Fiscal Year 2012 Final Technical Report

for the

Assessment of Land-based Sources of Air Quality Contaminants in the Binational Border Region of Southwestern New Mexico, Northwestern Chihuahua and West Texas

Principal Investigators

Dave DuBois
Erin Ward

New Mexico State University
Las Cruces, NM 88003

Prepared for:
New Mexico Department of Health
Office of Border Health
1170 N. Solano Dr.
Las Cruces, NM 88001

Additional Contributors:

Max Bleiweiss	Raymond Carr
Rosa Fitzgerald	Janet Greenlee
Juan Pedro Margez	Elizabeth Smith
Rebecca Armenta	Ilias Kavouras
Marie-Ceclie Chalbot	George Nikolich
Vic Etyemezian	Michael Baca
Stan Engle	Tomilee Turner

June 30, 2012

PREFACE

This project is being carried out by New Mexico State University in association with the University of Texas El Paso, Autonomous University of Juarez (Chihuahua), and the Desert Research Institute.

This work is being funded under a MOA 12312 with the New Mexico Department of Health, Office of Border Health.

Mr. Paul Dulin provided overall project management.

Contents

Table of Figures

List of Tables

1 Introduction

This report documents progress in ongoing activities from Phase I and completing a number of the Phase II studies for the Assessment of Land-based Sources of Air Quality Contaminants in the Binational Border Region of Southwestern New Mexico, Northwestern Chihuahua and West Texas. Phase II studies included

- Study IIa Inventory of landforms, soils, hydrology, vegetation, and landuse
- Study IIb Systematic assessment of Climatological and meteorological phenomena
- Study IIc Inventory and characterization of point and non-point sources
- Study IId Assessment of air quality based on past and ongoing monitoring data
- Study IIe Focalized studies of fungal spore dispersion from CAFOs
- Study IIf Pollen counts and dispersion studies
- Study IIg Distribution of air quality related chronic and infectious diseases

During this fiscal year we have also started on the phase III studies to include

- Study IIIb Modeling of air quality
- Study IIId Prescriptive recommendations for reducing air quality contamination using BACTs and BMPs

Four of the phase II studies are ongoing and will be continued in fiscal year 2013. Those include studies IId, IIe, IIf, and IIg.

2 Continued Monitoring Operations

During this fiscal year we have loaned Dr. Juan Pedro Margez both TSI DustTrak Nephelometers to be used in collecting PM_{10} during dust events in Cd. Juarez. He has been primarily using these on the campus of UACJ and at his home during high wind dust storms, using one to measure PM outdoors and the other indoors. This will be a very useful dataset to asses exposure to dust indoors where most of us spend the majority of our time.

We also have acquired a new microbalance that will be used to provide high quality filter weighing capability. In the past we have been limited by our use of an old microbalance in the Chemistry Department that has not been availability when we needed it. We were also unsure about its repeatability after being moved several times this year during our study. A new (floor model) Mettle-Toledo XP5 ultra-microbalance was purchased at the end of the fiscal year and will be installed in Skeen Hall to be used by faculty and students needing to weigh filters. Table 2-1 shows the specifications for this balance. This will be used to weigh our Teflon $PM_{2.5}$ filter samples for future sampling exercises.

Table 2-1. Microbalance specifications

Mettler-Toledo XP6 Max. Capacity: 6.1 g Readability: 1 µg Linearity: ±4 µg Minimum Weight (USP), typ.: 1.2 mg Repeatability: 0.8 µg (6 g) Settling Time: 7 s

Related to this we have started to collect a library of $PM_{2.5}$ filter samples with the AirMetrics MiniVol samplers at various locations at different times of the year for use in future studies. To store the filters we have purchased a small freezer to keep them in the laboratory before and after sampling. The freezer is capable of storing them in temperatures down to -14°F.

2.1 Micro and Satellite Sites

We continued to operate the project satellite sites in Lordsburg at the County Emergency Managers Office, Columbus at Martha's Bed and Breakfast, and at the Vado Water District pump house. Our plan is to keep operating these stations to collect base line meteorological data. We will be augmenting these meteorological stations with air quality instruments on an episodic basis.

Figure 2-1 shows the locations of the long-term core and satellite monitoring sites chosen to represent population exposure in the study region.

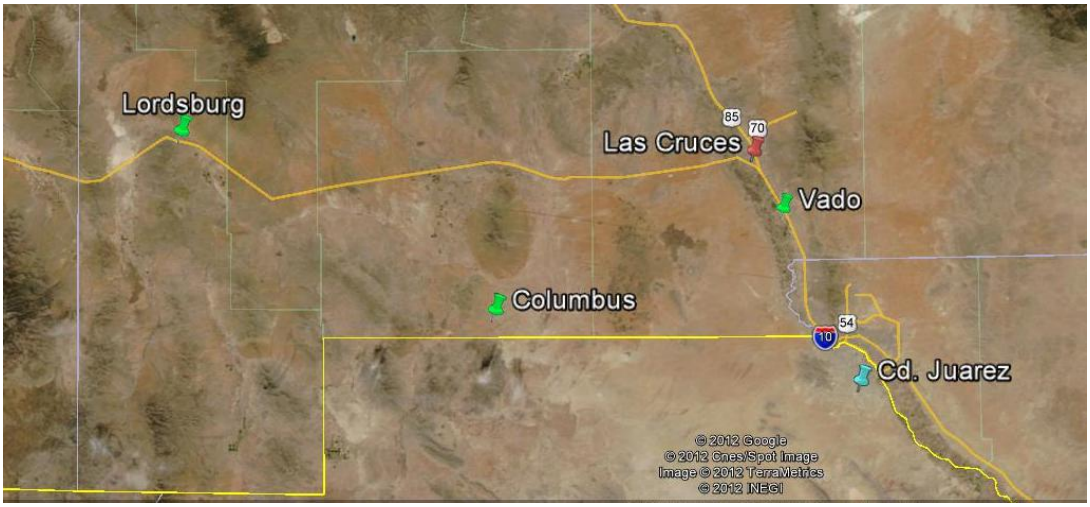


Figure 2-1. Map of the enhanced air quality monitoring network operating through FY12

As part of Study Ib from last year, ten micro and three satellite sites were identified as potential locations for new monitoring sites within the air quality/meteorological network.

Those sites are: Columbus, Deming, Hatch, La Union, Lordsburg, Rodeo, Sunland Park, and Vado in New Mexico and Cd. Juarez and Palomas in Mexico. Dr. Juan Pedro Margez has been operating the micro site in Cd. Juarez during the ozone season from May to September.

2.2 Plans for the Mobile Core Site

The plans for the "core" monitoring site in FY12 included continuation of measuring air quality at the current location. At its current location the mobile core site has been useful in providing hourly PM_{10} and $PM_{2.5}$ in the Las Cruces area where there are no continuous monitoring. At its current location it has been providing educational opportunities for students in training in air quality monitoring. It was used in the AGRO 450 "Introduction to Air Pollution" in the Fall semester of 2011 and in AGRO 620 "Instrumentation in Agronomy" in Spring semester of 2012.

3 Inventory of Landforms

The Study IIa report was delivered to NMOBH on September 30, 2011. No additional landform data sets were added in the last quarter. This effort provided us with a wealth of information that will be used as we investigate possible spatial models for wind erosion, suitable habitat for fungi, network assessment and design. A lot of the databases will also serve the purpose of basemap layers as we generate maps of the area. An important part of this study was acquiring census 2010 data. The population data for 58 population summaries was extracted at the county, census tract, census block group and census block level. As mentioned in the second quarterly report, we have added the Rangeland Ecological Assessment (REA) that provides some key information on land disturbance on the rangelands between populated areas.

4 Systematic Assessment of Climatological Phenomena

The Study IIb report was delivered to NMOBH on July 6, 2012. In this report we summarized the current state of knowledge of climate in the study region using data from the National Weather Service Cooperative observation network and the gridded PRISM Climatological geodatabase. Most of the study region is within climate division 8 or the southern desert climate division. Having all of the populated area in one climate division simplifies the analysis of climate. Topographic features play an important role in influencing wind patterns in the study region and is evident in the wind data collected. During the night we see downslope winds that blow gently from higher to lower terrain and a switch-over to upslope winds during the day as the ground surface heats.

We also reviewed the periodic nature of climate from the Atlantic Multi-decadal Oscillation that has a periodicity of about 50 to 60 years, to the Pacific Decadal Oscillation which has a 25 year period, and the shorter term El Niño Southern Oscillation (ENSO) that varies from 1 to 3 years. We discussed the impacts of ENSO on precipitation and temperature in the study region and found strong correlations that help us produce seasonal forecasts. A summary of the key indicators of drought was presented in this study. Another climate topic discussed was climate extremes including extreme precipitation events, floods, heat waves, and winter storms. While an exhaustive analysis was not part of this section, we did provide examples from the past and some statistics from the Cooperative network. An important topic in climate data analysis is the effect of the build environment on climate observations. This includes the urban heat island effect as well as the impacts of differing land use on wind patterns. Temporal trends in the daily temperature observations in the study region show both positive and negative slopes over time although most sites show positive slopes, meaning they are getting warmer over time. A conclusion found was that the built environment around the stations does not always contribute to the trend, showing an example of a station on a farm having the most positive slope of all the stations. Finally the study ended with a discussion about the data accessibility. We mentioned three different sources of data for the NWS Cooperative data.

5 Inventory and characterization of point and non-point sources

Study IIc was completed during this fiscal year and provided a summary of point, area and mobile, and biogenic air pollutant emissions. Examples of major point sources include power generation plant stacks and incinerators. Examples of area sources include residential wood combustion, agricultural tilling and controlled burns. Residential wood combustion is classified as an area source since it is usually estimated in urban areas with population as a surrogate for the emissions. These types can then be subdivided into their origin, either anthropogenic or biogenic and include: point source emissions, fugitive dust, wind-blown fugitive dust sources, biomass burning and mobile source emissions.

Various state and local government organizations are responsible for the collection of air pollution emission databases in the region. For example, the state of New Mexico Environment Department, TCEQ, and and the Arizona Department of Environmental Quality collect information to inventory PM_{10}, $PM_{2.5}$, NOx, CO, SO_2, VOC and NH_3 emissions from point, area, and mobile sources in their states. These inventories are collected in accordance with the Clean Air Act, state regulations and sent according to the EPA's Consolidated Emissions Reporting Rule (Federal Register, 2002). For the western US, the

Western Regional Air Partnership has summarized emissions that these agencies collect into a master database that can be used for air quality assessments and modeling. The latest emission inventory is housed at the WRAP Emissions Data Management System website, http://www.wrapedms.org/.

6 Assessment of Air Quality Based on Past and Ongoing Data

This report reviews what was accomplished in Study IId to assess the historical and ongoing data collect on air quality in the binational border region of southwestern NM, Northwestern Chihuahua, and West Texas. This report was divided into five sections.

The first section was devoted to an assessment of ozone and the effect wildfires have on concentrations in the region. In this study the annual trends and spatiotemporal patterns of 8-hr maximum O_3 concentrations in the Paso del Norte region were analyzed and their associations with fires were examined. O_3 measurements were retrieved from EPA's Air Quality System (AQS), while the times and locations of fires were acquired from USDA's MODIS fire detection module. Time series analysis of deseasonalized O_3 levels showed statistically significant declining trends for most of the sites located in populated areas and high correlation coefficients among each other due to reductions of NOx emissions. A 0.12 ppbv/yr increase of 8-hr O_3 concentration was computed for Chiricahua, a background site located in a Class I protected area, while moderate correlations with the urban sites were computed. The absolute 8-hr maximum O_3 concentrations were comparable in urban, rural and background sites. Strong relationships between the monthly 8-hr maximum O_3 concentrations and categorical variables representing the fire frequency for each month in six buffer zones were computed. Fires incidents near the sites (less than 250 miles) in central Arizona, central Texas and western Mexico triggered a decrease of 8-hr maximum O_3 concentration by 5 to 13 ppbv in urban and rural sites and an increase of 2 ppbv in Chiricahua due to the modifications of the VOC/NOx mixtures. Conversely, fire incidents in southeast US, Cuba and central Mexico contributed from 5 up to 19 ppbv due to mixing of aloft O_3 formed during transport. These findings indicated that regional fire incidents may trigger high O_3 episodes, possible NAAQS violations and an increased of hospitalizations from asthma and COPD by 1-3% annually.

The second section summarized historical PM_{10} and $PM_{2.5}$ in the study region. The pollutants of most concern in the region are ozone and particulate matter (PM_{10} and $PM_{2.5}$). Exceedances of the NAAQS for all three pollutants are routinely monitored in the PdN airshed. Exceedances of the PM_{10} NAAQS are monitored at all sites in the study region. Monitored concentrations of NO_2, SO_2, and lead are negligible and an in depth analysis of these pollutants is not included in the assessment.

The third section discussed the work that was done during the Palomas-Columbus air quality study. This study was to investigate the impacts of the cattle feedlot on ambient air quality in Palomas, Mexico. It turned out after starting the study that the cattle were no longer being sent to the Palomas cattle facility and we changed the scope of the project to accommodate the change in emission sources. We ended up changing the objectives to estimate the spatial and temporal distributions of PM_{10} concentrations, especially near fugitive dust sources and to estimate fugitive dust contributions based on existing PM_{10} emissions information.

The fourth section reviewed our work done to use satellite remote sensing to estimate population exposure to extreme dust events in the region. As of the end of FY12 we have identified 442 days during the period from April 2000 to May 2012 were there were dust events. Using the tools and method to extract plume outlines we are in the process of building the geodatabase of dust plume outlines from imagery acquired during those 442 days. We are also investigating other data sources that may provide clues on the extent of dust plumes based on the NWS Cooperative observation network. Some the observations go back to the 1890s and continue to the present. We also discussed some of the ongoing work in predicting dust episodes using the CHIMERE and DREAM model.

The final section briefly reviewed some of the chemical analysis that is ongoing to understand the sources of particulate matter in the region. This section shows some of the recent results that we have received through the analysis of PM_{10} and $PM_{2.5}$ filter samples from Sunland Park. We used a scanning electron microscope S-3400N Type II with Noran System Six 300 Nanotrace x-ray microanalysis system. This was done at the NMSU Microscopy Suite of the Core University Research Resources Laboratory. We began a microscopic analysis of a subset of the 47 mm PTFE Teflon filters of PM10 and PM2.5 aerosol collected at the Sunland Park City Yard site to observe individual particle morphologies and elemental composition. The vast majority of the particles in the 1 to 10 µm range are composed of geological materials such as Si, Ca, Fe, and Al.

7 Fungal spore dispersion from CAFOs

This report summarizes work during FY12 in Study IIe to investigate fungal species in the air and those that could be found in and around concentrated animal feeding operations. In this study we intend to characterize the bioaerosol particles from livestock feeding areas where numerous animals are present. This year we initiated our data collection in southern New Mexico to assess the fungal composition of bioaerosols at several locations including Columbus, Palomas (Mexico), Sunland Park, and Las Cruces. Additional locations were in

northwest El Paso, Texas and the area around Vado and Berino, NM. The objectives of this study are:

- Build a taxonomic database of bioaerosols in an near animal feeding operations within the Binational Border Region of Southwestern New Mexico, Northwestern Chihuahua and West Texas
- To acquire a database of environmental conditions in and around the study area that are relevant to studies of soil fungi

So far we have observed Fungal genera or species identified so far include

- Alternaria
- Aureobasidium
- Aspergillus niger
- Aspergillus fumigatus
- Clasdosporium
- Penicillium
- Rhizopus, and
- Stemphylium.

Of these fungal microorganisms, many have been reported to be associated with medical conditions. For example, Aureobasidium, a fungus with yeast-like growth known for its allergenic properties (asthma and hay fever), may become an opportunistic pathogenic microorganism associated with health issues such as pulmonary mycosis. Similarly, other fungal microorganisms such as Aspergillus niger and Aspergillus fumigatus are also associated with medical conditions including aspergillosis.

We have been collecting sample during thunderstorm as they have a tendency to loft dust from one location and carry it many miles from the source. During one of the samples during a thunderstorm, we measured the highest number of fungi in all the samples collected so far.

8 Pollen Measures and Dispersion

This report summarizes work during FY12 in Study IIf "Pollen Measures and Dispersion Studies." This is an ongoing study and this report only provides a work done in the first year. The first objective of this study is to investigate the sources of pollen measurements in the Las Cruces area if they are available. We have collected information on the relative pollen counts found in Las Cruces from a local allergist. The second objective is to investigate the use of alternate methods of pollen data collection. So far we have use a variant on the rotorod pollen collector but we are using microscope slides instead of rods. The third objective is to develop a protocol for pollen measurements. We have so far developed the sampling method and are working on the laboratory procedures. The final

objective is to develop a meteorological based pollen generation and dispersion model. So far we have investigated the use of the CALMET/CALPUFF and HYSPLIT Lagrangian models to simulate pollen transport and dispersion from various scales.

9 Air Quality Related Chronic and Infectious Diseases

This report summarizes work done in Study IIg "Distribution of air quality related chronic and infectious diseases" in FY12. This is an ongoing study and will be finalized in FY13. The following is the executive summary of the work done in FY12.

The border Counties are experiencing a steady growth with about 35% of population being below 18 or above 65 years old which puts a significant restrain on the available infrastructure and resources to maintain a basic level of services. There is significant variability on the population characteristics such as race/ethnicity, poverty/income and education level among the border Counties which is also a limiting factor in providing adequate services in the region. The indicators of most of these parameters are worse than the State's indicators.

A large fraction (more than 70%) of residents in the border Counties reported at least one behavioral risk factor (smoking, high blood pressure or cholesterol) for chronic diseases, with smoking being extremely high for adolescents. Behavioral risks did not demonstrate gender or race/ethnicity disparities. The impact of behavioral risks factors is diminished for families and individuals in the higher income brackets. Although more than 60% have health insurance, still about 10-20% did not seek medical care due to costs. The existing medical facilities and health professionals provide services to residents mostly living in urbanized communities; while those in rural areas have very limited access to health care. This pattern is clearly demonstrated by the comparison of health-related services and accessibility in Hidalgo County and Grant/Luna Counties.

The residents of border Counties are also exposed to environmental factors posing a significant risk on their health. Particulate matter and ozone are the primary risk factors in the region. In all communities, the levels of particulate matter are among the highest in the Nation, and exceed the threshold concentrations set by US EPA for the protection of human health. For ozone, threshold concentrations were exceeded in the past; current levels are slightly below the threshold value. Since, it is documented that there is no a safe threshold, below which health is not compromised by air pollution, air pollution remains a significant risk factor for respiratory and cardiovascular diseases.

The mortality rates in border Counties are decreasing since 1999 but they are higher than the State and national rates. African American females, White males and Hispanic males have the highest mortality. Cancer and heart diseases are the primary causes of death for

older adults (45+), while injuries are responsible for the mortality of younger adults. Chronic respiratory diseases are among the top six causes of death in the border Counties.

Mortality and hospitalization due to COPD and asthma are above the State's average. The hospitalization rates for COPD and asthma are increasing. The most significant increase was observed when COPD/asthma is listed as secondary diagnosis, meaning that COPD and asthma complication had an effect on the treatment or the length of the hospitalization. This indicates that COPD and asthmatic patients are more prone to hospital admissions. Younger adult females have higher rates than males of the same age.

One-third of hospitalized cases of coccidioidomycosis in New Mexico since 1999 were observed in border Counties; however, none of them died.

10 Prescriptive recommendations

This work is related to study IIId "Descriptive recommendations for reducing air quality contamination specific to causes, sources, and locations identified using Best Available Control Technologies (BACT) and Best Management Practices (BMPs)." Three plot sites were selected in the Las Cruces area; Coralles, Sonoma Ranch, and Diamond Springs #5. Each plot consisted of a total of 600 foot length plot and 100 foot in width broken down into twelve (12) 100ft x 50ft sections. Six treatments were selected with a buffer zone between each treatment. (Figure 10-1).

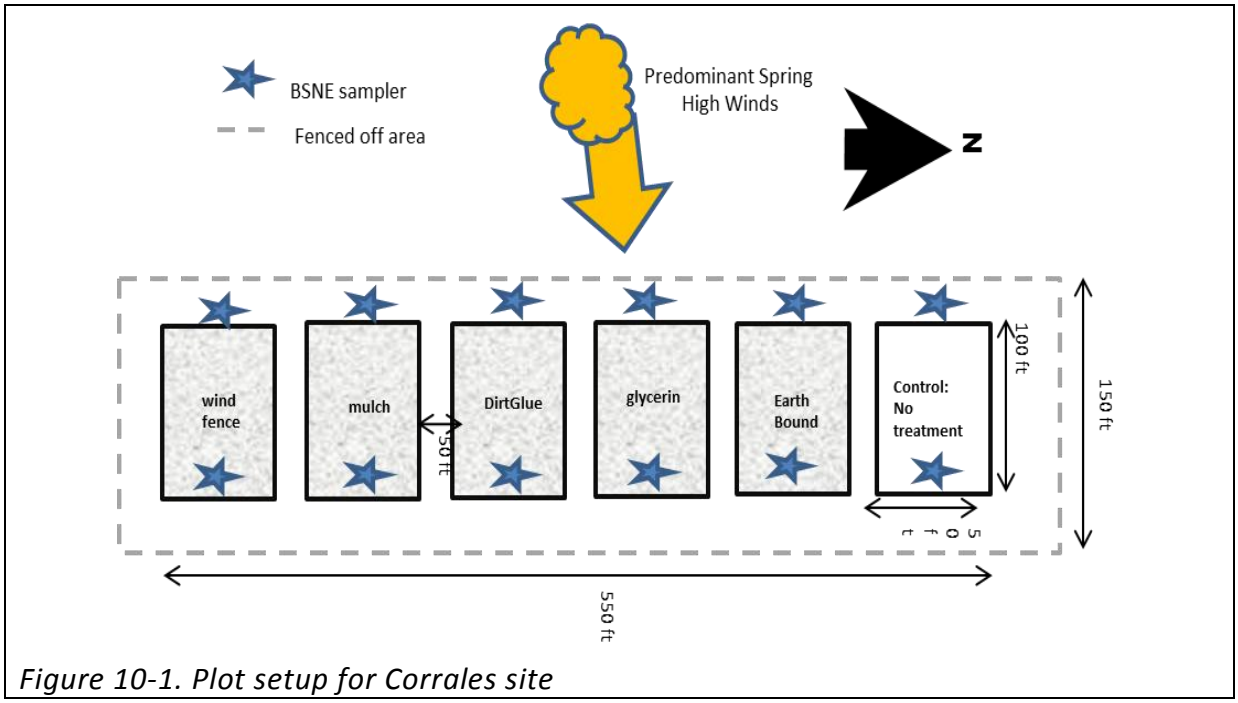


Figure 10-1. Plot setup for Corrales site

The treatments being tested are pecan mulch, wind barrier fence, chemical suppressants (Earth Bound, Dirt Glue), and natural glycerin.

Pecan mulch (harvest debris) was acquired from Stahmanns Farms, which is a local producer of pecan that is shipped around the globe. A Wind barrier fence is designed to slow the flow of air across the top few inches of ground. To prevent dune phenomenon a commercially available orange safety fence is being used at 4ft in height with 1x1 inch openings. If the initial fence is damaged by natural events it will be replaced and a double layer was used. If the fencing is damaged again, chicken wire fencing will be used to stabilize and strengthen the fencing.

Chemical suppressants being used is a polymer binder that is biodegradable through UV exposure. These will be broken down within a couple months and will give a good idea of effectiveness versus longevity. Chemical suppressants were applied using a water buffalo with a capacity of 500 gallons. Top Seal and Dirt glue are chemicals that are commercially available that provide temporary dust suppression through polymer binding and curing within and on top of the top soil profile. According to material provided, each compound has a life expectancy of 6 months to one year, where during the breakdown process the layers are scoured off by the wind and sand creeping and saltation.

The Glycerin compound that is being used has been supplied by Rio Valley Biofuels. The compound is recycled cooking oil, or mono-alkyl ester of fatty acids derived from vegetable oils and animal fats. According to the National Biodiesel Board, crude glycerol/ glycerin is biodegradable, nontoxic, and free of sulfur and aromatics.

The primary dust collection method will be using a Big Spring Number Eight (BSNE) sampler. The BSNE sampler is a wedge shape creating a partial vacuum system, using a screen top to form a low pressure system inside to prevent wind turbulence during a wind storm. The manufacture states that efficiency tests using fine sand less than 0.84mm diameter, and has a 90 percent collection efficiency which is not dependent on wind velocity. BSNEs were installed on stationary, non-rotating brackets, with the bottom of the 2x5cm opening of each box 50cm from the soil surface directly below the opening. BSNE stems were leveled when they were installed. Once particles are settled within the sampler, the dust can be collected and weighed using the dry weight method at the Jornada Research Facility on NMSU campus. Collection of samples will be performed after a high wind event where wind exceeded 25 miles per hour in the plot area or a period of one (1) month has elapsed with no significant wind event.

Statistical Analysis Software (SAS) will be used to perform the statistical analysis of effective dust suppression between each treatment method. Use inferential and descriptive statistics.

Site 1: Corrales - Current Status as of 6/27/2012

Sampled: 10 times

February:

Plots measures and plotted

21st- BSNEs installed, 12 units

April:

17th-Mulch and Fencing were applied;

23rd - Dirt Glue, Top Seal was applied

First application: 10:1 ratio

Second Application: 15:1 ratio

24th - Glycerin was applied

First application: 8.5:1 ratio

Second application: 15:1 ratio

25th- BSNEs installed- 4 additional units

8ft behind the fence

rotatable 3 tiered unit @ 10cm, 50cm, 100cm on center of the control site

May:

9th - a wind storm tore the initial fence down. This was replaced and a double layer was used.

9th – Checked CoCoRaHS rain gauge @ 9:30am = 0.40 inches of rain

10th – Check CoCoRaHS rain gauge @ 11:30 = 0.19 inches of rain

24th- PI-SWERL measurements done on Dirt Glue, Top Seal, Glycerin, and Control by the Desert Research Institute

Installed a Davis Vantage Pro Weather Station in a homeowners backyard

Site 2: Diamond Springs#5 - Current Status as of 6/27/2012

Sampled: 1 time

May:

23rd - Plots measures and plotted

24st-Experemental BSNEs installed, 9 units from The Desert Research Institute

rotate leveled units @ 10cm, 50cm, 100cm on center of the 3 plot sites

24th- PI-SWERL measurements done on all (6) untreated plots

June:

1st – BSNEs installed- 15 units

2 units per plot

1 rotatable 3 tiered unit on the designated control site, side along to the experimental BSNE from the DRI

Installed a Davis VantagePro Weather Station in a homeowners backyard

Site 3: Sonoma Ranch - Current Status as of 6/27/2012

Currently waiting on Site approval before site grading.

Data: Current Status as of 6/27/12: Data has been collected and looked at to notice problems occurring; however no statistical verification on the data is available at this time.

Please visit http://nmborderair.nmsu.edu/en/second-page/dust-control-study/ for pictures and updates.

11 Synergistic Efforts and Collaborations

The following list demonstrates efforts of synergism and collaboration with other research groups in our study.

- For Study IIId we continued to work with USDA Jornada Experimental Range/Agricultural Research Service staff on the dust control study and borrowed 36 BSNE samplers to be used at the demonstration sites.
- Borrowed three E-BAMs from NMED AQB for use in the Palomas-Columbus study
- Acquired from NMED AQB four high volume PM_{10} samplers for use in the study
- Borrowing two “enhanced BSNE” samplers from DRI for use at site #2. These samplers use real-time particle sensors to detect particles entering the BSNE containers. These instruments were built and designed as part of an NSF project for dust measurements.
- Our involvement with the Border 2012 Palomas-Columbus study was done in part from both project and funded by both programs in the Spring of 2012
- Completed installation of UNIDATA high capacity data storage server for use in archiving meteorological model output and satellite imagery for the public.

12 Public Information and Outreach

12.1 NM Smoke Coordination Work Group

The impacts of wildfire again became an important issue to health and again we made ourselves available to the public health community. Similar to last year we were invited to be part of the New Mexico Emergency Operations Center via conference calls. We worked in coordination with the NMED AQB, NM DOH, National Weather Service, USFS, and BLM on smoke and health advisories during the Whitewater-Baldy Complex fire. This year the group was lead by Josh Hall operating out of the US Forest Service and collaborating with the New Mexico Environment Department. We again supported this effort by using the NMDOH instrumentation to gauge air quality levels in our area. We also supported the smoke forecasts by generating daily trajectory forecasts from each fire to support health advisories in southwestern New Mexico.

12.1 Communication with the Media

Our project team has been contacted by the press regarding several topics related to the project. A few noteworthy interviews are shown below.

- Interviewed by KRWG TV on 10/19/11 (weather) and 10/25/11 (La Nina), 11/16/11 (freezes)
- KDBC, Channel 4 El Paso, May 10, 2012 on dust storms
- Interview by Las Cruces Sun News May 23 on smoke and dust storms
- Interview by Las Cruces Bulletin on dust control study
- Interview by Albuquerque Journal, June 22, 2012 on drought

12.2 Website Development

The NMSU SpARC team delivered a draft project website design to Dr. DuBois' team and was housed on a server in the NM Climate Center. The website was designed to be portable; after final content editing, it will be made available to other team members and the public. This prototype website was fully populated and includes all final project reports and deliverables, map products, geodatabases, and links to data sources and other sites of interest. Figure 12-1 shows the website home page. Installed and customized content management system to create and edit webpage content.

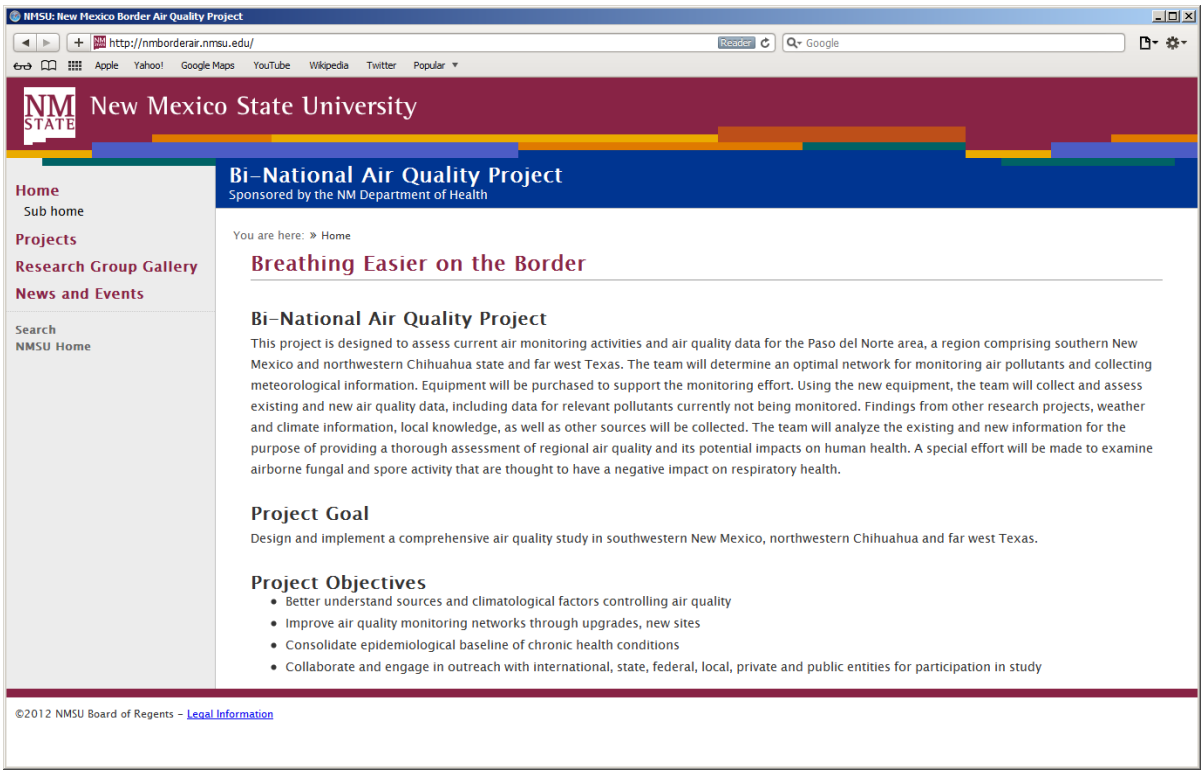


Figure 12-1. Public website in progress.

12.3 Border Air Quality Blog

Over the course of the FY12 we have generated 202 blog entries documenting conditions around the study area. As of June 30 the blog had 13,800 page views, with more than 1,000 during the month of June 2012. The most visits to the blog come from Google searches. Figure 12-2 shows the most frequent Google search results that have lead people to our project blog.

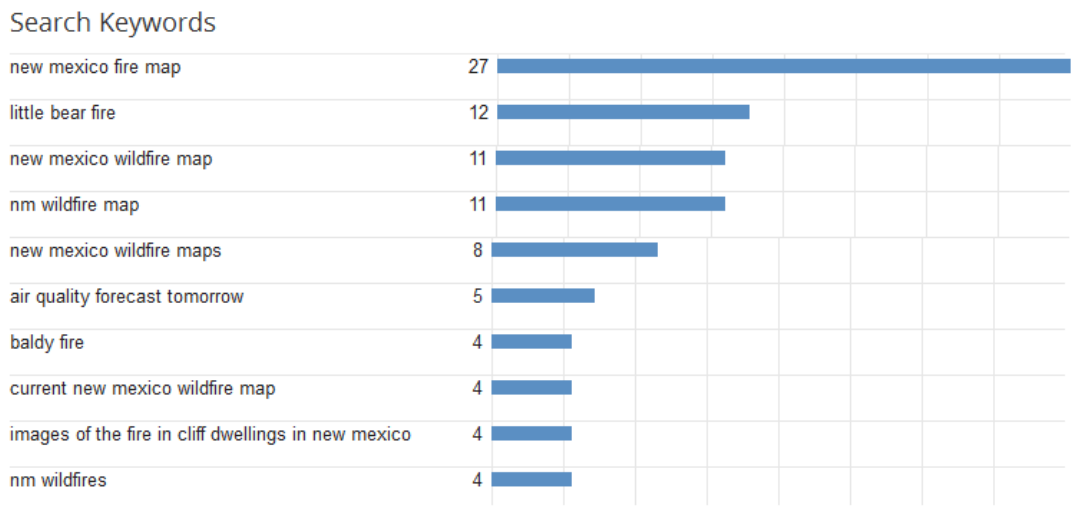


Figure 12-2. Google searches resulting in finding our project blog

The majority of the regular visitors to the blog come from the link provided on the NMED Air Quality Bureau smoke resources webpage, http://www.nmenv.state.nm.us/aqb/WildfireSmokeResources.htm. We also had a spike in the number of visits after a post to a pyrocumulus Yahoo Group (pyroCB) describing the smoke plumes from the fires.

12.1 Publications

A paper was published by Dr. Margez on the dust measurements of unpaved roads. Flores Márgez Juan Pedro, M.A. Ríos Ramirez, L.J. Moncada Hernandez, M.K. Shukla, D. DuBois, S. Sanogo, L. Liess (2012). Dispersion de Suelo al Aire en Areas Urbanas de Zonas Semi-Aridas del Norte de Mexico. XXXVI Congreso Nacional de la Ciencia del Suelo, 2011, 21 al 25 de Noviembre de 2011, San Francisco de Campeche, Campeche, México

A paper was submitted entitled "The effects of regional wildfires on ozone levels, asthma, and COPD hospitalizations" by Drs. Kavouras and Chalbot.

12.2 Social Media: Twitter

The project PI has been using Twitter to promote information, news, forecasts, and publications regarding air quality and climate this year. The @nmclimate account has submitted more than 200 tweets with more than 100 people following this account. Twitter is an interesting method of promoting information since the original post may be "re-tweeted" by a follower and picked up by one of their followers. This greatly multiplies the number of people that could receive the information.

12.3 Meetings

We held a Principal Investigator (PI) meeting at the beginning of the FY and one at the end of the FY with all investigators. Between these we had PI breakout meetings that dealt with the health study and one regarding the pollen and fungal dispersion study. Multiple meetings with the SPARC group were held to review tasks and create assignments.

12.4 Presentations

There were numerous presentations given either promoting the study or presenting one or more topics coved in the study. The following presentations were given in chronological order.

- Joint Advisory Committee meeting, El Paso, TX. October 27, 2011
- WERA-201 presentation on climate, air quality in NM in Davis, CA. Nov. 3-4, 2011
- EPA Rural Task Force meeting, Columbus, NM. December 7, 2011
- Valley Fever meeting, Tucson, AZ. January 12, 2012
- American Meteorological Society Annual meeting, New Orleans, LA. January 25, 2012
- Southwest Fire Ecology Conference, Santa Fe, NM. March 1, 2012
- Local American Meteorological Society meeting, Las Cruces, NM. March 8, 2012
- Climate Monitoring Workshop, EPSCoR, Las Cruces, NM. March 21, 2012
- WSMR safety meeting, WSMR Main Post. April 30, 2012

12.5 Outreach Material Development

We have drafted ideas for several educational videos that promotes important outcomes from the study so far. The following seven possible videos include:

VIDEO 1: Air Pollutants: Dirt, Dust, Mold

Intro; Large-scale examples (dust storms and weather conditions that contribute); Med-scale examples (construction, agriculture); Small-scale examples (housecleaning, gardening); when mold is a problem, Health risks (Valley Fever), As appropriate include weather conditions that sometimes contribute to the problem.

VIDEO 2: Air Pollutants: Smoke

Intro; Large-scale examples (wildfires and weather issues that contribute); Med-scale examples (controlled burns); Small-scale examples (fireplaces, barbeques); Health risks (info about lungs and people at risk, prolonged exposure and types of fuel burned), As appropriate include weather conditions (nighttime, cold air) that sometimes contribute to the problem. Also add terrain info.

VIDEO 3: Air Pollutants: Ozone, toxic gases

Intro; Large-scale examples (El Paso-); Med-scale examples (rush-hour traffic); Small-scale examples (household cleaners, pool chemicals); Health risks (more difficult to attribute), As appropriate include weather conditions that sometimes contribute to the problem (heat waves? Or Inversion?).

VIDEO 4: Air Pollutants: Pollen

Intro; Spring offenders is the borderland area (need list); Fall offenders (need list); Year-round offenders (need list); Health risks/effects (how to tell if you're having an allergic reaction), As appropriate include weather conditions that sometimes contribute to the problem (winds, spring/fall conditions).

VIDEO 5: What You Can Do

Intro; check AQI and show someone checking computer/ipad and on smart phone; Masks; change air filter in home; opening a window or turning on a fan to improve ventilation, etc.

VIDEO 6: How Air Quality is Measured

Intro; air quality mobile units; location map; checking measurements and what those measurements mean.

VIDEO7:Air Quality Research in the Borderland

Shots of researchers in action and maybe spotlight one or two key projects.

13 Challenges in the Development of the Project

We faced two primary challenges this year. The primary challenge during fiscal year 2012 was in the acquisition of health data from MMC. Project participants received permission to use the health data obtained at the Memorial Medical Center (MMC) and from Dr. Gaines office. We learned this Spring that Dr. Gaines had retired from his practice and new management had taken over. We are in the process of working with the new management to build a relationship with them. Regarding the MMC data, we continued to work closely with Dr. Bruce San Filippo in the request for the data and delivery. As of the end of FY12 we have not received the data from them. The approval is for a 3-year period from April 27, 2011 to April 26, 2014. As required by the committee we provided an annual update on the research progress to them this FY.

The other challenge in the project was in the collection of fungal samples from an active CAFO. We thought that we had it planned out with the Palomas facility but that did not work as planned. As a back-up plan, we are sampling on an episodic basis from a publically

accessible location the dairies between Vado and Berino, NM. This is not an ideal location but provides us with downwind samples of particles that very likely came from the cattle feedlot areas.

14 Conclusions and Next Steps

The next phase of the project will be to complete an assessment of what is causing air pollution through a source attribution analysis to determination likely pollutant sources. This will be done through modeling and geographic analyses. The modeling analysis may involve using the positive matrix factorization (PMF) model with the speciated aerosol data collected in earlier phases. The source attribution analysis will also involve the integration and analysis of emissions data and will use GIS to evaluate, quantify and analyze spatial variation in point and area source emissions. We will summarize data tables that were archived as part of the emissions data acquisition. The team will generate pollutant emission summaries for Toxic Release Inventory (TRI), National Emission Inventory (NEI) point and area, biogenic, and the Western Regional Air Partnership (WRAP) inventory as well as data from air quality monitoring stations, join these datasets to geographic locations, and use various spatial interpolation algorithms to generate surfaces. This may involve the investigation of an historical climate database from NWS COOP sites for haze, dust, and wind. In addition, SpARC will continue updating the monitoring stations shapefile (air quality and meteorology), to include changes in the COOP and CoCoRaHS networks. Dust plume data from Max Bleiweiss will be added to this comprehensive regional database, if available. A spatial and temporal subset of this database will be determined for modeling and analysis.

The last year of the study we will be focusing on promoting the results of the study to the public, practitioners, and other researchers working in the similar topics. Some of the ideas that we have discussed include:

- Public products such as a summary of data, maps, and graphics
- Showing how the information useful
- Produce films and 1-pagers
- We will also give presentations to groups focused on special topics. Some ideas for audiences include county commissioners and politicians
- We will target the media to get the information out including contact with local NPR and television stations.

Concluding the pollen dispersion study we will sketch out a plan for a possible early warning system that depends on seasonal pollen. For this we will use past data to estimate what is in the air and rely to the public the health hazards of pollen. Topics such as when is Aspirgillus in the air and is it harmful?

A result of this project will be in the area of remediation. We will provide a guide to what possible methods can be used and recommendations.

Most epidemiological studies which examine relationships between air pollution levels and human health need spatial and temporal variation. Effects of changes under different possible emission scenarios are also important in determining pollutant distributions and future air quality risks. Interpolated surfaces for selected emissions (possibly the Air Quality Index pollutants CO, NO_2, SO_2, O_3, PM) will be integrated with population data (classified to show density) and other socio-environmental data (e.g., Rangeland Ecological Assessment and land use) to create community profiles and risk prediction maps.

Study IIIb (AQ Modeling) and continuation of IId (AQ Assessment). Another major effort is scenario development for wind-generated dust using DUSTRAN (http://dustran.pnnl.gov/dustran.stm). DUSTRAN is a comprehensive dispersion modeling system, consisting of a dust-emissions module, a diagnostic meteorological model, and dispersion models. DUSTRAN was developed at Pacific Northwest National Laboratory. Through the process of data layering, the model domain, sources, and results--including the calculated wind vector field and plume contours--can be displayed with other spatial and geophysical data sources to aid in analyzing and interpreting the scenario. Model outputs include dust concentrations and deposition fields, which can then be analyzed using the health incidence data. DUSTRAN V1.0 works only with ArcGIS 9.2 and is not upwardly compatible with ArcGIS 10.x. DUSTRAN V2.0 Beta utilizes MapWindow GIS; this software is open-source and freely available for distribution. MapWindow GIS (Version 4.7) is included with the DUSTRAN V2.0 Beta installation.

Study IIIc – Health Correlation. Provide GIS analysis and mapping support for the health correlation study. This may also include the initial investigation of environmental variability in relation to coccidioidomycosis (valley fever), exploring climate and health, disease mapping, temporal and spatial variability. A study of this type in southern New Mexico can benefit from an integrative strategy which uses climate, surface variables, and disease-specific data in a spatially-explicit model. Data from the fungal-spore dispersion study (IIe) will provide value input to such a model. Support will be limited to availability of data and budget.

Investigate the use of North American Regional Climate Change Assessment Program (NARCCAP) data, which can be downloaded in NetCDF format and converted to raster format or feature class in ArcGIS using the multidimension tool. As with the NWS precipitation data, NARCCAP data has a time dimension, which the multidimension tool can display as timesteps.

Appendix A: Presentations given in FY12

Update on

Land-based Sources of Air Quality Contaminants in the Binational Border Region of Southwestern New Mexico, Northwestern Chihuahua and West Texas

Presented by
Dave DuBois
Project PI
NM State Climatologist
NMSU

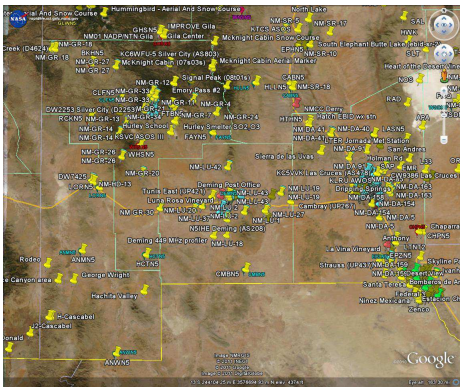
Presented at the Joint Advisory Committee meeting, October 27, 2011

Project Acknowledgements

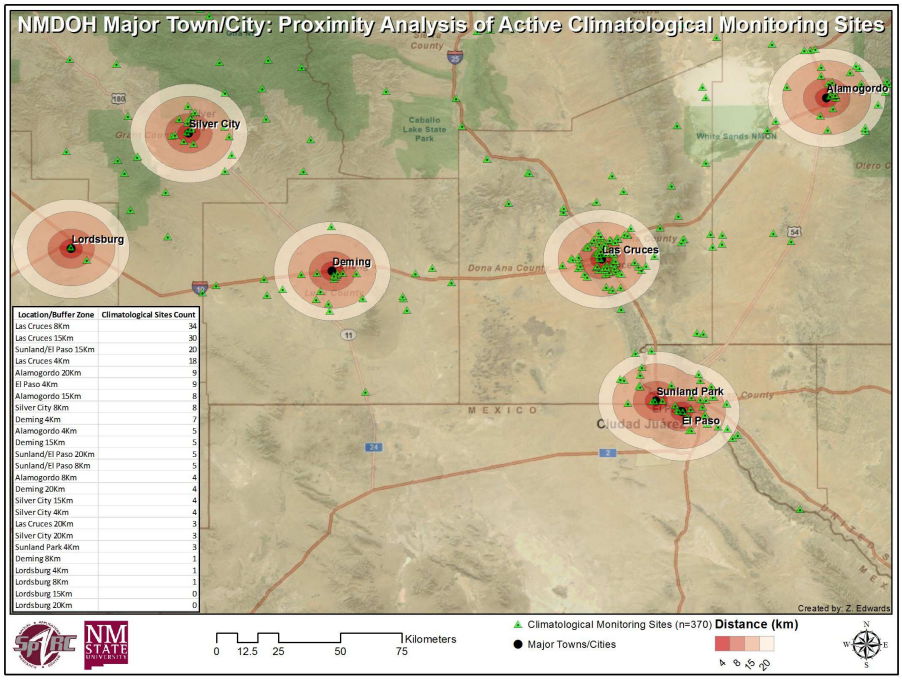
- Paul Dulin – NM DOH Project Manager
- Erin Ward - co-PI at NMSU
- Dr. Rosa Fitzgerald – principal at UTEP
- Drs. Juan Pedro Margez & Alfredo Granados – principals at UACJ
- Dr. Ilias Kavouras – principal at Univ. Arkansas
- Dr. Vic Etyemezian – principal at the Desert Research Institute

NM DOH Project Status

- We are in Year 3 out of 4 years
- Studies completed
  - Inventory of monitoring stations for climate and air quality
    - We're constantly updating this database as we find more stations
    - Quality of data and metadata is an issue

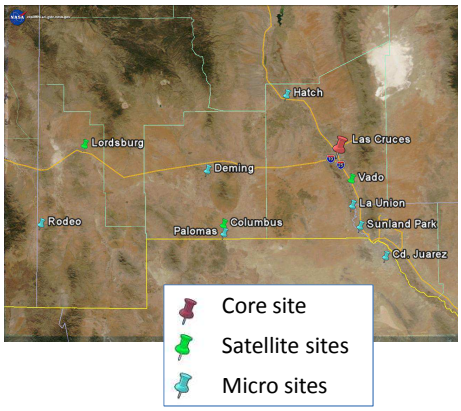


Add new sites, view in Google Earth and export to GIS geodatabase



Enhanced Monitoring Network

- Studies completed, FY11
  - Design of an optimal monitoring network



Columbus site, 1 of 3 "satellite" stations

Enhanced Monitoring Network

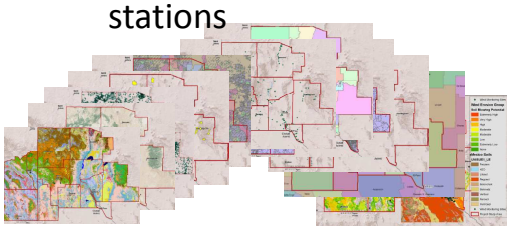
- Satellite sites for ozone and meteorology
- Test of micro-site started this summer

5-minute ozone using 2B instruments

Integrated aerosol samples on 47mm Teflon filters

NM DOH Project Status

- Studies completed this year
  - Inventory of landforms, soils, hydrology, vegetation, all types of land use
  - Created new landuse databases around satellite stations



Study IIa Final Technical Report:

Inventory of landforms, soils, hydrology, vegetation and all types of land use

for the

Assessment of Land-based Sources of Air Quality Contaminants in the Binational Border Region of Southwestern New Mexico, Northwestern Chihuahua and West Texas

September 30, 2011

Principal Investigators

Dave DuBois
Erin Ward

New Mexico State University
Las Cruces, NM 88003

Prepared for:

New Mexico Department of Health
Office of Border Health
1170 N. Solano Dr.
Las Cruces, NM 88001

Additional Contributors:

Raymond Carr Zach Edwards
Janet Greenlee

1

Studies in progress this year

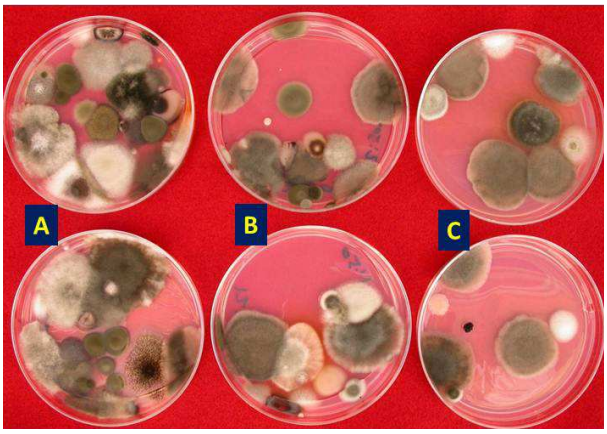
- Assessment of climatological & meteorological phenomena
- Inventory & characterization of sources of emissions
- Assessment of air quality from past and ongoing monitoring
- Studies of fungal spore dispersion from CAFOs
- Pollen measurements and dispersion study
- Distribution of air quality related chronic & infectious diseases

Distribution of air quality related chronic & infectious diseases

- Working with Univ. Arkansas Medical Sciences in the analysis of a 10-year health and allergy database
  - Allergy & Asthma Clinic of Southern New Mexico
  - Memorial Medical Center, Las Cruces
- Produce a regional health profile for air quality related chronic and infectious diseases

Analysis of fungal species and pollen

- Deposition and collection on rotorod samplers
- Lead by Dr. Soum Sanogo at NMSU

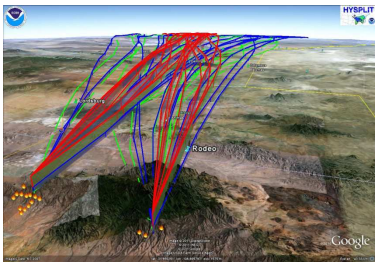


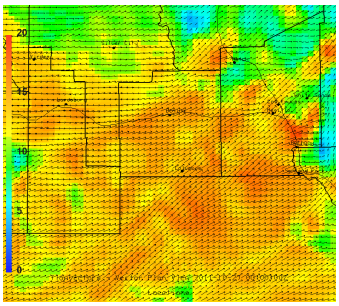
A: 10:50 am - 12:50 pm
B: 12:50 pm - 1:50 pm
C: 12:50 pm - 1:20 pm

genera
Fusarium,
Penicillium,
Aspergillus,
Alternaria,
Cladosporium, and
Aureobasidium

Dispersion of pollen and pollutants

- Running Weather Research and Forecasting (WRF) model at NMSU to generate wind fields for dispersion and trajectory models
- Experimenting with HYSPLIT and CALPUFF models for predictions



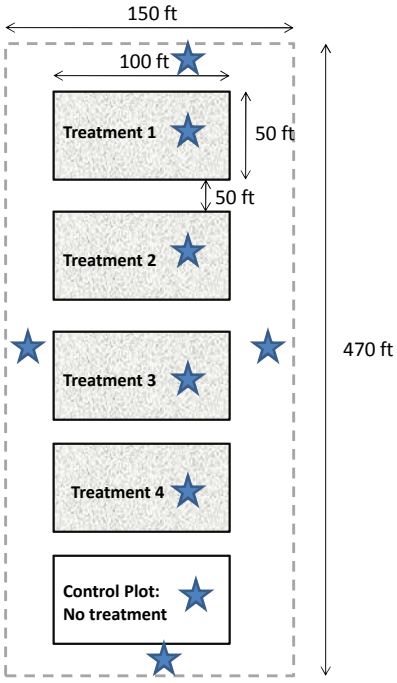


Dust Mitigation

- Assessment of dust control measures

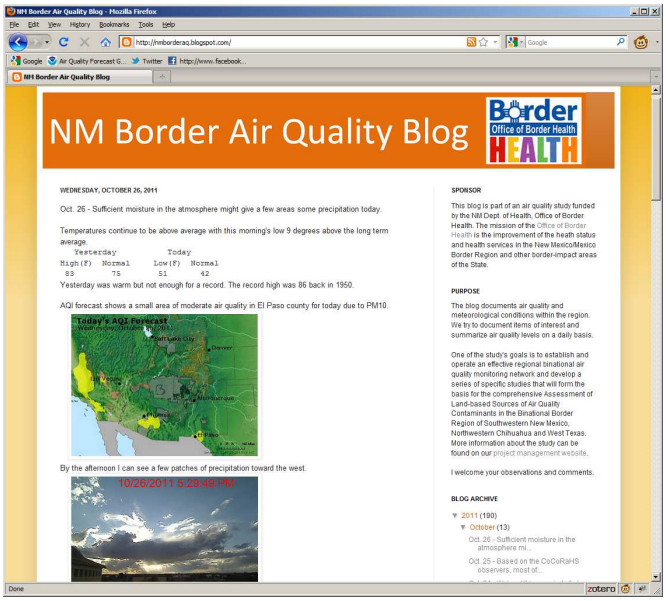
Treatments:
1. Wind fence
2. Glycerine surfactant
3. Dirtglue surfactant
4. Pecan mulch

Predominant Spring High Winds



BSNE sampler
Fenced off area

Public Outreach and Data Collection



Over 7,500 hits to blog since last year

Events that were classified in 2011 so far:

2 extreme (very cold, snow)

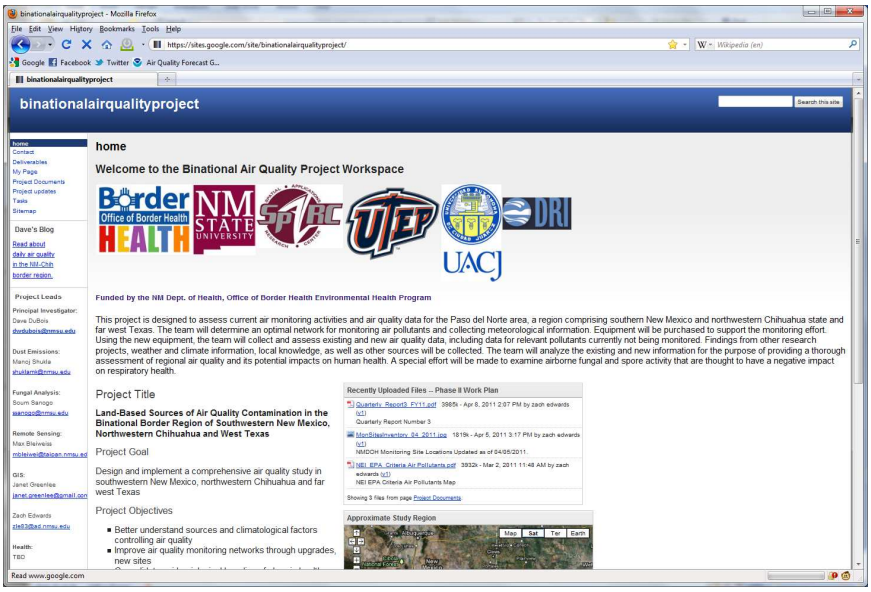
1 regional haze

28 low wind high particulate concentration events

12 high wind high particulate concentration events

13

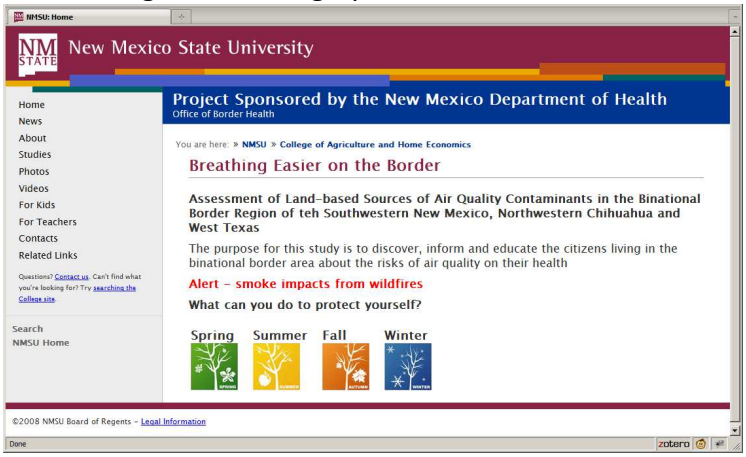
Project Website: Technical



14

Drafting Public Website

- Tie with NM DOH Environmental Public Health Tracking program
- Practical tips to help *reduce* exposure to air pollutants
- Educate using videos and graphics



Enhanced Monitoring

Land-based Sources of Air Quality Contaminants in the Binational Border Region of Southwestern New Mexico, Northwestern Chihuahua and West Texas

Presented by
Dave DuBois
NM State Climatologist
NMSU

Presented at the Border 2012 Rural Task Force Annual Meeting, December 7, 2011

Project Acknowledgements

- Paul Dulin – NM DOH Project Manager
- Erin Ward - co-PI at NMSU
- Dr. Rosa Fitzgerald – principal at UTEP
- Drs. Juan Pedro Margez & Alfredo Granados – principals at UACJ
- Dr. Ilias Kavouras – principal at Univ. Arkansas
- Dr. Vic Etyemezian – principal at the Desert Research Institute

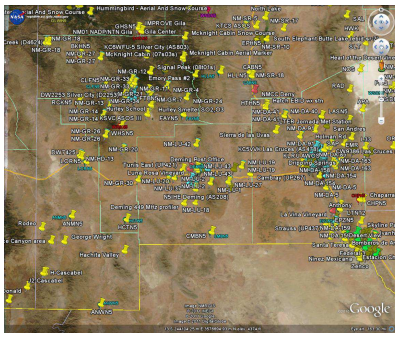
Monitoring Network Assessment

- Inventory of monitoring stations for climate and air quality

For health studies: Great need for long-term monitoring where people live

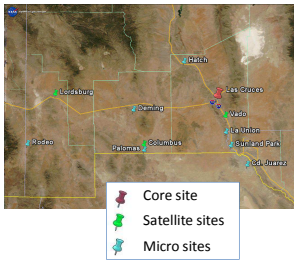
Includes climate and air quality monitoring

Includes federal , state, university, private sources



Enhanced Monitoring Network

- Satellite site network design
- Targeted for long-term operation



Columbus satellite site

Enhanced Monitoring Network

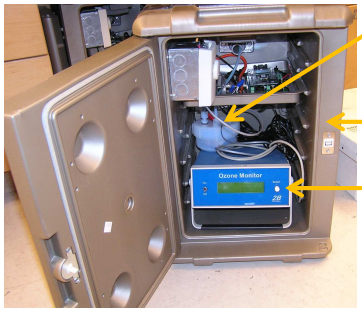
- Micro-sites fulfill short-term need
- Designed for surveys of new areas

ozone using 2B instruments

Temperature, RH

aerosol samples on Teflon filters

Portable Ozone Stations "µsite"



Solid state ozone sensor is being field tested

Inexpensive ($100) shelter to keep instrument cool

This instrument was recently classified as EPA Federal Equivalent Method

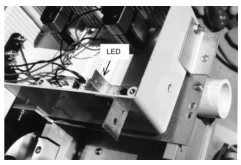
For Summer 2012

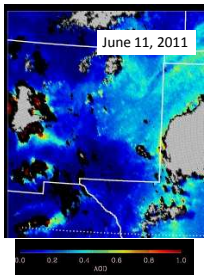
- Deploy at more sites across region
- Can add precipitation
  - HOBO® logger and tipping bucket
- Possible to add wind speed and direction
- Looking into inexpensive real-time particle samplers

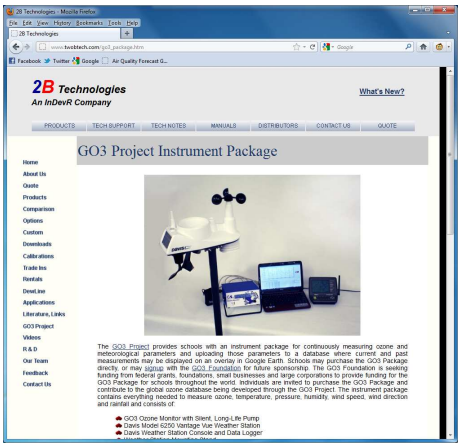
Dylos DC1100 particle counter
Two size ranges (small <0.5um, large >2.5um)
PC serial output
Battery powered
$290

Other Possibilities

DIY handheld sun photometer collects aerosol optical depth
$40 including digital voltmeter







Public Outreach and Data Collection

http://nmborderaq.blogspot.com/

Over 8,000 hits to blog since last year

Events that were classified in 2011 so far:

3 extreme (very cold, snow)

1 regional haze

28 low wind high particulate concentration events

12 high wind high particulate concentration events

Drafting Public Website

- Tie with NM DOH Environmental Public Health Tracking program
- Practical tips to help *reduce* exposure to air pollutants
- Educate using videos and graphics

Drought Webinar

Register at: www.southernclimate.org

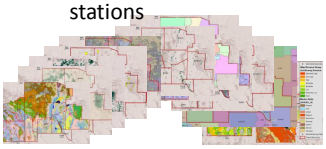
To register or for more information, contact:
Southern Climate Impacts Planning Program
http://www.southernclimate.org
405-325-2541 or scipp@mesonet.org

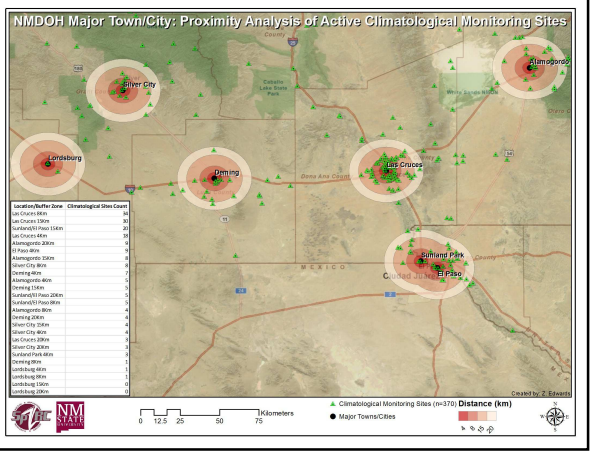
Webinar Topics:
- La Niña
- Cattle & Livestock
- U.S. Drought Monitor
- Ecological Impacts
- Assistance Programs
- Water Supply
- Ranch Drought Planning
- Wildfire
- Drought Ready Communities
- Agricultural Impacts

Archives on YouTube
http://www.youtube.com/user/SCIPP01

NM DOH Project Status

- Studies completed this year
  - Inventory of landforms, soils, hydrology, vegetation, all types of land use
  - Created new landuse databases around satellite stations





Studies in progress this year

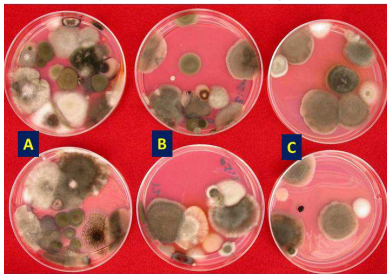
- Assessment of climatological & meteorological phenomena
- Inventory & characterization of sources of emissions
- Assessment of air quality from past and ongoing monitoring
- Studies of fungal spore dispersion from CAFOs
- Pollen measurements and dispersion study
- Distribution of air quality related chronic & infectious diseases

Distribution of air quality related chronic & infectious diseases

- Working with Univ. Arkansas Medical Sciences in the analysis of a 10-year health and allergy database
  - Allergy & Asthma Clinic of Southern New Mexico
  - Memorial Medical Center, Las Cruces
- Produce a regional health profile for air quality related chronic and infectious diseases

Analysis of fungal species and pollen

- Deposition and collection on rotorod samplers
- Lead by Dr. Soum Sanogo at NMSU

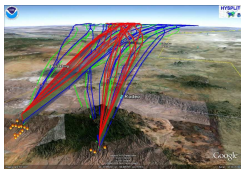


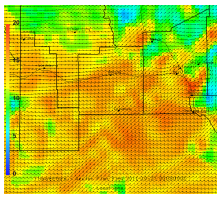
A: 10:50 am - 12:50 pm
B: 12:50 pm - 1:50 pm
C: 12:50 pm - 1:20 pm

genera Fusarium, Penicillium, Aspergillus, Alternaria, Cladosporium, and Aureobasidium

Dispersion of pollen and pollutants

- Running Weather Research and Forecasting (WRF) model at NMSU to generate wind fields for dispersion and trajectory models
- Experimenting with HYSPLIT and CALPUFF models for predictions





Dust Mitigation

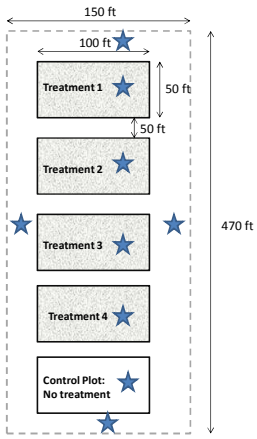
- Assessment of dust control measures

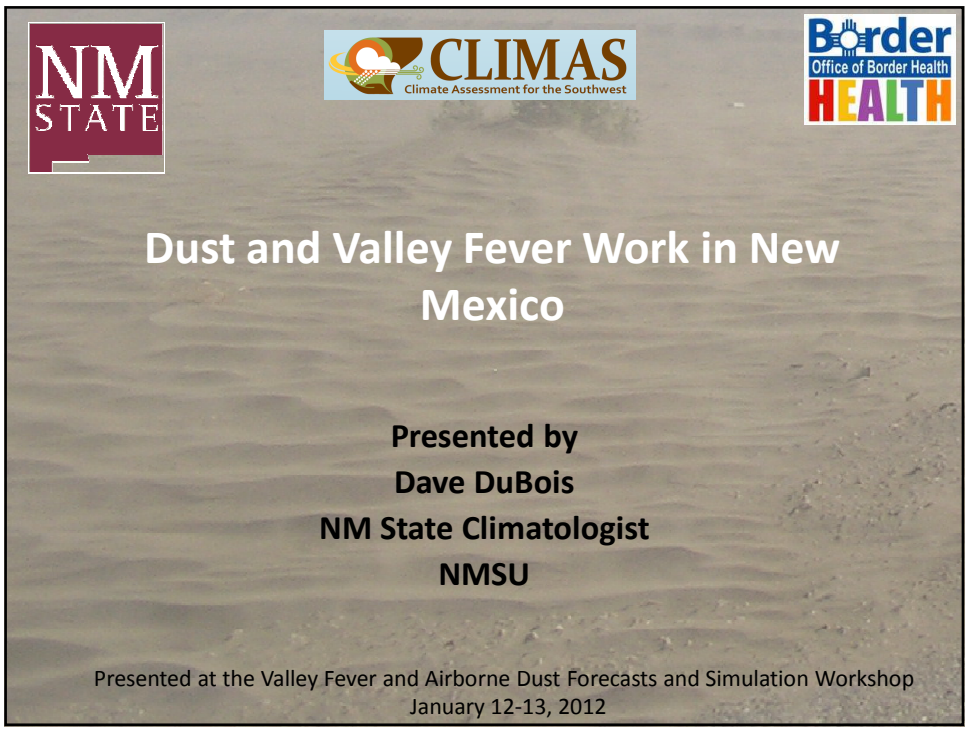
Treatments:
1. Wind fence
2. Glycerine surfactant
3. Dirtglue surfactant
4. Pecan mulch

Predominant Spring High Winds

BSNE sampler

Fenced off area





On-Going Dust Projects in New Mexico

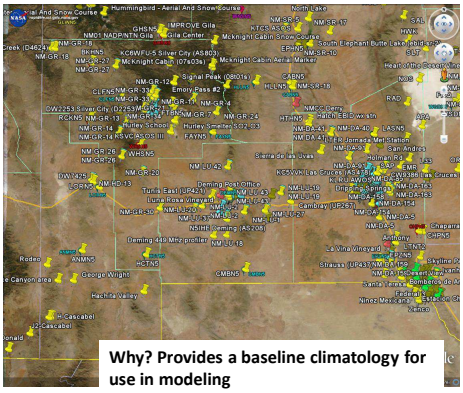
- NM Dept. of Health Air Quality Study
  - Series of interconnected studies
  - Comprehensive look at sources & monitoring
  - All pollutants including pollen, fungi
  - Study of 10-yr hospital admissions, allergy data
  - Provide recommendations and mitigation options
- Climate Assessment of the Southwest (CLIMAS)
  - Linkages between climate and air quality
- NM Env. Dept. Air Quality Bureau studies
  - Low wind NAAQS exceedances near Mexican border
  - High wind NAAQS exceedances in southern NM
- Urban Dust Control
  - City of Las Cruces test bed

NM DOH Project Acknowledgements

- Paul Dulin – NM DOH Project Manager
- Erin Ward - co-PI at NMSU
- Dr. Rosa Fitzgerald – principal at UTEP
- Drs. Juan Pedro Margez & Alfredo Granados – principals at UACJ
- Dr. Ilias Kavouras – principal at Univ. Arkansas
- Dr. Vic Etyemezian – principal at the Desert Research Institute

NM DOH Project Status

- We are in Year 3 out of 4 years
- Inventory of monitoring stations for climate and air quality
  - Continuous updates to database as we find/loose stations
  - Quality of data and metadata is an issue

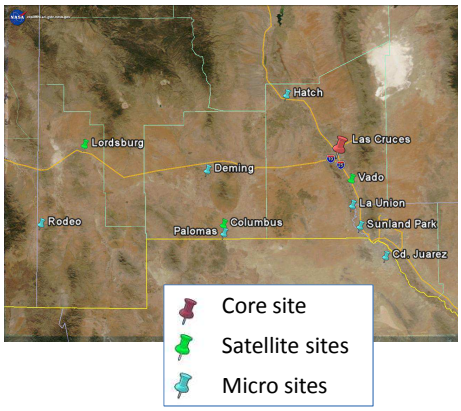


Why? Provides a baseline climatology for use in modeling

Add new sites, view in Google Earth and export to GIS geodatabase

Enhanced Monitoring Network

- Design of an optimal monitoring network
  - Fill-in holes in current network



Vado, NM site, 1 of 3 "satellite" stations

Enhanced Monitoring Network

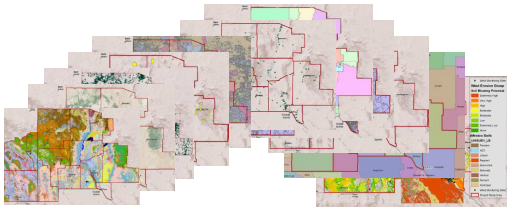
- Satellite sites for ozone and meteorology
- Test of micro-site started this summer

5-minute ozone using 2B instruments

Integrated aerosol samples on 47mm Teflon filters

NM DOH Project Status

- Studies completed this year
  - Inventory of landforms, soils, hydrology, vegetation, all types of land use
  - Created new landuse databases around satellite stations



Studies in progress this year

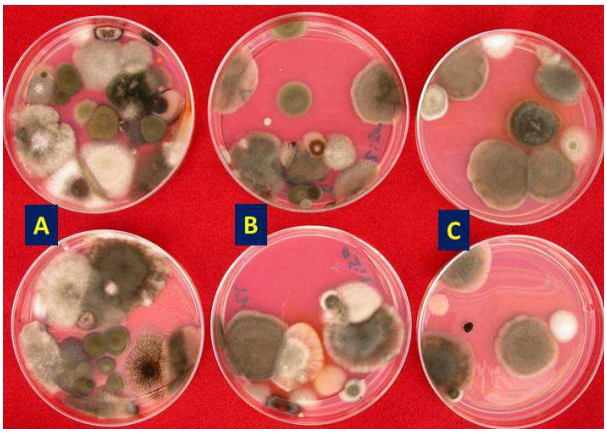
- Assessment of climatological & meteorological phenomena
- Inventory & characterization of sources of emissions
- Assessment of air quality from past and ongoing monitoring
- Studies of fungal spore dispersion from CAFOs
- Pollen measurements and dispersion study
- Distribution of air quality related chronic & infectious diseases

Distribution of air quality related chronic & infectious diseases

- Working with Univ. Arkansas Medical Sciences in the analysis of a 10-year health and allergy database
  - Allergy & Asthma Clinic of Southern New Mexico
  - Memorial Medical Center, Las Cruces
- Produce a regional health profile for air quality related chronic and infectious diseases

Analysis of fungal species and pollen

- Deposition and collection on rotorod samplers
- Lead by Dr. Soum Sanogo at NMSU

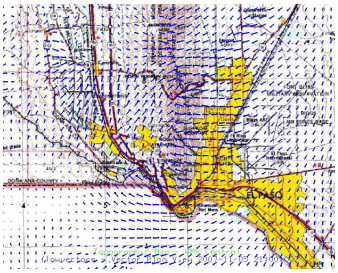


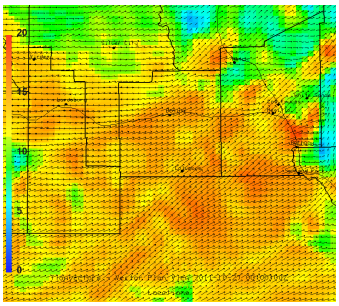
A: 10:50 am - 12:50 pm
B: 12:50 pm - 1:50 pm
C: 12:50 pm - 1:20 pm

genera
Fusarium,
Penicillium,
Aspergillus,
Alternaria,
Cladosporium, and
Aureobasidium

Dispersion of pollen and pollutants

- Running Weather Research and Forecasting (WRF) model at NMSU to generate wind fields for dispersion and trajectory models
- Experimenting with HYSPLIT and CALPUFF models for predictions

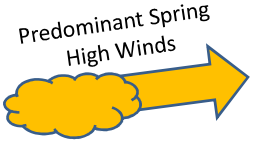


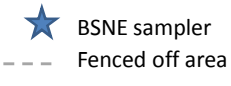


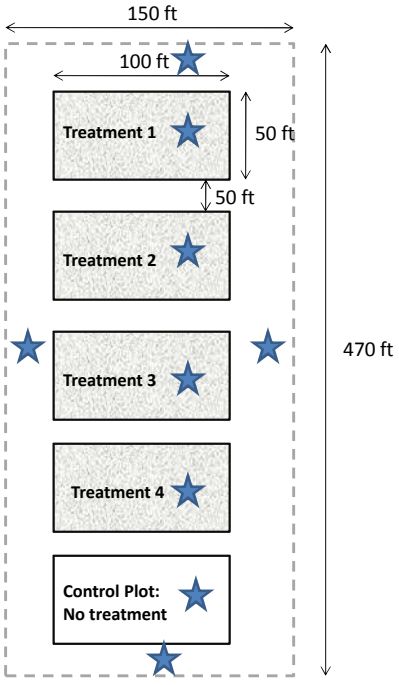
Dust Mitigation

- Assessment of dust control measures

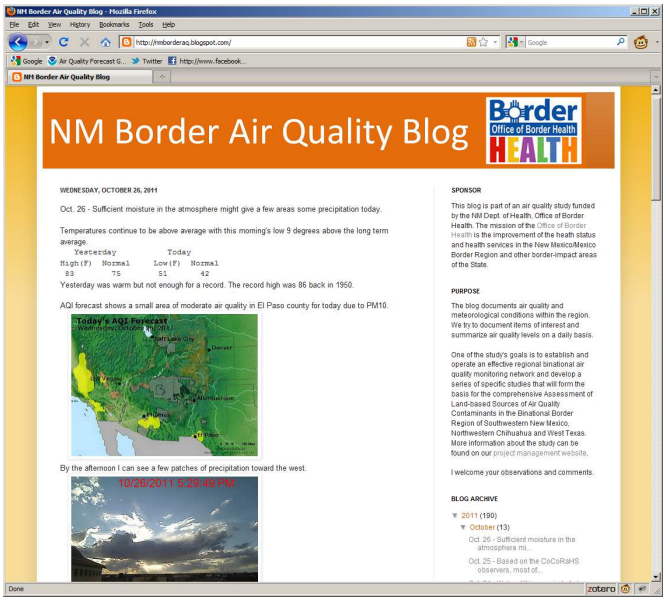
Treatments:
1. Wind fence
2. Glycerine surfactant
3. Dirtglue surfactant
4. Pecan mulch







Public Outreach and Data Collection



Nearly 9,000 hits to blog since last year

Events that were classified so far:

5 extreme (very cold, snow)

1 ozone episode

25 wildfire

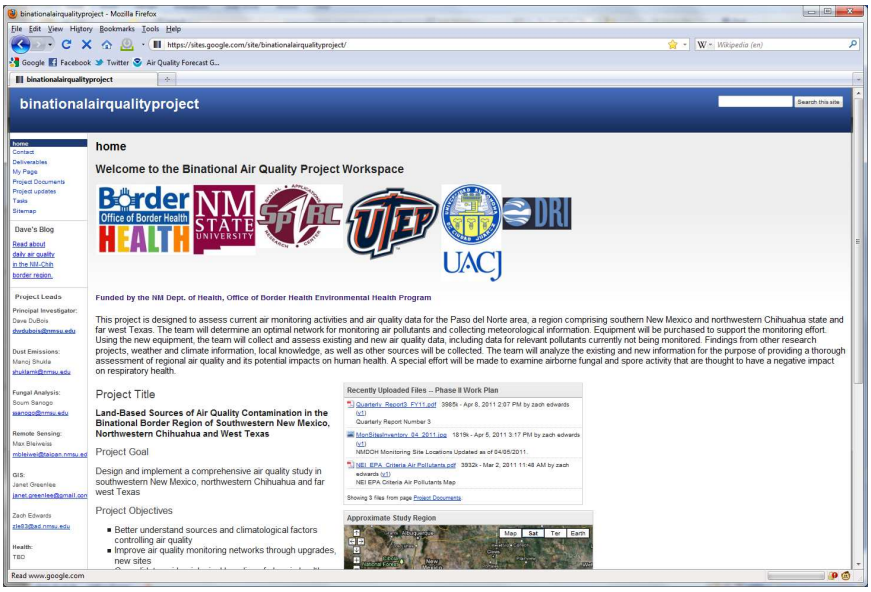
1 regional haze

40 low wind high particulate concentration events

27 high wind high dust events

13

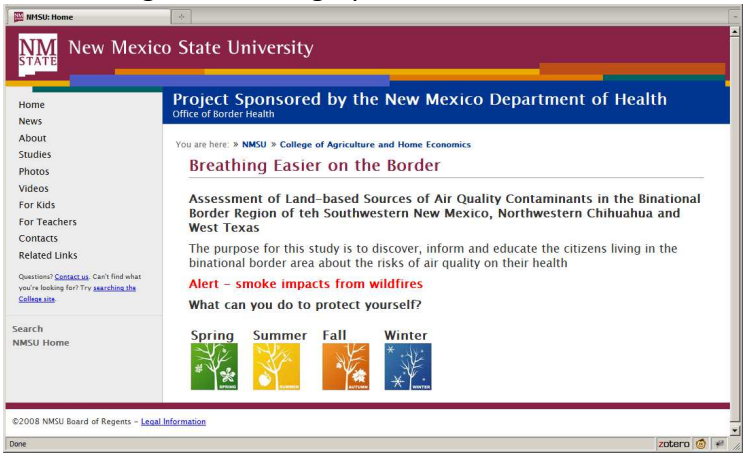
Project Website: Technical



14

Drafting Public Website

- Tie with NM DOH Environmental Public Health Tracking program
- Practical tips to help *reduce* exposure to air pollutants
- Educate using videos and graphics



IMPROVEMENT IN THE DIAGNOSIS, TREATMENT AND REPORTING OF COCCIDIOIDOMYCOSIS ("VALLEY FEVER") IN THE BORDER REGION

Katharine Perez-Lockett, BIDS/EWIDS Surveillance Officer

Paul Dulin, Director, Office of Border Health

Cocci in New Mexico

- What is the problem?
- Probability that cocci is underreported in New Mexico
  - Misdiagnosed (pneumonia, COPD, bronchitis, asthma, TB, lung cancer)
  - Ineffective treatments (often antibiotics)
  - Burden on healthcare (unnecessary costs)
  - Patient anxiety (what is wrong with them, why aren't they getting better?)

Rates of Valley Fever in New Mexico as compared to Arizona and California

Year of Reporting	Arizona	California	New Mexico
2008	4768	2391	38
2009	10,233	2459	49
2010	11, 888	4508	55

New Mexico Department of Health Cocci Initiative

- Education and awareness campaign for clinical providers in New Mexico
  - Statewide KAP survey of NM licensed clinicians
  - CME training in Las Cruces, May 2010, 65 attendees
  - Distribution of educational material from Valley Fever Center of Excellence
- Public education and awareness campaign
  - Billboards (in conjunction with TB)
  - Documentary
  - Educational material in provider offices
- Increase testing and diagnosis
- Increase reporting
- *Will we see increased numbers of cases?*

Survey of New Mexico Clinicians' Knowledge of Valley Fever

Based on 425 respondents of 3000 clinicians (or 14%)

- 66% do not feel confident in their ability to diagnose Valley Fever in a patient
- 64% do not feel confident in their ability to treat the disease
- 44% do not know if Valley Fever is a reportable disease
- Only 4% have received targeted education on the disease

Survey of New Mexico Clinicians' Knowledge of Valley Fever

- Only 31% consider Valley Fever when they have a patient with symptoms of severe respiratory disease
- Of those respondents who consider Valley Fever in their diagnosis, only 37% have ordered at least one diagnostic test to rule it out
- 91% did not manage a patient with Valley Fever in the last 12 months

Binational "Four Corners" Valley Fever Initiative: New Mexico-Chihuahua-Arizona-Sonora

- Signed agreements between Health Secretaries and Governors of all four states to work together
- Spanish translation of training modules for clinicians
- Training to develop capacity of laboratories
- Spanish-language media for improving awareness among the general public
- Improved epidemiology & reporting (surveillance)

Cocci in Mexico?

- Northern Mexico is within the endemic area
- No surveillance systems exist for cocci, scarce reports, not considered a notifiable disease
- Laboratory capacity is not developed in Mexican public health laboratories
- Symptoms and clinical features indistinguishable from TB
- As it is in New Mexico and Texas, the tendency exists in Mexico for under- and misdiagnosis

Binational "Four Corners" Initiative: New Mexico-Chihuahua-Arizona-Sonora

- Signed agreements between Health Secretaries and Governors of all four states
- Spanish translation of training modules for clinicians
- Spanish-language media for improving awareness among the general public
- Lab & Epi personnel exchanges
- Improving analytic capacity for labs for confirming cocci
- Improved epidemiology & reporting (surveillance)

Linkage with the Office of Border Health/NMSU Consortium Binational Air Quality Assessment

- Determination origins of dust and contaminant discharge/dispersal
- Determine linkages of climate, meteorological conditions and climate change to contaminants
- Correlate air quality and metrological phenomena with health conditions

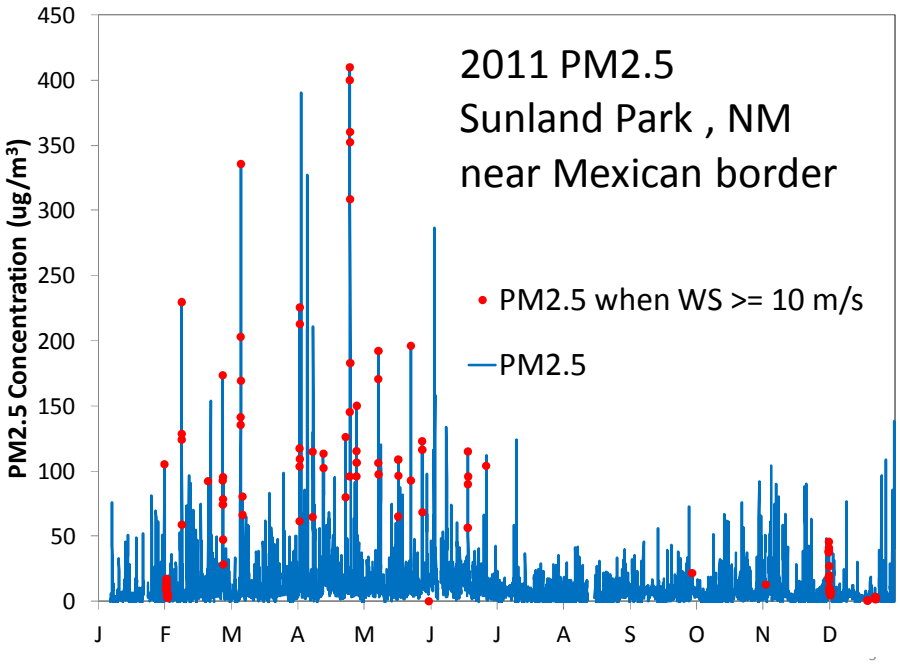
Dust Plume Identification for Human Exposure of Regional Dust Events Using Remote Sensing

Dave DuBois and Max Bleiweiss
New Mexico State University
Las Cruces, NM

Presented at the Third Symposium on Environment and Health
During the 92nd American Meteorological Society Annual Meeting

January 25, 2012

Motivation



Cocci in New Mexico

- Expected that Coccidioidomycosis (Valley Fever) is underreported in New Mexico
  - Misdiagnosed (pneumonia, COPD, bronchitis, asthma, TB, lung cancer)
  - Ineffective treatments (often antibiotics)

Coccidioides endemic zone

Fisher et al. 2007

- Education and awareness campaign for clinical providers in New Mexico and public
  - Increase testing and diagnosis
  - Increase reporting

4

Rates of Valley Fever in New Mexico as compared to Arizona and California

Year of Reporting	Arizona	California	New Mexico
2008	4768	2391	38
2009	10,233	2459	49
2010	11, 888	4508	55

5

Survey of New Mexico Clinicians' Knowledge of Valley Fever (2010)

Based on 425 respondents of 3000 clinicians (or 14%)

- 66% do not feel confident in their ability to diagnose Valley Fever in a patient
- 64% do not feel confident in their ability to treat the disease
- 44% do not know if Valley Fever is a reportable disease
- Only 4% have received targeted education on the disease

Project Goals & Objectives

- Land-based Sources of Air Quality Contaminants in the Binational Border Region of Southwestern New Mexico, Northwestern Chihuahua and West Texas
- Objectives
  - Better understand sources and climatological factors controlling air quality
  - Improve air quality monitoring network through upgrades, new sites
  - Consolidated epidemiological baseline of chronic health conditions
  - Collaboration and outreach to international, state, federal, local, private and public entities for participation in study

7

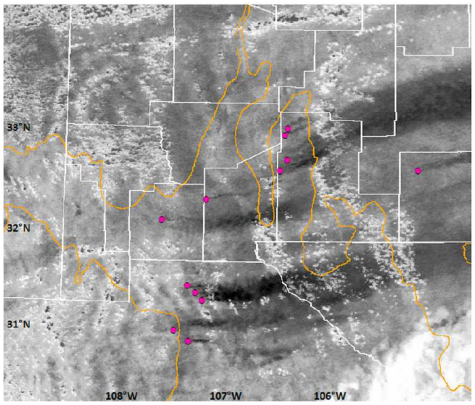
Management Team

- NM Dept. of Health/Office of Border health Program Mgr: Paul Dulin
- NMSU: Dr. Dave DuBois & Erin Ward
- Univ. TX El Paso: Dr. Rosa Fitzgerald
- Desert Research Institute: Drs. Ricky Tropp/Vic Etyemezian
- Univ. Arkansas Medical Sci.: Dr. Ilias Kavouras
- Univ. Ciudad Juarez: Drs. Juan Flores Margez & Alfredo Granados-Olivas

8

Inventory of Dust Sources

- Collect and evaluate past work



From Rivera Rivera et al. (2010) Atmospheric Environment

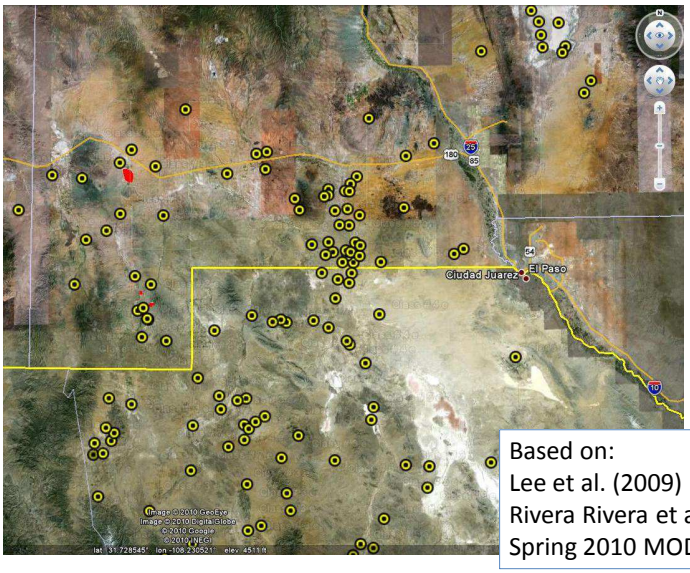
Investigated all available work on locating dust sources in the region.

Update and compare with sources during the study with enhanced monitoring and new sites

Estimate dust exposure at populated areas and assess the need for modifying existing monitoring network

9

Mapping Wind Blown Dust Sources



Based on:
Lee et al. (2009)
Rivera Rivera et al. (2010)
Spring 2010 MODIS

Dust Plume Identification

- 1-km MODIS thermal band brightness temperature difference image (band 32-band 31)
- Even though the spatial detail is not as fine as 250m color imagery, one can still discern the dust plume extent (white/grayish white) as opposed to the “weather” clouds (darker gray to black)
- determination of source locations (along with the true color images) and plume extent analysis
- As most dust events do not begin until the afternoon, mostly Aqua MODIS data were processed

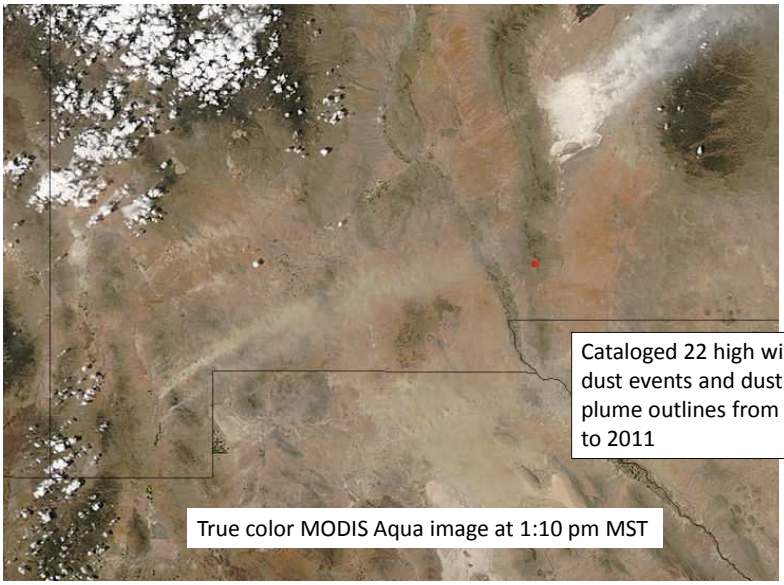
11

Data Processing

1. Subset the MODIS Level 1B image to the region of interest
2. Contour at a level of about 0.5 for the BTD images to isolate the dust event
3. Export the contours to a ENVI vector file
4. Export the evf to a shapefile
5. Save the picture of the BTD image overlaid with the state vector files as well as the contour as a jpeg file
6. For some events, save the picture with a different enhancement for the BTD image to enhance the plume structure
7. Intersect plume polygon with census data

12

April 29, 2010 Dust Episode

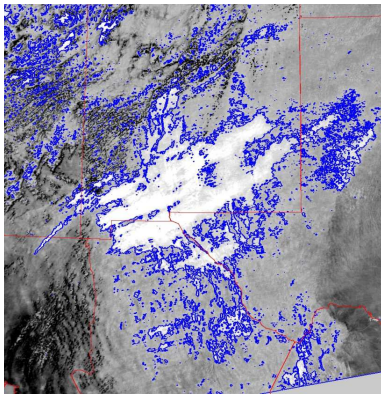


Cataloged 22 high wind dust events and dust plume outlines from 2009 to 2011

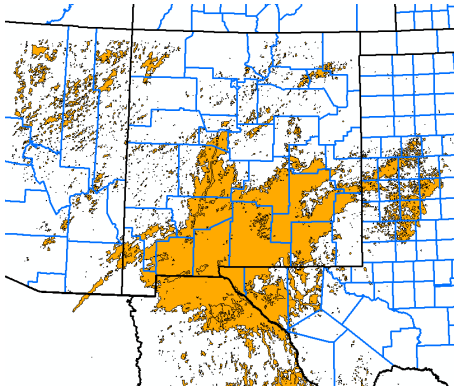
True color MODIS Aqua image at 1:10 pm MST

April 29, 2010 (day 119)

Export BTD image threshold from ENVI



Polygon outlines from Arcinfo

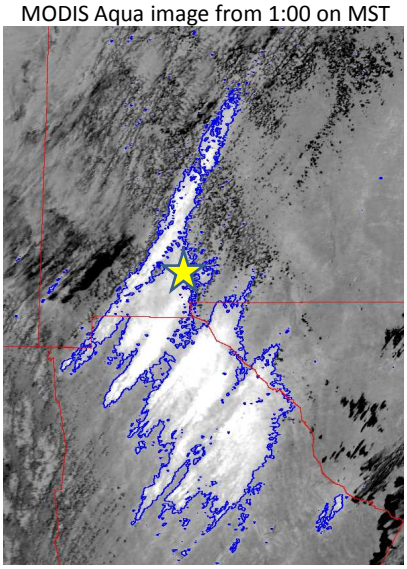


Within NM approximately 634,000 were within the dust plumes on this day

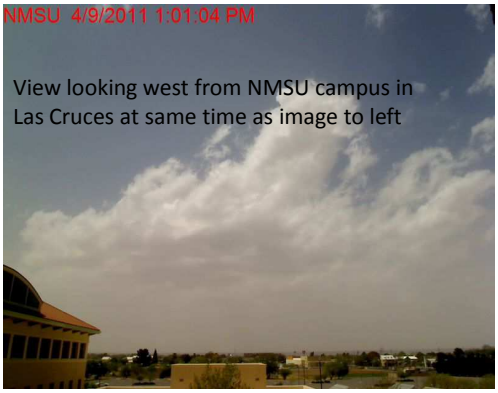
14

April 9, 2011, 20:00 UTC (day 99)

MODIS Aqua image from 1:00 on MST



Classic dust storm with cold front approaching from west; Winds 35 to 45 mph with gusts to 60 mph

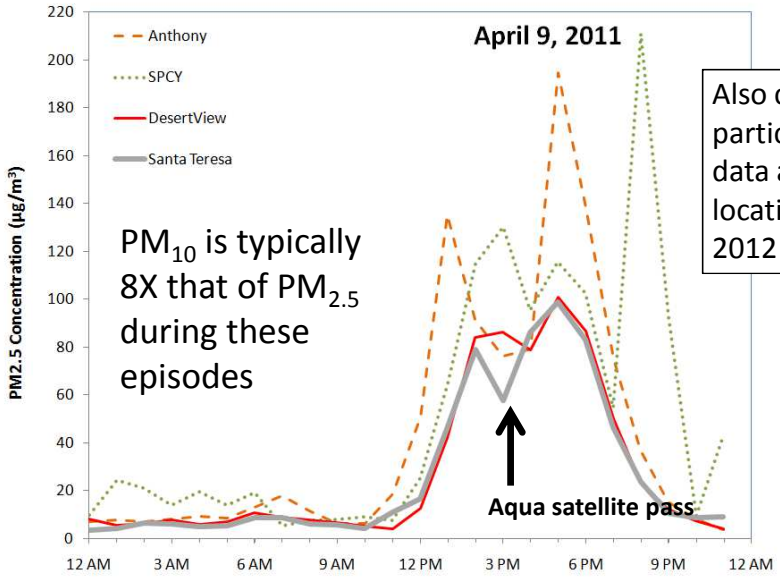


View looking west from NMSU campus in Las Cruces at same time as image to left

Within NM approximately 170,000 were within the dust plumes on this day

15

Classic southern NM $PM_{2.5}$ Impact



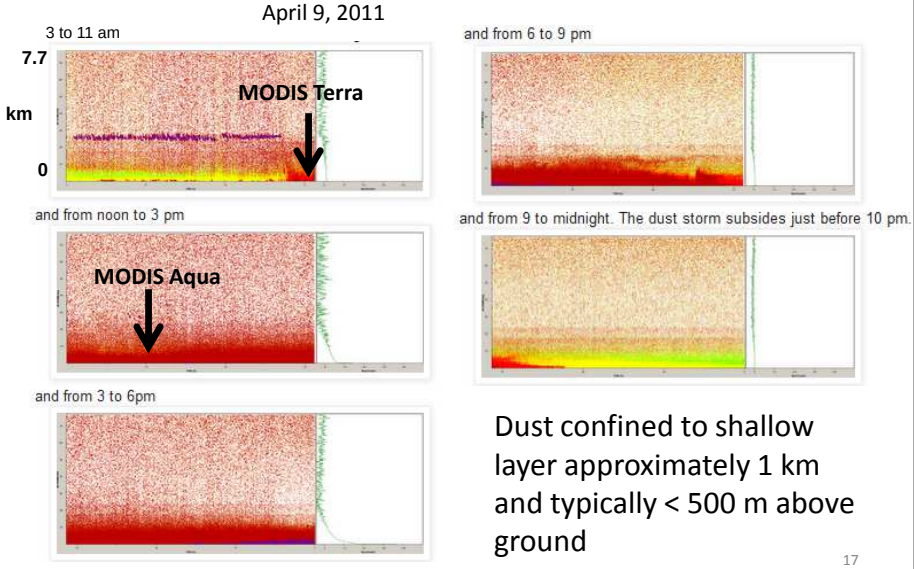
PM_{10} is typically 8X that of $PM_{2.5}$ during these episodes

Also collecting particle size data at three locations in 2012

16

Las Cruces Ceilometer during event

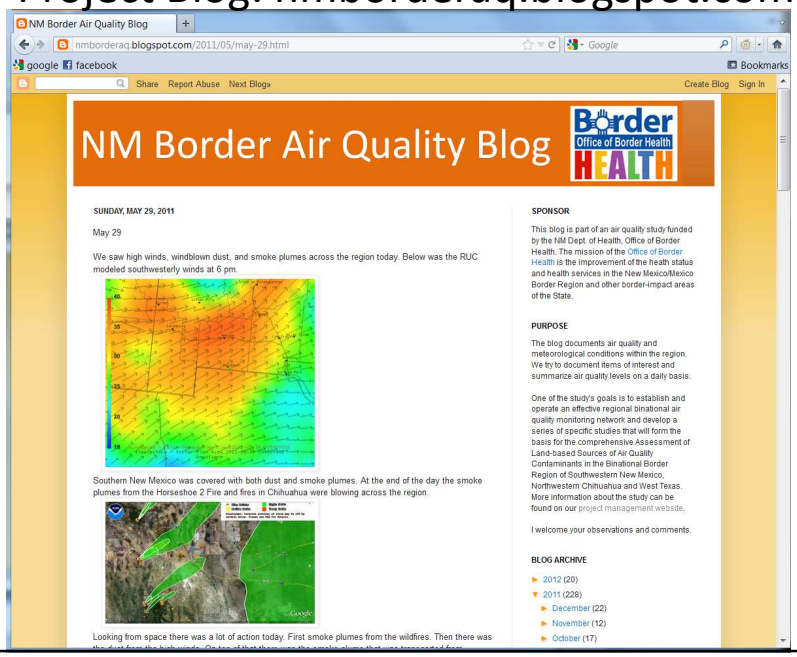
April 9, 2011



Dust confined to shallow layer approximately 1 km and typically < 500 m above ground

17

Project Blog: nmborderaq.blogspot.com



18

Current Plan

- Continue to map and collect data in 2012 and 2013 & update population exposure with 2010 census data
- Serve imagery and data on UNIDATA THREDDS server and events on RAMADDA
- Continue analysis of hospital admissions and allergy database
- Collaborate with others in modeling, sampling, and health data analysis

19

Dust Plume Identification for Human Exposure of Regional Dust Events Using Remote Sensing

Dave DuBois and Max Bleiweiss
New Mexico State University
Las Cruces, NM

Presented at the WSMR Safety Stand-down Meeting
April 30, 2012

Motivation

Project Goals & Objectives

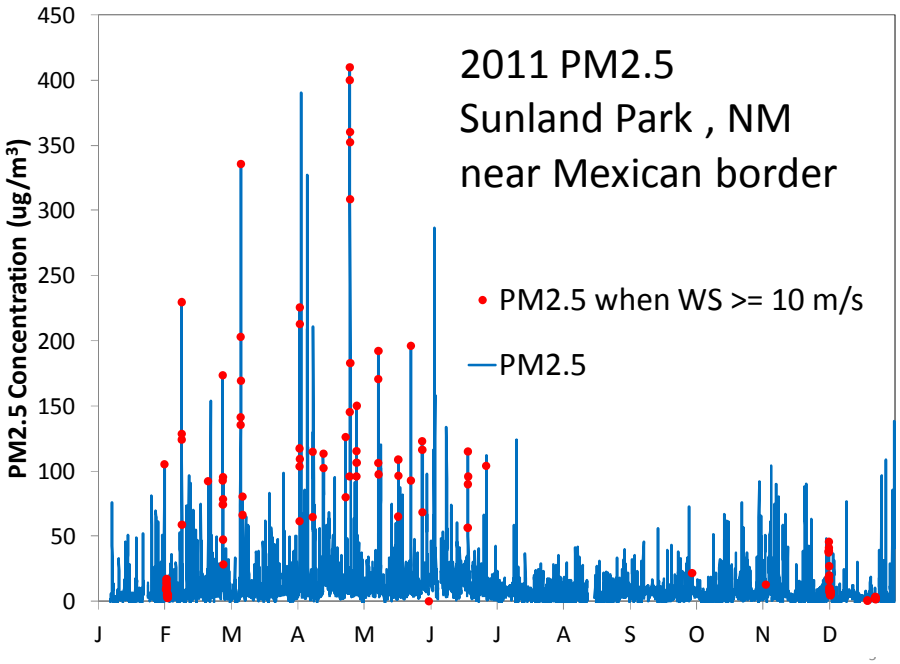
- Land-based Sources of Air Quality Contaminants in the Binational Border Region of Southwestern New Mexico, Northwestern Chihuahua and West Texas
- Objectives
  - Better understand sources and climatological factors controlling air quality
  - Improve air quality monitoring network through upgrades, new sites
  - Consolidated epidemiological baseline of chronic health conditions
  - Collaboration and outreach to international, state, federal, local, private and public entities for participation in study

3

Management Team

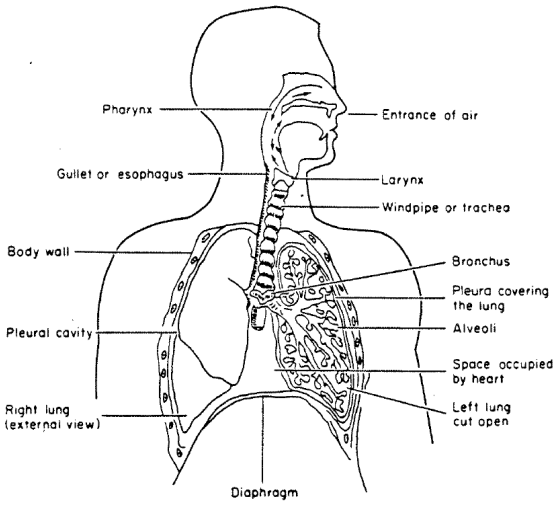
- NM Dept. of Health/Office of Border health Program Mgr: Paul Dulin
- NMSU: Dr. Dave DuBois & Erin Ward
- Univ. TX El Paso: Dr. Rosa Fitzgerald
- Desert Research Institute: Drs. Ricky Tropp/Vic Etyemezian
- Univ. Arkansas Medical Sci.: Dr. Ilias Kavouras
- Univ. Ciudad Juarez: Drs. Juan Flores Margez & Alfredo Granados-Olivas

4



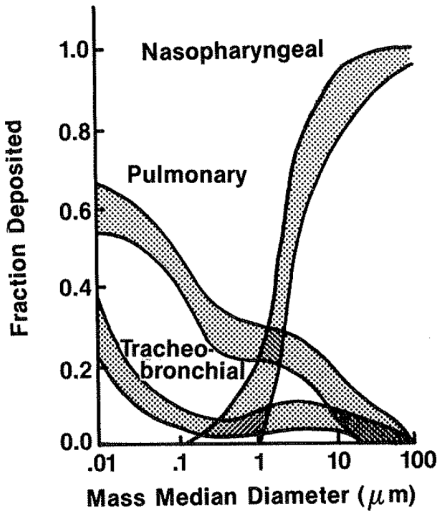
Inhalation Pathways

- Important question is how far does it go into the lung?



Respiratory Tract Particle Deposition

- Nasopharyngeal
  - nose and throat
- Tracheobronchial
  - windpipe and large airways
- Pulmonary
  - small bronchi and alveolar sacs



Health Effects of Dust

- A recent study linking dust levels in El Paso with hospital admissions (Grineski et al. 2010)
  - Dust events were significantly associated with children's acute bronchitis admissions
  - Dust and low wind events were associated with increased odds of hospital admissions for asthma and acute bronchitis amongst all ages and children, and the same was true for adults and dust
  - Low wind events were significantly associated with children's asthma hospitalizations

Cocci in New Mexico

- Expected that Coccidioidomycosis (Valley Fever) is underreported in New Mexico
  - Misdiagnosed (pneumonia, COPD, bronchitis, asthma, TB, lung cancer)
  - Ineffective treatments (often antibiotics)

Coccidioides endemic zone

Fisher et al. 2007

- Education and awareness campaign for clinical providers in New Mexico and public
  - Increase testing and diagnosis
  - Increase reporting

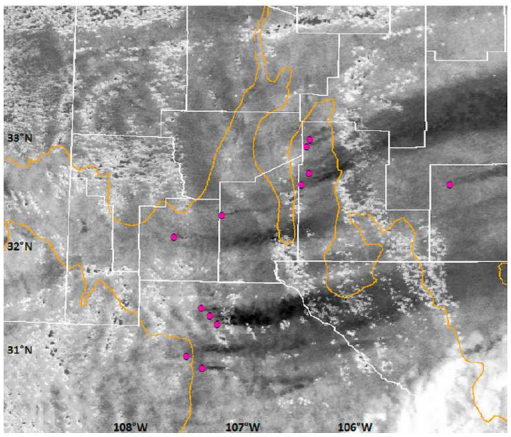
9

Health, Safety, and Air Quality

- Major Impacts to
  - Human health
  - Travel safety
  - Worker down time
- 2011 and 2012 had above average number of dust storms in southern NM and west TX
- March 18, 2012 storm was worst since 2003
  - More than 10x EPA standards for 24-hour PM_{10}

Inventory of Dust Sources

- Collect and evaluate past work



From Rivera Rivera et al. (2010) Atmospheric Environment

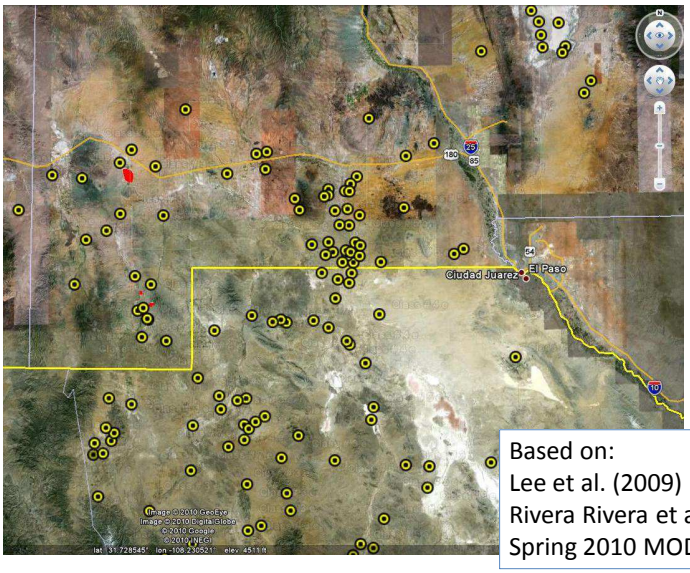
Investigated all available work on locating dust sources in the region.

Update and compare with sources during the study with enhanced monitoring and new sites

Estimate dust exposure at populated areas and assess the need for modifying existing monitoring network

11

Mapping Wind Blown Dust Sources



Based on:
Lee et al. (2009)
Rivera Rivera et al. (2010)
Spring 2010 MODIS

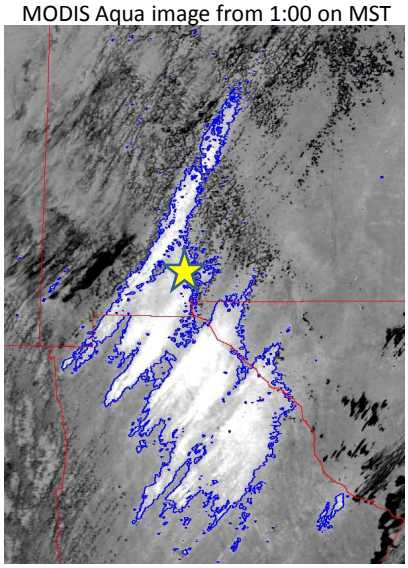
Dust Plume Identification

- 1-km MODIS thermal band brightness temperature difference image (band 32-band 31)
- Even though the spatial detail is not as fine as 250m color imagery, one can still discern the dust plume extent (white/grayish white) as opposed to the “weather” clouds (darker gray to black)
- determination of source locations (along with the true color images) and plume extent analysis
- As most dust events do not begin until the afternoon, mostly Aqua MODIS data were processed

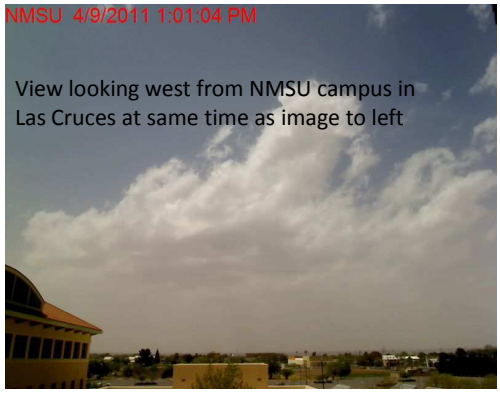
13

April 9, 2011, 20:00 UTC

MODIS Aqua image from 1:00 on MST



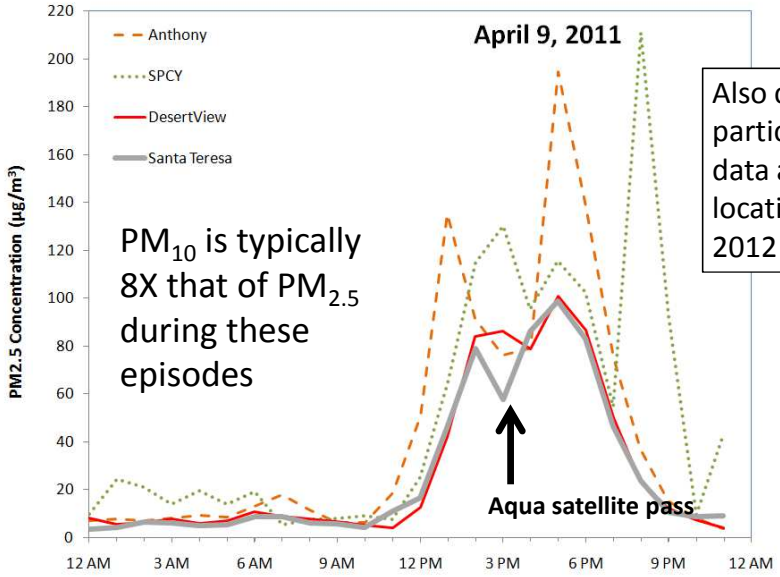
cold front approaching from west; Winds 35 to 45 mph with gusts to 60 mph



Within NM approximately 170,000 were within the dust plumes on this day

14

Classic southern NM $PM_{2.5}$ Impact

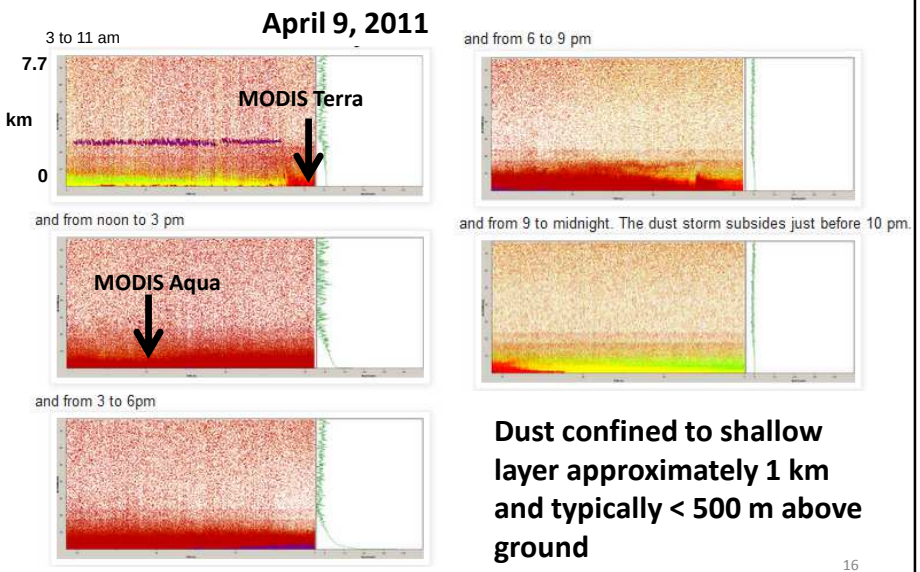


PM_{10} is typically 8X that of $PM_{2.5}$ during these episodes

Also collecting particle size data at three locations in 2012

15

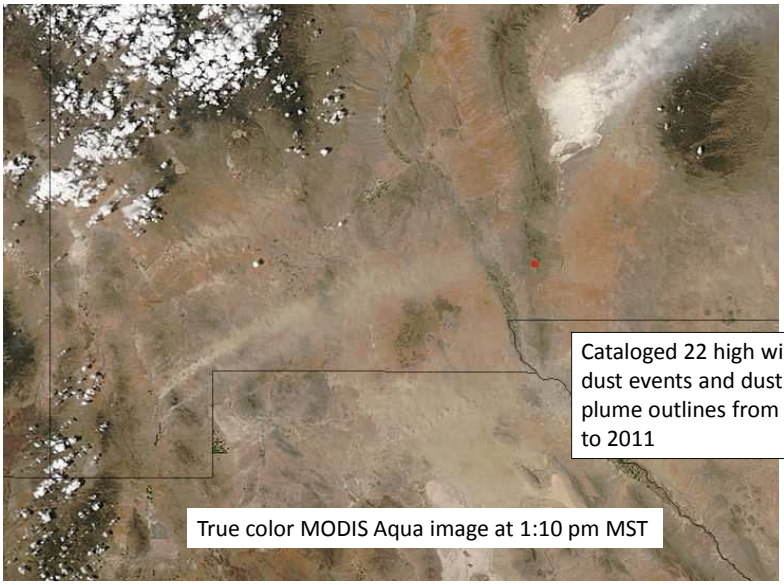
Las Cruces ceilometer during event



Dust confined to shallow layer approximately 1 km and typically < 500 m above ground

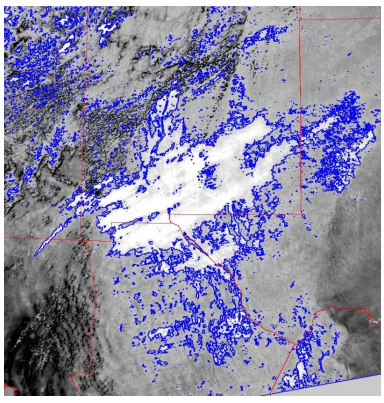
16

April 29, 2010 Dust Episode

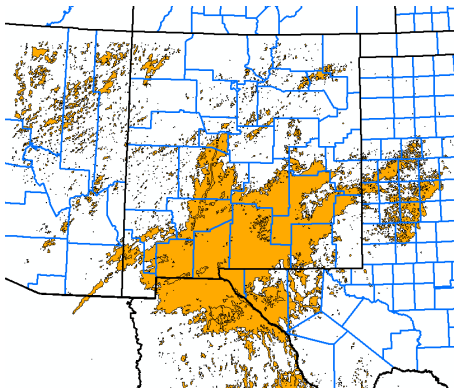


April 29, 2010 Dust Episode

Export BTD image threshold from ENVI



Polygon outlines from ArcGIS



Within NM approximately 634,000 were within the dust plumes on this day

18

Worst blowing dust day since 2003

March 18, 2012

Photo taken in Las Cruces, NM around noon

Visibility decreased to 1/4 mile at times

Resulted in multiple road closures

March 18, 2012 Storm

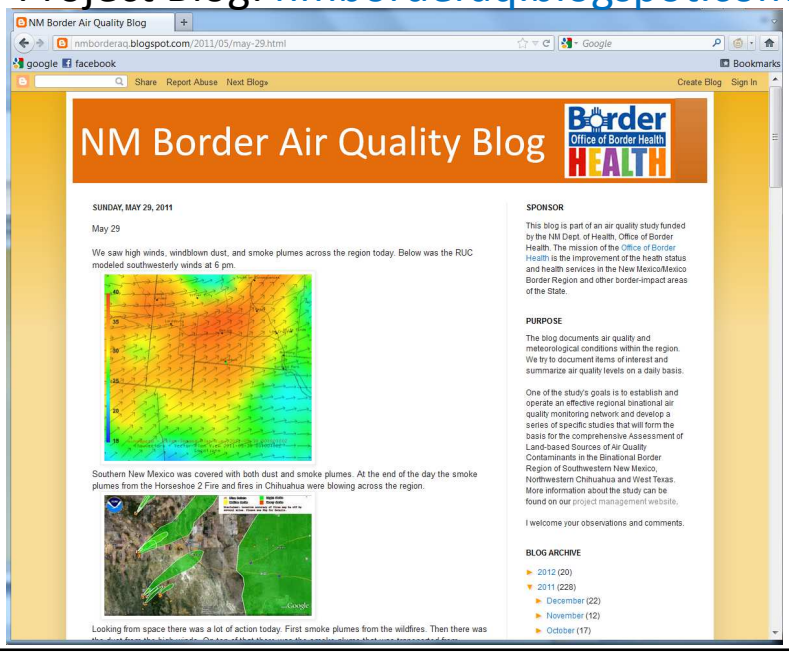
Two locations showed more than 10x US EPA health standard for daily PM10

Monitor Location	3/18/12 24-Hour Ave.	Previous 24-Hour Ave. Max	3/18/12 Max hourly Value	Previous Max hourly Value
Anthony Elem School	1740	775	8516	8078
Chaparral Elem School	1607	1110	7891	7889
Deming Airport	647	1033	4573	4874
Sunland Park Desert View Elem	1693*	420	7529	3559
Las Cruces Holman Road	1450*	542	10154	5009
Sunland Park City Yard	1262**	1109	7955	9999
Las Cruces West Mesa	1392	564	6882	3399

* missing one hour out of 24
** missing two hours out of 24

20

Project Blog: nmborderaq.blogspot.com



21

Current Plan

- Continue to map and collect data in 2012 and 2013 & update population exposure with 2010 census data
- Serve imagery and data on UNIDATA THREDDS server and events on RAMADDA
- Continue analysis of hospital admissions and allergy database
- Collaborate with others in modeling, sampling, and health data analysis

22


Dr. Dave DuBois
NM State Climatologist
dwdubois@nmsu.edu
575-646-2974
@nmclimate
nmborderaq.blogspot.com