely the responsibility of the authors (webmaster) and do not necessarily represent the official views of the Centers for Disease Control and Prevention.
Syndrome Reporting Information System™
The SYRIS system provides:

- Real-time, Syndrome-Based Reporting Tool
- 2-Way Real-time Communication System - 24/7
- Automated, Immediate 'Alerts' to Public Health Officials (PHO's)
- Health 'Alerts' to Vets, Doctors, Hospitals, & Schools
- Web-Based Tool for Easy Syndrome Entry and Communication
- Geographic Mapping of Disease Outbreaks
- Connects All Health Care Providers to a Common Database
- Instantaneous Geographic Mapping of Disease Outbreaks
- Full compliance with the requirements of Public Law 109-417 (the Pandemic and All-Hazards Preparedness Act)
SYRIS will be used by Public Health Officials for interactive display of PREAM pollen maps, syndrome reporting and alerts
Conclusions

✓ The residual signal indicates that the pollen event may influence the seasonal signal to an extent that would allow detection, given accurate QA filtering and BRDF corrections. MODIS daily reflectances increased during the pollen season.

✓ The DREAM model (PREAM) was successfully modified for use with pollen and may provide 24-36 hour running pollen forecasts.

✓ Publicly available pollen forecasts are linked to general weather patterns and roughly-known species’ phenologies. These are too coarse for timely health interventions. PREAM addresses this key data gap so that targeting intervention measures can be determined temporally and geospatially.

✓ The New Mexico Department of Health (NMDOH) as part of its Environmental Public Health Tracking Network (EPHTN) would use PREAM a tool for alerting the public in advance of pollen bursts to intervene and reduce the health impact on asthma populations at risk.

✓ SYRIS provides direct feedback from and to the health community.