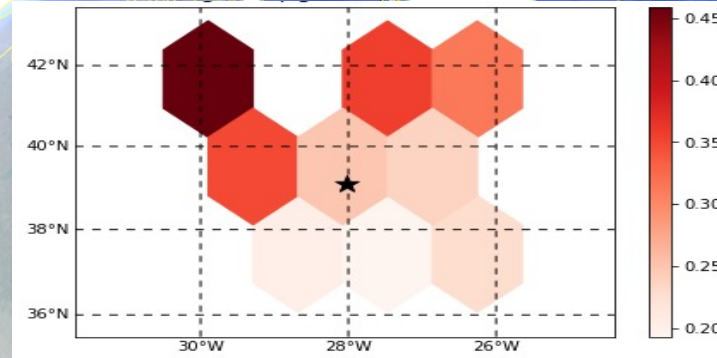




Using Long-Term ACSM Measurements for Model Evaluation

Jerome Fast, Shuaiqi Tang, Po-Lun Ma, and Maria Zawadowicz

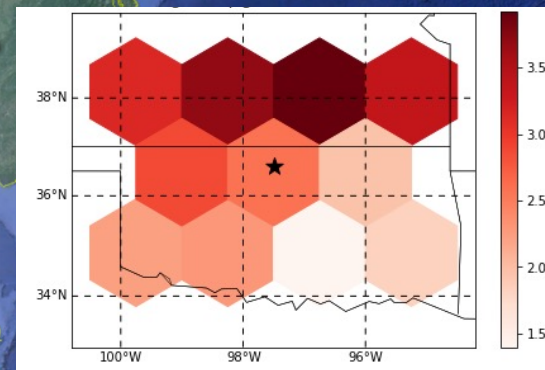
with support of EAGLES project



→ ENA

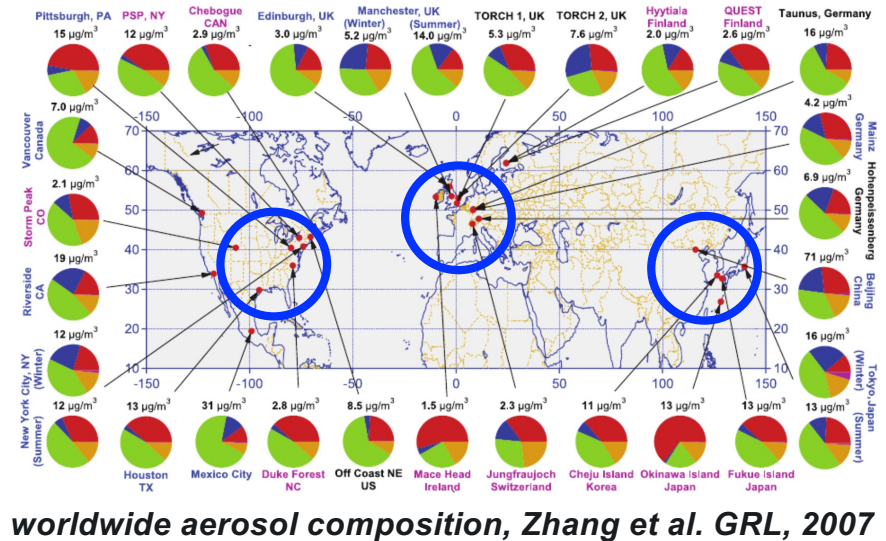
E3SM 1-Degree Simulations of Organic Matter

SGP ←



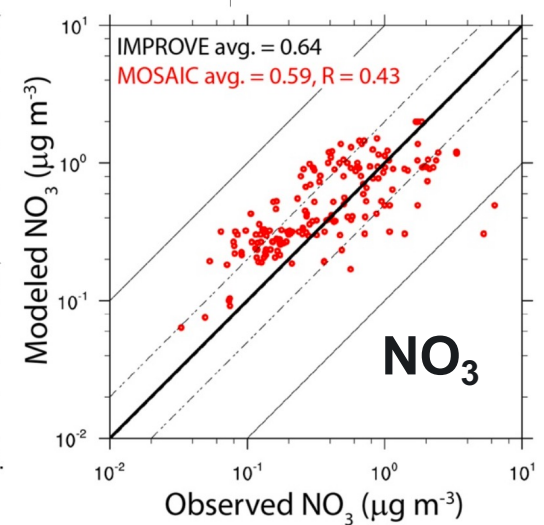
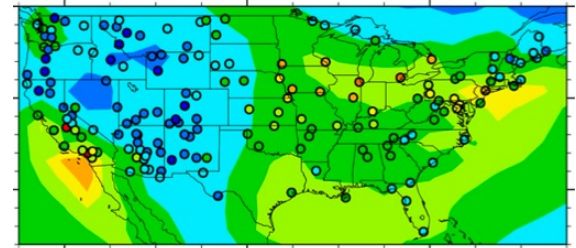
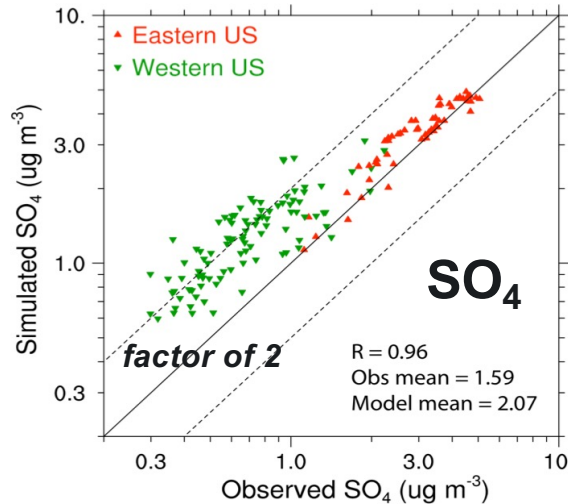
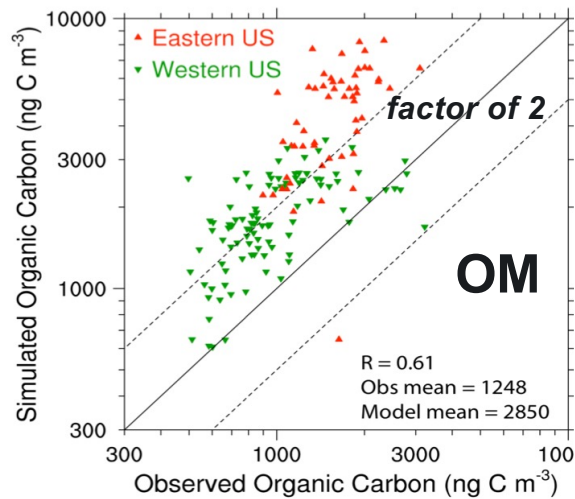
Motivation

- ▶ Uncertainties in aerosol radiative forcing from Earth System Models has essentially remained the same for IPCC reports since 1995.
- ▶ AMS measurements are available to evaluate models, but ...
 - ▶ measurement periods are relatively short (for climate models), measurement periods among sites do not necessarily overlap, measurement locations are biased towards land sites in the U.S., Europe, and East Asia, etc.
- ▶ ACSM measurements during long-term AMF deployments provide an opportunity to evaluate models in different regions over multiple seasons. When coupled with size distribution and CCN measurements, ACSM measurements can help shed light on reasons for biases in aerosol radiative forcing



Previous Evaluations

CAM5/MAM vs IMPROVE, Liu et al. GMD 2012

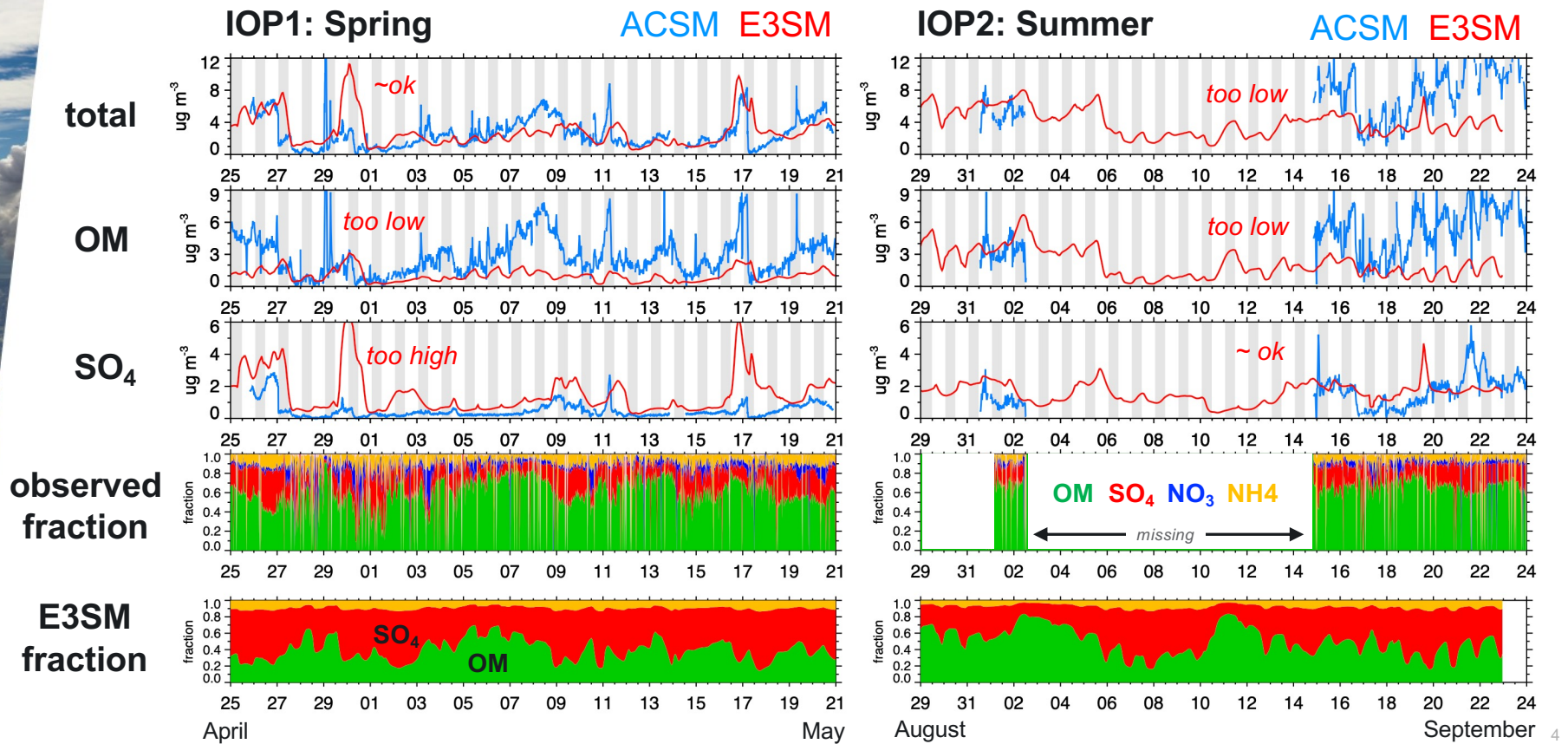


Note: IMPROVE: 24-h samples every 3 days (no diurnal variability information); does not provide more detailed information on OM that can be provided by mass spectrometer techniques (e.g. ACSM)

**CAM5/MOSAIC vs IMPROVE
Zaveri et al. JAMES 2021**

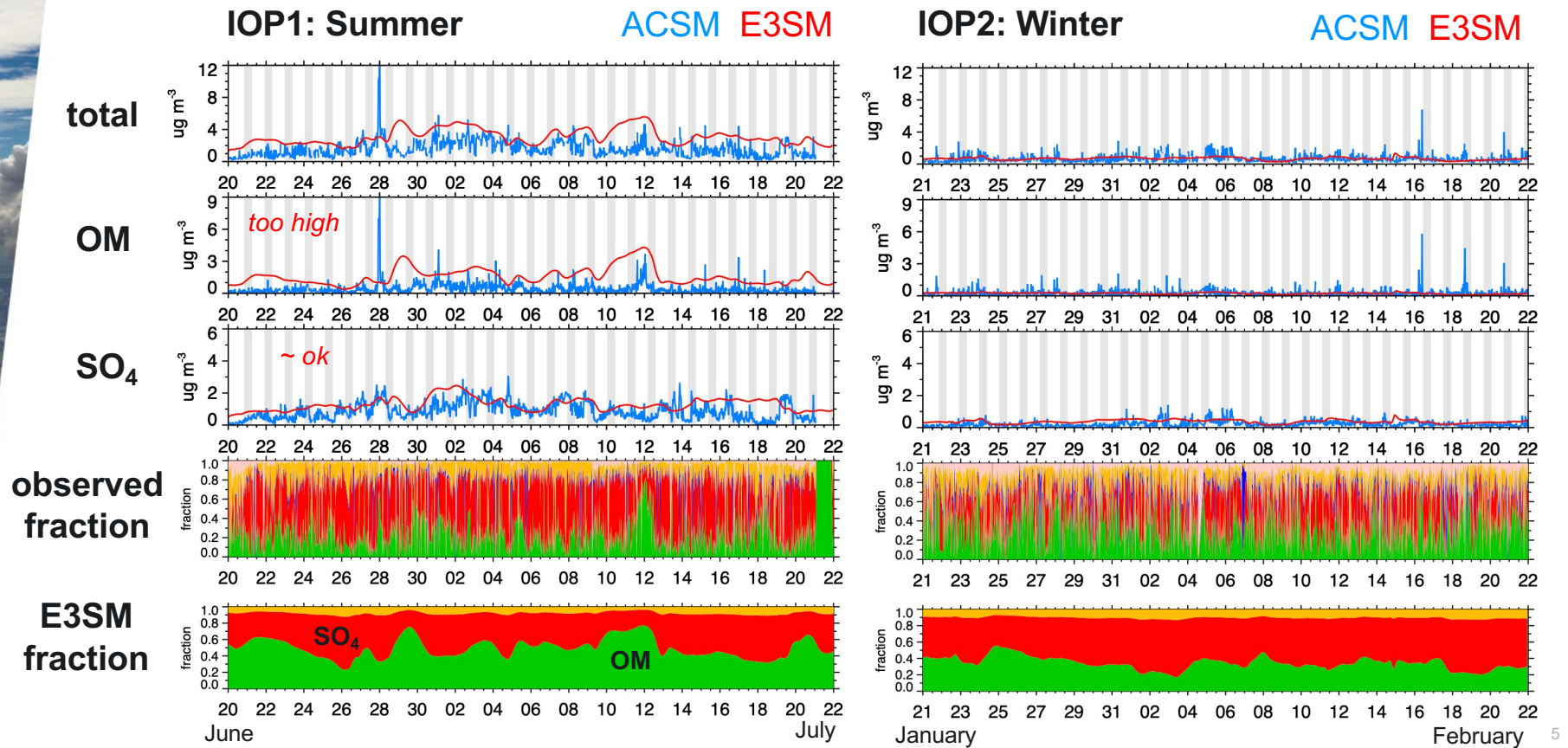
SGP ACSM: HI-SCALE

ACSM data part of new E3SM
aerosol diagnostics tool

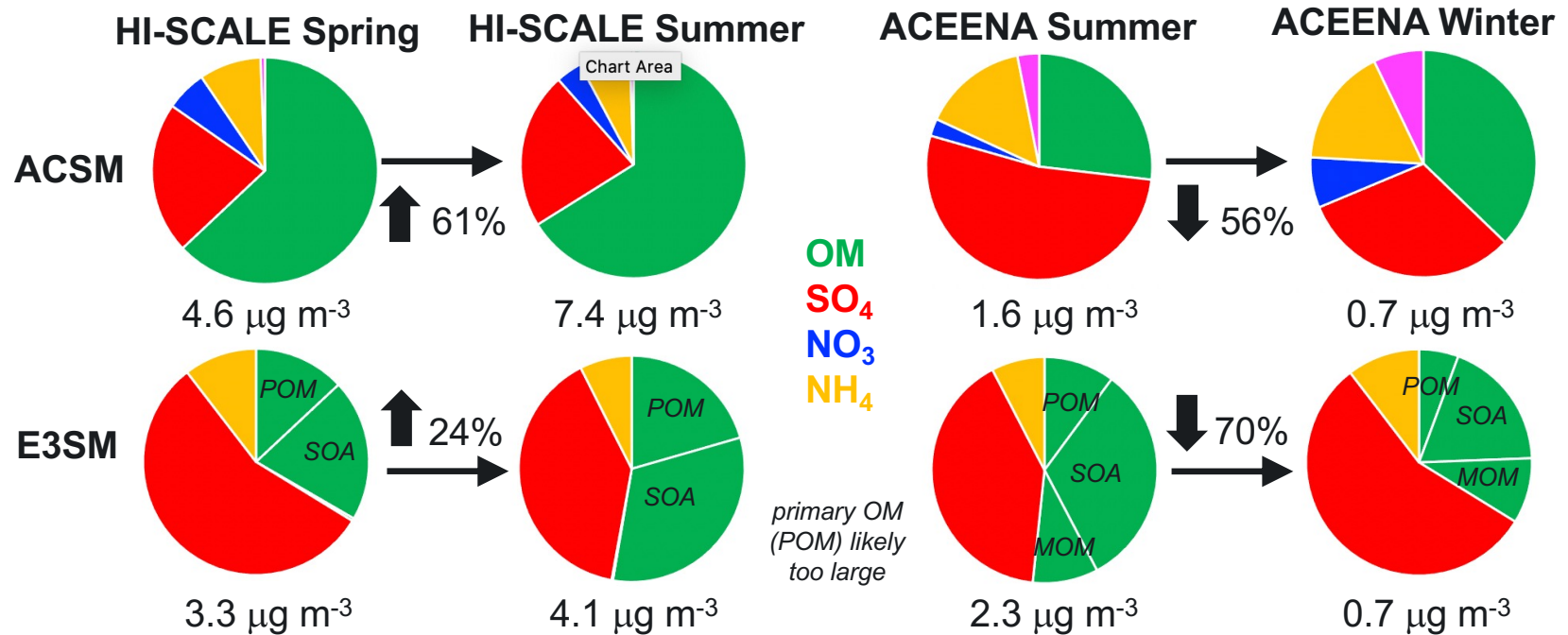


Azores ACSM: ACE-ENA

ACSM data part of new E3SM
aerosol diagnostics tool



Overall Seasonal Variations in Composition



- Errors in the relative fraction of SO₄ (hydrophilic) vs OM (hydrophobic) will affect calculation of CCN and aerosol activation, and consequently aerosol-cloud interactions

Summary and Next Steps

- ▶ E3SM simulations thus far focus on ARM IOP periods, but they will eventually include longer time periods to determine model performance over seasonal and interannual time scales.
- ▶ Speciation of organic matter from ACSM using PMF would be useful to shed light on simulated organic species
 - MAM currently saves primary vs secondary species
 - future versions of MAM could include additional OA speciation
- ▶ Other observations of aerosol number, size distribution, and CCN will be used to better understand reasons associated with errors in simulated CCN
 - i.e. effects of number vs size vs hygroscopicity