Workshop Wrap Up – A General Outline

Science Questions – Did we have the right ones in the beginning? Can we add to them or refine them?

Data – What data have we collected already? What more has/can be added to this? What further work is needed on this dataset? (Can we publish it / archive it?)

Tools – How did the breakouts go? Did people learn things? Do we have all the tools we need, or do we need more? What would make data mining older datasets easier?

Back to the Science Questions – Can we begin to address them with existing data and tools? (Or with data and tools that can be collected as a follow-on to this workshop)? Are there groups interested in collaborating on answering these questions? Working groups? Teams?

Other Products of this workshop -

NCAR website/database? Database publication?

Workshop reports – EOS and IGAC.

Additional topics:

Provide guidance to upcoming campaigns (FIREX, WE-CAN, FIREChem) on gaps in knowledge, plume sampling.

EMISSIONS:

- What are the organic compounds emitted from fires, and how do they vary? What are the primary factors (intensity, vegetation type) that control the organic composition of the emissions? What are the currently unidentified VOCs emitted by large wildfires?
- How much NH_3 is emitted from BB? How do emissions vary based on the type of land being burned and the strength of the fire?
- How BB emissions will be estimated within the modeling framework?

PLUME EVOLUTION: (many questions presented by the group, my attempt to condense them)…

- How do VOC concentrations, reactive nitrogen concentrations, VOC/NOx ratios, and ozone production vary as the plume evolves?
- How do SOA amount, composition and optical/microphysical properties change as the plume ages?
- What are the larger scale impacts of BB emissions and chemistry on oxidant levels and atmospheric composition in general?
- What are the atmospheric lifetimes of molecular organic tracers (i.e., anhydrosugars) and what processes control them? Where / when / how do they become cloud condensation nuclei (CCN)? What role do they play in clouds and how are their lifetimes influenced by cloud chemistry?

MIXING:

- How does the inclusion/mixing of background air, or other sources impact plume chemistry?
- What is the interaction of a wildfire plume with urban emissions?
- When and where do the plumes mix down to surface?

OTHER:

- Using ice cores, how can we determine how the fire regime has changed over time? Can we extrapolate higher order characteristics like size and location from ice core BB signals?

Data

Leading up to the workshop, we identified some data that might be useful… Are there more? Is there a group of people interested in building this data set?

	Funding Org.	Aircraft	Surface?	Location	Fire type	Age of plume	Date of measurement
ARCTAS	NASA	DC8		Alaska and Canada		*** See table 1 in Hornbrook et al.*	April, Jun-July 2008
ARCPAC	NOAA	P3		Alaska			April 2008
SENEX	NOAA	P3		SE U.S.			June 2013
INTEX-NA	NASA	DC8		NE U.S.			July-Aug 2004
SONGNEX-Summer 2015	NOAA	NA	Yes	Boulder Atmospheric Observatory	Aged disperse smoke	2-3 days	7/6 - 7/10/15 and 8/16-8/30/15
SEAC4RS	NASA	DC8, ER2		SE and Western U.S.	Ag. and forest wildfires		Aug-Sep 2013
DC3	NSF/NASA	GV, DC8		Central U.S.	Ag. and forest wildfires		May-June 2012
BBOP	DOE	G-1	Yes	NW US	wildfires	1-48 h	7/25 - 8/25/13
SLOBB		DHC-6 Twin Otter		Western US (CA)	Prescribed fires	young (ca. 2h)	11/10/09-11/18/09
SCREAM		DHC-6 Twin Otter		Eastern US (SC)	Prescribed fires	young (ca. 2h)	10/30/11-11/10/11

Data

More work needs to be done with these data…

- Add to the list.
- Identify plume encounters within the campaign datasets.
- Identify collections of data that can be used to address a particular science problem - e.g., problems related to emissions, or to plume evolution.
- Look at plume enhancement ratios for various species (as has been done for ARCTAS).
- Identify gaps in the datasets – what needs to be measured in future campaigns?
- Paper in a ‘data’ journal?
- Database on an NCAR website?

Tools

Had tutorials / breakouts on certain tools – BoxMox; R; IMPROVE; Fire datasets, etc.; Aircraft campaign data; atmospheric satellite data.

Comments? How did these go? Were they useful?

Do we have (all) the tools we need to go forward?

What else is needed?? (new mechanisms; …)

Make a list, identify people who will provide new tools?

What tools are needed to address these questions?

MODELS:

Chemical box model to test the reactivity and chemistry of organic compounds in different plumes.

Multi-scale (box, Lagrangian, 3D) models that model chemistry, thermodynamic properties, and microphysics of organic aerosol.

Coupled Lagrangian-Eulerian modeling (CMAQ-APT) to simulate various fire plumes and the physico-chemical changes of the selected organic tracers. Monte Carlo simulations for sensitivity analysis of the CMAQ-APT results.

3D sensitivity simulations (and possibly box modeling) to determine the contribution of fires to remote concentrations and explore chemical processes.

MEASUREMENTS and MEASUREMENT/MODEL COMPARISONS:

A high-throughput tandem mass spectrometry system, and field observations.

Integrated analysis based on remote-sensing data, in situ measurements, with appropriate photochemical models to detect the smoke plumes and estimate their contributions to the downwind air quality.

A combination of both measurements and modeling, using surface and upper level measurements to validate 3-D photochemical air quality models (suggestion: a coupled Eulerian model with a Lagrangian approach to better represent plume diffusion and dispersion).

Combine data from the FIREX lab and field studies with a coupled detailed chemistry model (ASP) and plume dispersion model (SAM). Use SAM-ASP for closure studies of the two campaign types (lab vs field) as well as build a sub-grid parameterization for the evolution of aerosols in BB plumes over time; test this parameterization in GEOS-Chem-TOMAS.

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Other Discussions / Next Steps:

EMISSIONS:

Measurements of organic species in biomass burning plumes (i.e., from aircraft and surface measurements). Emissions data/Emission factors of explicit organic compounds from lab and field studies.

Measurements of atmospheric ammonia in plumes from actual measurements as well as measurements made in laboratory studies.

PLUME EVOLUTION:

Laboratory (e.g., smog chamber, flow tube reactors) and field (e.g., aircraft, ground-based) measurements of organic aerosol size, mass, composition, and volatility.

Aircraft plume measurements at various transects downwind to trace the plume evolution, including aerosol size distribution, chemical species concentrations, CCN activity, etc. Laboratory data for cloud chemistry.

We need complete ice core biomass burning histories, and a (or multiple) sets of training data.

Detailed oxidation mechanisms for organic precursors (rate constants, products distribution, …) of biomass burning origin.

Airborne measurements (e.g., airborne lidar measurements of ozone) as well as soundings of thermal properties (e.g., radiosondes and/or dropsondes) close to the source and along the biomass burning plumes path until it hits an urban air quality network.

Fast measurement and characterization of organic species in a plume. Weather parameters such humidity, wind speed/direction, cloud cover, and presence of other nucleating particles (dust). Fire characteristics such as intensity, size, and vegetation.

Airborne and ground-based measurements of smoke plume tracers (e.g., CO), ozone precursors (e.g., VOC and NOx) and ozone profile in field campaigns.

Appropriate emission inventory for modeling framework.

Lab and field size, number, and composition measurements of biomass burning plumes over time of varied fuel types and conditions.