

# 2019 FIREX-AQ

## In-Situ Twin Otter Teleconference



**June 21, 2018**

1. Current instrument payload, preliminary science goals and questions for investigators
2. Proposed instrument layout
3. Flight plans – examples of what the in-situ twin otter can do
4. Initial thoughts on logistics with short range aircraft

	A	B	C	D	E	F	G
1	Instrument	Power (kVA)	Weight (lbs)	Deployed ? (1 = yes)	Deployed Weight (lbs)	Deployed Power (kVA)	Notes
2	AMS	1.1	415	1	415	1.1	From Environment Canada, Jan 25
3	Iodide ToF CIMS	1.1	380	1	380	1.1	UWFPS Weight
4	NCAR NO, NO2	1.5	378	1	378	1.5	From Andy Weinheimer, Jan 10
5	CL O3		58	1	58	0	From Andy Weinheimer, Jan 10
6	BrC PiLS	0.42	130	1	130	0.42	
7	CO, CO2, CH4, H2O	0.2	70	1	70	0.2	Picarro, "95% chance" that this can be loaned from Colm Sweeney
8	Met Probe	0.1	7	1	7	0.1	
9	Data Acquisition	0.1	10	1	10	0.1	
10	UPS	0	33	1	33	0	33 lbs = 770 W / 1000 VA / 1U Li Ion UPS, 87 lbs to go to 2700 W / 3000 VA / 2U
11	UCR VOC Sampler	0.2	50	0	0	0	Actual weight may be lower
12	POPS	0.2	10	0	0	0	Estimate
13	UHSAS	0.1	49	0	0	0	UWFPS Weight
14	UV O3		20	0	0	0	NOAA 2B Instrument
15	CRD-PAS	0.5	120	0	0	0	
16	<b>Equipment Subtotal</b>	<b>5.52</b>	<b>1730</b>	<b>9</b>	<b>1481</b>	<b>4.52</b>	
17							
18	Pilots		360	1	360		2 pilots
19	Scientists		360	1	360		2 operators
20	Life raft		70	0	0		
21	<b>Crew Subtotal</b>		<b>790</b>		<b>720</b>		
22							
23	<b>Total</b>	<b>5.52</b>	<b>2520</b>		<b>2201</b>	<b>4.52</b>	
24							
25	<b>Available</b>	4 kVA 115 VAC	<b>2200</b>		<b>2200</b>		From Lindsey Norman, September 2016, Allows 2.75 hr (actual 3 hr) flight duration
26		~3 kVA 28 VDC					Bill Dubé suggests actual power limit closer to 5 kVA total, rather than 7
27		up to 7 kVA					
28							



Totals

BrC PiLS

AMS

I-CIMS

NCAR NOx

# In Situ Twin Otter Scientific Goals – Preliminary List

## 1. Emissions

- Much less chemically detailed payload than a heavy aircraft, but will sample effectively in near field
- $\text{NO}_x$ , BrC and primary aerosol relative to CO,  $\text{CO}_2$
- I- CIMS will measure some primary compounds (e.g., nitrophenols?)
- UCR VOC sampler, if it is suitable, will provide a wide suite of primary VOC

## 2. Photochemistry

- Suite of secondary / oxygenated compounds from I- CIMS. What can this provide / what is calibrated ?
- SOA vs CO during downwind transects
- BrC production / bleaching
- $\text{O}_3$  photochemistry and production in downwind plumes

## 3. Nighttime chemistry

- Characterize  $\text{NO}_3$  production rates from  $\text{NO}_2 + \text{O}_3$  in fire plumes
- Secondary nighttime products (nitrated phenols, furans,  $\text{HNO}_3$ , etc. from I- CIMS) ??
- Nighttime secondary organic aerosol from AMS
- $\text{NO}_3 + \text{phenol}$  as source of BrC aerosol

## 4. Aerosol optics (covered above but repeated here)

- Primary emissions of BrC
- Photochemistry / nighttime chemistry to define time evolution

# Questions for Investigators / Instruments

(An incomplete list of known unknowns)

All investigators:

Updated estimates for weight, power, gas consumption, hazardous materials

Please check numbers in spreadsheets, including individual instrument tabs and provide updates

AMS

What is the actual payload weight / rack configuration, etc. (impacts the rest of the payload)

I- CIMS

Can the inlet extend out the left side of the rack (opposite to configuration from UWFPS) ?

What species are on the list of reported and calibrated species for FIREX AQ ?

NO, NO<sub>2</sub>, O<sub>3</sub>

Confirm weights and powers & identify any potential weight reductions

BrC PiLS

Will scientific goals be achievable with payload as currently set up?

Picarro

Borrow this instrument (Colm Sweeney) or acquire one? (Mission critical, so need certainty)

Met Probe

Unreliable winds during UWFPS – will need GPS antenna to back this system up

UPS

Will common 1000 VA / 32 lb UPS be sufficient to support instruments through power transitions (2 sec)?

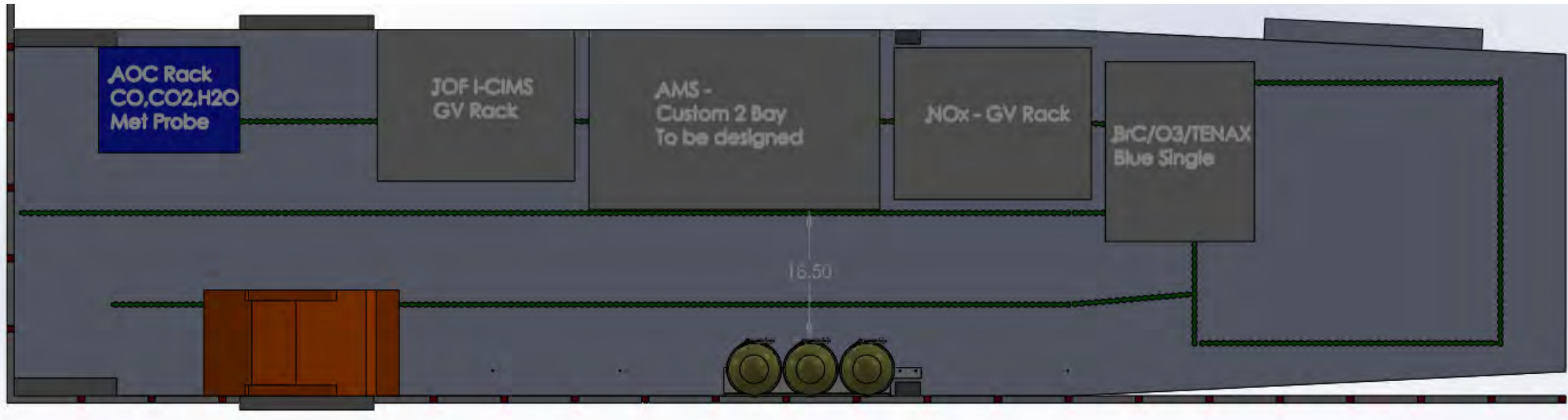
UCR VOC sampler

Work to assess viability in the coming months. Potentially very lightweight using existing NCAR designs ???

UHSAS / POPS

Instrument availability, and can this be accommodated in payload ? (Important to AMS & BrC PiLS)

# Layout 1



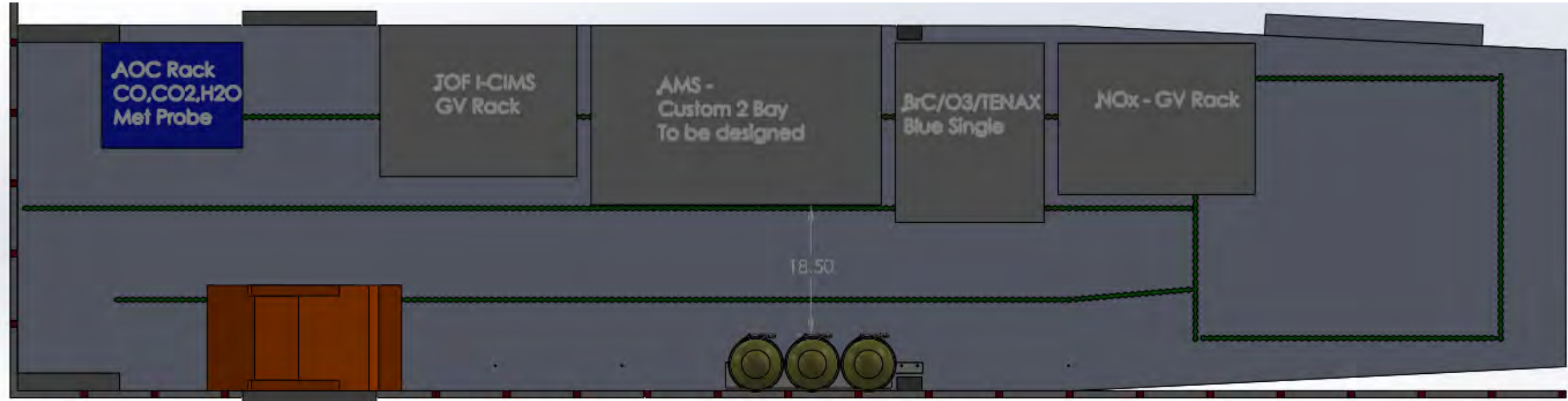
## Assumptions:

Envr. CA AMS is not flying, re-racked A. Middlebrook's AMS is

## Open Questions about this layout:

Sideways orientation derated loaded for both single bay and double bay blue racks?

# Layout 2



## Assumptions:

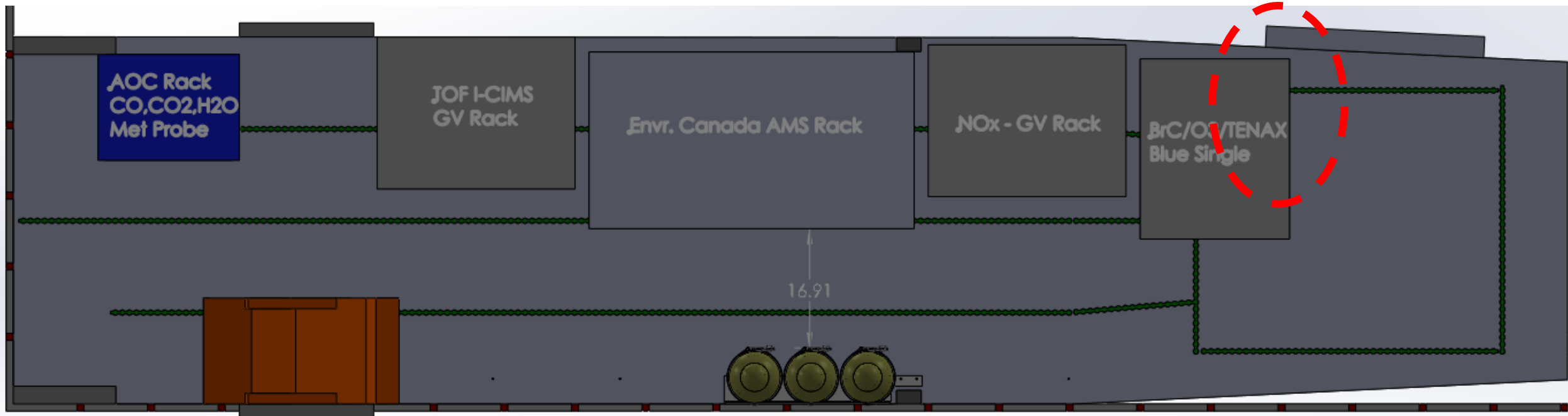
Envr. CA AMS is not flying, re-racked A. Middlebrook's AMS is

Open Questions about this layout:

Sideways orientation derated loaded for both single bay and double bay blue racks?

Mounting issues with aft GV rack location – Bill Dube to speak to this

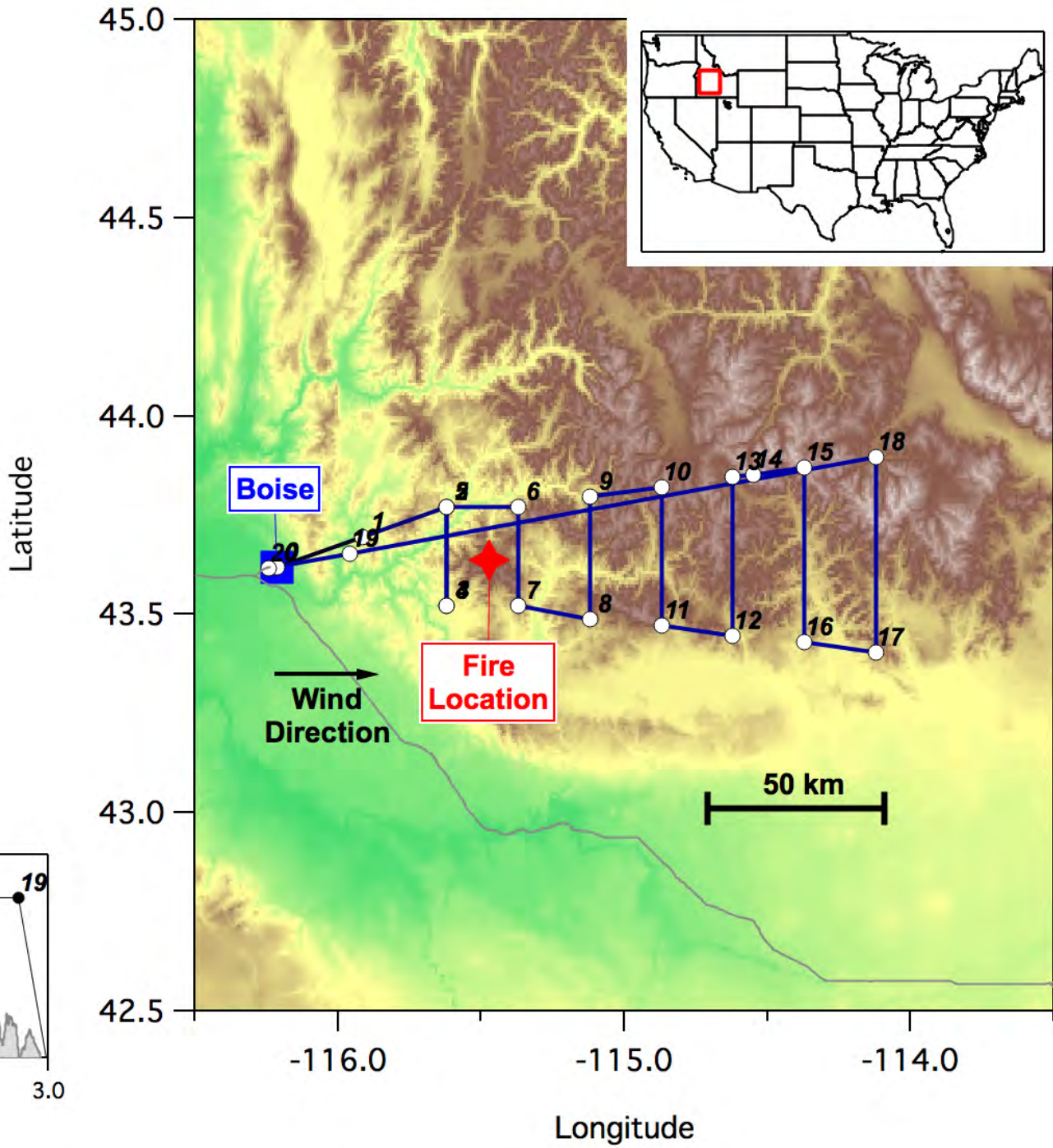
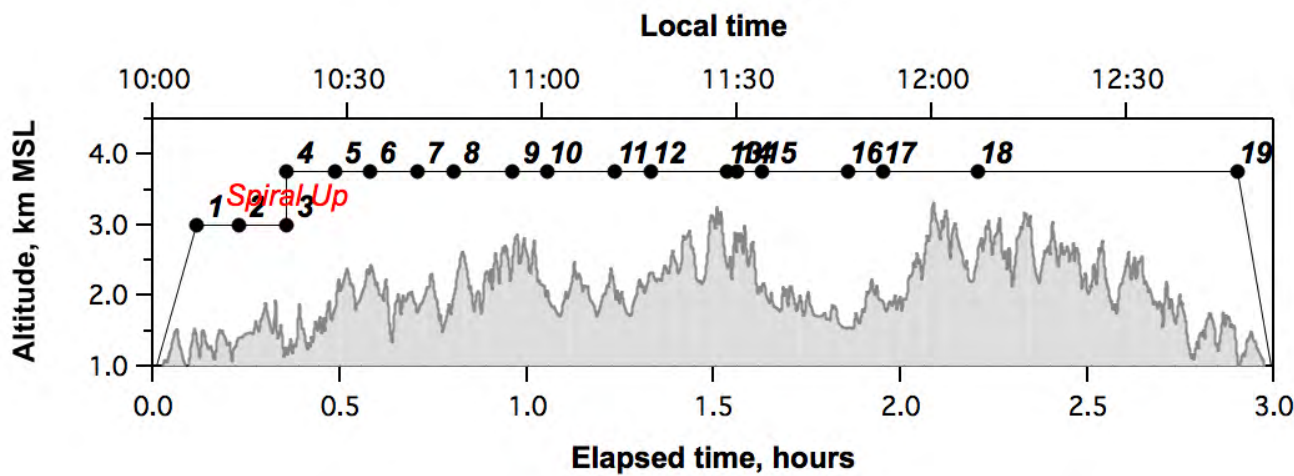
# Layout 3 – One reason to re-rack the AMS



This layout cannot fly due to aft egress 'violation', requiring BrC/Tenax to be pushed overboard...

# Example Flight Plan 1 – Shorter Range / Detailed Sampling

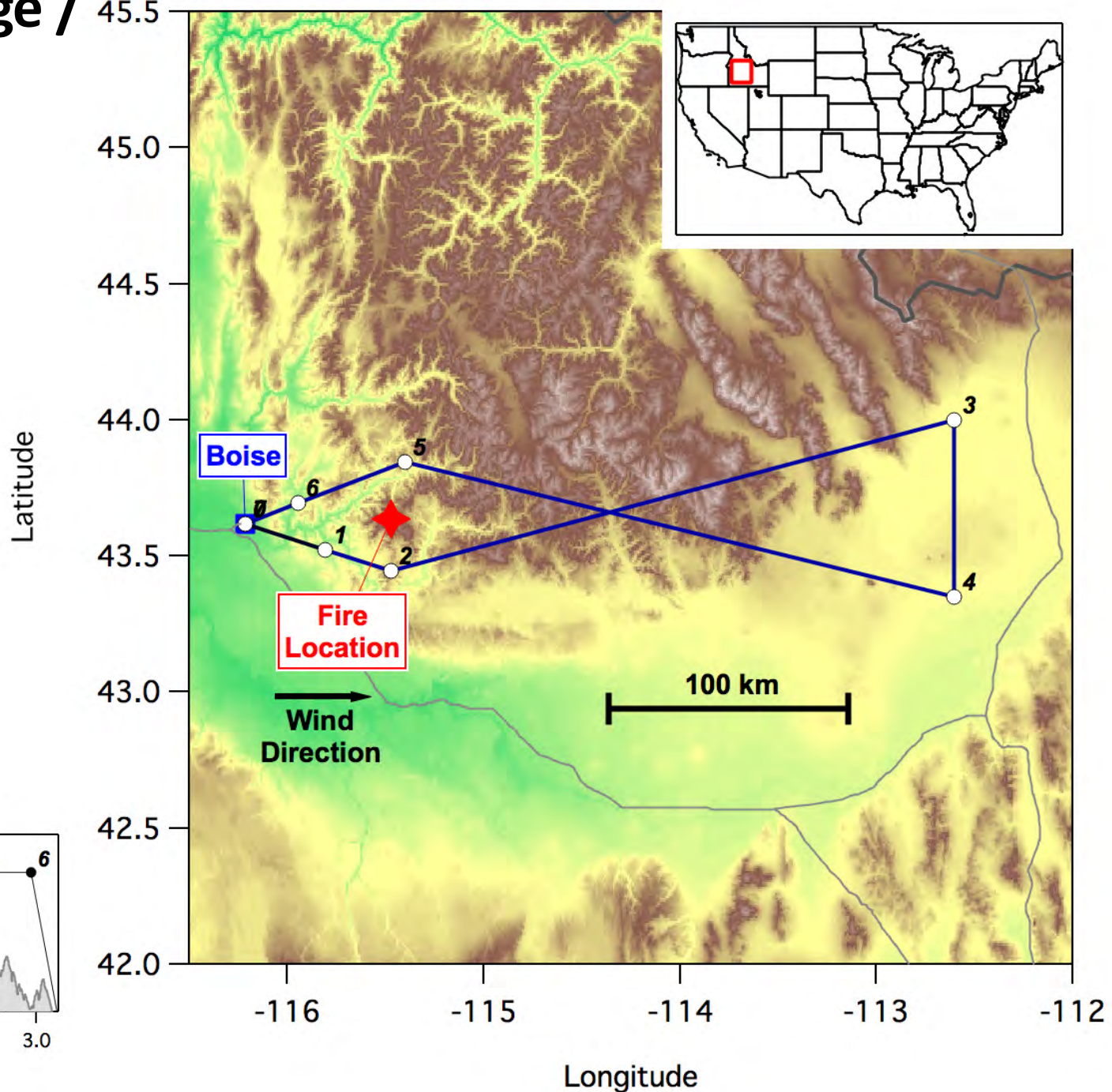
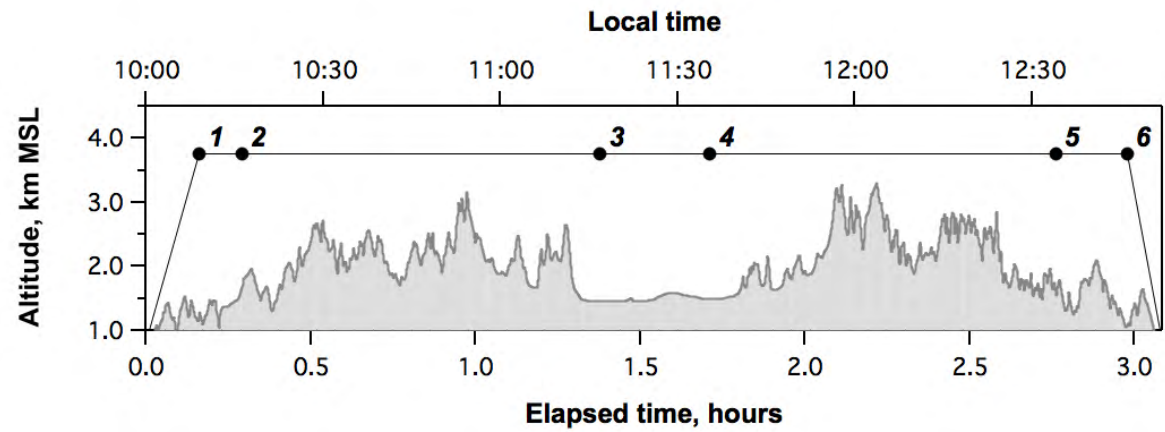
- 3 hour flight duration at 60 m s<sup>-1</sup> / 115 knots
- Perpendicular plume transects spaced by ~20 km, leg lengths ~ 25 – 50 km, progressively wider downwind
- 1 upwind / 5 downwind transects for total sampling distance of 100 – 120 km
- For wind speeds = 5 – 20 m s<sup>-1</sup>
  - ~ 1 hour / 15 min time evolution per transect
  - ~ 1 – 6 hours of total plume evolution





# Example Flight Plan 2 – Longer Range / More Time Evolution

- 3 hour flight duration at 60 m s<sup>-1</sup> / 115 knots
- Diagonal transects of fire plume to sample over ~250 km
- For wind speeds = 5 – 20 m s<sup>-1</sup>
  - ~ 14 hour / 3.5 hour total time evolution
  - ~ Observe changes along transects rather than with crosswind transects



# How to Sample Fires that are *not* next to Boise, Idaho ?

- Twin otter can easily ferry >500 km with or without operators
  - Salt Lake City, Missoula, Oregon, Washington should easily be within range for 500 km ferry flights, and longer ferries should be possible if they can be supported
- Sampling from airfields remote to Boise possible either as multi-day or single day deployments
- Support truck with equipment required for single / multiple day deployments would probably extend the range by at least 200 km, maybe further, even if the base is Boise
- Useful to think now about equipment list for such flexible excursions from Boise
- Actual plan will depend on the particular fire season

