

# Dust Detection Project

Ken Waters

National Weather Service

January 20, 2016

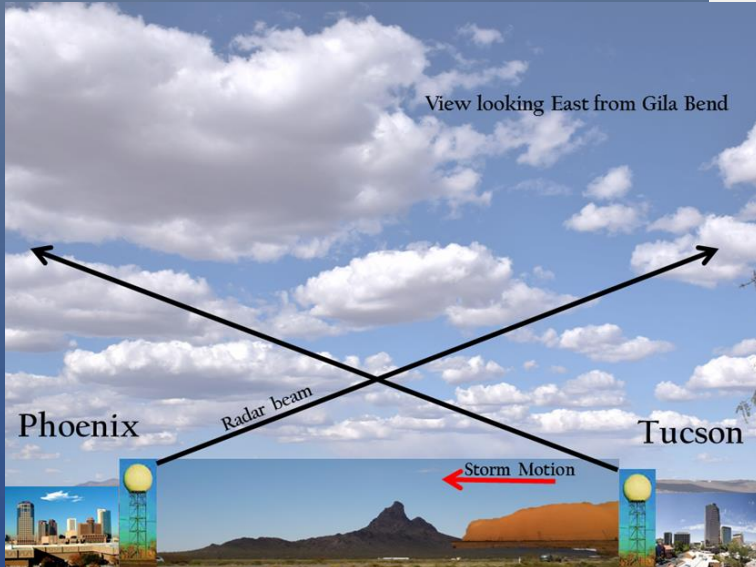
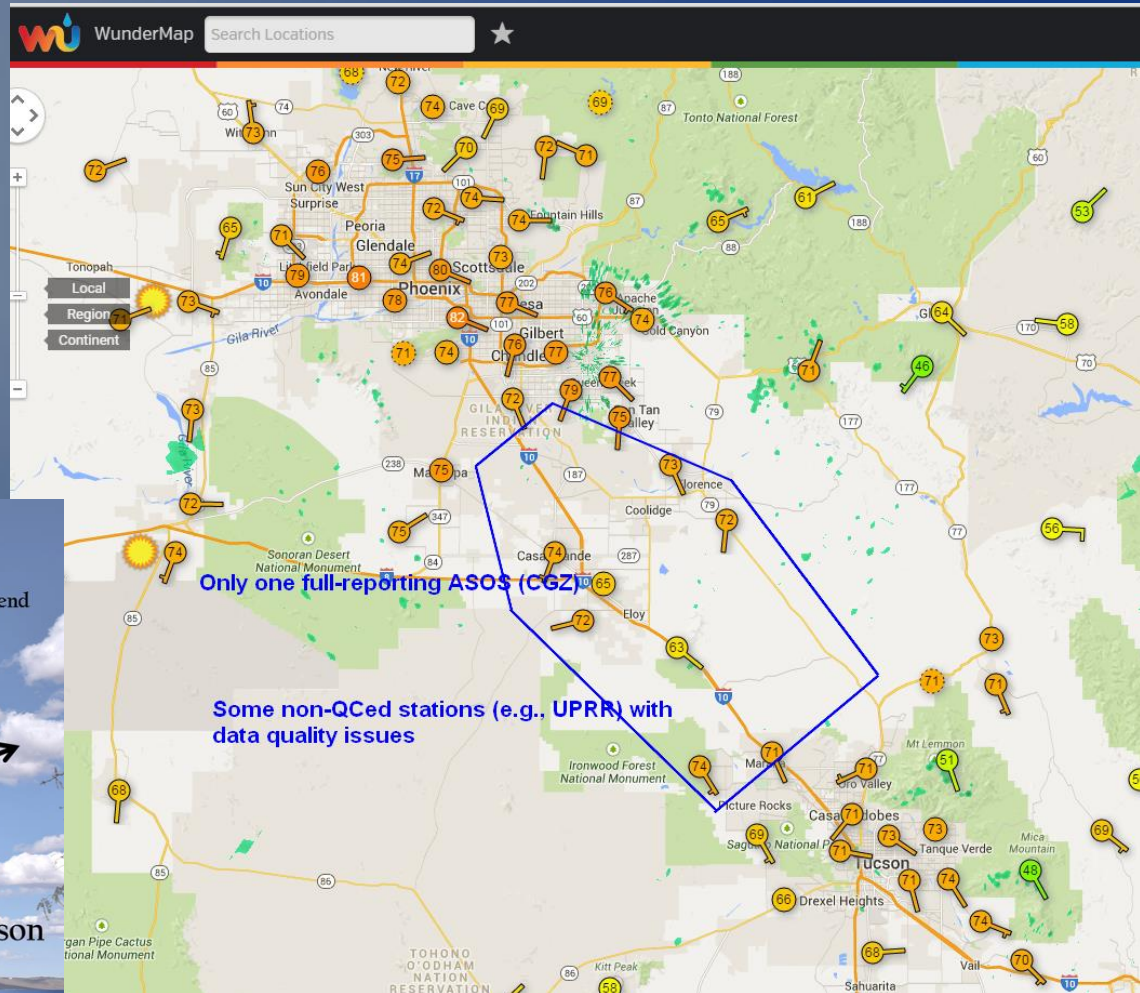
Dust Mitigation Workshop, Casa Grande

# Concept

- Dust storm detection is a major problem in Arizona due to limitations with existing radar, satellite, and surface observation systems to detect initial dust storm genesis
- Leverage off low-cost technologies now available

# PROBLEM: Detection of Dust Storms

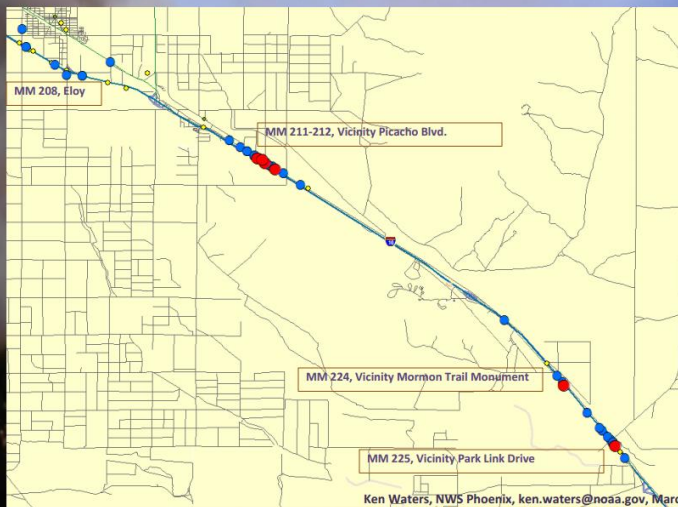
- Poor observational data sources (only one visibility sensor system along I-10 corridor)



# History

- Ken conducted a study (<http://www.wrh.noaa.gov/psr/dust/2013/presenta>

## I-10 Corridor Phoenix-to-Tucson



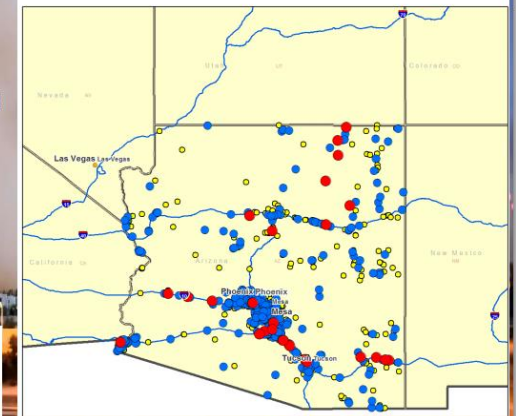
## Geographic Analysis

- Initial Observations:
  - As expected, strong correlation with traffic density (greatest numbers in Phoenix and Tucson and points between)
  - Some indication of “clumping” of reports indicating possible trouble spots – more

### Legend

- ADOT-2000-2011 - Deaths.csv Events
- ADOT-2000-2011 - Injuries.csv Events
- ADOT-2000-2011 - No Inj-Deaths.csv Events

Arizona Dust-Related Traffic Incidents  
2000-2011



Ken Waters, NWS Phoenix, ken.waters@noaa.gov, March 9, 2013

# History

- At the same time, Ken began exploring new technologies and theorized that low-cost particulate sensors could be used in lieu of expensive visibility sensors to detect dust storm conditions
- Started as a home experiment with attaching various environmental sensors to an Arduino (<http://www.arduino.cc/>)

# History

- ◉ Summer 2014: PSR MIC approved purchase of parts to build 4 prototype systems (~\$600)
- ◉ Fall 2014: Prototype system assembled and run inside the office
- ◉ Feb 2015: Worked with TWC to set up prototype website where real-time data

# Need Low-Cost, Easy-to-maintain Solution

The image shows two screenshots of an electronics website. The top screenshot is from SparkFun Electronics, displaying the product page for an Optical Dust Sensor (GP2Y1010AU0F) priced at \$11.95. A large orange '\$12' is overlaid on the page. The bottom screenshot shows a Grove - Dust Sensor priced at \$15, also with a large orange '\$15' overlaid. The background of the entire image is a desert landscape with red rock formations under a blue sky.

**SparkFun Electronics**  
0 items in cart | \$ USD | Wish Lists | You are not logged in | log in

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Home | Product Categories | Biometrics | COM-09689

**Optical Dust Sensor - GP2Y1010AU0F**  
COM-09689 (alt) \$/

Price: \$11.95  
Backorder

1 quantity  
Out of stock  
\$11.95 price  
\$10.76 10+ units  
\$9.56 100+ units

seed Open Hardware Facilitator

HOME | BAZAAR | WISH | PROPAGATE | BLOG | FORUM | WIKI | Sign In | Sign Out

My Account | Wish Lists | Quick Order | View Cart

NEW PRODUCTS | FEATURED PRODUCTS | SPECIAL OFFER | B-SQUARES | GADGETEER | MICROCONTROLLERS | KITS | COMMUNICATION | SENSORS | Radiation

Home > Sensors > Gas and Liquid > Grove - Dust Sensor

**Grove - Dust Sensor**

Price: \$15.50 (Price Feedback)  
SEN12291P  
Weight: 25Gram  
Units in Stock: 41  
Designed by: Others  
Other products from designer

Quantity: 1 Max: 41  
ADD TO CART  
ADD TO WISHLIST  
Like Send Be the first of your friends to like this.  
+1 1

From 2013 Dust Storm Workshop Presentation

# Sensor #1: Shinyei PPD42NS

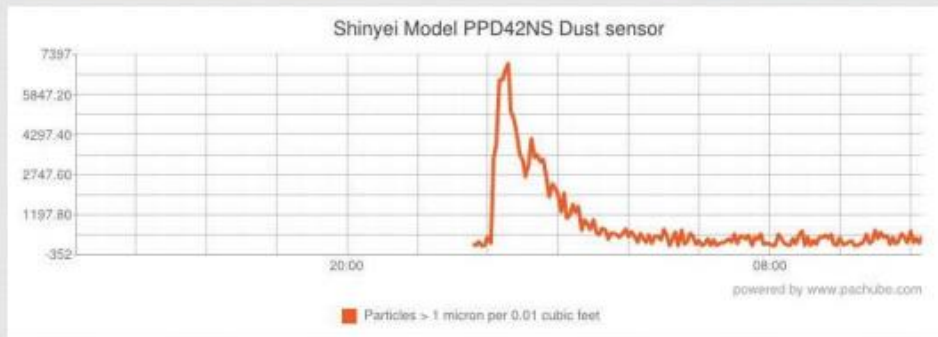


## Air Quality Monitoring

Automatically measuring and graphing Air Quality with an inexpensive device (Shinyei Model PPD42NS Dust Sensor)  
Copyright 2012, Chris Nafis



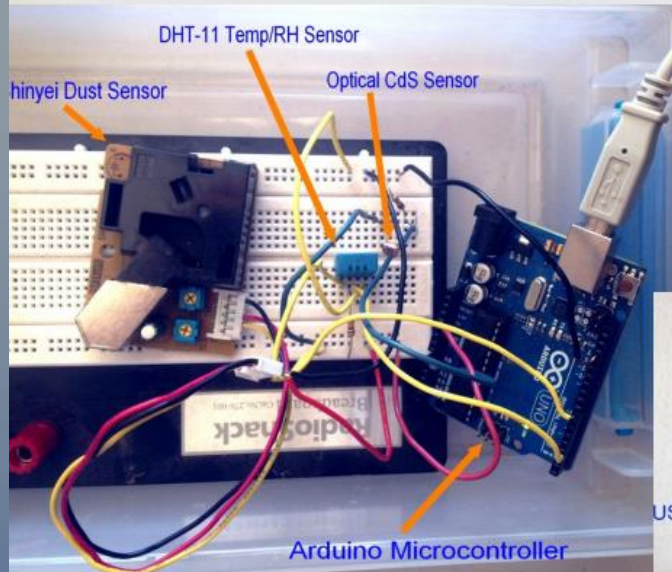
Produces digital output of both PM2.5 and PM10 particulate (microg/m<sup>3</sup>)



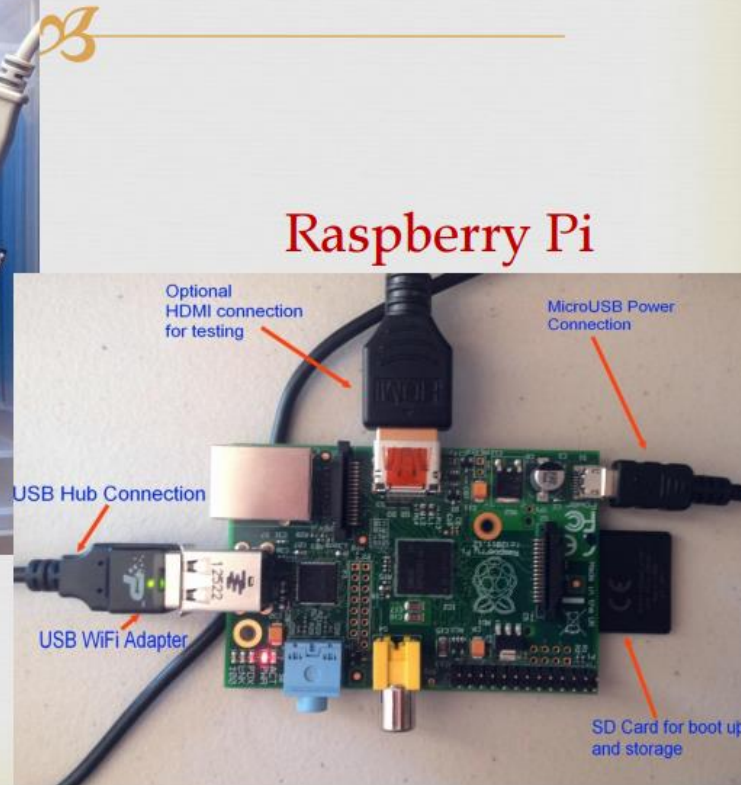
Source: <http://www.howmuchsnow.com/arduino/airquality/grovedust/>



# Dust Project Hardware



Arduino and Sensors



Raspberry Pi

## Components

Cost: ~ \$115.00

# Communications

- ◉ Deployed sensor uses available communications (typically wireless router)
- ◉ Uses wireless (wifi) adapter for Internet access
- ◉ Transmits data using SSH to [monsoonsafety.org](http://monsoonsafety.org)

# Partnerships

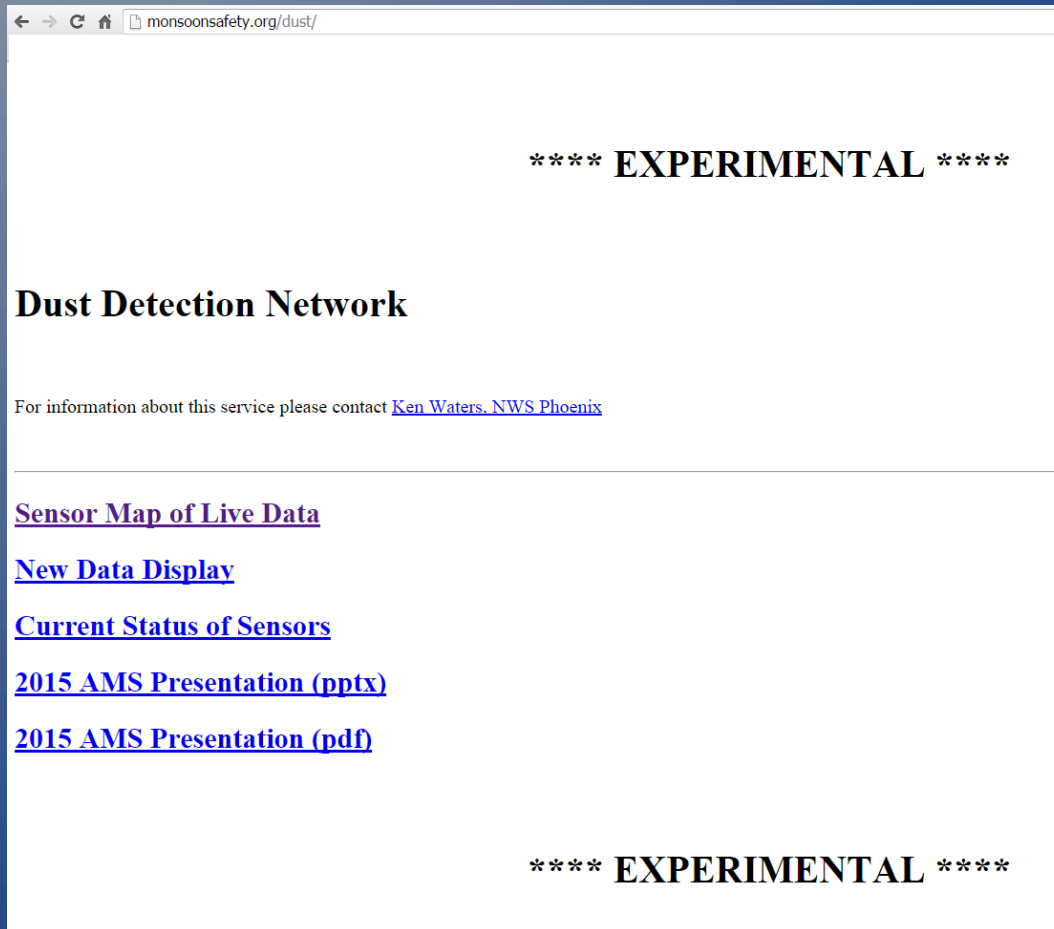
- Local and state agencies (e.g., ADOT, ADEQ, Pinal Co AQ, DPS) expressed great interest and offers to help
- ADOT Proposal (early 2015)
  - Install ~100 of these sensors along high-risk locations, primarily I-10
  - Proposal came about after several ADOT personnel attended our dust storm workshops

# Outreach

- Dust Workshop, Casa Grande, March 5, 2013
  - [http://www.wrh.noaa.gov/psr/dust/2013/presentations/Waters\\_DDN.pdf](http://www.wrh.noaa.gov/psr/dust/2013/presentations/Waters_DDN.pdf)
- Dust Workshop, Casa Grande, March 19, 2014
  - [http://www.wrh.noaa.gov/psr/dust/2014/presentations/Waters\\_Dust\\_Detection.pdf](http://www.wrh.noaa.gov/psr/dust/2014/presentations/Waters_Dust_Detection.pdf)

# Website

⦿ <http://monsoonsafety.org/dust>



A screenshot of a web browser displaying the website [monsoonsafety.org/dust/](http://monsoonsafety.org/dust). The browser's address bar shows the URL. The page content includes a header with the text "\*\*\*\* EXPERIMENTAL \*\*\*\*", followed by the main heading "Dust Detection Network". Below this, there is a line of text: "For information about this service please contact [Ken Waters, NWS Phoenix](#)". A horizontal line separates this section from a list of links: "[Sensor Map of Live Data](#)", "[New Data Display](#)", "[Current Status of Sensors](#)", "[2015 AMS Presentation \(pptx\)](#)", and "[2015 AMS Presentation \(pdf\)](#)". At the bottom of the page, there is another line of text: "\*\*\*\* EXPERIMENTAL \*\*\*\*".

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

## Dust Detection Network

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

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[Sensor Map of Live Data](#)

[New Data Display](#)

[Current Status of Sensors](#)

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

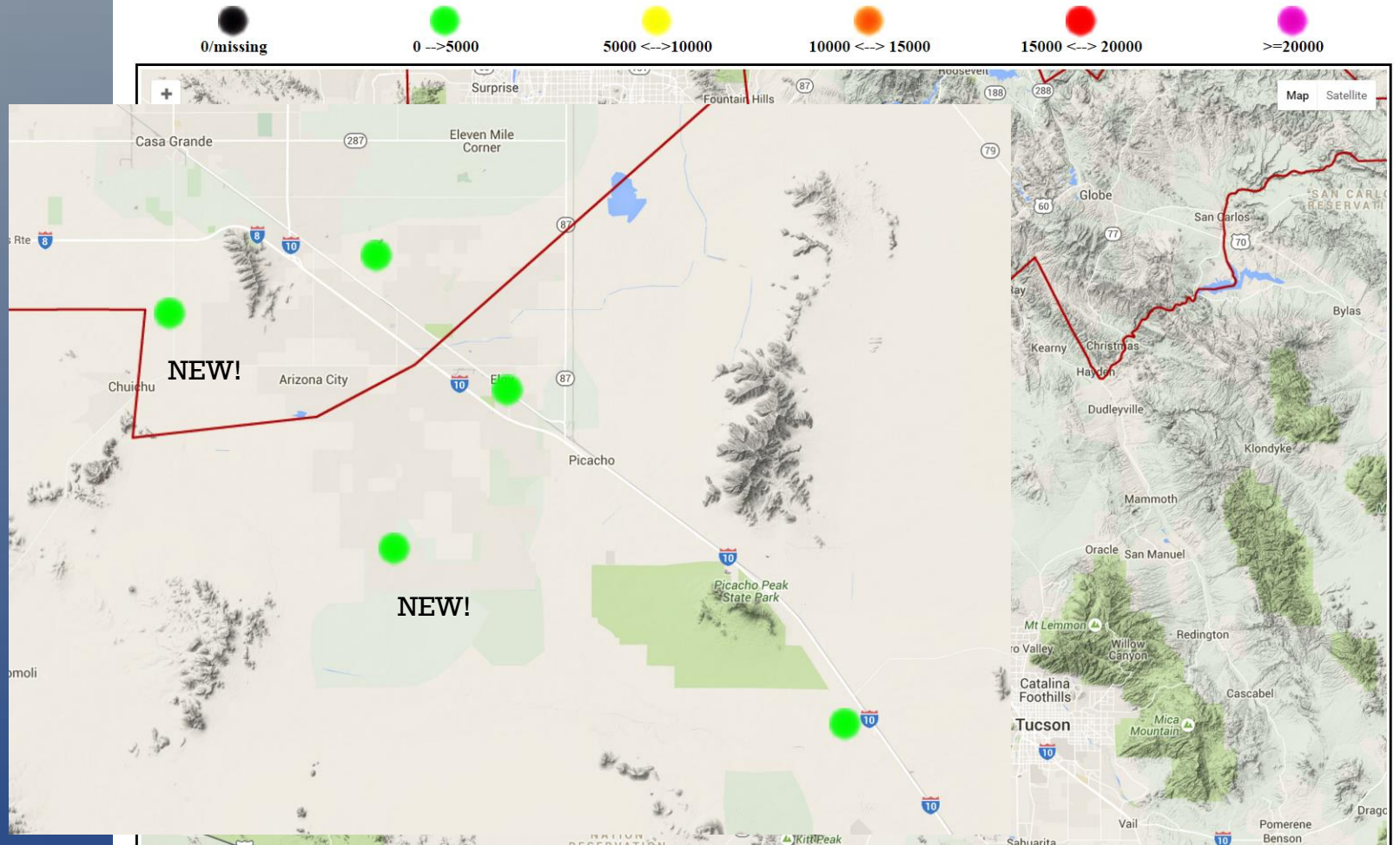
[2015 AMS Presentation \(pdf\)](#)

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

# Website

## Prototype Real-Time Dust Detection Network Web Page

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

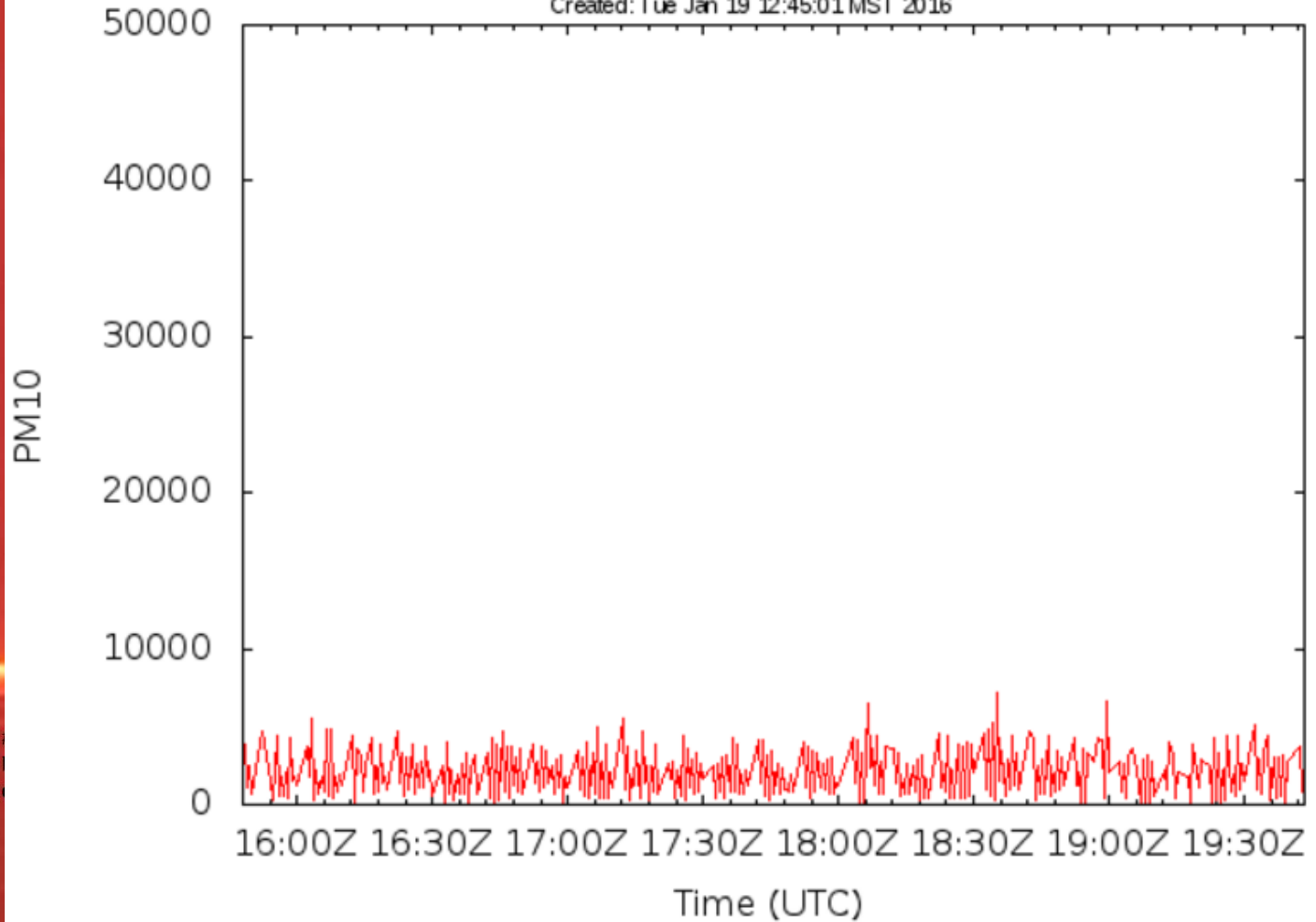


# Website

← → ↻

## 3-hr Dust Sensor Readings - Site ID: 007-RedRock

Created: Tue Jan 19 12:45:01 MST 2016



Sensors  
Sensors  
All of the

# Website

- Allows user selected start-end times

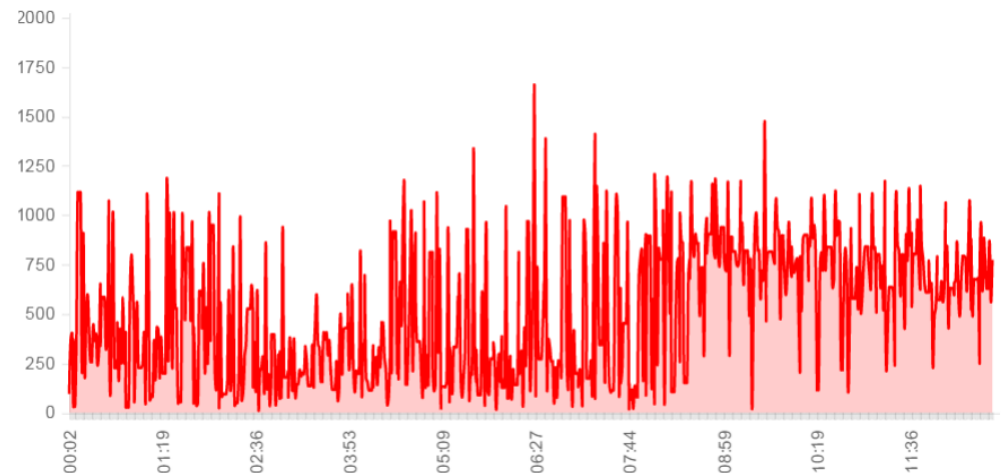
Select Raspberry Pi:  :

Start: [2016/01/19](#) 00:00

End: [2016/01/19](#) 23:59

[Generate Chart](#)

[Generate Table](#)





# Contact

- ◉ Ken Waters
- ◉ National Weather Service, Phoenix
- ◉ E-Mail: [ken.waters@noaa.gov](mailto:ken.waters@noaa.gov)
- ◉ Twitter: @wxphx
- ◉ Phone: 602-275-7002, x223