Dust storms: numerical simulations

P. Hyde, A. Mahalov, and J. Li

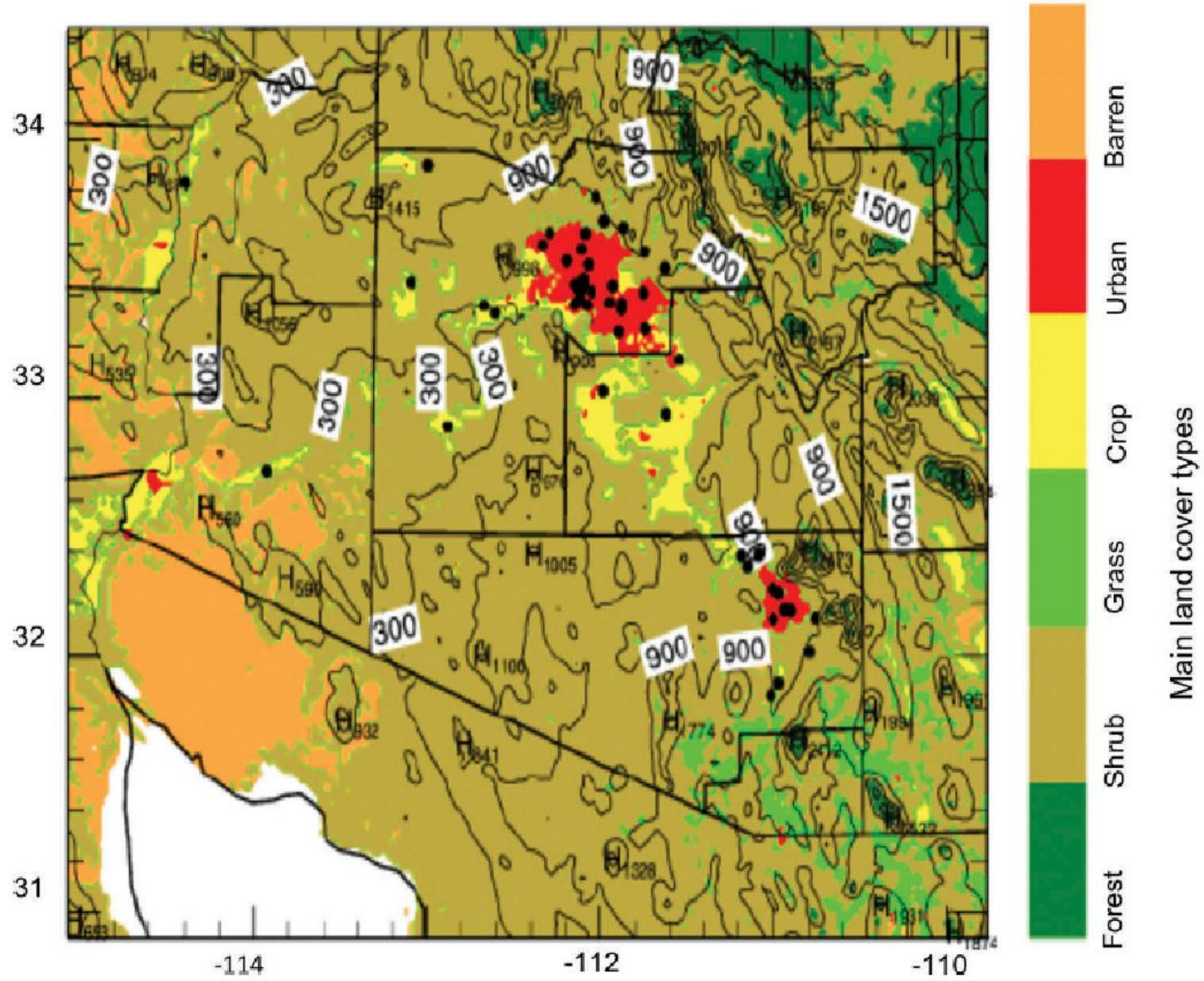
24 March 2021, Arizona Dust Storm Workshop

J. of the Air and Waste Management Assoc. 2017, **68**, 3, 175 - 195

Simulating the meteorology and PM_{10} concentrations in Arizona dust storms with the Weather Research and Forecasting model with Chemistry (Wrf-Chem)

Models employed

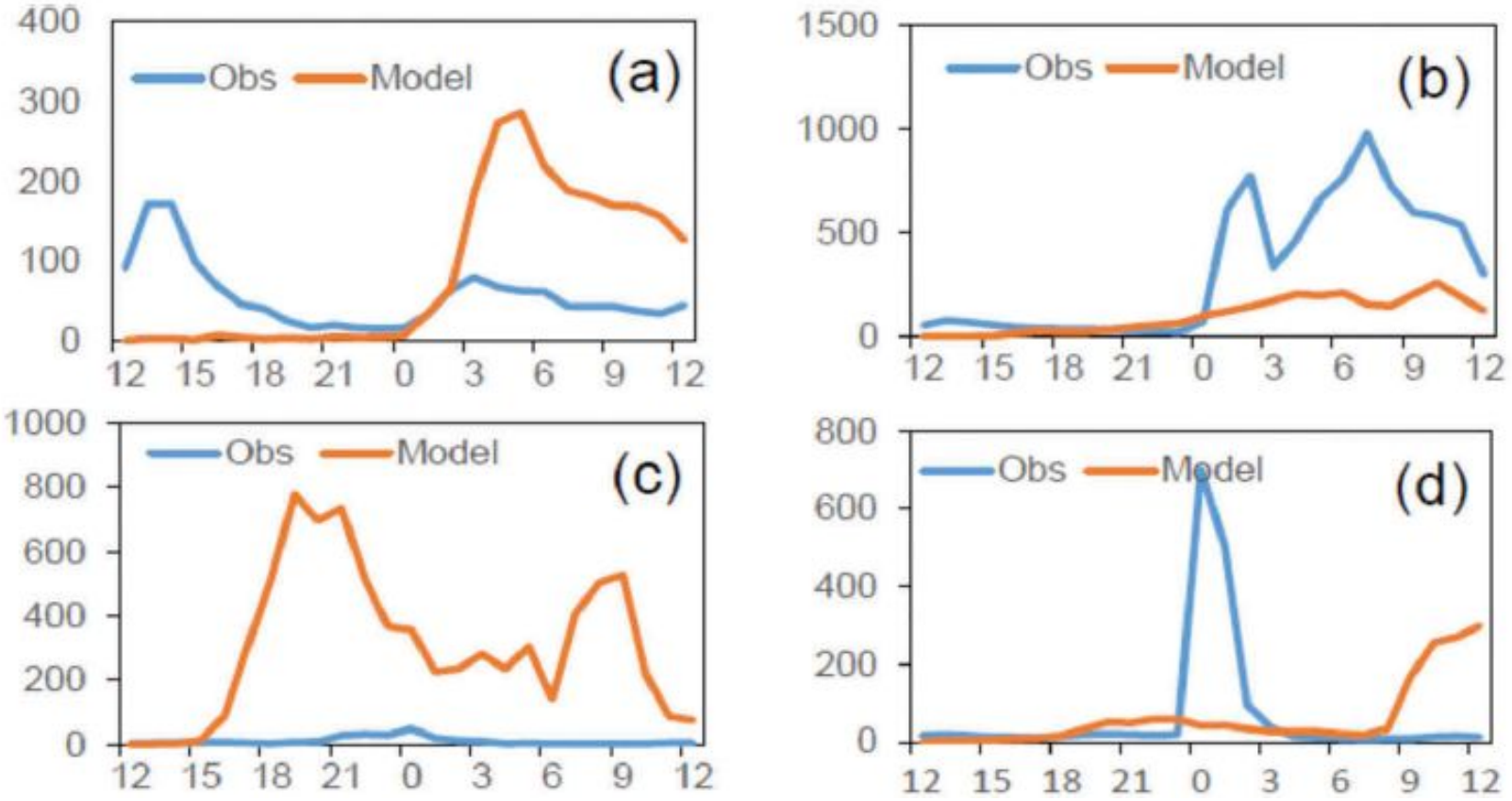
- Dust emissions model: U.S. Air Force
- Transport and chemistry model: Weather Research and Forecasting model with chemistry WRF-chem


34
33
32
31
-114
-112
-110
300
900
1500
Barren
Urban
Crop
Grass
Shrub
Forest
Main land cover types

Dust storms: note 24-hr [PM10], O, observed; M, modeled; health standard is 150 ug/m3

		Maximum hourly wind speed (m/sec)		24-hr	
Date	Type	O	M	O	M
4/14/2006	Dry cold front	21/29	12/14	725	337
7/12/2009	Monsoon	13/30	6/10	1386	45
1/21/2010	Dry cold front	12/30	16/19	1689	230
7/5/2011	Monsoon	8/26	12/16	1972	156
6/30/2013	Monsoon	14/23	12/11	139	31
7/21/2012	Monsoon	8/18	14/12	884	1696
7/3/2014	Monsoon	12/22	14/15	282	526
7/8/2014	Monsoon	7/21	9/10	899	25
6/28/2015	Monsoon	19/25	9/12	271	78

Pinal County: hourly PM10 measurements and simulated values: a and c are dry cold fronts; b and d are monsoon storms (avg of 8 – 13 sites)



Conclusions

- [PM10] can be quite elevated in dust storms, as much as 10X the health standard (these are measurements, not simulated values)
- [PM10] in dust storms is difficult to simulate
  - The storms themselves are extremely turbulent, so the dust concentrations change rapidly with time and throughout space
  - Co-located air pollution monitors often have widely different concentrations.
  - Land cover and rainfall estimates vary widely from the actual conditions
- The efforts to better simulate these storms could lead to better predictive tools that would improve public safety.

Thank you for your time and attention

- Peter Hyde
- Arizona State University (Tempe)
- peter.hyde@asu.edu
- 602 451 3487