Modeling Aerosol Layers Observed during the Two Column Aerosol Project (TCAP)

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Aircraft Deployment: July 2012

Overarching Goals

Understand the processes responsible for producing and maintaining aerosol distributions and associated aerosol and cloud radiative forcings off the East Coast of North America.

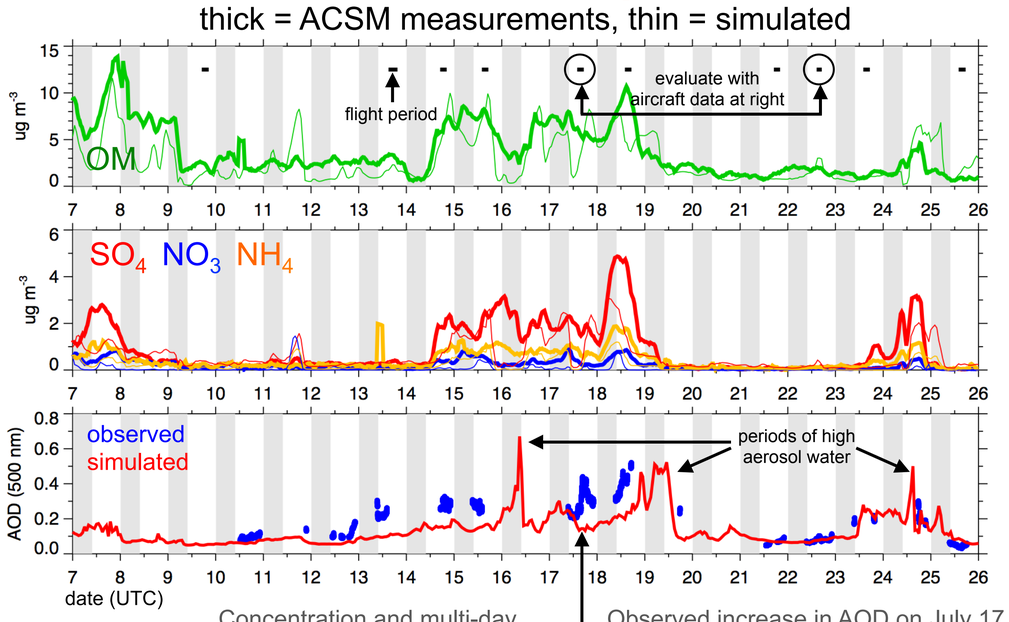
Evaluate the ability of models to adequately simulate the mass, composition, and size distribution of observed aerosol layers and determine how uncertainties in aerosol microphysical properties affect optical properties when compared to measurements.

Model Evaluation

The WRF-Chem model is used to simulate the emission, formation, mixing, transport, transformation, and removal of aerosols over the most of North America. between July 1 and 25, 2012.

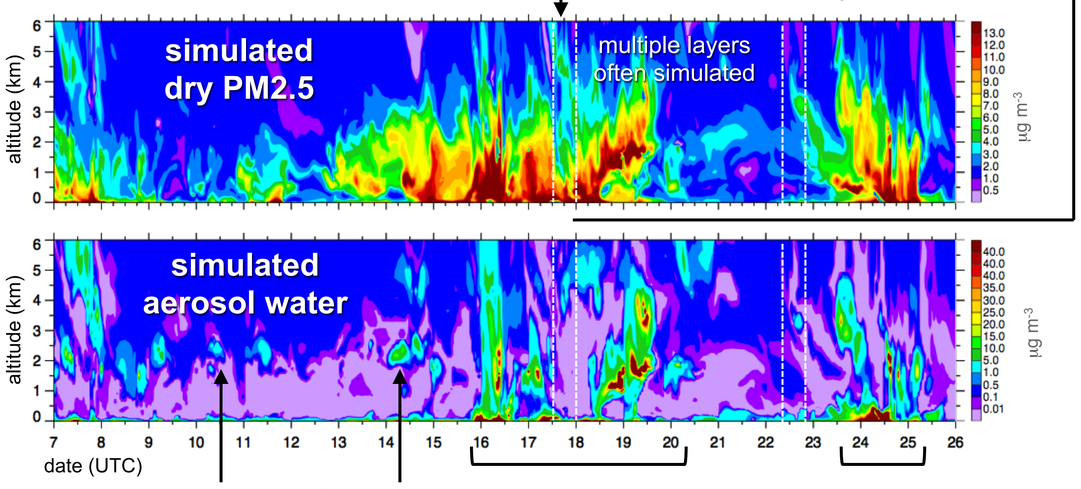
- **Domain Configuration**: *Δx = 36 and 12 km, 74 vertical levels*
- **Aerosol**: *SAPRC chemical mechanism, MOSAIC aerosol model with Volatility Basis Set (VBS) approach for SOA*
- **Cloud-Aerosol Interactions:** *Vertical transport, aqueous chemistry, wet removal) in both resolved and parameterized clouds*
- **Emissions:** *NEI 2005 anthropogenic adjusted to 2012, FINN biomass burning, MEGAN on-line biogenic, on-line sea-salt*
- **IC/BC**: *Global GFS analyses for meteorology and global MOZART simulation for trace gases and aerosols*

AMF Site on Cape Cod



Concentration and multi-day variation in simulated aerosol composition and AOD qualitatively similar to measurements

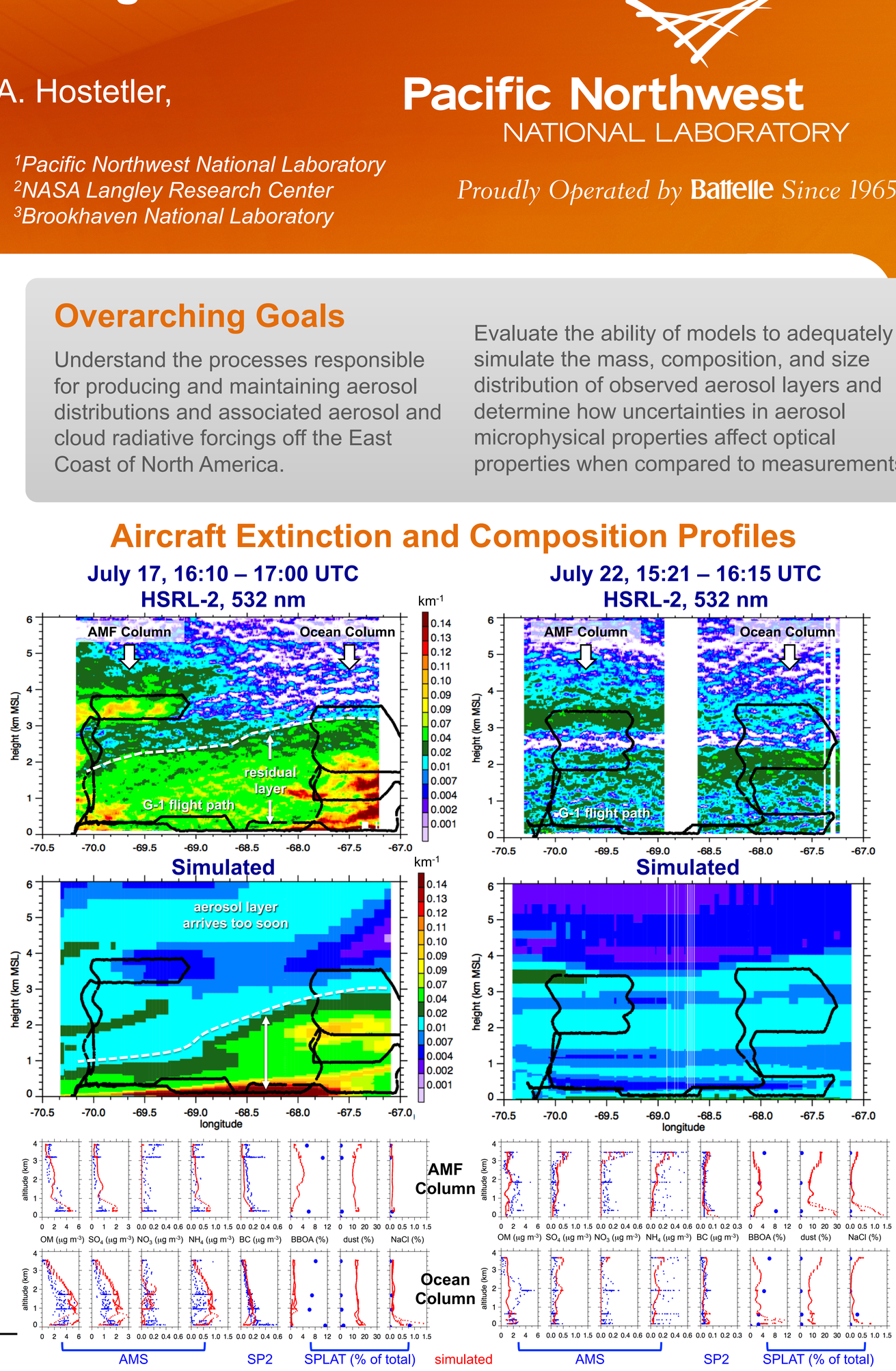
Observed increase in AOD on July 17 likely due to layer at 3-4 km. While simulated dry mass is slightly higher than observed, but aerosol water relatively low at this time.



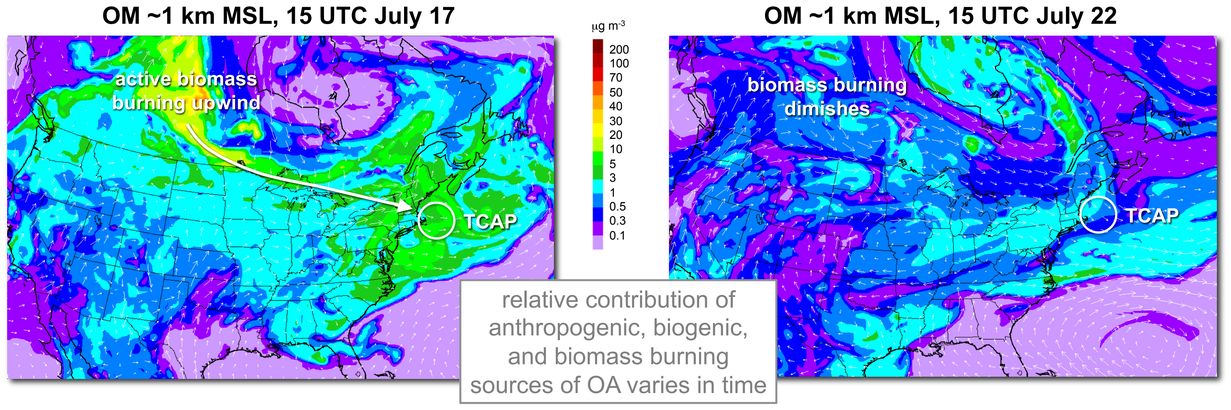
maximum values at top of residual layer where RH is higher

increase associated with changing meteorological conditions and transport of more aerosol into TCAP region

Aircraft Extinction and Composition Profiles



Vertical structure and composition are simulated well for some layers. Some errors may simply be due to timing of transported layers, while others may be related to emissions (e.g. biomass burning) – both are being investigated.



Next Steps

While the model qualitatively represents the composition and structure of the aerosol layers, the simulated uptake of water and size distribution still needs to be evaluated. Optical closure studies are being performed to assess the errors due to simulated aerosol microphysical properties and layer structure versus the errors resulting from the model's treatment of aerosol optical properties (e.g. mixing rules and mixing state).

U.S. DEPARTMENT OF ENERGY

ASR Atmospheric System Research

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