2019 FIREX-AQ Twin Otter & Mobile Labs Teleconference
April 9, 2019

1. Chem Twin Otter instruments & logistics
2. Iulia Gensch – Isotopic analysis of levoglucosan
3. NASA Langley & Aerodyne mobile labs
4. Twin Otter flight planning and coordination with mobile labs

Instrument	Position	Species Measured	Investigators	Institution	Status
Picarro CRDS	1	CO, CO_2, CH_4, H_2O	Colm Sweeney	NOAA GMD	✓
Met Probe & Diff GPS	1	RH, Temp, Pres, Winds, GPS, flight data	Mike Robinson, Steve Brown	NOAA CSD	✓
Tenax cartridge autosampler	1	Speciated VOC	Kelley Barsanti, Lindsey Hatch, Avi Lavi	UC Riverside	Mainly finished
I^- ToF CIMS	2	Acids (HNO_3, HONO, Organics), acid gases (N_2O_5, $ClNO_2$), Oxygenated organics, Organic nitrates, Halogens	Joel Thornton, Brett Palm, Carley Fredrickson, Zach Decker	University of Washington / NOAA	Calibrations Re-racking
Aerosol mass spectrometer, UHSAS	3	Aerosol composition + size distributions	Ann Middlebrook, Ale Franchin, Kathy Hayden, Shao-Meng Li	NOAA CSD Environment Canada	Re-racking
Brown carbon PiLS	4a	Spectrally resolved aerosol absorption	Rebecca Washenfelder, Lisa Azzarallo	NOAA CSD York University	Mainly finished
Chemi-luminescence	4b Floor	NO, NO_2, O_3	Andy Weinheimer, Denise Montzka, Geoff Tyndall, Frank Flocke	NCAR	Re-racking
TRAC Sampler	4a	Particle composition, mixing state, morphology	Alex Laskin, Jay Tomlin, Kevin Jankowski	Purdue University	✓
Offline WSOC analysis	4a	Particle composition	Cora Young, Lisa Azzarallo	York University	Incl. w/ BrC
jNO_2 heads	Camera port	NO_2 photolysis rates	Mike Robinson	NOAA CSD	Maybe

Links to Information about Twin Otters & Mobile Labs

Chem Twin Otter Payload Spreadsheet

https://docs.google.com/spreadsheets/d/1O0Tij-AY93KaB43RfqNDitCjnBwwj8q2P09koMyS8J0/edit#gid=660888805

Twin Otter & Mobile Lab Organization Spreadsheet

https://docs.google.com/spreadsheets/d/1UsNUt1p01yPSqkqvTFKMWMBGM4sFbagnt5WP8EsZUUs/edit#gid=0

Please be sure you have access to these sheets and that your information is updated in the appropriate tab

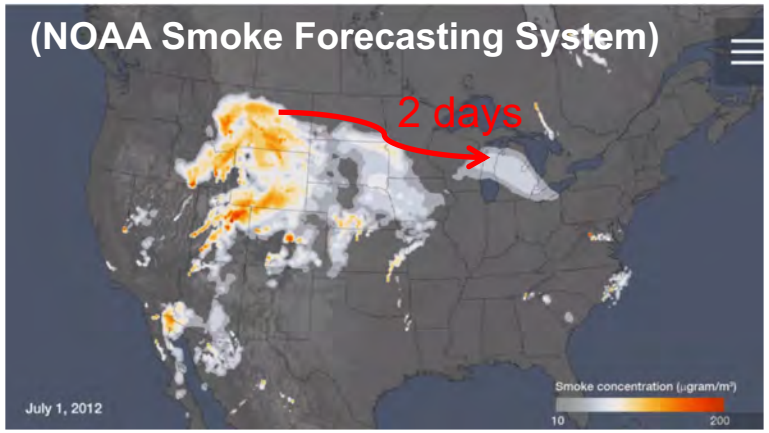
FIREX-AQ 2019 Web Site

https://www.esrl.noaa.gov/csd/projects/firex-aq/

This site is currently being updated
Logistics updates for schedules, shipping, project locations, etc. will be posted here as they are available

SMOKE AGING BY MEANS OF ISOTOPIC ANALYSES

Levoglucosan isotopic compound specific measurements



Needs (triple measurements):

- CSIA: 300ng levoglucosan
- TC: 30 µg OC+EC and quartz filter

Additional information by isotopes

- sources signatures (specific $\delta^{13}C$)
- extent of chemical degradation

↓

model validation

Gensch et al. EST2018

Sang et al. GRL2016

Sang et al. EST2012

FIREX-2019
Planning Notes for Ground Team

Agenda

1. **Calendar**
2. **People**
3. **Equipment**
4. **Gases**
5. **Lodging**

6. **Science Goals**
7. **Straw Plan**

Calendar

Dates in Idaho or *on* project

Met Twin Otter	July – mid August
Chem Twin Otter	mid July – August
NASA Large	mid July – August
Aerodyne AML	Aug 7th – 29th

August 2019

Sunday	Monday	Tuesday	Wednesday	Thursday	Friday	Saturday
				1	2	3
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

People *going* to McCall

Bruce Anderson	NASA Group Leader
Jiaju Chai	Brown
Carolyn Jordan	NASA
Scott Herndon	Aerodyne
Ed Fortner, Conner Daube,	Jordan Krechmer
Phil Croteau, Rob Roscioli	Christoph Dyroff
Megan Claflin, Brian Lerner	Francesca Majluf
Berk Knighton	MSU
Linday Hatch, Kelley Barsanti	UCR
Yuton Liang, Becca Wernis	Berkeley
Ben Sumlin	Washington University StL
Interns (3) + Marc Fiddler	NCA&T State University

People *not going* to McCall

Allen Goldstein, Nathan Kreisberg	Berkeley/Aerosol Dynamics
Meredith Hastings, Jack Dibb	Brown/UNH
Rodney Weber	Georgia Tech
Susan O'Neil	National Forest Service
Solomon Bililing	NCA&T State University

2019 - Instruments

{**ARI-AML**}

Gas: CO, HCN, HCHO, C_2H_6, CO_2, NO, NO_2, H_2O, CH_4, C_2H_2, Vocus-PTR

PM: HR AMS, SP2, WU-Stl Optical Properties of BrC

NCAR Spectral Radiometer (Sam Hall)

NASA Ceilometer (Jim Szyman)

{**ARI-Site @ McCall Activity Barn**}

ARI GC-TOF, Berkeley-CTAG, ACSM, ARISense, TWST?

{**AERONET team**}

2 mobile aeronets. Brent is on travel and we will get an update later. Perhaps Phillipe will comment on these assets?

Property	Instruments	MACH-2	Size Range	Resolution
Aerosol Microphysics	Particle Number Density	TSI 3775, hot TSI3775	> 7 nm	1 sec
	Ultrafine Particle Density	TSI 3789	> 2 nm	1 sec
	Aerosol Size Distribution	TSI SMPS w/3772 CPC	10 - 300 nm	60 sec
		TSI EEPS	6 - 560 nm	1 sec
		DMT UHSAS	70 - 1,000 nm	1 sec
		TSI APS	500-20,000 nm	1 sec
		TSI Optical Particle Spectrometer	300 - 10,000 nm	1 sec
Aerosol Optics	3-λ Scattering	Air Photon Nephelometer	NA	5 sec
	3-λ Scattering, f(RH)	TSI3563 Nephelometer	NA	5 sec
	3-λ Extinction	3-wavelength CAPS	NA	5 sec
	7-λ Absorption	Magee Scientific	NA	5 sec
	Hyperspectral Extinctiometer	SPEX	NA	60 sec
	3-λ Absorption Photometer	TAP	NA	5 sec
	3-λ Photo-Acoustic Spectrometers	ARI dPAS-3, ARI dPASS, DMT PASS-3	NA	10 sec
Aerosol Composition and Mass	Aerosol Ionic Composition	PTFE filters + IC	NA	intermittent
	Aerosol WSOC	PTFE filters + TOC	NA	
	EC/OC, Metals	quartz filters; sunset labs, ICP	NA	
	Black Carbon Mass and Size	DMT SP2, MAAP	60 - 900 nm	1 sec
	PM2.5	MetOne E-BAM	NA	1 hour
	PM2.5, PM10	Teledyne T640	180 - 10,000 nm	1 minute
Atmospheric Structure and Meteorology	cloud/aerosol profiles	Vaisala CL51 Ceiliometer	NA	60 sec
	Atmospheric Optical Depth, 280 – 660 nm	Pandora Sun Photometer	NA	60 sec
	Winds and Navigation Parameters	AirMar 200WX	NA	1 sec
	In Situ T, RH, P, winds	Weather Hawk	NA	1 sec
Chemical Instruments	CO, CO2, H2O	LGR	NA	1 sec
	CO2, H2O	Licor 840	NA	1 sec
	NOx	LGR NO2 w/O3 titration	NA	1 sec
	O3	thermo scientific	NA	1 sec

UNH and Brown will provide NOx, HONO, reactive nitrogen, isotope and mist chamber measurements

Instruments Langley

2019 - Gases

Compressed gases will be picked up from Airgas in Boise using the tracer truck and/or the AML

Contact Leah Williams for last year's vendor contact to place an order. Let Leah know so she can make sure your order doesn't put us over legal hazard weight.

williams@aerodyne.com

LN2? You will need to make arrangements, truck can't carry big dewars

Bring your regulator for your tanks, spares are limited

If your instrument is in the AML and consumption is modest
you can get away with using "house" zero air

Talk to Conner Daube, daube@aerodyne.com

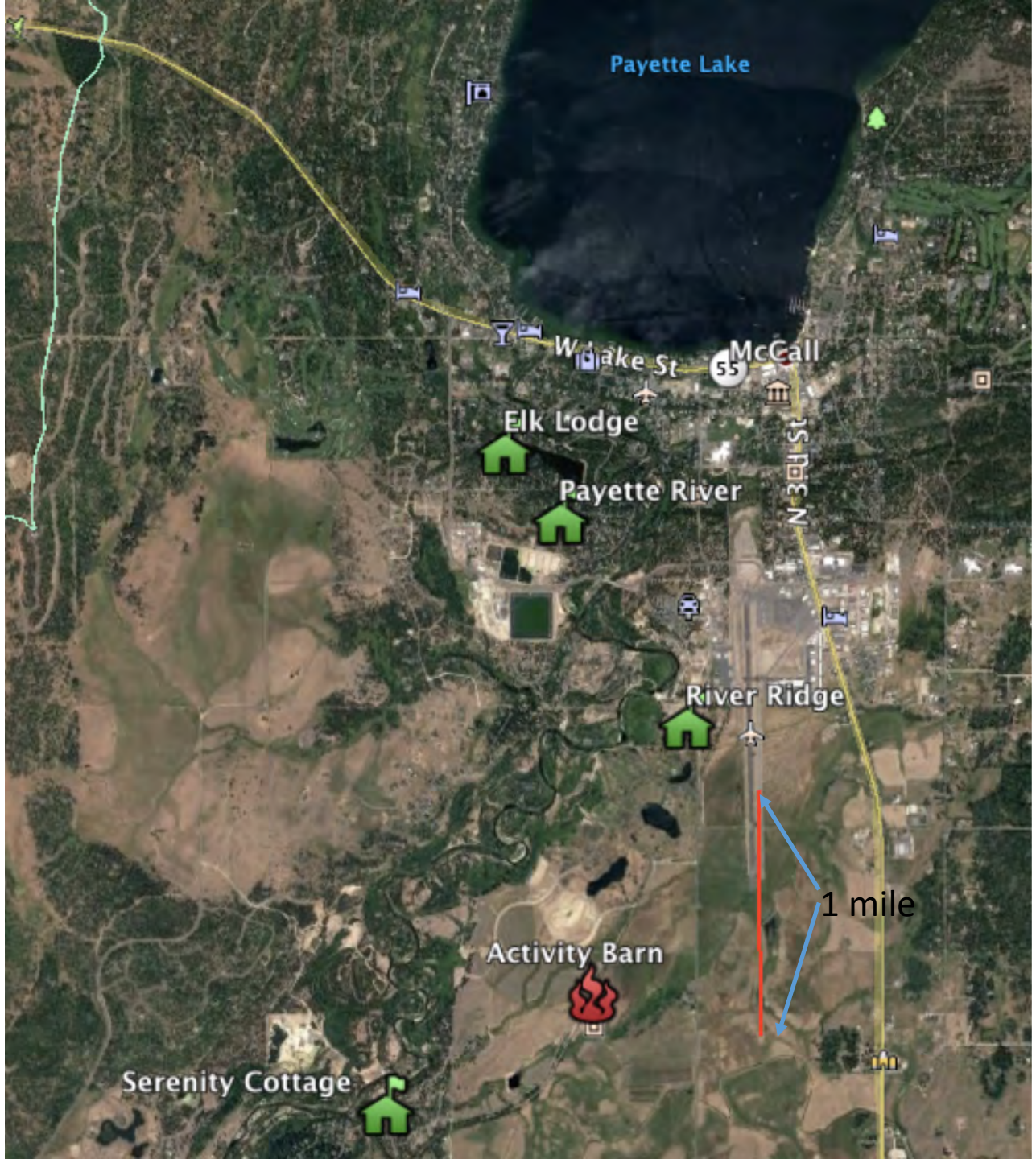
Lodging

1. Red Elk Lodge 8/7/2019 - 8/23/2019, 4 bedroom, 3 bath
   Interns + postdoc + early setup person
2. Serenity Cottage 8/7/2019 - 8/26/2019, 4 bedroom, 3 bath
   Yutong, Francesca, Becca, Lindsay
3. River Ranch 8/7/2019 - 8/29/2019, 4 bedroom, 3 bath
   Aerodyne, tbd
4. Payette River Cabin 8/10/2019 - 8/29/2019, 6 bedroom, 3 bathroom
   Aerodyne, tbd, UCR

The lodging situation is still in flux, but we have a bloc of some rooms to work with that are much more affordable than the hotels in town.

Room is $84/night

Lod



1. Calendar
2. People
3. Equipment
4. Gases
5. Lodging

6. Science Goals
7. Straw Plan

FIREX-AQ Science Questions

1. What are the emissions of gases and aerosols from North American fires?

How do emissions depend on meteorology, fuel, time of day or night, and fire conditions?

How do the relative and absolute amounts of smoldering and flaming impact smoke composition and injection altitude?

What is the amount, composition, and volatility of aerosol precursors including the previously unidentified fraction of the emissions including SVOCs, IVOCs, and BC, BrC and OC aerosols?

What are the emissions of greenhouse gases and air toxics?

How well do inventories represent BB emissions and their radiative properties, and what are the largest uncertainties affecting the inventories?

How does fuel species source impact chemical composition of gases and particulates

2. What chemical transformations affect those emissions?

What are the formation mechanisms for secondary species (ozone and secondary aerosol) and what environmental or chemical conditions control their relative importance?

How do aerosol optical and CCN properties evolve in fire plumes due to secondary production, particle phase transitions, and brown carbon bleaching and production?

How large are the variations in fire emissions compared to the changes from chemical processing?

What fraction of the organic aerosol is primary versus secondary at various time scales?

How do nighttime chemical transformations involving NO_3, N_2O_5 and O_3 influence the composition and evolution and the production of secondary organic aerosol in smoke plumes?

What are the mechanisms that lead to PAN formation in fire plumes during daytime and nighttime?

What is the diurnal cycle of free radical and oxidant production in fire plumes, and how important are reactions with different oxidants at various times of day

How important is the formation of organic aerosol from aqueous-phase processes?

QUESTIONS THAT CAN BE ADDRESSED WITH MOBILE LAB OBSERVATIONS

FIREX-AQ Science Questions

3. What is the local air quality impact of North American fires?

How well do local models predict the BB impact on air toxics including gases and aerosols, and visibility?

How does local meteorology impact fire evolution?

How large are the small-scale temporal and spatial gradients in fire plumes?

How important is nighttime smoke for populated areas and what are the health impacts?

How large are the regional impacts of small prescribed fires?

How much do small prescribed fires lead to population exposure?

4. What are the regional and long-term impacts of North American fires?

How strongly are the composition and distribution of pollutants over North America influenced by BB?

How far afield can BB emissions from prescribed fires impact air quality?

What are the likely future changes in BB impacts that could result from climate change and changes to fire management practices?

5. What are the climate-relevant properties of BB aerosols?

What roles do brown carbon and black carbon, other light-absorbing species, and internal mixtures play in the climate-relevant properties of smoke?

What intensive properties of BB aerosols can remote (i.e. satellite and AERONET) observations determine globally?

How well do regional and global models predict the BB influence on climate?

How can FIREX-AQ measurements improve remote retrievals of smoke?

What are the emissions of greenhouse gases and air toxics?

QUESTIONS THAT CAN BE ADDRESSED WITH MOBILE LAB OBSERVATIONS

Science Goals

At McCall

Quantify biomass burning species in mixed-aged air, assess exposure in alpine-valley town

Drive to the Fire

Quantify biomass burning species in relatively fresh air. Drive to smoke flooded valleys to investigate

vertical structure

temporal character of flooding/ventilating

PAM-oxidation flow reactor measurement

assess acute exposure in alpine-valley town

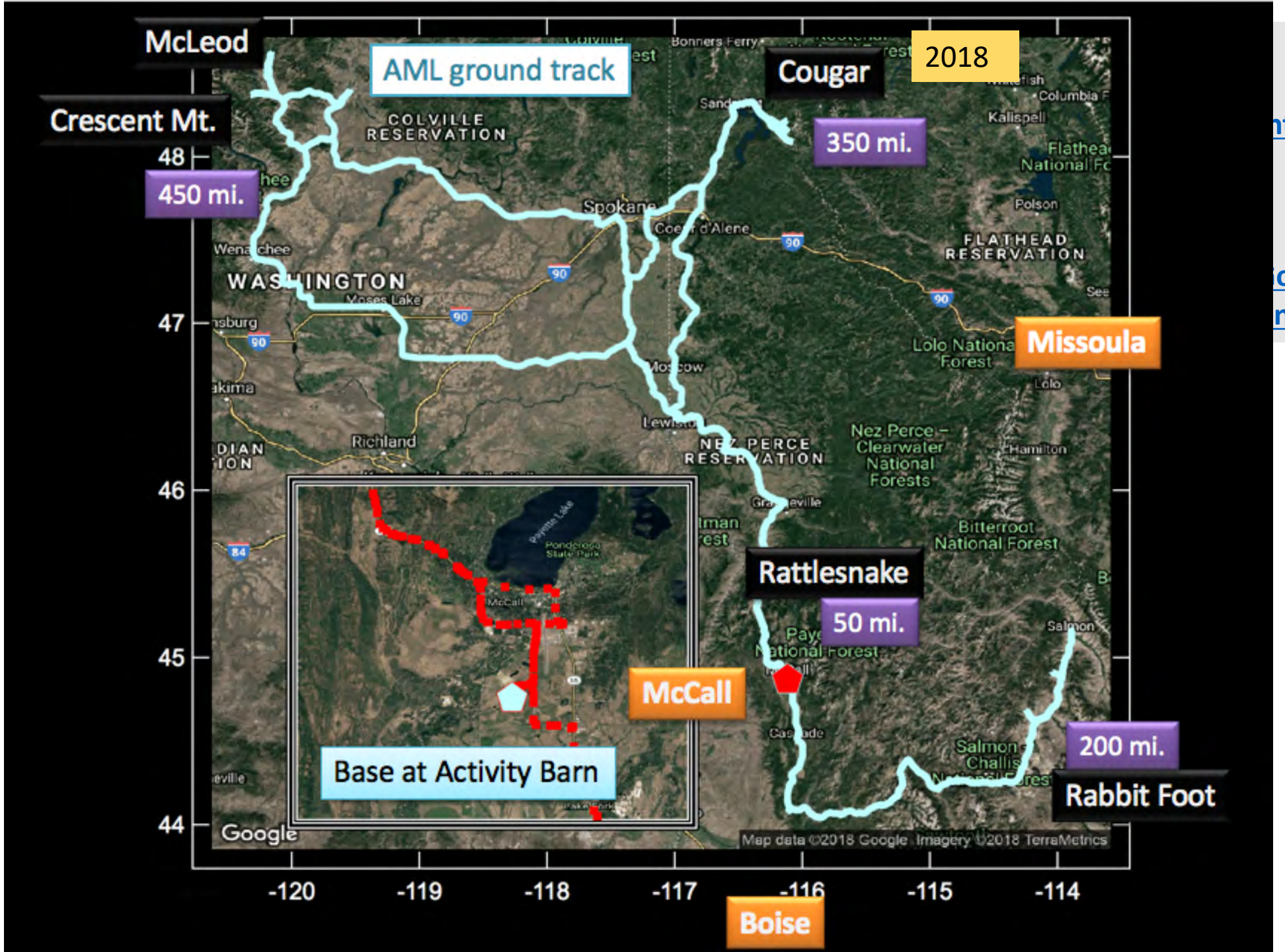
Aug. 13, 2018. Colin Mulvany
The Spokesman-Review

Straw Plan

August 2019

Sunday	Monday	Tuesday	Wednesday	Thursday	Friday	Saturday
				1	2	3
4	5	6	7 Setup	8 Setup	9 Sample McCall	10 Sample McCall
11 Drive Fire	12 Drive Fire	13 Sample McCall	14 Sample McCall	15 Drive Fire	16 Drive Fire	17 Sample McCall
18 Sample McCall	19 Sample McCall	20 Sample McCall	21 Sample McCall	22 Sample McCall	23 Drive Fire	24 Drive Fire
25 Sample McCall	26 Drive Fire	27 Drive Fire	28 teardown	29 depart	30	31

Reckless guess on activity to convey likely duty cycle of drive vs park


McLeod
Crescent Mt.
450 mi.
AML ground track
2018
Cougar
350 mi.
COLVILLE RESERVATION
WASHINGTON
FLATHEAD RESERVATION
Missoula
Rattlesnake
50 mi.
NEZ PERCE RESERVATION
Nez Perce – Clearwater National Forests
Bitterroot National Forest
McCall
Base at Activity Barn
200 mi.
Rabbit Foot
Boise
48
47
46
45
44
-120
-119
-118
-117
-116
-115
-114
Google
Map data ©2018 Google Imagery ©2018 TerraMetrics

Twin Otter Flight Planning & Interactions with Mobile Labs

• Frank Flocke has pointed out from the experience with WE-CAN that the operational altitude range in the Idaho mountains will be difficult for the Twin Otters

Peak terrain elevation = 12,000 feet
Chem Twin Otter operational ceiling = 12,000 - 14,000 feet
Met Twin Otter operational ceiling = 16,000 feet

IFR operations (> 2000 feet above terrain) may be impossible for fires in this area

• Flights using missed approaches into smoke filled valleys are likely feasible in that area and are the best interaction with the mobile labs, which will have a base of operations at McCall, near Boise

• Terrain further to the west, especially outflow from the Cascades, is likely to be more tractable for the Twin Otters to fly for fire plume chasing experiments

• Suggested operational plan, open for discussion from this group:

- Use Boise as a starting point and central base of operations for both Twin Otters
- Identify alternative bases of operation that can be accessed for periods of ~1 week at a time
- Move the Twin Otter operations as needed to areas with active burning and accessible outflow
- Mobile labs will move to areas of Twin Otter operation if there compelling reason for collaboration

Alternate Airfields

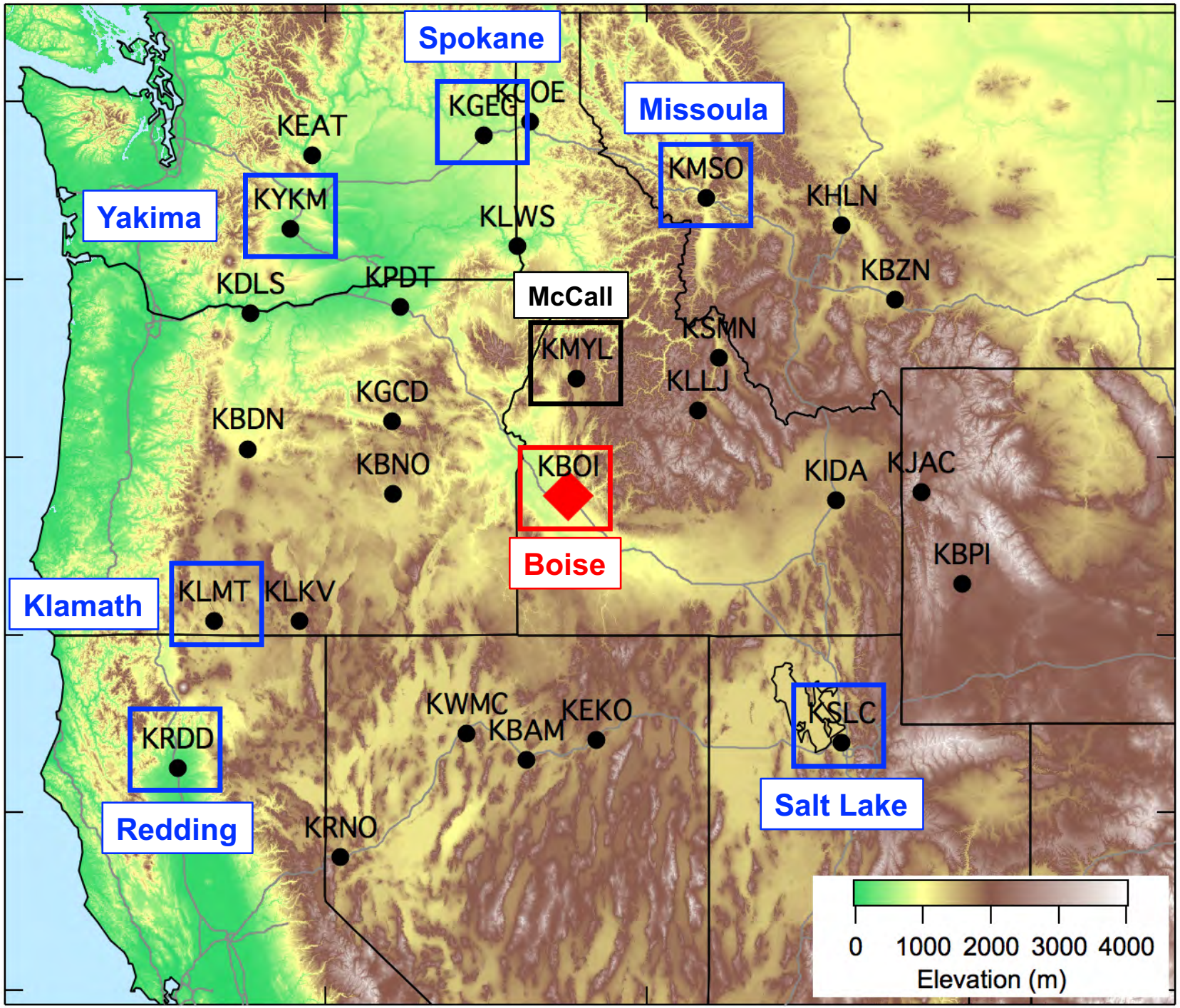
- Request is in to NOAA Aircraft Operations to identify FBOs at six alternate locations

  Missoula, MT
  Spokane, WA
  Yakima, WA
  Klamath / Crater Lake, OR
  Redding, CA
  Salt Lake City, UT

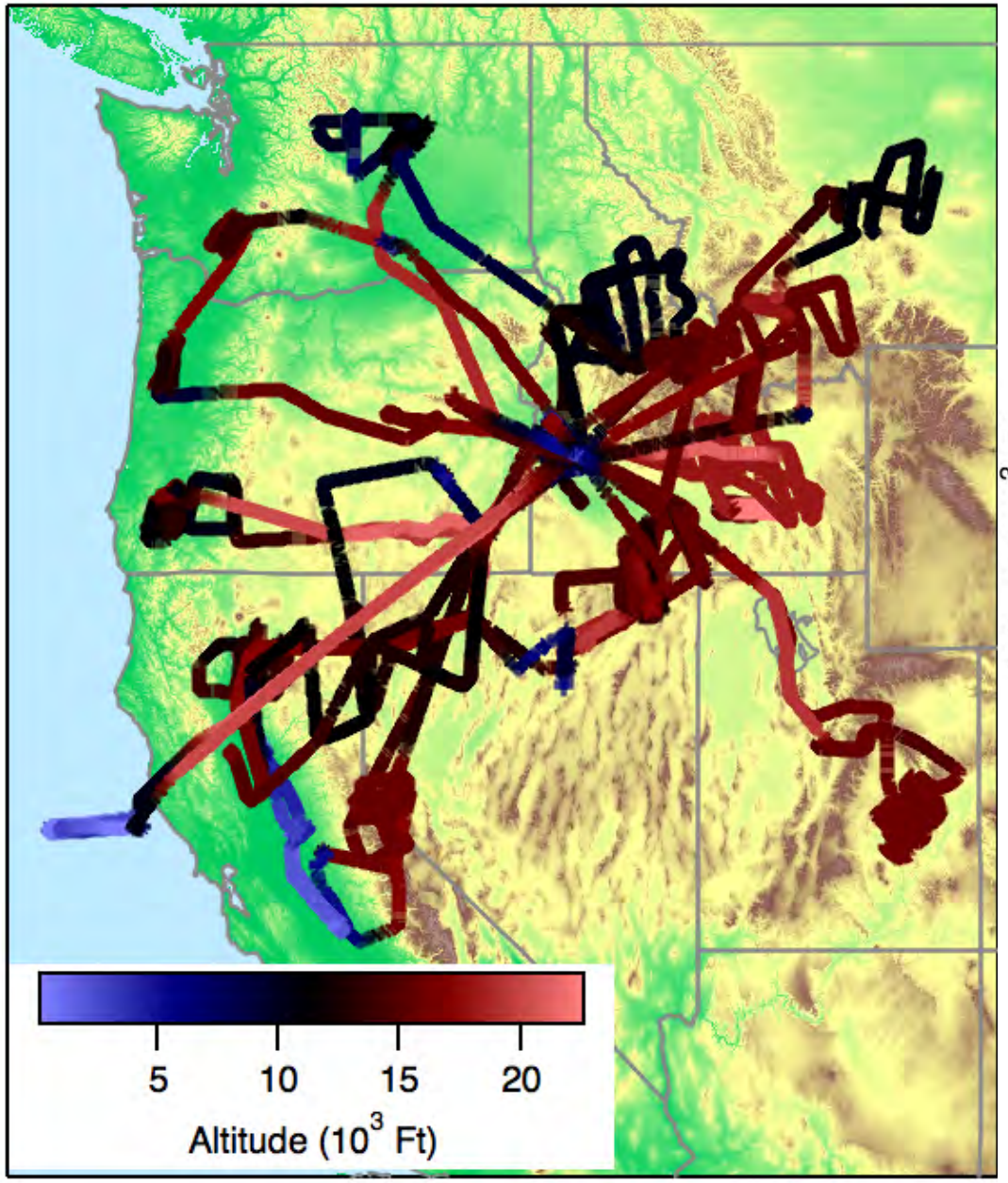
- Transits to these airfields would likely require 2-3 days on either side of a move before research flights could resume

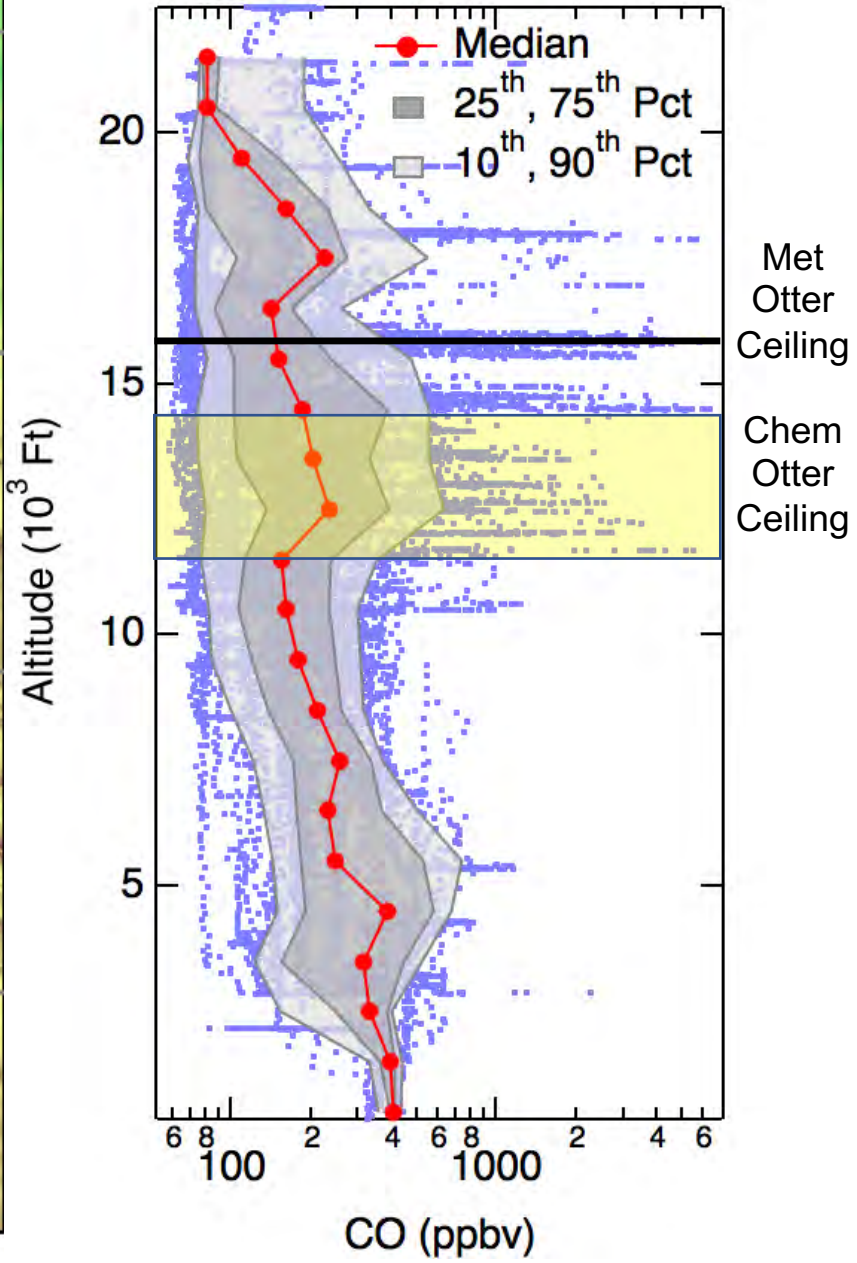
- Possibility for the chem otter to do this 1-2 times, and for the met otter to do this once

- Short ferries to smaller airfields would still be possible / likely from these bases, but no long ferries would be planned



WE-CAN 2018 Flights and Altitude Ranges





Twin otters will necessarily target lower level plumes than C-130 did during WE-CAN (or than DC-8 will during FIREX-AQ)

Areas with lower terrain on the west coast, Snake River Valley or northern Montana & Idaho will be best for plume chasing

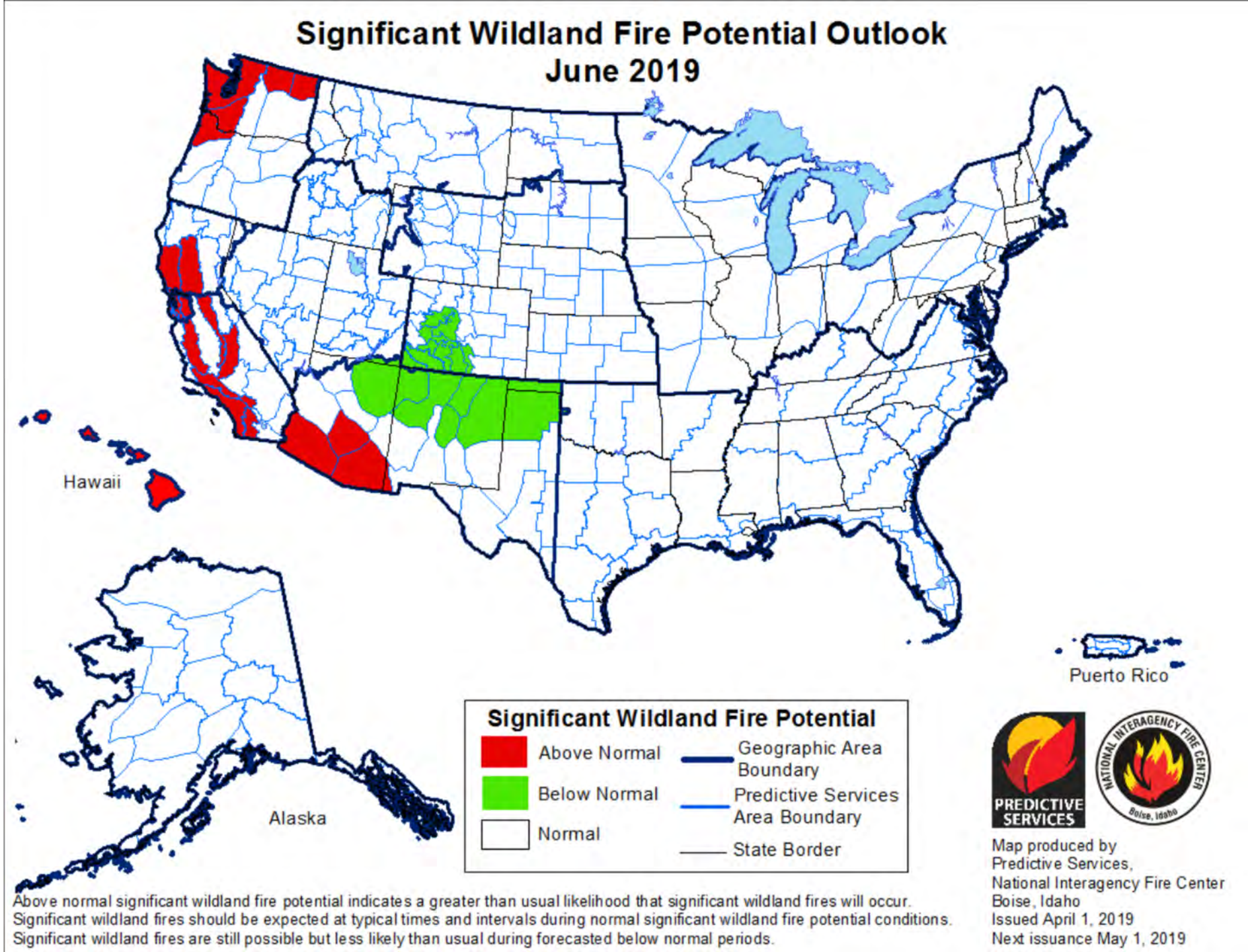
Altitude range difference may allow easier collaboration with DC-8 if same fires are targeted

Smoke impacted valley flights will be best for collaboration with mobile labs

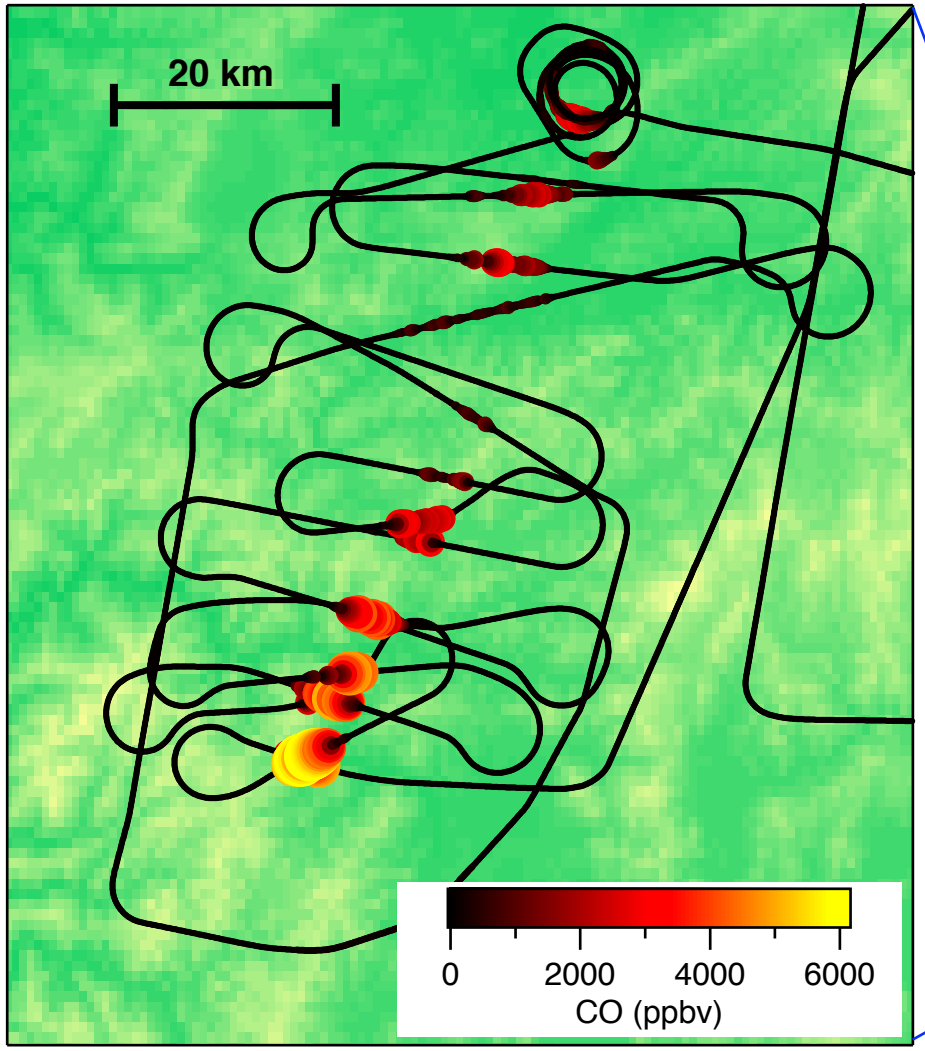
Fire outlook for June 2019

West coast is forecast to be fire impacted in early summer

Will look to forecasts such as this in May, June and July to develop plans for locations and schedules during the summer



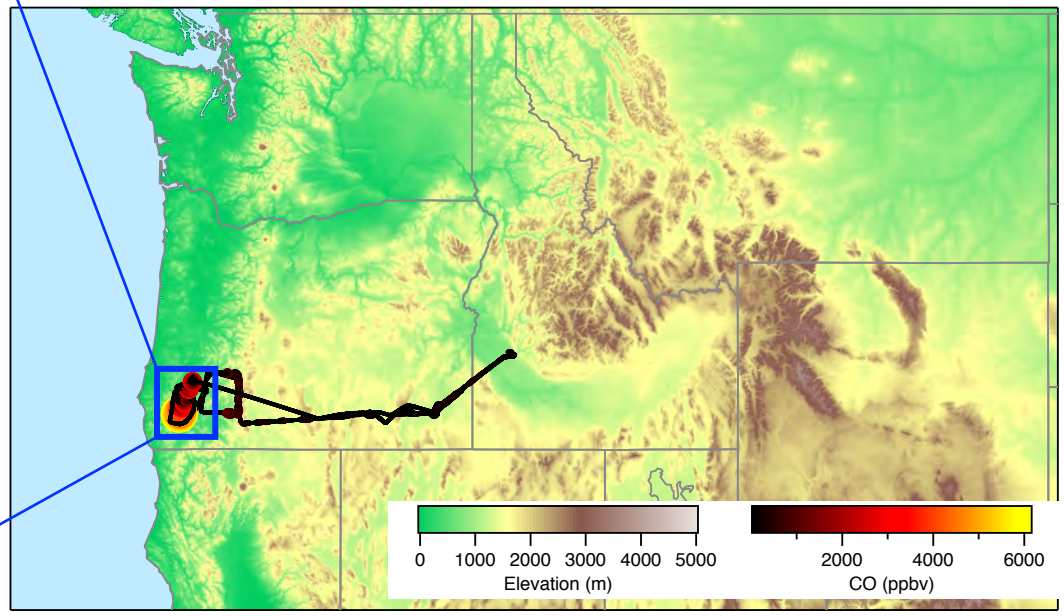
Example Plume Chasing Flight from WE-CAN



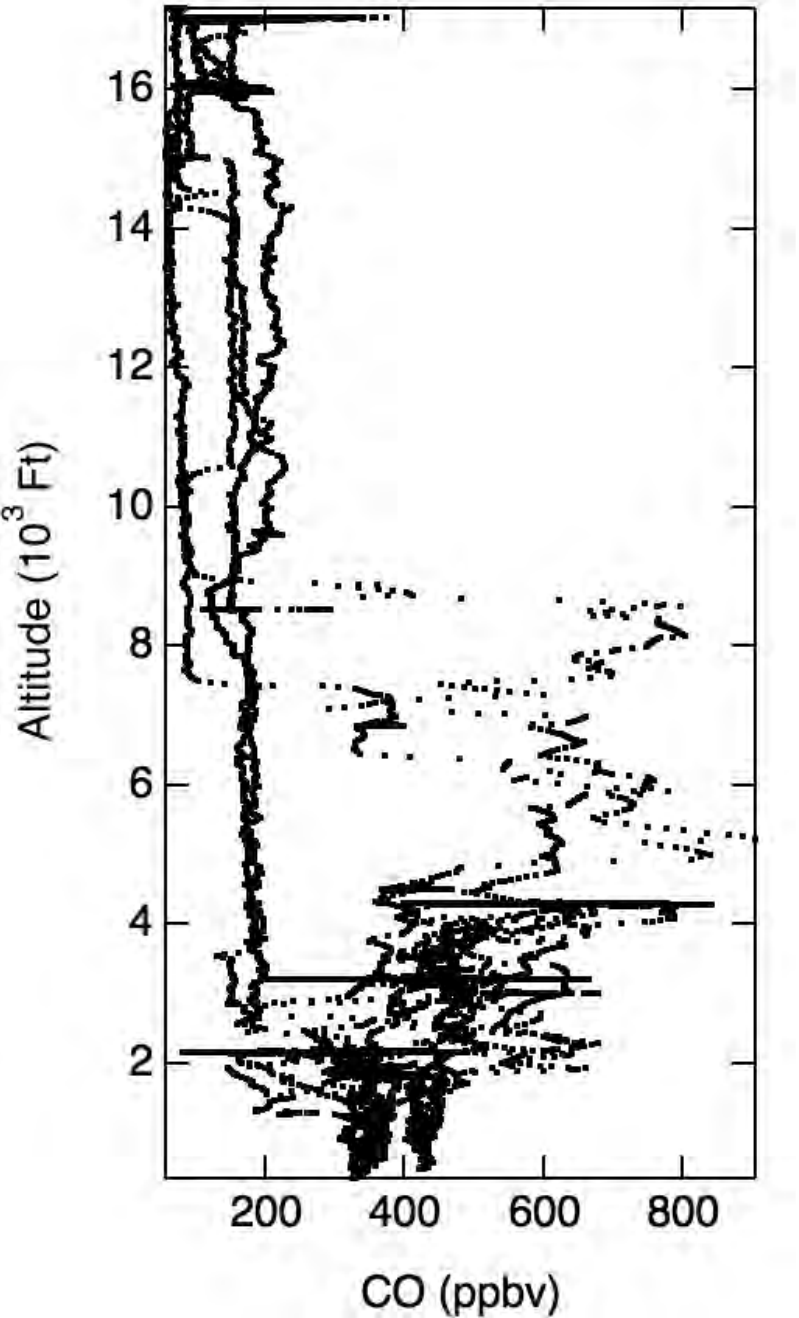
July 30, 2018, Flight to the Cascades

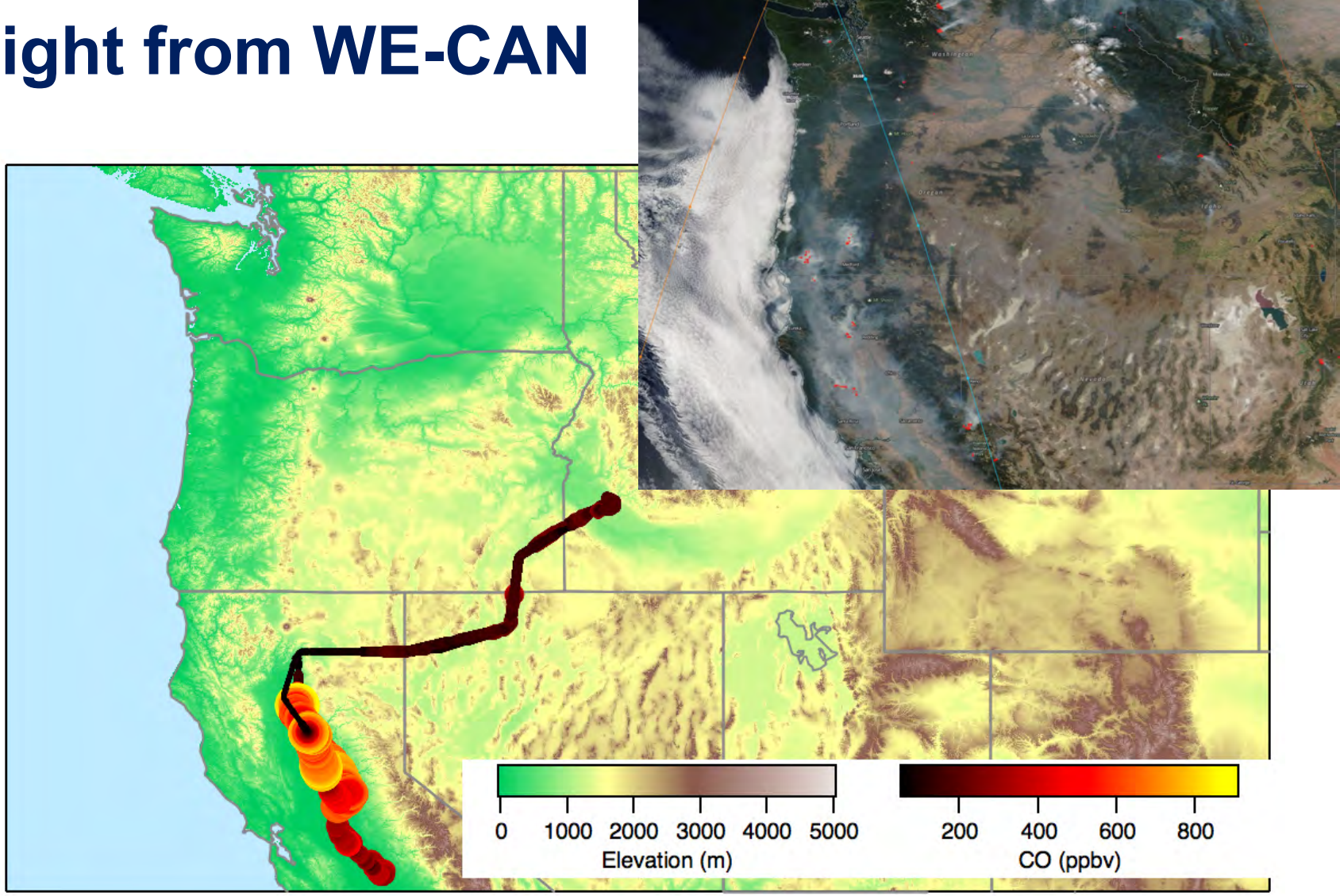
Accessible by the Twin Otters from either Klamath or Redding

Mainly in the altitude range of the Twin Otter aircraft



Example Valley Flight from WE-CAN





Twin Otters can access valleys in the entire domain

- Chem Otter: Repeated missed approaches for vertical profiling
- Met Otter: Survey smoke distribution and fire weather from above plume
- Mobile Labs: Ground based sampling at valley floor

Support for Twin Otter Operations

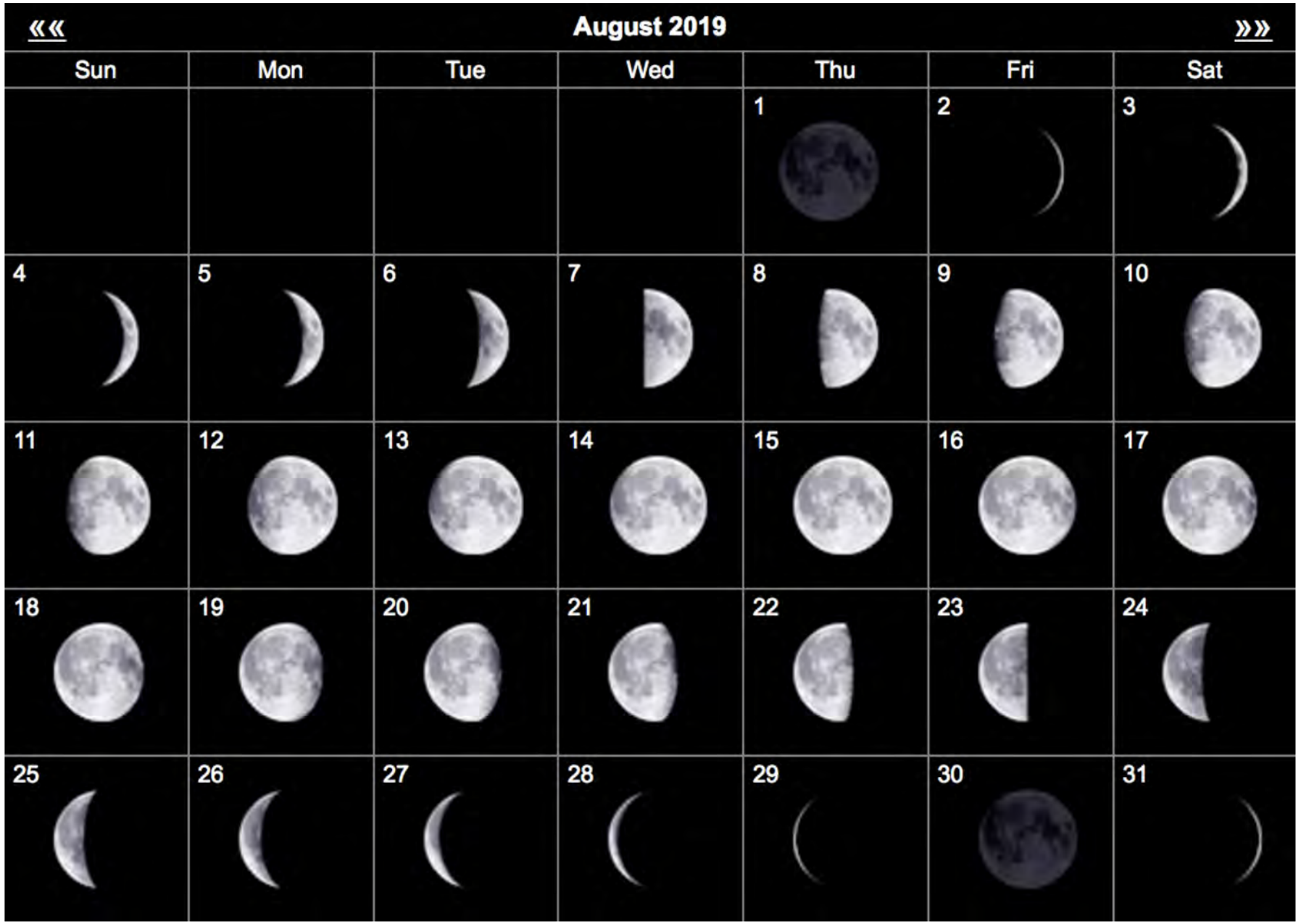
1. Moving truck: Currently looking into rental of 24’ moving truck to make enough of the operation mobile so that we can easily relocate from Boise

2. Support truck: Will likely use CSD pickup truck with an aircraft GPU, generator and air conditioning unit to support short ferry flights from whichever airfield we are based from.

3. Support personnel: Likely a requirement to drive the support truck and assist with mobile operations

    There will be only ~10-12 scientists in the field at any one time
    Additional personnel to drive the support truck and assist with moving will be important
    Currently working to identify mechanisms to make that happen

Night Flight Schedule



Night flights remain a scientific goal for the otters

Also a goal for the mobile labs if they are sampling continuously in smoke impacted valleys during nighttime drainage flow

Full moon will assist with nighttime operations

August 12 – 19 will be the best week for nighttime operations