

# 2019 FIREX-AQ NOAA Twin Otter Teleconference

## February 5, 2019



1. CHEM Twin Otter Instruments, payload & schedule
2. MET Twin Otter Instruments, payload & schedule
3. Logistics updates
4. Ground site discussion

Instrument	Position	Species Measured	Investigators	Institution
Picarro CRDS	1	CO, CO <sub>2</sub> , CH <sub>4</sub> , H <sub>2</sub> O	Colm Sweeney	NOAA ESRL GMD
AIMSS Met Probe / Differential GPS	1	RH, Temp, Pres, Winds, GPS, flight data	Mike Robinson, Steve Brown	NOAA ESRL CSD
Tenax cartridge autosampler	1	Speciated VOC	Kelley Barsanti, Lindsey Hatch, Avi Lavi	UC Riverside
I <sup>-</sup> ToF CIMS	2	Acids (HNO <sub>3</sub> , HONO, Organics), acid gases (N <sub>2</sub> O <sub>5</sub> , ClNO <sub>2</sub> ), Oxygenated organics, Organic nitrates, Halogens	Joel Thornton, Brett Palm, Carley Fredrickson, Zach Decker	University of Washington / NOAA
Aerosol mass spectrometer, UHSAS	3	Aerosol composition + size distributions	Ann Middlebrook, Ale Franchin, Kathy Hayden, Shao-Meng Li	NOAA ESRL CSD Environment Canada
Brown carbon PiLS	4a	Spectrally resolved aerosol absorption	Rebecca Washenfelder, Jakob Lindass	NOAA ESRL CSD
Chemiluminescence	4b Floor	NO, NO <sub>2</sub> , O <sub>3</sub>	Andy Weinheimer, Denise Montzka, Geoff Tyndall, Frank Flocke	NCAR
TRAC Sampler	1 ?	Particle composition, mixing state, morphology	Alex Laskin	Purdue University
Offline WSOC analysis	4a	Particle composition	Cora Young, Lisa Azzarallo	York University

Instrument	Power (kVA)	Weight (lbs)	Deployed ? (1 = yes)	Deployed Weight (lbs)	Deployed Power (kVA)	Position	Notes
AMS	1.1	415	1	415	1.1	3	From Environment Canada, Jan 2018
Iodide ToF CIMS	1.1	380	1	380	1.1	2	UWFPS Weight
NCAR NO, NO2	1.1	369	1	369	1.1	4b	Current estimate from re-racking effort
CL O3		65	1	65	0	Floormount	Weight not included above, electrical included
BrC PiLS	0.42	192	1	192	0.42	4a	Includes rack weight for station 4
CO, CO2, CH4, H2O	0.2	52	1	52	0.2	1	Confirmed loan from Colm Sweeney, weight confirmed w/mini pu
Met Probe	0.1	7	1	7	0.1	1	
Data Acquisition	0.1	10	1	10	0.1	1	
UPS	0	33	1	33	0	1	33 lbs = 770 W / 1000 VA / 1U Li Ion UPS, 87 lbs to go to 2700 W
UCR VOC Sampler	0.2	30	1	30	0.2	1	Weight remains an estimate
TRAC Sampler	0.03	10	1	10	0.03	1 ?	From Alex Laskin, Nov 2018
POPS	0.2	10	0	0	0		Estimate
UHSAS	0.1	49	0	0	0		UWFPS Weight
UV O3		20	0	0	0		NOAA 2B Instrument
CRD-PAS	0.5	120	0	0	0		
<b>Equipment Subtotal</b>	<b>5.15</b>	<b>1762</b>	<b>11</b>	<b>1563</b>	<b>4.35</b>		
Pilots		360	1	360			2 pilots
Scientists		360	1	360			2 operators
Life raft		70	0	0			
<b>Crew Subtotal</b>		<b>790</b>		<b>720</b>			
<b>Total</b>	<b>5.15</b>	<b>2552</b>		<b>2283</b>	<b>4.35</b>		
<b>Available</b>	4 kVA 115 VAC ~3 kVA 28 VDC up to 7 kVA	<b>2200</b>		<b>2200</b>			From Lindsey Norman, September 2016, Allows 2.75 hr (actual 3 Bill Dubé suggests actual power limit closer to 5 kVA total, rather

# Current Twin Otter Mechanical Layout

Picarro

VOC Sampler

Met probe & Flight

Scientist Computer

TRAC ?

I- CIMS

AMS  
UHSAS

BrC PiLS  
NO, NO2

O3



- Ozone instrument now floor mounted at aft of cabin.
- Pumps for NO, NO2, O3 and BrC PiLS to be floor mounted under station 4

# Deployment Schedule

**July 15: Project Start Date**

**This date not impacted by  
December – January Shutdown**

**July 17 – 26: Integration at Research Aviation Facility (RAF), Broomfield CO**

**July 29 – 31: Test flights and transit to Boise**

**Will move transit earlier if  
possible – discuss later**

**August 2 – September 7: Research flights**

**September 9-11: Transit to and de-installation at RAF**

**September 12: Project End Date (Last possible date, may end sooner)**

**Probably end project  
earlier than Sept 12 –  
discuss later**

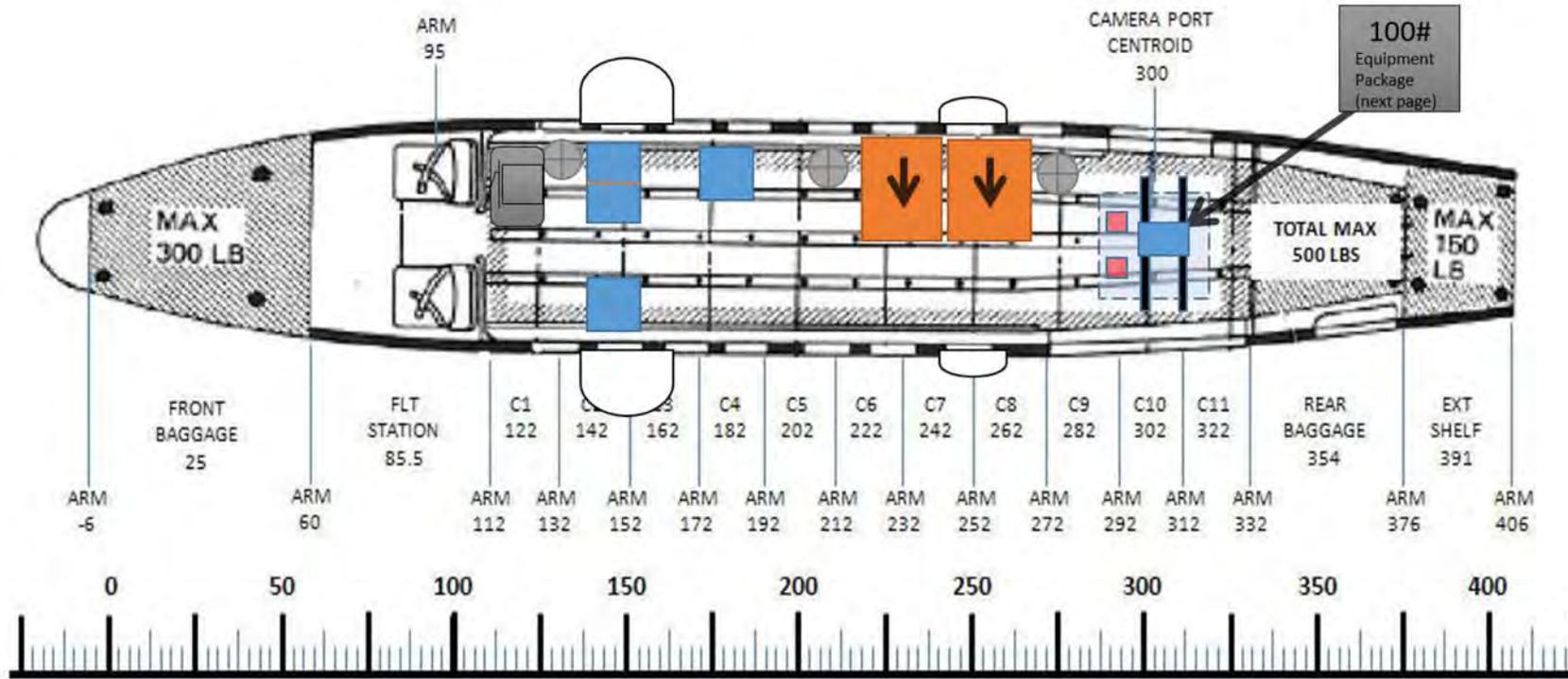
**180 flight hours on the schedule (!)**

**Probably cannot use all hours**

# Twin-Otter Configuration

FIREX-AQ

N46RF – No Aux Tank Installed



**LEGEND**



Double  
Seat



Table



Side Facing Rack

Instrument / Package	Mode / Sub element	Info	Product
Scanning Doppler Lidar	Conical Scanning	LOS wind Speed & Aerosol BS Intensity	Horizontal wind profiles
	Vertical Staring		Vertical wind & Aerosol ABI Profs
Fire Radiative Power	Scanning Radiometers	1.6µm & 4µm	Scan range ±30° from nadir
	Imager	1.6µm	
	FLIR Duo R	7.5 - 13.5µm	
TO Met Package	P, T, RH		
GPS / INS	Pos / Orientation Info	20Hz Rate	

# NOAA Twin Otter N46 FIREX-AQ SCHEDULE

July 2019						
Monday	Tuesday	Wednesday	Thursday	Friday	Saturday	Sunday
15	16	17	18	19	20	21
Transit from Calgary AB to RAF		Install Lidar In N48		Test Flight	Transit to ID	Science Flights
22	23	24	25	26	27	28
Science Flights						
29	30	31				
Science Flights						

August 2019						
Monday	Tuesday	Wednesday	Thursday	Friday	Saturday	Sunday
			1	2	3	4
				Science Flights Chem Twin Otter		
5	6	7	8	9	10	11
Science Flights Chem Twin Otter						
12	13	14	15	16	17	18
Science Flights		Transit to RAF	De-install	Chem Twin Otter		

Days on station : 24      Sunday July 21<sup>st</sup> – Tuesday Aug 13th  
 Total Flight Hours : 120

Chem Twin Otter on Station for Science Flights

Hours  
 Transit Flights: 12  
 Test Flights : 8  
 Science Flights : 100

Assume 8 hours / flight day  
 100/8 = 12 flight days  
 24 days on station  
**1 flight day every 2 days**

# Flight Planning & Logistics

- Twin Otter endurance = 3 hours, insufficient to reach fires unless they are in the immediate vicinity of Boise

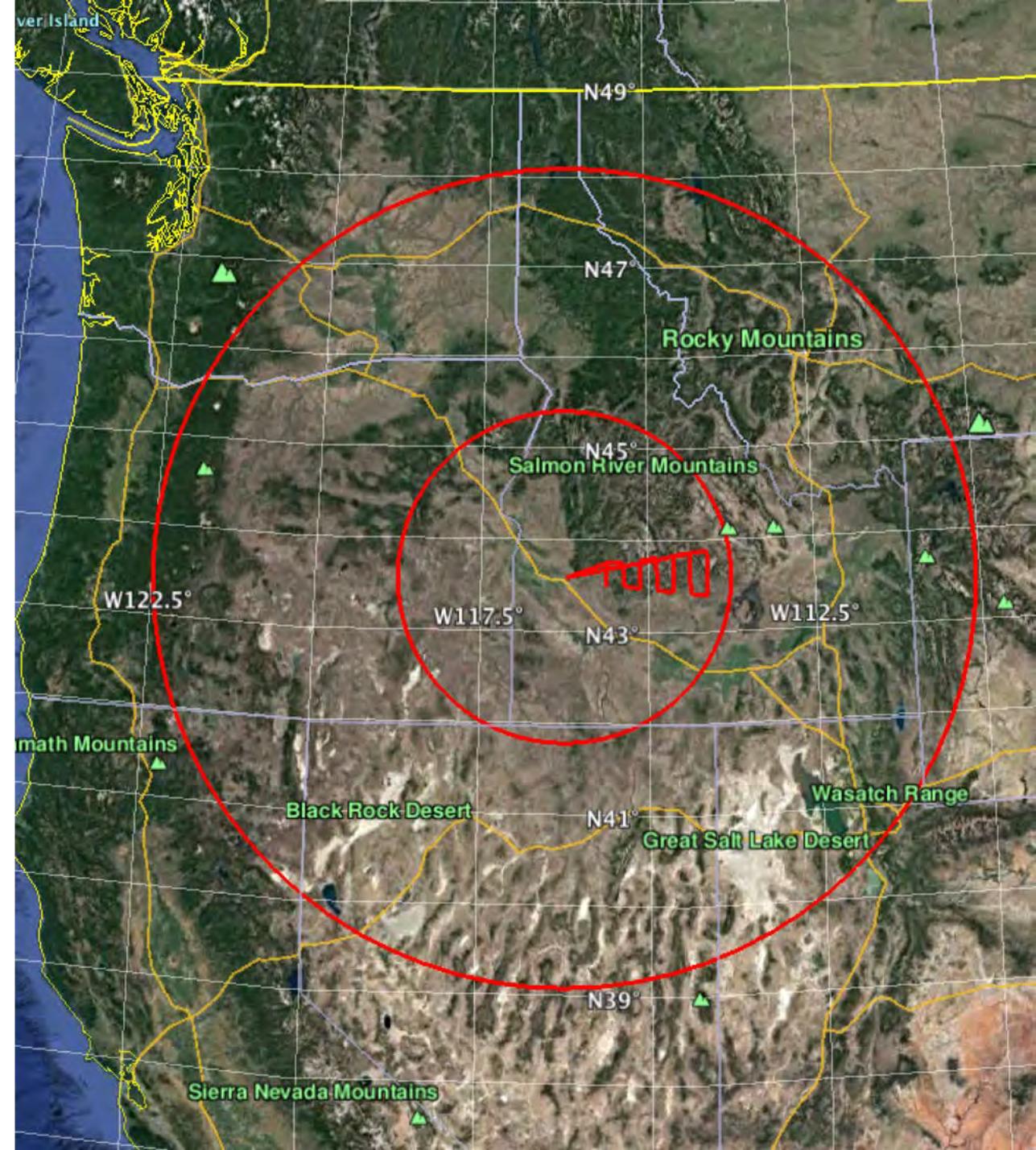
- Twin Otter can ferry >500 km (3 hours)

Salt Lake City, Missoula, Oregon, Washington should easily be within range for 500 km ferry flights

Shorter ferry flights (<200 km) requiring only 1 hour have a more limited range of accessible airfields from Boise

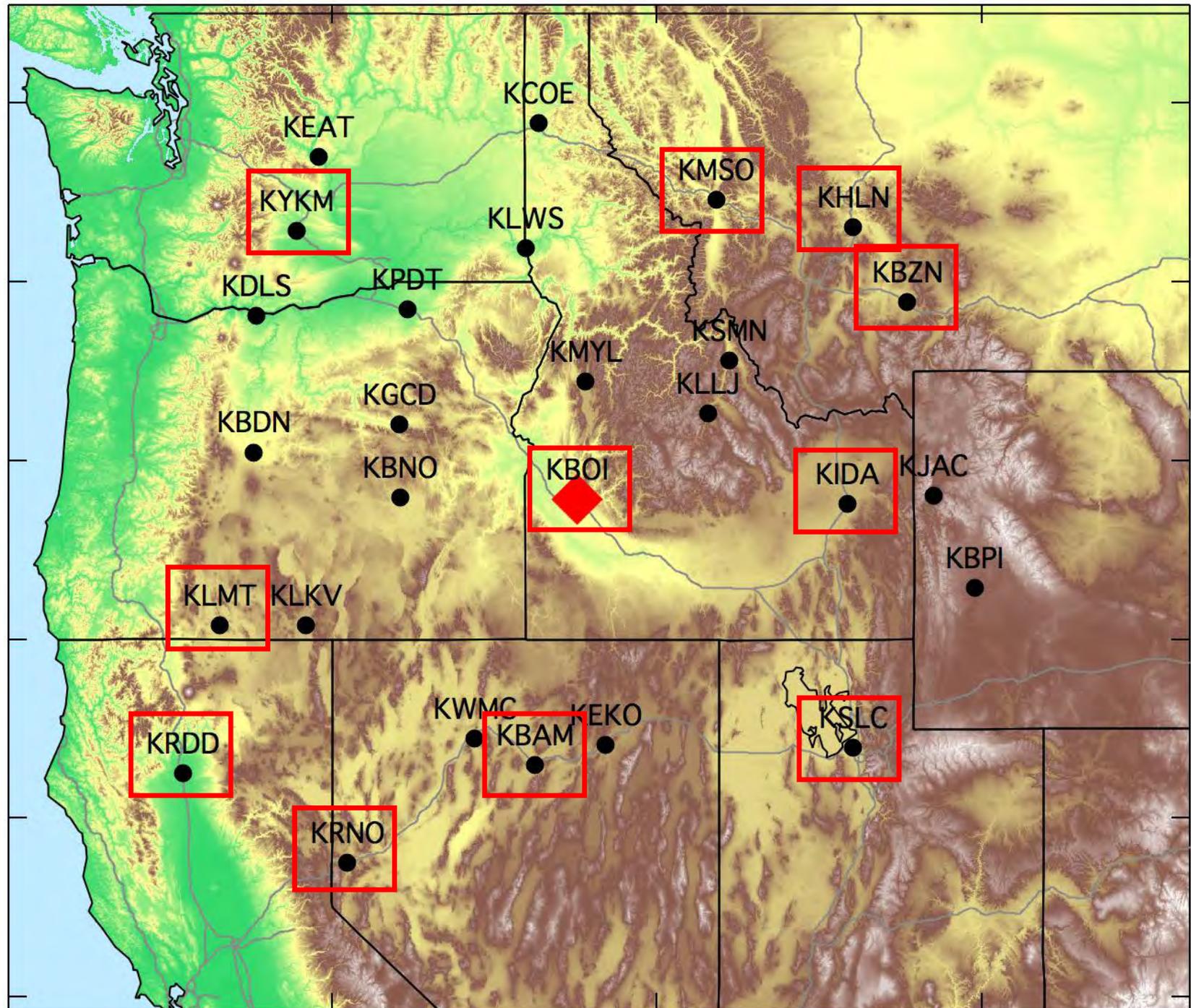
- Sampling from airfields remote to Boise possible either as multi-day or single day deployments

- Support truck with equipment may be required for multiple day deployments



# Survey of Regional Airfields in the Northwest

- Survey of 26 airfields through the region (other than Boise)
- Red boxes indicate contract fuel
- We are allowed to use the other airfields as needed, but fuel cost is ~50% higher
- Furthest airfield on this list (Redding) is within single ferry flight range



Airfield	Identifier	Contract Fuel	Block Transit Time (hours)	Lat	Lon	Drive Distance (miles)	Drive Time (hours)	Flight Distance (km)	Flight Time (hours)
Boise, ID	KBOI	Yes	0	43.5644	-116.2229	0	0	0	0.00
McCall, ID	KMYL	No	0.9	44.887	-116.1018	108	2.25	148	0.41
Salmon, ID	KSMN	No	1.3	45.1233	-113.8814	249	5	255	0.71
Challis, ID	KLLJ	No	1.1	44.5236	-114.2178	190	3.75	193	0.54
Idaho Falls, ID	KIDA	Yes	1.6	43.5137	-112.0708	280	4	335	0.93
Lewiston, ID	KLWS	No	1.6	43.3745	-117.0154	267	5	319	0.89
Coeur d'Alene, ID	KCOE	No	2.2	47.7743	-116.8195	378	7	471	1.31
Missoula, MT	KMSO	Yes	1.9	46.9163	-114.0906	363	7.5	409	1.14
Bozeman, MT	KBZN	Yes	2.1	45.7772	-111.1503	476	7.6	471	1.31
Helena, MT	KHLN	Yes	2.1	46.6067	-111.9832	487	7.5	475	1.32
Wenatchee, WA	KEAT	No	2.4	47.3988	-120.2068	418	6.75	528	1.47
Yakima, WA	KYKM	Yes	2.2	46.5682	-120.5441	363	5.5	477	1.32
Columbia Gorge, WA	KDLS	No	2.2	45.6194	-121.1683	348	5.25	454	1.26
Bend, OR	KBDN	No	2	44.094	-121.2002	319	5.25	404	1.12
Crater Lake, OR	KLMT	Yes	2.3	42.1562	-121.7332	424	7	476	1.32
Burns, OR	KBNO	No	1.2	43.591	-118.9554	188	3	220	0.61
John Day, OR	KGCD	No	1.3	44.4029	-118.9679	189	3	239	0.66
Pendleton, OR	KPDT	No	1.6	45.6947	-118.843	222	3.5	315	0.88
Lakeview, OR	KLKV	No	1.9	42.1611	-120.3991	327	5.5	375	1.04
Redding, CA	KRDD	Yes	2.8	40.509	-122.2934	527	9	606	1.68
Reno, NV	KRNO	Yes	2.5	39.4991	-119.7681	422	6.5	540	1.50
Winnemucca, NV	KWMC	No	2.6	40.8966	-117.8059	257	4.25	324	0.90
Battle Mounain, NV	KBAM	Yes	1.6	40.5991	-116.8743	316	5	334	0.93
Elko, NV	KEKO	No	1.6	40.825	-115.7913	237	4.25	307	0.85
Salt Lake City, UT	KSLC	Yes	2.2	40.7884	-111.9778	339	5	467	1.30
Jackson, WY	KJAC	No	2.1	43.607	-110.7378	369	5.75	442	1.23
Big Piney, WY	KBPI	No	2.3	42.5822	-110.1089	466	7	509	1.41

# Support for Ferry Flights ??

**This Truck Could be Yours !!**



- Refueling procedure would be much smoother with our own support crew, but would require 2 of us to drive to airfields. Approach could enable “suitcase” flights with an overnight stay for the aircraft. Could rotate support crew duty weekly.
- 16’ Truck with lift gate is available. Total truck rental cost ~\$5000, including gasoline. However, still looking into GPU and A/C carts to see if feasible to carry by truck.
- Drive times to identified airfields are mainly in the 2-6 hour range, with a few that are 7-9 (Montana, Cascades, Northern California)

• Alternative is to rely on airfield crews to supply a power cart and A/C unit on call for up to one hour at a time. If rentals of GPUs and A/C carts look prohibitive, this would be the only viable option.

**Bottom line: There are plenty of airfields within range of Boise, and logistics to support ferry flights do not appear too costly or unreasonable. Plan to base out of Boise only.**

# Ground Support Truck (Pickup?)

- Air Conditioner : CSD has a 39 kBTU/hr (10 kVA equivalent) unit that draws 4.2kVA 3 Phase / (26x44x38 in) / 400lb.
- Power Requirements : 10 kVA : 4 kVA Aircraft + 4 kVA Air conditioner
- Example of 12 kVA / 3 Phase generator \$5k / 300lb / (31x25x27 in)

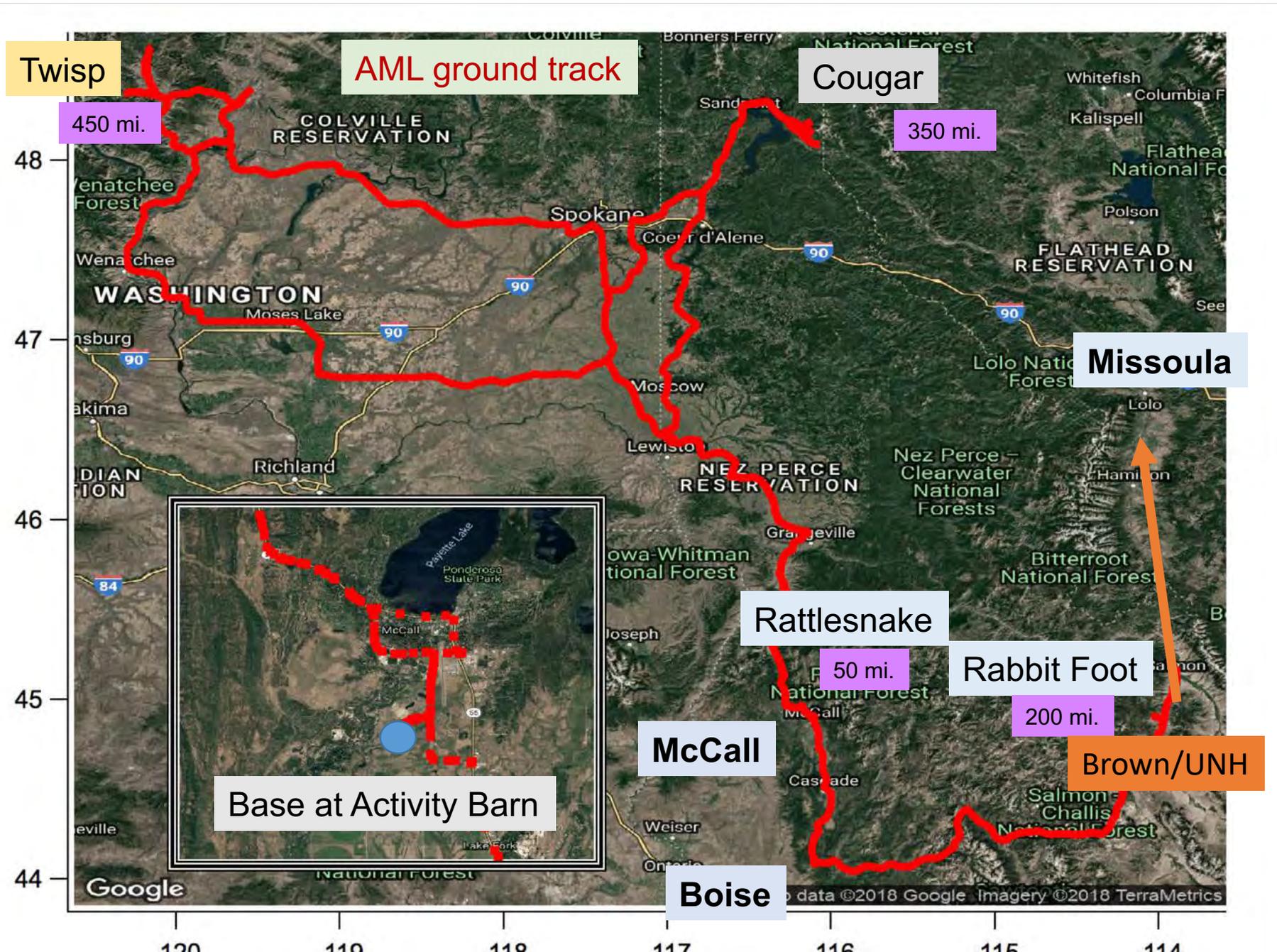


Could fit these in the back of a pickup truck

# Coordination and Support between the two Twin Otters

- MET Twin Otter estimated endurance = 5 hours                      CHEM Twin Otter endurance  $\leq$  3 hours
- MET Twin Otter can provide information about plume location, geometry, depth, winds, etc.
  - e.g., where it is, what altitude range is it in, how wide is it, which direction is it going
- MET Otter ***might*** drop a support person on the ground if CHEM otter is relying on FBO equipment
- Daily Logistics
  - MET Otter takes off 1-2 hours ahead of CHEM Otter
  - MET surveys the burn region, finishes survey and communicates information to CHEM Otter crew
    - Best Case: Line of sight radio modem communication between the aircraft
    - Worst Case: Pilot to pilot communication
  - CHEM Otter crew uses info from MET Otter to adjust flight plans in field
  - Short ferries (e.g., McCall ID): CHEM executes up to 2 science flights                      Ferry flight home does not need scientific power
  - Long ferries (e.g., Yakima WA): CHEM executes 1 science flight
  - MET otter departs prior to CHEM otter departure if 2 science flights (limited by crew time)
    - No coordination on the back end of the flights

# FIREX – August, 2018 Field Deployment





# Ground Team Dates and Locations

## Langley

Late July - Mid August, will probably be there about the same time as the DC-8. We're pretty flexible however--could come early or stay later.

Idaho/Montana; will try to stay close to the ARI mobile lab to create a more extensive data set of aerosol/smoke observations.

## Brown/UNH

mid July to end of August (could shift later depending on whether we end up with no students on the field team, as Fall classes are driving time to be finished).

tbd, but definitely more interested in Western wild fires than following the DC-8 to central US to target agricultural fires.

## Missoula

July thru September of 2019, as long as it's smoky with connection to a longer term record from 2017-2018.

UM campus for most data, possible additional data from Fire Lab near airport.

## Aerodyne

August 9th - August 29th

McCall as possible base, maybe investigate staging from Salmon too

# Other items

- The NOAA UAV will operate from the CU mobile lab
- Ground Teams are keen to have liaison with the modelers. No, or slow internet preclude full reliance some model products. HRRR and Blue Sky
- Steve was going to check on suitability of TO at McCall airport
- Steve was going to loop in Alan Brewer for the met-TO coordination