Isolating Weakly and Strongly-Absorbing Classes of Carbonaceous Aerosol: Optical Properties, Abundance and Wet Removal

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Significance

- Inorganic and carbonaceous particles affect global radiative balance
- Importance of aerosols on the hydrologic cycle
  - Primary particles impact on CCN formation
  - Influence droplet activation (composition vs. size)
  - Absorbing and non-absorbing particles affect cloud optical properties
- Will characterize aerosol properties as inputs to models describing aerosol-cloud interactions, and aerosol direct and indirect impacts on climate

Overall Objective and Approach

- Objective:
  - Improve understanding of the anthropogenic influence of light-absorbing aerosol on direct solar radiation, CCN, and aerosol abundance

- Approach:
  - Combination of focused laboratory studies, modeling studies, and interpretation of field data

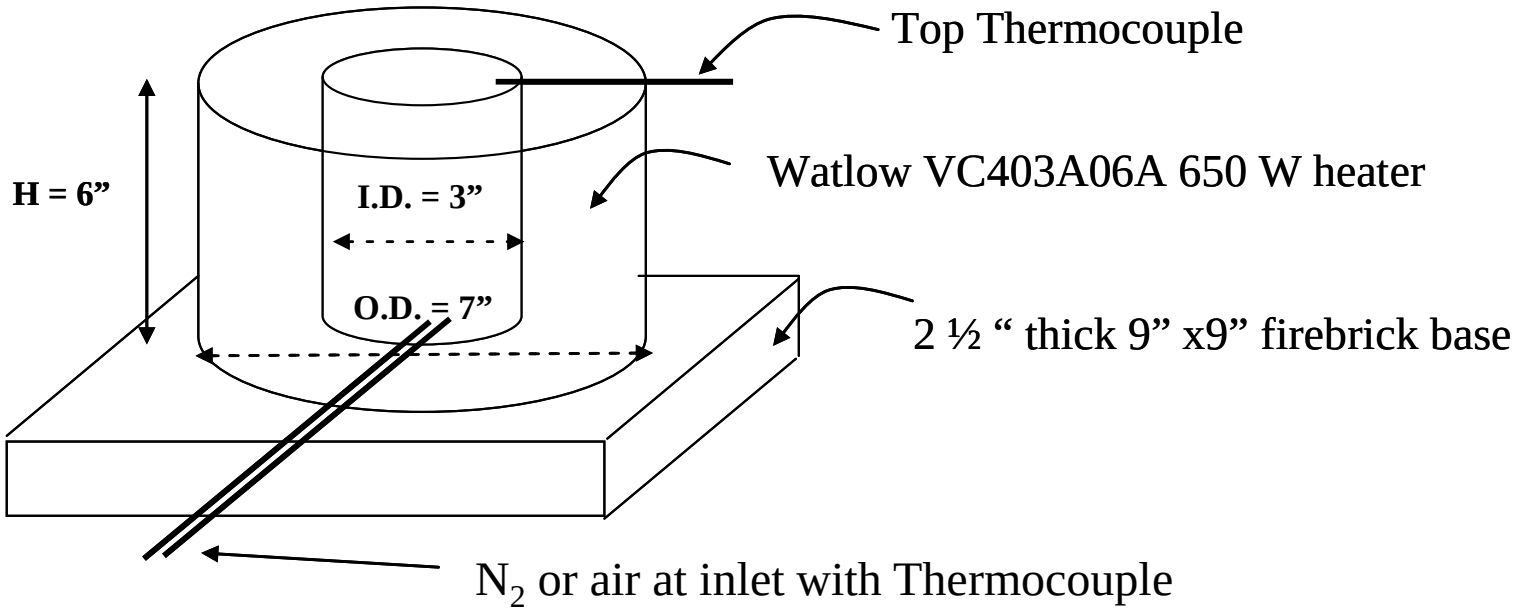
Specific Objectives

- *Generate fresh and aged aerosols:* seed aerosol contains specific black or organic carbon material
- *Measure key climate-relevant properties*: optical properties at high sub-saturated RHs and super-saturated RHs
- *Enhance a particle-resolved model:* particle aging to predict spectral absorption and scattering
- *Determine climate-relevant classes of particles:* important for use in models by integrating lab. and modeled results
- *Evaluate predictions:* Compare results with *field data* from ASR fixed sites and field programs.

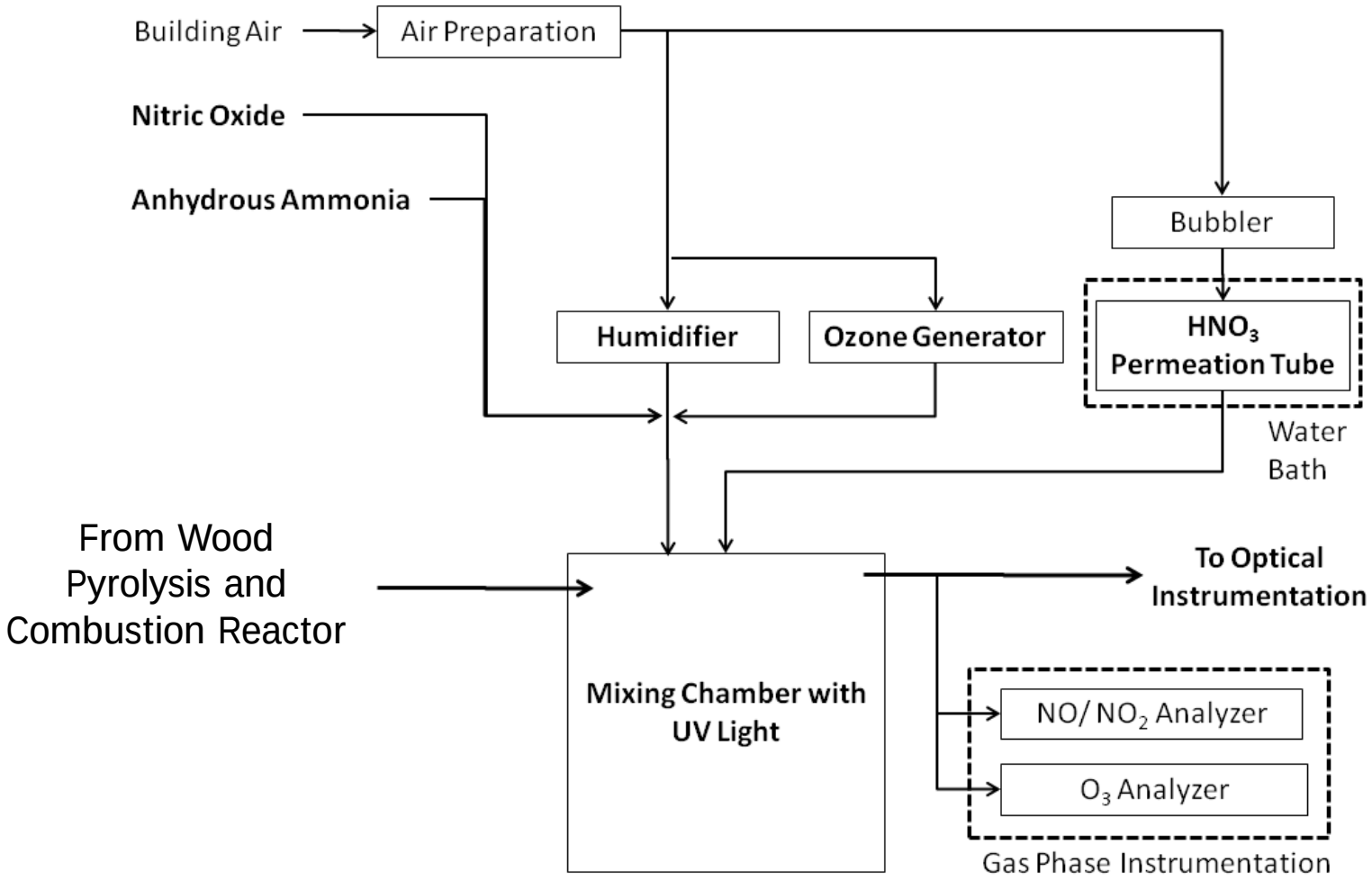
Aerosol Type and Laboratory Generation

Aerosol Type	Generation
Light absorbing organic carbon	Pyrolysis reactor: N_2 carrier gas
Black carbon	Combustion reactor: Air carrier gas

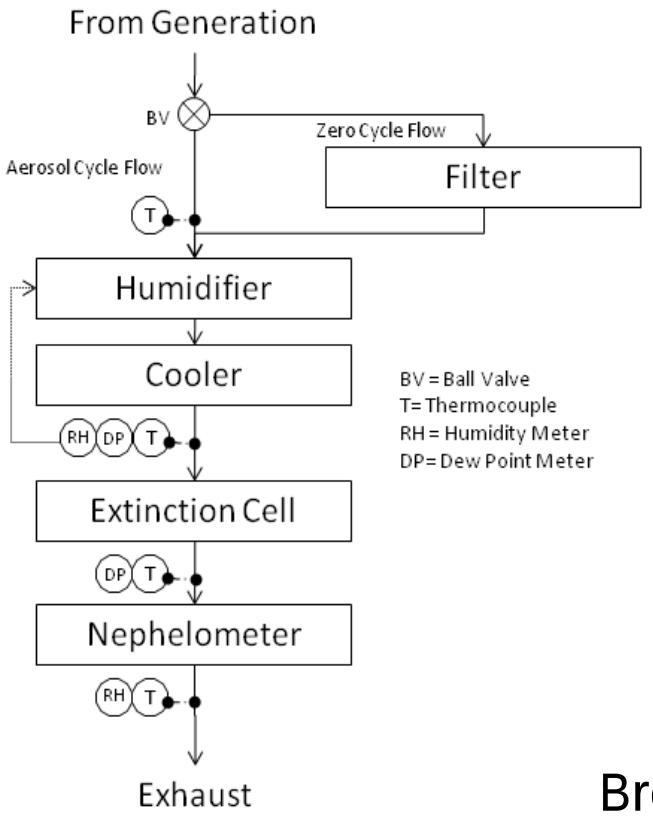
- **Pyrolysis and Combustion Reactor**

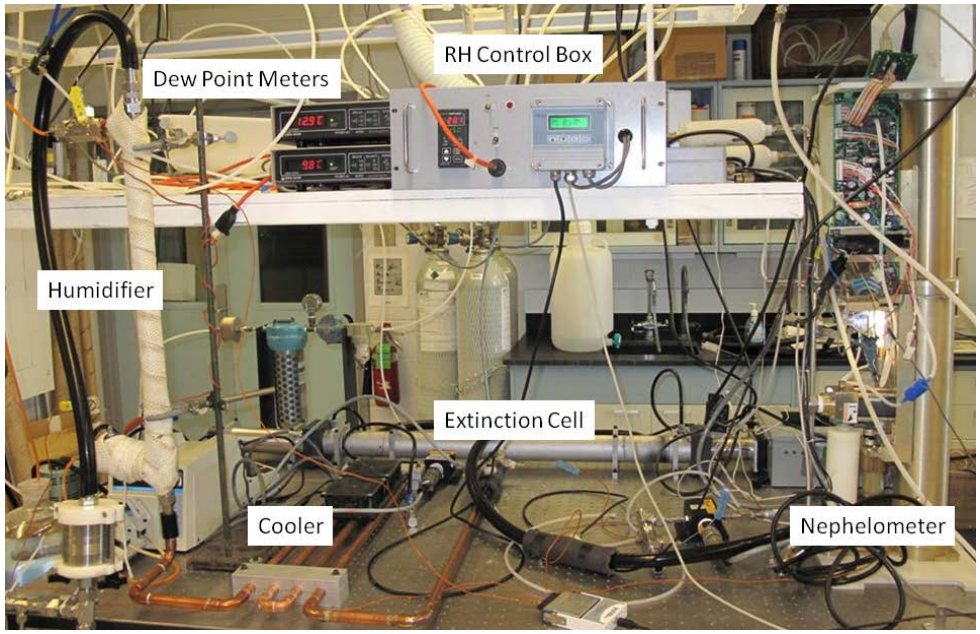


Aerosol Aging Apparatus



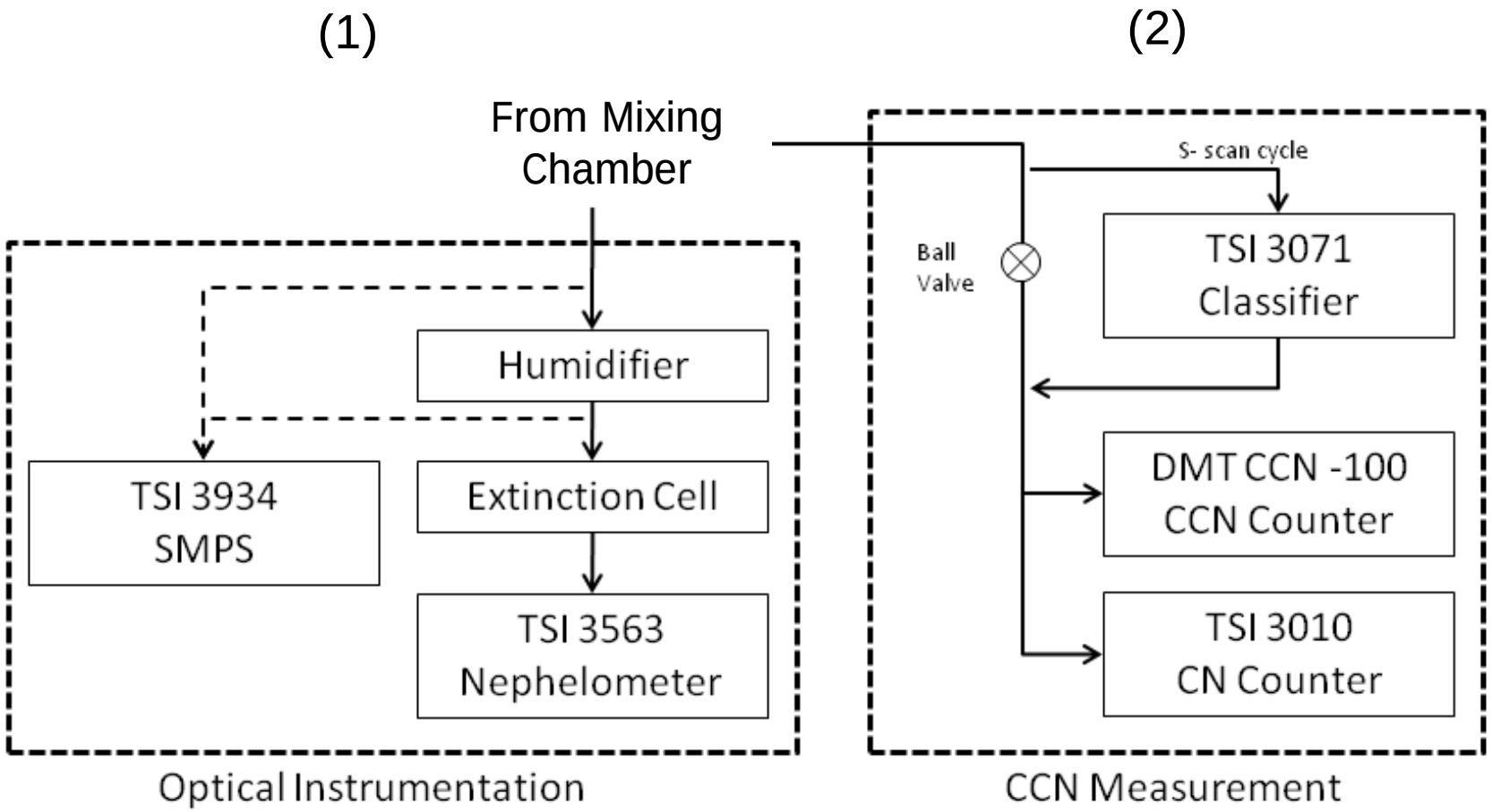
Laboratory Aerosol Detection (1): Optical Detection at Sub-Saturated RH Conditions



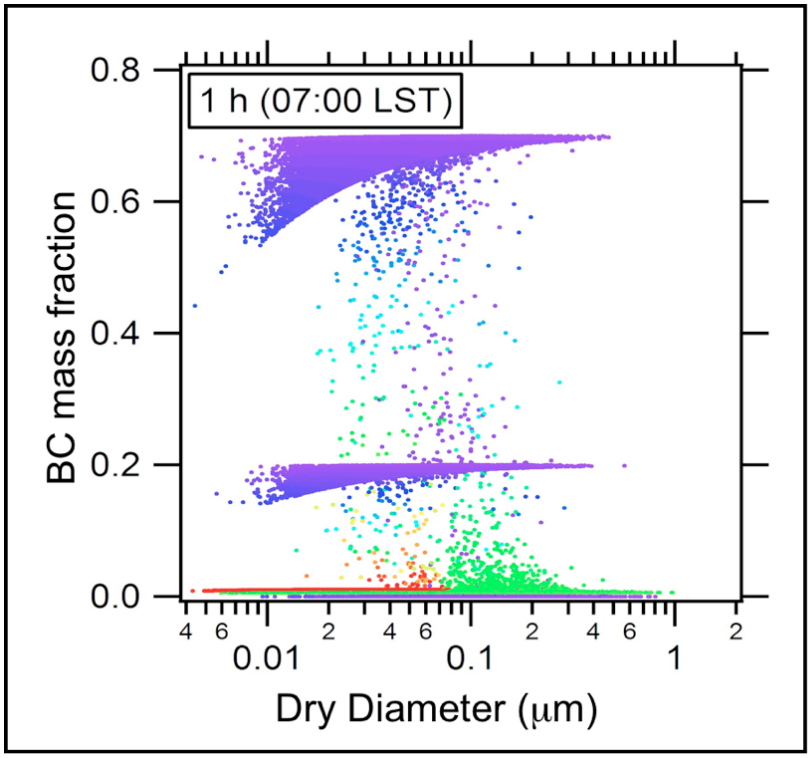


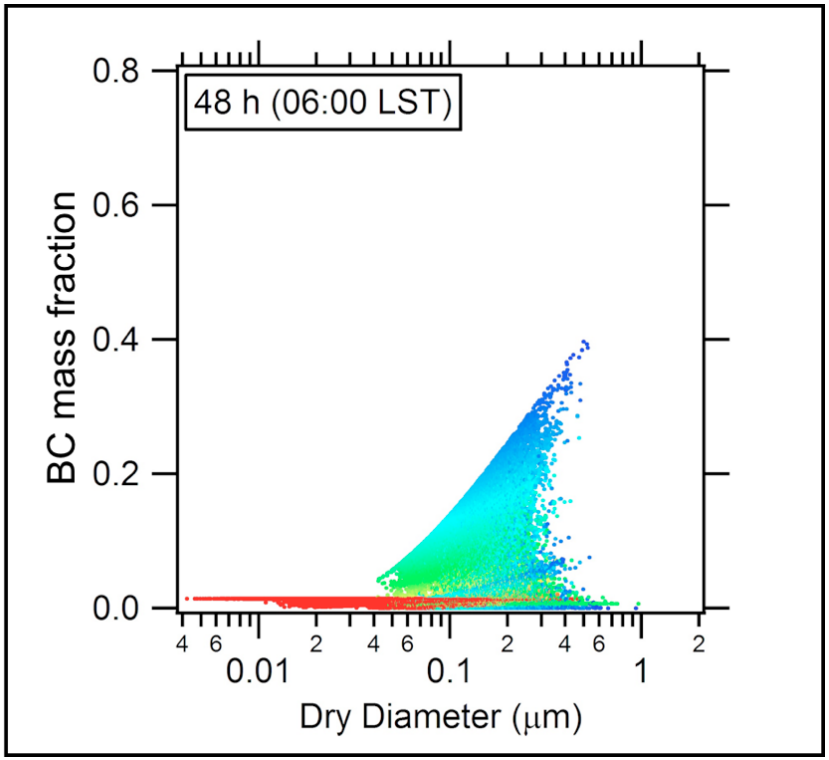
Brem, Bond, and Rood (9:25-10 AM, Wed., Aerosol Life Cycle PI Talks, Regency Ballroom)

Laboratory Aerosol Detection (2): New CCN Measurements



Example PartMC-MOSAIC Output: Urban Plume Scenario





Zaveri, Barnard, Easter, Riemer, and West (2010) JGR

Isolate Climate-Relevant Classes

- Identify important reactions or processes through simple experiments
- Incorporate these reactions into PartMC-MOSAIC
- Use PartMC-MOSIAC to determine which:
  - Properties are important in governing climate-relevant properties
  - Which aerosol types have those important properties
- Design laboratory experiments that evaluate needed information
- Perform the laboratory experiments to provide additional aerosol properties
- Return the information to PartMC-MOSAIC for re-evaluation
- Communicate the resulting important aerosol classifications to large-scale modelers using bin and sectional models

Evaluation with ASR Efforts

- Long-term measurements: ARM site
  - Three events for modeling, prioritizing where aerosol was observed at ground level taking advantage of ARM Aerosol observing system
- Intensive field campaign: CARES
  - Measurements are ideal for constraining, evaluate, and improve our model simulations with PartMC-MOSAIC
  - Size-resolved CCN measurements are a priority for evaluating predictions of PartMC-MOSAIC.
- Future work
  - Ganges Valley Aerosol Experiment (GVAX) campaign as an ideal test bed for our aerosol absorption apportionment measurements

Comments and Questions

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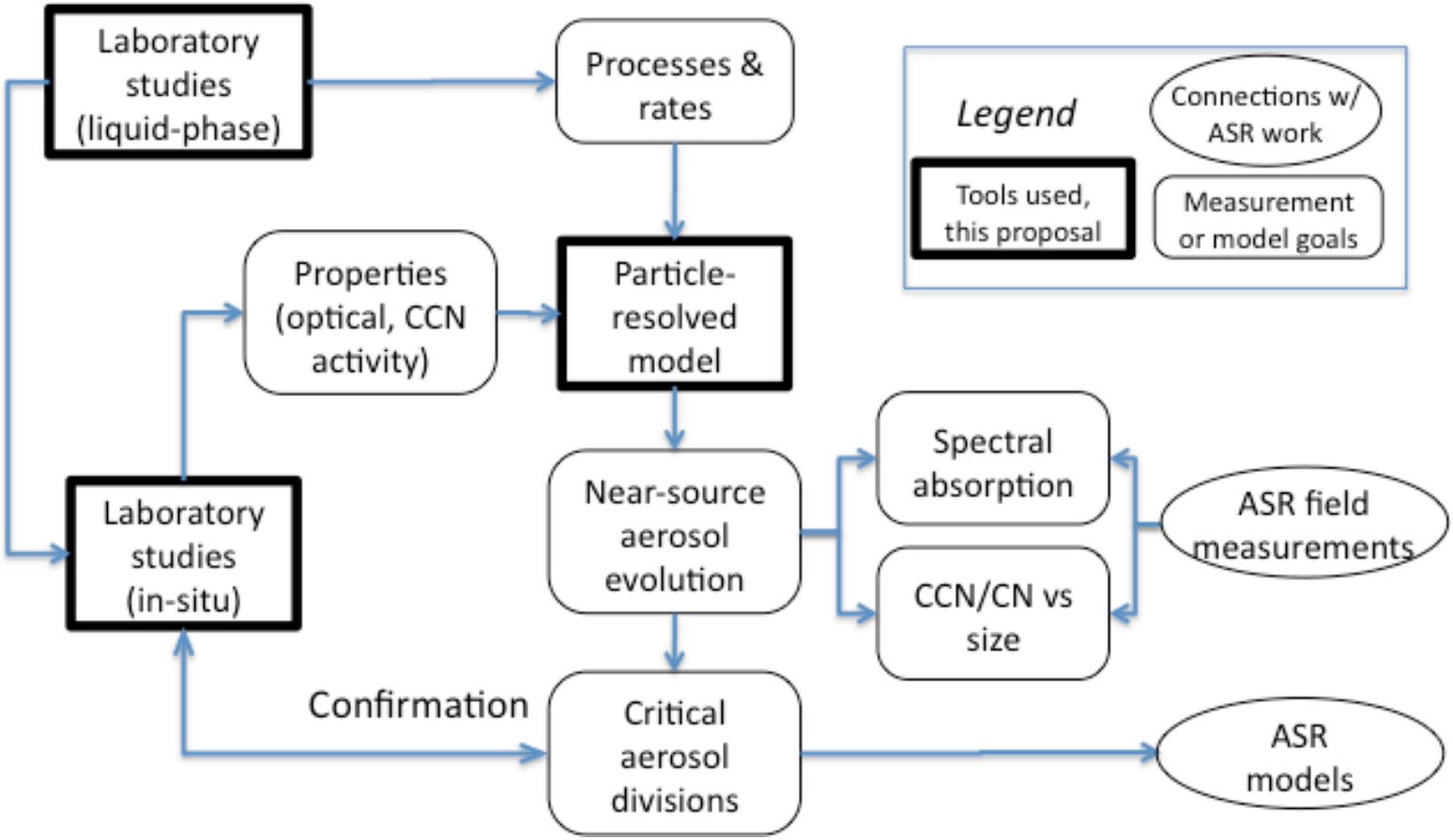
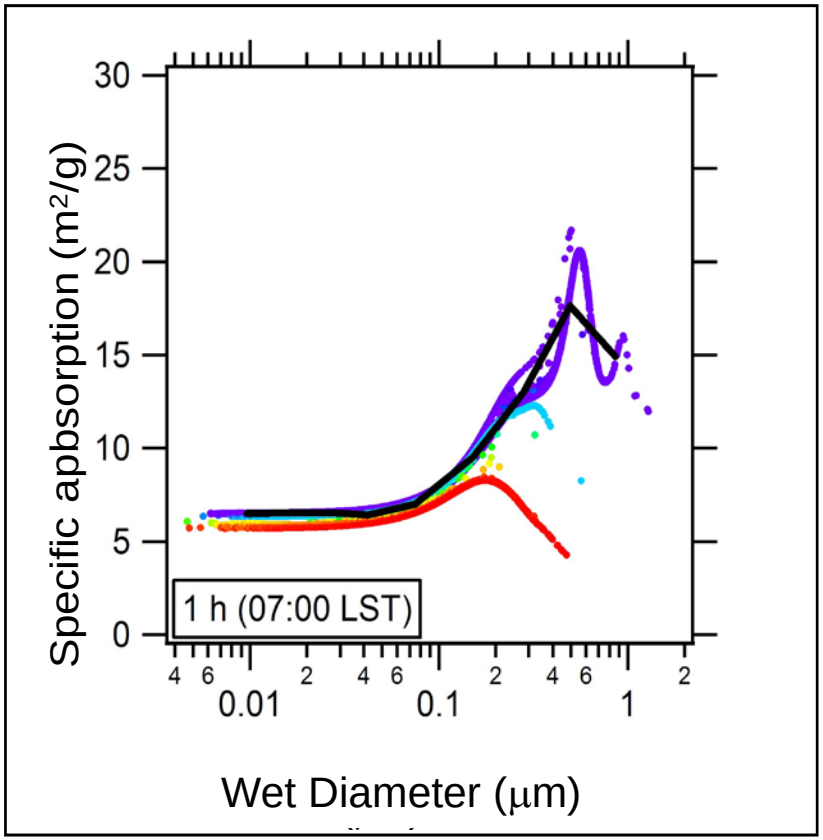
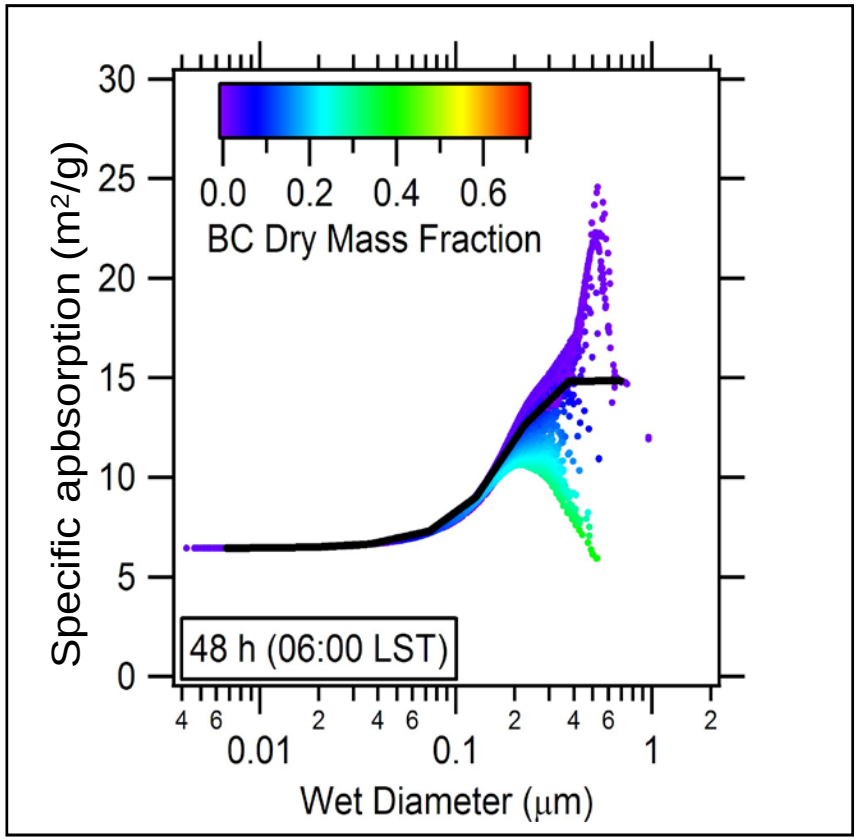
Relationship Between this Project and Other ASR Efforts



Evolution of BC Absorption: Dependence on Wet Diameter





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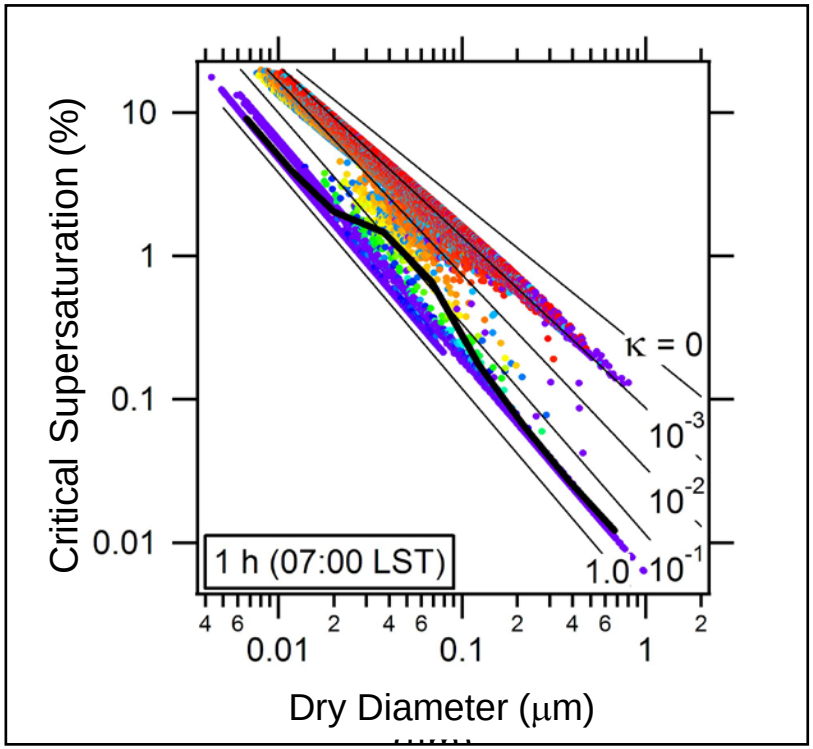
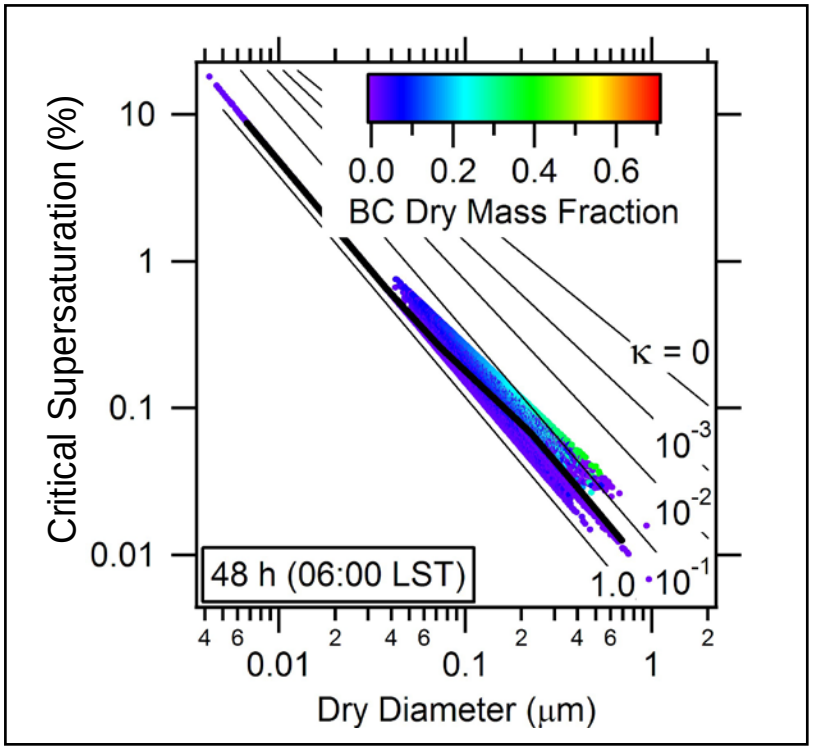
Evolution of BC Absorption: Dependence on Dry Diameter





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