Dust events and Its Impact on Air Quality and Human Health

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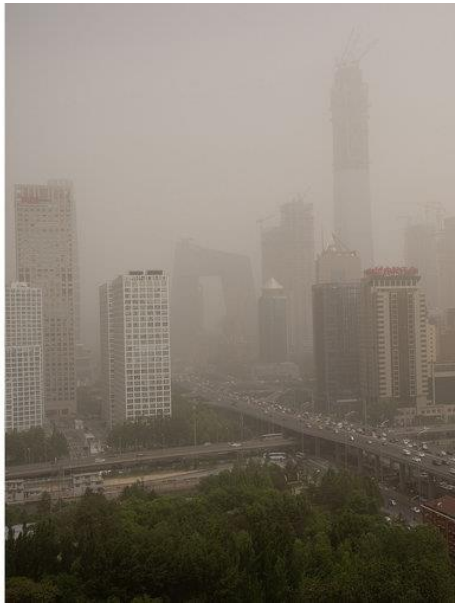
Dust storm vs Dust event

Visibility <1 km ; Visibility <10 up to 1 km (WMO) NWS- ¼ Mile <402 m



https://www.nytimes.com/2017/05/05/world/asia/dust-storms-northern-china-beijing.html?action=click&module=RelatedLinks&pgtype=Article

Sandstorms vs Dust storms

Taken by Prof Haim Zohar

Taken by Dr Eli Ganor

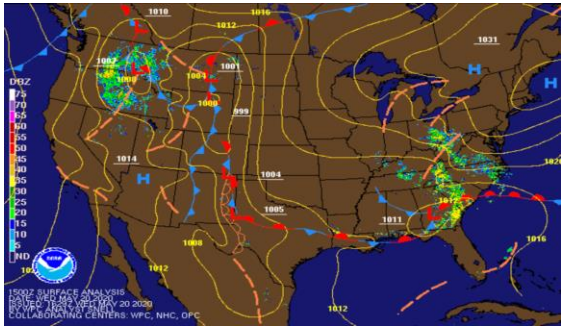
Strong winds associated with dust events are a result of two different meteorological disturbances

Dust storm vs Haboob (Synoptic vs. Convective)

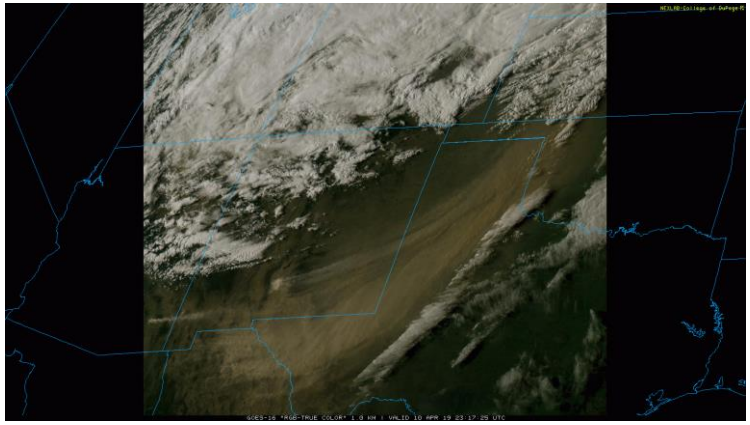
Haboob - Blasting/Drifting/ Windy/ Blowing

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

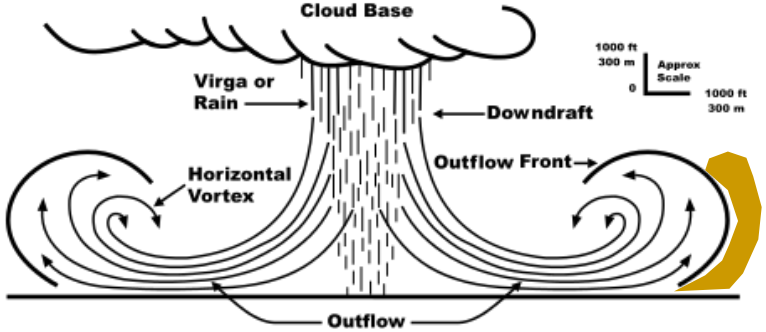


NOAA NWS Archive, 2020



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

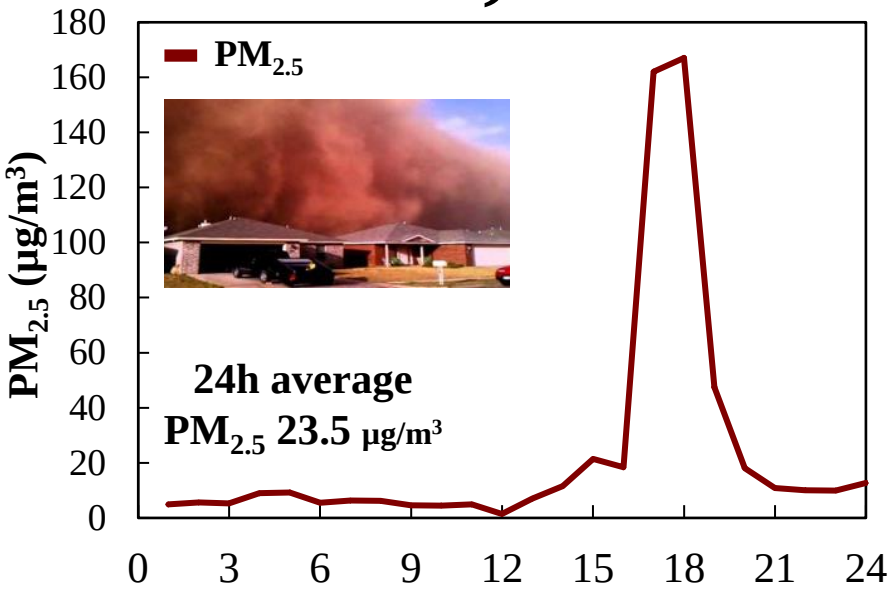
- Outflows
- Micro- and macroburst
- Downburst



wikipedia

Gifbay.com

October 17, 2011



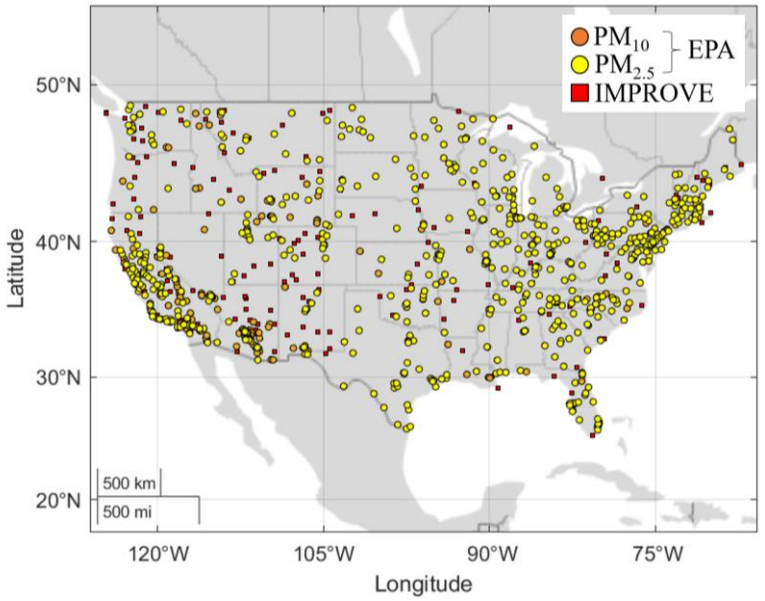
24h	WHO	EPA
$PM_{2.5}$ (µg/m³)	25	35
PM_{10} (µg/m³)	50	150

Average across the day mask the fluctuation (max) of the dust concentration

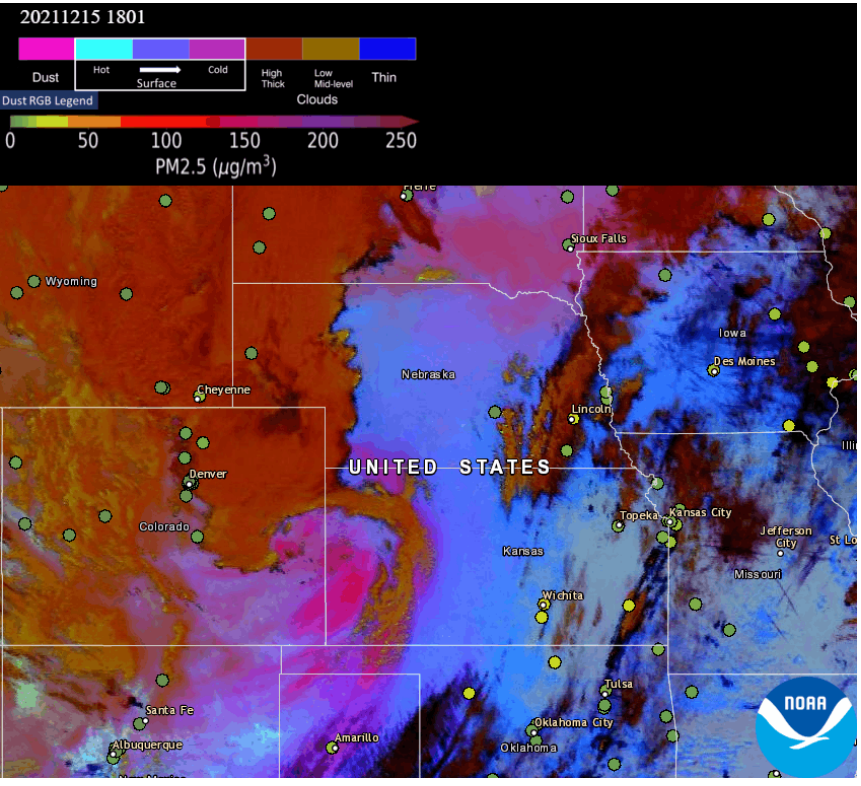
http://www.atmo.ttu.edu/bruning/TTUHaboob-2011Oct17.mp4

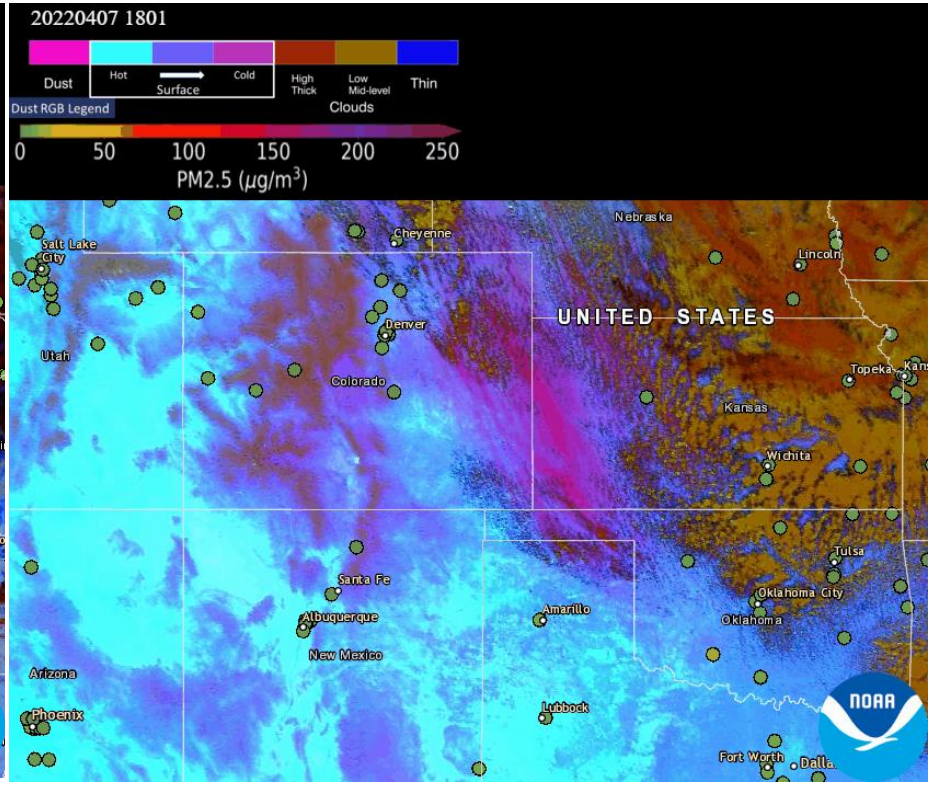
Taken from Dr. Eric Bruning website

Measurement of PM across the USA

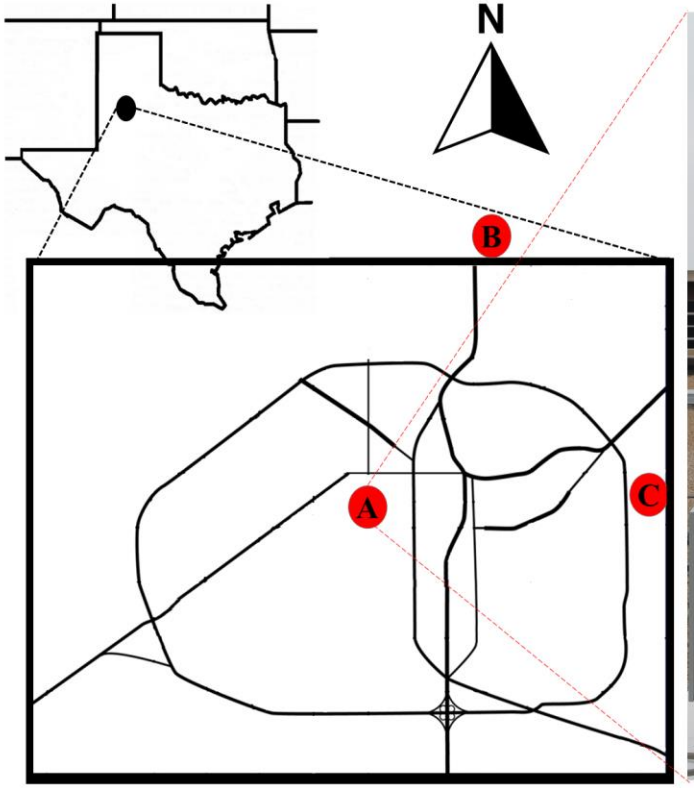


No sensor No Dust





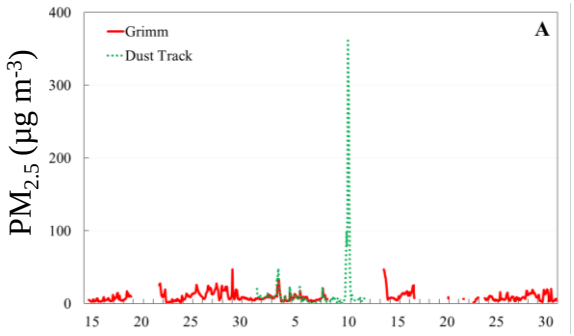
AErosol Research Observation Station (AEROS)



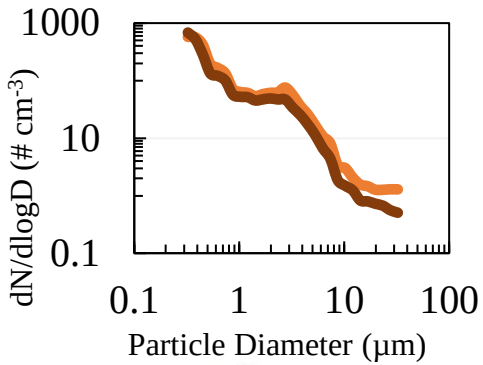
Ardon-Dryer et al. AMT 2022

AErosol Research Observation Station (AEROS)

PM_1, $PM_{2.5}$ PM_4 PM_{10}



Total Particle Concentration & Size Distribution



- Optical Particle Sizer (OPS 3330 - TSI)
- DustTrak DRX aerosol monitor (8533EP - TSI)
- Portable Aerosol Spectrometer (PAS, Grimm-11D)
- Harvard Impactor system
- Filter holder A Davis Vantage Vue® meteorological station

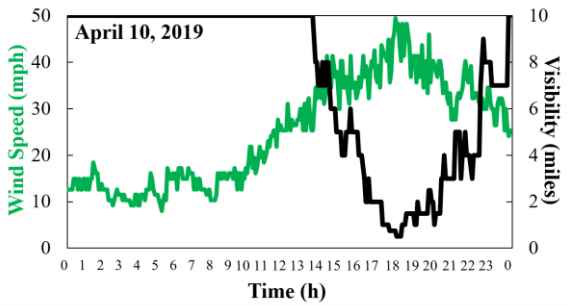
April 10, 2019

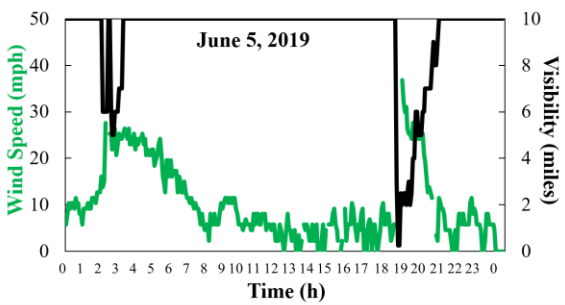
June 5, 2019

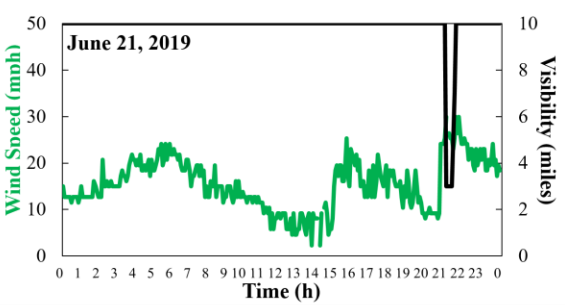
June 21, 2019

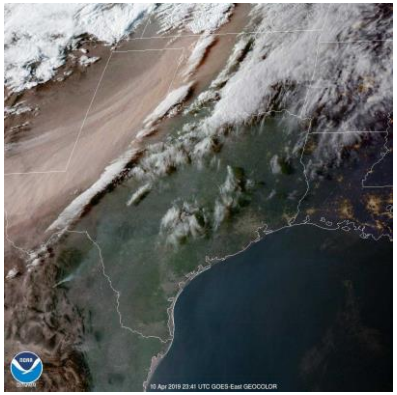
Synoptic event

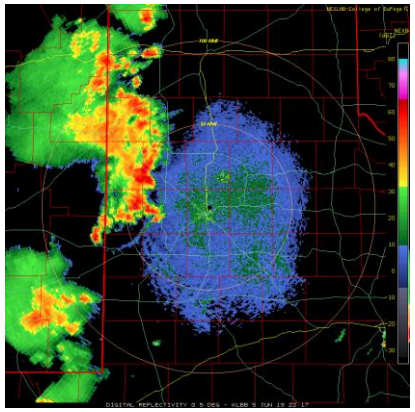
Convective events



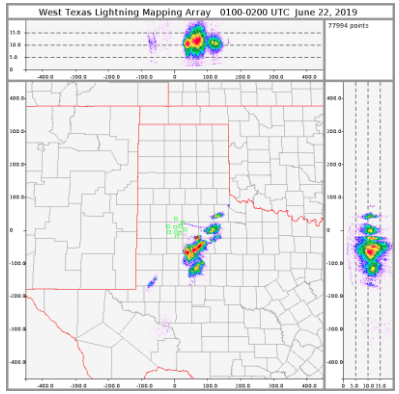








https://www.weather.gov/lub/events-2019-20190605-haboob



http://pogo.tosm.ttu.edu/wtlma/view_rthour.php?date=19062&time=0100&density=1&zoom=0

Ardon-Dryer and Kelley, under review

PM mass concentration

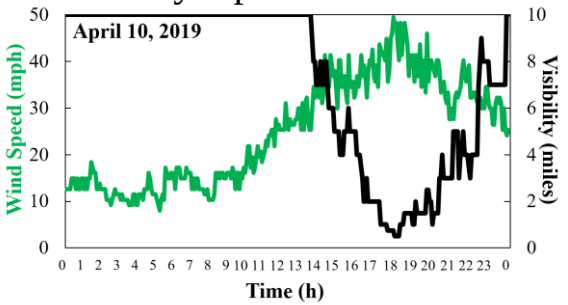
PM Mass Concentration - Daily average

Daily values ($\mu g\ m^{-3}$)	April 10	June 5	June 21
PM_1	64.7 ± 113	21 ± 121	26.5 ± 95
$PM_{2.5}$	72.6 ± 123	22.2 ± 126	27.7 ± 99
PM_{10}	129 ± 195	29.5 ± 184	37.8 ± 129

PM ($\mu g/m^3$)	WHO 24h	EPA 24h
$PM_{2.5}$	25	35
PM_{10}	50	150

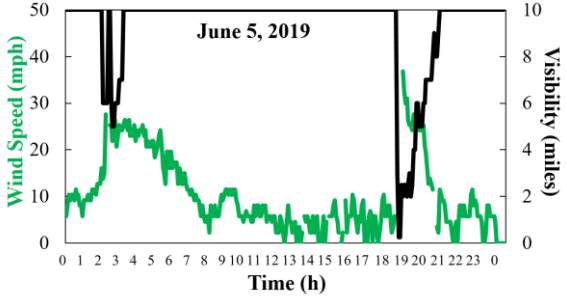
April 10, 2019

Synoptic event

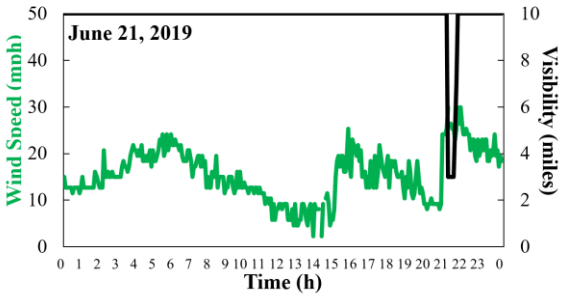


June 5, 2019

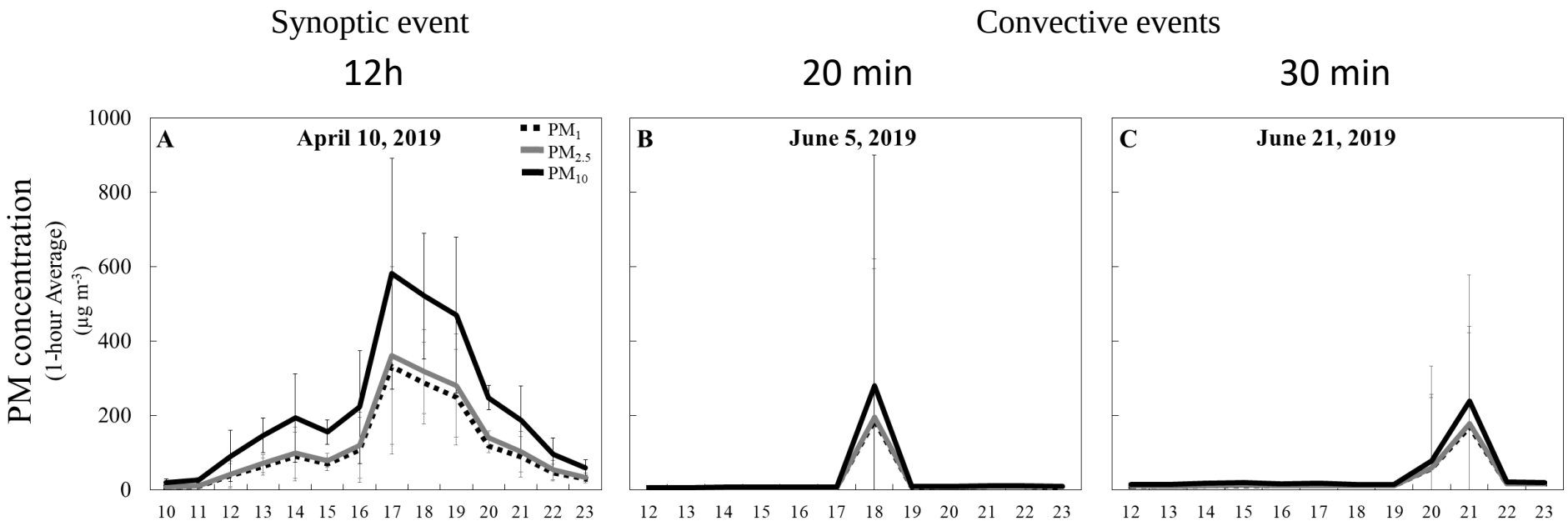
Convective events



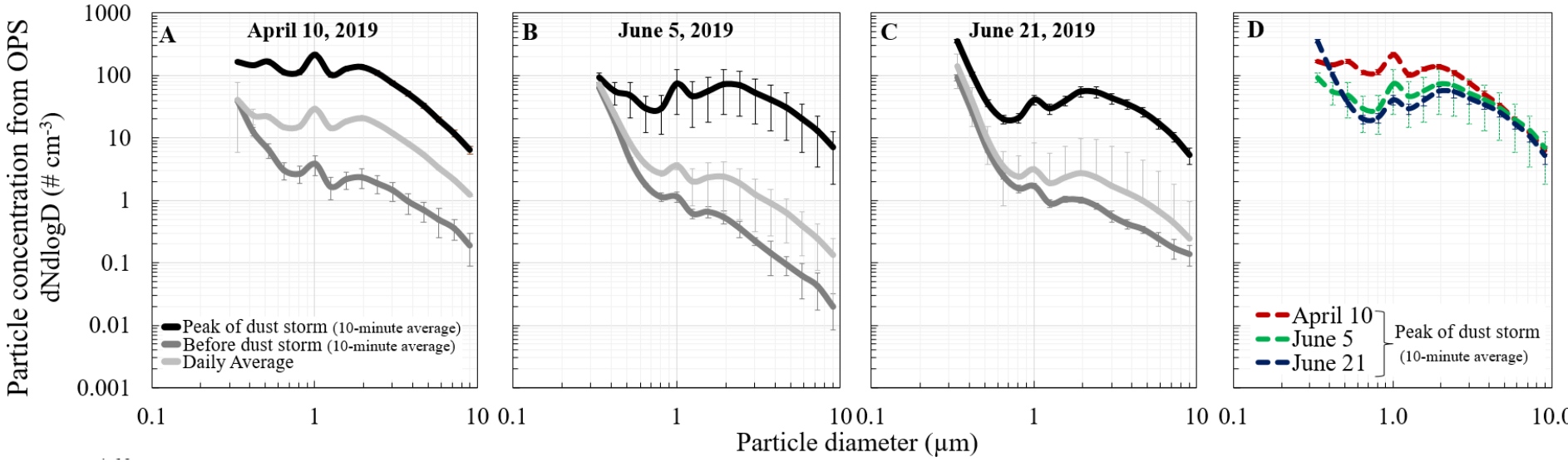
June 21, 2019



PM mass concentration - (µg m^{-3})



A significant difference between the dust particle concentrations when comparing measurements from before the dust storm and at its peak. The dust storms contain a high concentration of smaller particles.

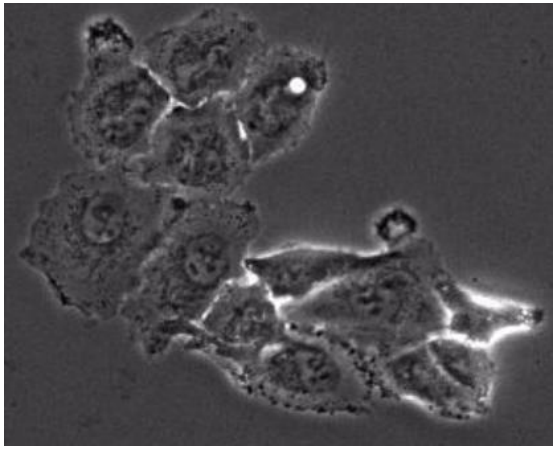


Epidemiological studies, In Vivo (animal) & In vitro (cells) methods

Epidemiological studies

In vivo (animal)

In vitro (cells) Tissue culture



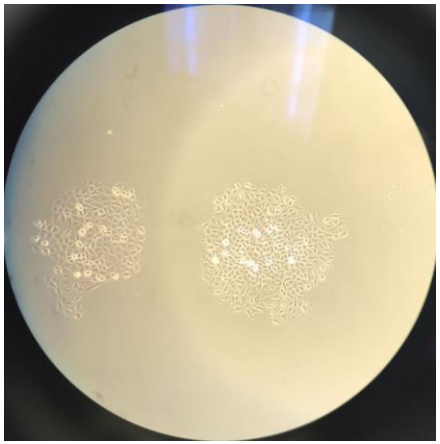
Impact of dust storm on health

Positive correlation		No significant correlation	
Japan	*Matsukawa et al. 2014*	**Australia**	*Merrifield et al. 2013*
USA	*Grinesk et al. 2011*	**Spain**	*Tobías et al. 2011*
Cyprus	*Middleton et al. 2008*		

Calculation of cell viability

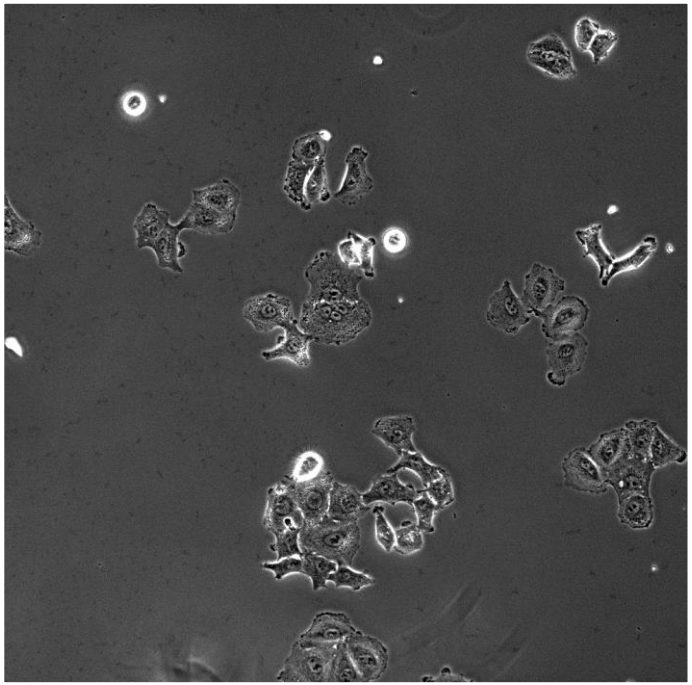
Cell population

- Plate cells on 5cc plate
- Two plates (2 biological repeats)
- Count cell viability after 24 & 48h

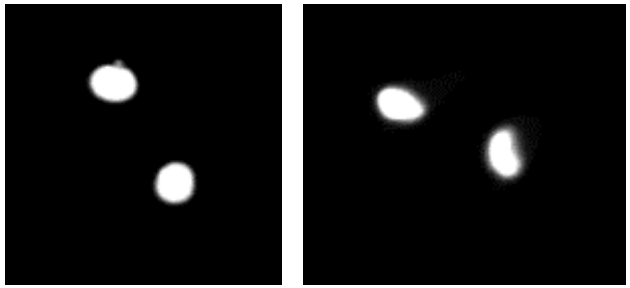


Single cells

- Plate cells on 2cc plate
- Continue observation of cells
- Count cell viability every 15 min

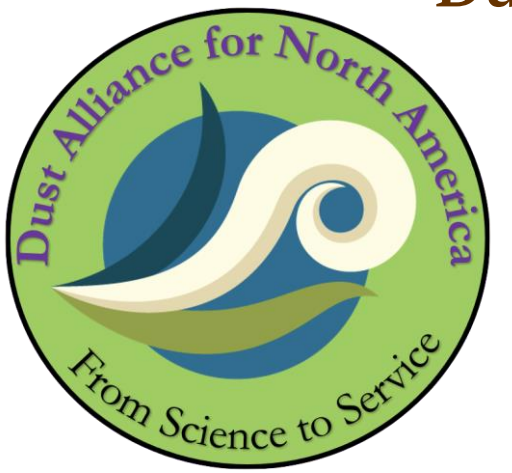


Living cells **Dying cells**



Ardon-Dryer et al.2020

Dust Alliance for North America (DANA)



dustalliance.na@gmail.com

The Dust Alliance for North America (DANA) is an informal partnership of scientists and practitioners with purpose to accelerate transition of research into service.

Mission Statement: With a focus on North America, foster global collaboration to mitigate airborne dust risks to health, safety, and quality of life.

Sign up to join Dust Alliance for North America (DANA)

DANA Spring Webinar Series, 2022
DATES: Every 2nd Friday from February to May
TIME: @1 pm ET (12 pm CT, 11 am MT, 10 am PT)

Thank you for your attention

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