



2019 FIREX-AQ Twin Otters, Mobile Labs & Ground Sites Teleconference

December 19, 2019



1. Ezra Wood (Drexel) – Boise ground site
2. Nancy Johnston (LCSC) – ground sites Lewiston, Boise, etc.
3. Carolyn Jordan (NASA) – Langley MACH-2 Mobile Lab
4. Meredith Hastings (Brown)/Jackson Kaspari (UNH) – Langley MACH-2 Mobile Lab
5. Brian Lerner (ARI) – McCall Activity Barn and Aerodyne Mobile Lab
6. Alan Brewer (NOAA) – Met Twin Otter
7. Rebecca Washenfelder (NOAA) – Chem Twin Otter
8. Bob Yokelson (UMT) – Missoula and broader picture
9. Other Updates?
10. Coordination discussion and next steps

Boise Ground Site

Ezra Wood, Drexel University

Boise Ground Site

Dates: ~August 1 - 30



Meridian DEQ monitoring site

Participants:

ID Dept. of Env. Quality (Ed Jolly)

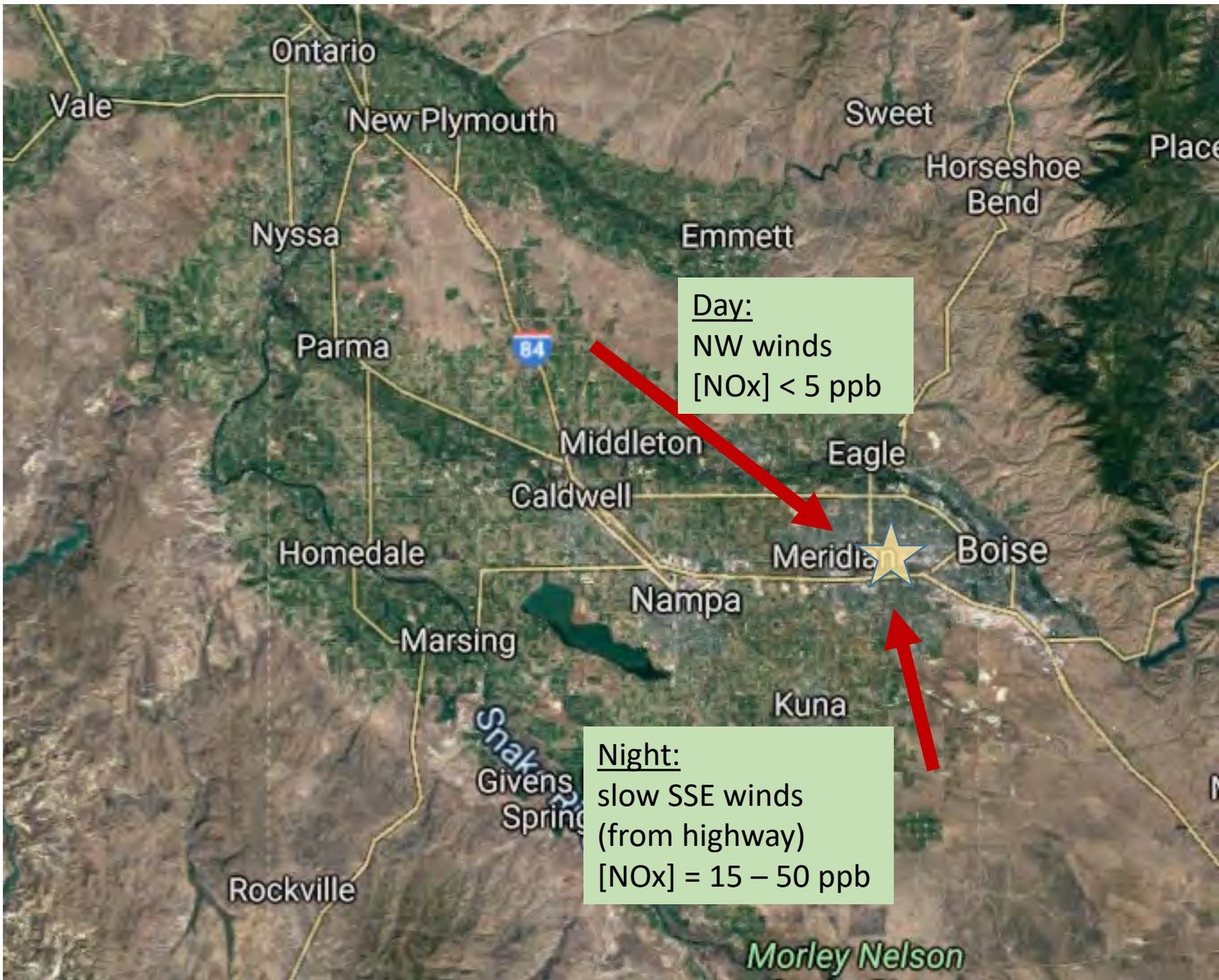
EPA ORD (Landis/Long)

Drexel U. (Ezra Wood)

U. Washington – Bothell (Dan Jaffe)

Lewis & Clark State College (Nancy Johnston)

Villanova College (Kabindra Shakya)



Instrument	Measurement	Who
ECHAMP	RO ₂ + HO ₂ (and P(O ₃))	Drexel
I- CIMS	HONO, HCN, HNCO, formic/acetic/prop/pent/pyruvic acids	Drexel
CAPS	NO ₂	Drexel
Suitcase VOCs	8-hr speciated VOCs	UW (Jaffe)
spectro radiometer	photolysis rates	UW/UH
chemiluminescence	NO	UW
Sampler & GC-MS	Speciated VOCs (1 hr & longer)	Lewis&Clark
Thermo/Teledyne	NO/NO _x , CO, O ₃ , ...	EPA/DEQ
Magee Sci	BC, TC	EPA
API boxes	CO, CO ₂ , O ₃ , H ₂ S, NH ₃ , NO ₂	EPA
Filters/IC	Inorganic components of PM _{2.5} (24-h ave)	Villanova
T640	PM _{2.5} , PM ₁₀	EPA
Campbell	Ceilometer	EPA

Drexel U. – Ezra Wood

Main goal:

Characterize O₃ formation in urban area affected by smoke

Data status:

Instruments online Aug 11 – Aug 29 (w/ occasional gaps):

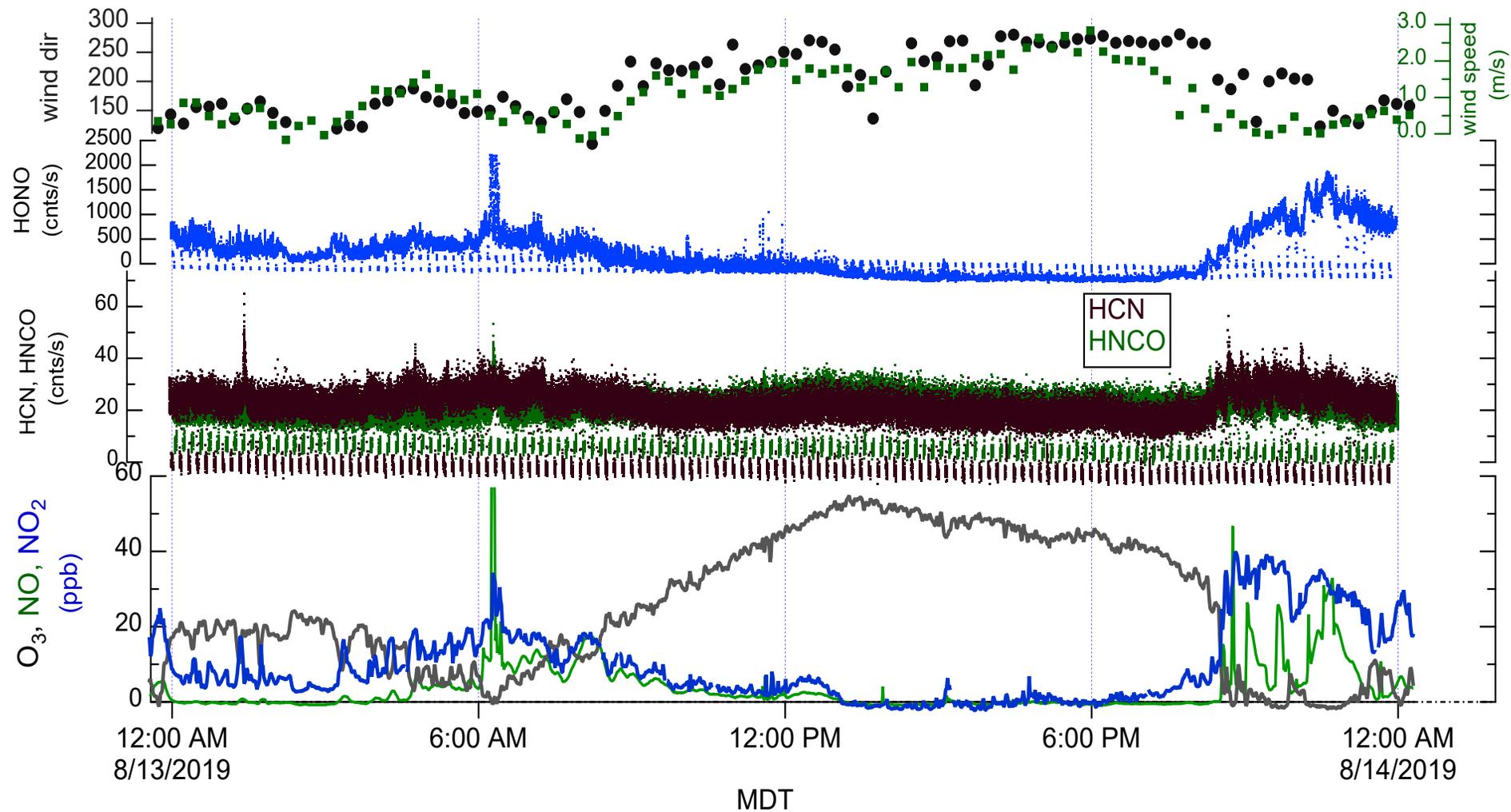
1. CAPS NO₂ done
2. Preliminary ECHAMP HO₂ + RO₂
3. F-CIMS: Still processing. Final calibrated numbers will be

generated for HONO, HCN, HNCO, and formic/acetic/propanoic/pyruvic/pentanoic acids. Estimates/relative values can be provided for other compounds (e.g., ISOPROOH, N₂O₅, ClNO₂...)

How to access:

Not determined yet. Boise ground site will discuss.

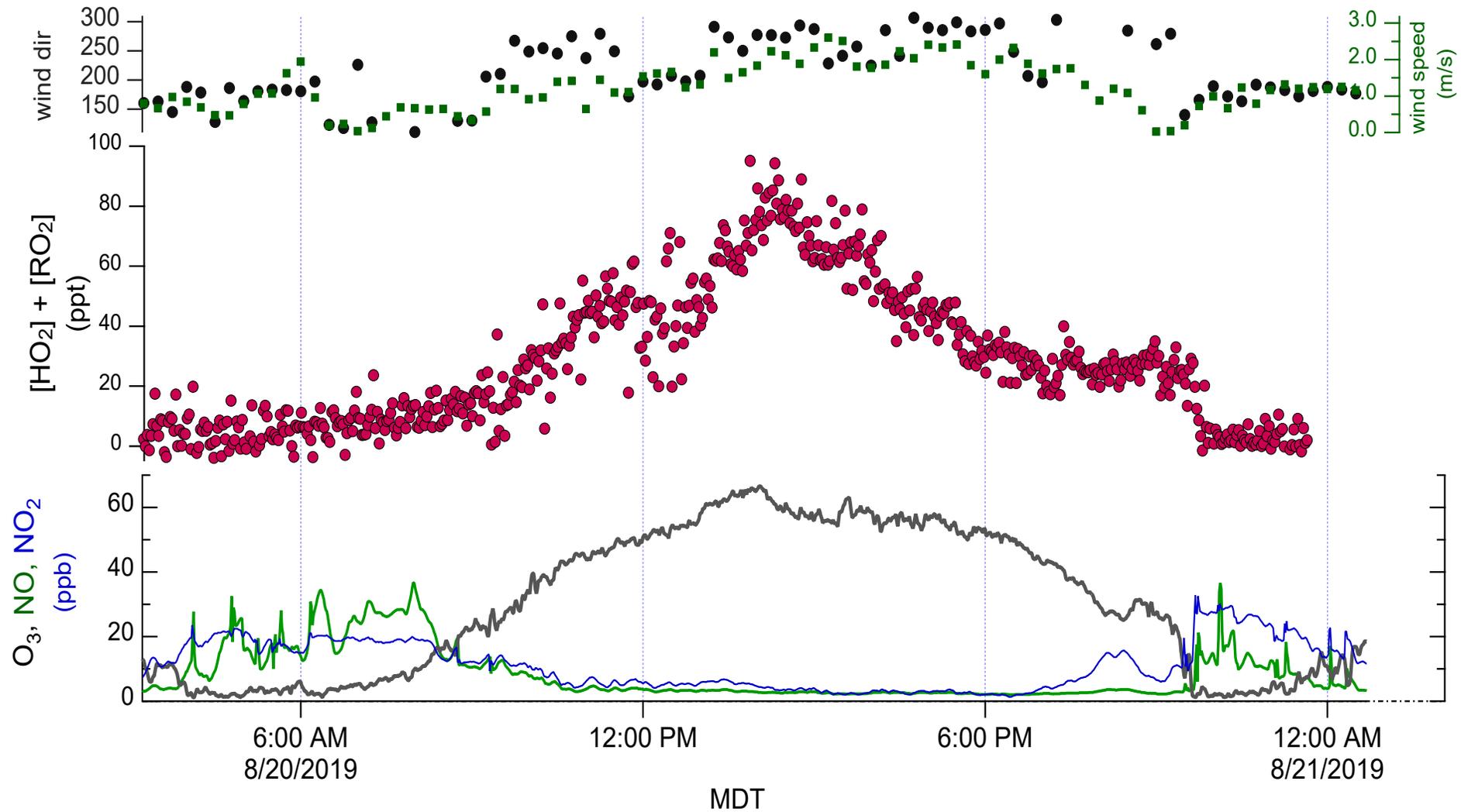
Meridian ground site preliminary data:
met, I⁻ CIMS (HONO, HCN, HNCO), NO_x & O₃



Met, NO, and O₃ data: ID DEQ

- 1. No obvious photochemical HONO source
- 2. Discernable HCN (and HNCO?) vehicular emissions

Meridian ground site preliminary data:
met, RO₂ + HO₂, NO_x & O₃



Summary of what we learned:

- August 2019 was anomalously un-smoky in Boise.
- Consistent diurnal wind pattern will enable a comparison of 3 main types air masses:
 1. “fresh” urban/highway emissions
 2. Urban emissions after ~1-2 hrs of photochemistry
 3. “Meridian / Treasure Valley air”

Ideas for potential collaborations:

- Quantifying relative importance of urban vs. smoke vs. photochemical sources of HNCO/HCN/HONO/organic acids etc.
- Will be examining the data much more closely in the months to come...
- Happy to compare to measurements aloft.

Boise and LCSC Ground Sites

Nancy Johnston, Lewis and Clark State College

LCSC VOC GROUP – Nancy Johnston

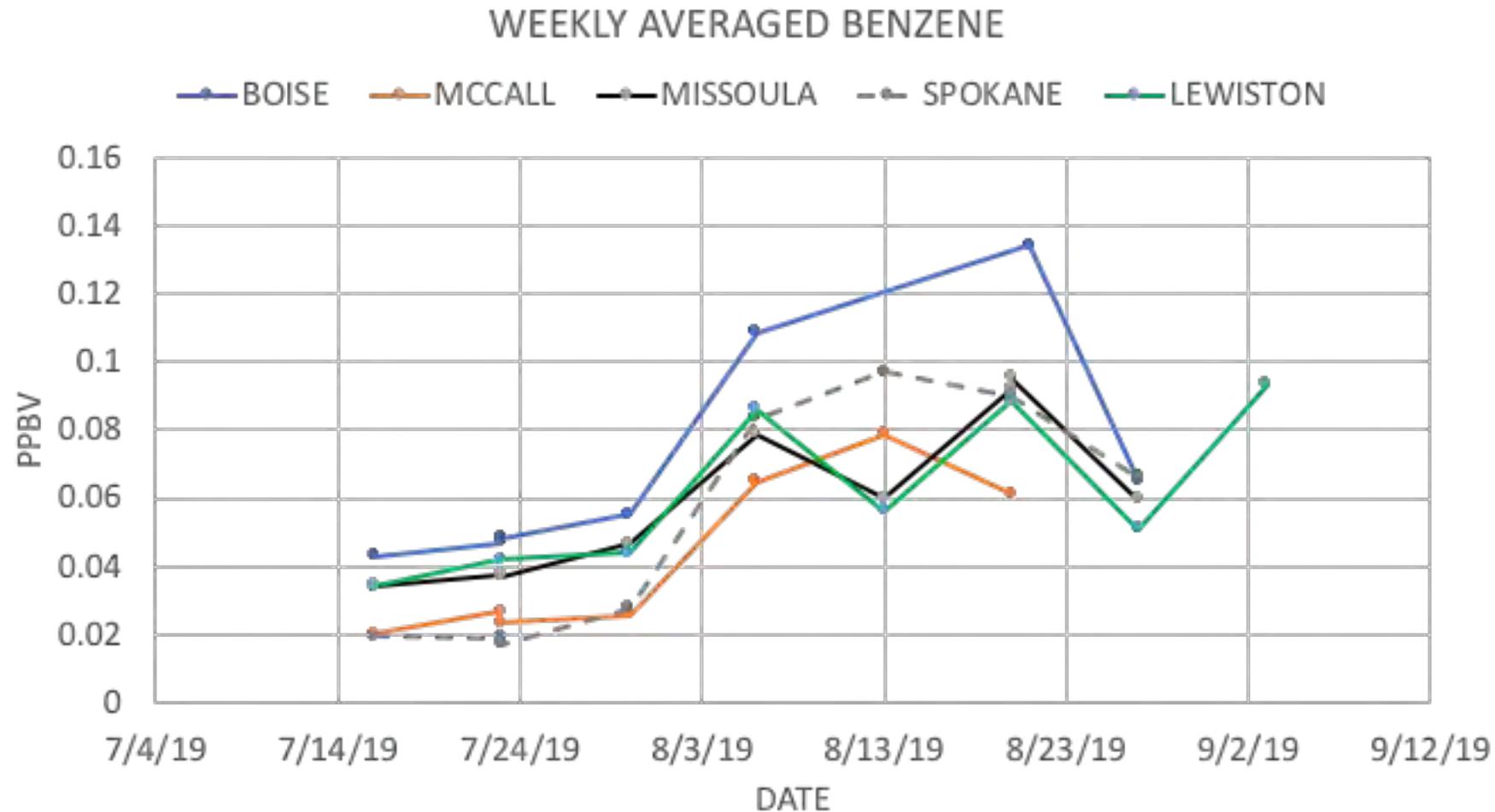
- GOALS

- Determine human exposure to selected VOCs such as benzene during fire episodes vs background
- Determine VOC/Terpene content of wildfire smoke

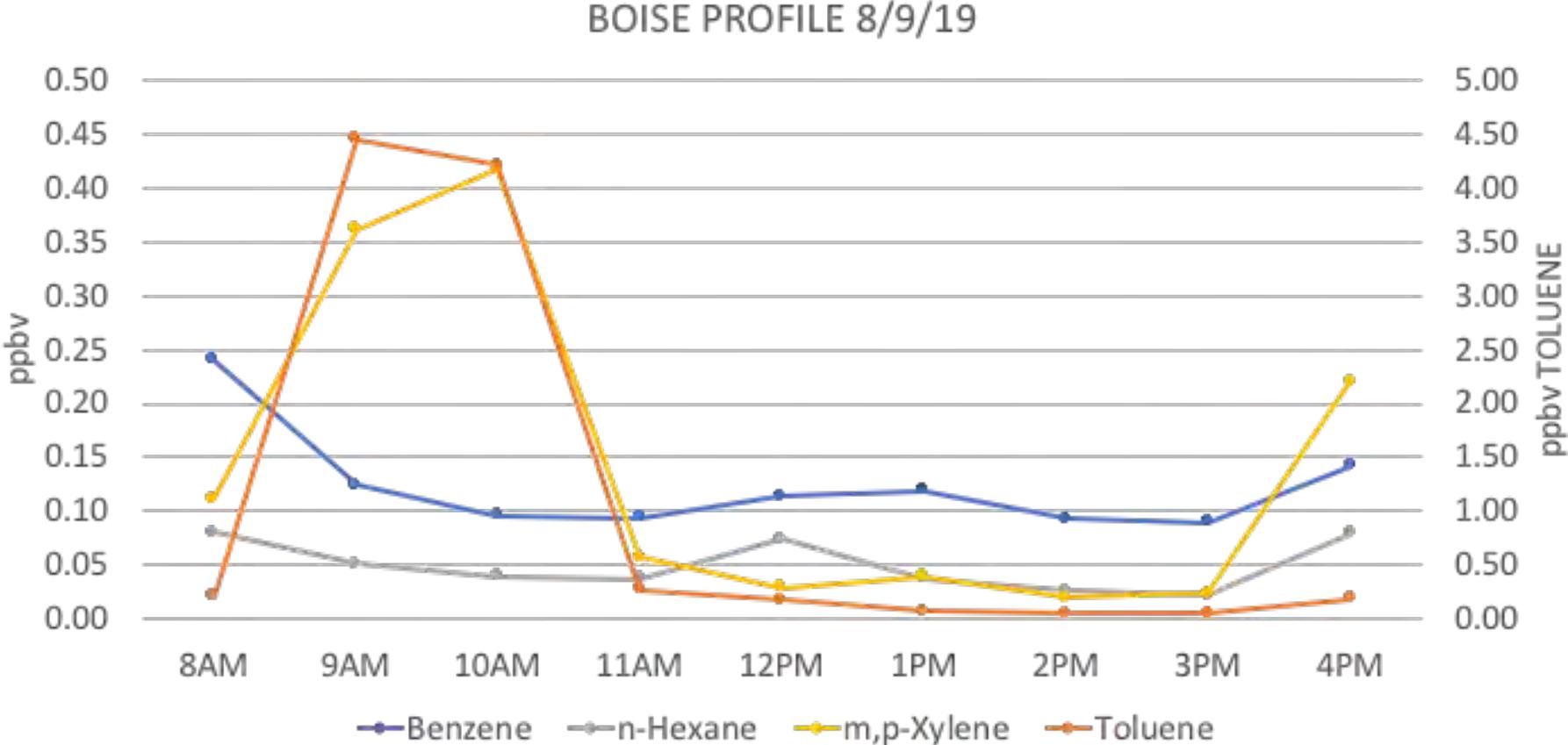
- METHODS

- Tenax sorbent passive samplers – weekly collection
- Several locations - Boise, McCall, Lewiston, Missoula, Spokane
- TD/GC/MS analysis @ Lewis-Clark State
- Grab samples during fire events
- Sampled Williams Flat and Nethker Fires

Summer trends – Passive VOC samplers

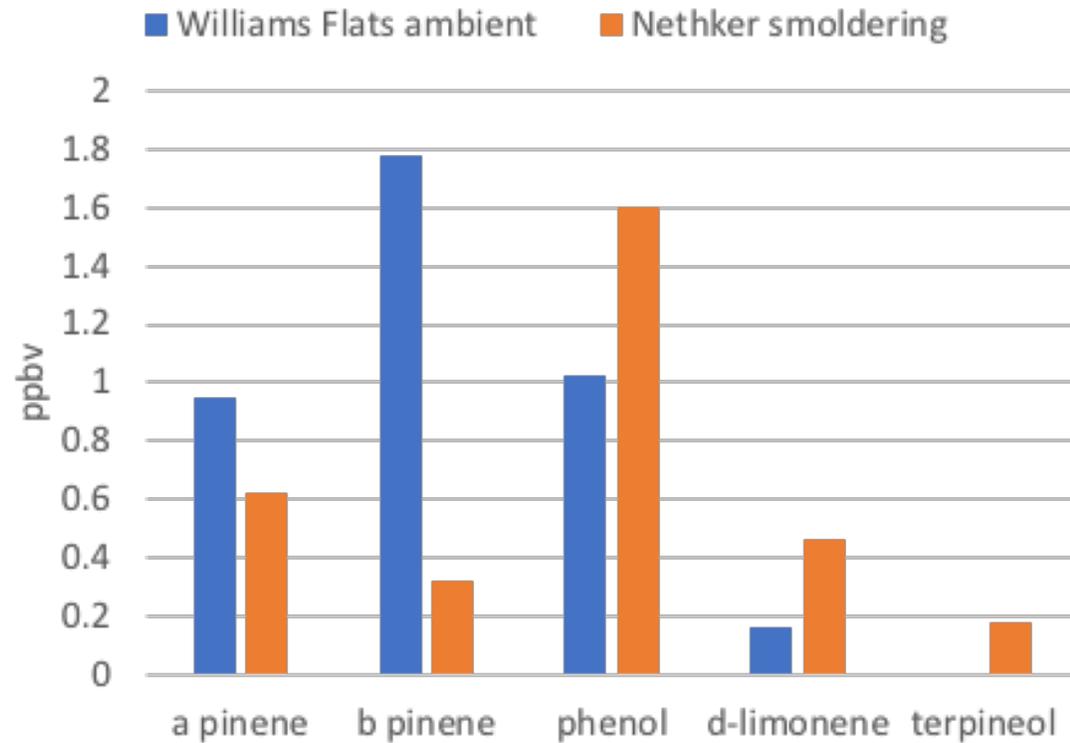


Grab sampling - Boise

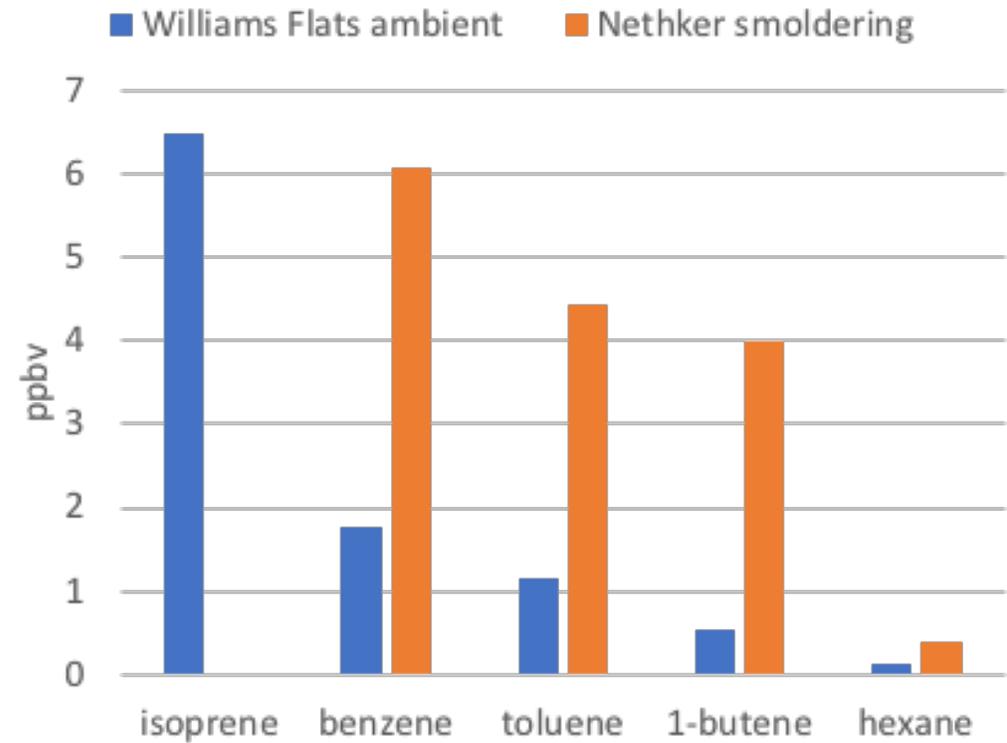


Composition of Wildfire smoke

Wildfire smoke composition



Wildfire smoke composition



NASA Langley Mobile Lab MACH-2 Overview

Carolyn Jordan, NASA

Deployment Locations

Month	Sunday	Monday	Tuesday	Wednesday	Thursday	Friday	Saturday
July	14	15	16	17	18	19	20
	21	22	23	24	25	26	27
	28	29	30	31	1	2	3
August	4	5	6	7	8	9	10
	11	12	13	14	15	16	17
	18	19	20	21	22	23	24
	25	26	27	28	29	30	31
September	1	2					

Color Key	
Fires	Color
Vader	Idaho
Shady	Idaho
Black Diamond	Montana
Williams	Washington
Nethker	Idaho
Little Bear	Utah
Castle	Arizona
Cow	Oregon



Fire	Location	Start Date	UTC Hours	
			start	end
Vader	Stanley ID	21-Jul	21:09:41	23:59:59
		22-Jul	0:00:00	15:54:46
		25-Jul	3:40:03	13:15:18
Shady	Challis ID	28-Jul	2:08:20	6:13:42
		29-Jul	0:17:32	4:08:17
		29-Jul	13:10:07	18:20:00
Black Diamond	Lincoln MT	2-Aug	1:51:20	5:09:00
Williams Flat	Hunter WA	3-Aug	21:38:28	23:59:59
		4-Aug	0:00:00	16:45:52
	Wilbur and Fruitland WA	4-Aug	18:30:18	23:59:59
		5-Aug	0:00:00	21:34:00
	Fort Spokane, Wilbur and Hunter WA Area	5-Aug	0:26:17	15:06:21
		5-Aug	15:44:43	21:34:07
		5-Aug	23:53:51	23:59:59
		6-Aug	0:00:00	21:39:00
		6-Aug	22:19:10	23:59:59
		7-Aug	2:30:21	15:32:37
Nethker	South of Burgdorf Hotsprings on Warren Wagon Road north of McCall ID	9-Aug	16:25:09	23:59:59
		10-Aug	0:00:00	1:30:44
		10-Aug	14:47:37	22:52:01
		11-Aug	3:09:54	7:58:53
		11-Aug	8:00:34	18:41:45
		12-Aug	3:32:31	18:36:59
		14-Aug	0:53:16	8:29:19
		15-Aug	23:50:30	23:59:59
Little Bear	King's Creek Campground near Bryce Canyon UT	20-Aug	0:30:52	4:07:27
		20-Aug	12:12:17	18:20:13
		20-Aug	21:26:39	23:59:59
		20-Aug	0:00:00	2:30:37
		21-Aug	11:40:14	15:33:26
		21-Aug	19:49:37	23:55:57
Castle	Hyw 67 south of Jacobs Lake AZ	22-Aug	13:30:00	23:22:20
		23-Aug	1:14:36	9:03:46
Cow	NF-14 South of Prairie City OR	26-Aug	20:06:55	23:59:59
		27-Aug	0:00:00	2:08:05
		27-Aug	17:49:41	23:59:59
		27-Aug	0:00:00	8:34:31

Vader Creek Fire near Stanley ID, July 21

Home 4:39:28 AM

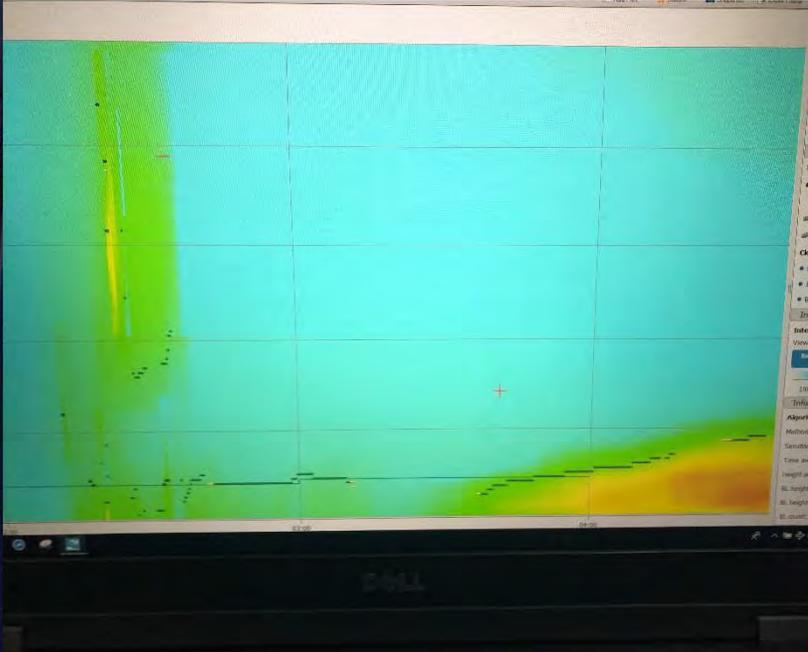
- Home
- Dashboard
- Alerts
- Calibration >
- Utilities >
- Setup >

PM10	153.6 ug/m3
PM2.5	48.2 ug/m3
PM10-2.5	105.4 ug/m3

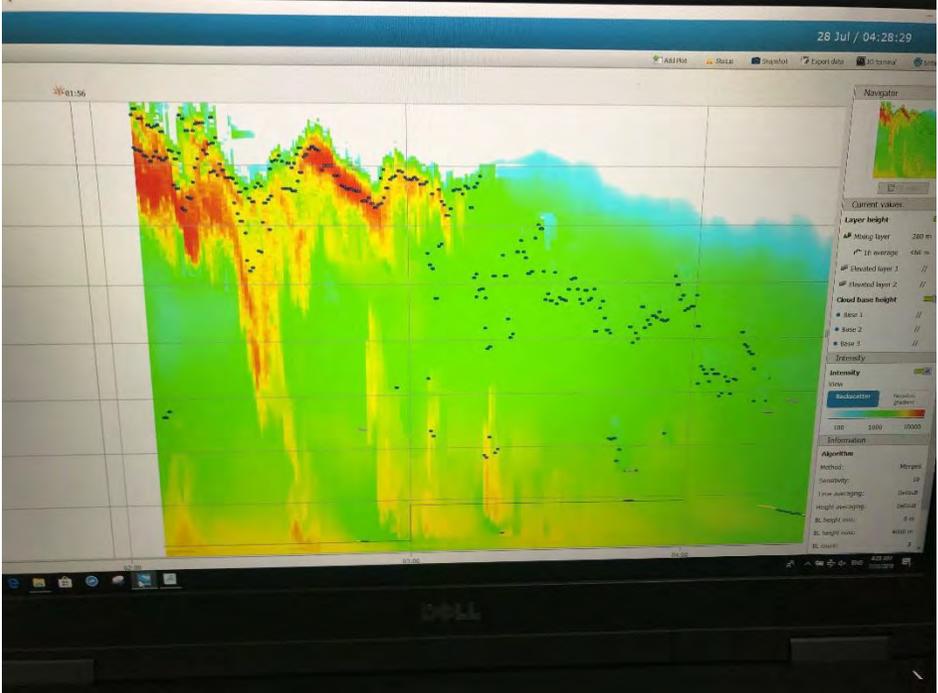
4.99 LPM Sample Flow	-62.6 degC Ambient Temp	23.4 % Sample RH
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> Home Mode: SAMPLE

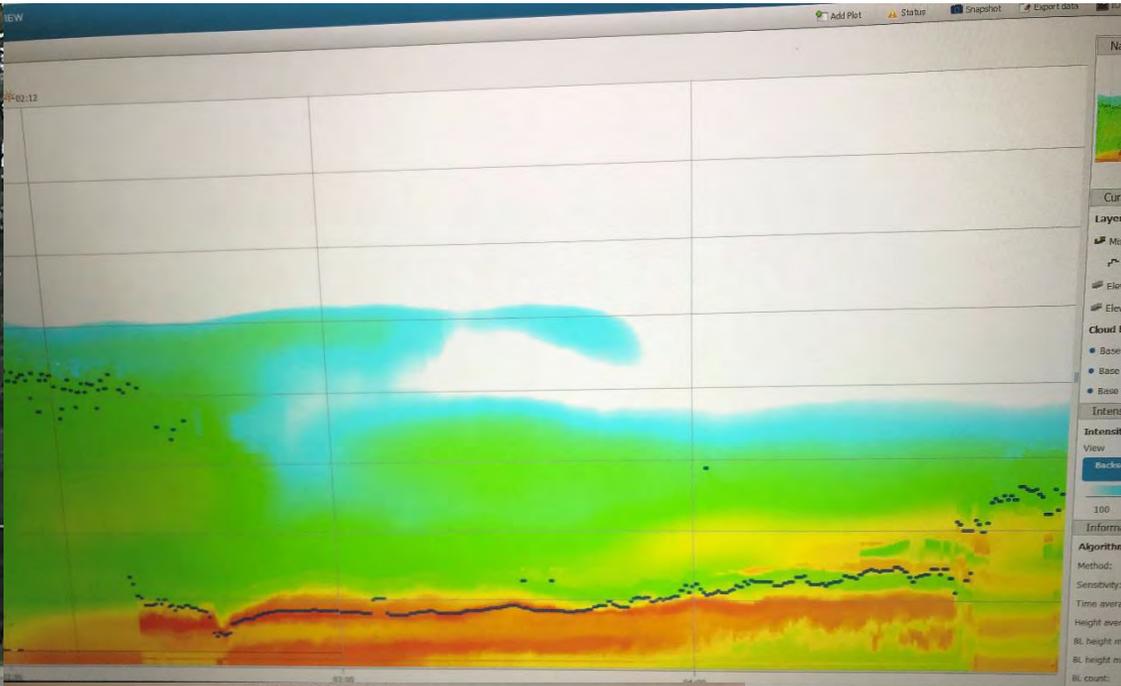
PM MASS MONITOR - MODEL T640



Shady Fire near Challis ID, July 27-29



Black Diamond Fire, Lincoln MT, Aug 2



[CO] = 763.55 PPB
[H2O] = 3546.66 PPM
[CO2] = 452.74 PPM

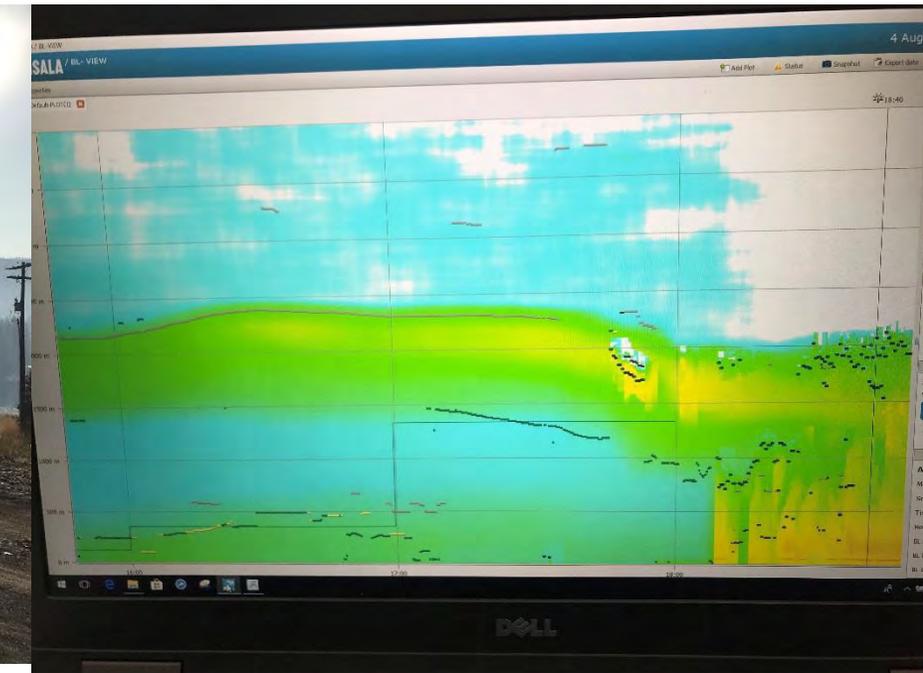
INSTRUMENTATION

4:58:54 AM

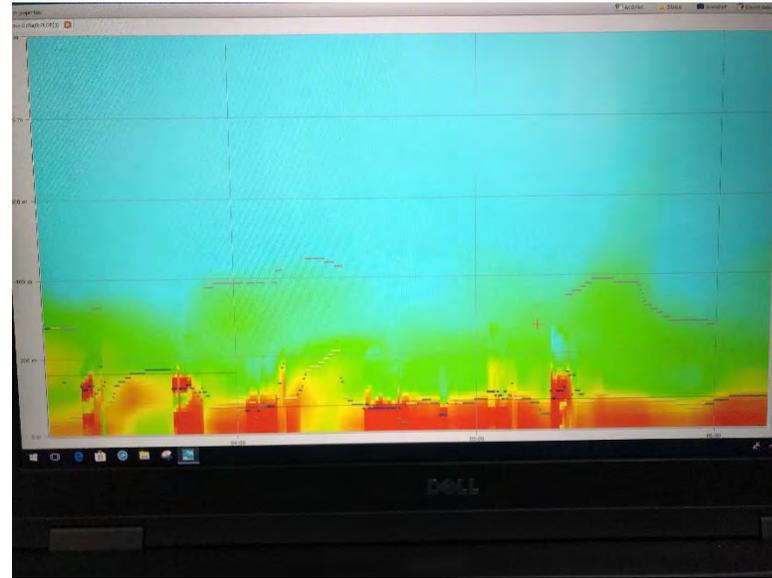
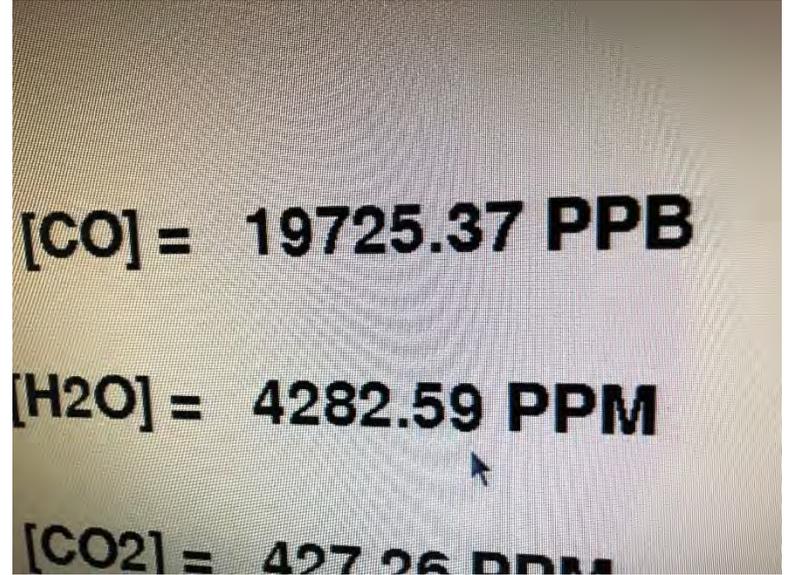
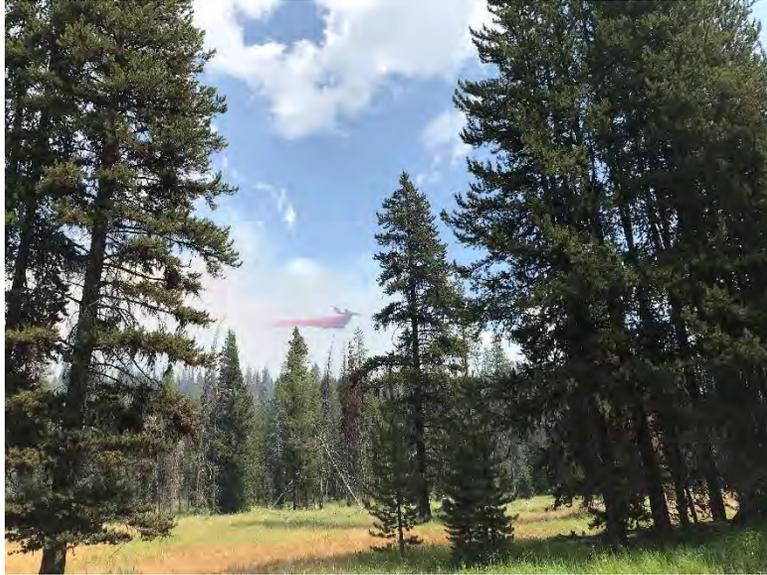
PM10	279.0 ug/m ³
PM2.5	246.4 ug/m ³
PM10-2.5	32.6 ug/m ³

-62.5 degC
16.8 %
Sample RH

Williams Flats WA, Aug 3 - 7



Nethker Creek ID, Aug 9 - 16

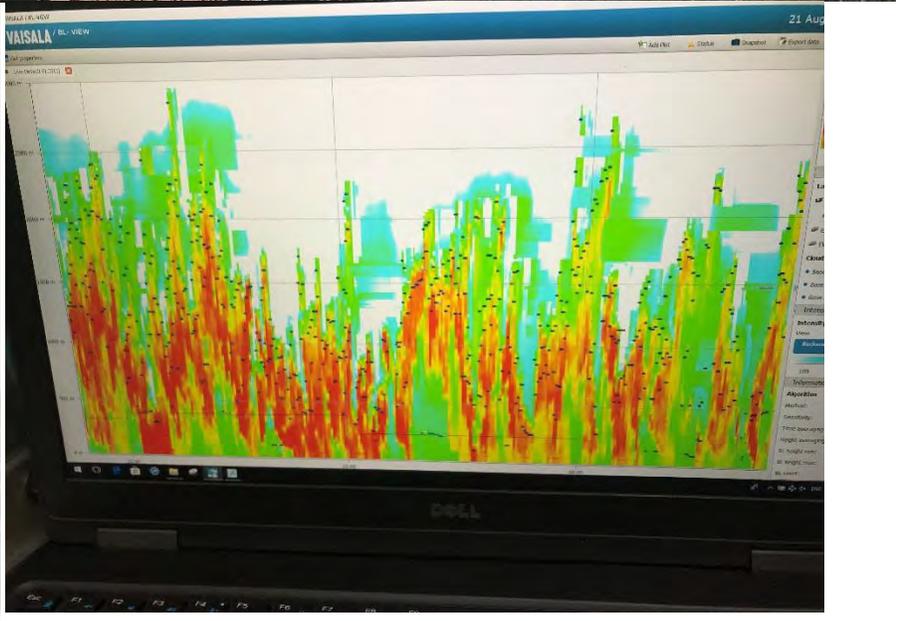




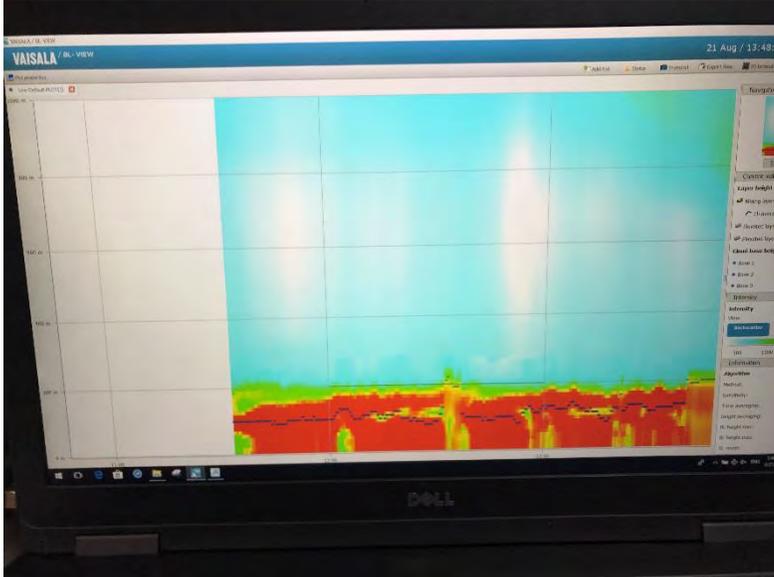
[CO] = 17542.59 PPB
[H2O] = 3120.77 PPM
[CO2] = 428.72 PPM



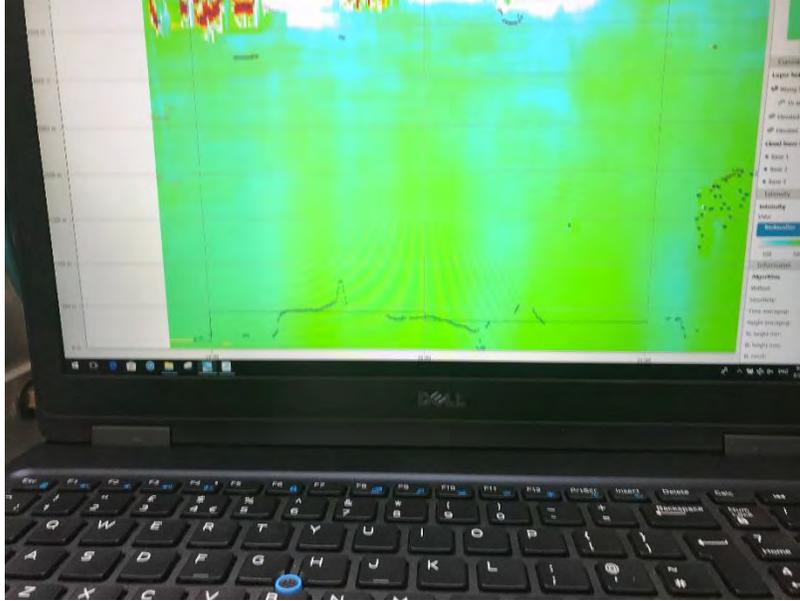
Little Bear Fire, Bryce Canyon Utah



Little Bear Fire, Bryce Canyon Utah



Castle Fire, Jacobs Lake AZ – Aug 22-23



Sampled smoke
at night, no good
photos of fire



Cow Fire, Prairie City OR – Aug 26-27





NASA Langley Mobile Lab MACH-2

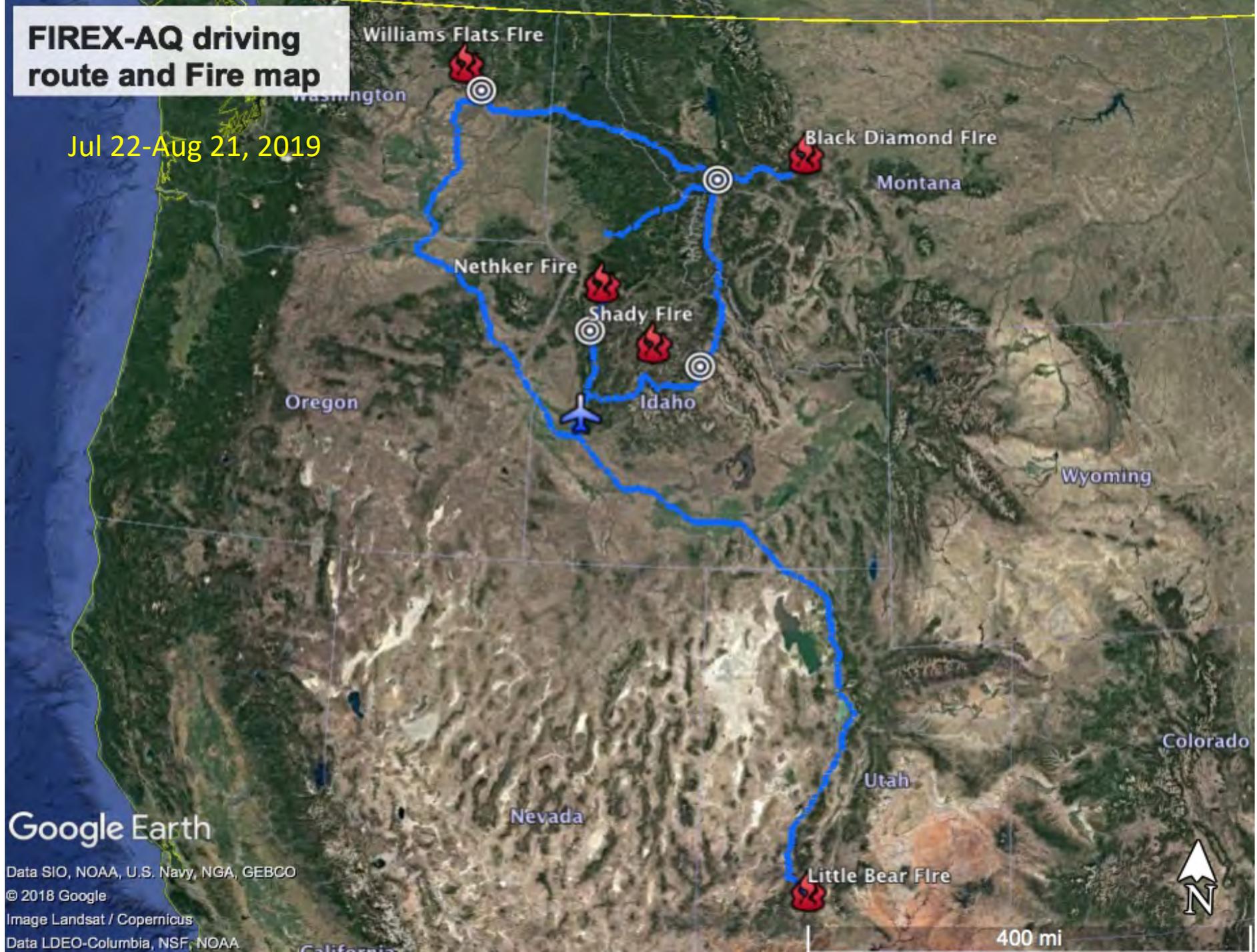
Meredith Hastings, Brown University

Jackson Kaspari, University of New Hampshire

FIREX-AQ data progress for
Brown Team — Isotopically
tracking reactive nitrogen
species from wildfire

FIREX-AQ driving route and Fire map

Jul 22-Aug 21, 2019



Google Earth

Data SIO, NOAA, U.S. Navy, NGA, GEBCO
© 2018 Google
Image Landsat / Copernicus
Data LDEO-Columbia, NSF, NOAA

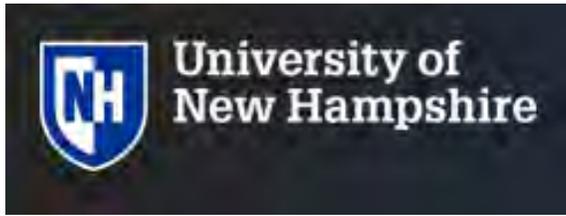
Reactive N samples were collected in the field, followed by sample treatment and analyses for isotopic composition via IRMS at Brown

Species	Collection Time per sample	Active sampling technique	# of samples	Isotopic analyses	Analyses done?
NO _x	1-2 h	Basic KMnO ₄ Impinger	57	δ ¹⁵ N	Yes
HONO	2-12 h	Annular denuder (carbonate)	21	δ ¹⁵ N, δ ¹⁸ O, Δ ¹⁷ O	Yes
NO ₂	2-12 h	Annular denuder (guaiacol)	21	δ ¹⁵ N, δ ¹⁸ O, Δ ¹⁷ O	Yes
HNO ₃	2-12 h	Nylasorb filter	21	δ ¹⁵ N, δ ¹⁸ O, Δ ¹⁷ O	Yes
p-NO ₃ ⁻	2-12 h	Teflon filter	21	δ ¹⁵ N, δ ¹⁸ O, Δ ¹⁷ O	Yes
NH _x	3-24 h	Quartz filter	16	δ ¹⁵ N	No

Sampling condition: flaming vs smoldering, fresh vs aged plume, day vs night

Data processing plan

- Finish all isotopes data processing by 1/15/2020
- Finish all data corrections for interference (e.g. self-emissions) by 2/20/2020
- Get all preliminary analyses done by 3/2/2020

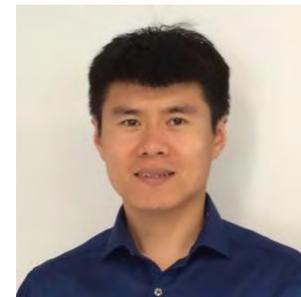


FIREX-AQ data progress for University of New Hampshire Team — Evolution of reactive nitrogen species in wildfire smoke

UNH
Team:



Special
Thanks:



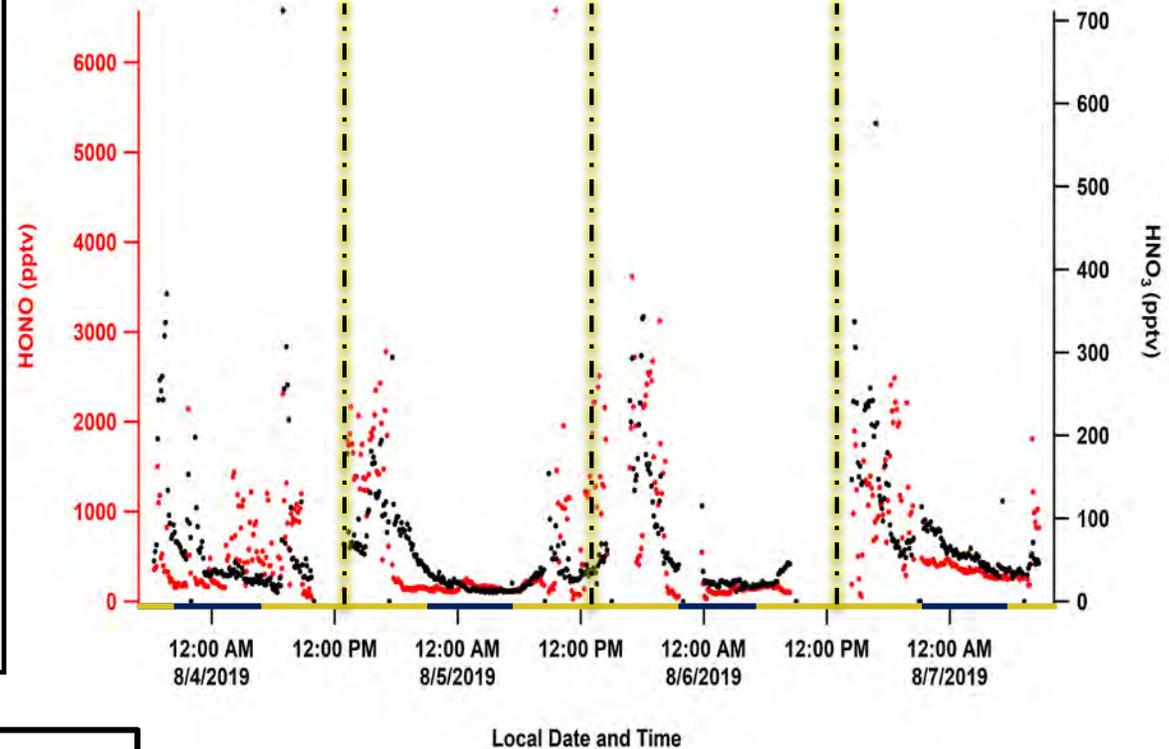
Nitric and Nitrous Acids were analyzed by IC in the field in near real time, filter samples for aerosol associated ions were extracted in the field and returned to UNH for analysis

Species	Collection Time per sample	Active sampling technique	# of samples	Analyses done?
HNO ₃	5 minutes	Mist Chamber	1,200	Yes
HONO	5 minutes	Mist Chamber	1,200	Yes
Cl ⁻ , NO ₃ ⁻ , SO ₄ ²⁻ , C ₂ O ₄ ²⁻ , Na ⁺ , NH ₄ ⁺ , K ⁺ , Mg ²⁺ , Ca ²⁺	0.5-15 hours	Fluoropore filter, Analysis by IC	37	Yes

Data processing plan

- Data quality assessment completed by 1/15/2020
- Submit data to archive at LaRC well before 3/6/20
- Interpretation, manuscript prep beginning

Example of Processed Data for William's Flats Fire



Major Focus

William's Flats and Nethker due to long collection periods

McCall Activity Barn and Aerodyne Mobile Lab

Brian Lerner, Aerodyne Research Inc.

FIREX-AQ-2019

Acknowledgements: NOAA, NSF

Monika Kopacz

Ken Mooney

Sylvia Edgerton



Aerodyne Research, Inc.

University of California at Berkeley

Washington University at St. Louis

Montana State University

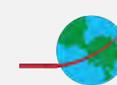
University of Maryland, Baltimore County

North Carolina A&T

Aerosol Dynamics Inc.

Brookhaven National Labs

Aerodyne Mobile Laboratory (AML)



Infrared Laser Absorption Spectroscopy (TILDAS)

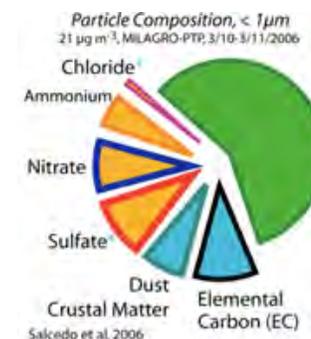
Combustion	Stable photo-oxidants
CO ₂ CO NO ₂ NO SO ₂	O ₃ HCHO
Oil & Gas	Biomass burning
CH ₄ C ₂ H ₆	HCN
	Biological
	N ₂ O

Proton Transfer Reaction – Mass spectrometry (Vocus)

Odors	Aromatics
H ₂ S CH ₃ SH	benzene, toluene, xylene
Oxygenates	Alkenes
methanol, acetone	propene, butene, isoprene
...and much more	

Aerosol Mass Spectrometer (AMS)

Mass
Diameter
Composition



typical **Field team members** *FIREX was a much broader group*



Conner
Daube



Tara
Yacovitch



Rob
Roscioli



Jordan
Krechmer



Ed
Fortner



Jason
Curry



Francesca
Majluf



Berk
Knighton



Scott
Herndon

Data

McCall:

GC data [ARI] is preliminary

CTAG data [UCB] unknown

Aerosol data [ARI, WashU] not complete, unknown

AML: (mobile + stationary)

Gas Tracers [ARI]: not complete

AMS [ARI]: not complete

Vocus [ARI]: preliminary

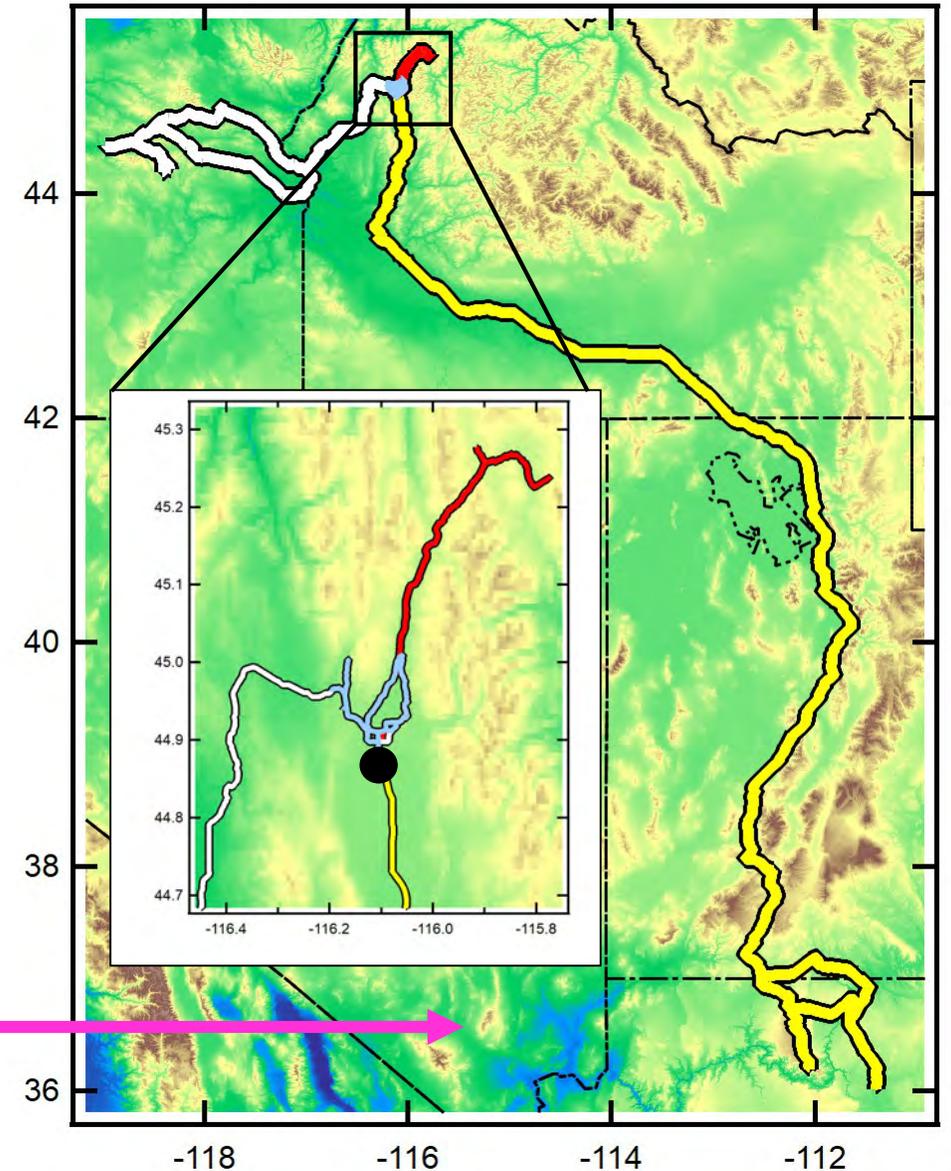
Filter samples [WashU]: unknown



No one is going to be working on this until January. CO & HCN will be high priority

The gps data (as a suite of igor binary waves) is available at this link

- <https://herndon.homeunix.net/owncloud/index.php/s/lOb8WErTMAFIPW4>



NOAA Met Twin Otter

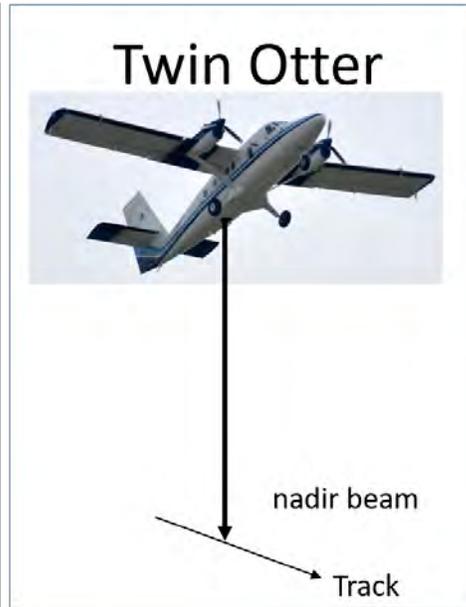
Alan Brewer, NOAA ESRL CSD

Scanning Doppler Lidar

Scanning Mode

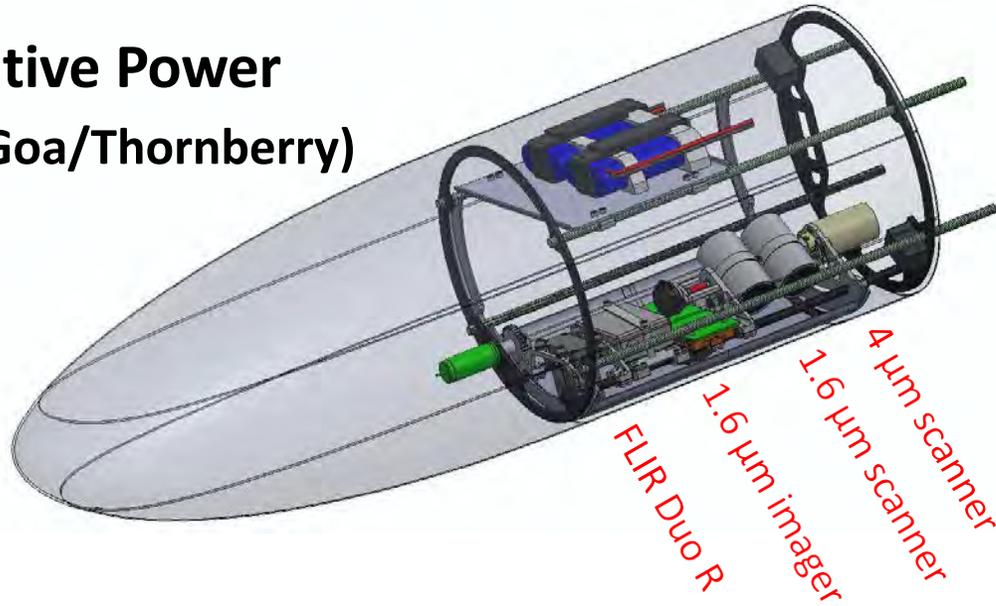
Vertical Staring mode

Lidar



Fire Radiative Power

Night-Fox (Goa/Thornberry)



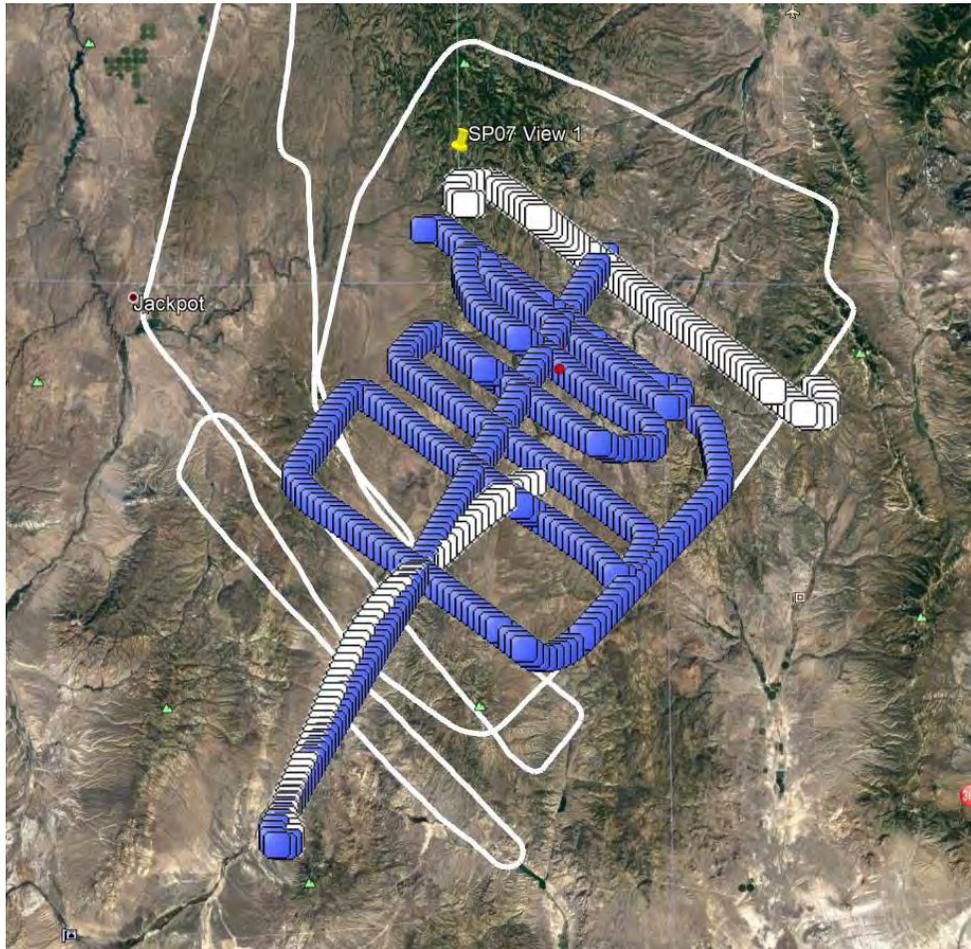
Reformatted UAV FRP Package

Met-Otter FIREX-AQ Flights

	ID	FLT	Start	Hours	Description
Test	TSF1	1	7/21/2019	3.2	Boulder test flight 1
Test	TSF2	2	7/22/2019	2.8	Boulder test flight 2
Transit	TRF1	3	7/22/2019	2.8	transit from Denver to Utah
Transit	TRF2	4	7/22/2019	1.7	transit from Utah to Boise
Science	SF1	5	7/24/2019	5.3	Sheep (Grass Fire)
Science	SF2	6	7/26/2019	4.2	Shady
Transit	TF3	7	7/27/2019	2.6	Transit Boise, ID to Medford, OR
Science	SF3	8	7/27/2019	3.8	Milepost 97
Transit	TRF4	9	7/28/2019	1.4	Transit Eugene, OR to Boise, ID
Science	SF4A	10	7/29/2019	4.0	Shady, Barren Hills, Crab
Science	SF4B	11	7/30/2019	2.9	Beescove, Crab, Baren Hills
Science	SF5A	12	8/1/2019	5.0	Shady, Barren Hills, Nevada Mtn
Science	SF5B	13	8/2/2019	1.5	Nevada Mtn, Shady
Science	SF6	14	8/3/2019	4.6	Lizzy, Shady - Attempt to coord. w
Science	SF7	15	8/5/2019	4.5	Goose - Coord with Chem Otter
Science	SF8	16	8/7/2019	4.3	Granite Gulch
Science	SF9A	17	8/9/2019	5.6	H-163 Complex
Science	SF9B	18	8/9/2019	2.9	Nethker
Science	SF10	19	8/10/2019	4.4	Nethker
Science	SF11	20	8/11/2019	4.0	Nethker / Boise Plume
Transit	TRF5	21	8/12/2019	2.8	Transit to Yampa
Test	TSF3	22	8/12/2019	3.2	Transit to Boulder & Test Flight 3
Test	TSF4	23	8/13/2019	2.8	Boulder Test Flight 4
			Total Hours	80.1	

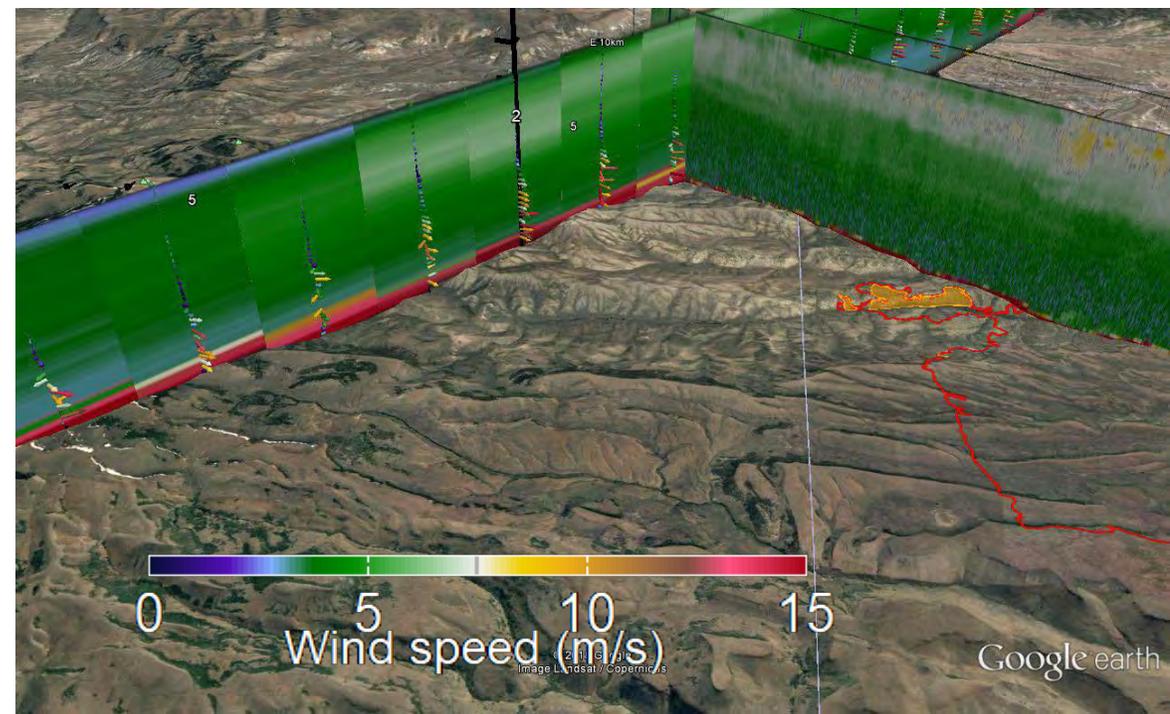
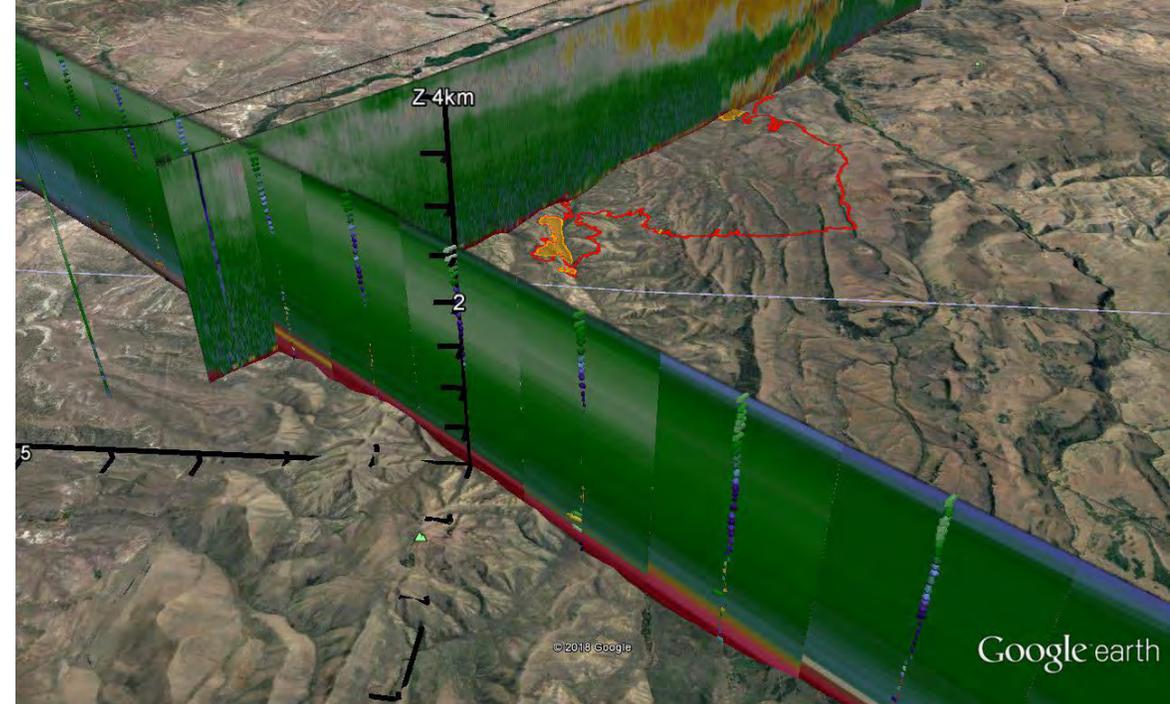


Goose Fire 2019-08-05

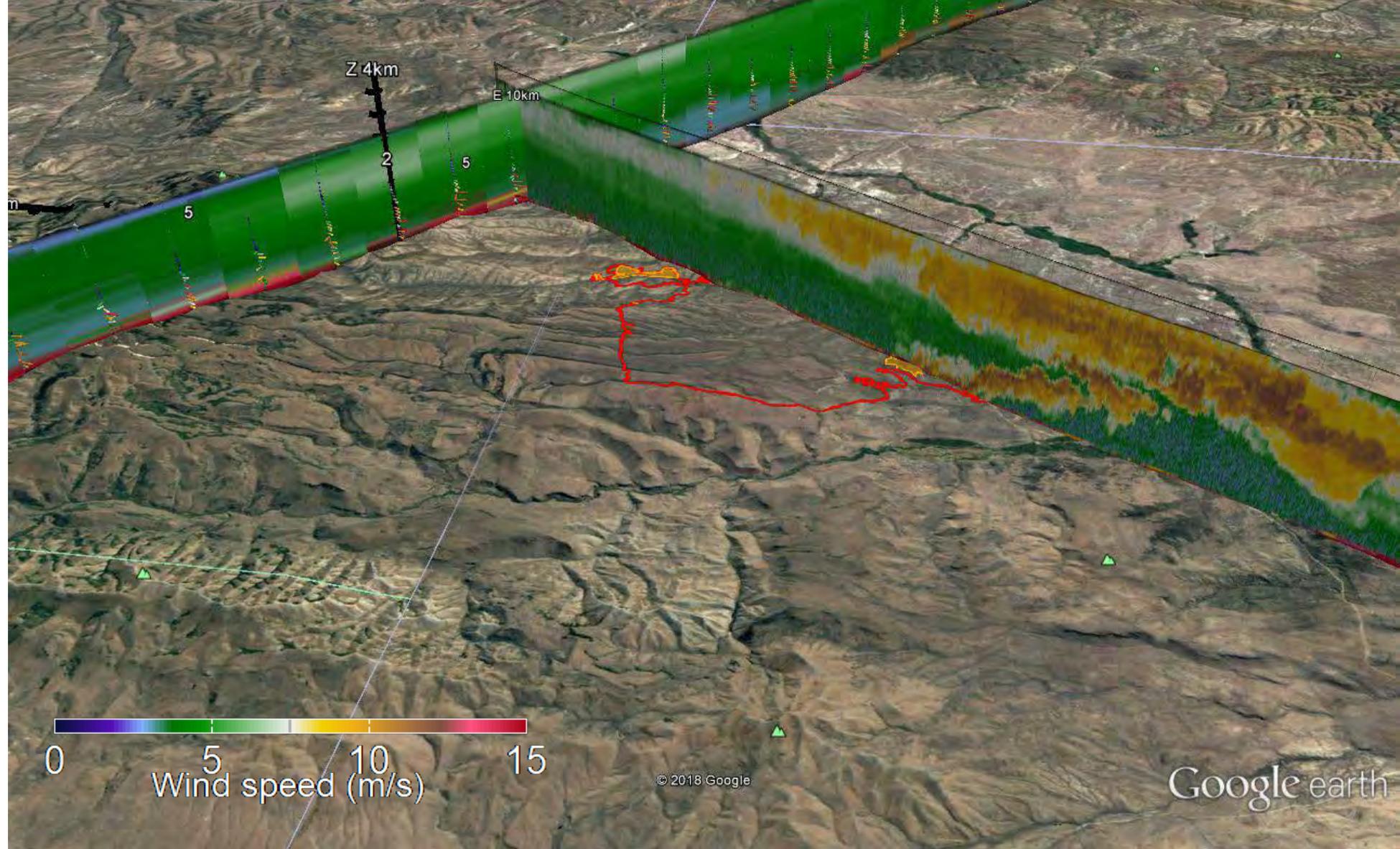


Lidar Products (vertical profiles of):

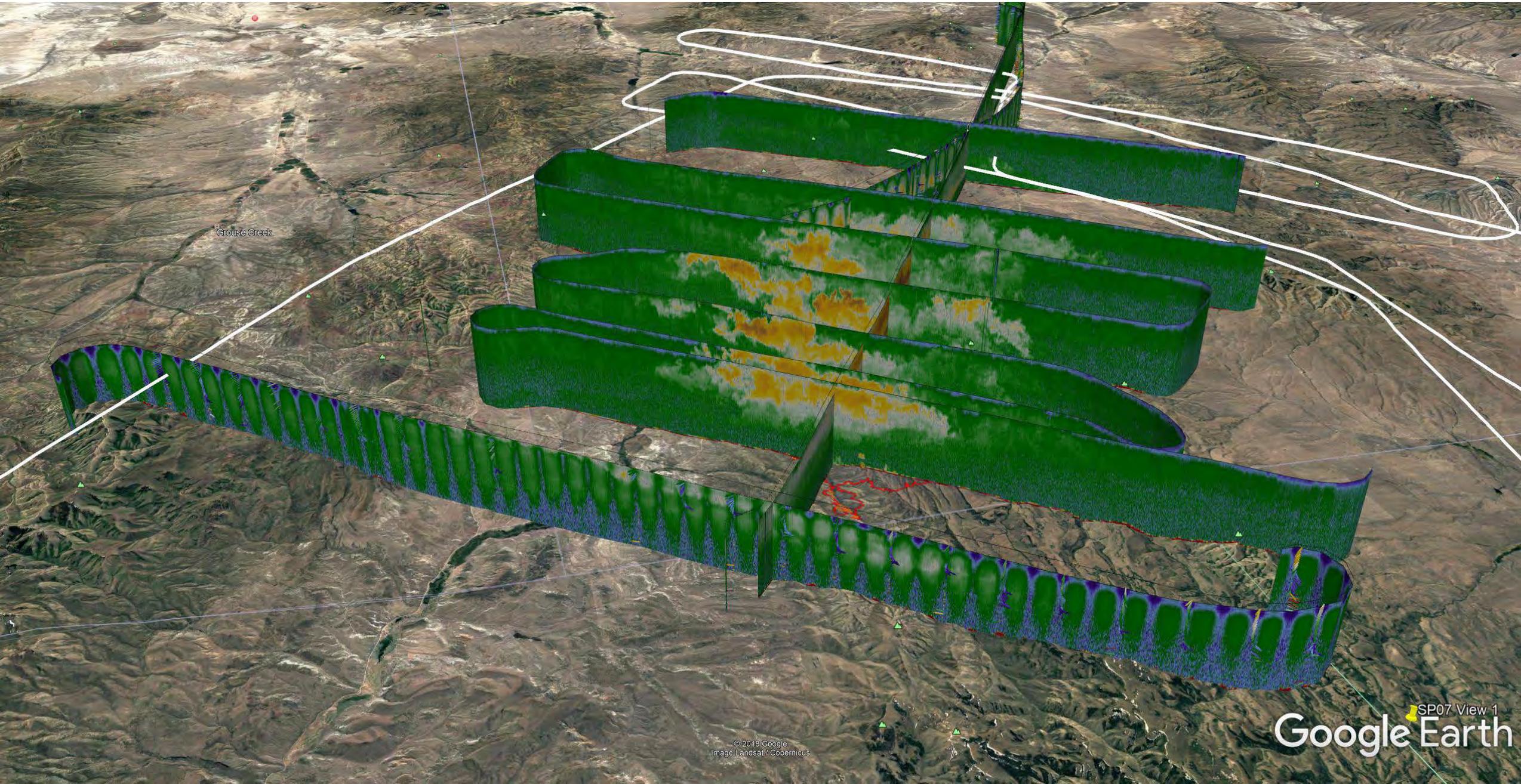
- Aerosol Backscatter Intensity
- Horizontal Wind Speed and Direction
- Vertical Wind Speed



Goose Fire 2019-08-05



Nearly 180 degree wind shear as a function of height



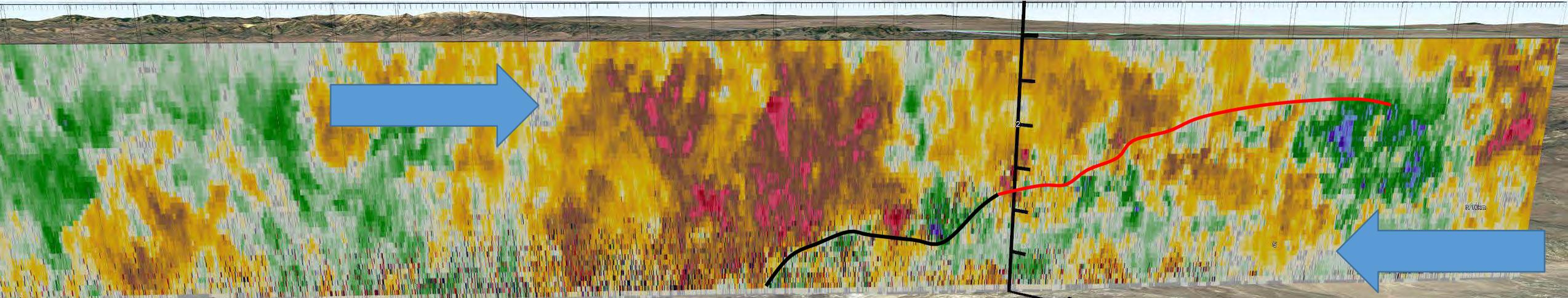
Crouse Creek





23 Mile Reservoir





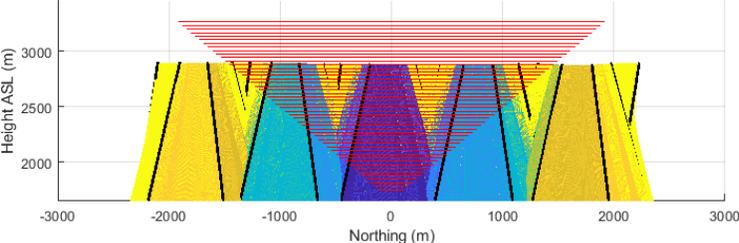
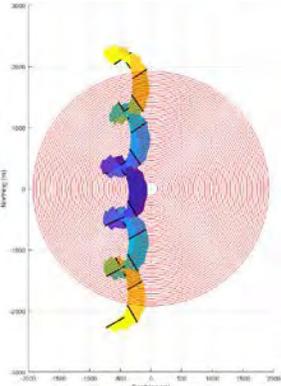
23 Mile Reservoir



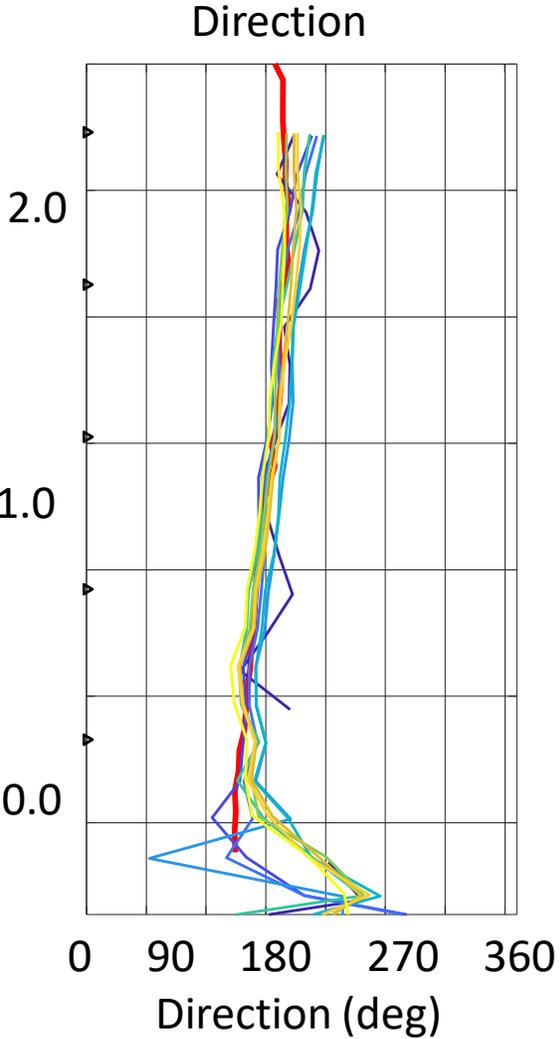
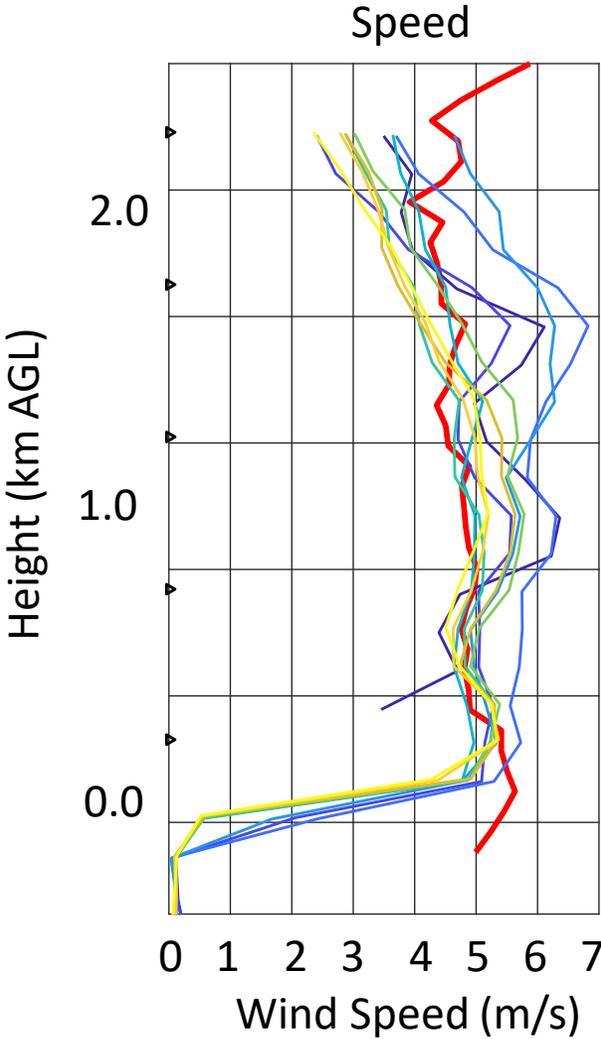
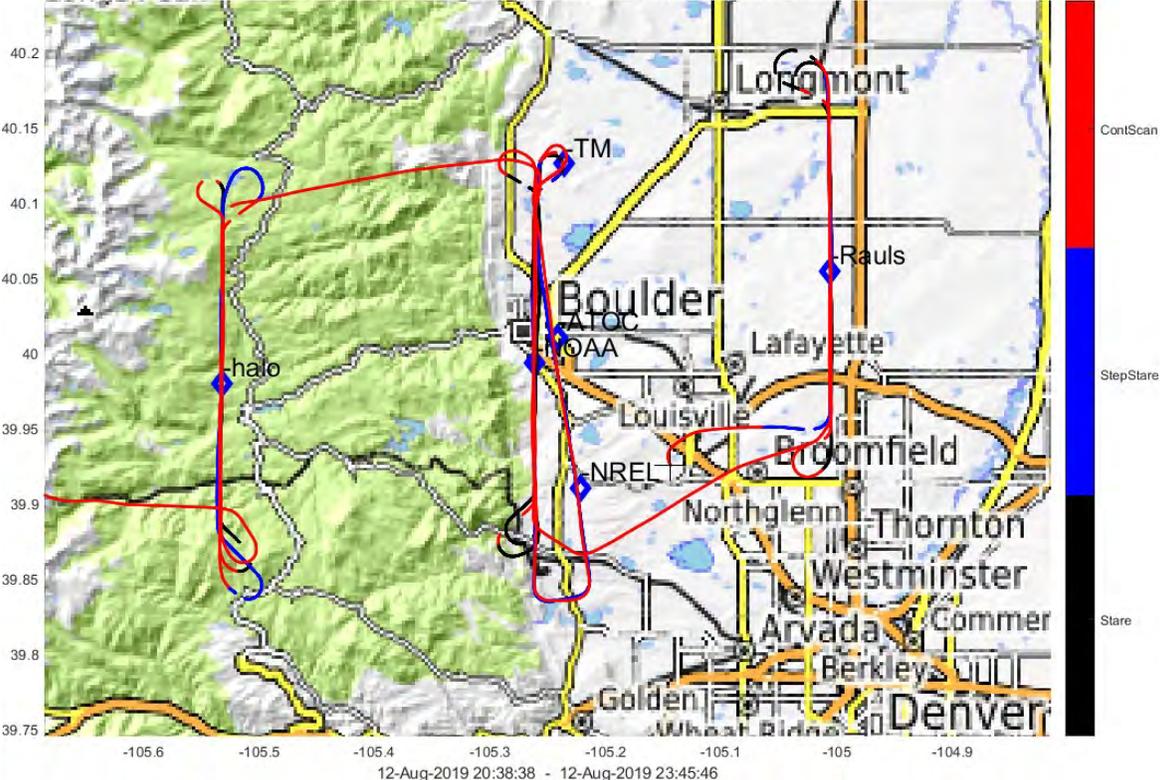
Comparison Measurements: Boulder

Flew over Ground Based Lidars

- Mountains : Nederland
- Transition : Boulder
- Plains : Erie



(Lat,Lon) = (40.2271, -106.0393) Zoom 9 Path Length 0.0 km / 0.0 Min



Boulder Line :
 Aircraft: MD02 – CS Ground: Dalek

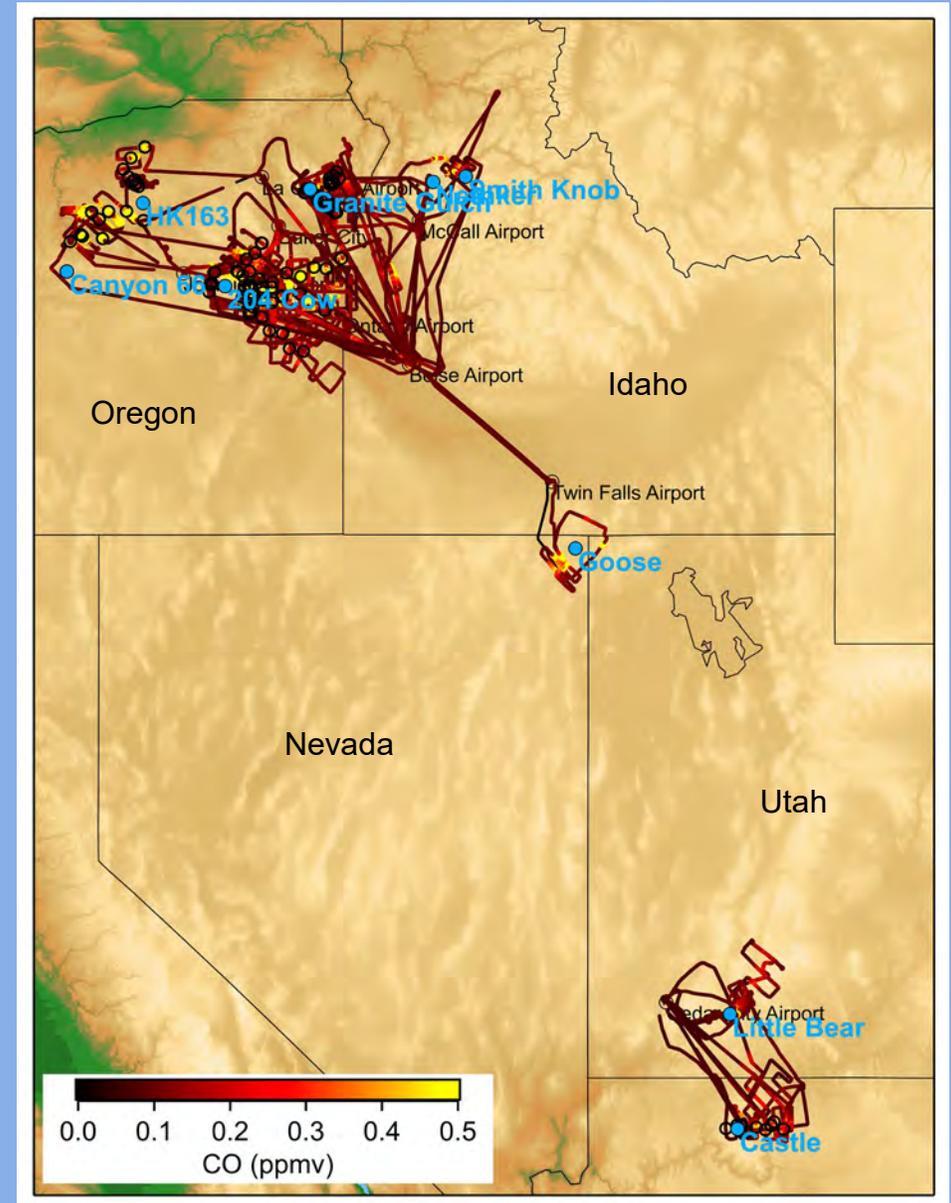
NOAA Chem Twin Otter

Rebecca Washenfelder, NOAA ESRL CSD

Chem Otter Flight Summary



Fire Name	State	Dates Sampled	Total Flights	Sunset or Night
204 Cow	Oregon	8/5, 8/24, 8/25, 8/27, 8/28, 9/3	15	7
Granite Gulch	Oregon	8/9, 8/16, 8/17	6	3
Castle	Arizona	8/20, 8/21	4	3
Little Bear	Utah	8/20, 8/21	3	0
Canyon 66	Oregon	9/4	3	1
Smith Knob	Idaho	9/5	2	0
Nethker	Idaho	8/9	2	0
HK 163	Oregon	8/9	1	0
Goose	Nevada	8/5	1	0



Chem Otter Data Availability

All RA data is available here: <https://esrl.noaa.gov/csd/projects/firex-aq/data.html> as ICARTT and Igor files

A spreadsheet with flight information is here (email me if you aren't able to view it):

https://docs.google.com/spreadsheets/d/1puikxaDmMgNoscQ_-I1vTQKAr1jNtZUYtiOtpqJTifU/edit?usp=sharing

Flight Num	Flight Leg	Start Time (UTC)	Stop Time (UTC)	Duration	Time of Day	Sunset (UTC)	Sunset Location	Start Airport	Start Code	Stop Airport	Stop Code	Fire Name	Fuel Type	Flight Scientist	Instrument Scientist
1	20190729	07/29/2019 17:20:00	07/29/2019 19:25:00	2:05:00	Afternoon			Rocky Mountain Metro	BJC	Rocky Mountain Metr	BJC	Small ag fire	Grass fire	Mike Robinson	Ale Franchin
2	20190803	08/03/2019 22:08:00	08/04/2019 00:28:00	2:20:00	Afternoon			Boise Airport	BOI	Boise Airport	BOI	None	N/A	Mike Robinson	Rebecca Washenfelde
3	20190805_L1	08/05/2019 21:49:00	08/05/2019 22:33:00	0:44:00	Afternoon			Boise Airport	BOI	Twin Falls Airport	TWF	None (Transit)	N/A	Ale Franchin	Geoff Tyndall
4	20190805_L2	08/05/2019 23:43:00	08/06/2019 01:44:00	2:01:00	Afternoon			Twin Falls Airport	TWF	Twin Falls Airport	TWF	Goose		Ale Franchin	Geoff Tyndall
5	20190805_L3	08/06/2019 02:37:00	08/06/2019 03:22:00	0:45:00	Night	8/6/2019 1:53	Twin Falls, ID	Twin Falls Airport	TWF	Boise Airport	BOI	None (Transit)	N/A	Ale Franchin	Geoff Tyndall
6	20190809_L1	08/09/2019 15:21:00	08/09/2019 16:58:00	1:37:00	Morning			Boise Airport	BOI	La Grande Airport	LGD	Granite Gulch		Mike Robinson	Brett Palm
7	20190809_L2	08/09/2019 17:58:00	08/09/2019 20:31:00	2:33:00	Afternoon			La Grande Airport	LGD	La Grande Airport	LGD	HK163		Mike Robinson	Brett Palm
8	20190809_L3	08/09/2019 21:26:00	08/09/2019 23:40:00	2:14:00	Afternoon	8/10/2019 2:00	McCall, ID	La Grande Airport	LGD	Boise Airport	BOI	Nethker		Mike Robinson	Brett Palm
9	20190810	08/10/2019 15:18:01	08/10/2019 17:22:01	2:04:00	Morning			Boise Airport	BOI	Boise Airport	BOI	None (Nethker?)		Ale Franchin	Zach Decker
10	20190811	08/11/2019 22:46:00	08/12/2019 00:52:00	2:06:00	Afternoon			Boise Airport	BOI	Boise Airport	BOI	None	N/A	Mike Robinson	Ann Middlebrook
11	20190816_L1	08/16/2019 21:17:00	08/16/2019 23:40:00	2:23:00	Afternoon			Boise Airport	BOI	McCall Airport	MYL	Granite Gulch		Ale Franchin	Zach Decker
12	20190816_L2	08/17/2019 00:49:00	08/17/2019 03:15:00	2:26:00	Sunset	8/17/2019 1:56	Baker, OR	McCall Airport	MYL	McCall Airport	MYL	Granite Gulch		Ale Franchin	Zach Decker
13	20190816_L3	08/17/2019 04:12:00	08/17/2019 06:56:00	2:44:00	Night			McCall Airport	MYL	Boise Airport	BOI	Granite Gulch		Ale Franchin	Zach Decker
14	20190817_L1	08/17/2019 23:12:00	08/18/2019 01:48:00	2:36:00	Afternoon			Boise Airport	BOI	McCall Airport	MYL	Granite Gulch		Mike Robinson	Ann Middlebrook
15	20190817_L2	08/18/2019 02:43:00	08/18/2019 05:15:00	2:32:00	Night	8/18/2019 1:54	Baker, OR	McCall Airport	MYL	Boise Airport	BOI	Granite Gulch		Mike Robinson	Ann Middlebrook
16	20190820_L1	08/20/2019 19:29:00	08/20/2019 21:48:00	2:19:00	Afternoon			Cedar City Airport	CDC	Cedar City Airport	CDC	Castle (also Little Bear?)		Ale Franchin	Zach Decker
17	20190820_L2	08/20/2019 22:45:00	08/21/2019 01:19:00	2:34:00	Afternoon	8/21/2019 1:16	Kaibab, AZ	Cedar City Airport	CDC	Cedar City Airport	CDC	Little Bear		Ale Franchin	Zach Decker
18	20190820_L3	08/21/2019 02:18:00	08/21/2019 05:01:00	2:43:00	Night			Cedar City Airport	CDC	Cedar City Airport	CDC	Castle		Ale Franchin	Zach Decker
19	20190821_L1	08/21/2019 20:35:00	08/21/2019 22:54:00	2:19:00	Afternoon			Cedar City Airport	CDC	Cedar City Airport	CDC	Little Bear		Mike Robinson	Matt Roberts

Amber Soja and Emily Gargulinski have begun compiling Chem Otter fire information here:

https://docs.google.com/spreadsheets/d/1_Jfc3GP9taF8lvP82VHplX1lgsUvvQV7P9CTxrJNRV8/edit?usp=sharing

with latitude, longitude, fuel type, burned area, and more

Chem Otter Preliminary Analysis

Summary of Short Science Presentations in November

Mike Robinson (NOAA): Examination of daytime and nighttime NO_x photochemistry, and daytime NO_x vertical structure

Christos Stamatis (UC Riverside): Identification of markers for different fuel types (beta-phellandrene and camphene) in VOC cartridges

Zach Decker (NOAA; U Washington): Observation of oxygenated aromatics in I- CIMS data (catechol and guaiacol)

Ann Middlebrook (NOAA): Good correlations between aerosol measurements

Rebecca Washenfelder (NOAA): First look at water-soluble aerosol absorption in downwind transects.

Lisa Azzarello (York University): Good progress with analyzing offline aerosol filter and water samples

Jay Tomlin (Purdue): Good progress with analyzing aerosol impaction substrates



Missoula and Broader Picture

Bob Yokelson, University of Montana

Missoula ground-based monitoring update

1. Data status

- Complete for 2017, 2018, and 2019 fire seasons, except for 2019 CO coming soon.
- Products: Abs/Scat 401/870 nm, PM, BC, BrC, O₃, NO_x, CO, and varying by year Hg (2019), NH₃ (2017), etc
- Request from us directly.

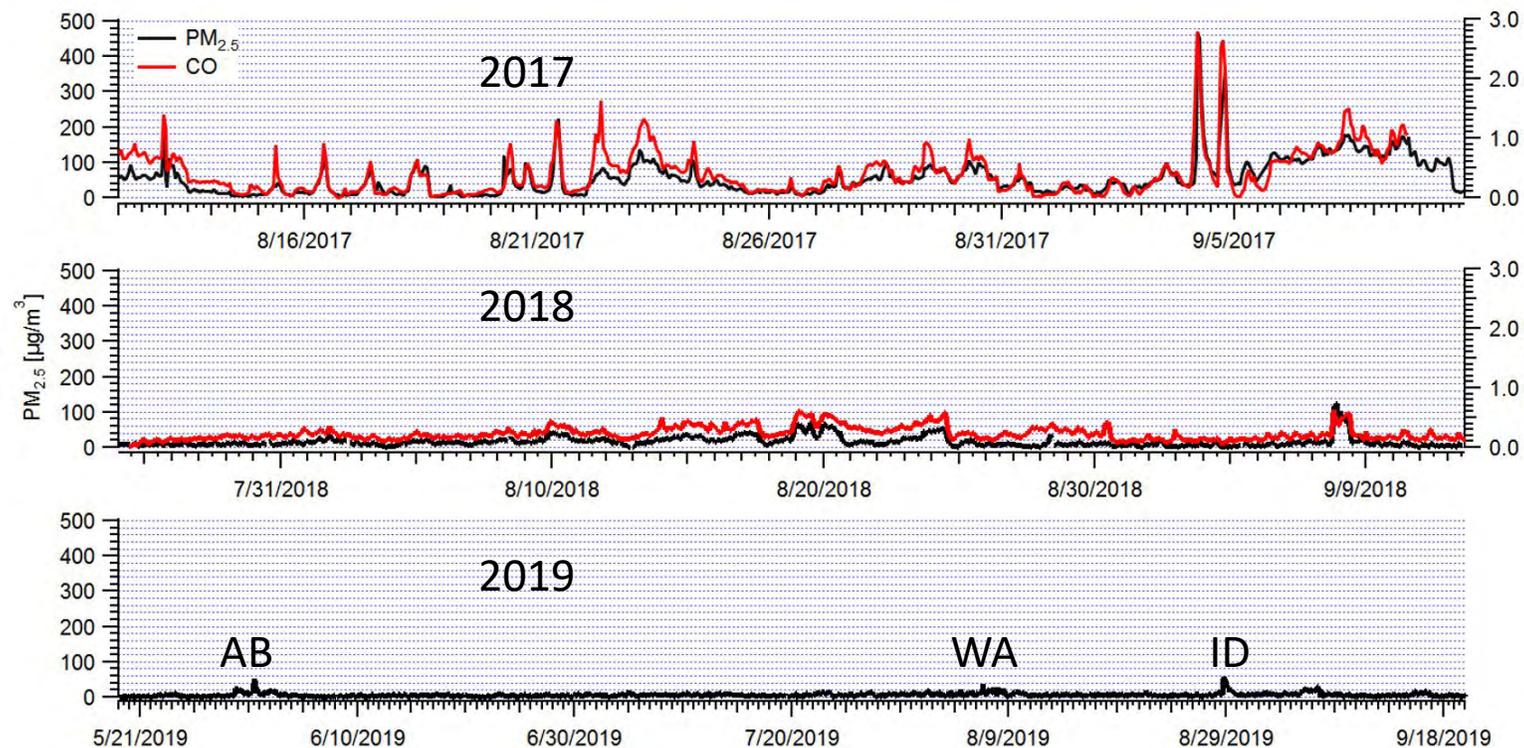
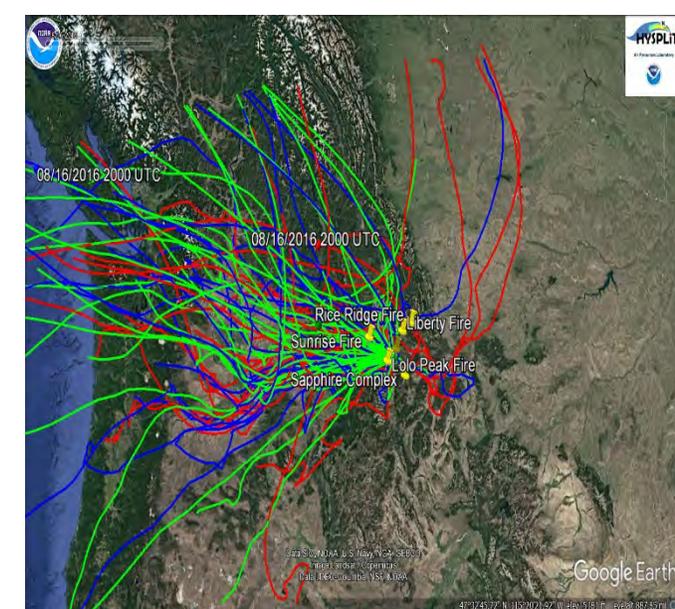
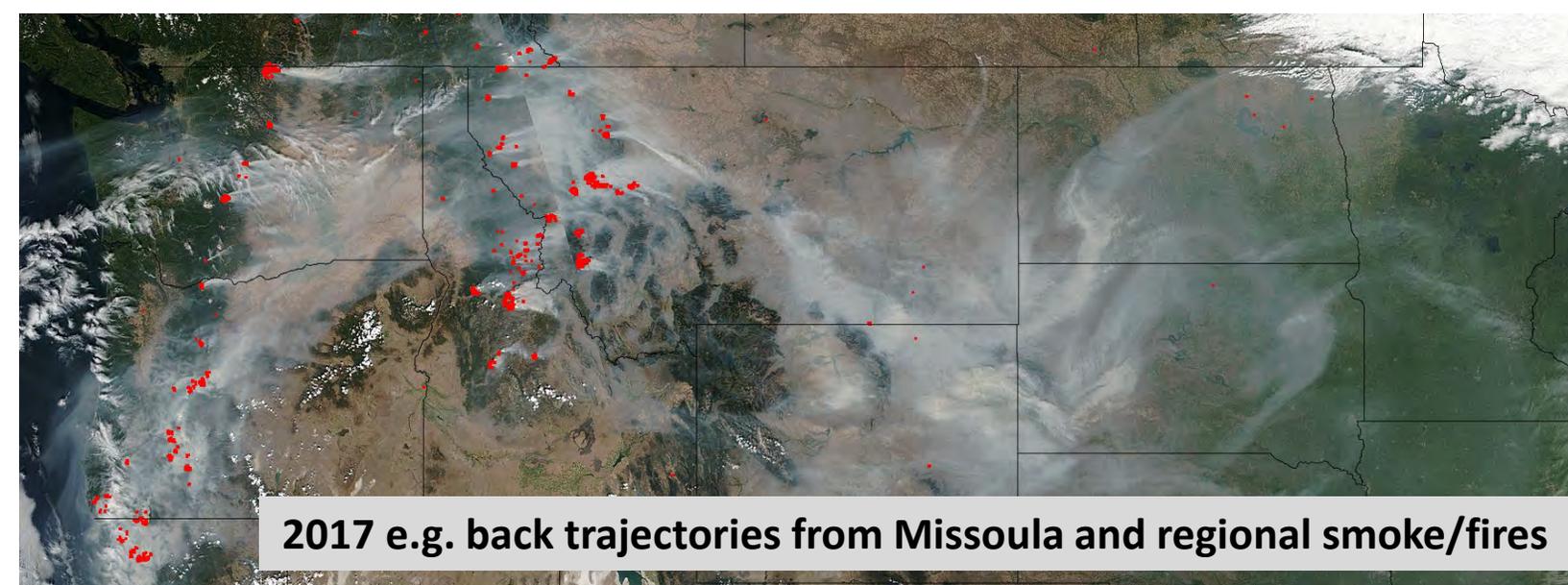
2. No overlapping with planes!

Smoke plumes are not well-mixed and spatial/temporal overlap is good, but not only reason for multiple platforms. Because wildfires are numerous, large, long-lasting, and complex it is hard to sample entire fires representatively. Thus we employ ground-based sampling of smoke downwind of a very large selection of fires burning at all stages of their life cycle to provide some top-down constraints on typical overall western US wildfire emissions and impacts. I.e. planes and MSO are both attempt to measure average emissions/impacts and worth comparing. In general a large-scale phenomenon that requires multiple sampling approaches.

Mid-day emissions and transport change with time (fuels). Rim Fire example

Event/Study	Date (2013)	CH ₄ /CO ₂ ppb/ppm	Wind Direction	Fire Behavior
Ignition	Aug 17			
Liu et al	Aug 26	8	NE	intense
Yates et al	Aug 29	6.5	NE	intense
Yates et al	Sep 10	18.3	W	“more smoldering”
Containment	Oct 24			still burning

- 3 samples of one fire. 58-78K wildfires/year. What’s the right “number” to use??
- Can we sample a large number of fires at all different stages of their life cycle and also constrain total smoke production?
- In addition to predicting the outcome of smoke evolution based on source sampling and models, can we measure it?



**Interannual variability,
but smoke every year!**

Findings so far based on over 1000 hours of smoke data:

- BC/CO ratios: year to year variability, but similar on average to aircraft (so far)
- PM/CO: ~50% lower at MSO than measured at source, evaporation at surface?
- BC/PM: ~1-2% confirms smoke is overwhelmingly organic, as from air
- O₃ was elevated >10% when smoke transported to the valley
- NO_x was local and spurs pNO₃ events up to ~2 ppbv/hr and sometimes BrC formation
- AAE: Lower for aged smoke than for fresh
- BrC Absorption: accounts for ~50% of absorption at 401 2017&2018, 2019 TBD
- MSC and MAC increase when switching from 1>2.5 micron cyclone cut-off
- Our findings could constrain smoke production; characterize combustion; inform model calculations of smoke production, chemistry, SOA, and optical properties.

Other Updates?

Thoughts for Joint Efforts?

Post-FIREX-AQ TOMLG Next Steps

- Please add/correct information to the FIREX-AQ web pages
 - Consider including contact information for data
 - Send Info to Cathy Rasco at c.burgdorf.rasco@noaa.gov
- Science meeting for all FIREX-AQ participants
 - NASA Langley Research Center in Hampton, Virginia
 - Week of 16-20 March 2020
- Another TOMLG meeting before then?