Fire research in the NCAR Atmospheric Chemistry Observations & Modeling (ACOM) Laboratory

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Gold Hill fire
Boulder Daily Camera, Sept. 8, 2010
ACOM integrative research

- Developing predictive capability relies on the quantitative integration of observations and models spanning local-to-global scales
- This challenge requires state-of-the-science chemical instrumentation, aircraft facilities, Earth-system modeling, data assimilation and HPC
- Presents an opportunity for cross-community partnerships
Process-level fire emissions research

Emission Factors

- Evaluation of chemical processes with model and novel chemical mechanism
  - Test impacts of newly identified chemical species
  - Evaluate new chemical mechanisms
  - Quantify chemical processes in biomass burning plumes

Development of Emission Estimates

- Daily emission estimates available for 2002–present
- Full suite of chemical species provided for input to chemical and climate models

Emission Factors

- Emission factors derived from field and lab studies
- Updates to community datasets

Daily Fire Emissions for the Western US

Daily Emissions of Particulates & Gases from FIRE

Fire INventory from NCAR (FINN)
Field campaigns

Enhancement ratios from fires in Alaska, California, Canada and Asia (spring and summer)

Plume age calculated from HC ratios

[Enhancement ratios from fires in Alaska, California, Canada and Asia (spring and summer)

Plume age calculated from HC ratios

[Hornbrook, Apel, et al., ACP, 2011]

NASA ARCTAS 2008 DC-8 VOC observations from several instruments (TOGA, PTRMS, WAS) correlated with CO measurements indicating fire plume intercepts
The satellite perspective

Terra/MOPITT unique multispectral retrievals of CO provide height information to distinguish fire source regions from free troposphere long range transport of pollution.
Chemical forecasts

FINN fire emissions

AIRPACT
Air-quality Forecasting for the Pacific NW

MOZART-4/chemical assimilation driven by GEOS-5 forecast meteorology

Chemical forecast used as boundary conditions for real-time air quality applications and field campaign flight planning

http://www.acom.ucar.edu/acresp/forecast/
Predicting fire behavior

Coupled Atmosphere-Wildfire Model

- State-of-the-art capability
- Based on 20 years of coupled model R&D (Coen)
- Fully coupled fire-atmosphere model (WRF-Fire)
- Features:
  - Scott & Burgan fuel models
  - 100 m weather grid forcing
  - 30 m fire model grid
  - 10 m terrain data
  - User based fire ignition

High Park Fire (Ignition: 6/7/12 near Fort Collins, Colorado)

Courtesy of NCAR/RAL and Janice Coen
NCAR ACOM/ACCORD Workshop: Analysis of existing biomass burning datasets
July 13-14, 2017

Following NAS Future of Atmospheric Chemistry Research Recommendation 3:
NSF should encourage mining and integration of measurements and model results that can merge and exploit past datasets to provide insight into atmospheric processes, as well as guide planning for future studies.

The overall goals of this workshop will be to:

• Discuss science questions associated with biomass burning;
• Learn about existing datasets that can be used for data mining and analysis;
• Train on tools and models for data analysis;
• Develop collaboration and networking opportunities with other scientists.

Attending: >50 early career scientists, post-docs and graduate students