

ARSET

Applied Remote Sensing Training

<http://arset.gsfc.nasa.gov>

 @NASAARSET

You Can Run, But You Can't Hide: Juniper Pollen Phenology and Dispersal

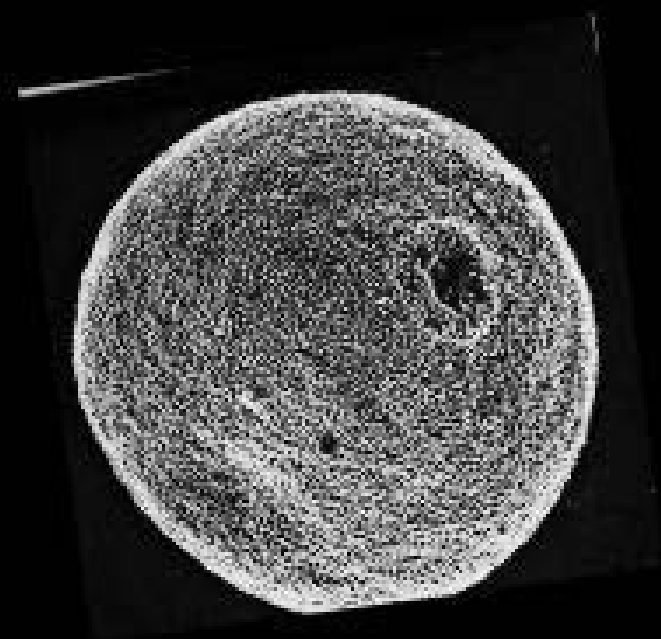
Jeffrey C. Luvall, Marshall Space Flight Center

Integration of Airborne Aerosol Prediction Systems and Vegetation Phenology to Track Pollen for Asthma Alerts in Public Health Decision Support Systems

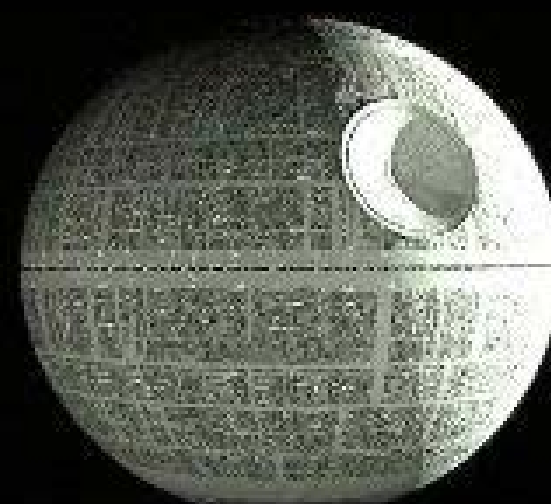
- Jeffrey C Luvall, Marshall Space Flight Center
- William A. Sprigg, Alfredo Huete, Goran Pejanovic, Slobodan Nickovic, Guillermo Ponce-Campos, University of Arizona
- Heide Krapfl, Environmental Health Epidemiology Bureau, NM Department of Health
- Amy Budge, Earth Data Analysis Center; Alan Zelicoff, 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

Moscow Birch Pollen





Grass Pollen



The Death Star

TotallyLooksLike.com

Pollen and Respiratory Disease: What Little is Known*

- High concentrations of pollen allergens have also been shown to occur in thoracic particles (<10 microns in diameter) and respirable particles (<2.5 microns). These correlated well with airborne pollen concentrations
 - airborne pollen results in exposure of the lower airways and lung to pollen allergens
- The association between air pollution and the number of daily deaths may be related to the inflammatory potential of very small particles
 - suggests that high airborne pollen concentrations, which nowadays are mainly seen as triggers of allergic symptoms, may have far more serious effects than previously thought.

Poaceae pollen concentrations (grains per m ³ air)			
<22	22-77	78-135	>135
Relative risk	Relative risk (95% CI)	Relative risk (95% CI)	Relative risk (95% CI)
1.000	1.015 (1.002-1.029)	1.012 (0.994-1.029)	1.061 (1.038-1.084)
1.000	1.095 (1.053-1.139)	1.124 (1.069-1.181)	1.150 (1.079-1.225)
1.000	1.104 (1.049-1.163)	1.093 (1.023-1.168)	1.168 (1.077-1.266)
1.000	1.019 (1.010-1.028)	1.019 (1.008-1.031)	1.043 (1.028-1.058)

- Increase in mortality of:
 - cardiovascular disease
 - chronic obstructive pulmonary disease
 - pneumonia
 - total

Bert Brunekreef, Gerard Hoek, Paul Fischer, Frits Th M Spijksma. Relation between airborne pollen concentrations and daily cardiovascular and respiratory-disease mortality. Lancet Vol 355 (2000): 1517-8.

Burkard Spore Trap



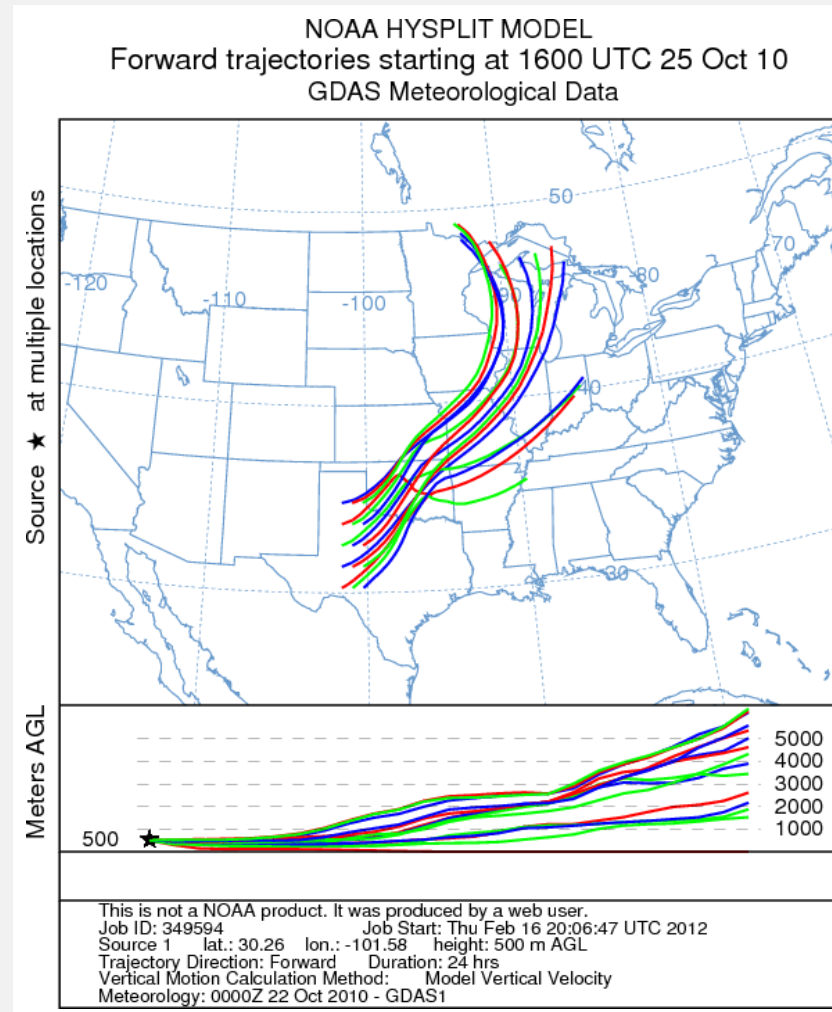
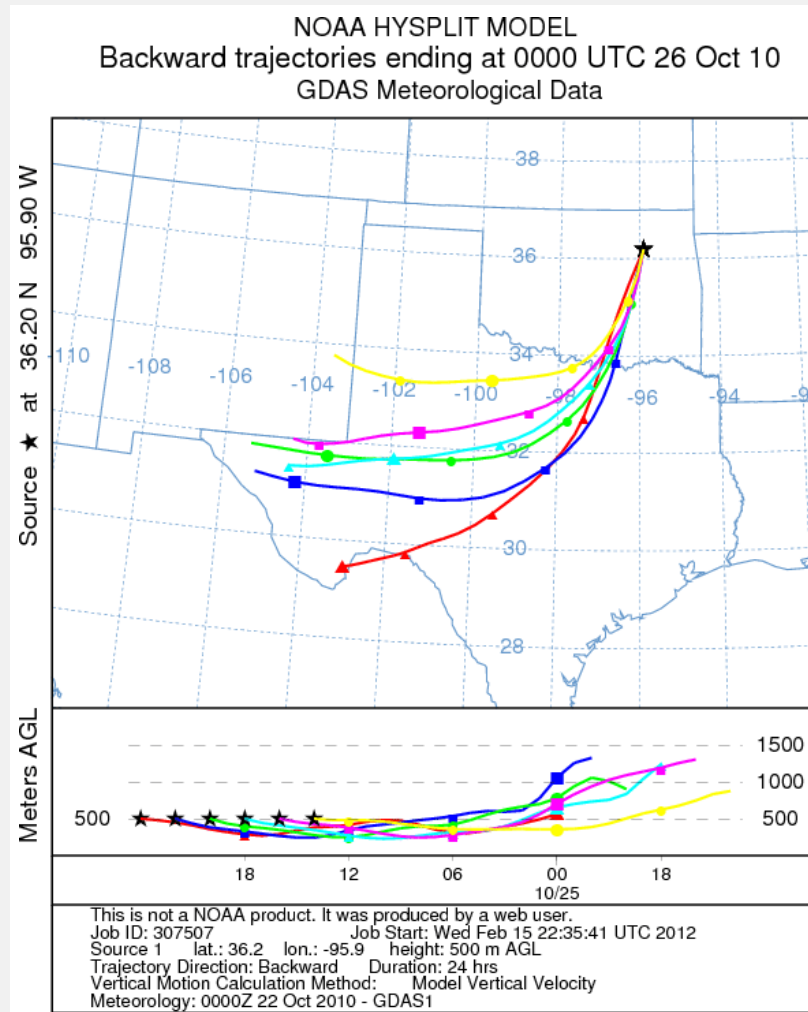




Juniper Species and Pollination Season

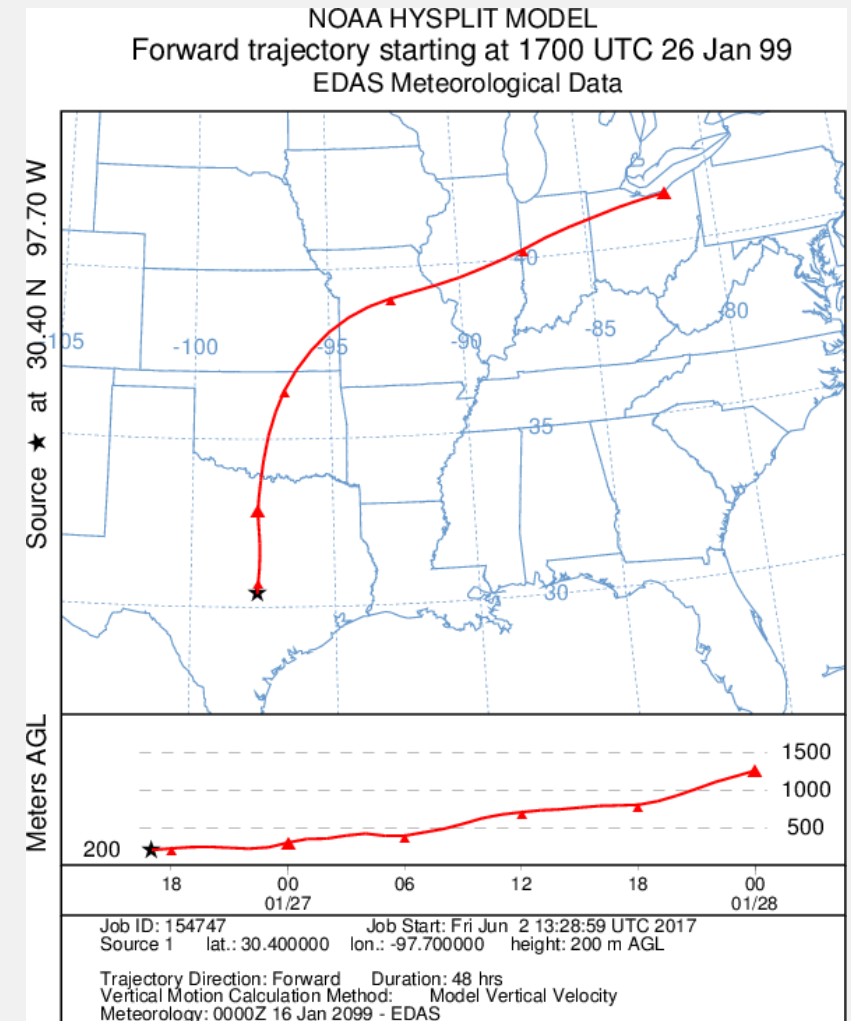
- **Juniper Ashei (J_a)**
 - mostly found to be distributed over Texas and Oklahoma and pollinates during **December to January**. The dispersion of juniper pollens during December – January is mostly restricted to J_a type.
- **Juniper Pinchotti (J_p)**
 - mostly distributed over Texas and pollinated during **October-November**. The dispersion of juniper pollens during this period is mostly restricted to J_p type.
- **Juniper monosperma (J_m) and Juniper scopulorum (J_s)**
 - Prevalent in New Mexico and pollinates during **March-April** period. The dispersion of juniper pollens during this period is mostly restricted to J_m and J_s types

Trajectory Analysis Indicates the Pollen Originated in Southwest Texas Approximately 8 Hours Earlier



Continental Transport

- Jan 27, 1999, Jim Anderson in London, Ontario, reported atmospheric Juniperus pollen 58 pollen grains/m³
- Trajectories show that the source of this pollen was Texas population of Juniperus ashei
- Our Jan 26 forecast indicated that the “pollen has the potential to travel very long distances”



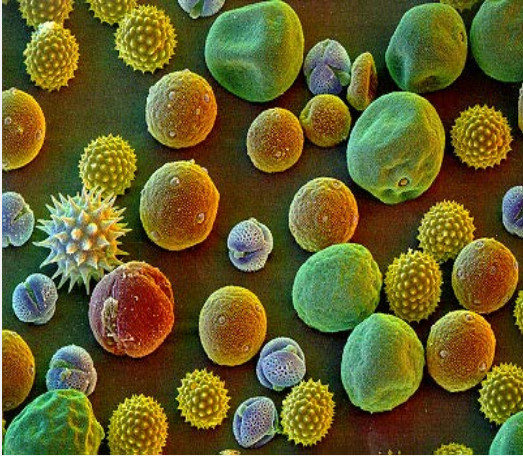
Pollen Forecasting

- Simplest models based on previous years' pollen data
- Phenology models based on flower development
 - Start-date forecasts for spring pollen based on winter weather
 - Growing degree days calculated from past data
 - Remote sensing to determine “greening”
- Day to day forecasting models use meteorological conditions and phenology
 - Statistical models identify meteorological factors
 - May incorporate dispersion models to show where pollen is going to travel
- Yearly severity based on preseason meteorological data – often previous summer

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/identification
- 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.”*

Top Pollen Producing Species



Los Alamos

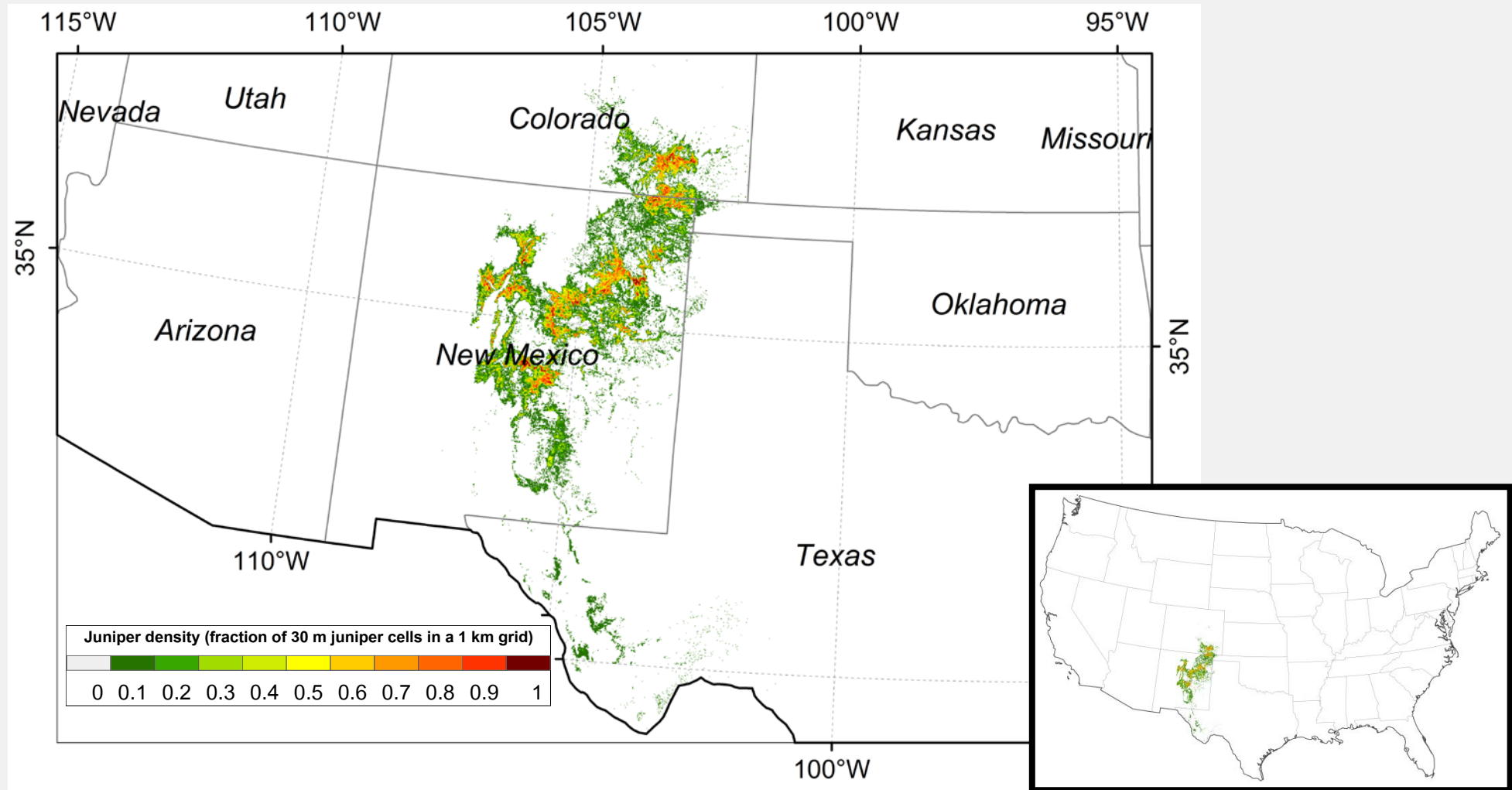
- juniper
- sagebrush
- pine
- Alternaria*
- oak
- grass
- ragweed
- goosefoot
- Cladosporium*
- Myxomycete*
- cottonwood
- mulberry
- aster
- elm

Albuquerque

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

*fungal/slime mold spores

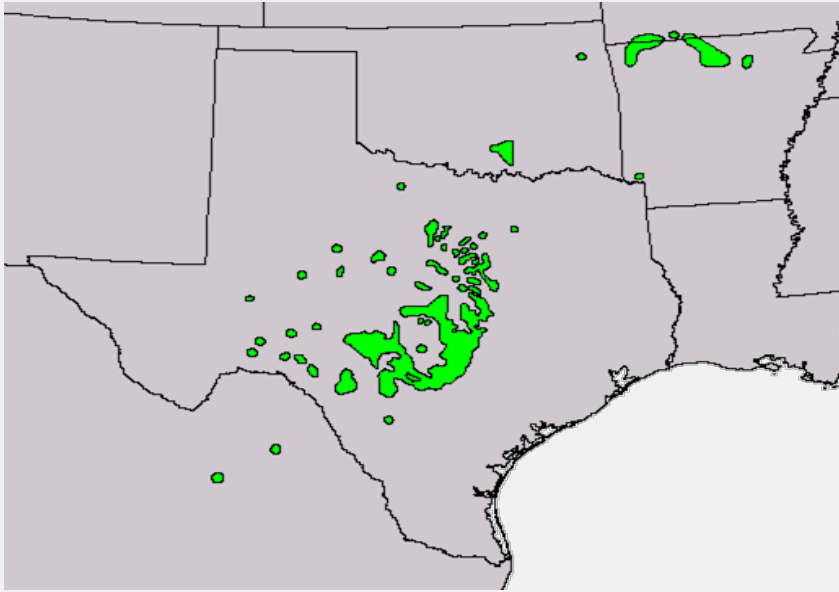
Southern Rocky Mountain Juniper Woodland and Savanna



Seed Cones and Pollen Cones of *Juniperus Pinchotii* (Red Berry Juniper)

Fall Pollinating Juniper: mid-September to late November





Diversity of *J. Ashei* Locations

Sonora



Balcones



Pollen Release









Pollen Per Cone

Sonora	472,000 pollen grains/cone
Dallas	402,000 pollen grains/cone
San Marcos	374,000 pollen grains/cone
Junction	363,000 pollen grains/cone

Summary Statistics: 2010 & 2011 Juniperus Pinchotii Pollen Seasons

Location	Average Daily Concentration (Pollen Grains/m ³)	Peak Daily Concentration (Pollen Grains/m ³)	Date of Peak	Peak Hourly Concentration (Pollen Grains/m ³)	Time of Peak Hour	Date of Peak Hour
2010						
Erick, OK	337	5,563	25-Oct	15,898	10:00 AM	25-Oct
Sonora, TX	286	3,019	25-Oct	12,152	10:00 AM	25-Oct
San Angelo, TX	653	5,542	1-Nov	10,195	Noon	1-Nov
2011						
Erick, OK	12	214	16-Oct	800	10:00 AM	16-Oct
Sonora, TX	64	428	26-Oct	2,422	10:00 AM	31-Oct
San Angelo, TX	60	493	26-Oct	2,747	4:00 AM	26-Oct
Quanah, TX	22	190	19-Oct	703	8:00 PM	19-Oct

Airborne Dust Simulations and Forecasts

University of Arizona, NASA Earth System Science, & University of New Mexico



- Phoenix Dust Storm
- June 7, 2006
- Department of Atmospheric Science

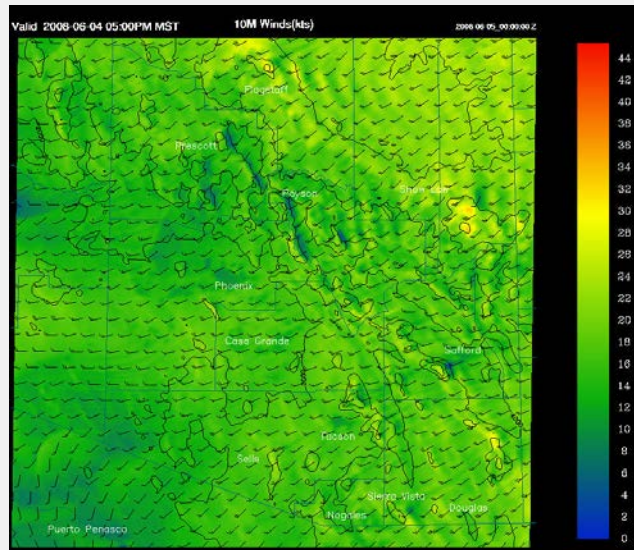
<http://www.atmo.arizona.edu/faculty/research/dust/dust.html>, Photo by Robb Schumacher, Arizona Republic

Weather: DREAM

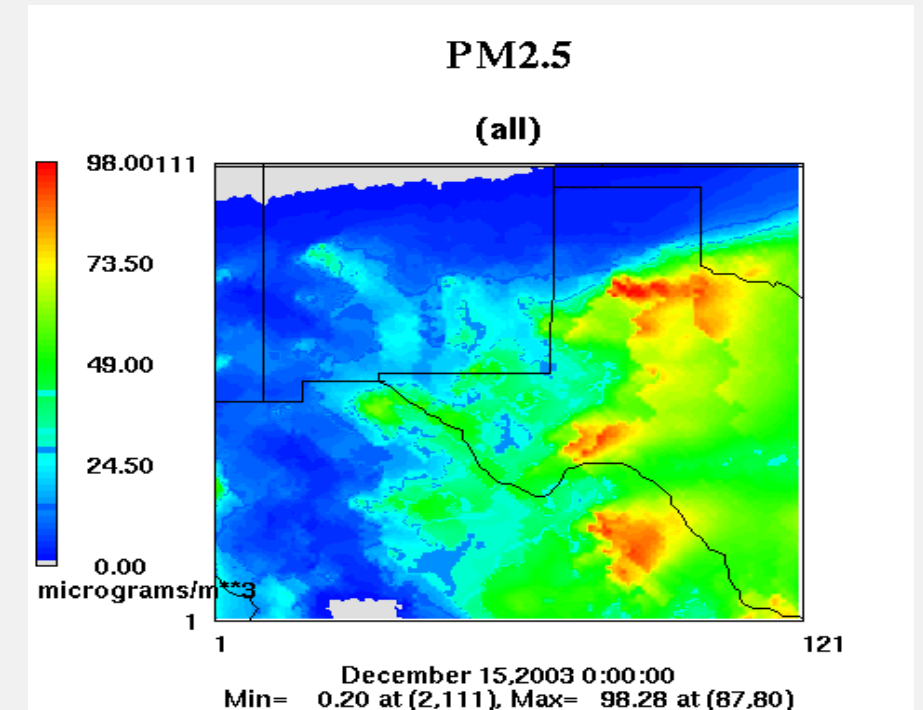
Dust Regional Atmospheric Modeling (DREAM)

- MM5
- WRF

UA WRF 10 m Wind Forecast



Slide Adapted from Adapted from Betterton



S. Nickovic et al., A model for prediction of desert dust cycle in the atmosphere, JGR 106, 18113–18129 (2001).

Yin et al., Modeling wind-blown desert dust in the southwestern United States for public health warning: A case study, Atmos. Environ. 39, 6243-6254 (2005).

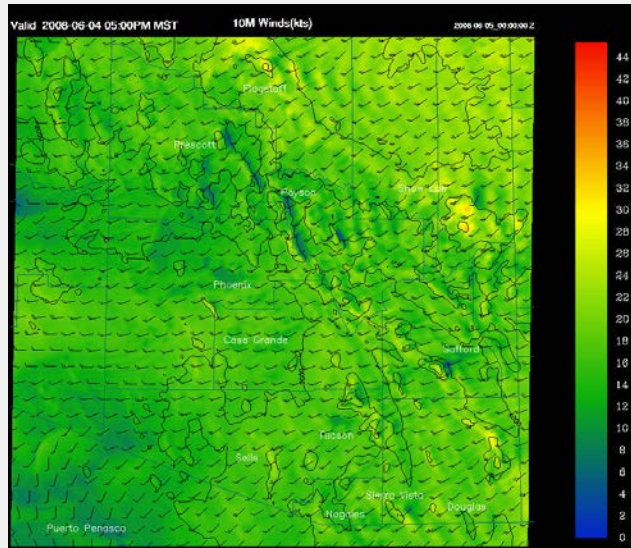
Yin et al., The impact of using different land cover data on wind-blown desert dust modeling results in the southwestern United States Atmos. Environ., 41, 2214-2224 (2007).

Weather: DREAM → Pollen: PREAM

Dust Regional Atmospheric Modeling (DREAM)

- MM5
- WRF

UA WRF 10 m Wind Forecast



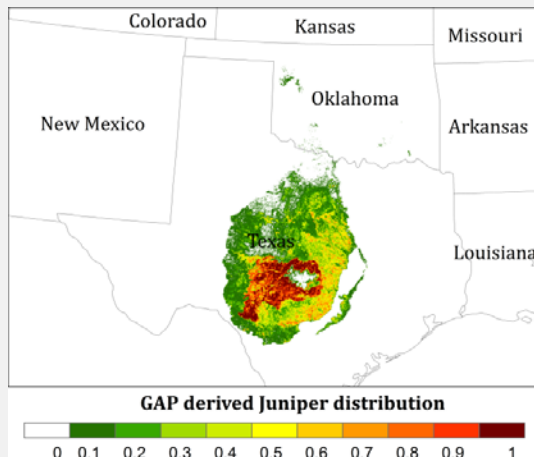
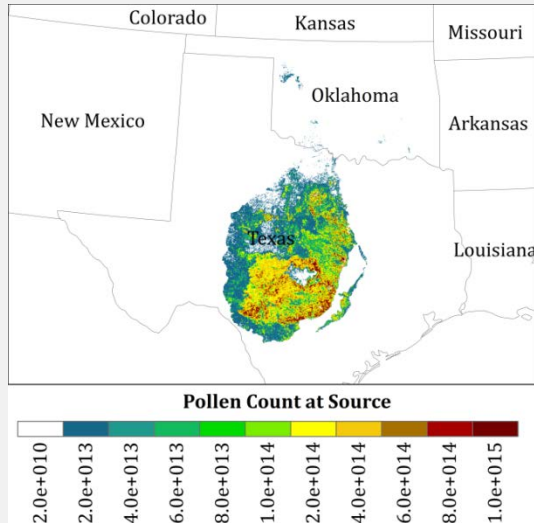
Pollen REgional Atmospheric Modeling (PREAM) system

- Model horizontal domain: Southwest US
- Model resolution: ~19 to 40 km
- Bins: 4, sized by pollen grain size distributions
- Boundary conditions: driven by the NCEP/WRF
- 1 degree global forecasts used to refresh; initial conditions every 24 hrs, boundary conditions every 6 hrs
- Model Output: Every 3 hr maps of pollen surface concentrations (grains/m³) out to 48 hr.

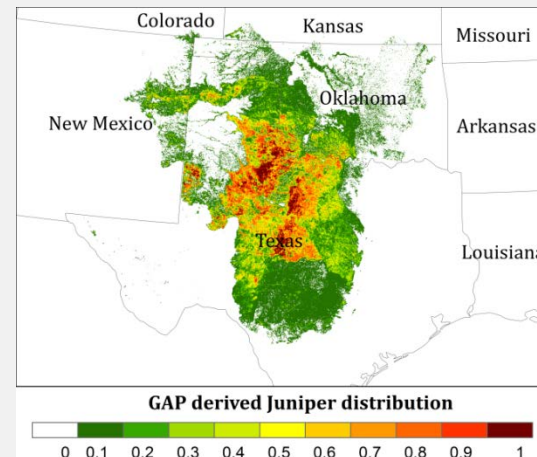
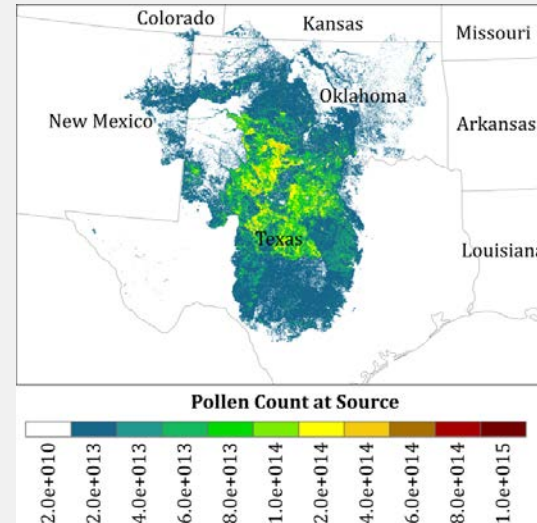
Pollen Source
MASK (PREAM)

GAP derived
distribution

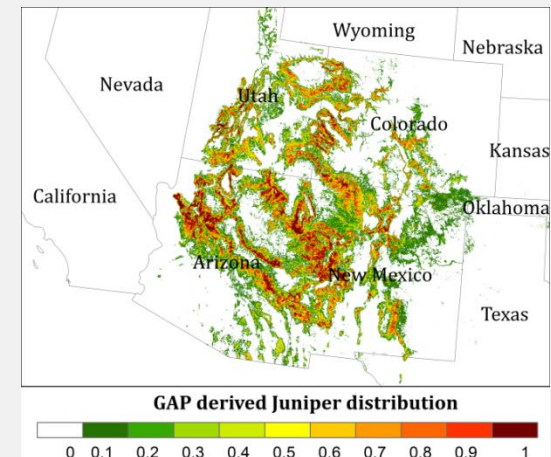
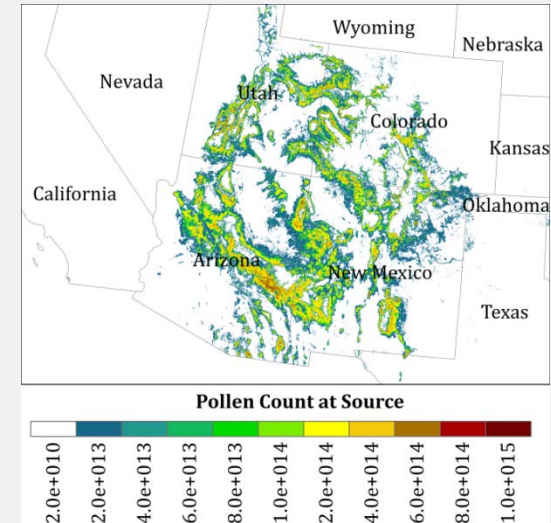
Juniper Ashei Dec-Jan



Juniper Pinchotii Oct-Nov



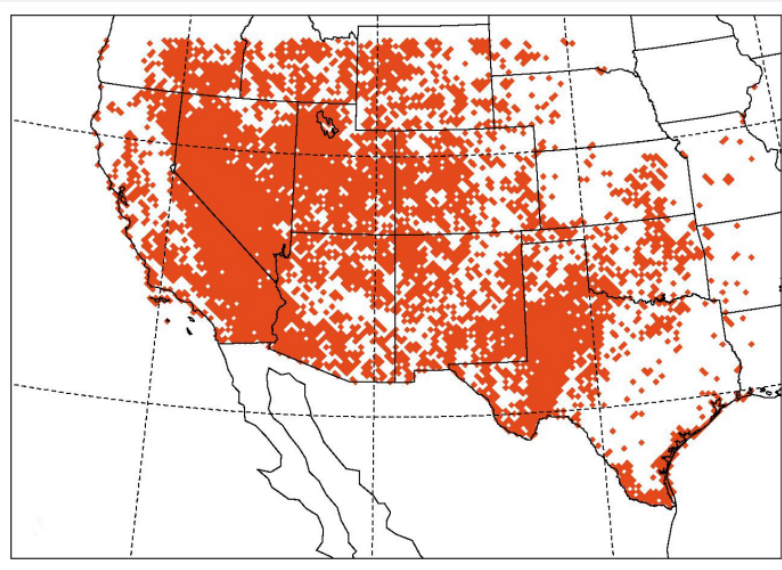
Juniper Monosperma & *Scopulorum* Mar-Apr



Spatial resolution: ~1 km (990 m)

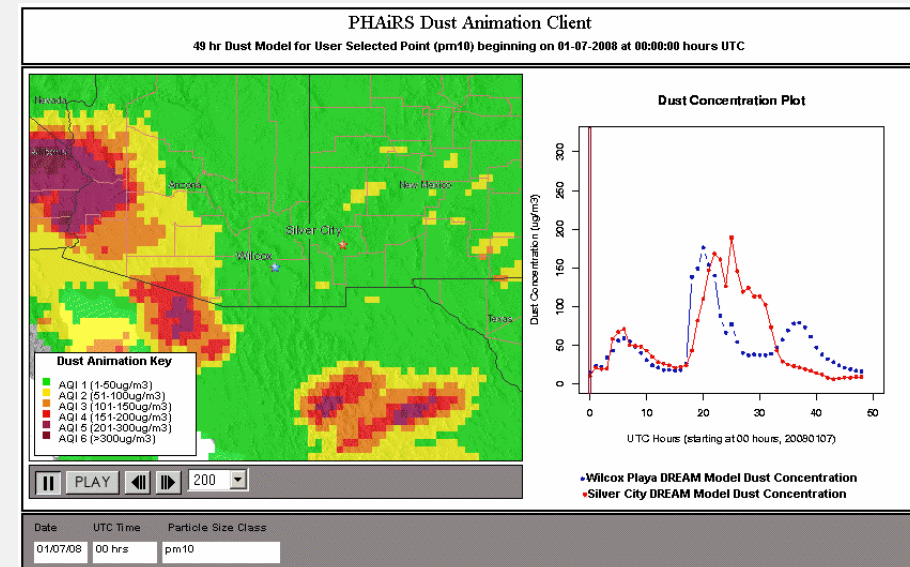
Phenology and Pollen Transport

NASA MODIS Data



Pollen sources derived from **phenological** maps

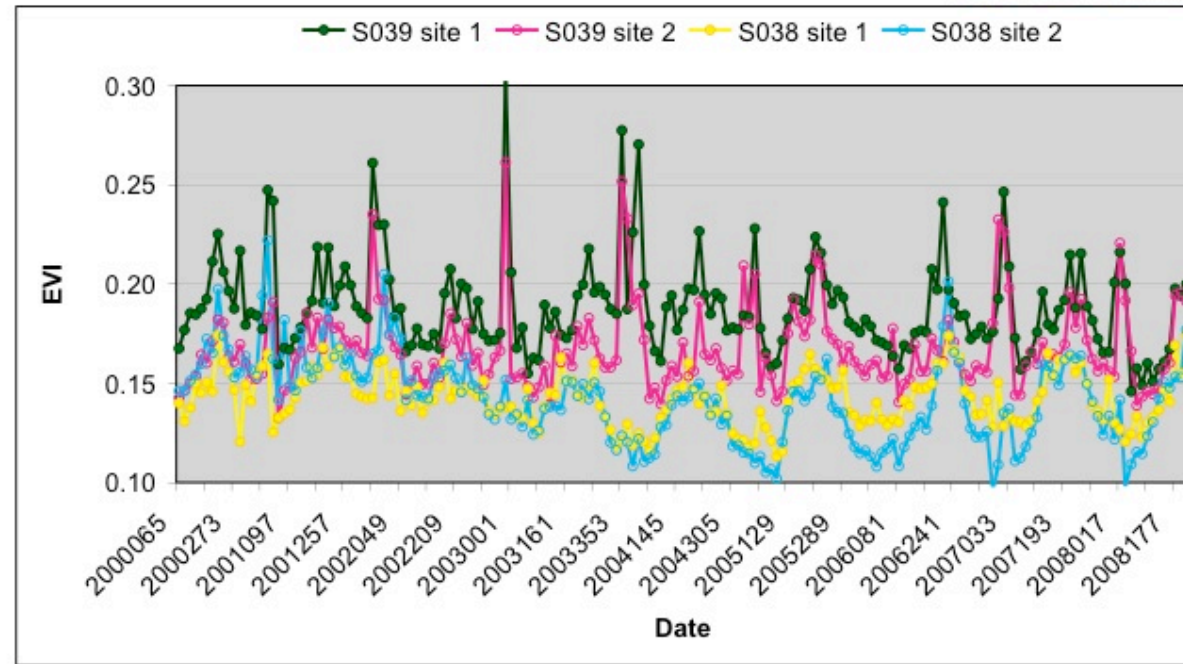
DREAM: U of A Numerical Meteorological Particulate Transport Model



Final Product: Predicted concentrations of pollen in time and space

MODIS Juniper Time Series

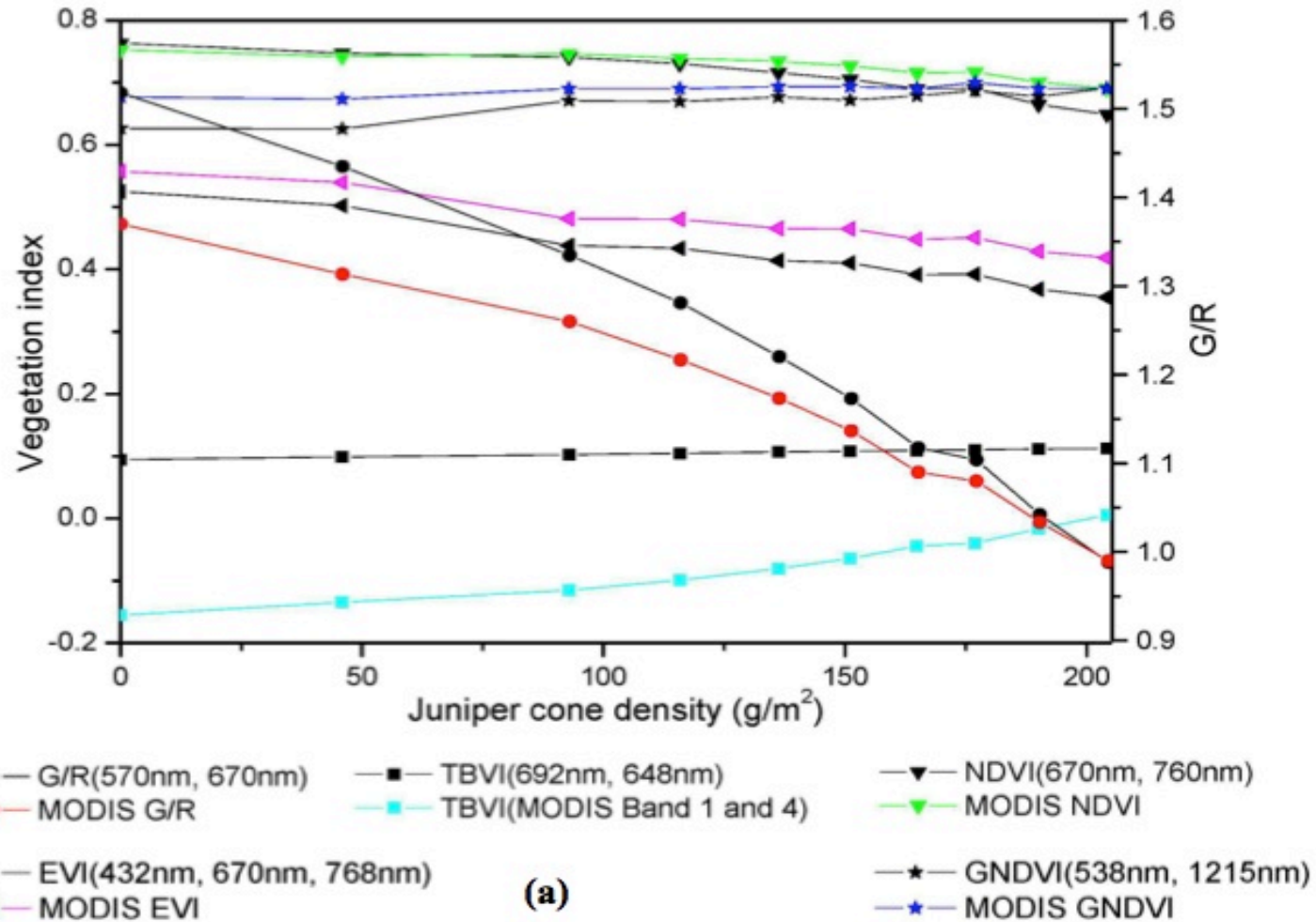
Enhanced Vegetation Index



70-90% density



Figure 6. (a)Vegetation index and (b) relative changes of vegetation index (including G/R) at different juniper cone densities, those vegetation indices calculated by MODIS Bands and narrow bands with the best-fit R^2 values in Table 2



Article

Response of Spectral Reflectances and Vegetation Indices on Varying Juniper Cone Densities

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Tel.: +86-10-8217-8181; Fax: +86-10-8217-8177.

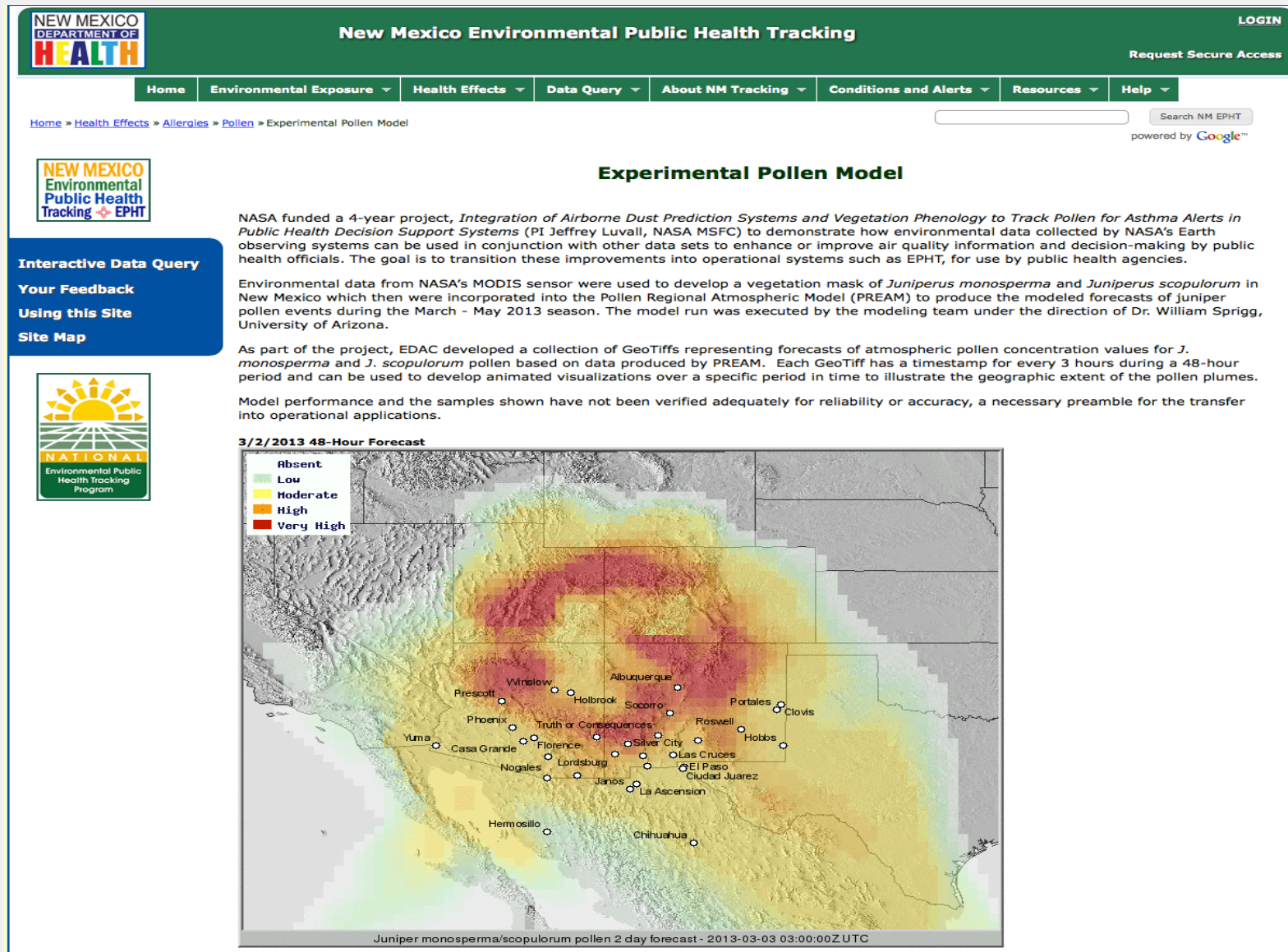
Received: 24 August 2013; in revised form: 29 September 2013 / Accepted: 8 October 2013 /

Published: 22 October 2013

Juniper Canopy Phenology Response

- WV2, Jan 6, 2011
 - R: 765 – 901 nm
 - G: 856 – 1043 nm
 - B: 442 – 515 nm
- G/R Ratio Strongest Sensitivity to Cone Density
 - G: 545 – 565 nm
 - R: 620 – 670 nm
- VIIRS
 - G: m4, 545 – 565 nm
 - R: m5, 662 – 682 nm





Source: New Mexico Environmental Public Health Tracking

National Environmental Public Health Tracking Network

<http://ephtracking.cdc.gov/>

The screenshot shows the homepage of the National Environmental Public Health Tracking Network. At the top left is the CDC logo with the text "Centers for Disease Control and Prevention" and "CDC 24/7: Saving Lives. Protecting People.™". To the right is a search bar with the word "SEARCH" and a magnifying glass icon. Below the search bar is a blue button labeled "CDC A-Z INDEX" with a dropdown arrow. A green banner across the middle contains the title "National Environmental Public Health Tracking Network". Below this banner are social media icons for Facebook, Twitter, and a plus sign. The main text describes the Tracking Network as a system of integrated health, exposure, and hazard information. It lists what users can view on the network: maps, tables, and charts about chemicals, chronic diseases, and location. Below this, it says "You can also:" and lists three options: "Try our new Data Explorer", "Search for Information by Location", and "Visit State & Local Tracking Portals". To the right of the text is a large image of a red house with a green overlay that says "Tracking in Action" and "Mapping Radon Exposure in Washington". Below the image are four small black circles. At the bottom, there are three promotional banners: "EXPLORE OUR NEW DATA QUERY TOOL" with a "View & download" link, "INFO BY LOCATION" with a "Data for you!" link, and "STATE & LOCAL TRACKING PROGRAMS" with a "Websites Grantee Profiles" link.

CDC Centers for Disease Control and Prevention
CDC 24/7: Saving Lives. Protecting People.™

SEARCH

CDC A-Z INDEX ▾

National Environmental Public Health Tracking Network

f t +

The National Environmental Public Health Tracking Network (Tracking Network) is a system of integrated health, exposure, and hazard information and data from a variety of national, state, and city sources.

On the [Tracking Network](#), you can view maps, tables, and charts with data about:

- chemicals and other substances found in the environment
- some chronic diseases and conditions
- the area where you live

You can also:

- [Try our new Data Explorer](#)
- [Search for Information by Location](#)
- [Visit State & Local Tracking Portals](#)

Tracking in Action
Mapping Radon Exposure in Washington

EXPLORE OUR NEW DATA QUERY TOOL
View & download

INFO BY LOCATION
Data for you!
View data by

STATE & LOCAL TRACKING PROGRAMS
Websites
Grantee Profiles

Juniper Pollen Project

<http://www.usanpn.org/node/2434>

Join us in tracking juniper phenology for better allergy and asthma predictions!

[USA-NPN Home](#) | [Nature's Notebook Home](#) | [Contact Us](#)

 *Taking the Pulse of Our Planet*

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[Home](#) » [Juniper Pollen Program Landing Page](#)

JUNIPER POLLEN PROGRAM LANDING PAGE

Project Goals

The purpose of this effort was to model pollen release and concentrations. Improved models:

- support public health decisions for asthma and allergy alerts in New Mexico, Texas and Oklahoma
- augment the Centers for Disease Control and Prevention's Environmental Public Health Tracking Network
- extend surveillance services to local healthcare providers subscribing to the Syndrome Reporting Information System (SYRIS)

The real-time models are based on weather data and satellite information and be verified by on-the-ground observations.

During this project, observers tracked the following species:



Juniper Pollen Project

<http://www.usanpn.org/node/2434>

- Project background:
 - Model pollen release and concentrations
 - Support public health decisions for asthma & allergy alerts
 - Real-time models will be verified by on-the-ground observations of pollen release
- Join us!
 - We need your observations of juniper phenology to verify our models



Juniper Pollen Project: A Quick Example

Pollen
cones

Do you see...?

Pollen release

In at least 3 locations on the plant, pollen is released from a male cone when it is gently shaken or blown.

Full pollen release

For the whole plant, at least half (50%) of the male cones release pollen when gently shaken or blown.

Seed
cones

Do you see...?

Ripe seed cones

In at least 3 locations on the plant, a ripe seed cone is visible. The berry-like seed cones are considered ripe when they have turned dark blue or purple in color, and are often covered with a whitish film that rubs off.



The American Academy of Allergy, Asthma, and Immunology

<http://www.aaaai.org/global/nab-pollen-counts/south-atlantic-region>

 American Academy of Allergy Asthma & Immunology

Find an Allergist / Immunologist | Search Your Symptoms | Ask the Expert

Search AAAAI... 

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CONDITIONS & TREATMENTS EDUCATION & TRAINING PRACTICE RESOURCES ABOUT AAAAI

Home > Global > NAB Pollen Counts > South Atlantic region

SHARE |

NAB: POLLEN & SPORE LEVELS - SOUTH ATLANTIC

Please select a city to view the Pollen and Mold Level for that location. [Click here](#) to return to the map of the United States or visit the [NAB Homepage](#).



- [Asheville, NC](#)
- [Birmingham, AL](#)
- [Charleston, SC \(Station 1\)](#)
- [Charleston, SC \(Station 2\)](#)
- [Charlotte, NC](#)
- [Greenville, SC](#)
- [Marietta \(Atlanta\), GA](#)
- [Miami, FL](#)
- [San Juan, PR](#)
- [Tampa, FL](#)
- [Savannah, GA](#)

[Why isn't there a pollen counter where I live?](#)

READING THE CHARTS

The NAB pollen and mold spore levels were developed using the chart below. The concentrations in the chart (pollen or spores per cubic meter) were statistics from all certified counting sites. The levels correspond to different ranges for each of the pollen categories and for fungal spores. The concentrations were translated into levels based on the following:

- Low levels are concentrations that are less than the median or 50th percentile (i.e. half the counts were below the median.)
- Moderate levels are concentrations that fall between the 50th and 75th percentile
- High levels fall between the 75th and 99th percentile
- Very high levels are above the 99th percentile (99% of the counts are below this level)

Based on these definitions, we suggest the following ranges for low, moderate, high, and very high.

NAB SCALE							
* MOLD		GRASS		TREE		WEED	
0 - 6499	Low	0 - 4	Low	0 - 14	Low	0 - 9	Low
6500 - 12999	Moderate	5 - 19	Moderate	15 - 89	Moderate	10 - 49	Moderate
13000 - 49999	High	20 - 199	High	90 - 1499	High	50 - 499	High
>50000	Very High	>200	Very High	>1500	Very High	>500	Very High

** These mold levels were determined based on outdoor exposure to natural occurring spores in the environment and should not be applied to indoor exposure which may represent an entirely different spectrum of spore types.*

These levels and the corresponding ranges are based entirely on ecological measurements, not on health effects. Because the data were from all certified counting stations, the ranges allow comparisons between sites across the country and may be more appropriate than a range based on local numbers. This does mean that, for some stations, some categories will never be high. Because of this, a few stations have determined the ranges for their own locations and do not use these national ranges.

NATIONAL ALLERGY BUREAU POLLEN AND MOLD REPORT

Date: May 31, 2017

Location: Birmingham, AL

NAB Station: [Alabama Allergy and Asthma Center](#)

Trees	Weeds	Grass	Mold
  ABSENT	  ABSENT	  LOW CONCENTRATION	  NOT COUNTED
No Trees allergens noted today	No Weeds allergens noted today	Top 3 Species: Grass Family, all types (<i>Gramineae</i> / <i>Poaceae</i>)	NOT COUNTED

[View Calendar of Data](#)
[Using the Levels](#)

Change Date of Report:
 5 / 31 / 2017
 Go

NATIONAL ALLERGY BUREAU POLLEN AND MOLD REPORT

Date: March 31, 2017

Location: Birmingham, AL

NAB Station: [Alabama Allergy and Asthma Center](#)

Trees	Weeds	Grass	Mold
  HIGH CONCENTRATION	  MODERATE CONCENTRATION	  ABSENT	  NOT COUNTED
Top 3 Species: • Oak (<i>Quercus</i>) • Willow (<i>Salix</i>) • Maple, Box elder (<i>Acer</i>)	Top 3 Species: • Sheep Sorrel, Dock (<i>Rumex</i>)	No Grass allergens noted today	NOT COUNTED

[View Calendar of Data](#)
[Using the Levels](#)

Change Date of Report:
 3 / 31 / 2017
 Go

NATIONAL ALLERGY BUREAU POLLEN AND MOLD REPORT

To see what pollen and mold types are associated with these concentration levels, please click the date link.

Location: Birmingham, AL

Counting Station: [Alabama Allergy and Asthma Center](#)

<< MAY 2017						
	1 Trees Weeds Grass Molds	2 Trees Weeds Grass Molds	3 Trees Weeds Grass Molds	4 Trees Weeds Grass Molds	5 Trees Weeds Grass Molds	6 Trees Weeds Grass Molds
7 Trees Weeds Grass Molds	8 Trees Weeds Grass Molds	9 Trees Weeds Grass Molds	10 Trees Weeds Grass Molds	11 Trees Weeds Grass Molds	12 Trees Weeds Grass Molds	13 Trees Weeds Grass Molds
14 Trees Weeds Grass Molds	15 Trees Weeds Grass Molds	16 Trees Weeds Grass Molds	17 Trees Weeds Grass Molds	18 Trees Weeds Grass Molds	19 Trees Weeds Grass Molds	20 Trees Weeds Grass Molds
21 Trees Weeds Grass Molds	22 Trees Weeds Grass Molds	23 Trees Weeds Grass Molds	24 Trees Weeds Grass Molds	25 Trees Weeds Grass Molds	26 Trees Weeds Grass Molds	27 Trees Weeds Grass Molds
28 Trees Weeds Grass Molds	29 Trees Weeds Grass Molds	30 Trees Weeds Grass Molds	31 Trees Weeds Grass Molds			

Using the Counts

Red = very high concentration

Orange = high concentration

Yellow = moderate concentration

Green = low concentration

Black text = no count

