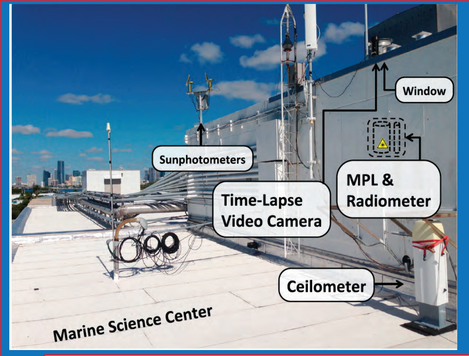


Selected Applications of AERONET, MicroPulse Lidar, and surface aerosol measurements at Miami, FL

*Paquita Zuidema[1], **pzuidema@miami.edu** Claudia Alvarez[1], Rodrigo Delgadillo[1],Samantha Kramer[1,] Michael Perez[1], Ken Voss[2]*
University of Miami, [1]Rosenstiel School, Dept. of Atmospheric Sciences [2]Dept. of Physics

Background

Miami, Florida has hosted an AERONET site at its U of Miami Rosenstiel campus, 4 km off the mainland, since 1995, first established by Ken Voss. In 2011, this site was updated with 2 new sunphotometers ('Key_Biscayne1' & '2') through NSF funding, along with a micropulse lidar (MPL). Dust filter sampling, first established by Joe Prospero, continued. Miami is subject to long-range dust transport (June-Sept), biomass burning emissions from nearby sugar-cane fields, occasional urban emissions from northern cities, in a background of sea spray and light urban pollution. The heaviest aerosol loading is typically either dust or smoke.

Fig. 1: Monthly-mean aerosol concentrations by species, from 1989-1996.Replotted from Prospero 1999[1].

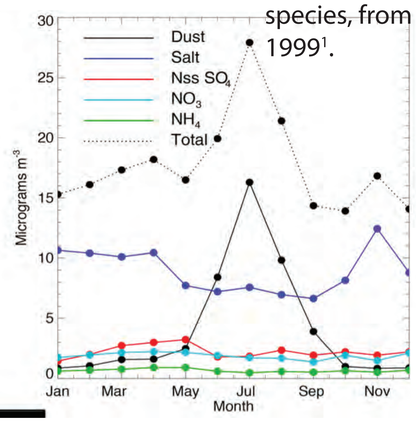
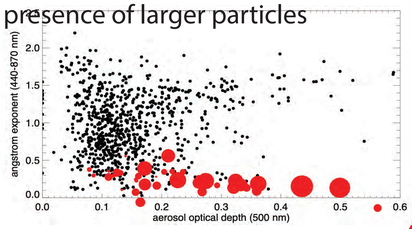


Fig. 2: 1995-2012 Aeronet Angstrom exponent versus AOD. red circles proportional to the dust mass in 2012 indicates higher AODs& presence of larger particles



long-range transported dust is much less in Miami than Barbados -but dust is typically detected every day in the summer. from Zuidema et al. 2019[2]

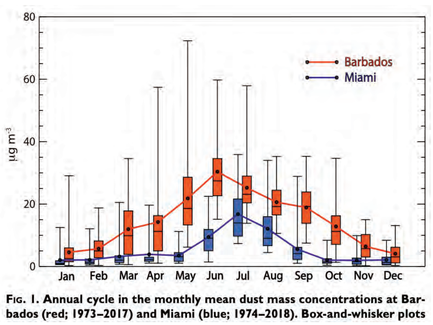
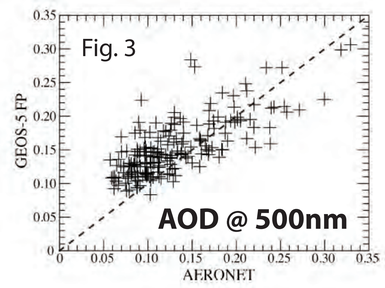
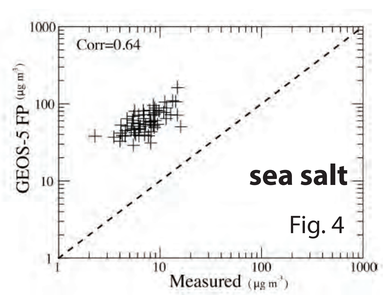


Fig. 1. Annual cycle in the monthly mean dust mass concentrations at Barbados (red; 1973–2017) and Miami (blue; 1974–2018). Box-and-whisker plots

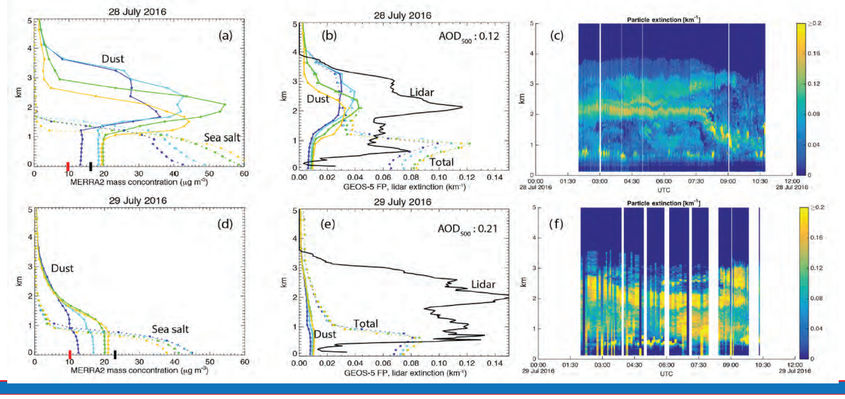
How well is dust represented within MERRA2?

The MERRA2 aerosol reanalysis reflects a successful MODIS AOD assimilation scheme, aided by AERONET. AERONET, MPL aerosol vertical structure and surface-based measurements were combined from the summers of 2014, 2015 and 2016 and applied to better understand MERRA2 strengths/weaknesses, in Kramer et al. 2020[3].
MERRA2 AODs match AERONET (V2) values reasonably well (Fig. 3), a remaining overestimate at lower AODs may reflect too much sea salt mass in MERRA2 (Fig. 4), and the underestimate at higher AODs missing emissions/transport.





In addition MERRA2 does not distribute enough of the aerosol extinction into the free troposphere in comparison to AERONET-constrained MPL-derived extinction profile. We think in part this is because MERRA2 has overestimated a sea salt mass/extinction contribution to the total AOD. (we understand the MERRA2 team is correcting this).



How many clouds are optically-thin?

AERONET AODs were applied to constrain an MPL retrieval of the vertical extinction profile, with time-lapse camera images used to distinguish cloud from aerosol, in Delgadillo et al.[4] Such clouds mostly reside at the lifiting condensation level, with ~15% of all available MPL samples possessing cloud optical depths < 1.0, indicating they are common enough to be radiatively important.

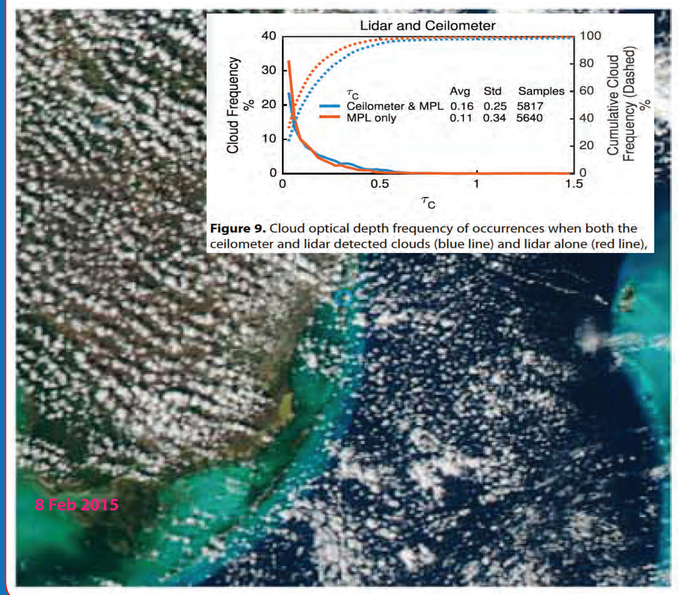


Figure 9. Cloud optical depth frequency of occurrences when both the ceilometer and lidar detected clouds (blue line) and lidar alone (red line),

the future

new work by Cassandra Gaston (see poster) is connecting the AERONET measurements at Barbados to those in Miami, building on an expanded surface site in Barbados.

[1]Prospero, J. M.: Long-term measurements of the transport of African mineral dust to the eastern United States: Implications for regional air quality, J. Geophys. Res., 104, 15917–15927, 1999 [2] Zuidema, P., C. Alvarez, S. J. Kramer, L. Custals, M. Izaguirre, P. Sealy, J. M. Prospero, E. Blades, 2019: Is summer African dust arriving earlier to Barbados? The updated long-term in-situ dust mass concentration records from Ragged Point, Barbados and Miami, Florida. Bull. Am. Meteor. Soc., 100, p. 1981-1986, doi:BAMS-D-18-0083.1 [3]Kramer, S. J., C. Alvarez, A. Barkley, P. R. Colarco, L. Custals, R. Delgadillo, C. Gaston, R. Govindaraju, and P. Zuidema, 2020: Apparent dust size discrepancy in aerosol renalysis in north African dust after long-range transport. Atmos. Chem. Phys., 20, p. 10047-10062, doi:10.5194/acp-20-10047-2020.[4]Delgadillo, R., K. Voss and P. Zuidema: Characteristics of optically-thin coastal Florida cumuli from surface-based lidar measurements, J. Geophys. Res., 123, 10591–10605, https://doi.org/10.1029/2018JD028867, 2018. [5]Mayol-Bracero et al, under review. This work has been supported by NSF Major Research Instrumentation award 0923217.