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

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Review September 2010

Science Update

1. Pollen Sampling
2. Remote Sensing
3. DREAM

Outreach Activities

1.National Phenology Network
2. School
3. Medical Community

Presenations & Abstracts

Students

Housekeeping- Schedule, Budget, Problems

FY11 Plans

Pollen Collection

Air sampling for Juniperus ashei pollen started 2 locations in the Arbuckle Mountiains southern OK & 4 locations Edwards Plateau. (nov 23. 09-Jan 2010) (Burkhard & Tauber samplers)

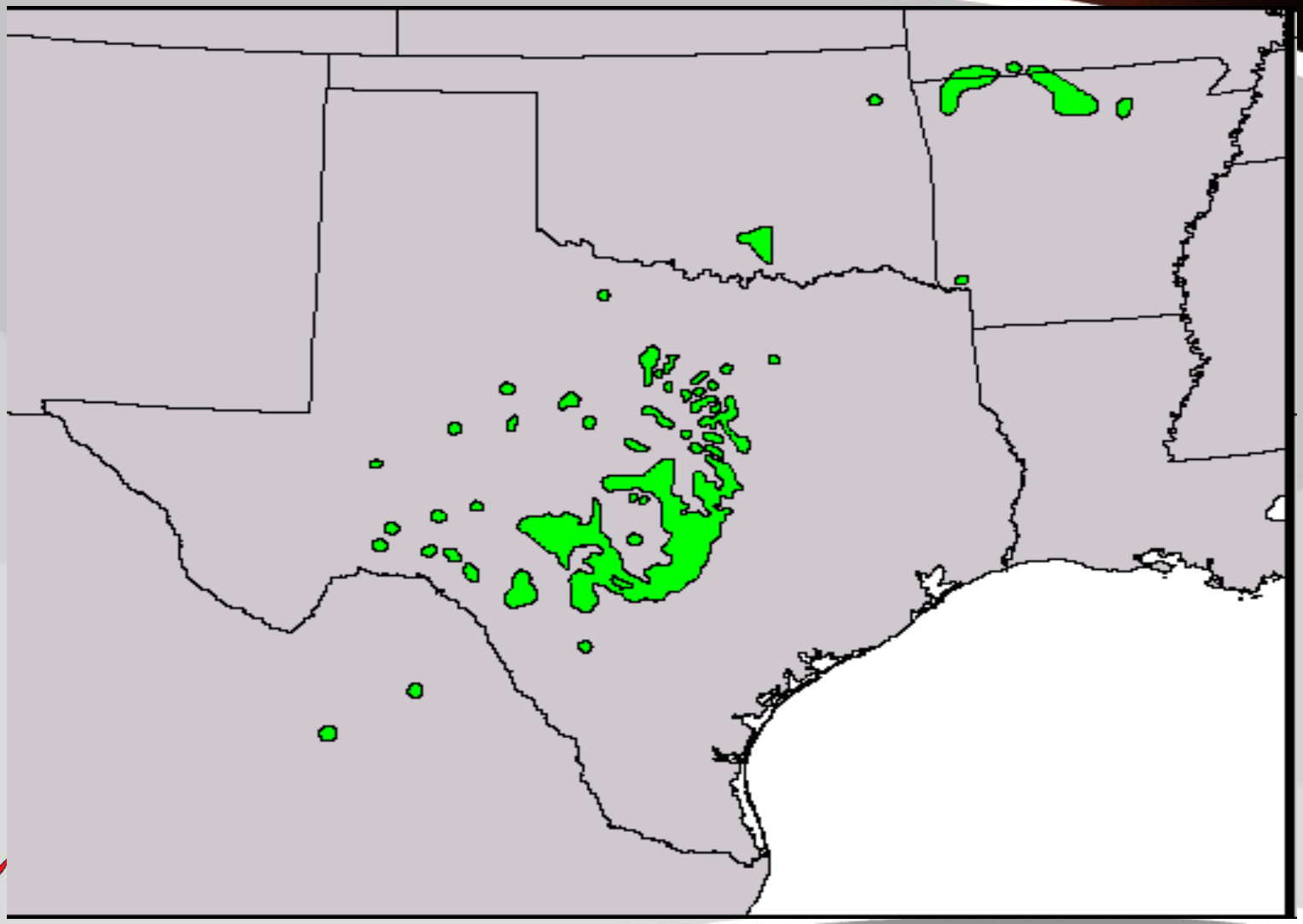
Field work was conducted in mid-December in southern Oklahoma and the first week of January in Texas to determine *Juniperus ashei* population characteristics

Mature pollen cones were collected and dried to determine the number of pollen grains per cone

On 1 February 2010, the samplers were moved to New Mexico to monitor pollen release in the *Juniperus monosperma* and *J. scopulorum* populations. Sampling at six locations (Jemez Springs, Santa Fe, two sites in Los Alamos, and two site Tijeras) continued until 15 May 2010.

Texas in August to monitor the *Juniperus pinchotii* populations. This species releases pollen from mid-September until late November.

Juniperus ashei distribution

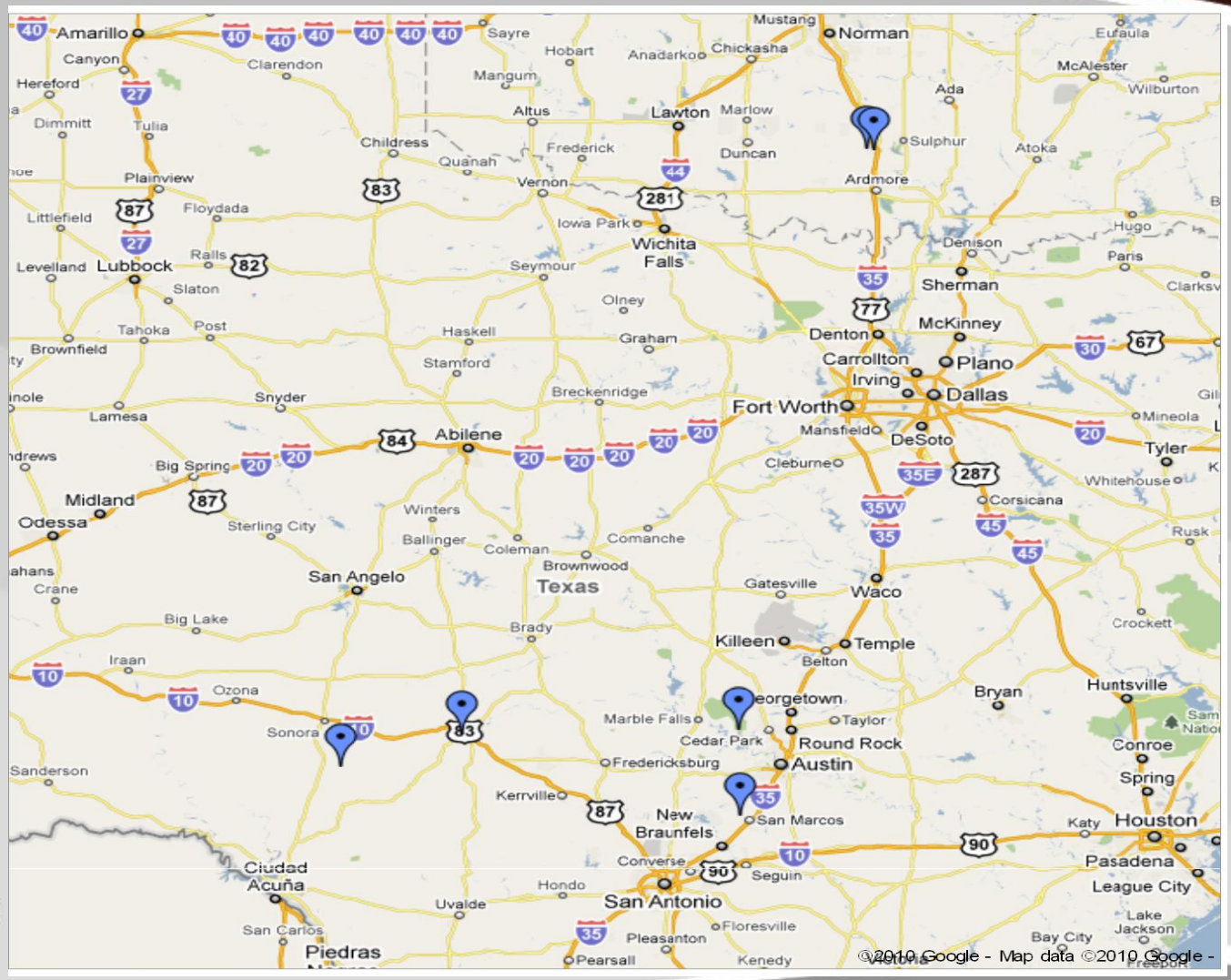


http://www.conifers.org/cu/ju/ashei.htm

Juniperus ashei data collection and air sampling locations

- Camp Classen, Davis, OK
- Crossbar Ranch, Davis, OK
- Balcones National Wildlife Refuge, TX
- San Marcos, TX
- Texas Tech University, Junction, TX
- Texas A&M Research Station, Sonora, TX

Sampler Locations



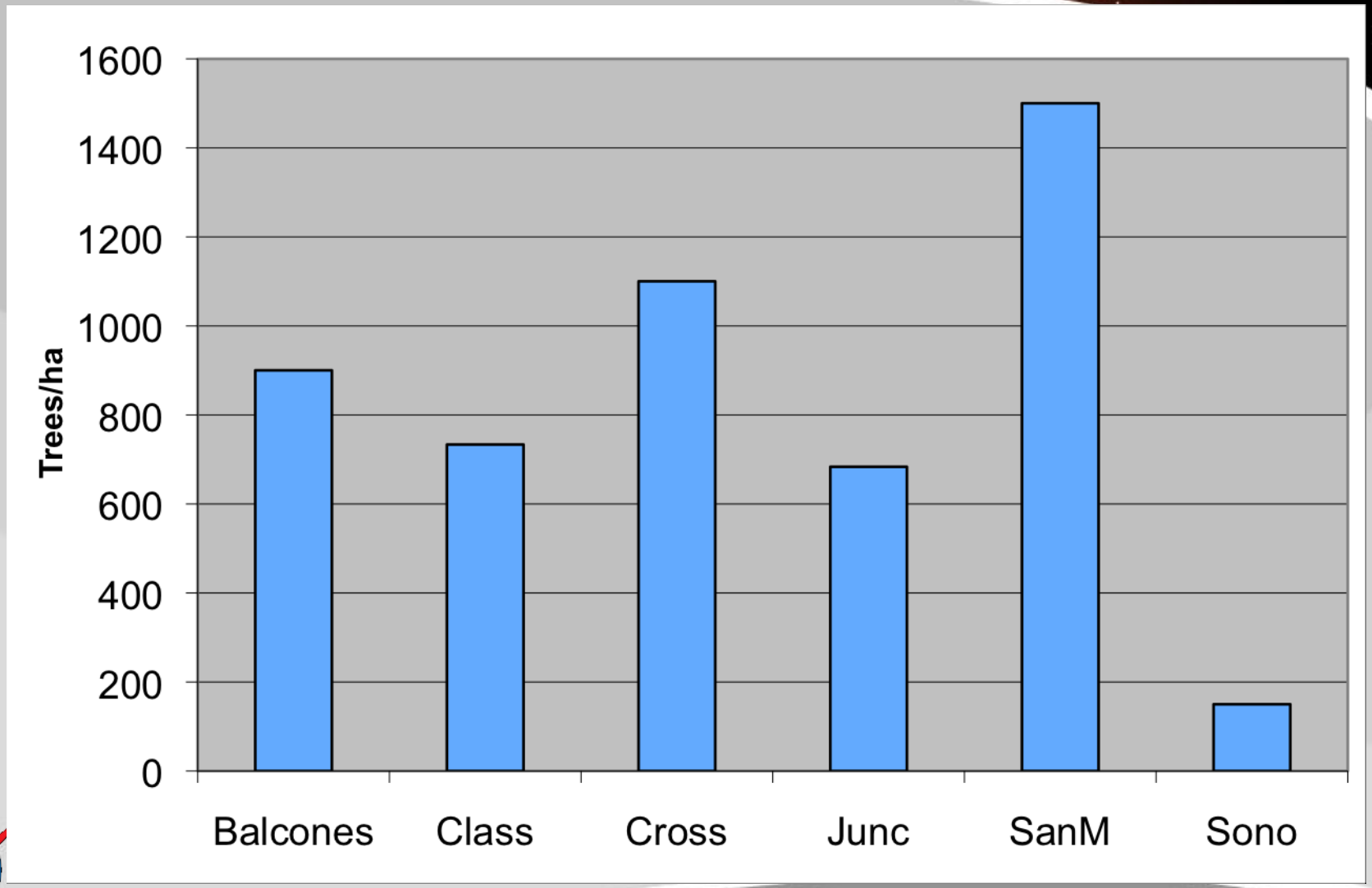
Texas and Oklahoma Field Sites

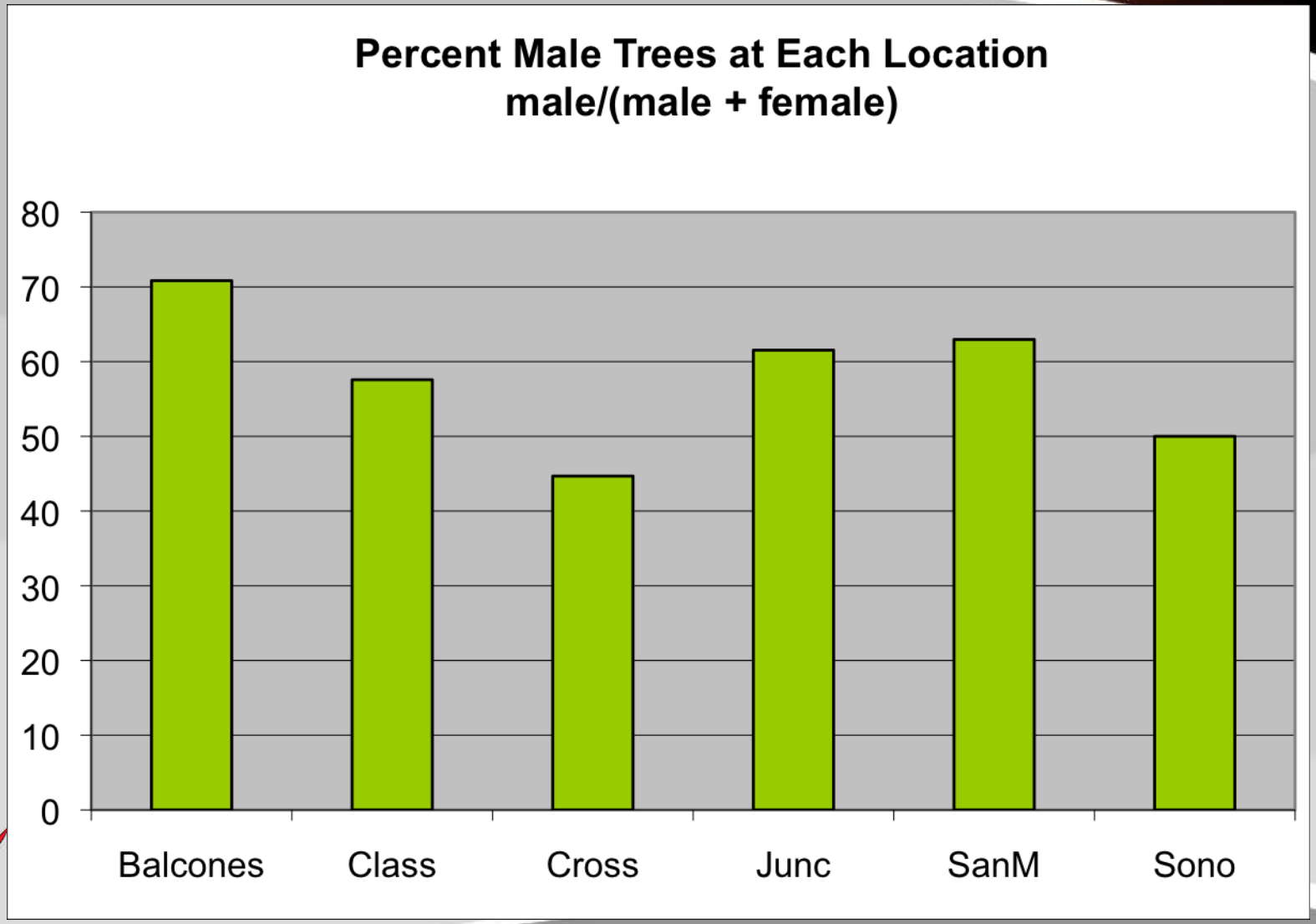
- Each field location consisted of six 100 m^2 (0.06 ha) randomly selected plots within a larger 10,000 m^2 area close to each Burkard sampler
- For each plot, data were collected for cone production, male/female ratio, stand density, tree heights, trunk diameters, and percent of live vegetation per tree
- Cone samples were also collected to determine pollen production per cone

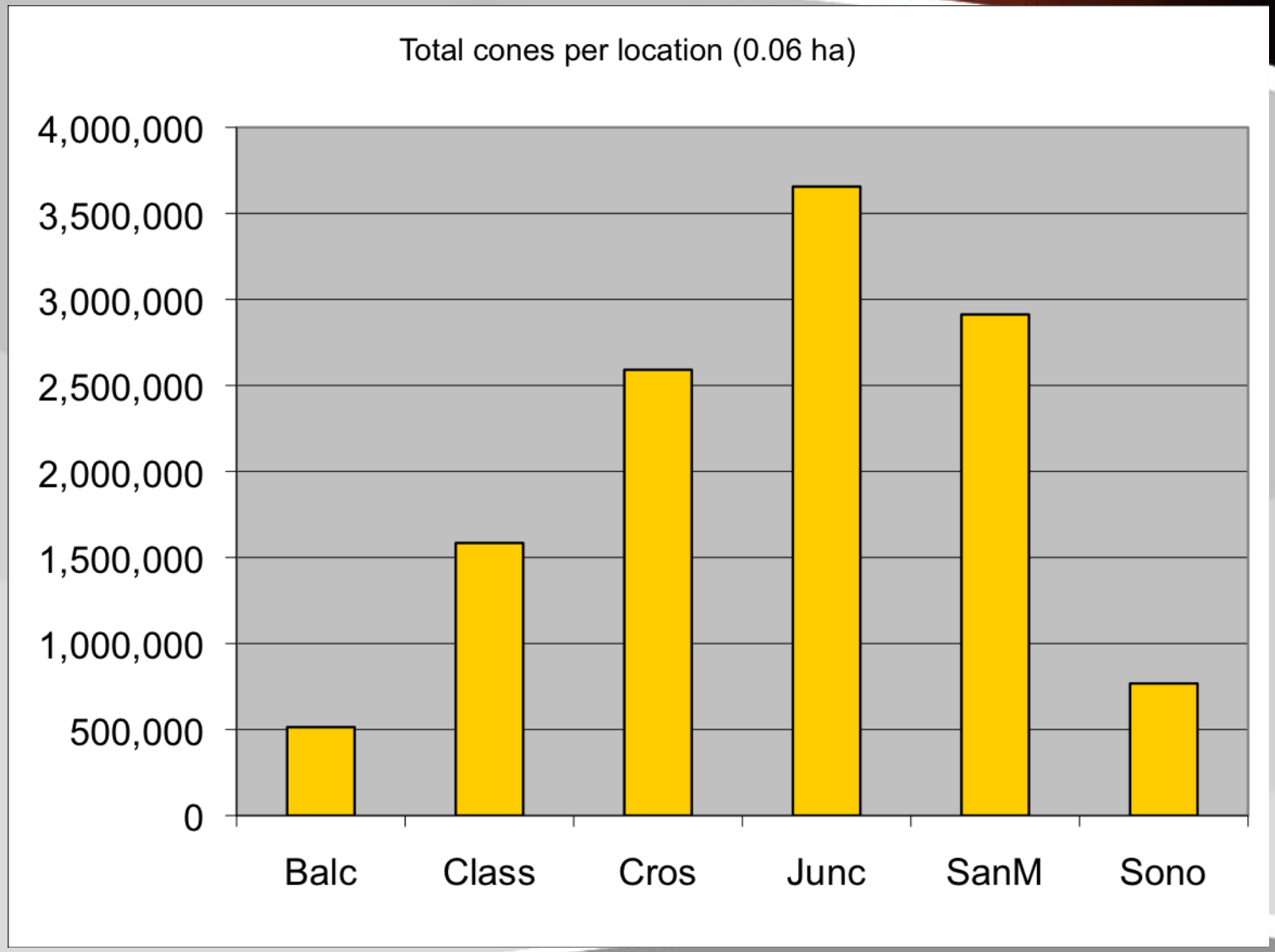
Tree Density

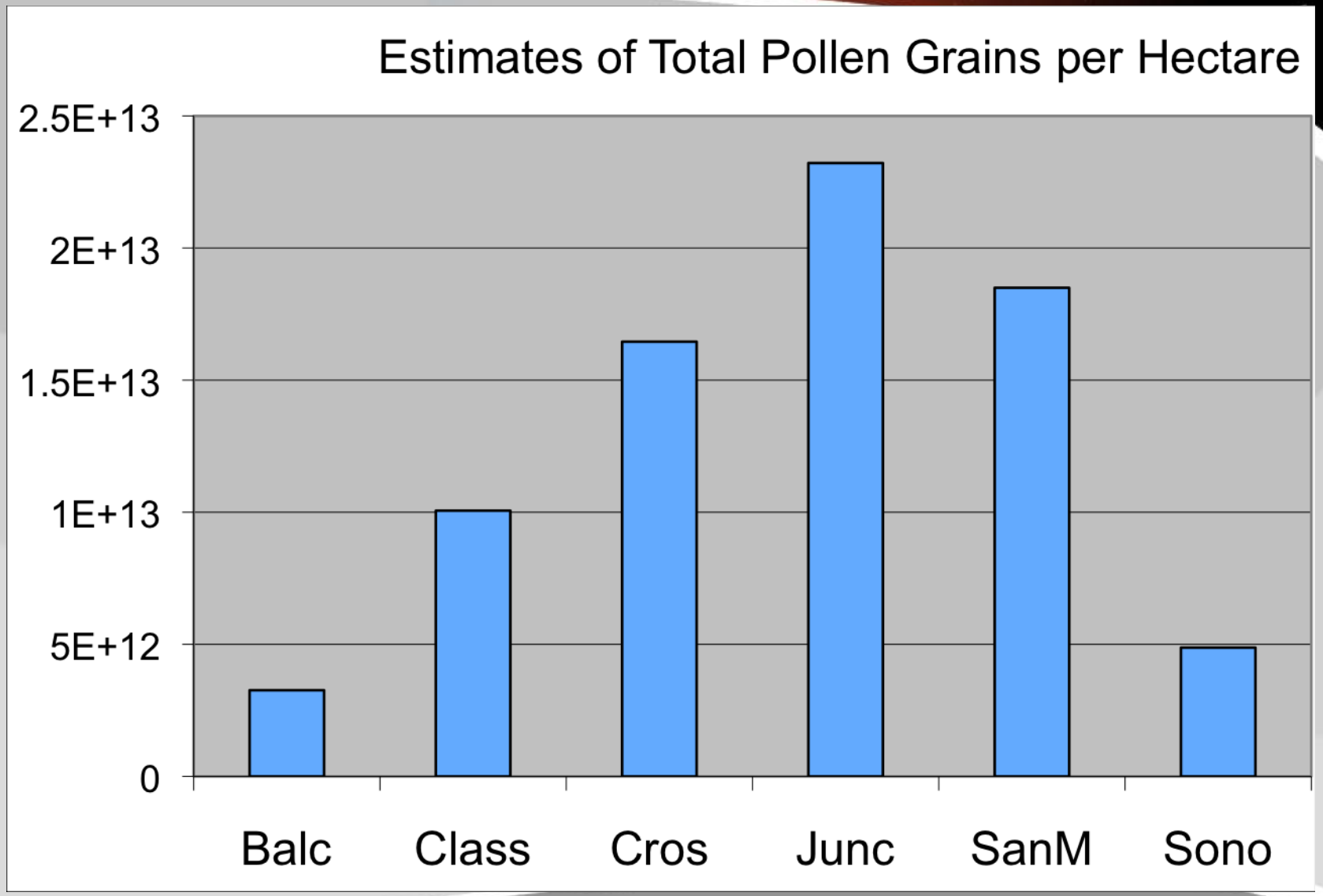
- Density = number of mature trees/area
- A “mature” tree was determined in each location and was defined as any tree taller than the shortest cone producing tree

Density of mature trees per hectare

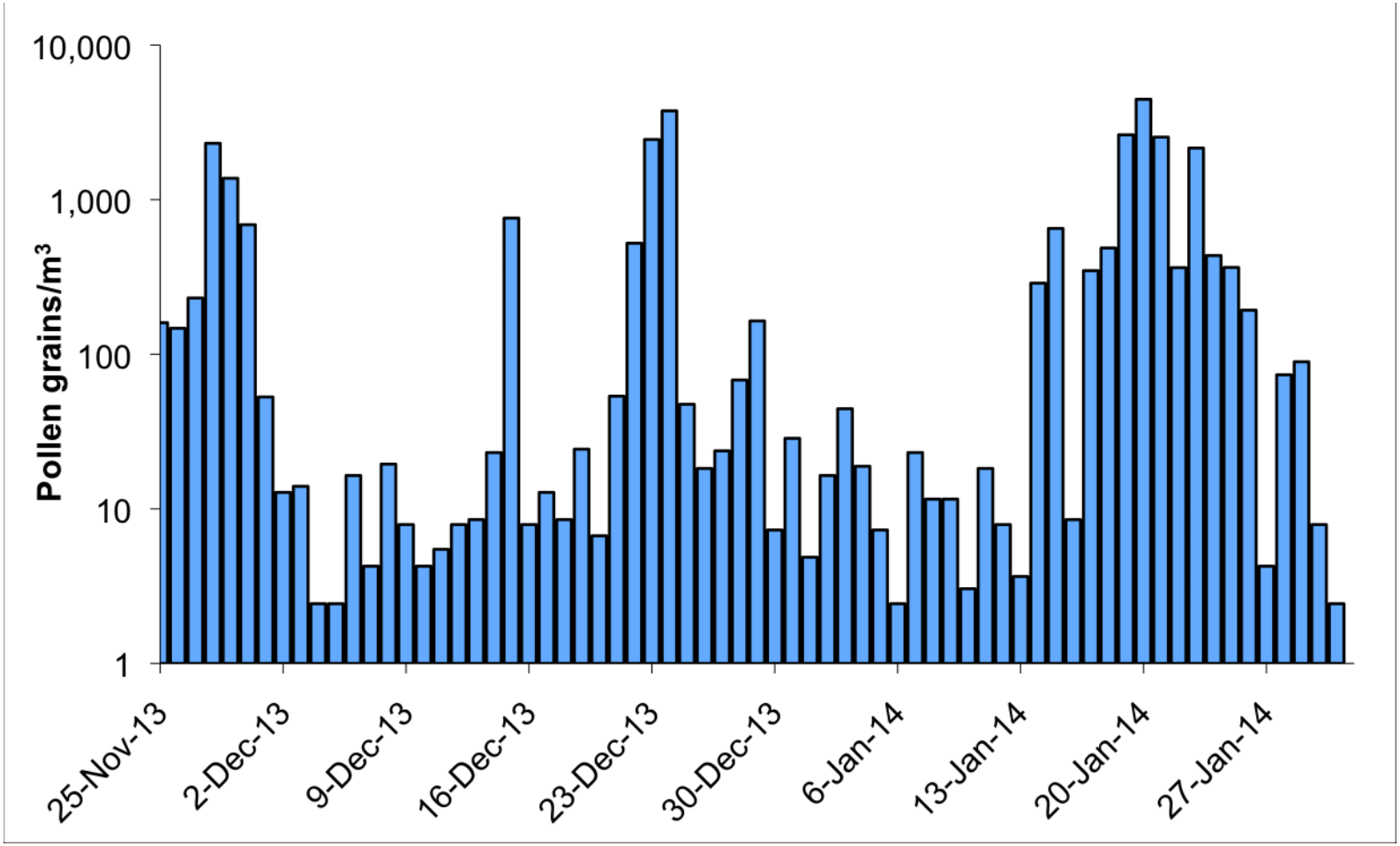



Percent Male Trees at Each Location
male/(male + female)
80
70
60
50
40
30
20
10
0
Balcones
Class
Cross
Junc
SanM
Sono


Total cones per location (0.06 ha)
4,000,000
3,500,000
3,000,000
2,500,000
2,000,000
1,500,000
1,000,000
500,000
0
Balc
Class
Cros
Junc
SanM
Sono

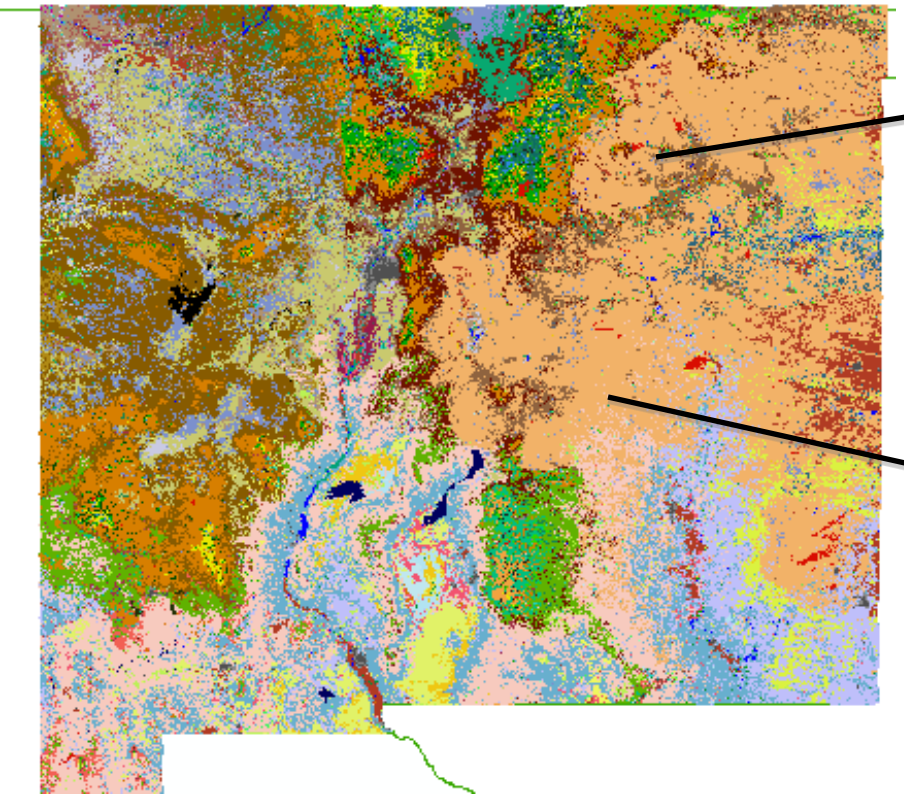

Estimates of Total Pollen Grains per Hectare
2.5E+13
2E+13
1.5E+13
1E+13
5E+12
0
Balc
Class
Cros
Junc
SanM
Sono

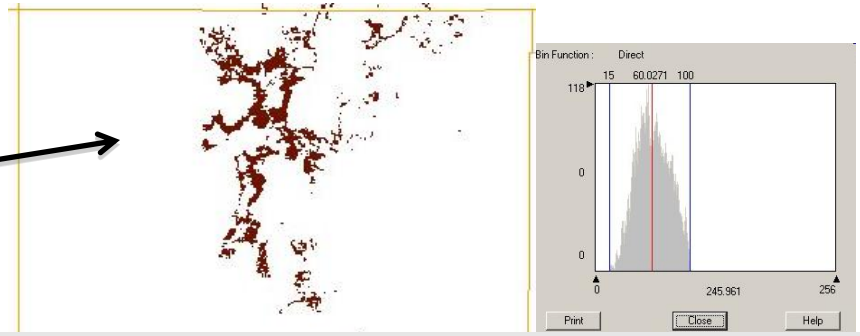
Mean Daily Concentration* of Airborne *Juniperus ashei* Pollen at Camp Classen, Davis, OK



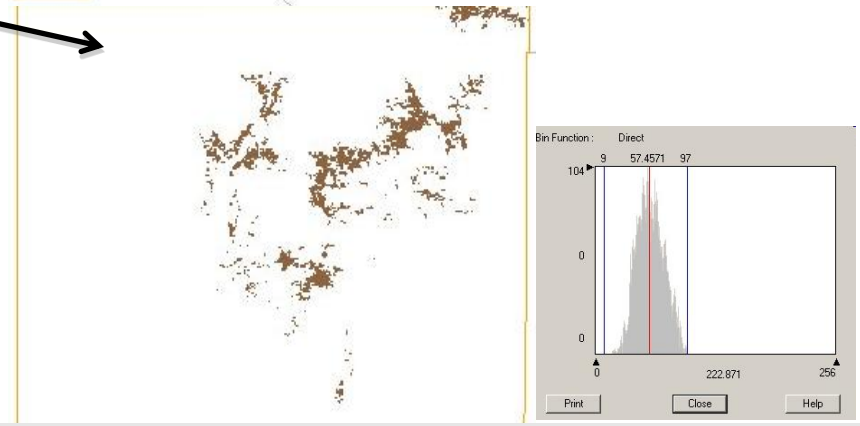
*Concentration for each day is the mean of 12 bihourly concentrations

Previous Work: Mapping the spatial distribution and relative frequency distribution of Juniper land cover classes from the New Mexico SWReGAP Data



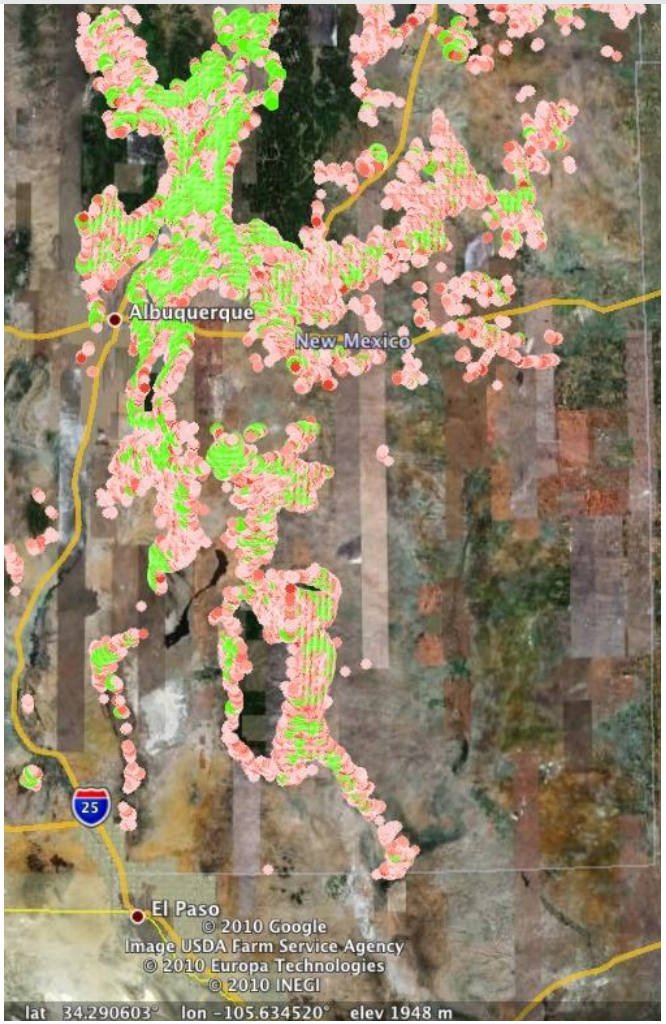


Class S038, Southern Rocky Mountain Pinyon-Juniper Woodland



Class S074, Southern Rocky Mountain Juniper Woodland and Savanna

Goal: Quantify Juniper Pollen Emission "**Sources**" for input to PREAM model.



Juniper density (relative)*

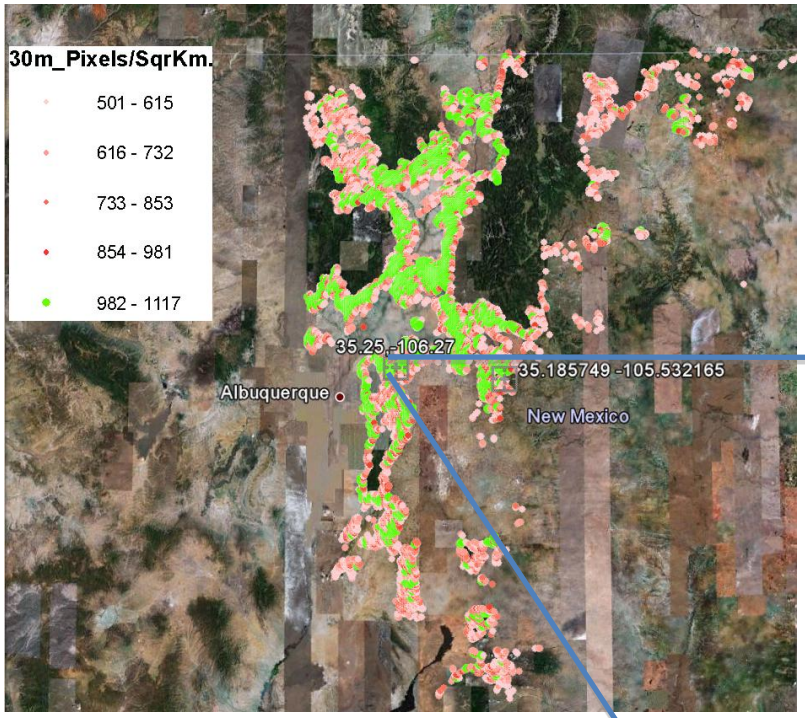
- 50%
- 60%
- 70%
- 80%
- 90%

*Juniper from Land Cover classes S038, S074, and S112 are mapped.

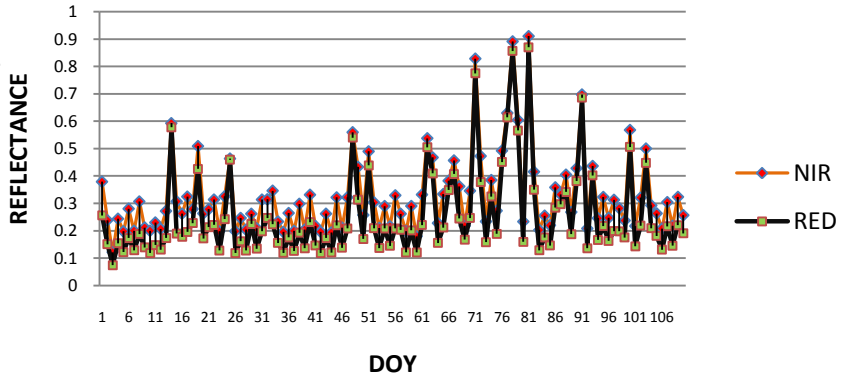
Challenge: *Juniper is commonly mapped as "Land Cover Classes" and actual Juniper tree cover is not known.*

Site 1 S038

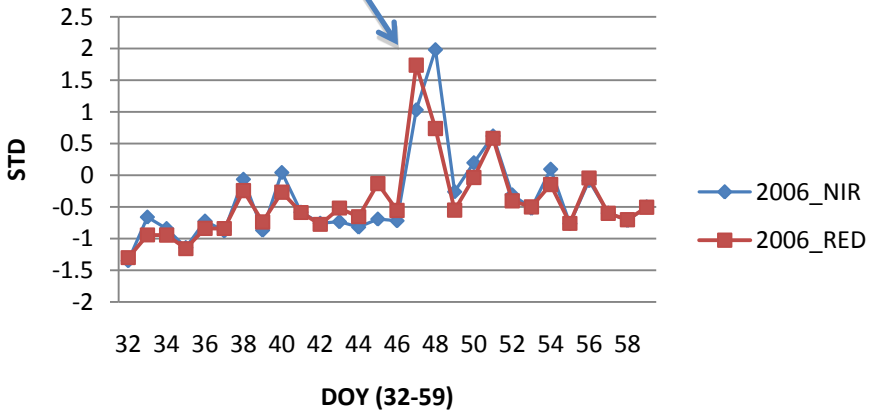
Density of S038 class



2006 Daily_250m pixel (MOD09GQ) Site_1 (20 Miles east-Albuquerque)

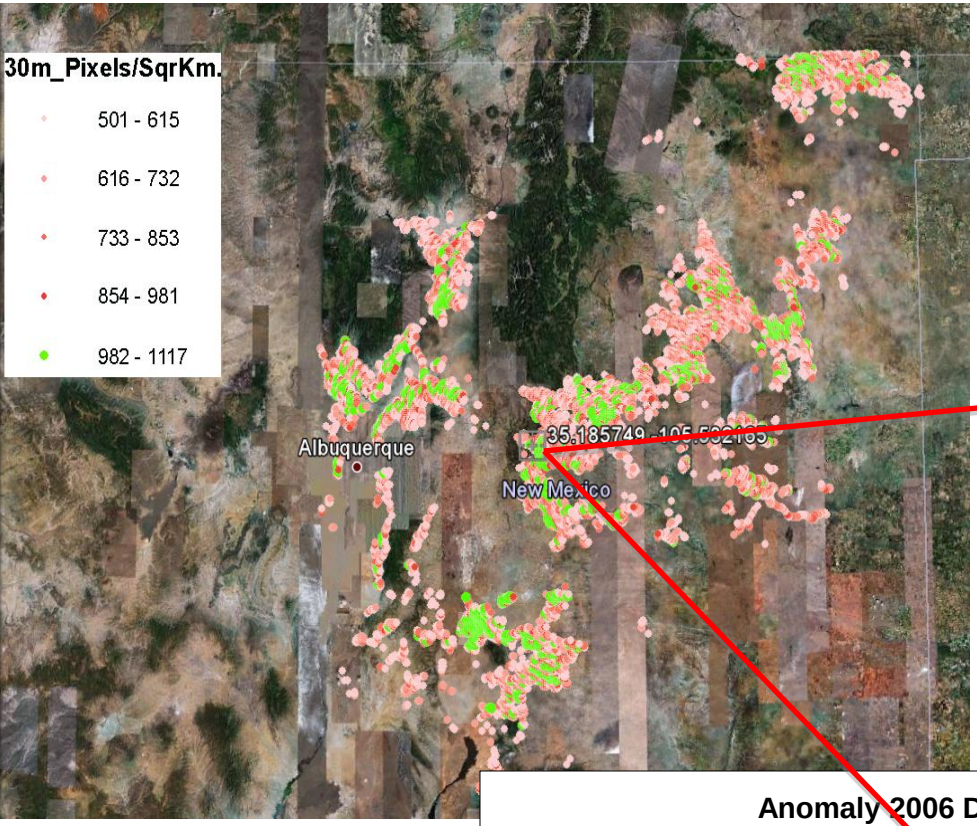


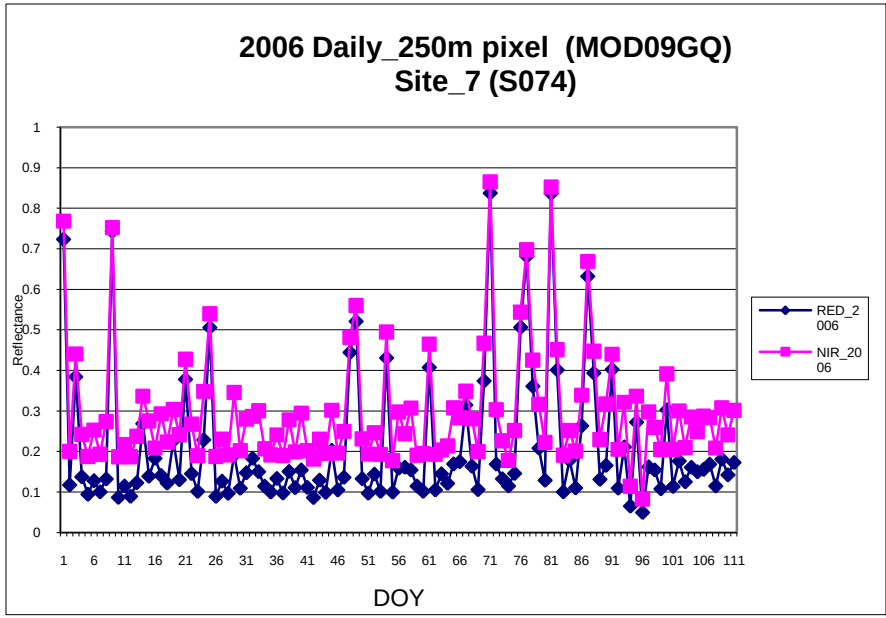
Anomaly_MOD09GQ_250m-Pixel Site1 - February-2006

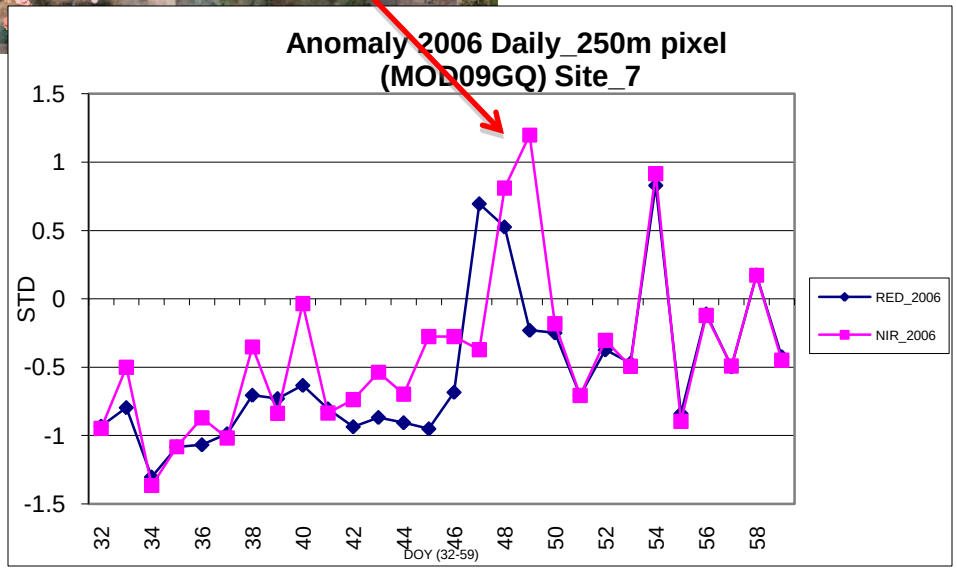


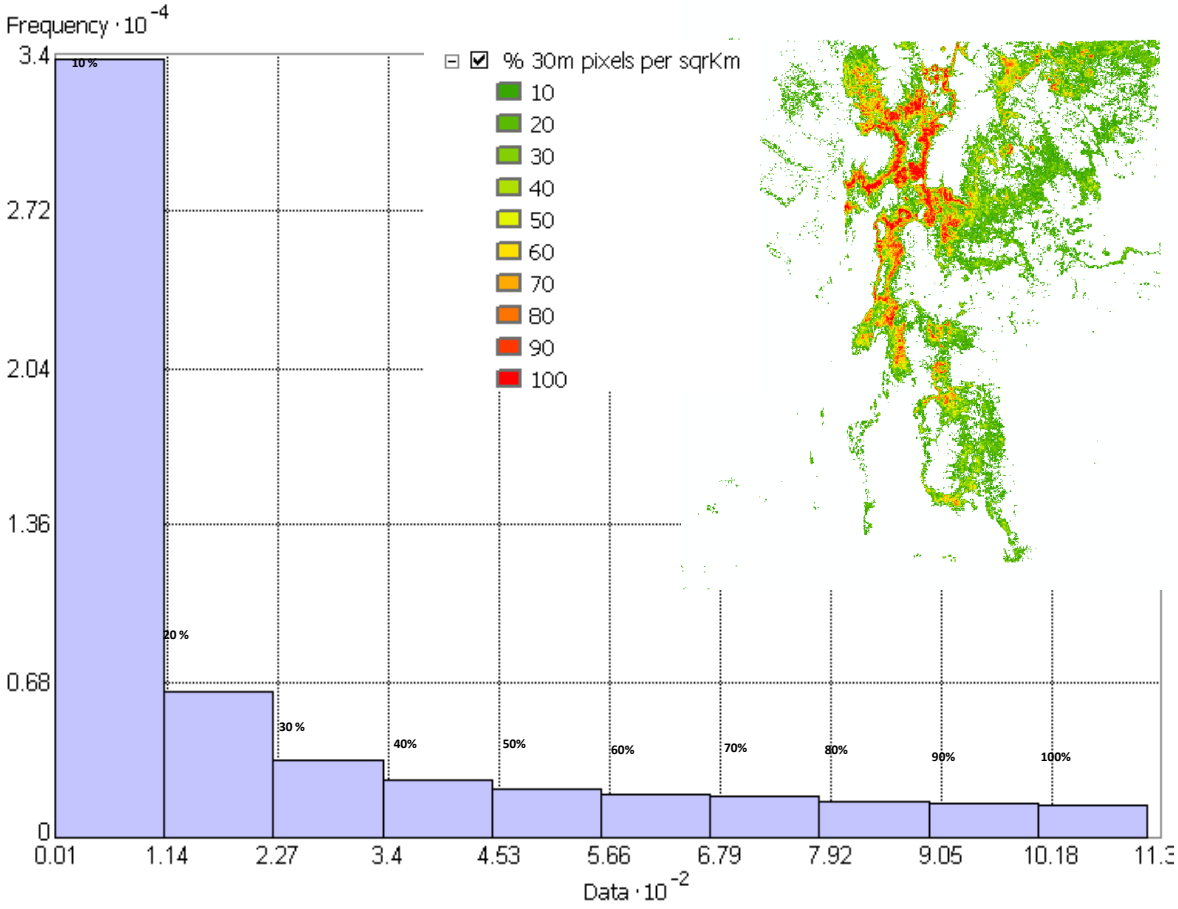
Density of S074 class

Site 7 S074

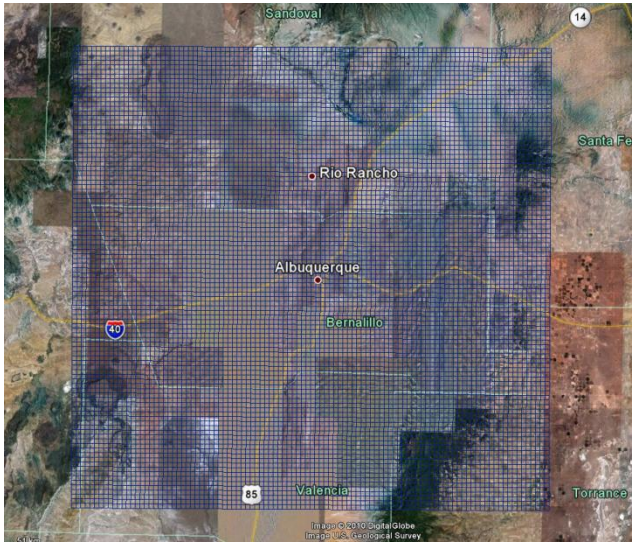








Count	: 56093	Skewness	: 1.5939
Min	: 1	Kurtosis	: 4.4214
Max	: 1117	1-st Quartile	: 16
Mean	: 207.9	Median	: 64
Std. Dev.	: 285.67	3-rd Quartile	: 285

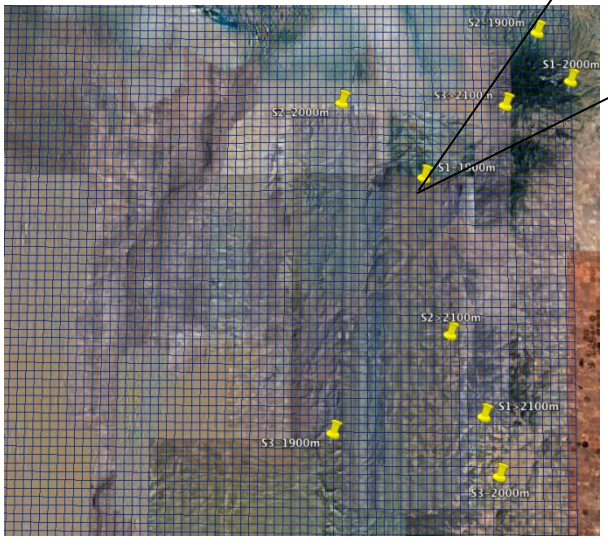


Albuquerque Grid 100x100km

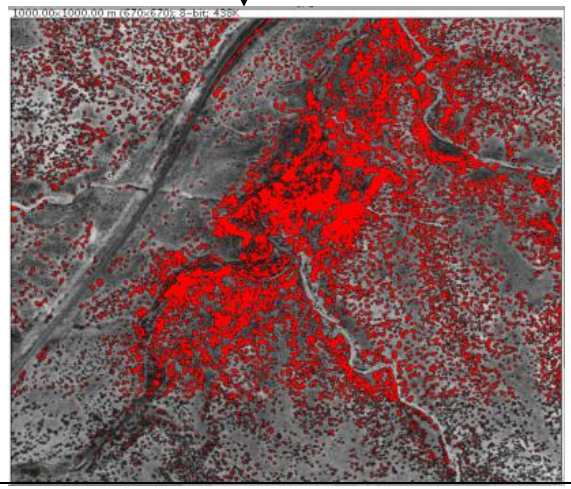
1km

1km

Binary Classification

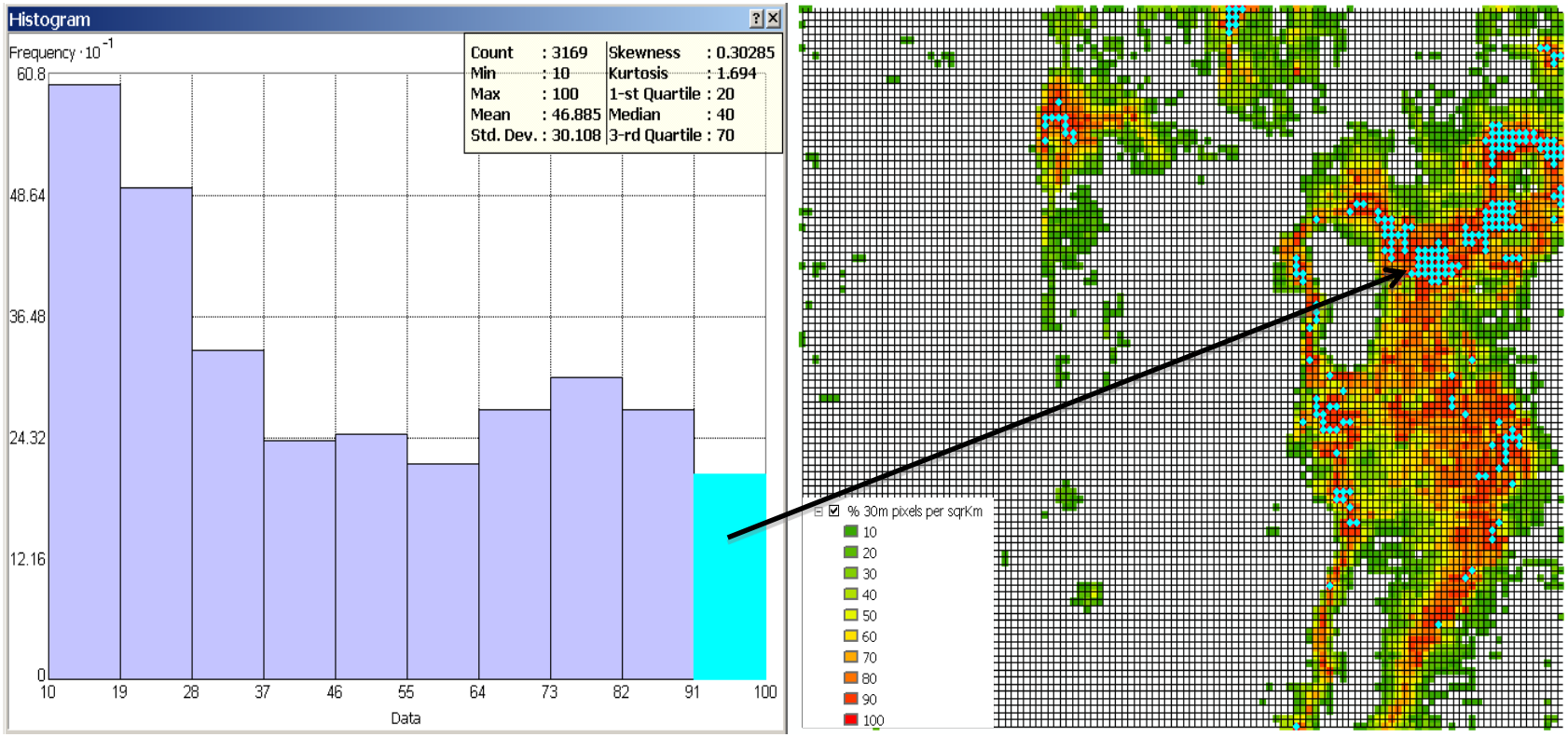


Sites at different elevations



Result: ~ **16.9%** woody tree cover

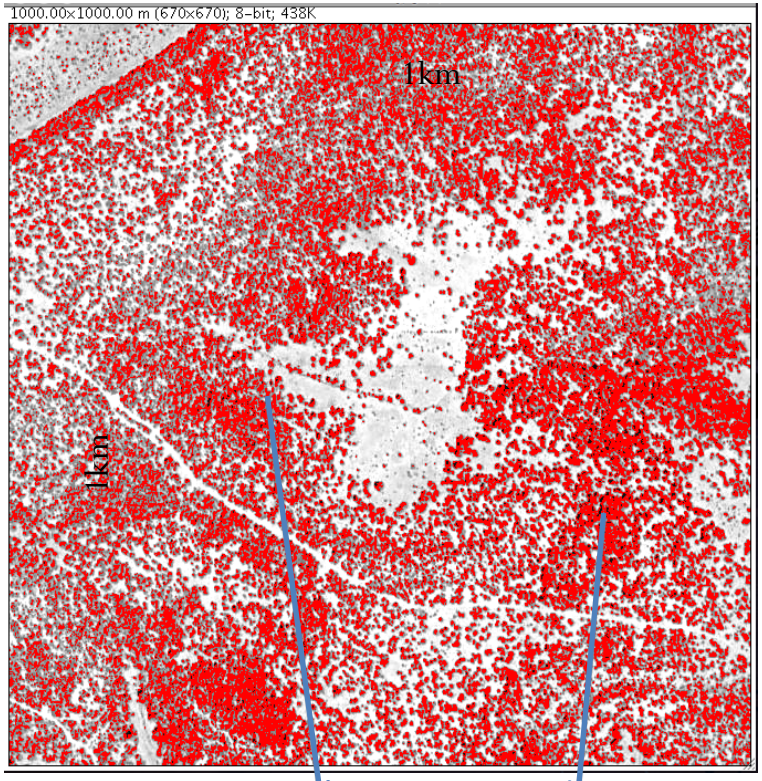
Sites in a range from 90-100% within the 100x100km grid



The class S038 was masked with the 100x100km grid to find those pixels with higher percentage of 30m pixels per square km using the histogram tool.

Sample 1 at 2100m or above (S1>2100m)

Scale bar

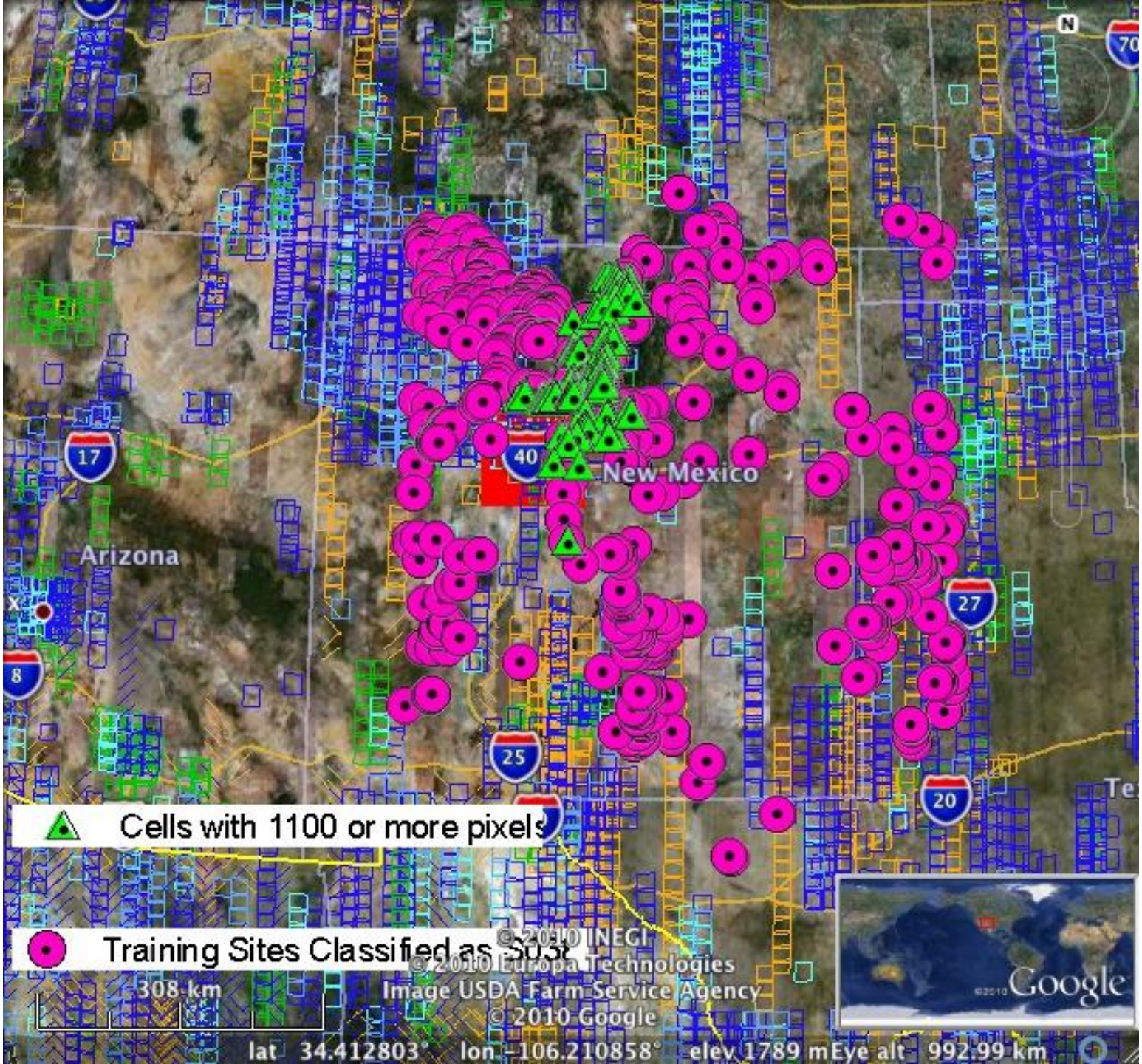


Red is woody tree cover

Black is shadow

This pixel (S1>2100m) has:
-Elevation:~ 2122m
-Class S038: **1013 (value of green dot)** pixels as Juniper in 30m/pixel. It means **90,6%** of pixels consider as Juniper.

Results:
-The cell area: 1,000mx1,000m=1,000,000m^2, there is:
- **313,495m^2** is woody tree (the Red area).
- ~ **31.3%** woody tree cover
- %Juniper = 31.3%x 90.6%/100%= **28.35%**


New Mexico
Arizona
Cells with 1100 or more pixels
Training Sites Classified as S03
© 2010 INEGI
© 2010 Europa Technologies
Image USDA Farm Service Agency
© 2010 Google
308 km
lat 34.412803° lon -106.210858° elev 1789 m Eye alt 992.99 km

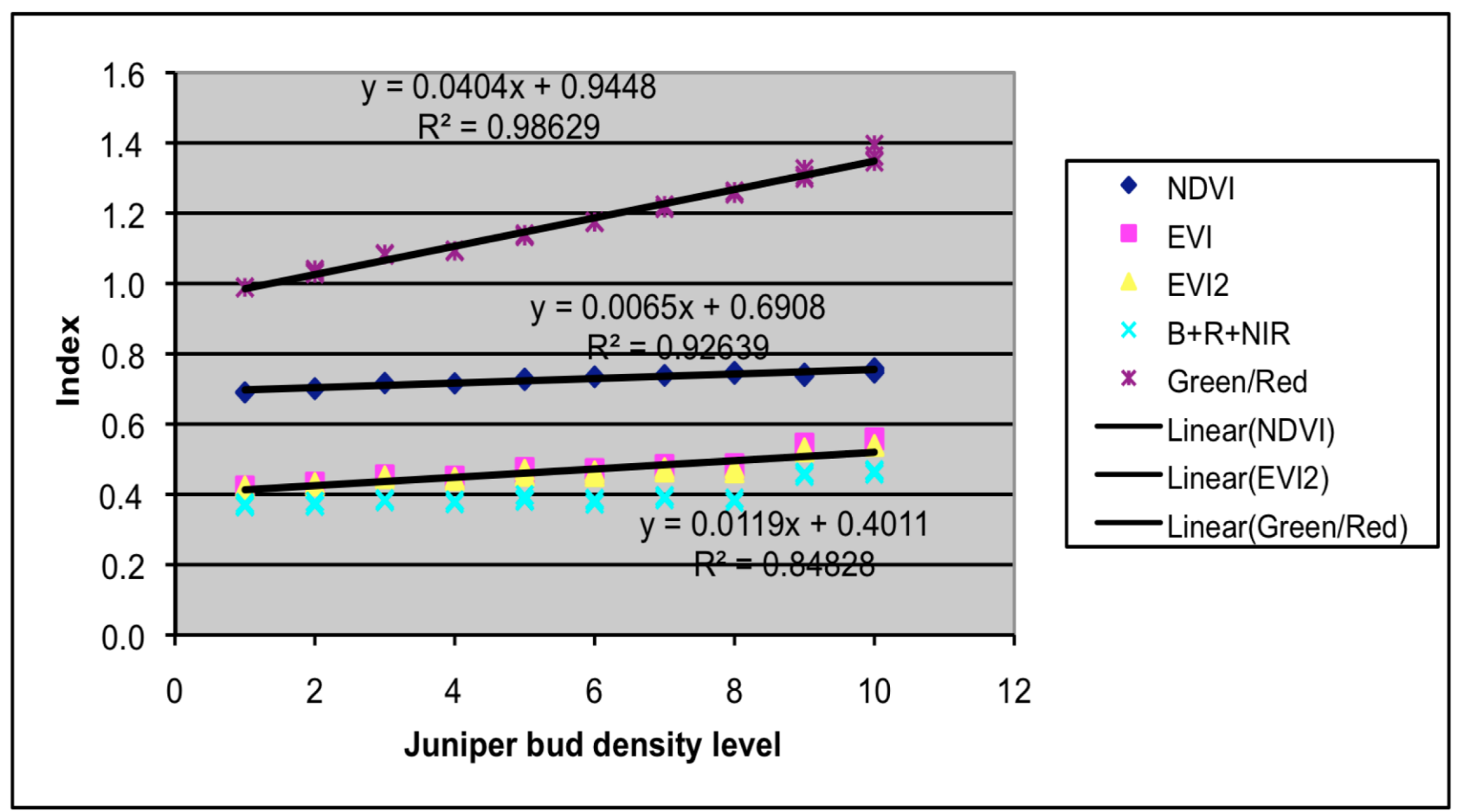

04/13/2009 14:11


04/13/2009 15:05

Spectral characteristics of male juniper canopies at different bud density levels

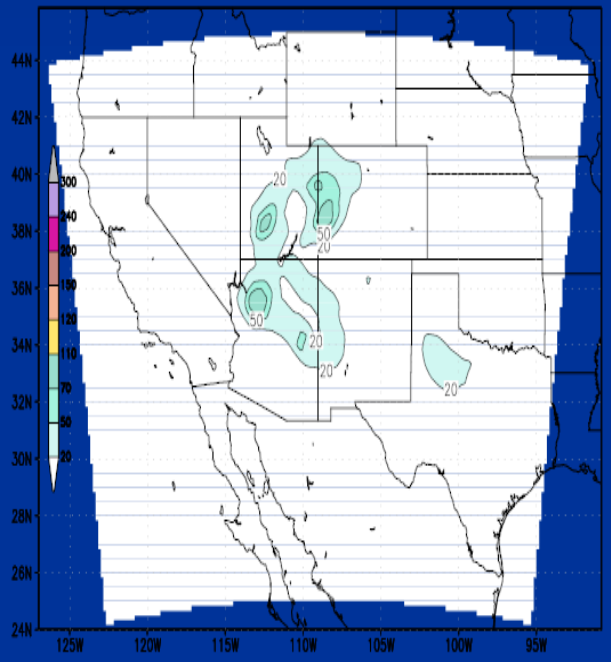
Density level	Bud density (g/m^2)
1	204.2
2	190.0
3	176.9
4	164.9
5	151.1
6	136.2
7	115.8
8	92.9
9	45.9
10	0.0

Relationships between spectral indices and juniper bud density levels

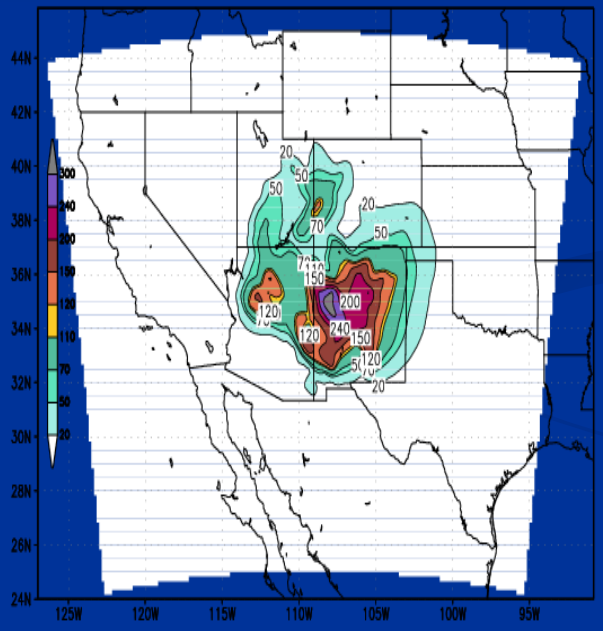


Juniper Pollen
Near-surface concentration (Nm3)

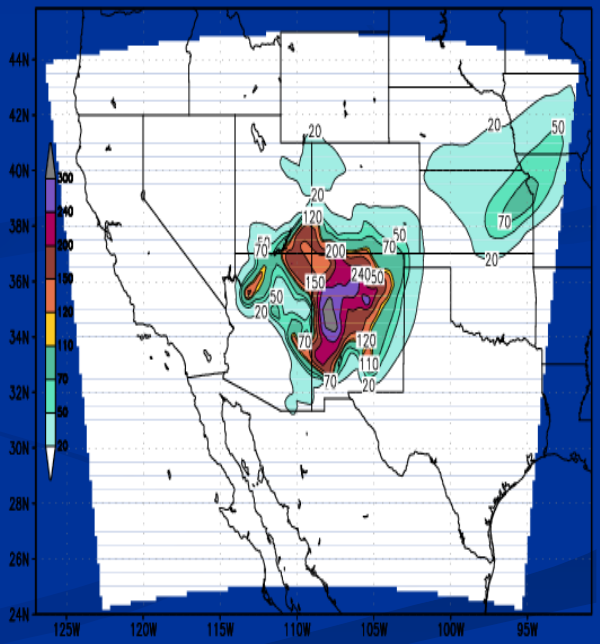
PREAM



6 March 2006

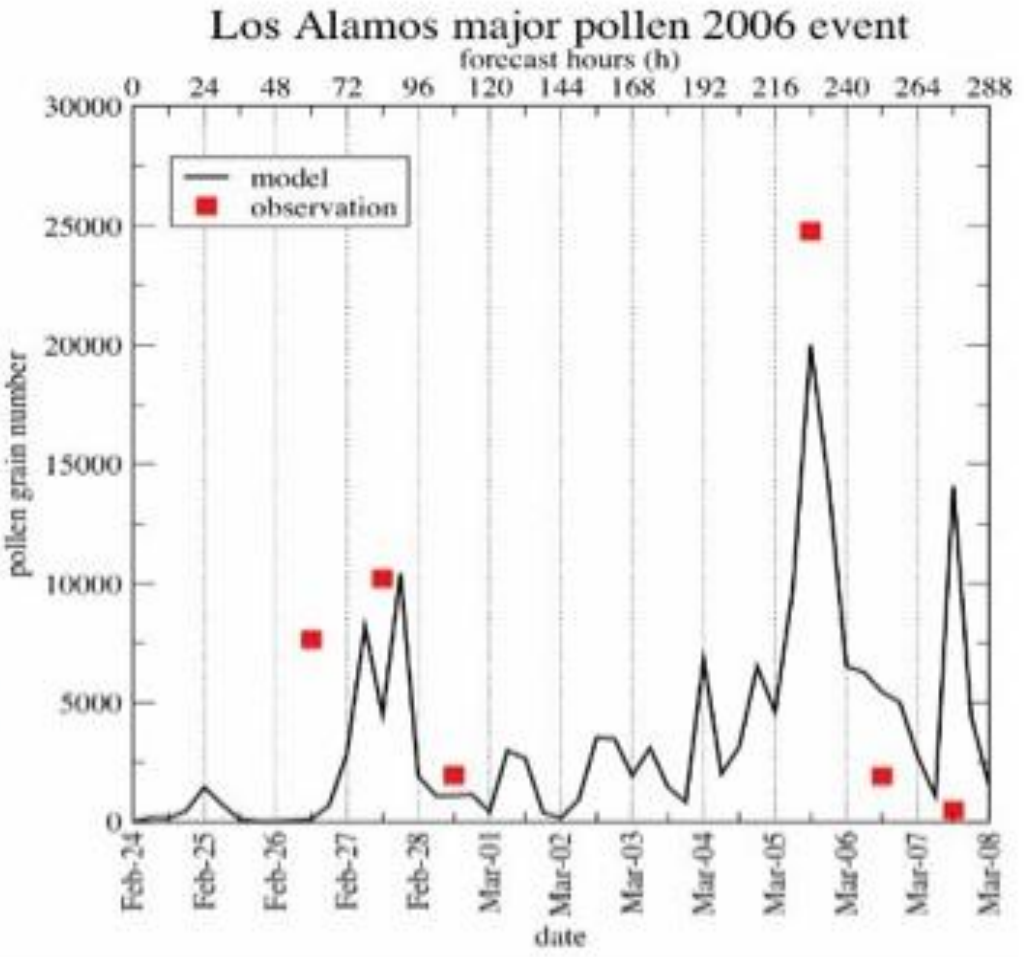


9 March 2006



11 March 2006

DREAM (Dust REgional Atmospheric Model)
– as --
PREAM (Phenology REgional Atmospheric Model)



USA npn National Phenology Network

A new data resource—*a national network of integrated phenological observations across space and time*

<u>Key Goal</u>

Understand how plants, animals and landscapes respond to environmental variation and climate change

USA National Phenology Network

Taking the Pulse of Our Planet

Log In

ABOUT | PARTICIPATE | RESOURCES | EDUCATION | RESULTS | ARCHIVE

Search Site | search

western columbine

View All Species

Join Us!

We are looking for volunteers to help us monitor plant and animal species found across the United States. Click "Observe" to join us!

Observe

Featured Projects

1 of 2 ››

Sponsors

USA National Phenology Network

The USA National Phenology Network brings together citizen scientists, government agencies, non-profit groups, educators and students of all ages to monitor the impacts of climate change on plants and animals in the United States. The network harnesses the power of people and the Internet to collect and share information, providing researchers with far more data than they could collect alone.

Learn more about us

What is phenology?

Phenology refers to recurring plant and animal life cycle stages, or phenophases, such as leafing and flowering, maturation of agricultural plants, emergence of insects, and migration of birds. Many of these events are sensitive to climatic variation and change, and are simple to observe and record. As an USA-NPN observer, you can help scientists identify and understand environmental trends so we can better adapt to climate change.

Why is phenology important?

USA-NPN News | **Phenology Feed** | **Join the Conversation**

- Phenoclimatology Position at UA
- Introducing the USA-NPN Video
- ***Nature's Notebook:*** "How to Observe" Handbook and Training Videos
- Phenology Special Issue in the Philosophical Transactions of the Royal Society
- USA-NPN Reports (including Strategic Plan and 2009 Annual Report)
- Call for Papers: 4th Annual PROSE in Tucson, AZ, October 2010

- Recent Media Reports
- Newsletter Archive

Are you...?

New to phenology?

Ready to start observing?

One of our partners?

Interested in creating a partnership?

An educator?

Interested in finding data to use?

A media outlet?

USA National Phenology Network, National Coordinating Office
1955 E. Sixth St., Tucson, AZ 85721
Admin Login

Juniper Pollen Project

Join us! How to participate…

1.**Select a site** to make juniper phenology observations.

A site is the area which encompasses any juniper plants you choose to observe. This may be your backyard or a local park.

2. **Select your juniper plants** to observe.

Identify one or more individual juniper plants to track. We are tracking four juniper species for this effort:

- redberry juniper, Pinchot's juniper (*Juniperus pinchotii*)
- Ashe's juniper, mountain cedar (*Juniperus ashei*)

You can learn more about each of these species and how to identify them on the Juniper Pollen Project web page (www.usanpn.org/JPP).

3. **Register yourself** with Nature's Notebook.

Create an account with Nature's Notebook at www.usanpn.org. All you need is a valid email account. When you are registering, identify yourself as a part of this effort by selecting 'Juniper Pollen Project' from the 'Partner Organization' drop-down menu.

4. **Register your site**.

Using the online mapping tool, the address of your site, or latitude and longitude, create and describe your site in Nature's Notebook.

5. **Register your individual juniper plants**

Register your individual juniper plants with Nature's Notebook.

6. **Record your observations** of your juniper plants.

We invite you to track several phenophases of your juniper, including:

- Pollen cones – In at least 3 locations on the plant, an unexpanded male pollen cone (or strobilus) or an expanded cone with unbroken pollen sacs is visible. Do not include spent male cones that have released all of their pollen but remain on the plant.
- 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.
- Unripe seed cones – One or more unripe female cones (or "berries") are visible on the plant. Unripe female cones are berry-like and green in color.
- Ripe seed cones – One or more ripe female cones (or "berries") are visible on the plant. The berry-like female cones are considered ripe when they have changed color.

Using datasheets that you download from www.usanpn.org/juniper_pollen_project, record the following for each of your species:

- **Yes (Y)** – if you saw that the phenophase (e.g., open flowers) ***is*** occurring
- **No (N)** – if you saw that the phenophase ***is not*** occurring
- **Uncertain (?)** – if you were not certain whether the phenophase was occurring, or if you did not check for the phenophase

7. **Report your data** in Nature's Notebook online.

As you collect data during the season, log in to Nature's Notebook and enter the observations you recorded.

Recruitment handout

Also available:

- Training presentation
- Online information:

  www.usanpn.org/JPP

(link direct from USA-NPN homepage as well)

Presentations 2009-2010

“Quantification of *Juniperus ashei* pollen production for the development of forecasting models” was prepared and submitted for presented at the 9th International Congress on Aerobiology in Buenos Aires, Argentina in August, 2010.

UNM Project ECHO Pulmonary/Asthma Telehealth Clinic on April 9, 2010, "Pollen Forecasting for Environmental Public Health". The audience for this was statewide and included health practitioners from school nurses, community MDs, to pulmonary MD specialists.

Aerobiology subcommittee of American Academy of Allergy, Asthma, and Immunology. Feb 2010.

Invited seminar - City College of New York

Accepted Presentations

November 2010 American Public Health Association (APHS) annual conference

Annual meeting of the American Academy of Allergy, Asthma, and Immunology in March 2011. (2)

AMS January 2011

ISRSE 34th Sydney April 2011

School Outreach

Orrin- met with the Albuquerque Public Schools three or four times last year to discuss their involvement with the pollen project

Coordinating with Stan notifying schools about air quality and their dust advisory template.

Students

Graduate student, Landon Bunderson,
University of Tulsa (Estelle)

NASA INSPIRES Student – Grace Coggins

Year 1

Pollen Sampling Activities

Identification of Juniper communities – *Juniperus asheii Dec09, Juniperus sp. Feb-Nov*
Pollen timing concentrations/size distributions - Tauber Traps & Burkard samplers
Humidity effects on pollen weight/extine separation
ID & Obtain pollen count data from creditable sources

Remotely Sensed Data

Track phenology to ID pollen formation (MODIS)
Identification of Juniper communities (Landsat, GAP data)
Spectrometry measurements from of Juniper pollen phenology.

DREAM Modeling

Pollen size distribution characterization
Surface pollen concentrations
Humidity effects on weight
Spatial /time resolution
Parameterization & Optimization

Public Health Supp*ort*

Modification of SYRIS to accept pollen tracking data
Preliminary data products for EPHTN
Recruitment of allergists for SYRIS
Hospital records for asthma and COPD

Year 2

Pollen Sampling Activities

Pollen timing concentrations/size distributions - Tauber Traps & Burkard samplers
Humidity effects on pollen weight/extine separation
ID & Obtain pollen count data from creditable sources
Recruitment of observers for NPN.

Remotely Sensed Data

Track phenology to ID pollen (male cones) formation & density (MODIS)

DREAM Modeling

Use measured surface pollen concentrations from sample sites
Humidity effects on weight
Spatial /time resolution
Parameterization & Optimization

Public Health Supp*ort*

Modification of SYRIS to accept pollen tracking data
Preliminary data products for EPHTN
Recruitment of allergists for SYRIS
Hospital records for asthma and COPD