High-Resolution Modeling of Aerosol Composition and Optical Properties Associated with Anthropogenic and Biogenic Precursor **Emissions during CARES**

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Objectives

Organic matter (OM) comprises a large fraction of the total aerosol burden in many places of the world; however, large uncertainties remain in the prediction of secondary organic aerosol (SOA) formation and transformation that likely affects aerosol radiative forcing. Our current objectives are to:

- Use the WRF-Chem model and measurements from the Carbonaceous and Radiative Effect Study (CARES) to test and evaluate predictions of aerosol mass, composition, and size over regional spatial scales produced by state-ofthe-science aerosol process modules
- Quantify performance of simulated OM and SOA based on the volatility basis set (VBS) approach
- Produce a "control" simulation for comparing against future improved treatments of SOA
- Evaluate anthropogenic and biogenic emissions that affect SOA formation and transformation

Anthropogenic VOC Emission Rates model domain ∆x = 4 km simulated OM, 21 UTC June 27, 2010 671 TO. CARES ampling associated with peak SOA Biogenic Isoprene Emission Rates

Model Description

SOA: 2-species VBS approach for anthropogenic SOA, coupled MOSAIC aerosol model with 4 size bins and SAPRC trace-gas chemistry [Shrivastava et al., 2011]

Pacific Northwest

Boundary Conditions: Time-varying BC for chemistry and aerosols obtained from global MOZART model

Emissions: On-line biogenic emissions from MEGAN model, anthropogenic emissions from CARB ARCTAS 2008 inventory where trace-gas emissions are reduced by 1/3

Simulation Period: All of June 2010, with 3-days of spin-up

Evaluation Methodology: Employ the Aerosol Modeling Testbed [Fast et al., 2011] with the CARES "testbed case"



Results at Surface Sites

Results Aloft Aerosols (µg m-3) Trace Gases (ppb) G-1: June 23 Morning Flight G-1: June 23 Afternoon Flight mean 32.1 0.4 . C. Martin Martin Contraction of the Contraction o BC 24.9 T0 Urban Site 0.2 02 NOx 6.5 0.0 1.0 malle. 0.0 NO 0.5 Communities warmen so, 0.0 so **n** 3.1 ua m ON 0.39 SO2 Mr. Mr. MAD NH. isoprene 0.60 0.32 Ministerial 0.5 0.0 layer ald MVK+MACR 0.93 0.20 IVK+MACR BC altitude (km) altitude (km) 0.12 0.5 terpene 17 18 Time (UTC) 19 23 00 Time (UTC) 01 0.0 model mean 5.4 µg m 11 13 15 17 19 21 23 25 27 29 date (UTC) 3 5 7 9 11 13 15 17 19 21 23 25 27 29 date (UTC) 5 Percentiles HSRL Backscatte Simulated HSRL Backscatte Simulated 03 39.8 32.8 32.8 NOX Here white will routh 32 NO 0.3 Callen which is which the 123 166 HSRL Extinction Simulated HSRL Extinction Simulated OOA 0.0 M. M. LANLLANDLUNAS 0.08 erved mean 3.2 μg m⁻¹ Setyan et al. [2012] SO SO2 Mr. Mr. uppme 0.17 NH isoprene 1.21 0.83 2200 2300 2330 0000 time (UTC) 0.3 Mark Late 5 Walls 2300 2390 Sime (UTC) 0.010 km⁻¹ ulated extinction too high (consistent with surface AOD comparis and most likely due to simulated OM and BC being too high 0.0 MVK+MACR 0.75 BC 0.40 Future Steps 0.3 WAD terpéne 1.4444 1.444 1.444 1.444 0.12 0.59 model mean 5.5 µg m 0.0 Acknowledgements: This research was Implement multi-generational chemistry of biogenic 3 5 7 9 11 13 15 17 19 21 23 25 27 29 date (UTC) 3 5 7 9 11 13 15 17 19 21 23 25 27 29 date (UTC) supported by the U.S. DOE's Atmospheric SOA precursors and examine anthropogenic-biogenic System Research (ASR) program under

 Simulated OM usually too high Simulated BC too high at T0, are primary particulates too high?

- Biogenic species better at remote site Simulated NOx and CO too high also suggests emissions may be too high
- interactions
- Investigate sensitivity to semi-volatile SOA precursors Compare with SOA from CAM5's Modal Aerosol Model
- contract DE-AC06-76RCO 1830 at PNNL with measurements supported by ARM Climate Research Facility.

