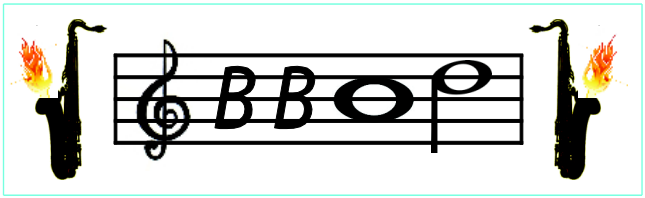
Time Evolution of Biomass Burn Plumes

Kleinman, Sedlacek, Kuang, Lewis, Springston, Wang, Yokelson, Fortner, Freedman, Onasch, Adachi, Buseck, Arnott, Chand, Collier, Dubey, Mei, Shilling, Thomlinson, Zaveri, Wigder, Zhang, and BBOP team

BBOP: Biomass Burn Operational Period.

35 Research Flights



Plumes from Wildland and Prescribed Burns, 15 min to 4 hours old

Aerosol and Trace Gas Emissions

Growth of Aerosol Mass

Downwind evolution of

Size distribution, Morphology, Optical properties

Hygroscopicity, Chemical Composition

See Presentations and Posters later today

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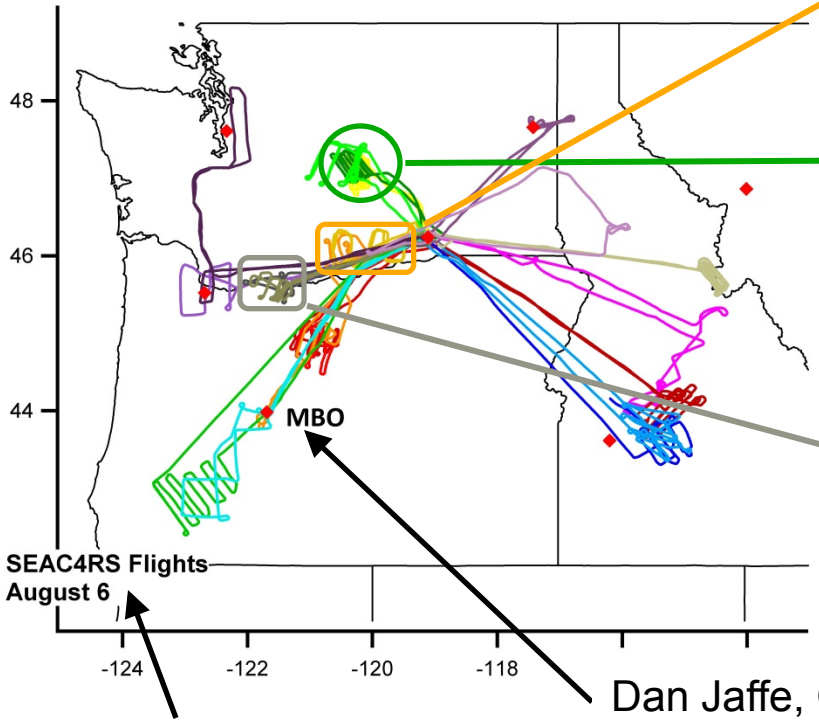
ARM CLIMATE RESEARCH FACILITY

ASR Atmospheric System Research

Flights

Wildland Fires: Shrub, Forest
Urban: Seattle, Portland, Spokane, Nashville, Memphis
MBO (3)
SEAC4RS: Joint mission Aug., 6
Prescribed Ag. Burns, SE US



Dan Jaffe, Qi Zhang

Bob Yokelson, Rich Ferrare, Ralph Khan, Charles, Ichoku

726a Mile Marker 28, 26K acres

730b Colockum Tarps, 80K acres

821b Government Flats, 12K acres

Is SOA Formed in Wildland Fire Plumes?

We Need:

Fires to Sample

A measurement of SOA or a surrogate

A conservative tracer to account for dilution

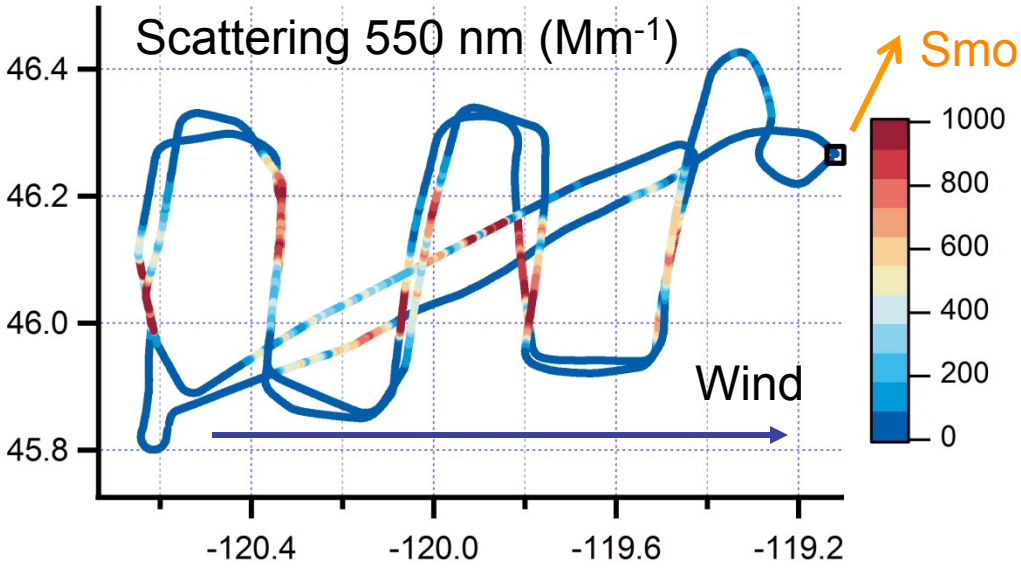
Time markers

SOA or Surrogate*	Conservative tracer*	Age Marker
OA: SP-AMS	CO	Winds
UHSAS volume	rBC: SP2	NOx/NOy
PCASP volume	BC: SP-AMS	toluene/benzene
Scattering	CH_3CN, benzene: PTR-MS	

d[OA]/dt: 4 SOA x 5 Tracers x 3 Ages = 60 different answers

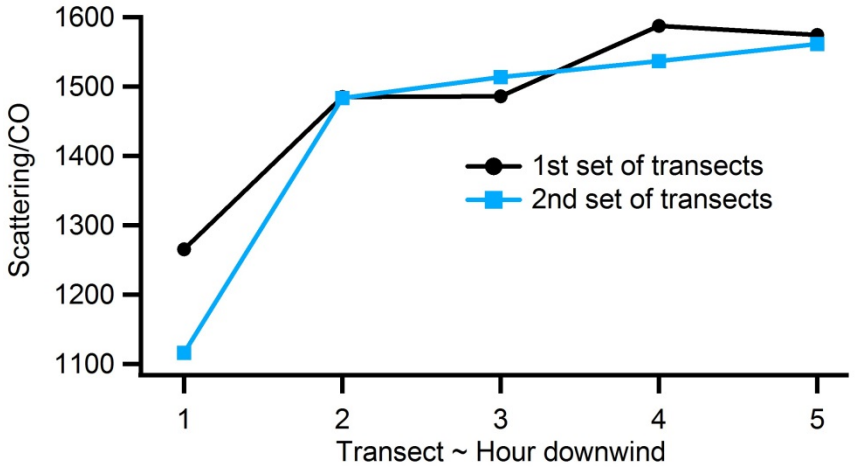
* x number of ways of subtracting background

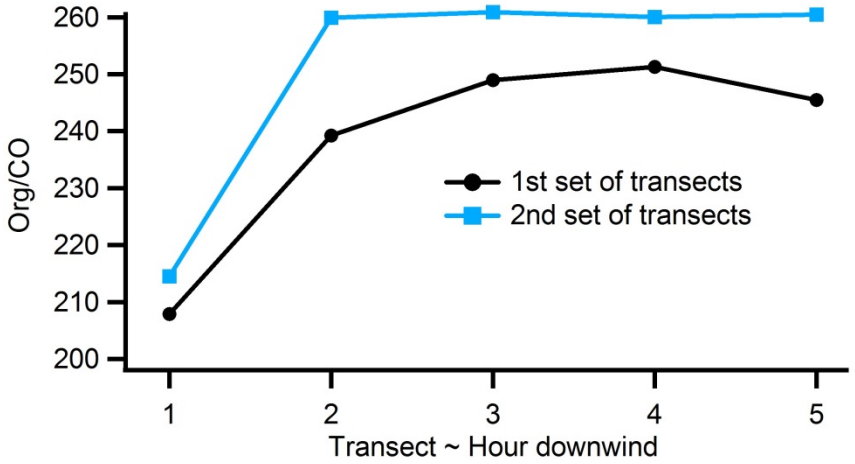
SOA Formation: 726a, Mile Marker 28



Smoke reached airport in Pasco, WA

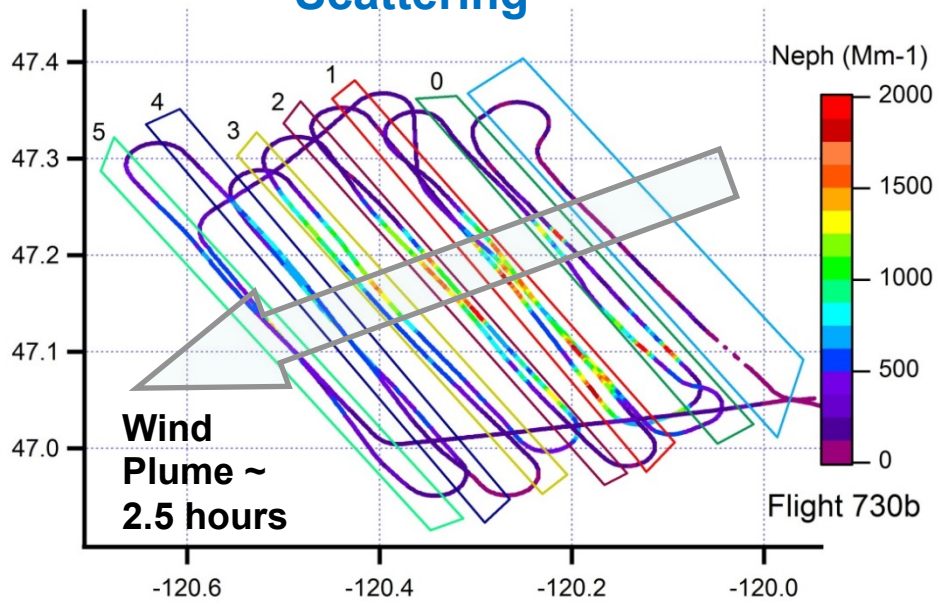
- CO is the conservative tracer.
- **Scattering and Org increase by 20-35%, mainly in the 1st hour**
- Volume and scattering give SOA because aerosol is > 90% OA



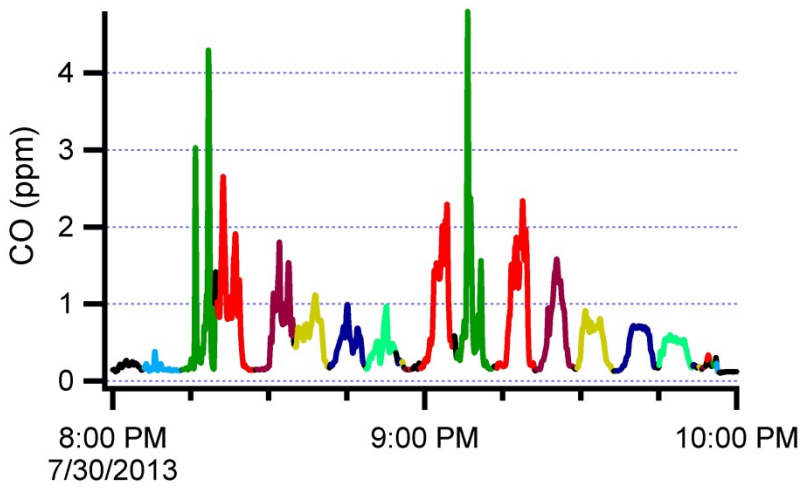


SOA Formation: 730b, Colockum Tarps

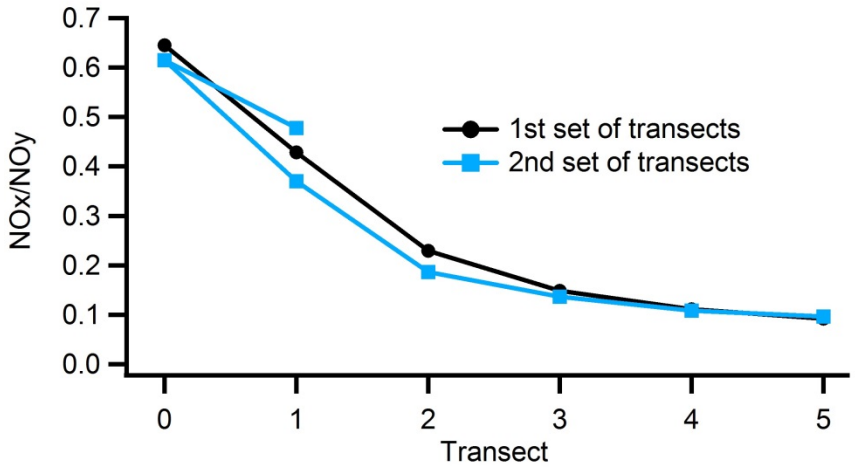
Scattering



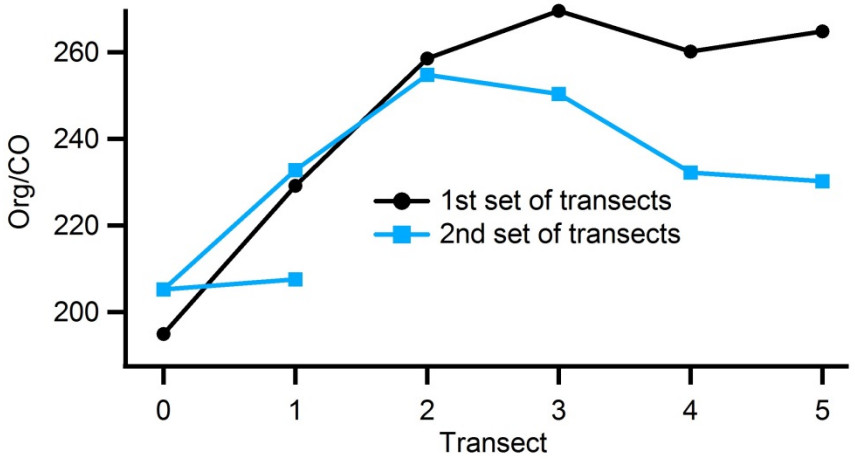
CO, conservative tracer



Rapid aging from NOx clock

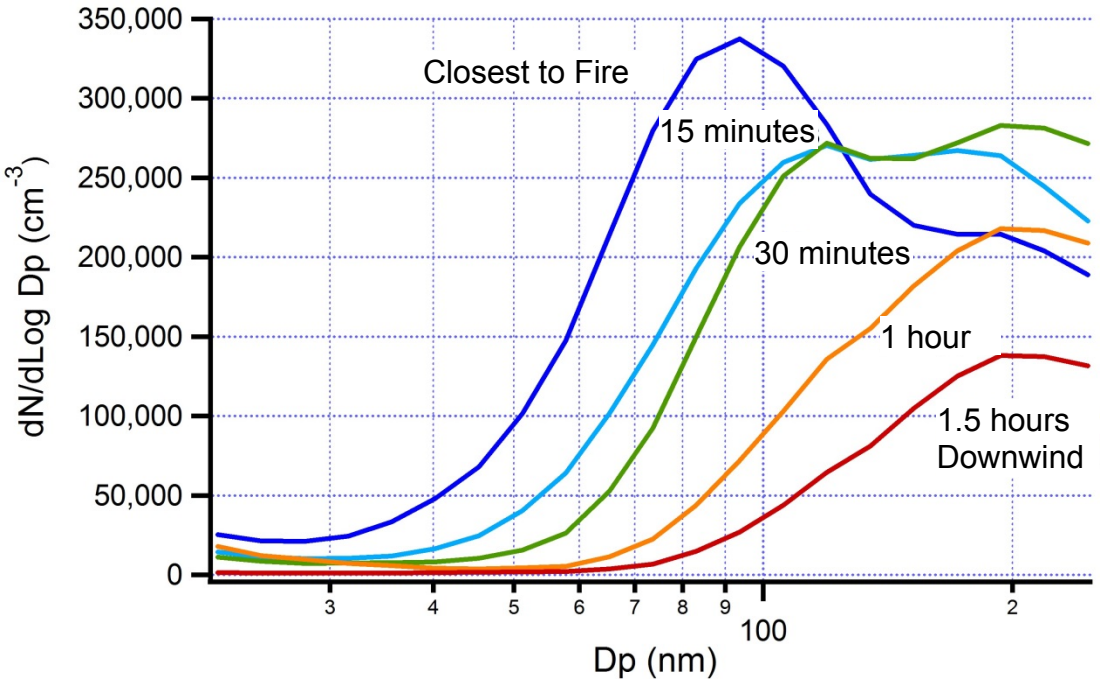


~ 25% SOA production



Time Evolution of Aerosol Size Distribution from FIMS

821b Along Plume Leg

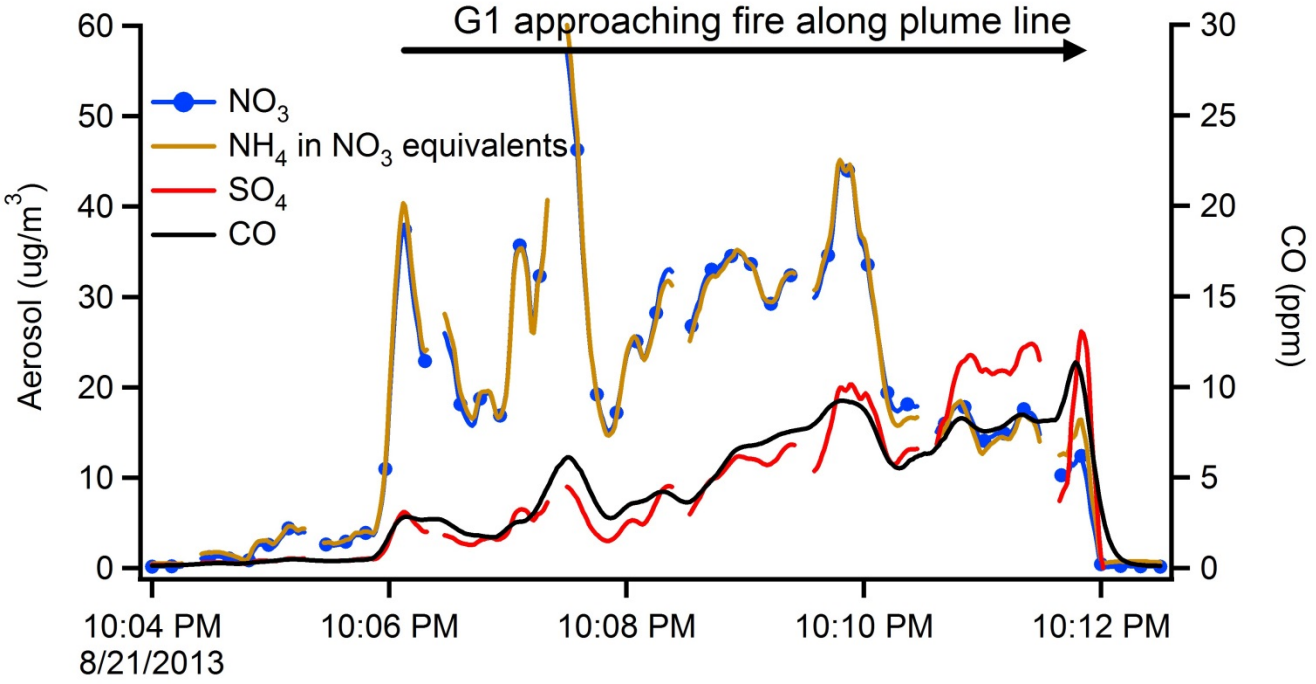


FIMS N/CO = 21 ± 2.3 (cm^{-3}/ppb). **No coagulation?**

FIMS volume/CO increases downwind. **SOA from condensation?**

Sulfate, Nitrate, and Ammonium from SP-AMS

821b Along Plume Leg



Sulfate ≈ CO — **Sulfate is primary**

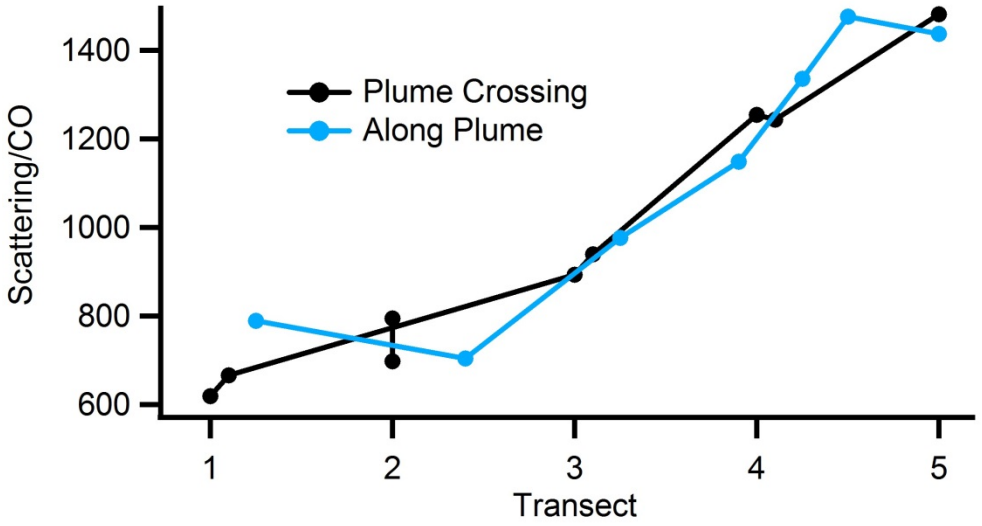
Nitrate/CO increases downwind — **Nitrate is secondary**

There is enough NH_4^+ to neutralize NO_3^- — **?**

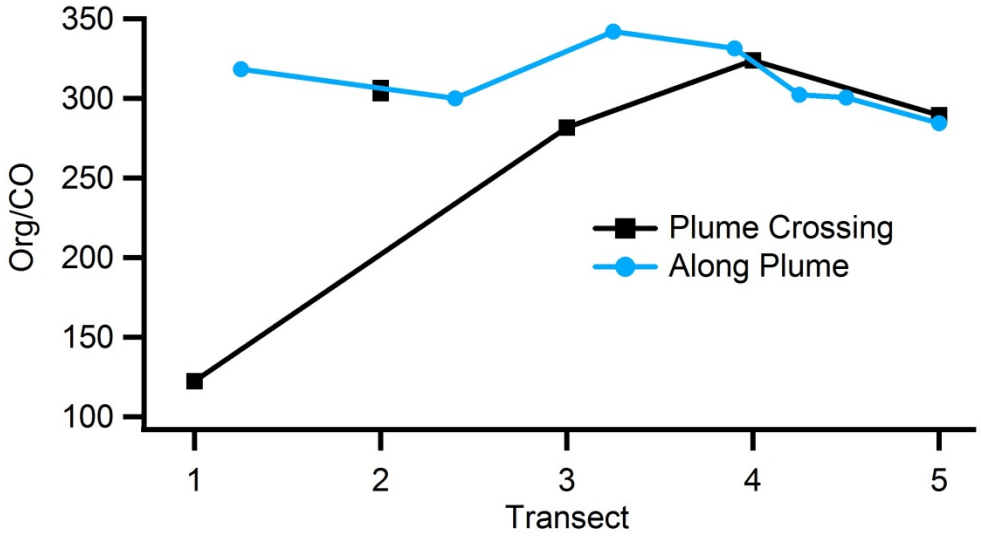
No more, No less.

Comparison of 2 Measures of SOA Formation

Flight
821b



Nephelometer
plus CO



SP-AMS
plus CO

Thank You

No trees were intentionally harmed in the making of this presentation.

A great number of trees were destroyed in BBOP.
But it was not our fault.