CSD spearheads black carbon research focused on HIGH IMPACT topics with large uncertainties and high stakes

HIGH STAKES
- Major short-lived forcer
- Large anthropogenic sources
- Dramatic health impacts
- Impacts on hydrological cycle
  -> Focus for policy action

LARGE UNCERTAINTIES
- Sources
- Abundance
- Optical properties/evolution
- Climate relevant processes

**Figure 1.1.** Schematic overview of the primary black-carbon emission sources and the processes that control the distribution of black carbon in the atmosphere and determine its role in the climate system. 

*Bond et al., 2013 – 286 citations*
CSD Research Foci

**Instruments**
- Photo-acoustic spectrometry
- Laser-induced incandescence
  - Single-particle soot photometer (SP2)
  - BC in snow/ice
- Calibration materials

**Field Work**
- BC abundance: Remote, source regions
- Emissions: shipping, marine fuels, flaring
- BC microphysics: size distributions, aging, coagulation, hygroscopicity
- BC in cryosphere, removal processes, aging
- Topdown/bottom up inventories
- Regional and global model comparisons
- Optical properties/data analysis

**Modeling**
- IPCC AR5
- Bond et al., “Bounding BC” 2013

**Assessments**
CSD Research Foci

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Assessments
BC in the remote compared to global models

MEASUREMENTS:
HIAPER Pole-to-Pole Observations (HIPPO) Campaign: NSF GV
• Five 3-week flight series over 3 years
• 67S to 85N latitudes over Pacific
• ~750 vertical profiles of BC with SP2

MODELING:
• AeroCom: initiative to enable model and measurement comparisons of aerosol deliverables.
• 16 global models participate

RESULT:
AeroCom biased high by 3X on average, 4X in column load, and 17X over 250 hPa

Global model estimates of BC forcing are being reduced in response to this work

Schwarz et al., GRL, 2010 & 2013 – 68 citations
BC in the Cryosphere

**INSTRUMENTATION**
- Nebulizer characterized for size dependent efficiency
- SP2 configured to allow quantification of “giant BC”

**FIELD WORK**
- Snow samples from semi-rural and rural Colorado
- Aged and fresh snow

**RESULTS**
- BC in snow shifted to larger size
- Giant BC observed in most samples
- Mass absorption efficiency can be decreased 40% - a dominant uncertainty in BC snow-albedo forcing

CSD is unearthing new mechanisms and processes affecting BC snow albedo forcing.
Future

AIRBORNE CAMPAIGNS
• Atmospheric Tomography Experiment– NASA DC8, 2016 – 2020
• Fire Influence on Regional and Global Environments (FIREX) – NOAA P-3 – 2018
• Observations of Fire’s Impact on the Southeast Atlantic Region - NSF C130 2017
• KORUS - NASA DC8 - 2016
• GO-AHEAD – NOAA Balloon/UAV

GROUND/LABORATORY CAMPAIGNS
BC Aging and Removal/Deposition in Snow – BARDS 2015
Storm Peak Ice Nucleation Study – 2015
FIREX Fire Lab Study – 2017