

Classification of Dust Storms in Phoenix AZ and Their Implication on Air Quality



Greg McCown / saguaropictures.com

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2021 Arizona Dust Workshop

Strong winds associated with dust storms are a result of two different meteorological disturbances

Dust storm vs Haboob (Synoptic vs. Convective)

Synoptic – scale used in meteorology that ranges from hundred of kilometers

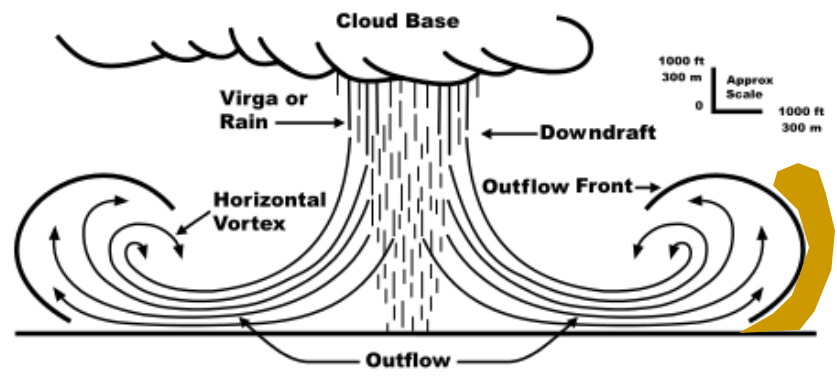
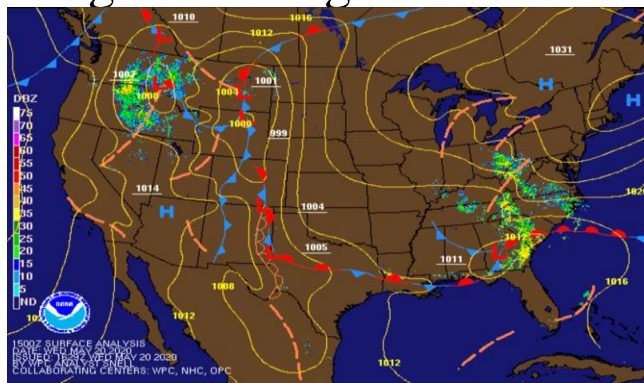
(AMS Glossary, 2012)

- Front (warm and cold)
- Cyclones (low and high)
- Troughs and ridges

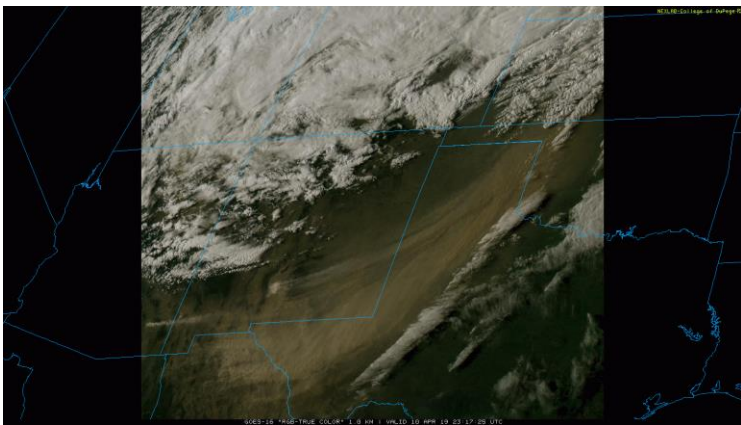
Convective – quick increase of winds as a result of a thunderstorm

- Outflows
- Micro- and macroburst
- Downburst

NOAA NWS Archive, 2020



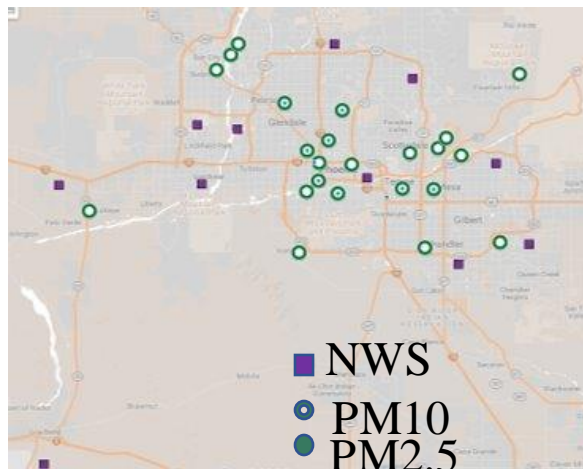
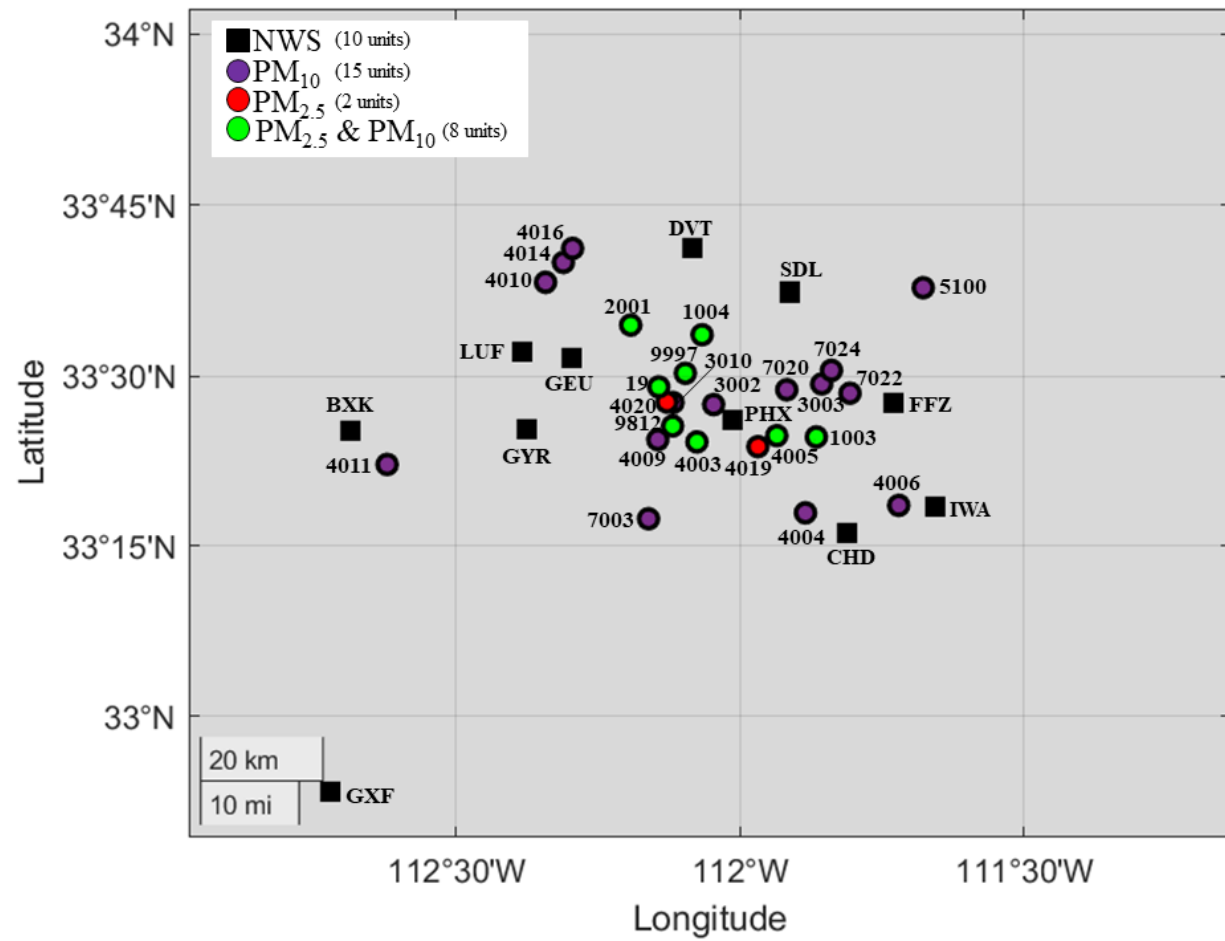
wikipedia



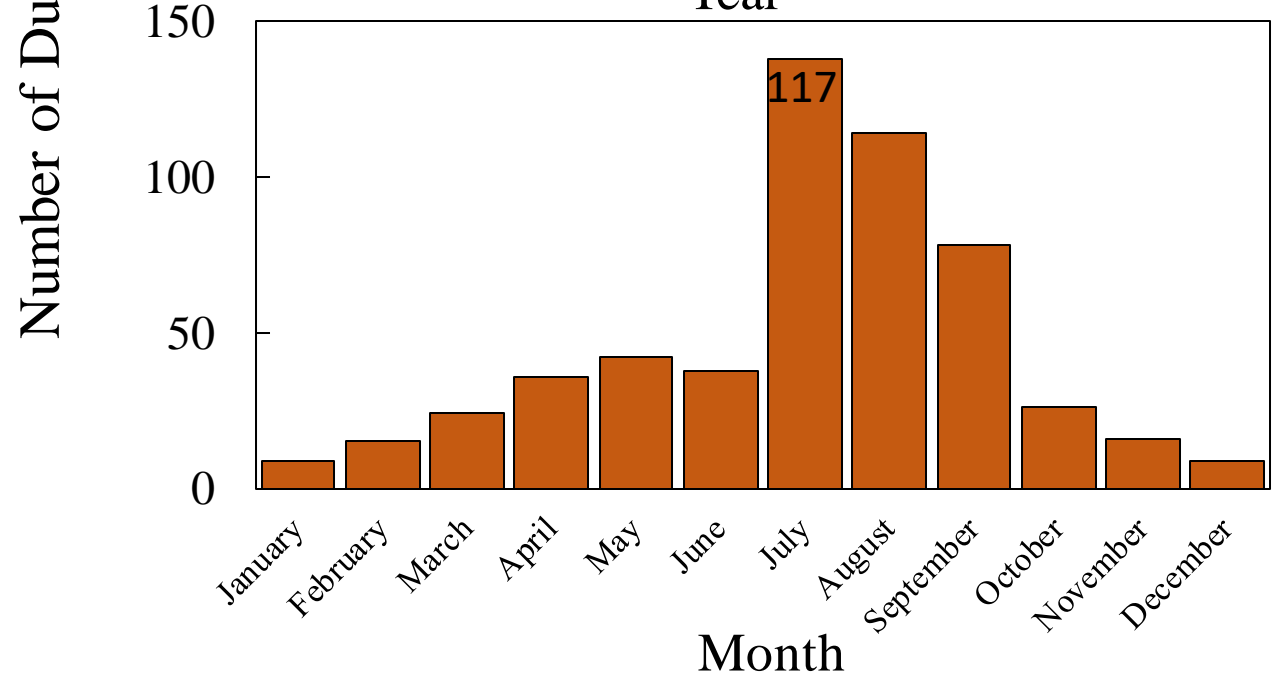
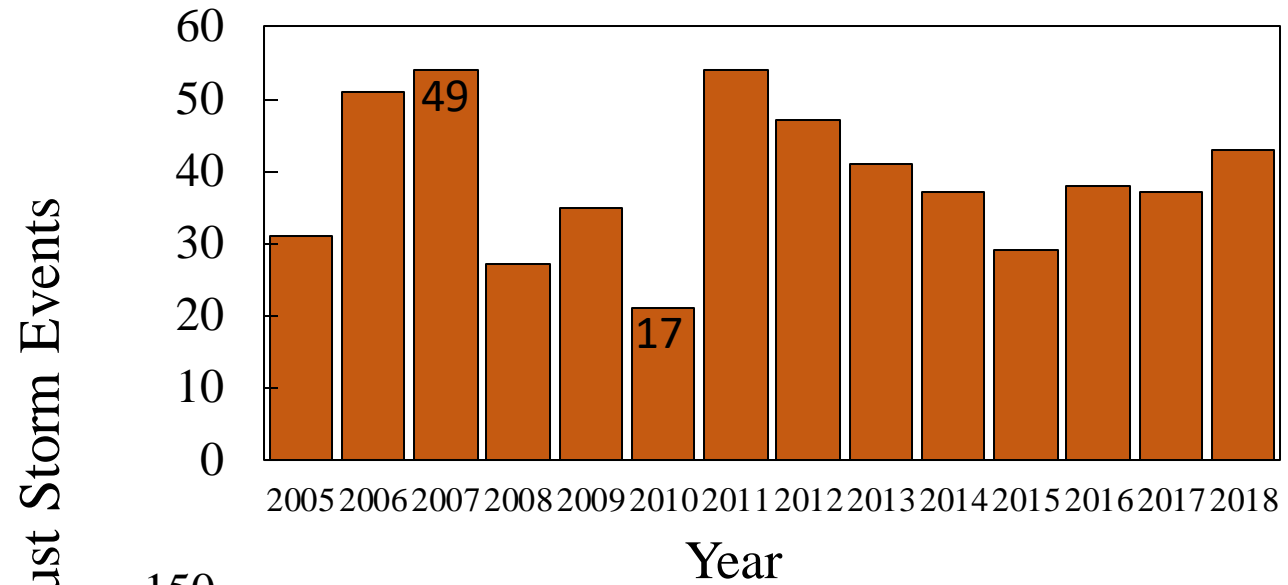
Gifbay.com

Methodology

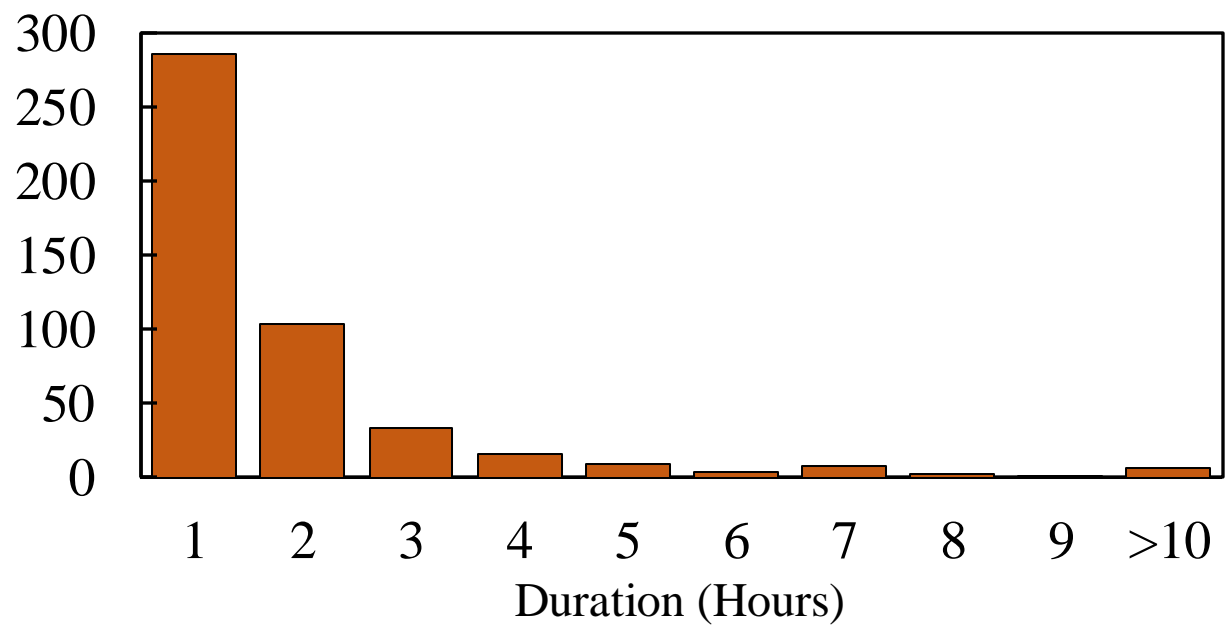
- 10 NWS station in Maricopa county (2005-2018)
METAR weather codes: BLDU (Blowing Dust), DS (Dust Storm), or DU (Widespread Dust).
AFD (Area Forecast Discussion) and NOWPSR (Short Term Forecast) reports for cause.
- Particulate Matter station
8 stations with $PM_{2.5}$ (2010-2018) & PM_{10} (2005-2018)
15 PM_{10} station (2005-2018)
2 $PM_{2.5}$ station (2014-2018)



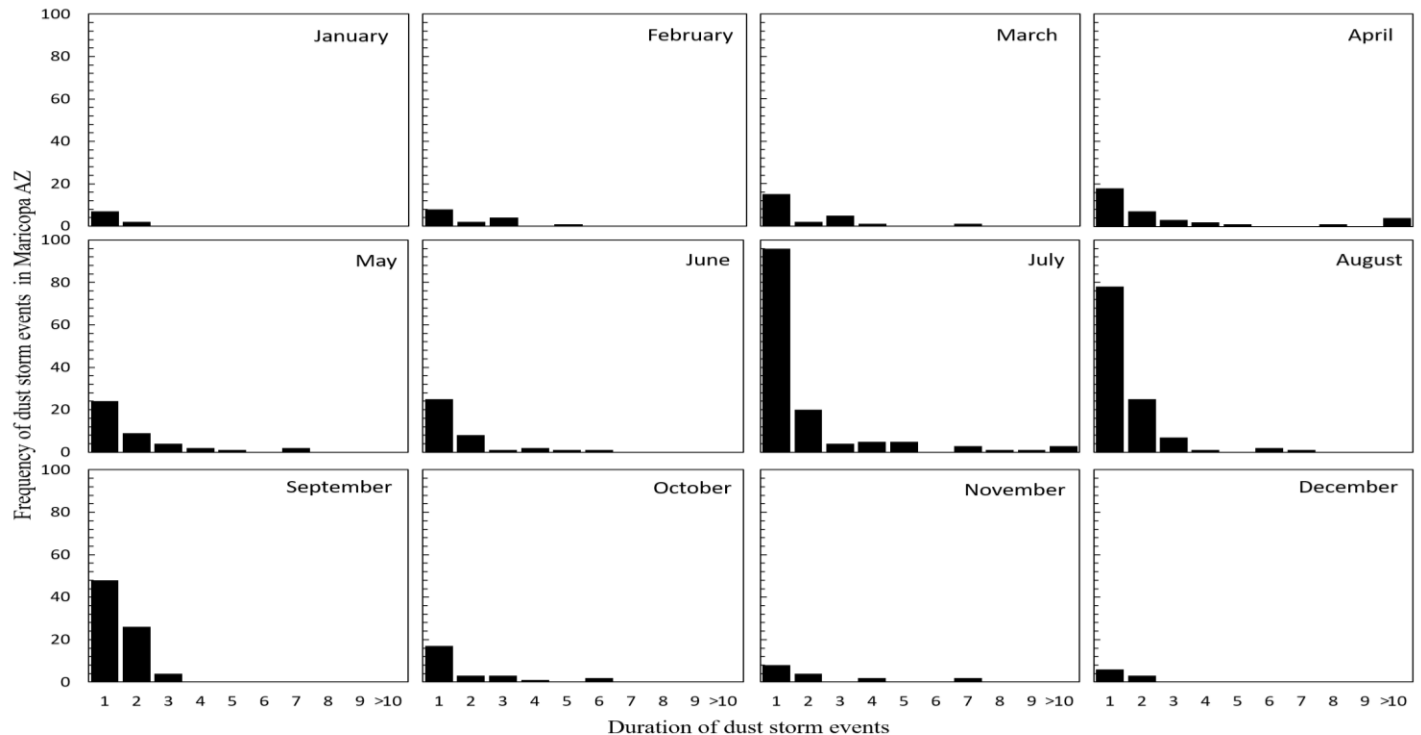
Frequency of dust storm events based on NWS reports (471 dust storms)



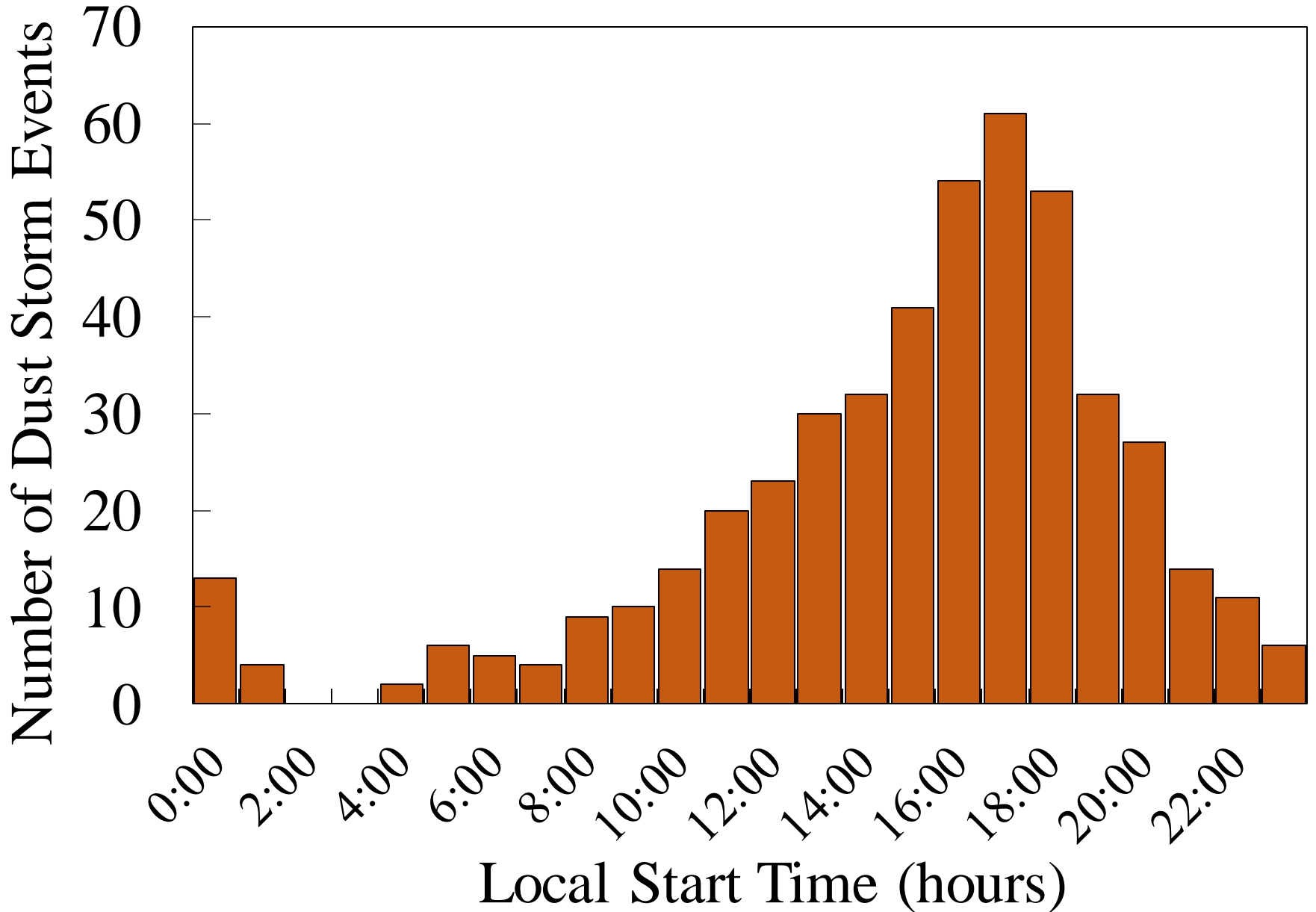
Number of Dust Storm Events



- Majority ($\approx 60\%$) of DS lasted one hour.
- Nearly all ($\approx 95\%$) had a duration between 1-5 hours.



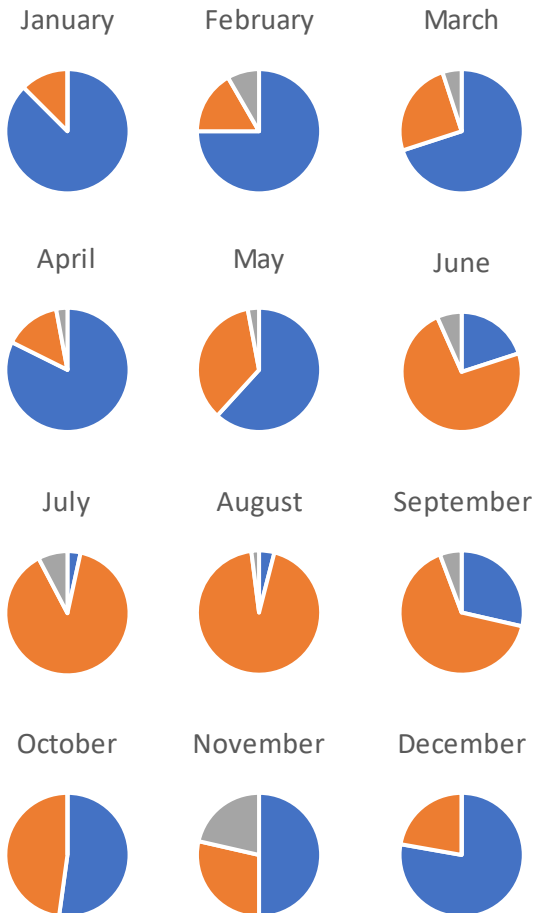
Most Dust storm occur in late afternoon early evening



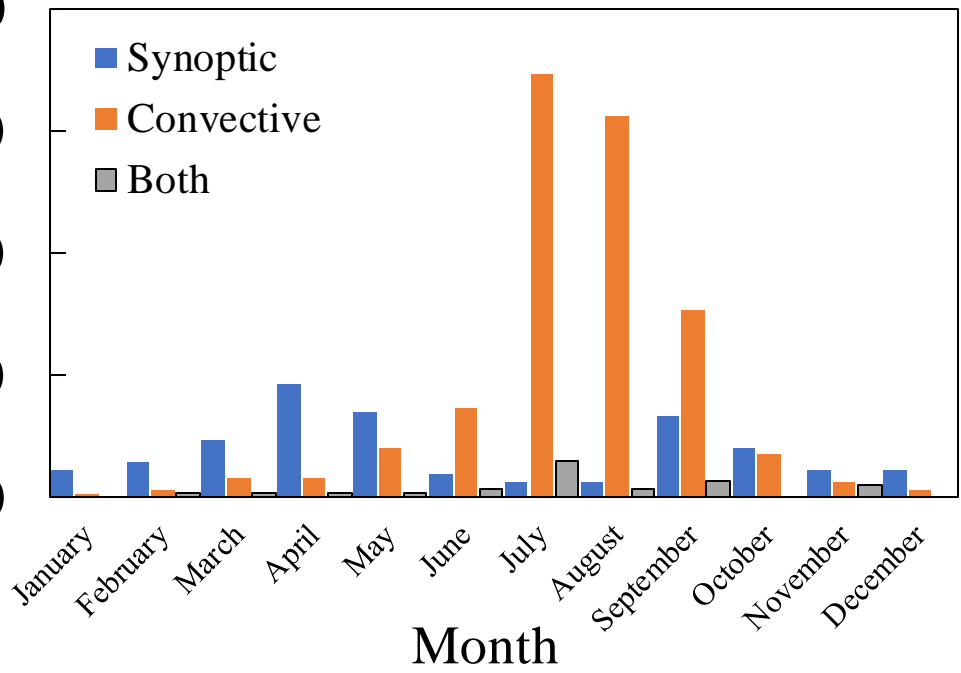
Cause for DS

- 308 Convective DS
- 139 Synoptic DS
- 24 Both DS (Synoptic + Convective)

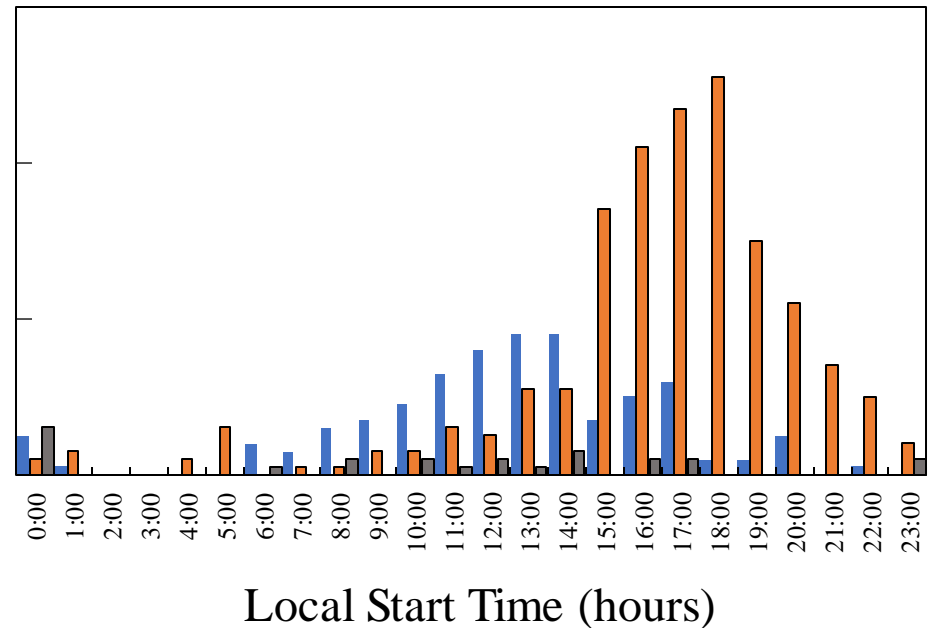
Frequency of Dust Storm cause per month



Number of Dust Storm (days)

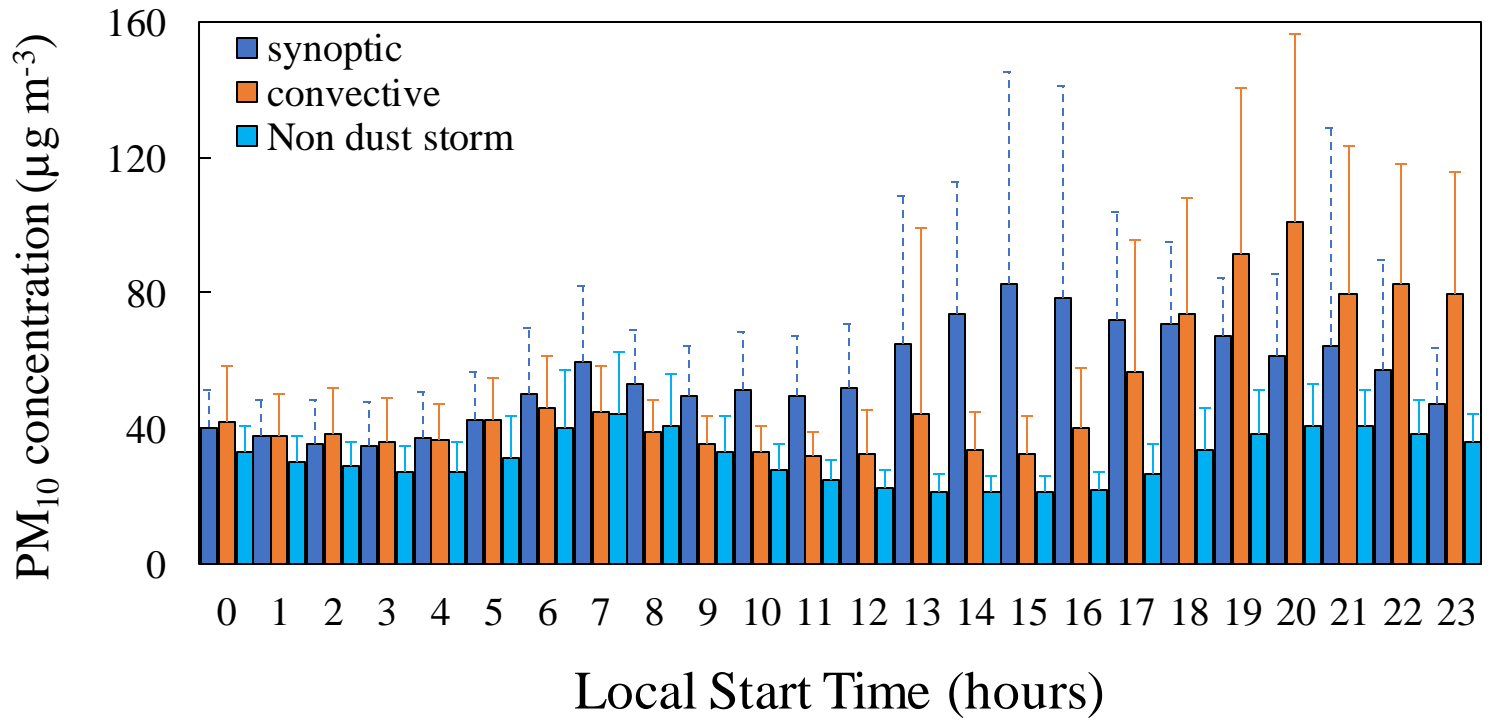
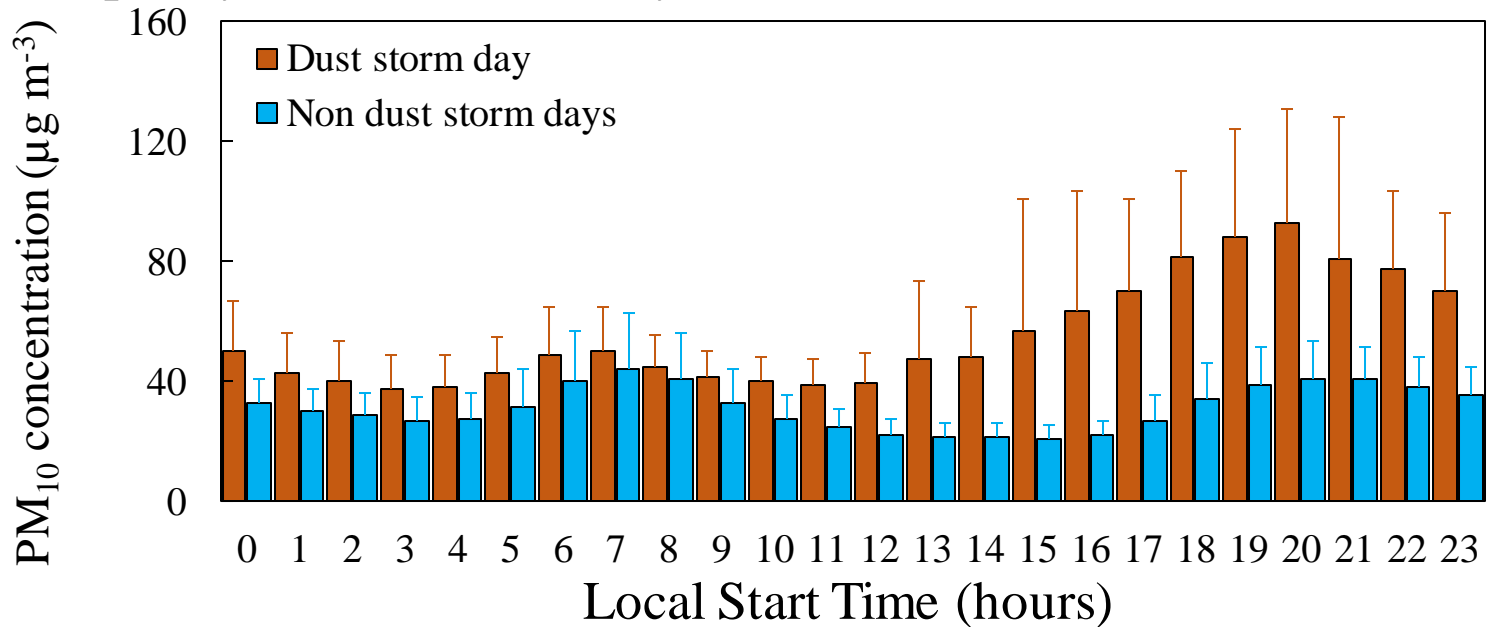


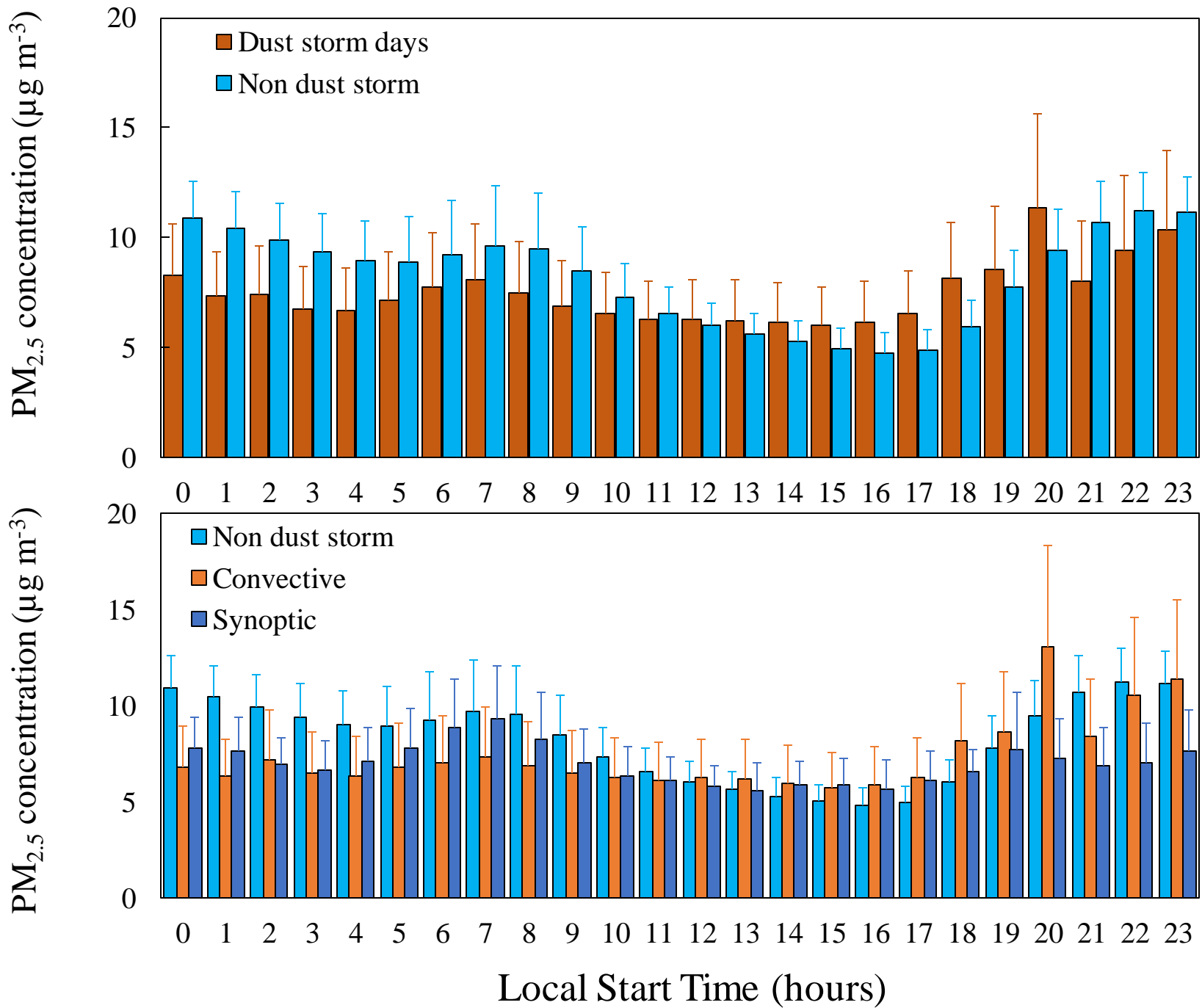
Number of Dust Storm (days)



Local Start Time (hours)

Impact of Air quality on dust storm days



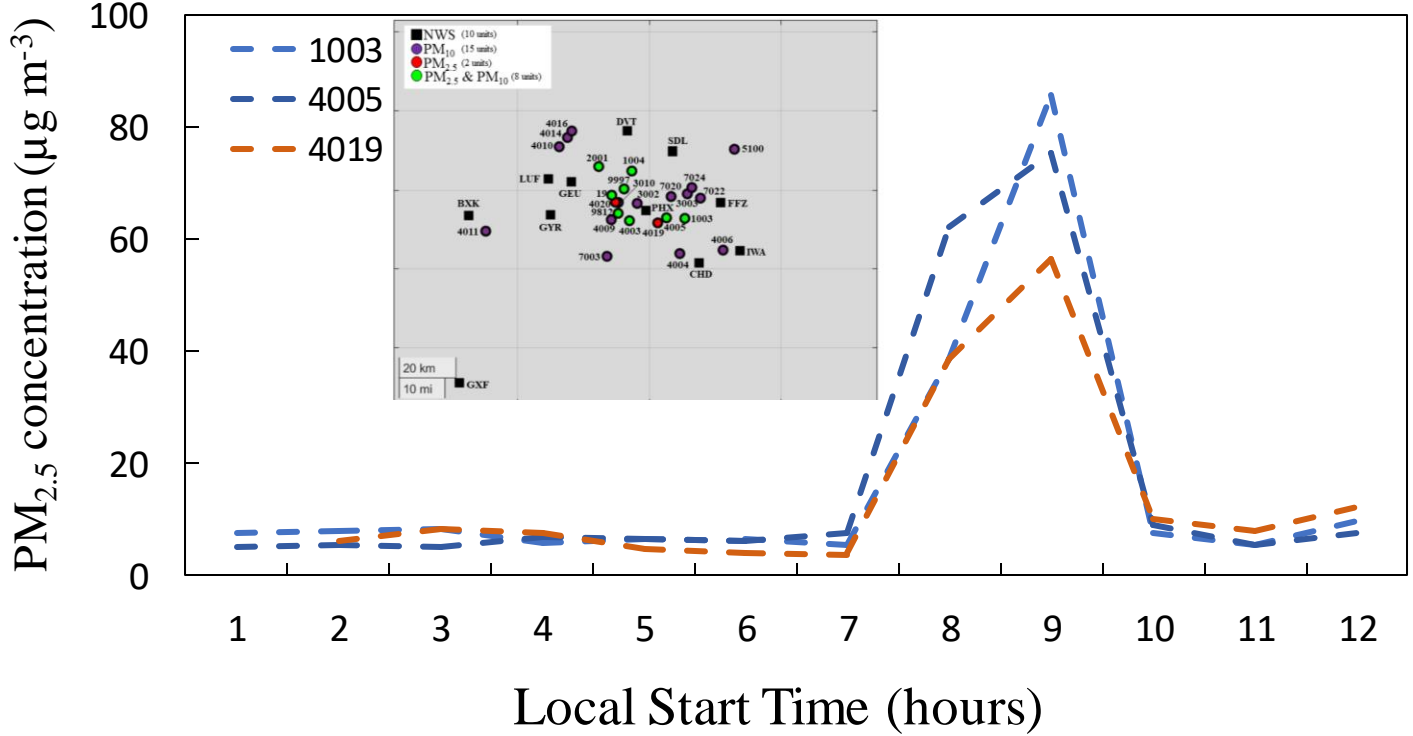
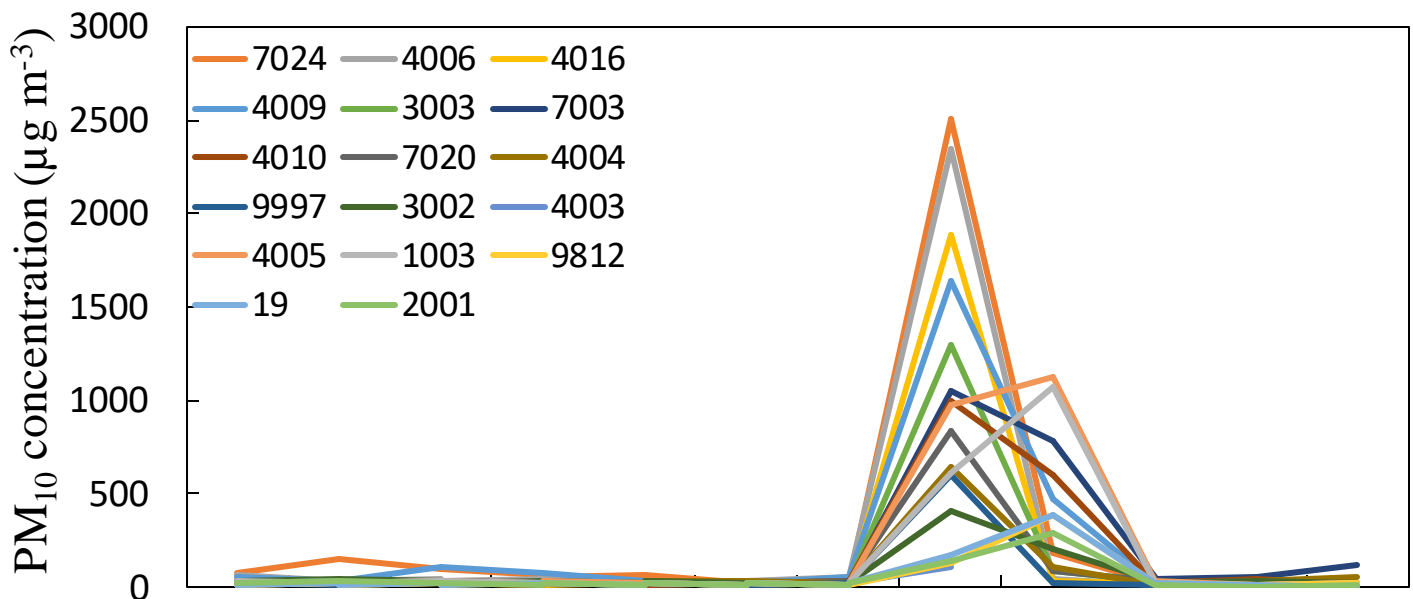


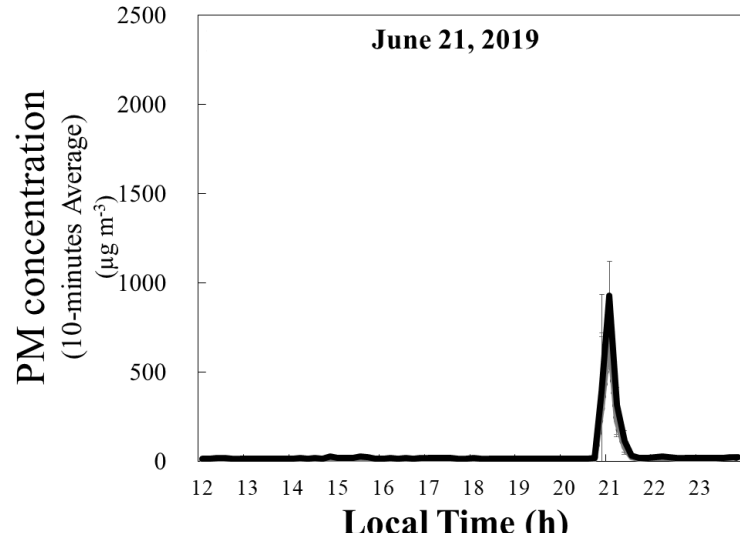
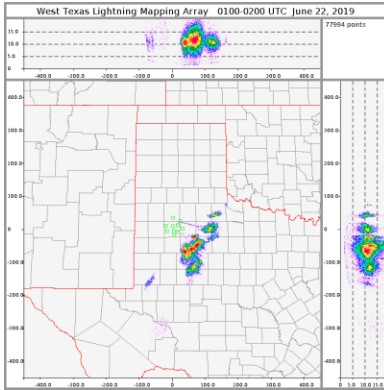
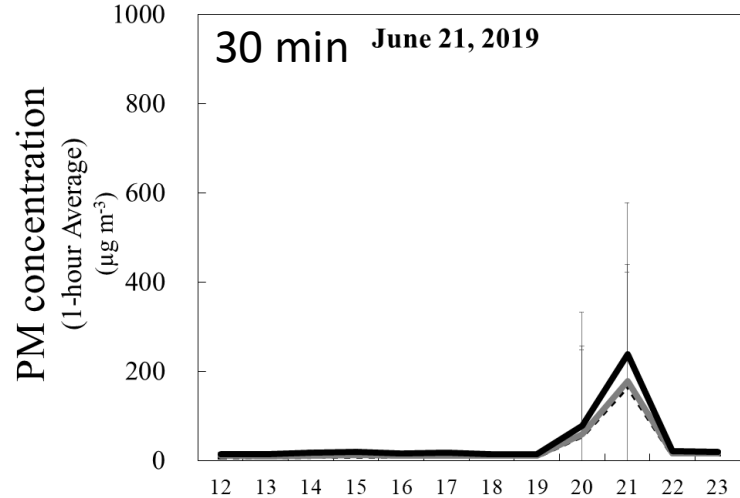
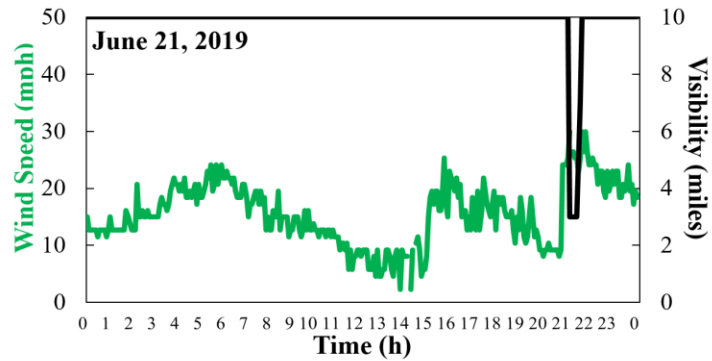
July 30, 2018

Daily Averaged

	Station ID	ave	SD
PM2.5	1003	12.8	17.0
	4005	12.0	17.8
	4019	13.5	12.6
PM10	7024	166.3	499.4
	4006	153.6	469.5
	4016	156.5	389.5
	4009	197.5	328.7
	3003	95.9	257.6
	7003	167.5	251.5
	4010	164.6	246.6
	7020	76.9	165.2
	4004	111.6	132.9
	9997	64.7	121.0
	3002	67.9	83.3
	4003	59.5	53.4
	4005	127.8	287.0
	1003	108.1	237.5
	9812	78.0	89.6
19	75.5	94.5	
2001	83.7	98.9	

	WHO	EPA
PM _{2.5}	25	35
PM ₁₀	50	150





Main Conclusions:

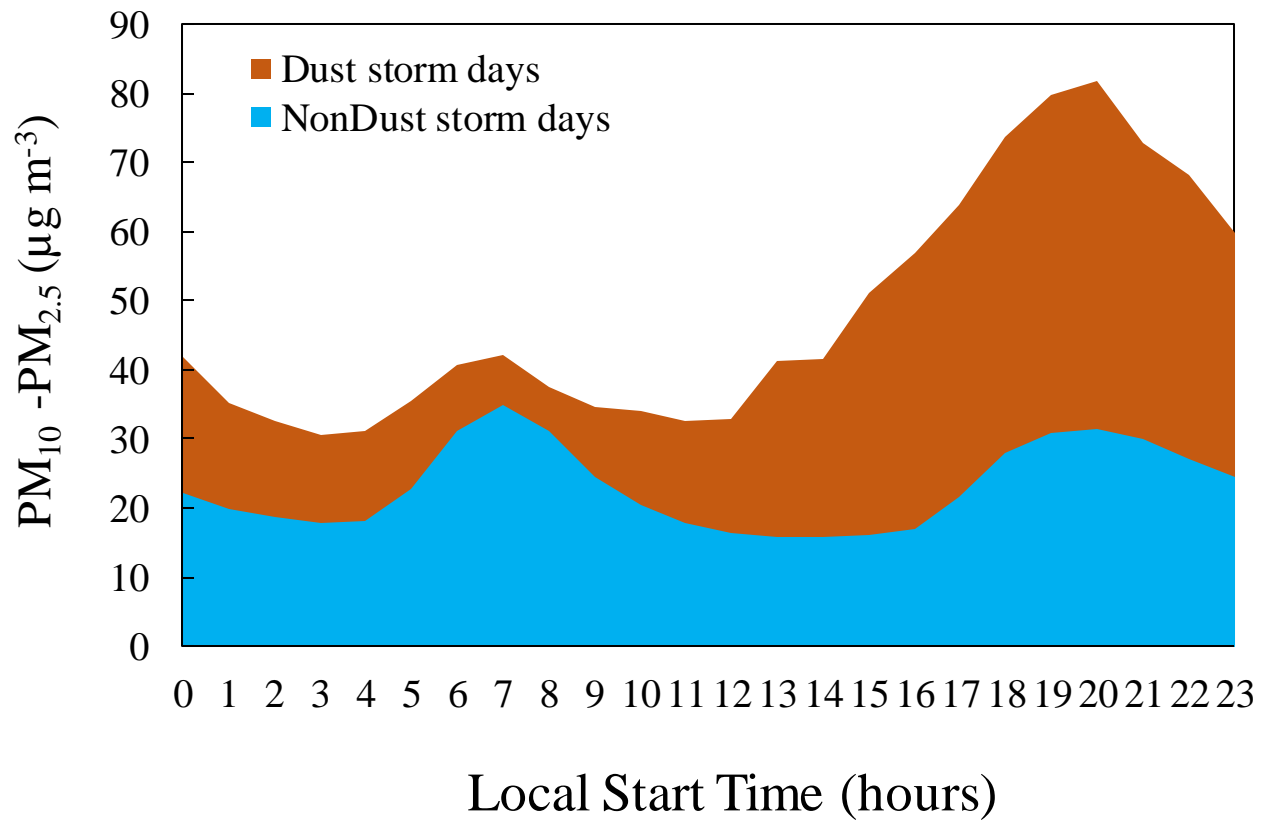
- More than 470 DS events occurred in Maricopa 2005-2018
- Most DS occur in summer months
- Majority ($\approx 60\%$) of DS lasted one hour or less.
- Most Dust storm occur in late after noon early evening
- Majority of the DS are convective
- Time difference found between convective and synoptic DS
- Large impact on air quality was found on PM_{10}



Thank you for your attention

*Please contact me for potential collaborations
Karin.ardon-dryer@ttu.edu*





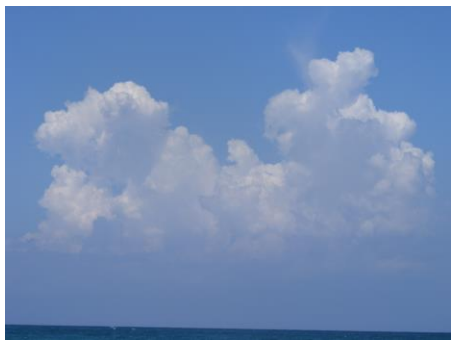
Why should we care about dust storm?



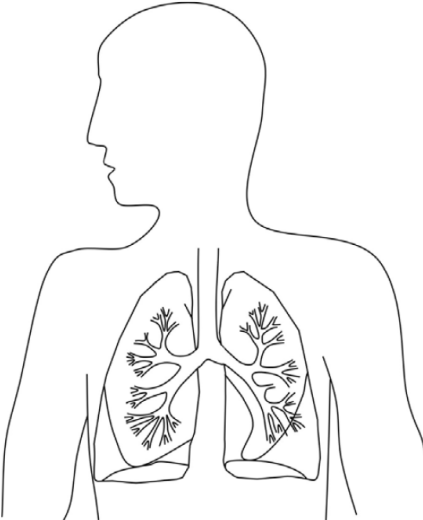
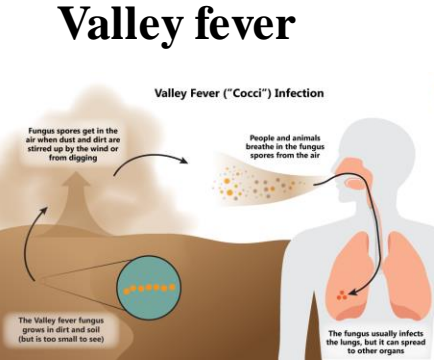
Taken by Julio Reyes



Taken by Joe Merchant



2011-10-17, 17:10:00



Ardon-Dryer et al.2019

Dust particle (diameter size)

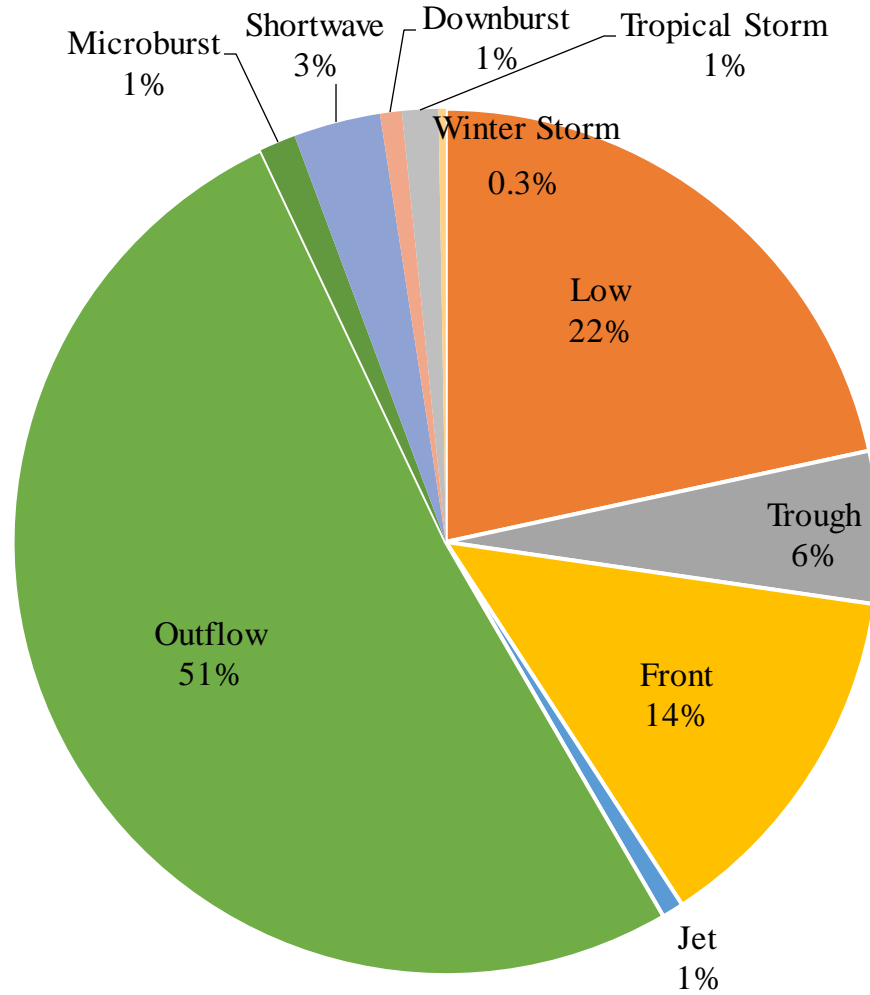
- > 10 μ m
- 2.5-10 μ m
- < 2.5 μ m



2011-10-17, 17:08:27

<https://www.cdph.ca.gov/Programs/CID/DCDC/Pages/Coccidioidomycosis.aspx>

Maricopa Dust Storm Causes 2005-2018



- Low
- Trough
- Front
- Jet
- Outflow
- Microburst
- Shortwave
- Downburst
- Tropical Storm
- Winter Storm