

# Dust Detection Network --- Update

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Dust Storm Workshop  
Coolidge-Casa Grande, AZ

# Dust Storm Classification: #1



Commonly seen types in Arizona:

(1) Large-scale monsoonal  
"haboob" dust storms

- Typically June-August
- Caused by strong outflow winds out of decaying severe thunderstorms that radiate outward from the storm
- Threat area: primarily southern half of AZ, southeastern CA, southwest NM
- Fetch (track) as long as 300 miles!
- Movement typically 40 mph
- Visibility often zero
- Most extreme examples can be 5,000 - 8,000 feet in height

Gust-Front Dust Cloud (Haboob) Moving Across the Llano Estacado Toward Yellow House Canyon, Texas 18 Jun 2009



Leaflet



Source: [http://www.goes-r.gov/users/comet/EUMETSAT/at\\_dust/print\\_3.htm](http://www.goes-r.gov/users/comet/EUMETSAT/at_dust/print_3.htm)

# Dust Storm Classification: #2

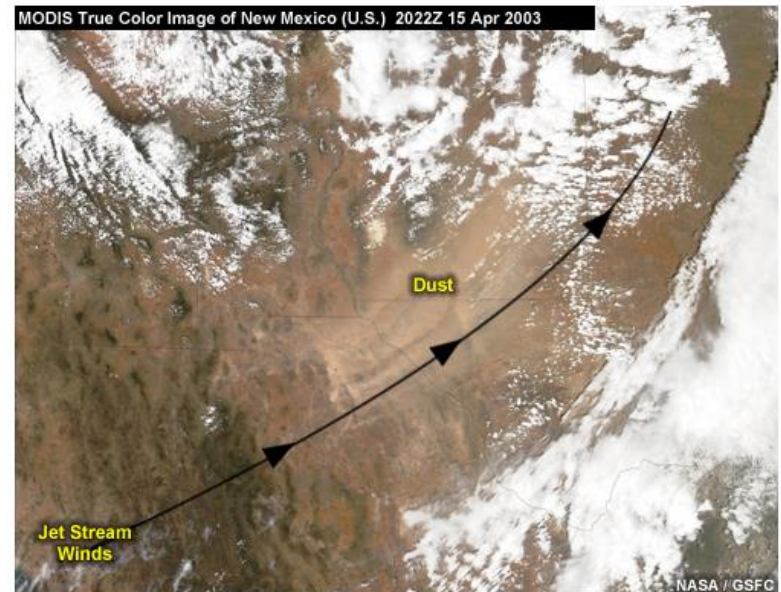
## Commonly seen types in Arizona:

- Synoptic (e.g. large frontal/pressure systems)
  - Most typical January-April
  - Widespread high winds of 25-50 mph
  - Caused by strong pressure gradient associated with winter cold front systems (can be pre-frontal or post-frontal)
  - Typically widespread lower visibilities (1-5 miles)
  - Threat area is region-wide but especially northern regions such as NE AZ [Navajo country and along I-40]



## American Southwest Example

Postfrontal dust storms are also common across the American southwest. This MODIS true colour image shows one that originated in northern Mexico and western Texas. A jet maximum had rounded the base of an upper-level trough, transporting momentum and therefore strong winds to the surface.



Source: [http://www.goes-r.gov/users/comet/EUMETSAT/at\\_dust/print\\_3.htm](http://www.goes-r.gov/users/comet/EUMETSAT/at_dust/print_3.htm)

# Dust Storm Classification: #3

2



Credit: Dan Niegocki



nd-i--north-  
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# Dust Storm Warning and Dissemination Process



## Warnings/Advisories:

- ☞ Dust Storm Warnings issued by NWS offices using AWIPS
  - ☞ Typically from 30 to 90 minutes in duration
  - ☞ Issued by “public zones” --- no capability to issue targeted warnings based on the threat
  - ☞ Based on forecast methodologies but also **more on observations from volunteer spotters**

## Blowing Dust Advisories

- ☞ Typically from 1 hour to 10 hours in duration
- ☞ Not used for situations where extremely low visibility (< 1/8 mile) is expected
- ☞ Similar to a “Watch” where we can indicate conditions may be likely for blowing dust over a large area



WWU575 KTWC  
042344 NPWTWC

URGENT - WEATHER MESSAGE

NATIONAL WEATHER SERVICE TUCSON A7 444 PM MST MON JUL 4 2011

AZZ502-504>506-050745- /O.NEW.KTWC.DS.W.0003.110706T2300Z-110707T0100Z/

TOHONO O'ODHAM NATION-TUCSON METRO AREA-

SOUTH CENTRAL PINAL COUNTY-SOUTHEAST PINAL COUNTY- INCLUDING THE CITIES OF...MARANA...PICACHO PEAK

STATE PARK 444 PM MST MON JUL 4 2011

...DUST STORM WARNING IN EFFECT FROM 4 PM TO 6 PM MST WEDNESDAY...

THE NATIONAL WEATHER SERVICE IN TUCSON HAS ISSUED A DUST STORM WARNING...WHICH IS IN EFFECT FROM 4 PM TO 6 PM MST WEDNESDAY.

\* TIMING...STRONG OUTFLOW WINDS FROM THUNDERSTORMS MOVING THROUGH EASTERN PINA COUNTY WILL CONTINUE WEST INTO THE TOHONO OODHAM NATION AND NORTHWEST THROUGH PINAL COUNTY.

\* WINDS...EAST GUSTS OF 30 TO 50 MPH.

\* VISIBILITY...WILL BRIEFLY BE DOWN TO LESS THAN ONE-QUARTER OF A MILE.

\* IMPACTS...MOTORISTS SHOULD BE PREPARED TO QUICKLY CHANGING CONDITIONS IN BLOWING DUST. PRECAUTIONARY/PREPAREDNESS ACTIONS...

A DUST STORM WARNING MEANS SEVERELY LIMITED VISIBILITIES ARE EXPECTED WITH BLOWING DUST. BLOWING DUST CAN QUICKLY REDUCE VISIBILITY...CAUSING ACCIDENTS THAT MAY INVOLVE CHAIN COLLISIONS AND MULTIPLE PILEUPS. IF DENSE DUST IS OBSERVED BLOWING ACROSS OR APPROACHING A ROADWAY...PULL YOUR VEHICLE OFF THE PAVEMENT AS FAR AS POSSIBLE TO STOP. TURN OFF THE LIGHTS...SET THE EMERGENCY BRAKE...AND TAKE YOUR FOOT OFF OF THE BRAKE PEDAL TO ENSURE BRAKE LIGHTS ARE NOT ILLUMINATED.

STAY TUNED TO NOAA WEATHER RADIO...COMMERCIAL RADIO OR TELEVISION STATIONS...OR YOUR CABLE TELEVISION PROVIDER FOR LATER STATEMENTS CONCERNING THIS DUST STORM.

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# Dust Storm Warning and Dissemination Process

## Dissemination

- Emergency Alert System [EAS]
  - Goes to media, emergency managers, and other partners
- Internet sites (NWS, weather partners, etc.)
- Wireless Emergency Alerts [WEA]
  - New program established in 2012
    - Includes Tornado warnings, Flash Flood warnings
  - Very strong public reach as most smartphones are alerted
  - One drawback: because of use of public zones it often has an overreach
  - Consumer guide at

<http://transition.fcc.gov/cgb/consumerfacts/wea.pdf>



WMUS75 KTWC  
042344 NPWTWC

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RADIO OR TELEVISION STATIONS...OR YOUR LOCAL NEWS STATIONS...MAY BE PROVIDING ADDITIONAL INFORMATION CONCERNING THIS DUST STORM.



# Dust Storm Detection Network

## ☞ Motivation

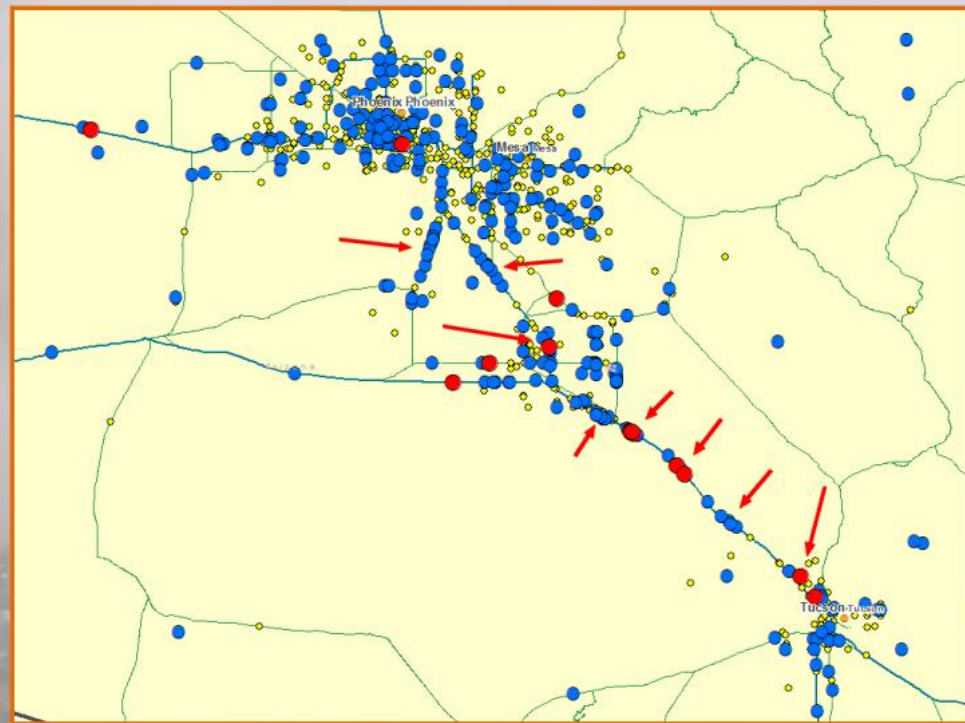
☞ Paucity of real-time observations along common dust storm corridor in Pinal County

## ☞ GIS study

([http://www.wrh.noaa.gov/psr/dust/2013/presentations/Waters\\_Accident\\_Analysis.pdf](http://www.wrh.noaa.gov/psr/dust/2013/presentations/Waters_Accident_Analysis.pdf))

showed common accident locations

## Problem Area Identification



Ken Waters, NWS Phoenix, ken.waters@noaa.gov, March 5, 2013

# Dust Storm Detection Network

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## Mission:

### GOALS:

- 1) Inexpensive
- 2) Use new technologies newly available
- 3) Designed to be a discrete [dust or no dust?] indicator rather than a precise scientific measurement
- 4) Use available Internet and power thus minimizing infrastructure cost
- 5) Careful placement to be typically “upwind” from highways like I-8 and I-10

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# Dust Storm Detection Network

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## Two Primary Functions

Allow regular monitoring of particulate values for each of the sensors; prepare graphs to view the data.

Monitor conditions in real-time and issue alerts in the event dust storm conditions are detected.

# Dust Storm Detection Network

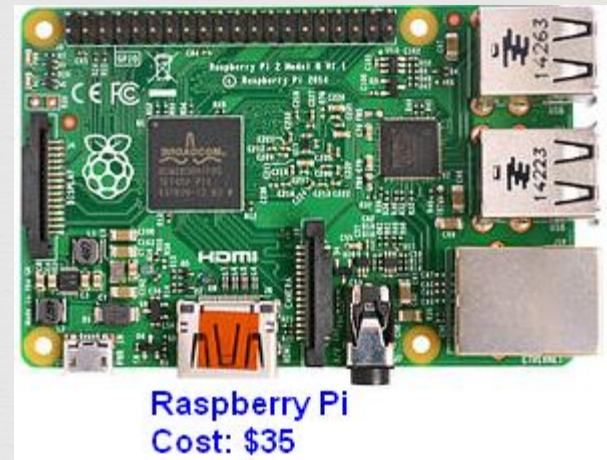
## ☞ Motivation

☞ Take advantage of new low-cost technologies (e.g., Internet of Things [IoT])

☞ Arduino

☞ Raspberry Pi

☞ Air particulate sensors



# Installation



- ❧ Find sites with available power + Internet access [either Ethernet or WiFi]
- ❧ Prefer fairly secure location not likely to be tampered with
- ❧ Mechanically secure the box so that high winds will not disrupt it



# Dust Storm Detection Network

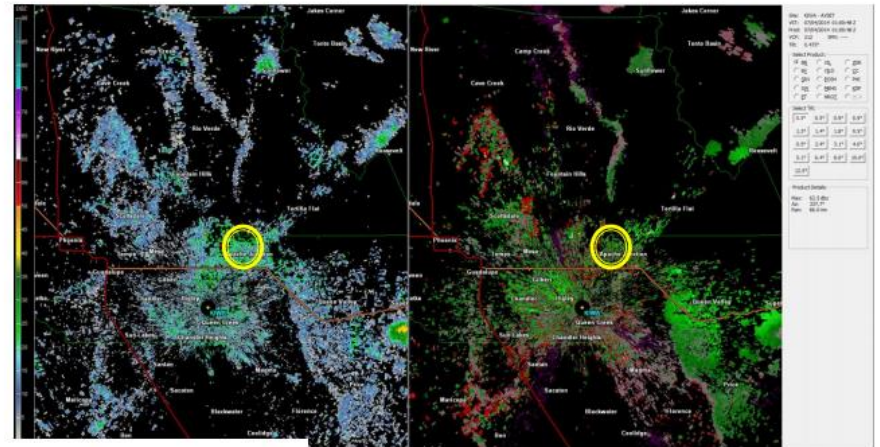
## History

2013: home-grown experimentation collecting particulate data captured first feather dust storm event

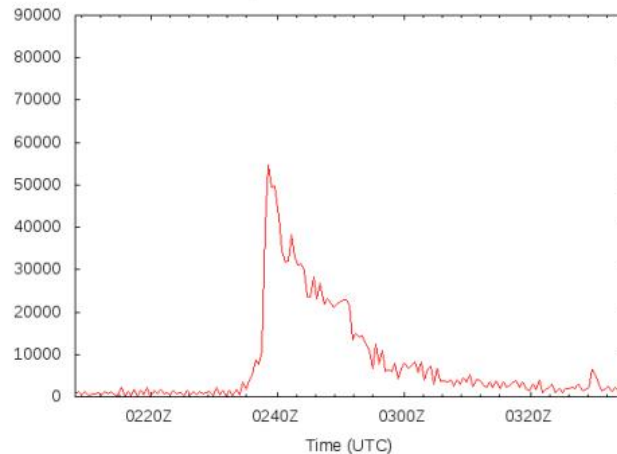
2014: Haboob event captured

### July 3<sup>rd</sup>

Classic monsoon severe microburst outflow signature



3 July 2014 East Mesa Dust Sensor



# Dust Storm Detection Network

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## History

- 2013: First sensor deployed to collect data
- 2015: Built website to store data, sensor status; began to add additional field sensors.
- 2015: Developed valuable partnership with Pinal County Sheriff's Office to find suitable locations for sensors to be hosted.
- 2016: Network built out to include 9 operational sensor packages

# Dust Storm Detection Network Website



☞ URL:

<http://monsoonsafety.org/dust/>

\*\*\*\* EXPERIMENTAL \*\*\*\*

## Dust Detection Network

For information about this service please contact [Ken Waters, NWS Phoenix](#)

[Sensor Map of Live Data](#)

[New Data Display](#)

[Current Status of Sensors](#)

[2015 AMS Presentation \(pptx\)](#)

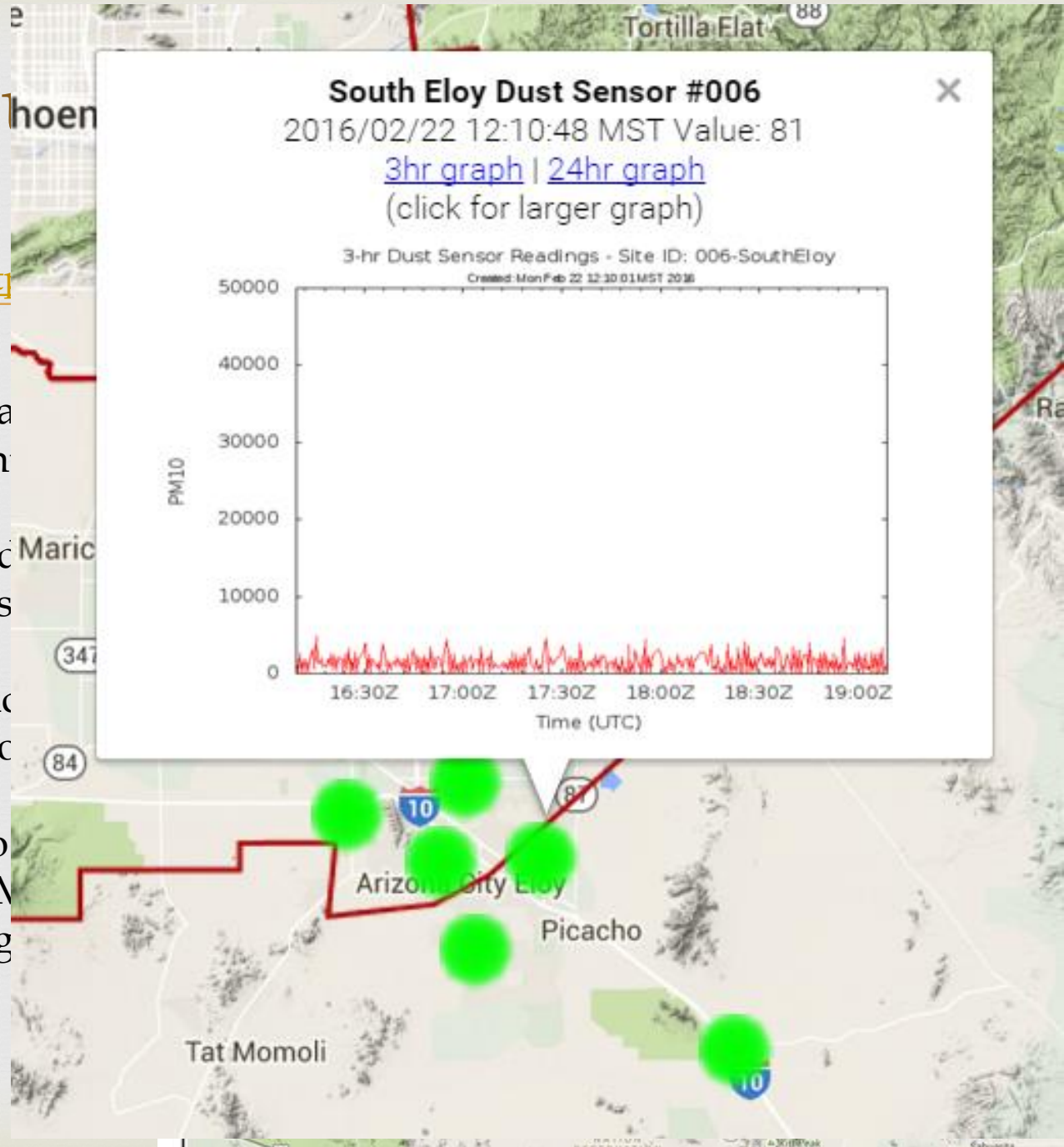
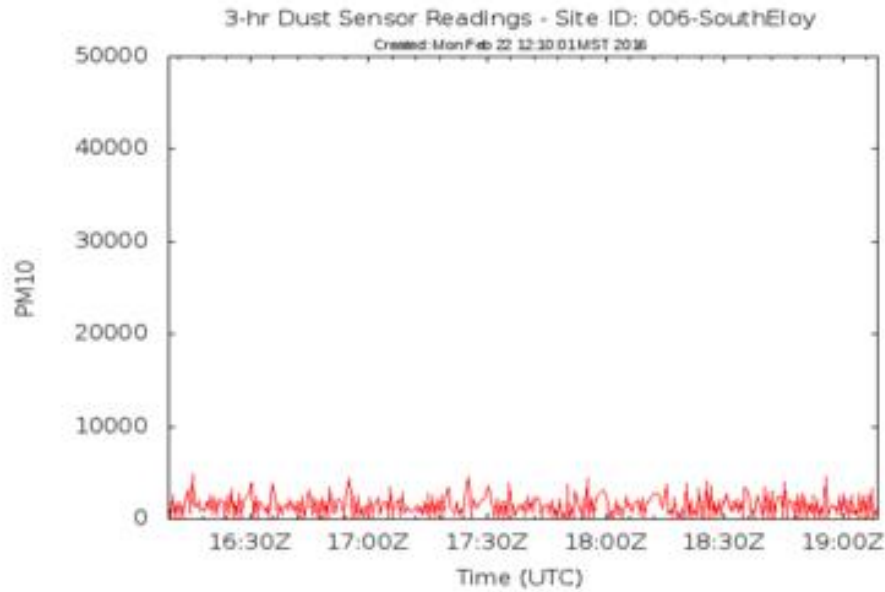
[2015 AMS Presentation \(pdf\)](#)

\*\*\*\* EXPERIMENTAL \*\*\*\*

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**South Eloy Dust Sensor #006**  
 2016/02/22 12:10:48 MST Value: 81  
[3hr graph](#) | [24hr graph](#)  
 (click for larger graph)



URL: <http://...>

Graph updates every 5 min

Color-coded show intensity

Values indicate concentration [note: not equitable to standard PM values of  $\mu\text{g}$ ]

# Dust Storm Detection Network Event

ALERT: Dust Sensor 007-RedRock

Inbox x

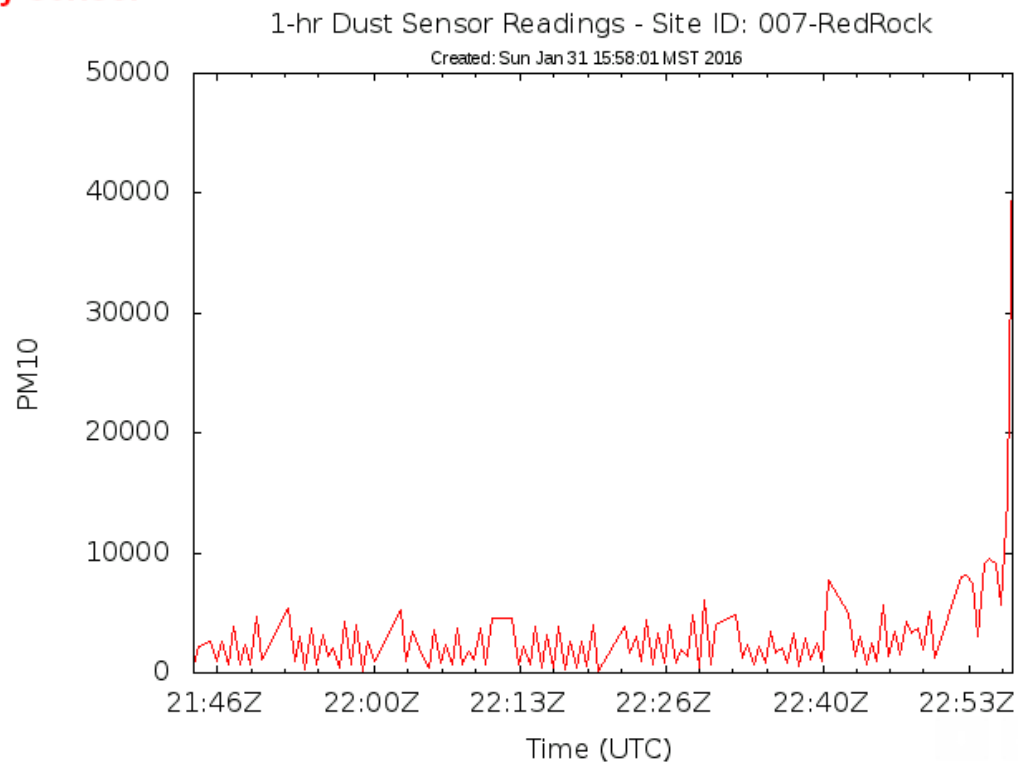


Jan 31 ☆



**Actual e-mail Alert on January 31st, 2016  
for Red Rock/Avra Valley sensor**

60 min Graph



this new prototype dust sensor network, including their graphs of PM-10 particulates (dust) on the following website: <http://monsoonsafety.org/dust/dustMap.php>.



# Maintenance



- Minimal maintenance required so far --- although we're still learning
- Have had one deployed sensor with sudden high noise level beginning in early March
  - Did a site visit and determined that it may be due to an issue with the Raspberry Pi
  - Returned the package to NWS and ordered replacement to be tested and redeployed

# Dust Detection Network



## Future:

- ❧ Tweak alerting algorithm
- ❧ Expand network of responders receiving the alerts
- ❧ Possibly deploy 1-4 more carefully placed sensors
  - ❧ Goals:
    - ❧ Target known trouble spots
    - ❧ Place sensors upwind from trouble spot if possible
- ❧ Deploy Raspberry Pi webcams (3 are in stock) to capture images on a few of the sensors



# Questions? Resources



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- ☞ Twitter: @wxphx
- ☞ Office: 602-275-7002, x223



## RESOURCES:

Arizona Dust Storm Workshops:  
<http://www.wrh.noaa.gov/psr/dust/>

Dust Detection Network:  
<http://monsoonsafety.org/dust/>

## ☞ Dan Leins

- ☞ Science Operations Officer, NWS Tucson
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- ☞ Office: 520-670-5156, x224

