

RISING FROM THE DUST THE PHOENIX DUST STORM (PHX-DUST) SCALE

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- Twenty-two authors from twelve different groups or agencies, primarily in southern Arizona
 - Researchers, forecasters, local media
 - Maricopa County Air Quality District (MCAQD)
 - Maricopa County Flood Control District (MCFCD)
- Collaborative, outreach-focused, “simple”

WHY MAKE A DUST SCALE?

- Unique location: need for a local method of classifying dust, ample monitoring – synoptic vs convective
- Public outreach: education on dust hazards, awareness
- Management: health and wellbeing, transportation
- Research: how are dust events changing, dust source regions, etc.



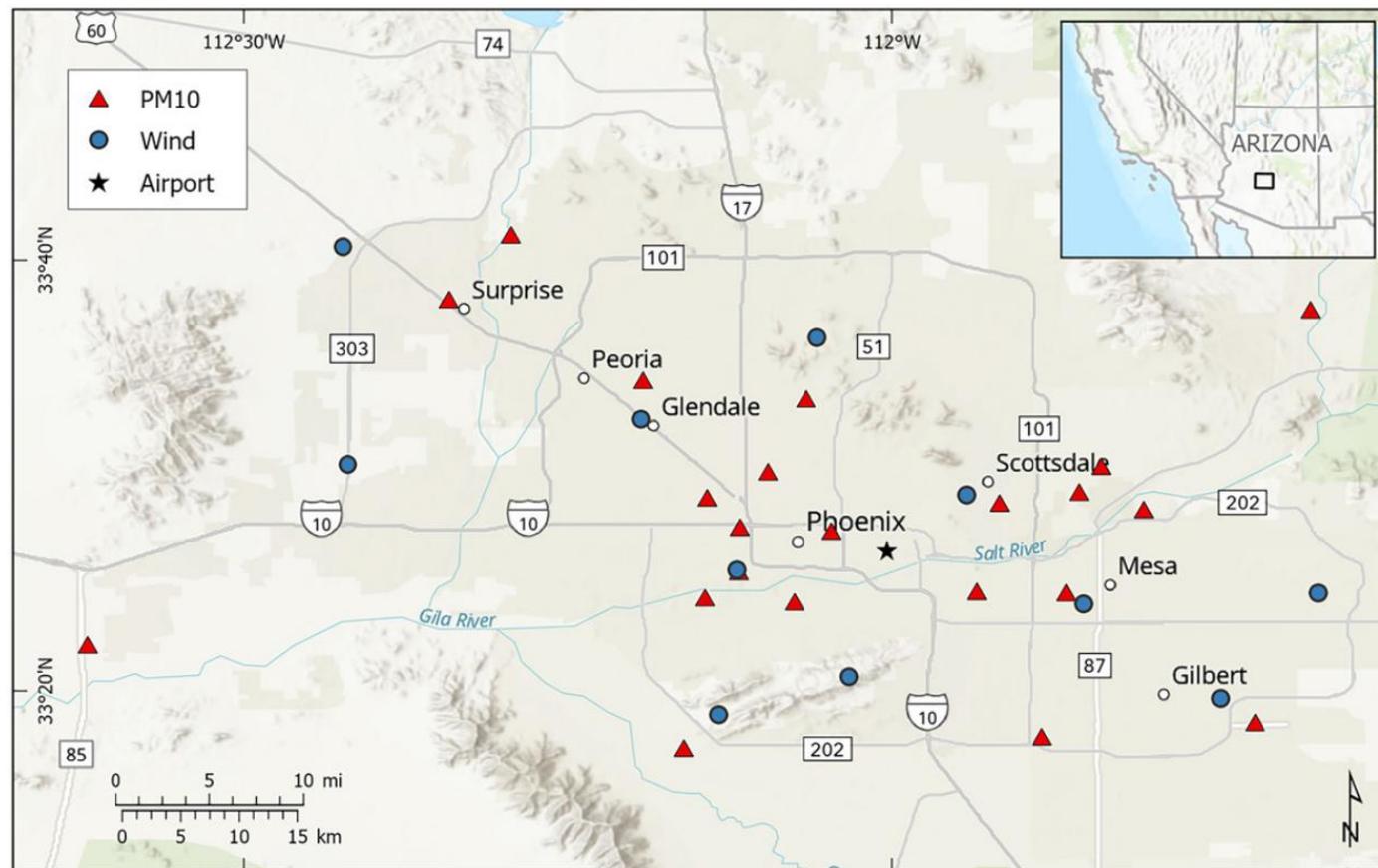
DUST STORMS IN PHOENIX

- Convective: Collapsing storms and/or those with strong outflow boundaries produce strong winds which kick up a “gust front”
- Synoptic: Not all storms are convective, some are synoptic (cold front) during non-monsoon months

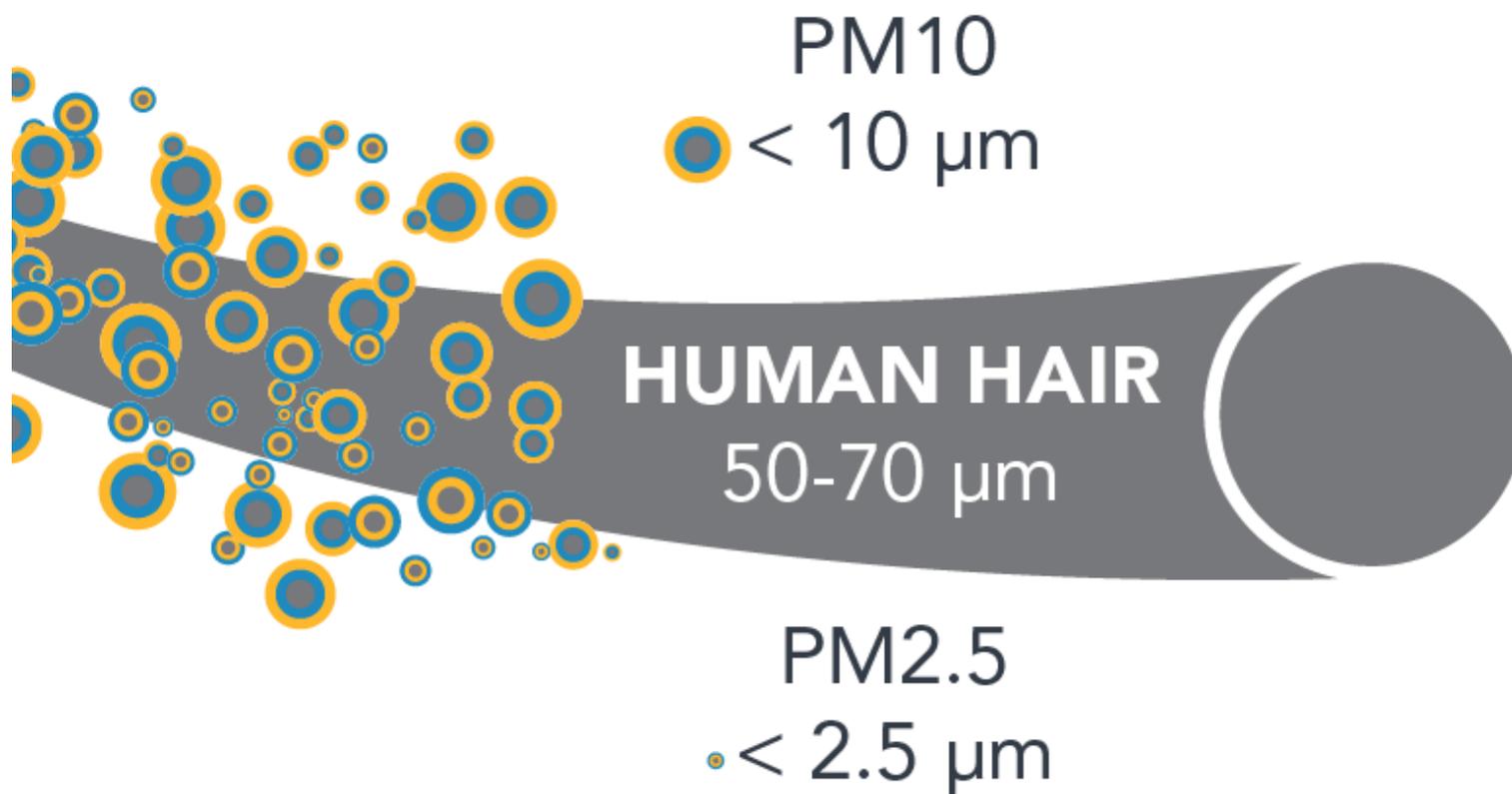


MONITORING DUST & WIND

- MCAQD maintains a network of 22 air monitoring sites, with data starting in 1961
- FCDMC network of 11 wind monitoring locations
- 189 events defined by scale between 2010 and 2023



Particulate Size Comparison



PHX-DUST SCALE CATEGORIES

PHX-DUST	1	2	3	4	5
PHX-DUST primary category					
Minimum PM ₁₀ concentration	1000 $\mu\text{g m}^{-3}$	2000 $\mu\text{g m}^{-3}$	3000 $\mu\text{g m}^{-3}$	4000 $\mu\text{g m}^{-3}$	5000 $\mu\text{g m}^{-3}$
PHX-DUST secondary categories					
Spatial coverage (% of stations over 500 $\mu\text{g m}^{-3}$)				Widespread (<i>W</i>) dust: over 50%	
				Isolated (<i>I</i>) dust: under 50%	
Duration (hours with at least 1 station exceeding 500 $\mu\text{g m}^{-3}$)				Long (<i>L</i>) duration: over 3 h	
				Short (<i>S</i>) duration: under 3 h	
Wind gust (peak wind gust in miles per hour)				High wind gust (<i>H</i>): 25+ mph	

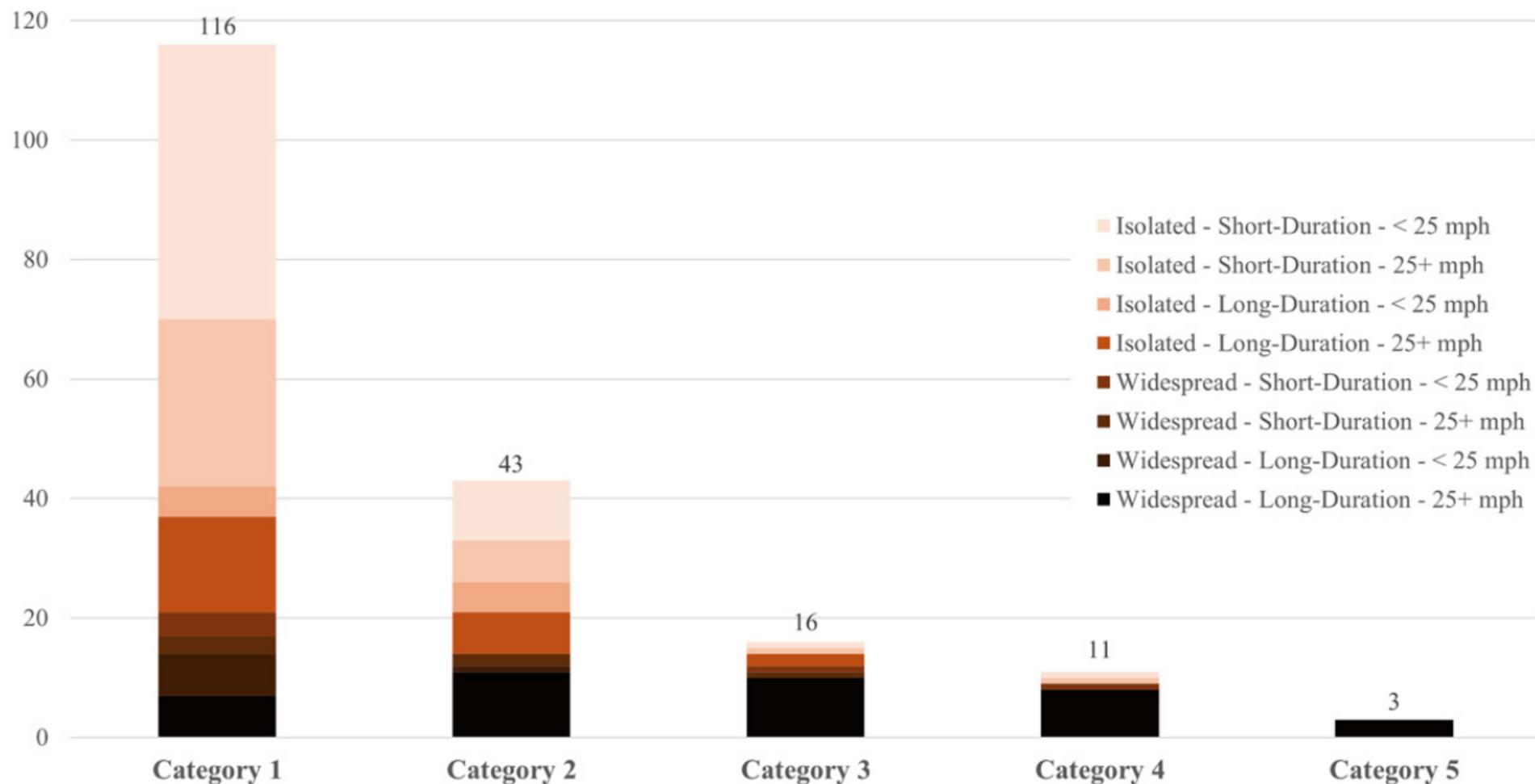


FIG. 3. Histogram of the 189 dust events affecting the Phoenix metropolitan area between 2010 and 2023, categorized by dust concentration ($\mu\text{g m}^{-3}$), spatial coverage (% of network covered by $500 \mu\text{g m}^{-3}$ or higher concentrations), time duration (h), and wind speed (mph, 25 mph, 11.2 m s^{-1}) over the network (English units of wind speed are used for general public accessibility).

JULY 5, 2011

CATEGORY 5 - WLH

Greatest hourly concentration of 6,348 $\mu\text{g}/\text{m}^3$
100% of stations exceeded background concentration
Duration of 6 hours
Peak wind gust of 49 mph

	Category 5 – WLH Widespread, Long-Duration, High Wind Gust	Category 5 – WLH Widespread, Long-Duration, High Wind Gust	Category 4 – WLH Widespread, Long-Duration, High Wind Gust	Category 3 - WLH Widespread, Long-Duration, High Wind Gust	Category 2 – WLH Widespread, Long- Duration, High Wind Gust	Category 1 – ISH Isolated, Short-Duration, High Wind Gust
	5 July 2011	31 August 2023	18 August 2011	26 August 2013	4 November 2011	29 July 2012
Maximum PM₁₀ Concentration (µg/m³)	6348 µg/m ³	5803 µg/m ³	4373 µg/m ³	3242 µg/m ³	2745 µg/m ³	1134 µg/m ³
Spatial Coverage (%)	100%	73%	100%	58%	100%	33%
Duration (hours)	6 hours	3 hours	5 hours	3 hours	6 hours	2 hours
Peak Wind Gust (mph and m/s)	49 mph (21.0 m/s)	55 mph (24.6 m/s)	37 mph (16.5 m/s)	29 mph (13 m/s)	33 mph (14.8 m/s)	35 mph (15.5 m/s)
						

AUGUST 25, 2025

CATEGORY 2 WSH

Greatest hourly concentration of 2,076 $\mu\text{g}/\text{m}^3$

Rain followed within a few minutes of the dust in many of the locations,
bringing down the dust concentrations almost immediately



PHX-DUST LIMITATIONS?

- Being limited to hourly average concentrations could miss “peak”
- However, aligns well with sustained exposure to dust hazards
 - Subcategories still defined as a strong wind event, widespread dust impacts



PHX-DUST LIMITATIONS?

- Darker inside storm may have been due to lofted dust above surface
 - Highlights that visual characteristics aren't the best measure for intensity
- This scale is meant for post-event analysis
- PHX-DUST scale isn't set in stone!



Melanie Metz Storm Chasing

FUTURE OF PHX-DUST SCALE

- Increased public awareness and engagement - PHX-DUST website
 - Brief writeups and data available within a day of the event (depending on when the storm happens)
 - Available before start of 2026 monsoon season
- Opportunities for future research



THANK YOU! QUESTIONS?

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Link to BAMS article

