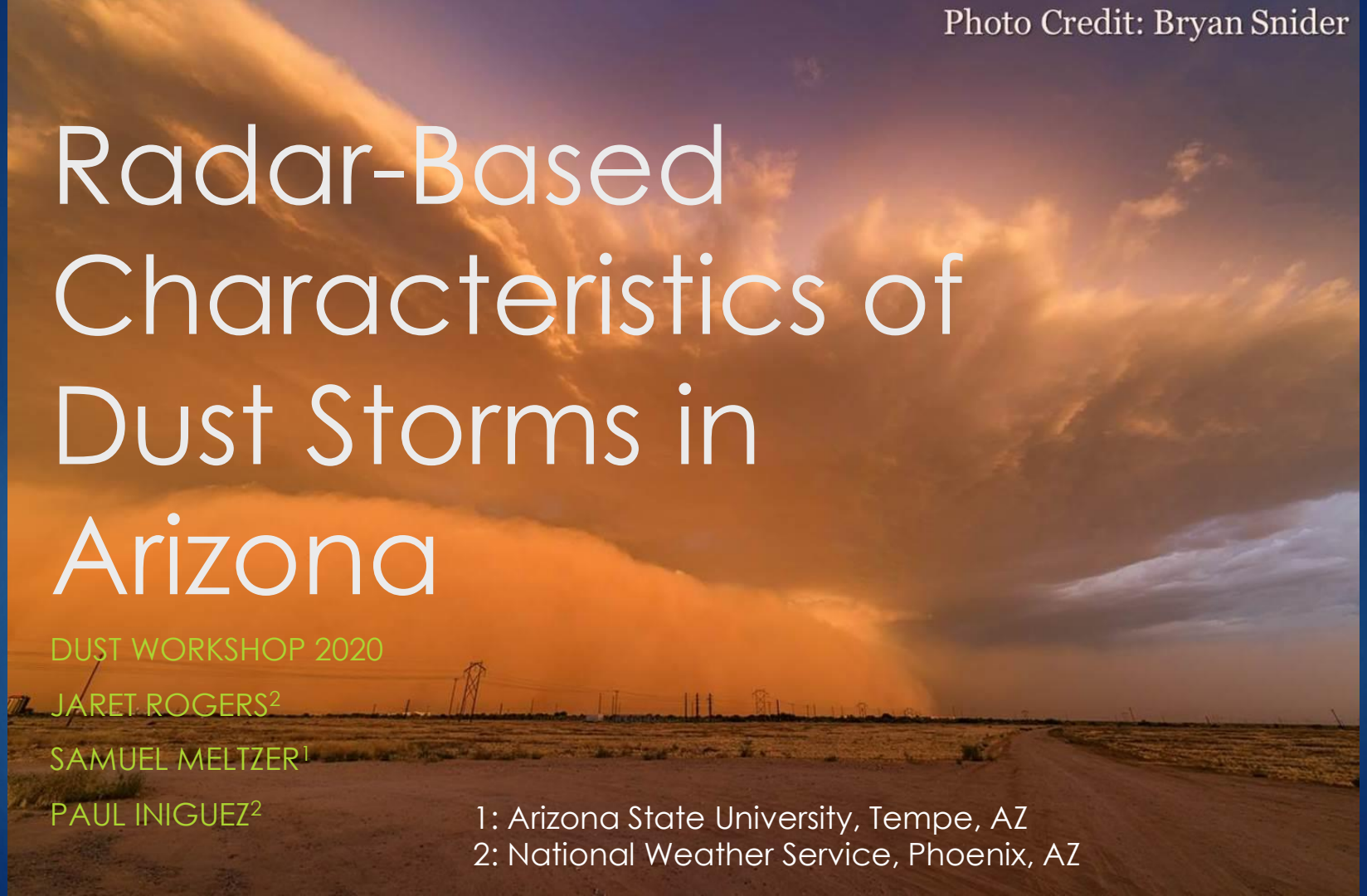

Radar-Based Characteristics of Dust Storms in Arizona

DUST WORKSHOP 2020

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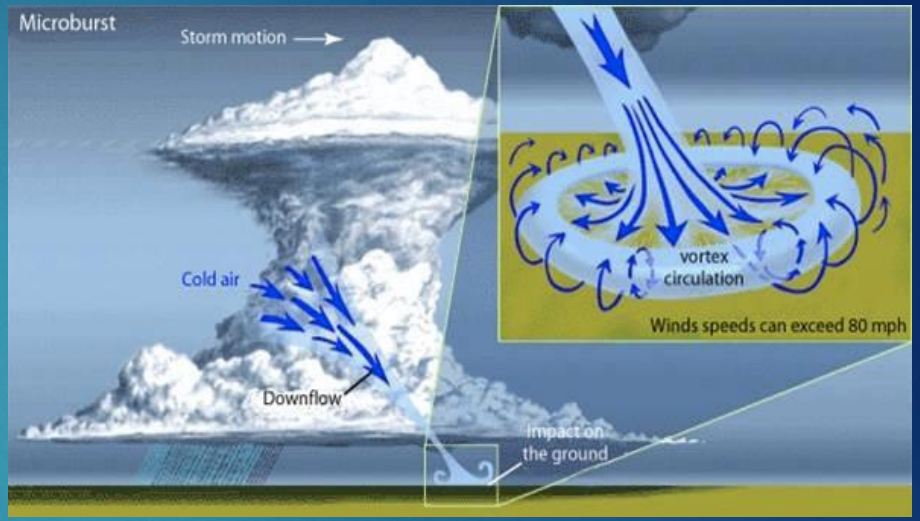
Dust Storm (Haboob) Definition

"An intense sandstorm or dust storm with sand and/or dust often lofted to heights as high as 1500 m (~5000 ft), resulting in a "wall of dust" along the leading edge of the haboob that can be visually stunning."
– AMS Glossary

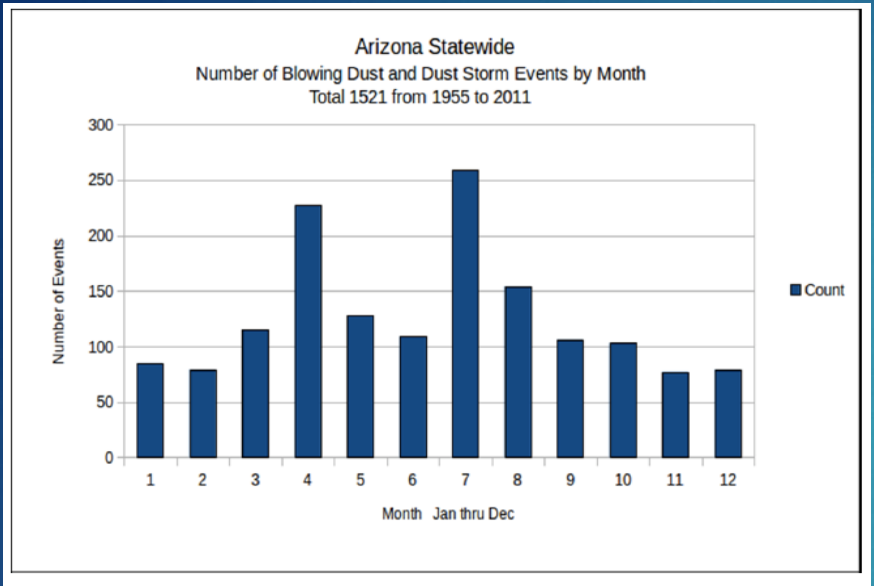


- **NWS definition:** Dust storm warning is ¼ or less mile visibility.
- NWS warnings now use polygons (Waters 2018).

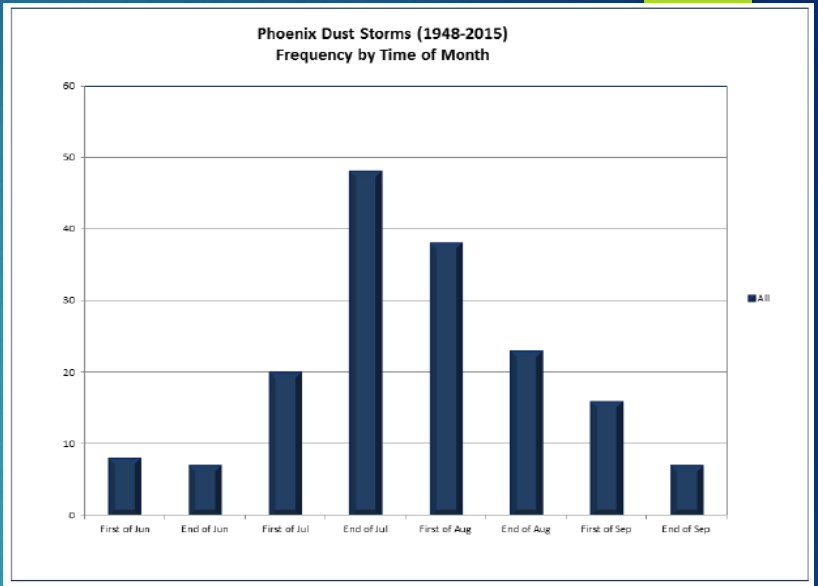
Impacts

Past Incidents Due to Dust Storms

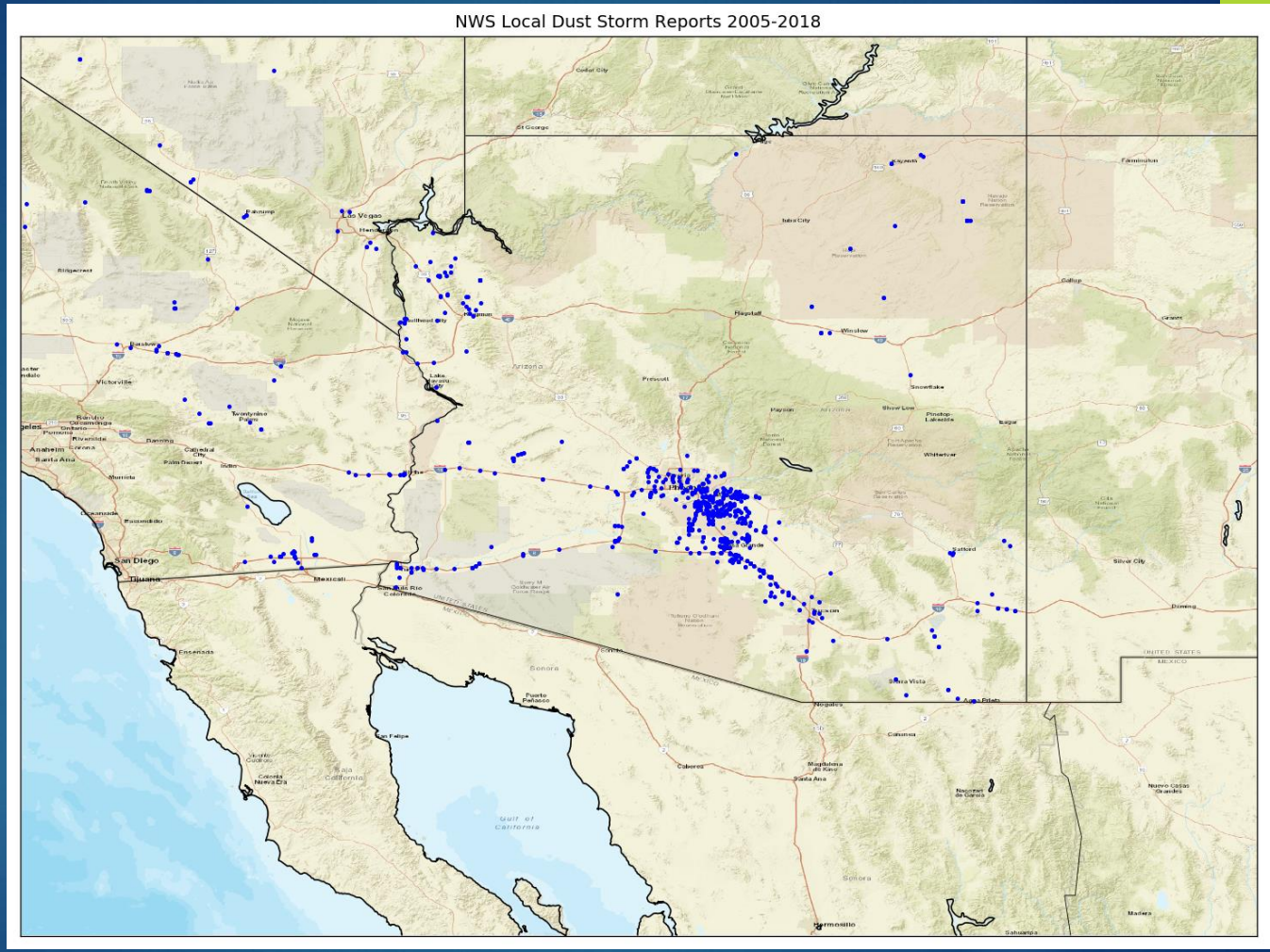
- **28 June 1970** – 12 fatalities after several vehicles collided on Interstate 10 near Casa Grande.
- **9 April 1995** – 10 fatalities and 20 injured on Interstate 10 near Bowie after 4 different accidents, totaling 24 vehicles.
- **12 July 1964** – 8 fatalities and 25 injured after 9 cars, 3 trailer rigs, and 1 pickup were involved in a chain reaction collision on Interstate 10 near Red Rock.
- **4 Oct 2011** – 1 fatality and 15 injured in 25 vehicle crash on I-10



Statewide Arizona dust events
Adapted from Lader et al. 2016

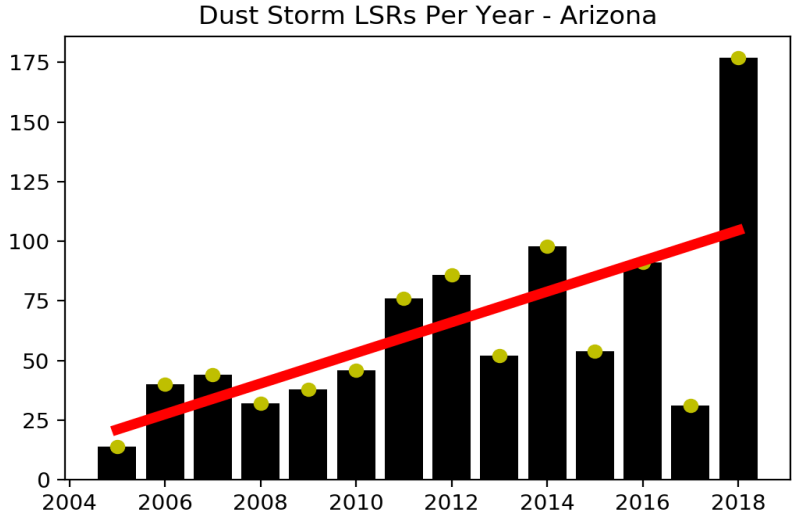


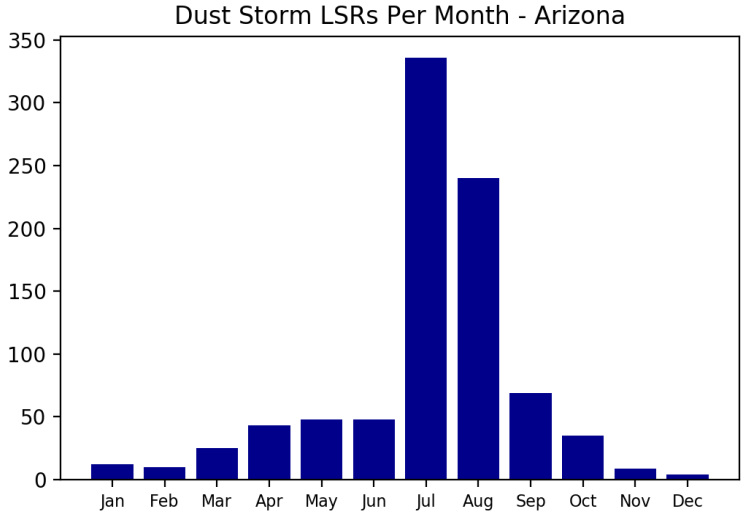
Phoenix dust events
Adapted from Lader et al. 2016



Dust storm NWS local storm reports (2005-2018)

Dust Storm Climatology (LSRs)



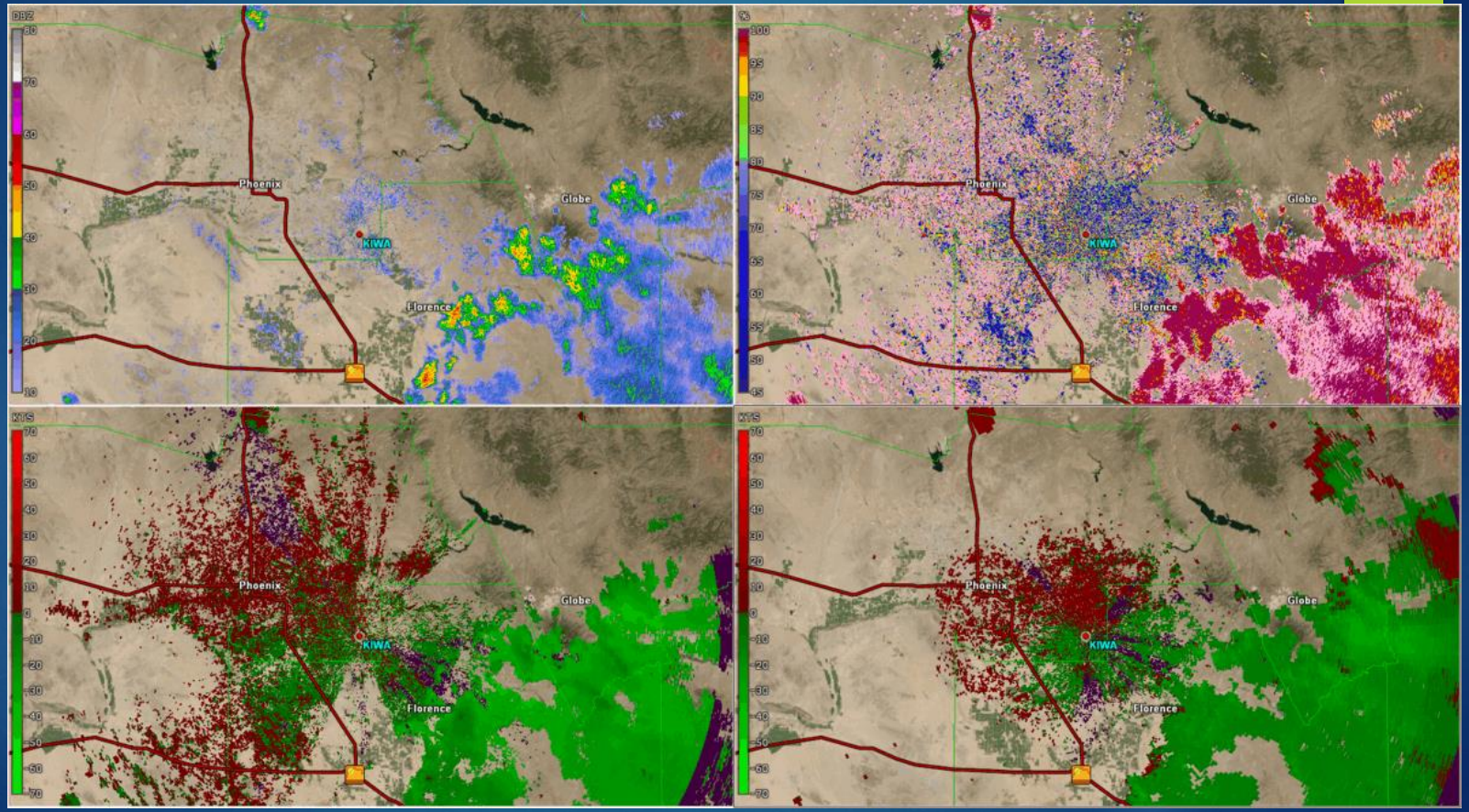


* 2018 shattered previous record with 175 reports.

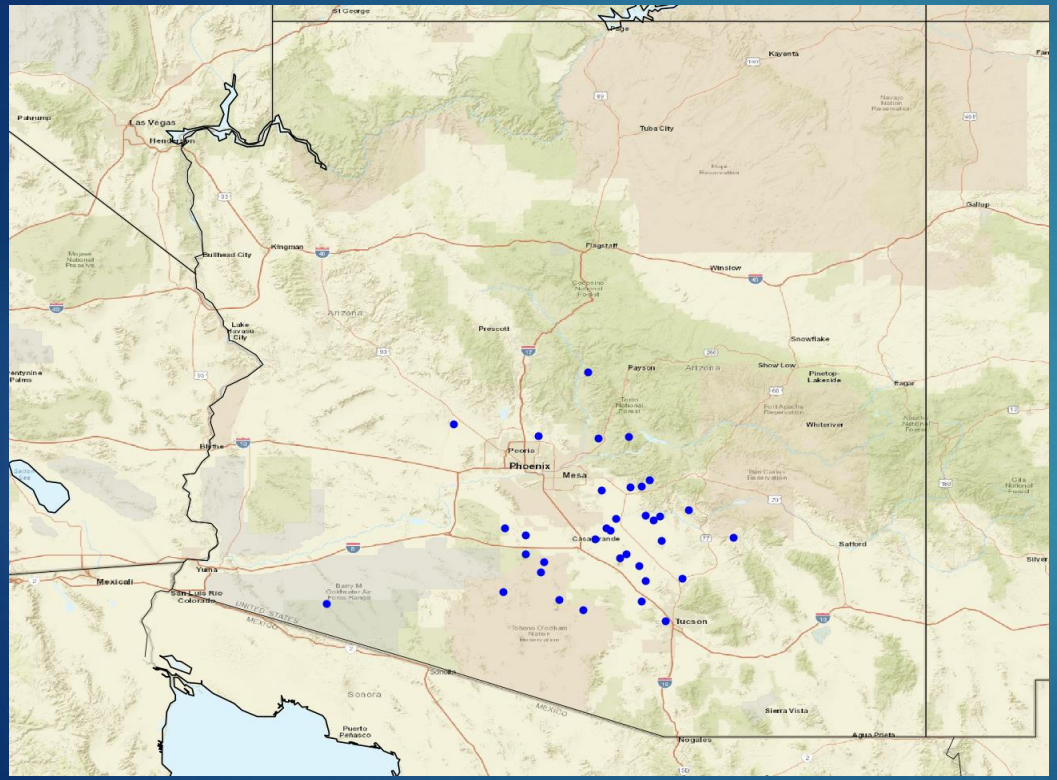
Radar Analysis of Dust Storms

- **Goal: Create a small climatology of summer haboobs across southern/central Arizona, using combination of radar and storm reports.**
- Dataset: 35 unique dust storms from 2010 through 2018.
  - >= 3 dust storm reports (1/4 mile) separated by more than 20 miles.
  - Most affecting Phoenix-Tucson corridor (radar coverage, report density).

Radar example – July 21, 2012

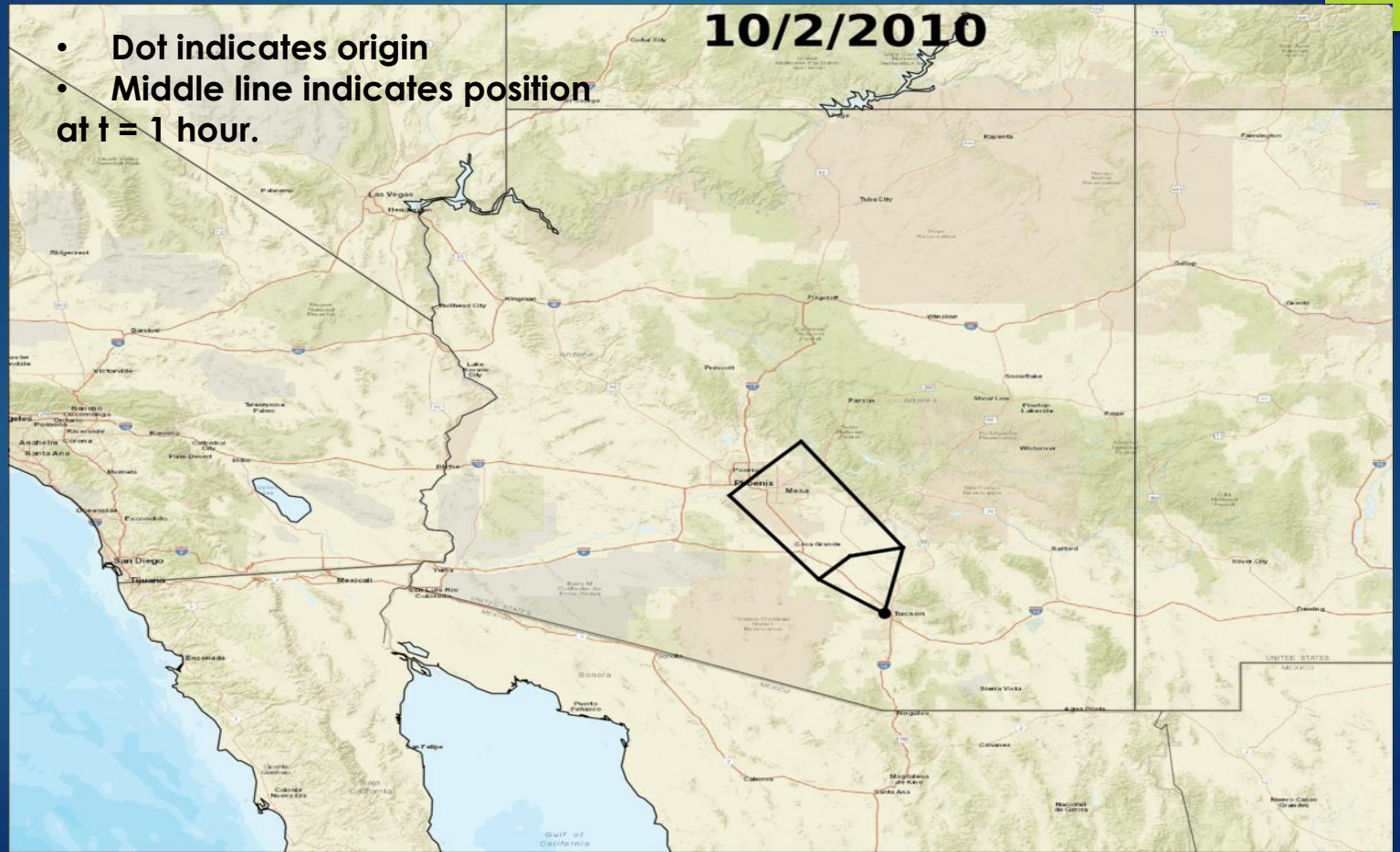


Origin points

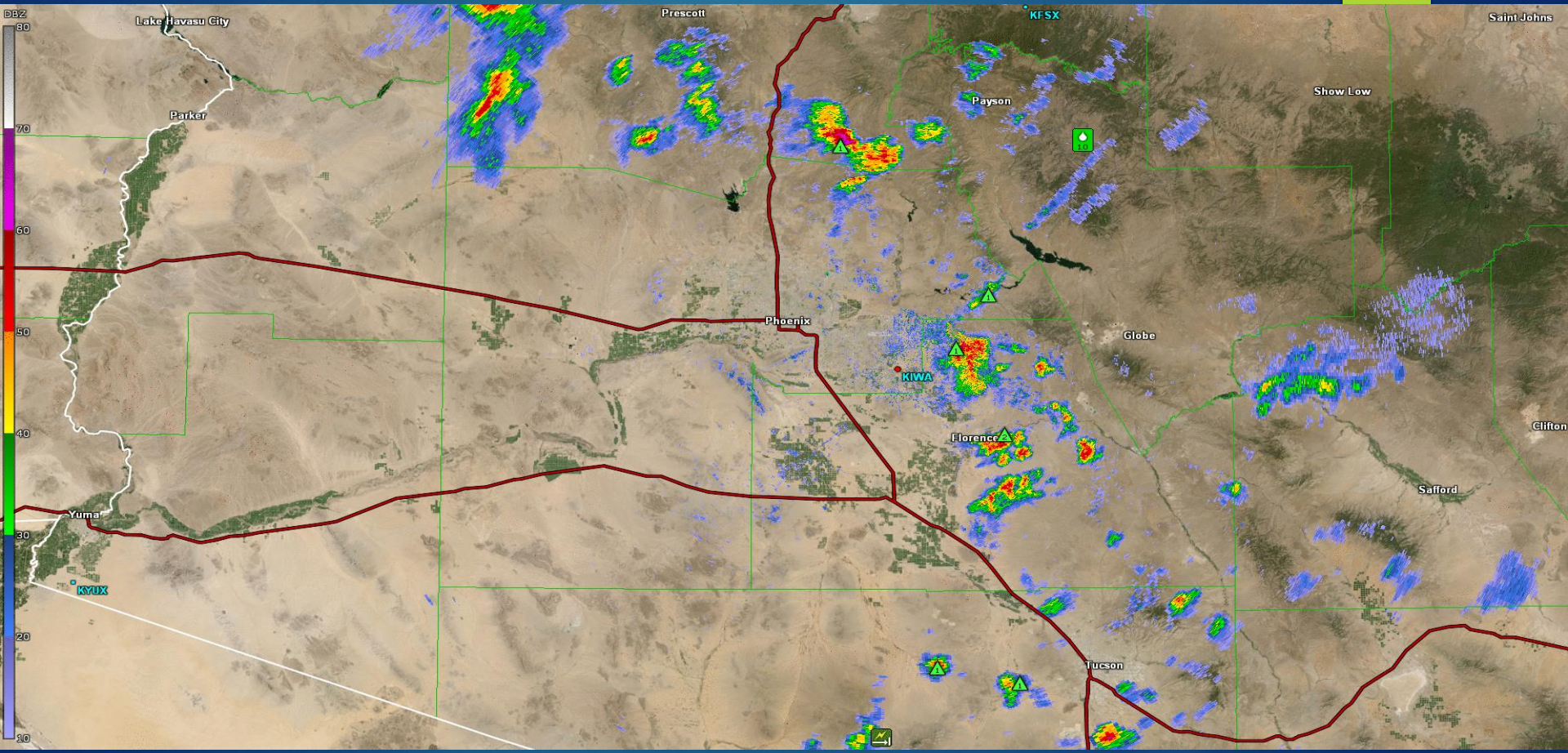


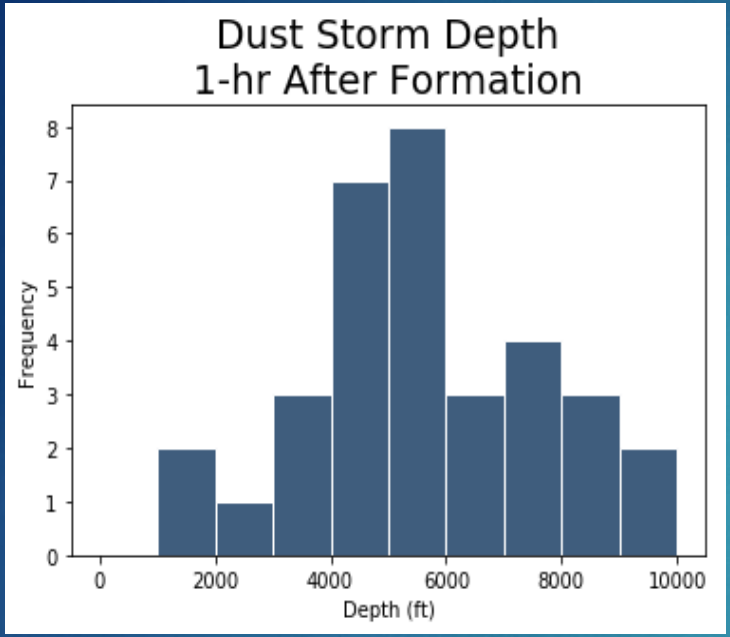
- Origin point of outflow that eventually produces dust storm.
- Clustered south/east of Phoenix.
- Subset of dust storm outflows originate over higher terrain north and east of Phoenix.

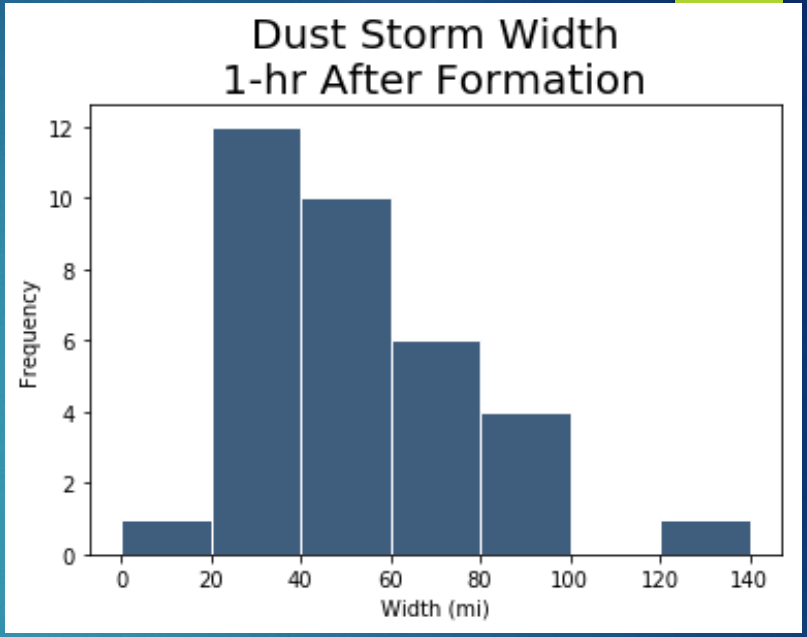
Radar-Analyzed Dust Storm Events



July 9th, 2018 Dust Storm Event

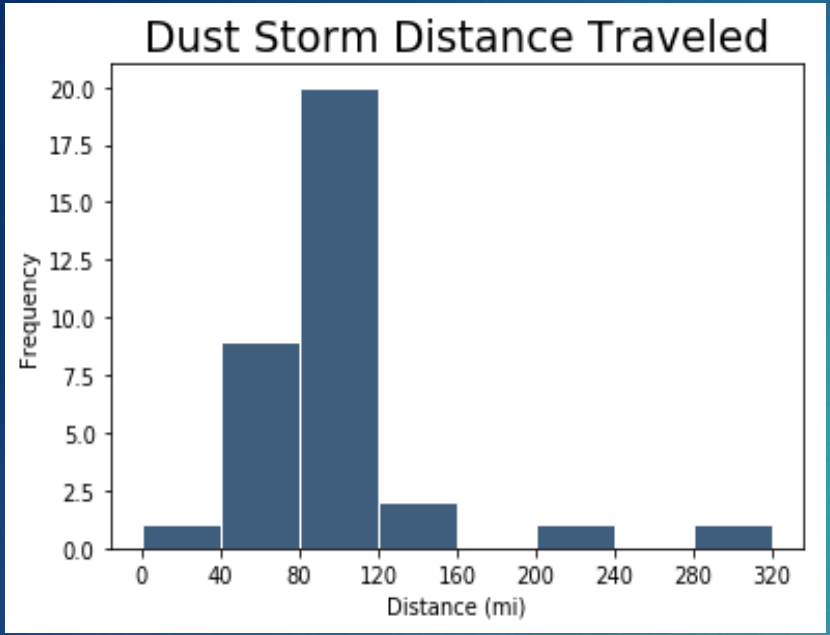


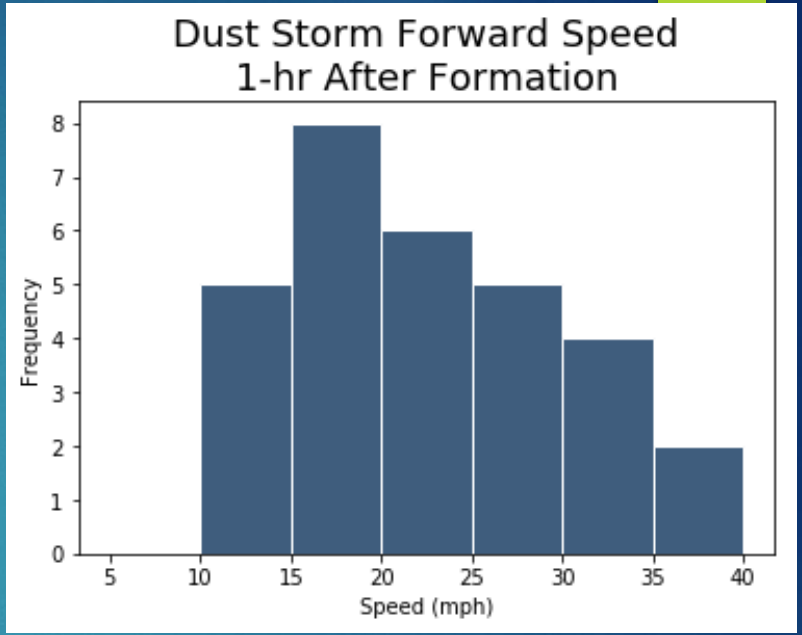




- Median depth: 5600 ft.
- Maximum depth: 9900 ft.

- Median width: 48 mi.
- Often reflects most intense portion of thunderstorm outflow boundary.





- **Median distance:** 89 mi.
- **Maximum distance:** 303 mi.*
- Longest-traveled dust storms generally move west to east.

- **Median forward propagation speed:** 22 mph.
- **Maximum speed:** 37 mph.

* 7/30/2016

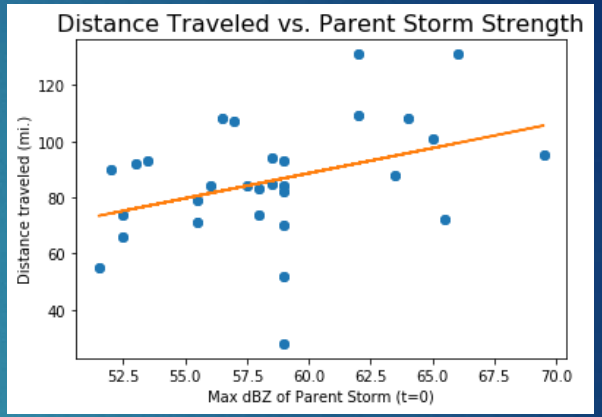
Predictability of Dust Storms

Factors Influencing Dust Storms

- Location of formation
  - Availability of loose dust
- Population
  - Reports
- Strength of parent storms?
- Meteorological environment
  - (e.g., greater boundary layer mixing)
- Orientation of steering flow
- Convection regenerating behind outflow

Predictability of Dust Storms

- Potential Ways to Characterize Dust Storm Intensity:
  - Dust Storm depth (t = 1 hr)
  - Dust Storm path length
    - Dependent on orientation of flow.
  - Regeneration of convection
  - Environment (not covered).



- Very small influence of parent storm strength (surface reflectivity) vs. length traveled.

- Otherwise, predictability via storm-scale characteristics is very low.

Conclusions

- Dust storms maximized between Phoenix and Tucson corridor.
- Most travel <100 mi. On occasion (once every 4 years on average), can travel > 200 mi.
- Predictability of characteristics using storm-scale attributes is low.
- Future work to consider incorporating environmental information, null cases, and population weighting.

Credit: Chris Frailey. 2 July 2014

Thank you!

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