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

David P. Edwards

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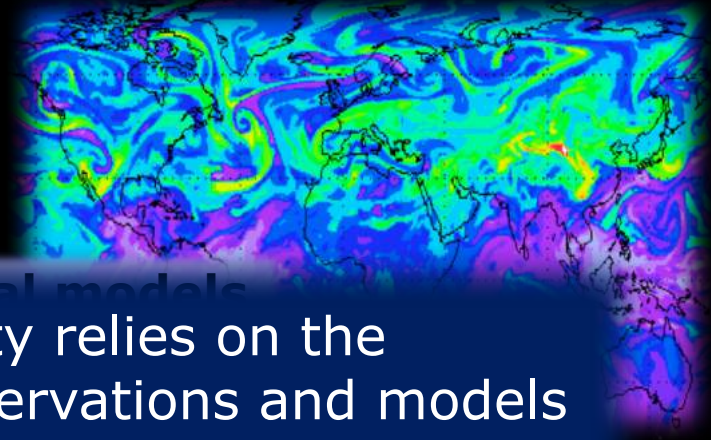
Gold Hill fire
Boulder Daily Camera, Sept. 8, 2010

ACOM integrative research

Remote sensing

Global models

- 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

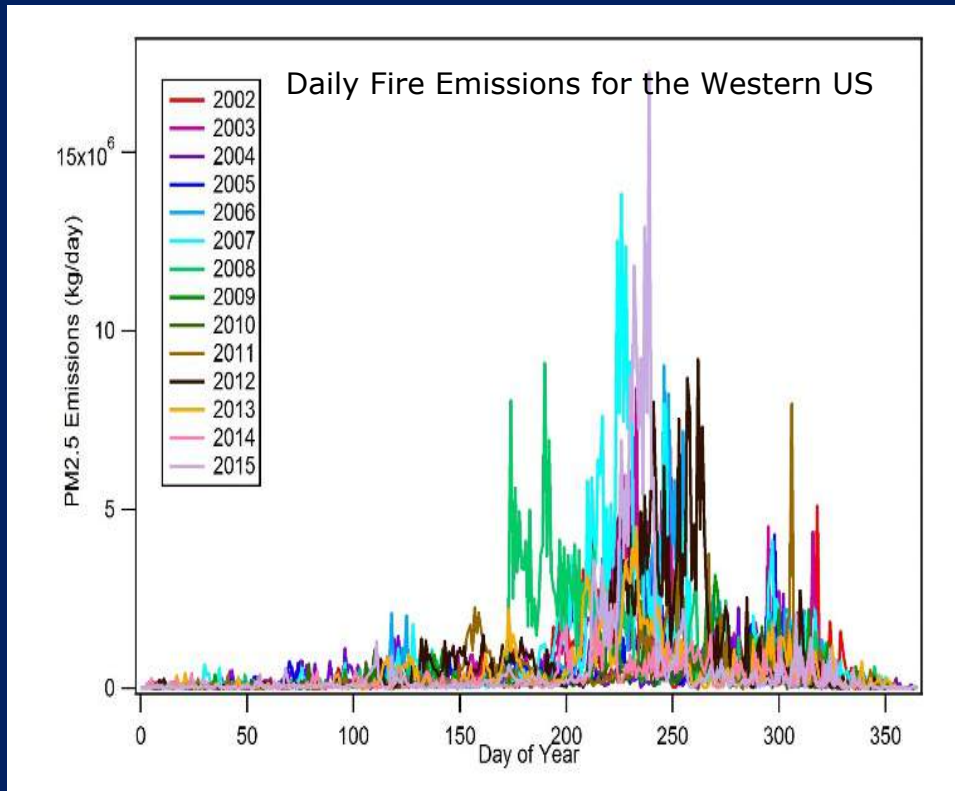**Aircraft**

Regional models

Lab studies

Process models

Emission Factors
-
-

Daily Fire Emissions for the Western US

(Legend: 2002, 2003, 2004, 2005, 2006, 2007, 2008, 2009, 2010, 2011, 2012, 2013, 2014, 2015)

PM2.5 Emissions (kg/day) vs Day of Year

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

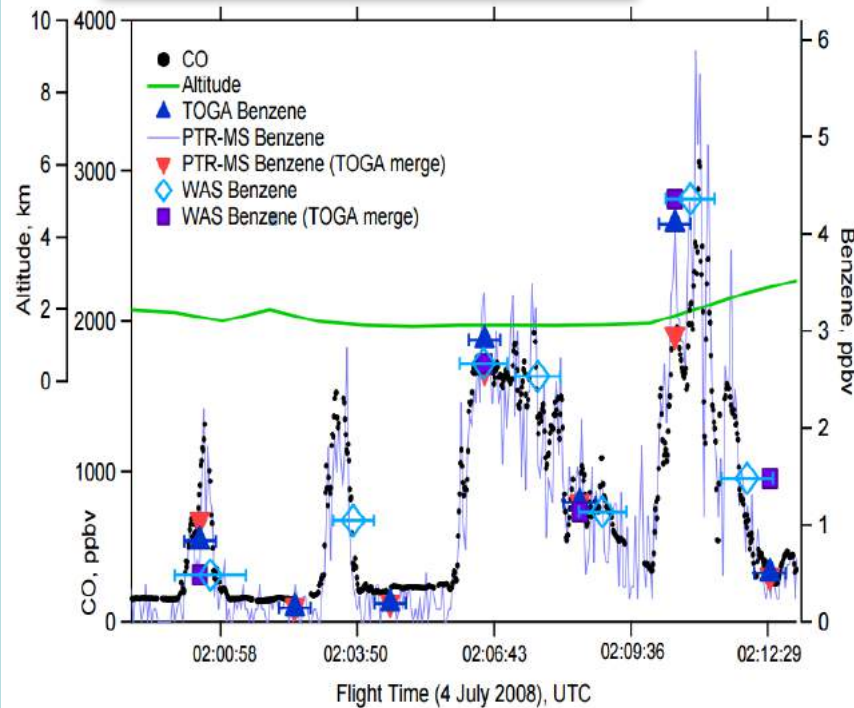**Evaluation of** …nical …esses with …model and …el chemical …hanism
…t impacts of …wly identified …emical species …aluate new …emical …chanisms …antify …emical …cesses in …mass burning …mes

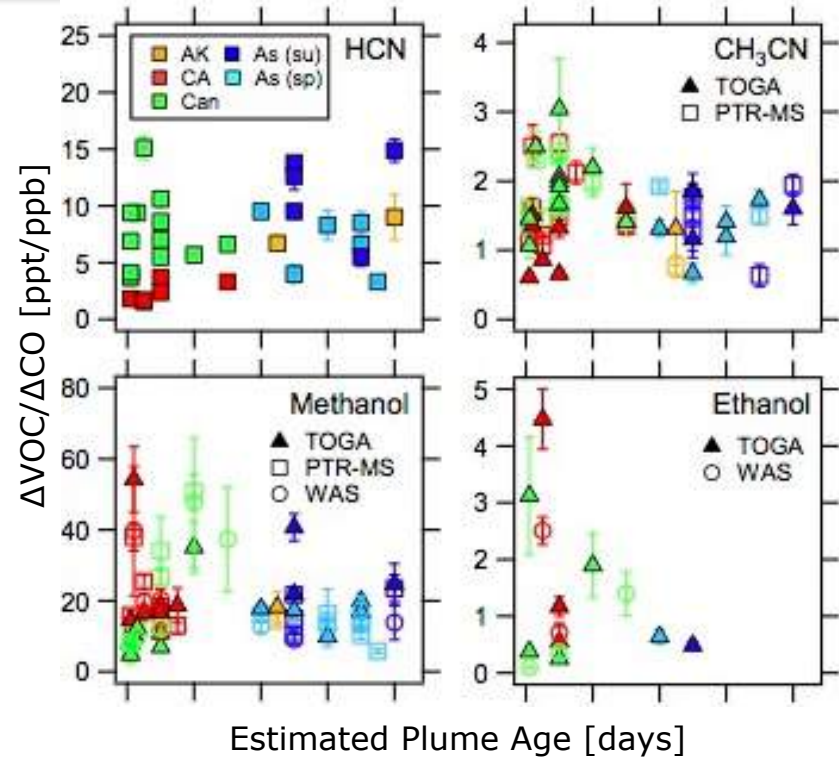Emission Factors = Daily Emissions of *Particulates & Gases* from FIRE

open shrubland
woody savanna
savanna
grassland

Fire INventory from NCAR (FINN)

Field campaigns

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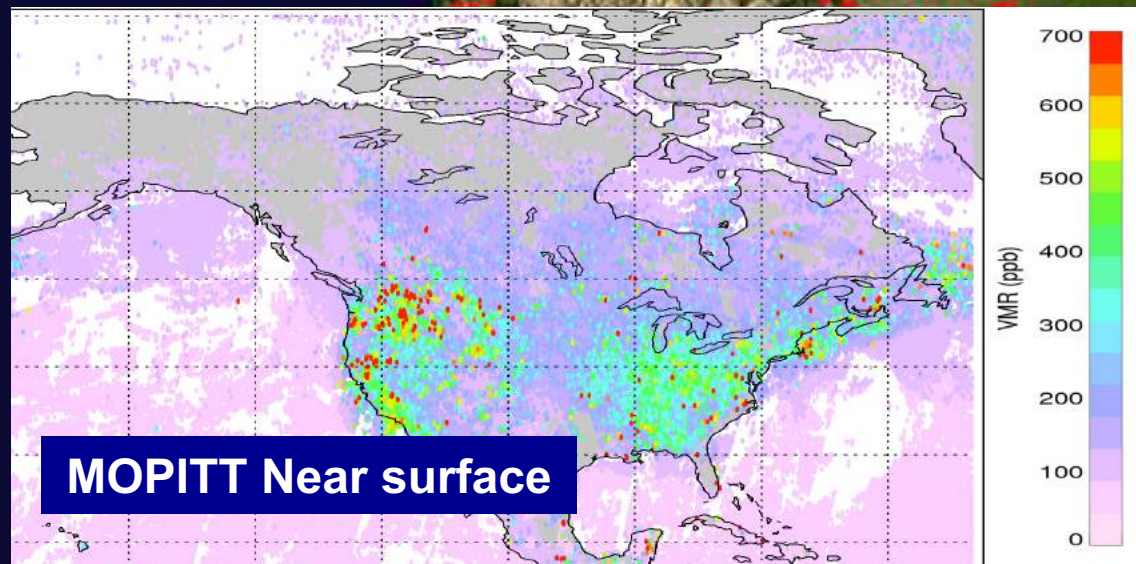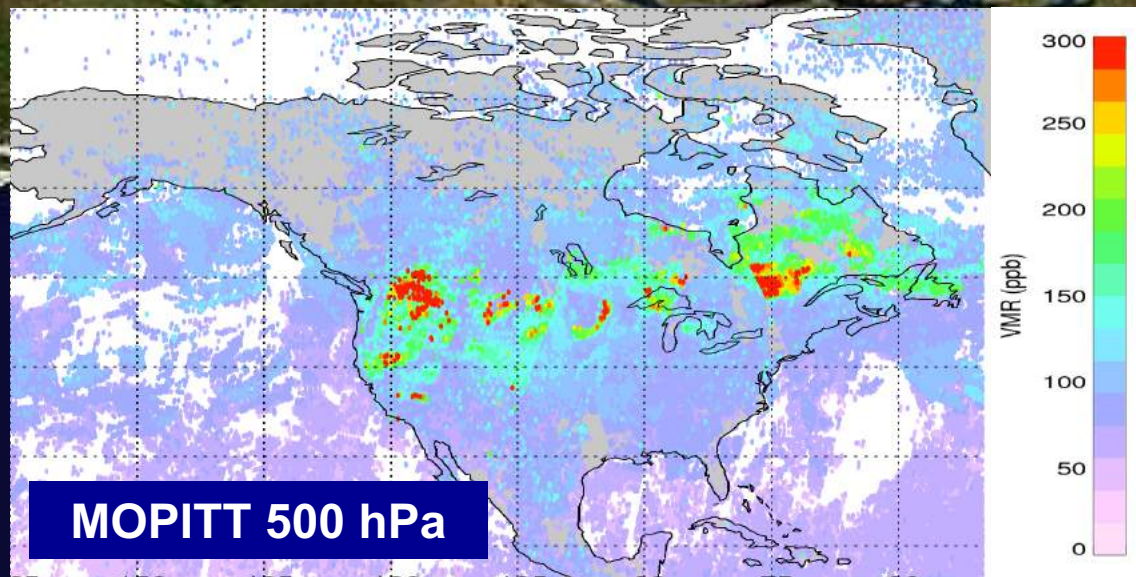

Estimated Plume Age [days]

- Enhancement ratios from fires in Alaska, California, Canada and Asia (spring and summer)
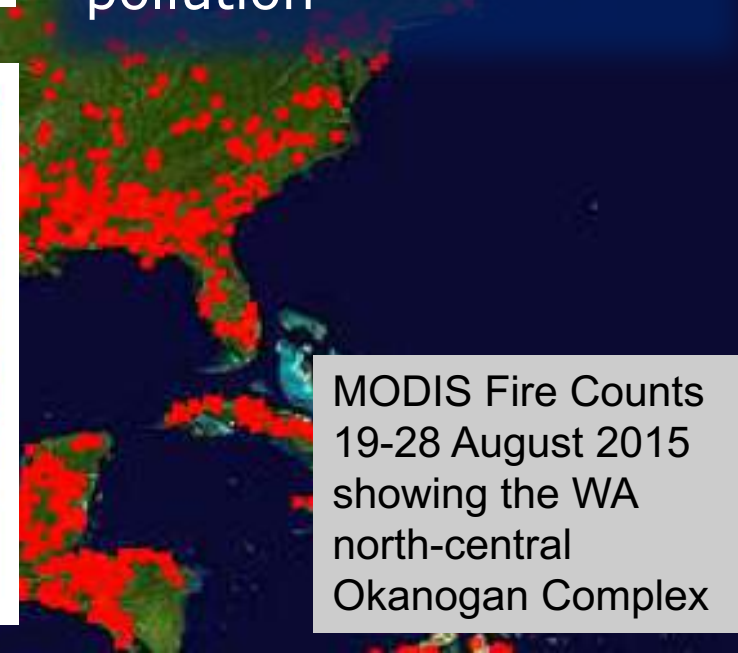- Plume age calculated from HC ratios

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

The satellite perspective
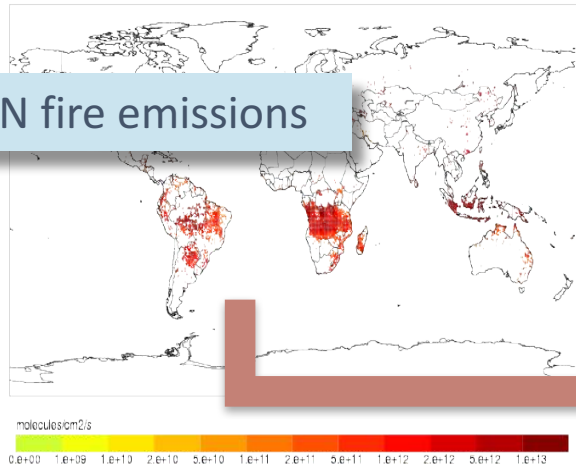

MOPITT 500 hPa

MOPITT Near surface

Terra/MOPITT unique multispectral retrievals of CO provide height information to distinguish fire source regions from free troposphere long range transport of pollution
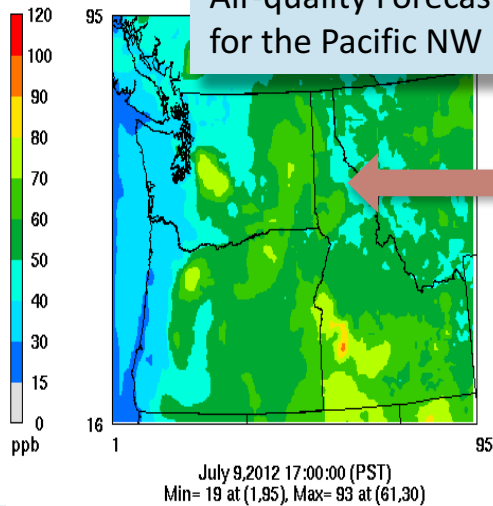
MODIS Fire Counts 19-28 August 2015 showing the WA north-central Okanogan Complex

FINN fire emissions

WASHINGTON STATE
UNIVERSITY

AIRPACT
Air-quality Forecasting
for the Pacific NW

MOZART-4 / MOPITT CHEMICAL FORECASTS

Compound: O3
Altitude: 4 km   Domain: Global

O3 20120708-18Z 4km

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

These images are from a MOZART-4 simulation driven by meteorology from the NCEP Global Forecast System. The CO fields are updated with MOPITT CO retrievals. Biomass burning emissions are estimated using near-real-time MODIS fire counts from the University of Maryland FIRI output files of these forecasts can be retrieved here. You can also make your own plot

MOZART

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

July 9,2012 17:00:00 (PST)
Min= 19 at (1,95), Max= 93 at (61,30)

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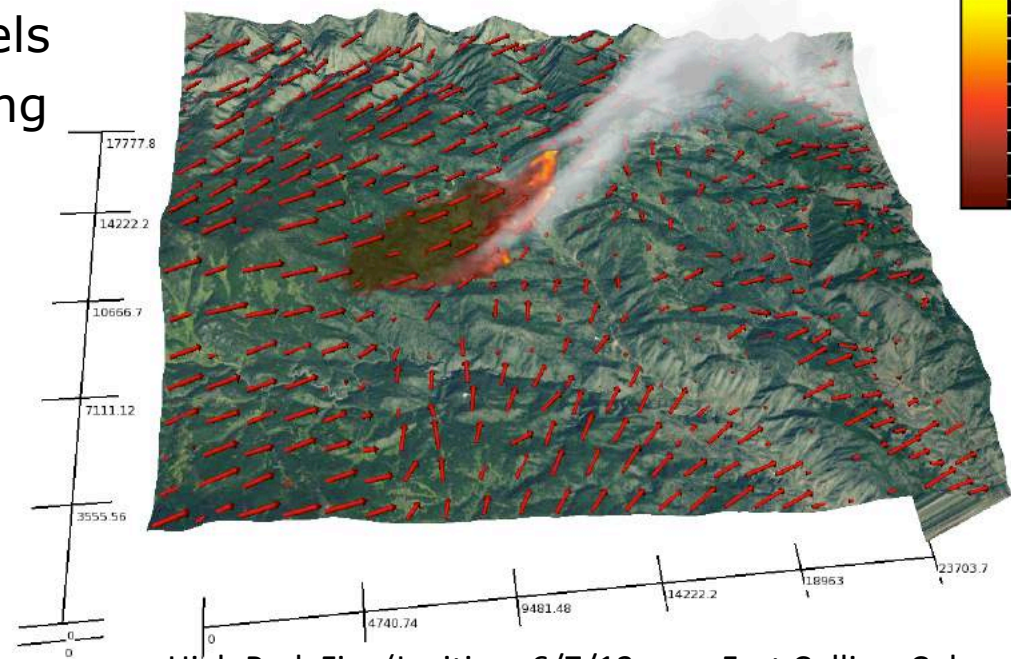
ACOM   NCAR   NSF
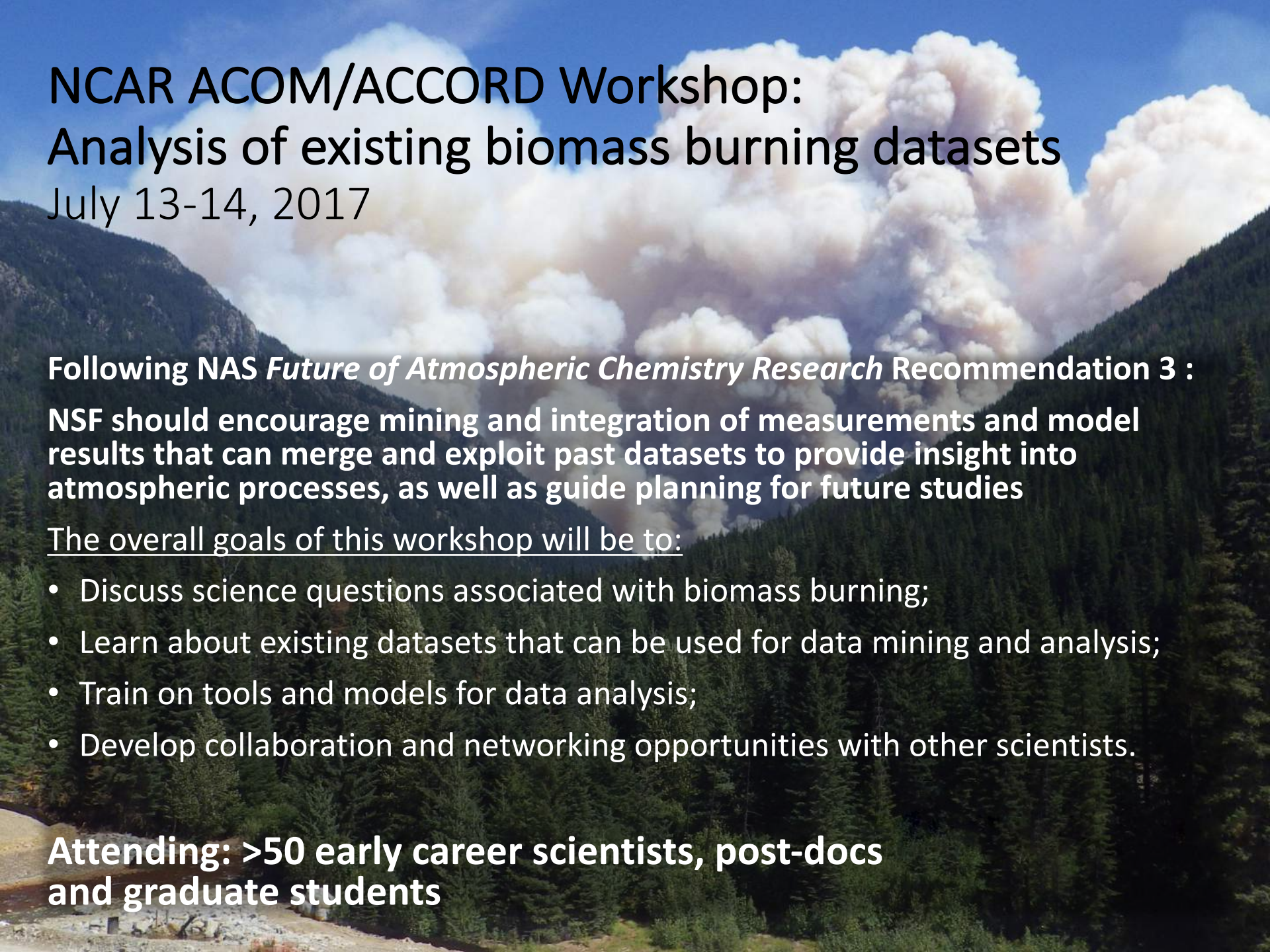
Predicting fire behavior

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