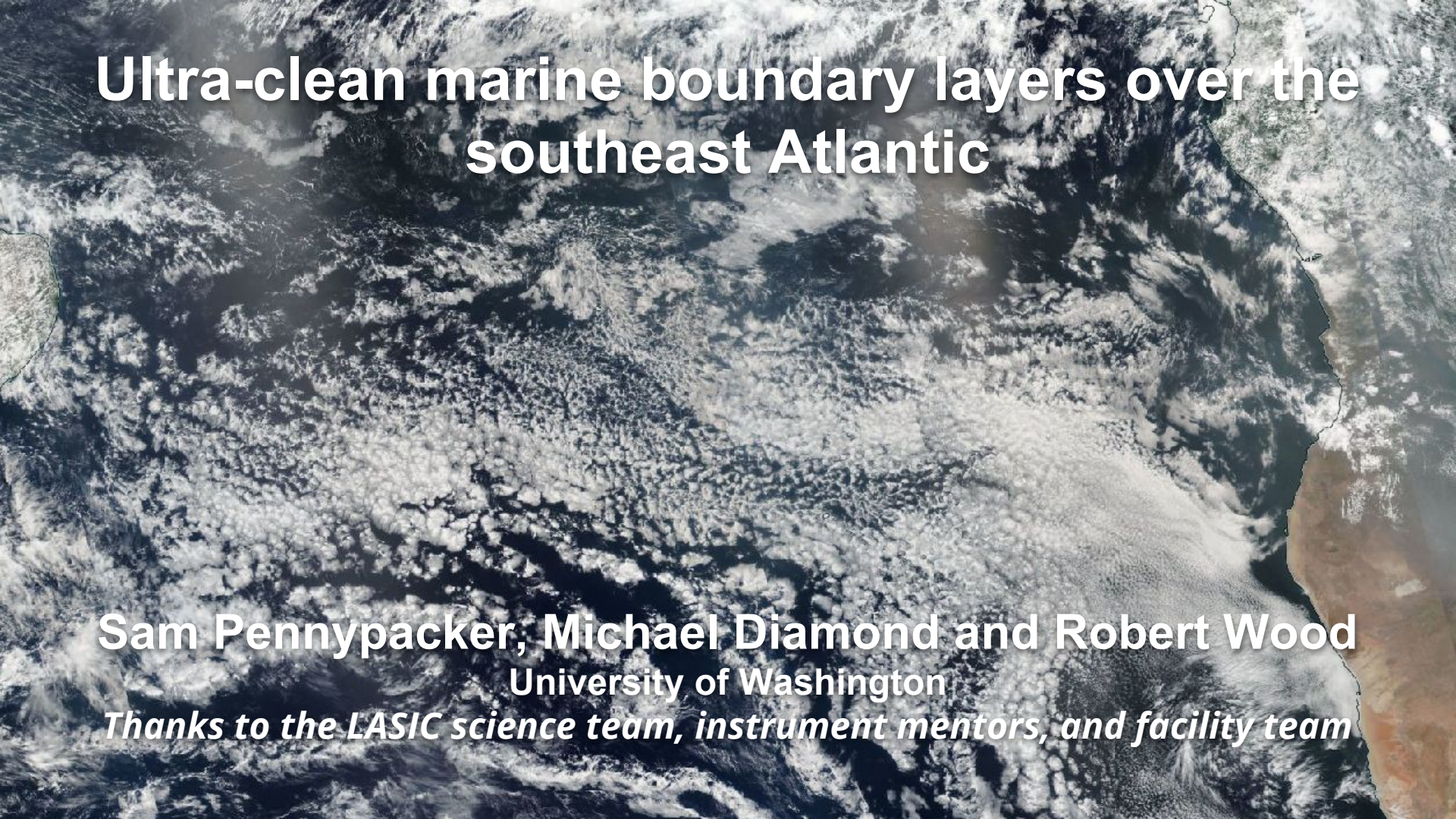
Ultra-clean marine boundary layers over the southeast Atlantic



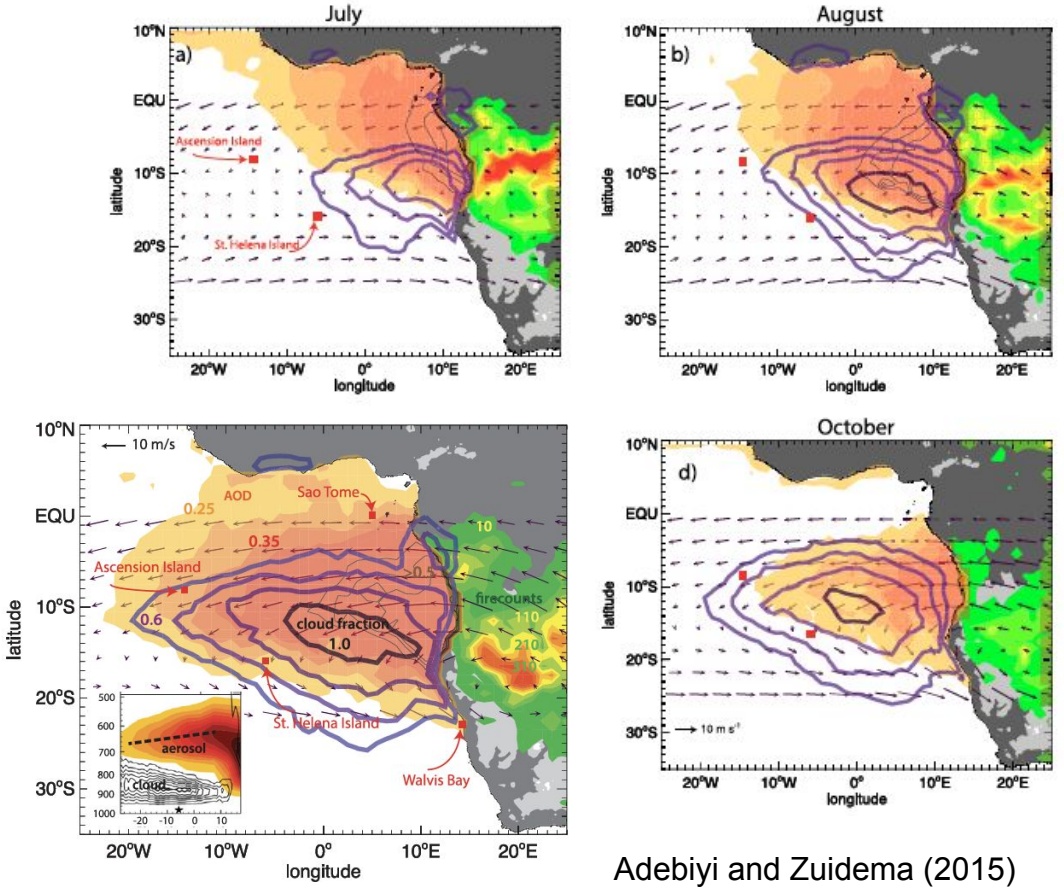
Sam Pennypacker, Michael Diamond and Robert Wood

University of Washington

Thanks to the LASIC science team, instrument mentors, and facility team

Southern African biomass burning season

- Cloud cover and AOD both peak in September

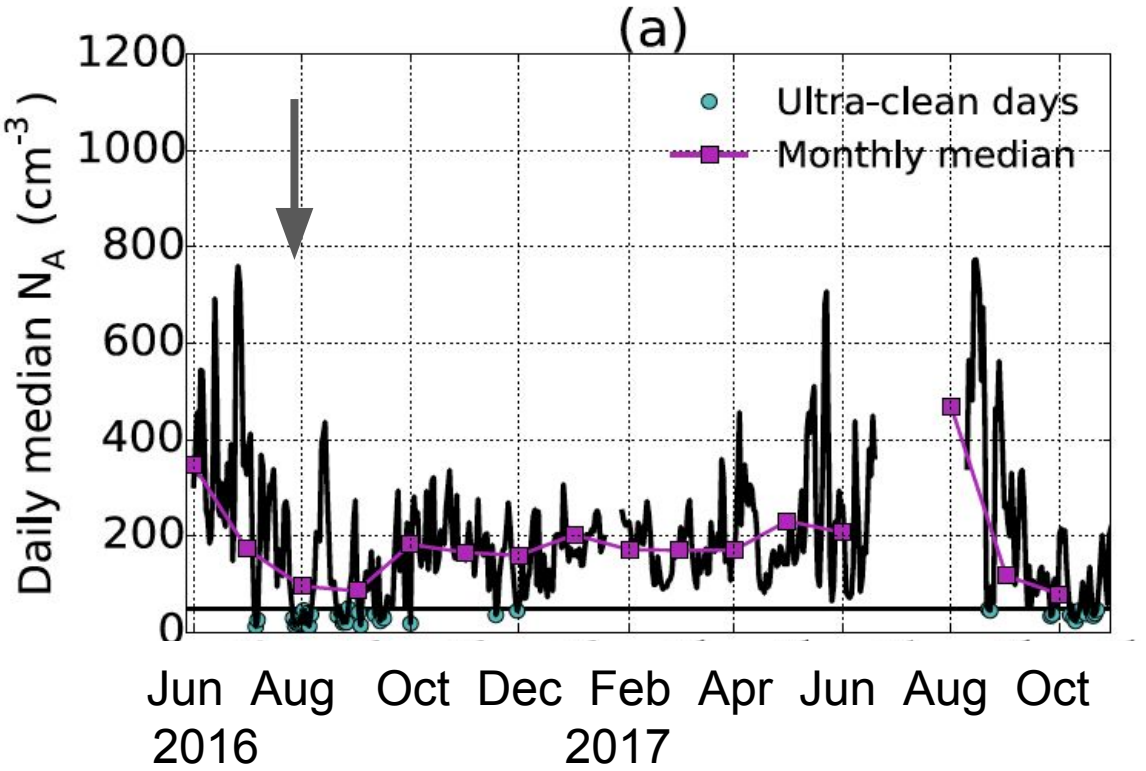


Adebiyi and Zuidema (2015)
Zuidema et al. (2016, *BAMS*)

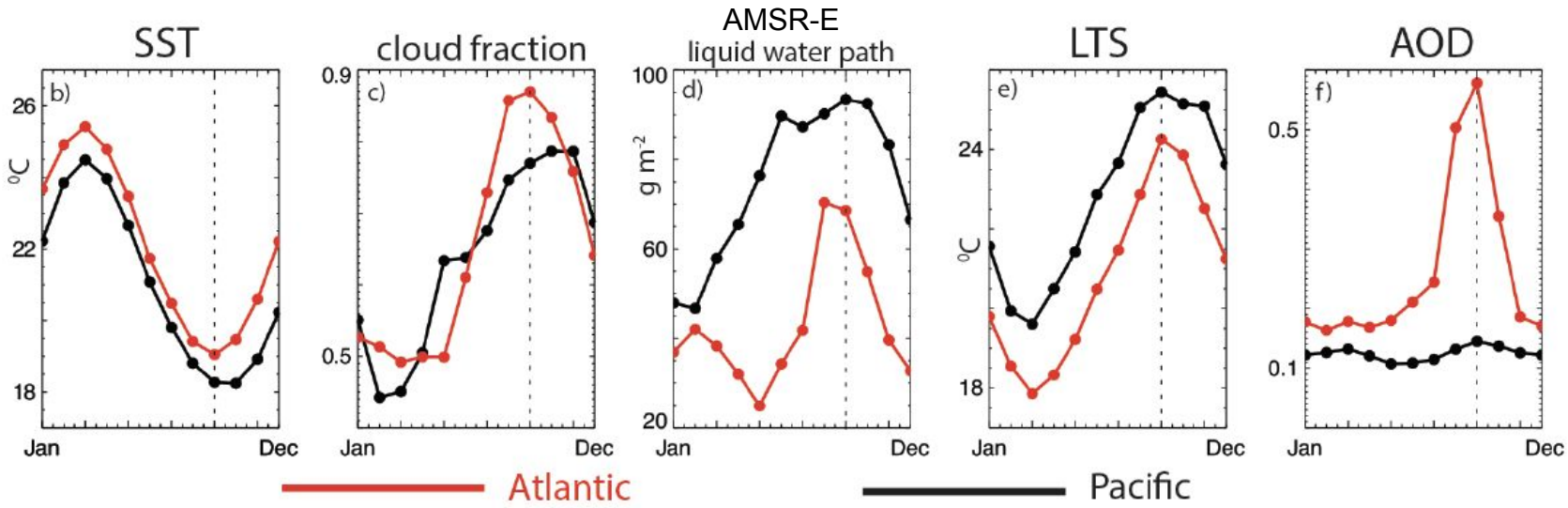
Time series of UHSAS (d > 100 nm) at ASI

Frequent occurrence of low UHSAS concentration (N_A < 50 cm^{-3}), especially during the BB season (July-Oct)

Why do these events occur?



AOD *and* LWP both maximal during Southern African BB burning season

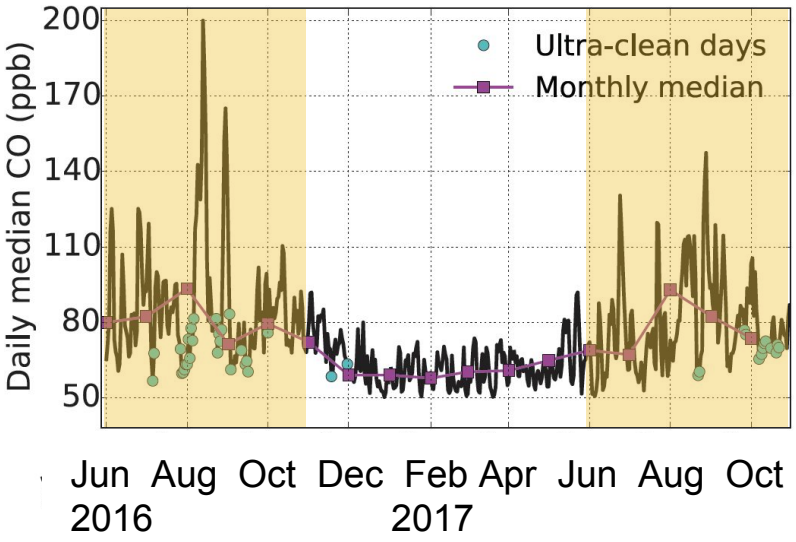


Zuidema et al. (2016, U.S. CLIVAR Eastern Tropical Oceans Synthesis Working Group, *BAMS*)

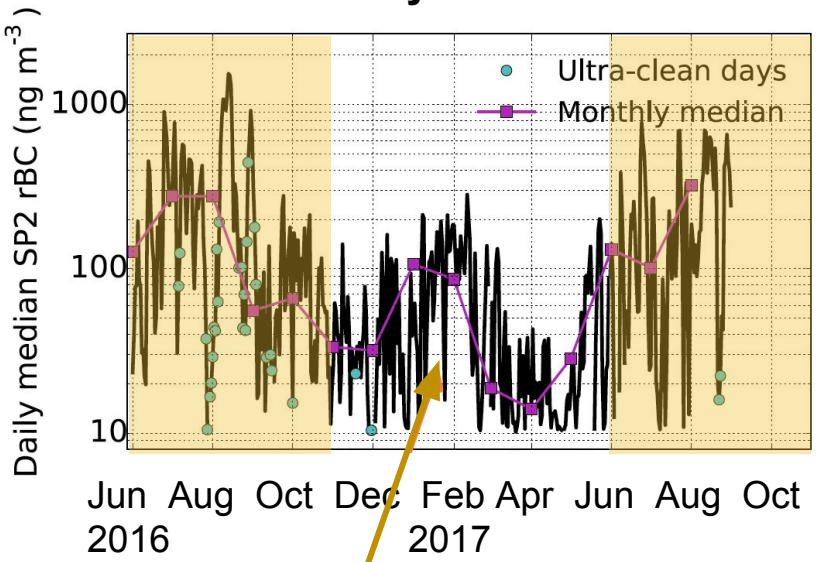
BB Aerosol Seasonality

Most ultraclean events occur within S. African BBA season
Most have low CO, but have more variable rBC

Carbon monoxide

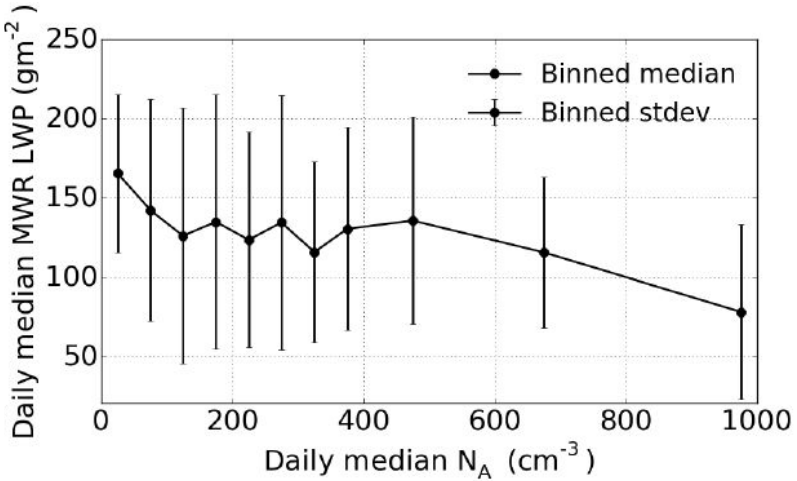


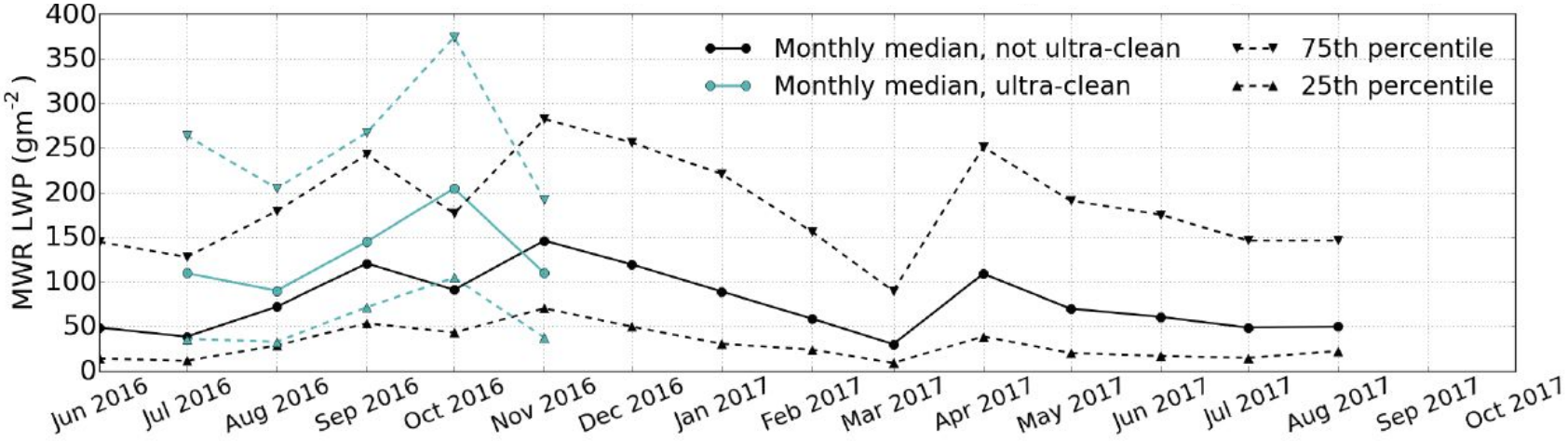
Refractory black carbon

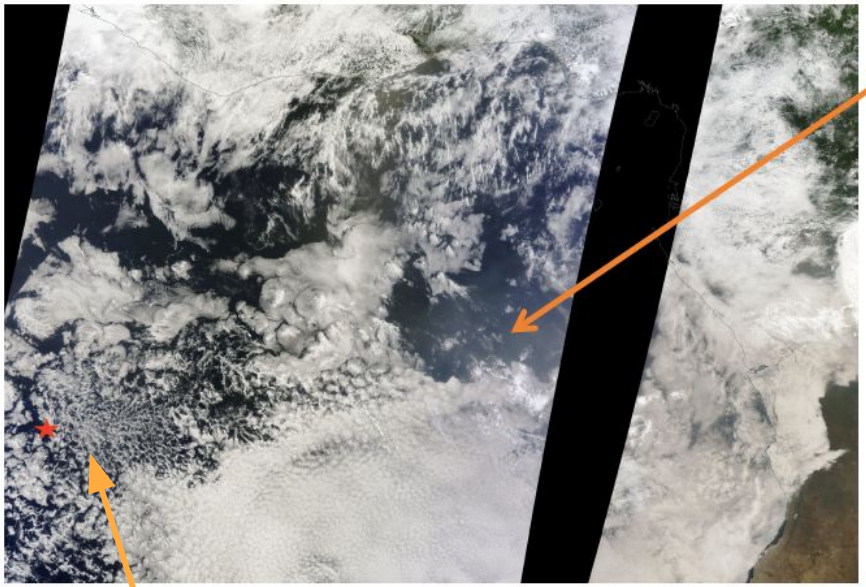


Northern African BB season evident in rBC - no CO signature!!!?

LWP is higher on days with low N_A







Biomass burning smoke

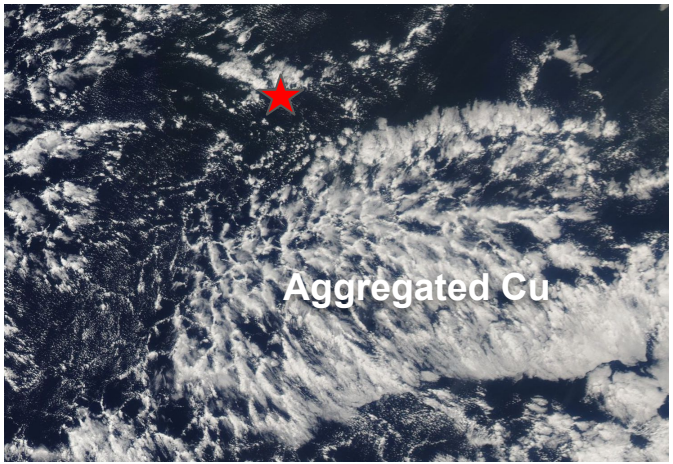
Terra/MODIS true color image from Aug. 24, 2016, an ultra-clean day at ASI

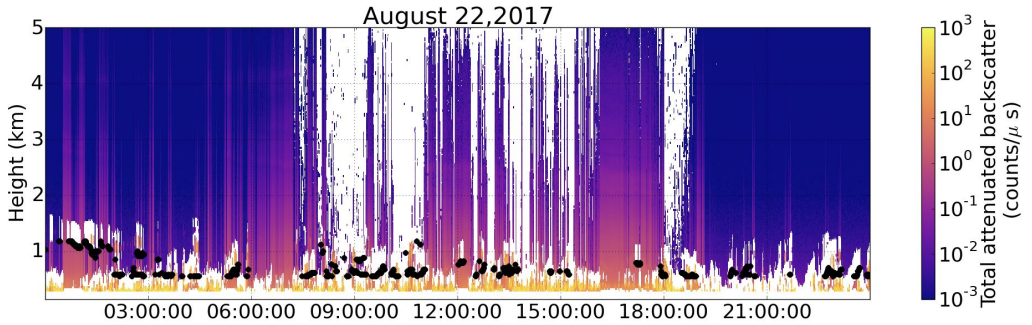
★ = ASI

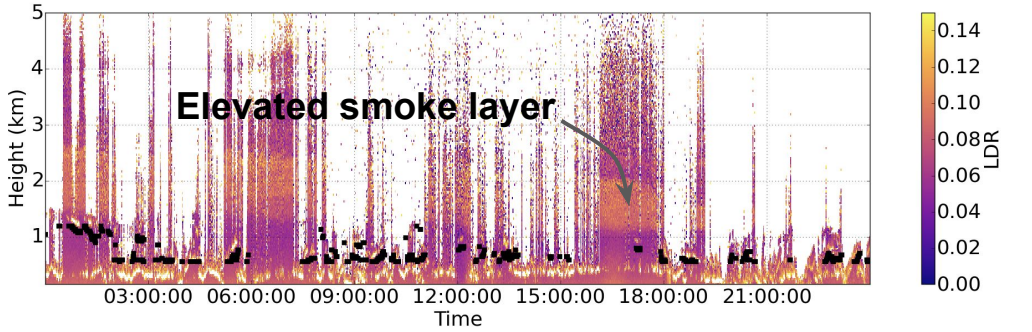
Open cells over ASI. In other regions (e.g. SE and NE Pacific, open cells are typically associated with very low aerosol concentrations

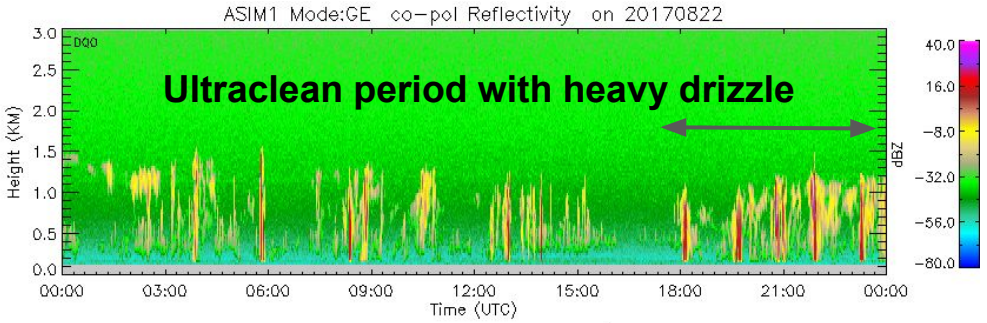
Ultraclean MBL with smoke layer aloft

MODIS Aqua [13:30]

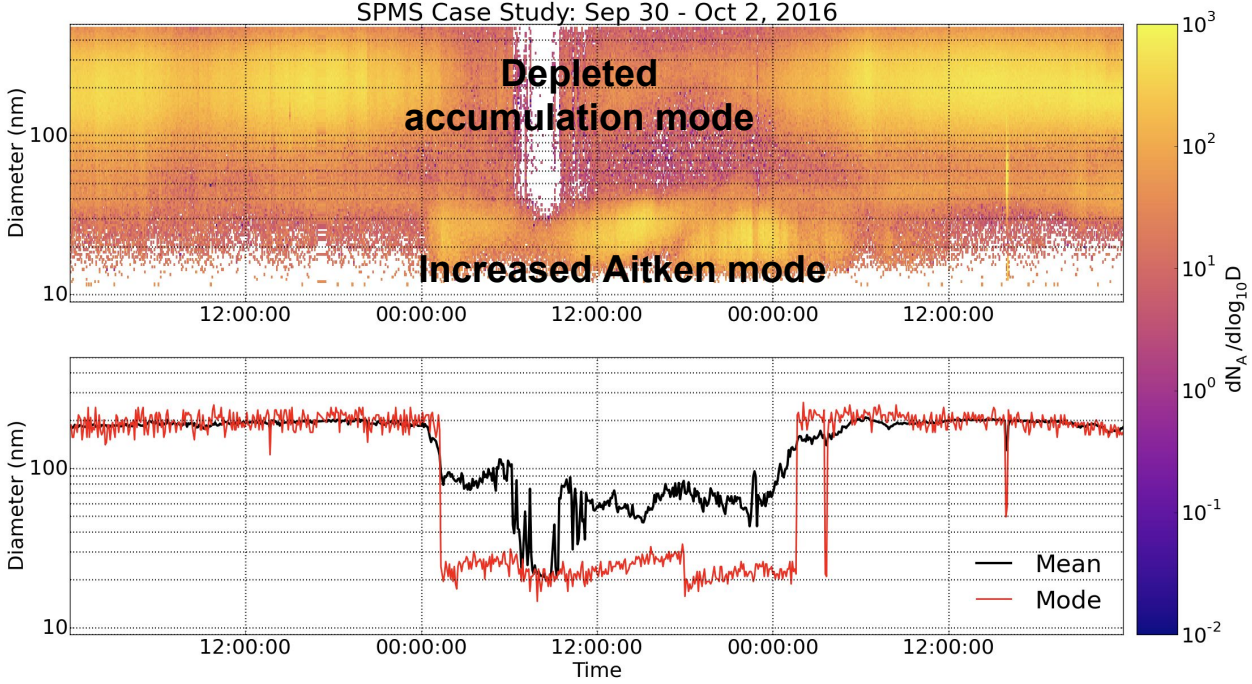




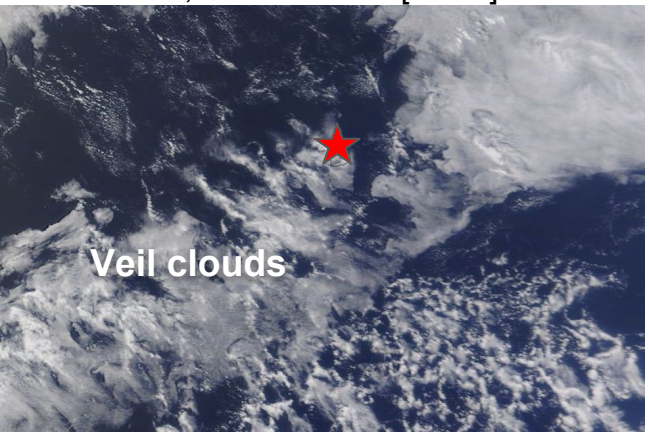




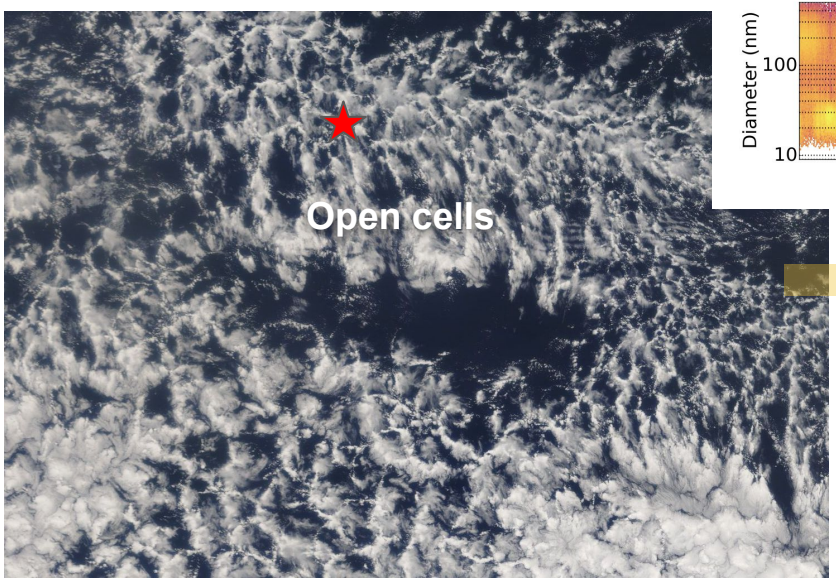
SPMS Case Study: Sep 30 - Oct 2, 2016

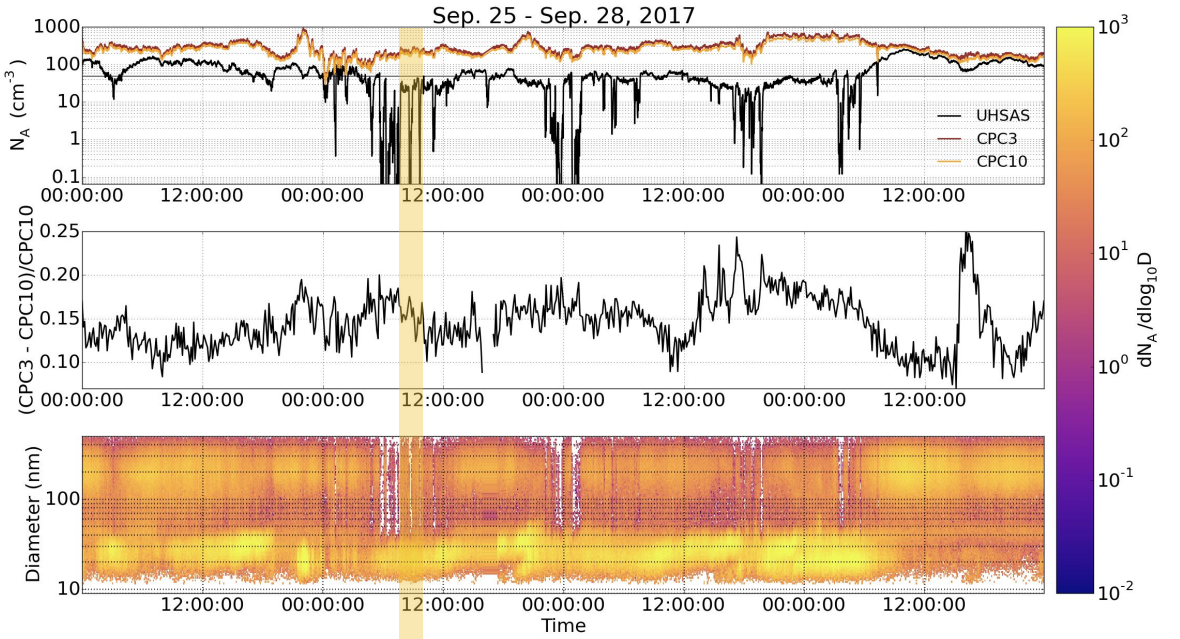


1 Oct 2016, MODIS Terra [10:30]



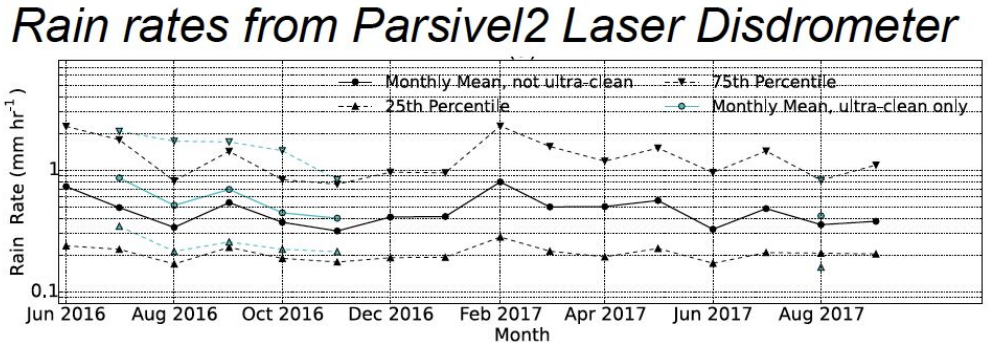
26 Sep 2017, MODIS Terra [10:30]





Next steps

- Examine Lagrangian air mass history of ultraclean events to ascertain sources and sinks
- Quantify precipitation rates at ASI using KAZR and along PBL back-trajectories using new AMSR-E dataset “calibrated” using CloudSat (Ryan Eastman and Matt Lebsock)
- Collaborate with LASIC science team to understand covariability of CO, rBC, N_A and relate to above-cloud BBA layers and AOD



Summary

- High variability in accumulation mode aerosol concentration during season influenced by S. African smoke
- Ultra-clean days (N_A, UHSAS conc. < 50 cm^{-3}) occur frequently at ASI during the Southern African BB season
- Some ultraclean days but not all have low CO and rBC
- Cleanest days associated with high LWP
- Ultra-clean days are not completely explained by a lack of contact with smoke, supporting a role for drizzle scavenging in setting MBL aerosol