Deriving CAO Aerosol Size Distribution and Composition Parameters from Observations

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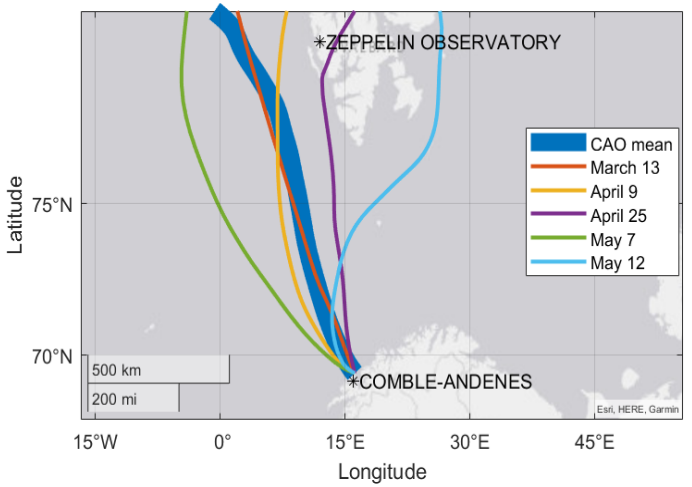
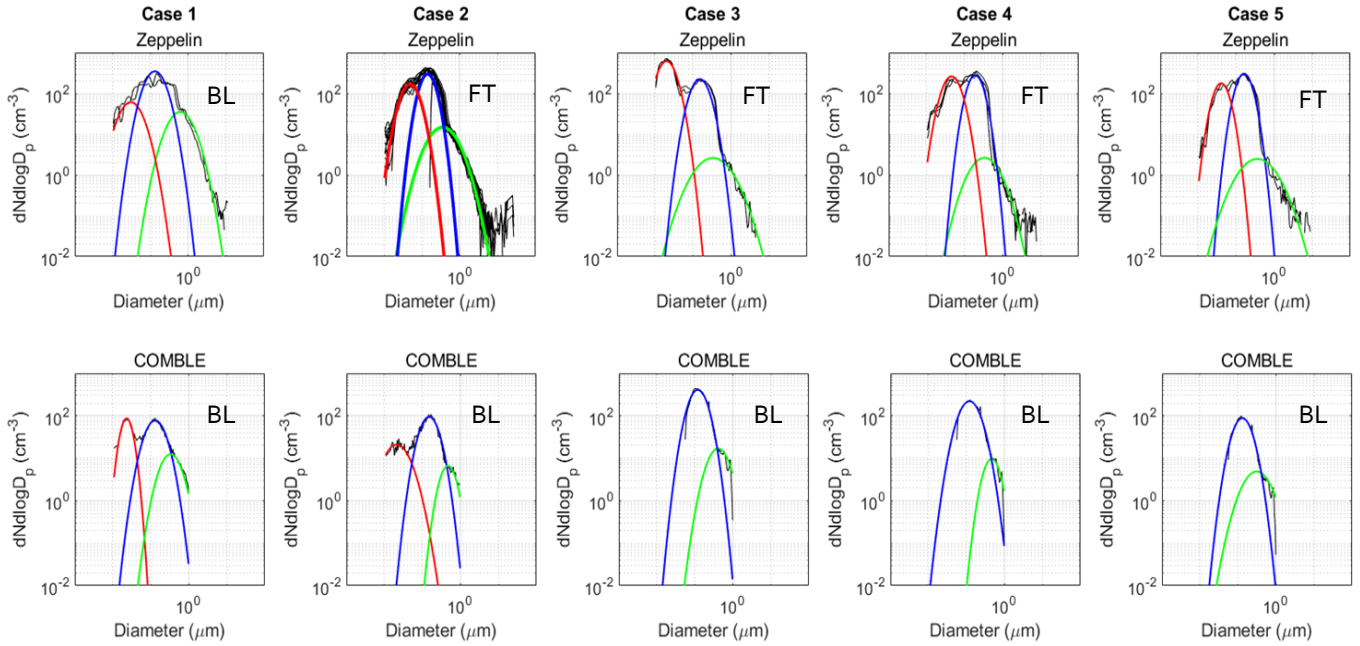
CAO Case Selection: a Fortuitous Complement of Zeppelin Measurements

- CAO events identified during COMBLE at Andenes, Norway
- Several CAOs back-trajectories pass within 200 km of Zeppelin Observatory in Svalbard
- 5 selected cases in the springtime months: 3/13, 4/9, 4/25, 5/7, 5/12
  - Upwind/Initial condition: Zeppelin Observatory
  - Downwind/endpoint: COMBLE Andenes site



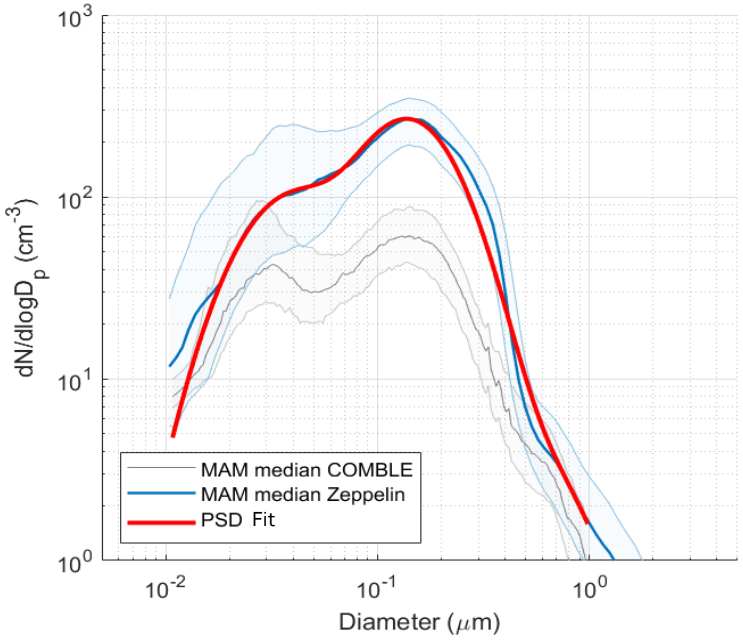
Upwind
Zeppelin

Downwind
COMBLE



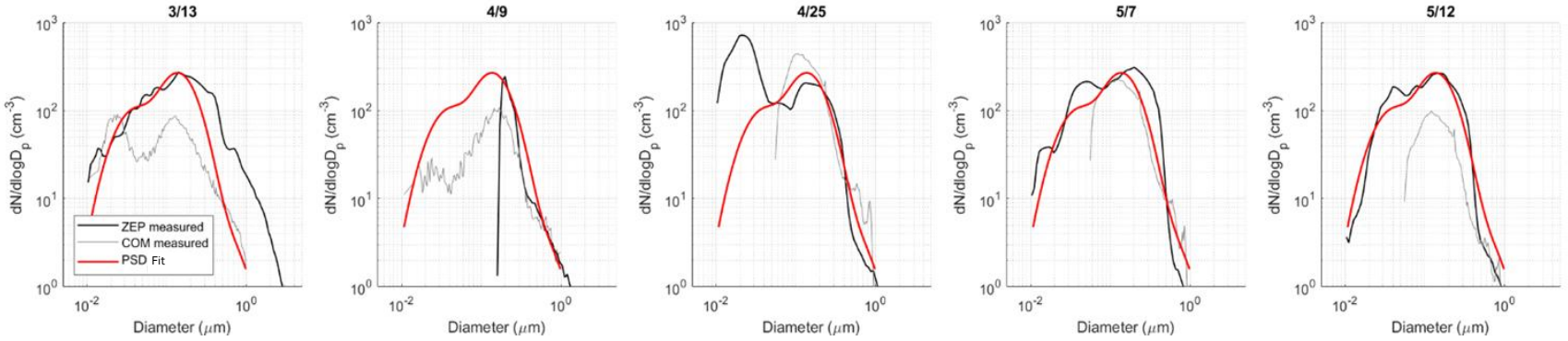
- 3 lognormal modes fitted to observed size distributions
- Caveats to using case-specific modal fits
  - Missing data
  - Observations in both BL and FT

Zeppelin-informed Aerosol PSD Specification



- Tri-modal fit to springtime (March-May 2020) median of size distribution measurements at Zeppelin Observatory

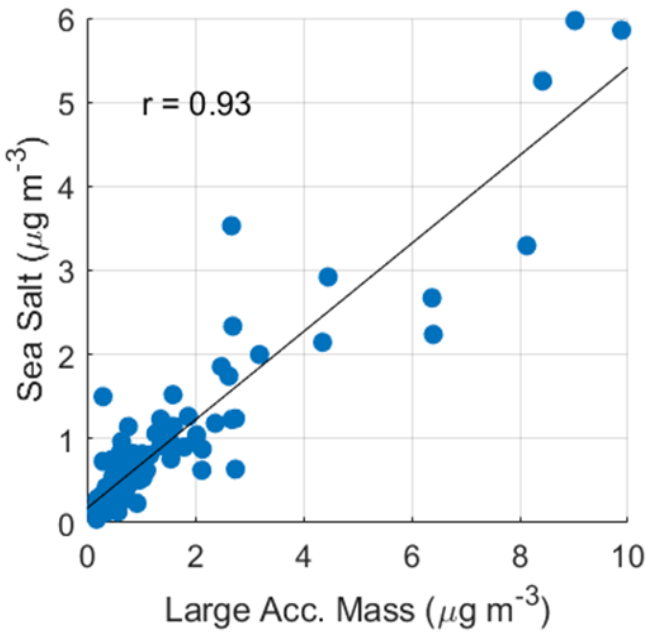
	N (cm^{-3})	D_g (µm)	σ_g
Mode 1 (Aitken)	58	0.04	1.7
Mode 2 (Accumulation)	134	0.14	1.6
Mode 3 (Sea Spray)	2	0.50	1.7

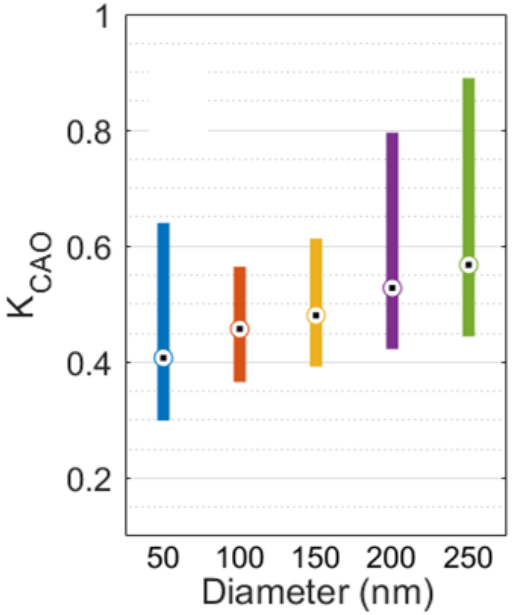


- Median modal fit similar to accumulation mode of each case

Specification of Composition for Each Mode

- Correlations between ion mass and modal mass retrieved from PSD fits at Zeppelin
  - Large accumulation mode: primarily sea salt
  - Accumulation mode: mixture of sea salt, NH_4^+ , SO_4^{2-}
  - Aitken mode: NH_4^+ , SO_4^{2-}
- HTDMA-derived kappa in the accumulation mode size range at Andenes (COMBLE)
- Inferred kappa parameter
  - Mode 1 (Aitken): **0.3**
  - Mode 2 (Accumulation): **0.5**
  - Mode 3 (Sea spray): **0.9**
- CCN calculation with estimated kappa
  - Within 7% of observations





	CCN (cm^{-3}) Case 1	CCN (cm^{-3}) Case 2
Measured	44 ± 4%	48 ± 4%
K = 0.5	47	49