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NRC Convair 580 Operations during WINTRE-MIX

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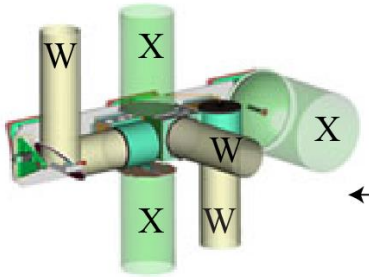
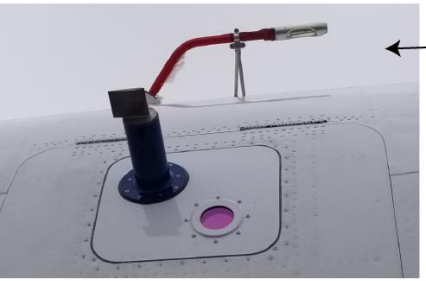
WINTRE-MIX Workshop – 13-Dec-2021

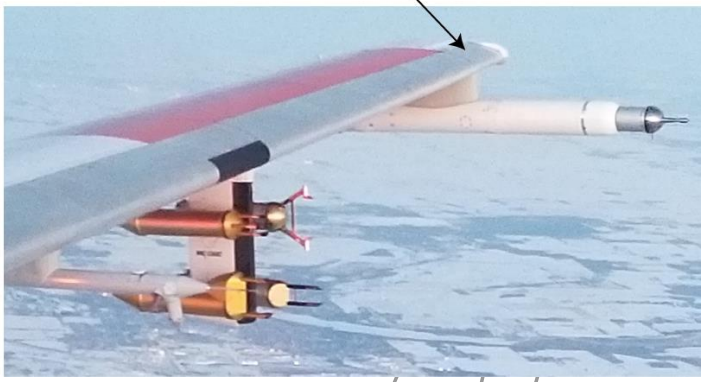
Outline

- **Instrumentation**
  - Capabilities
  - Status & Plan
- **Real-time data communication**
- **Flight Planning/timeline**

NRC Convair-580 Research Aircraft







Extensive in-situ and remote sensing capabilities for measurements of atmospheric state, compositions (aerosol, cloud and precipitation – type, size, phase and bulk properties).

- Crew: 2 pilots + 10 project personnel
- Endurance: 4 – 5 hours
- Range: ~1000 km
- Vertical ceiling: 23,000 ft (7000 m)
- Research payload: 2000 kg
- Min speed 150 knots
- Jointly instrumented by NRC Canada and Environment and Climate Change Canada

NRC Conviar-580 during WINTRE-MIX- Sensors and tools

Parameters	Sensors
Aircraft state	Inertial Navigation Systems (4), and GPS (2)
Atmospheric state	Rosemount Temperature Sensors (4), Licors (2) – Dew point, Chilled Mirror, Multiple pressure transducers including 3 5-hole probes
Aerosol (size and concentrations)	UHSAS, SP2, CCN Counter, CPC
Bulk microphysical measurements (IWC, LWC)	**Nevzorov**, SAE Icing Detector
Icing	Goodrich Icing Detector (2)
Cloud Particles (Size and concentrations)	FCDP, **CDP**

Parameters	Sensors
Cloud Imaging Probes	**2D-S** CIP, 2D-C, Particle-I, CPI
Precipitation Imaging Probes	**PIP**, HVPS-3
Radars	NRC Airborne W and X (NA**W**X) radar, Pilot X-band Radar
Lidar	355 nm - Zenith
Communication	PLANET – Ground – Aircraft data exchange and flight coordination
	In-flight – QP Monitor Satellite phone option

Extensive in-situ and remote sensing systems

Communication: Intercom system for crew and ground-aircraft data exchange tool (PLANET)

Backup ground-aircraft communication – Satellite phone

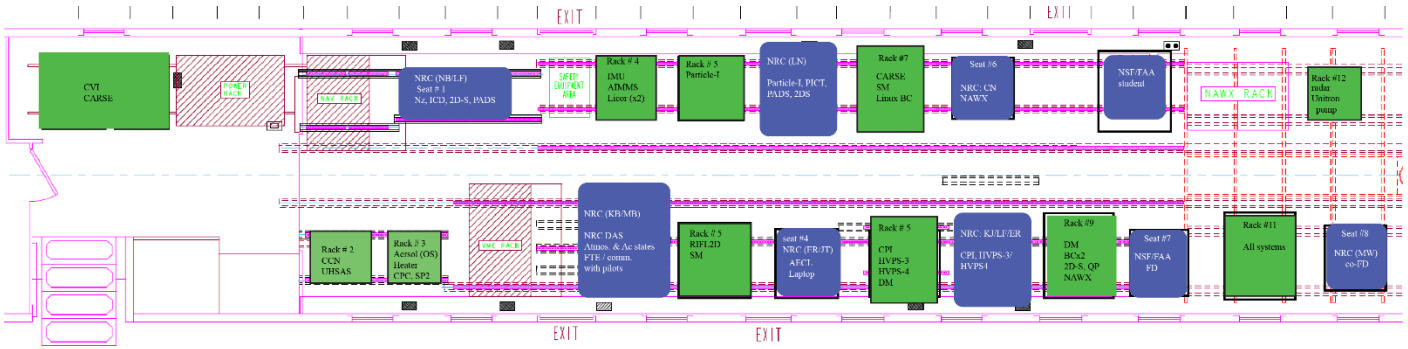
Instrumentation status and plan

	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
Novembor																		Aircraft refrun from				Aersol: cels, cabin, Qpmonitor, CVI; pylons installation, aircraft tail inspection; some rack work started (CPI and Aerosol)										
December	FCDP, CDP, Particle-I, CPI, 858 tested					R102 TAT PUW, L7k, L840a Chilled Mirror installed				Engine run; rack installatio ns	Convair wing 3D scan		Paper work - close mode cards	AMTC PICTU R ; Pilot Prof.	Shaked own flt. 1	PICTU R-AW flight	Backup flt				Shakedown/calibratio n flt		December shutdown									
January				NAWX Calibration; wind box cal; repeat probe test						Aerosol install week							Aerosol +CVI final integ. &		CVI AW	CVI shakdo wn flight				FAA Demo Start								
February	WINTRE-MIX START/Op ening house										FAA Demo Ends																				
March															WINTRE-MIX Ends																

All core sensors are installed and shakedown flight planned for this week (Wed/Thursday)

Jan: Aerosol sensors and CVI – Up to four flights (AW, calibration and shakedown flights)

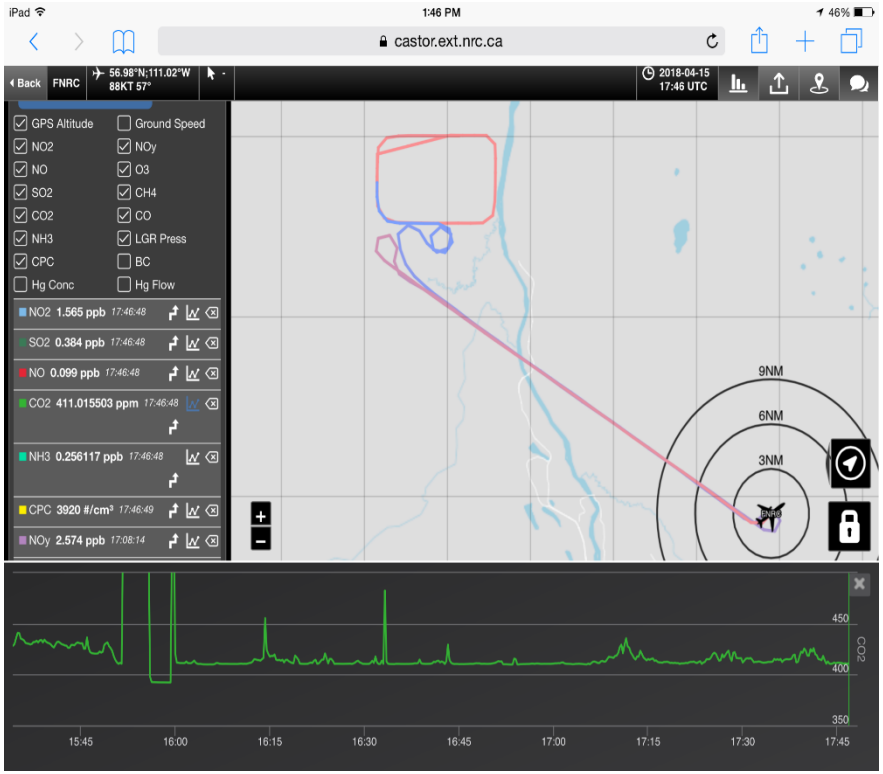
WINTRE-MIX – Floorplan and Crew

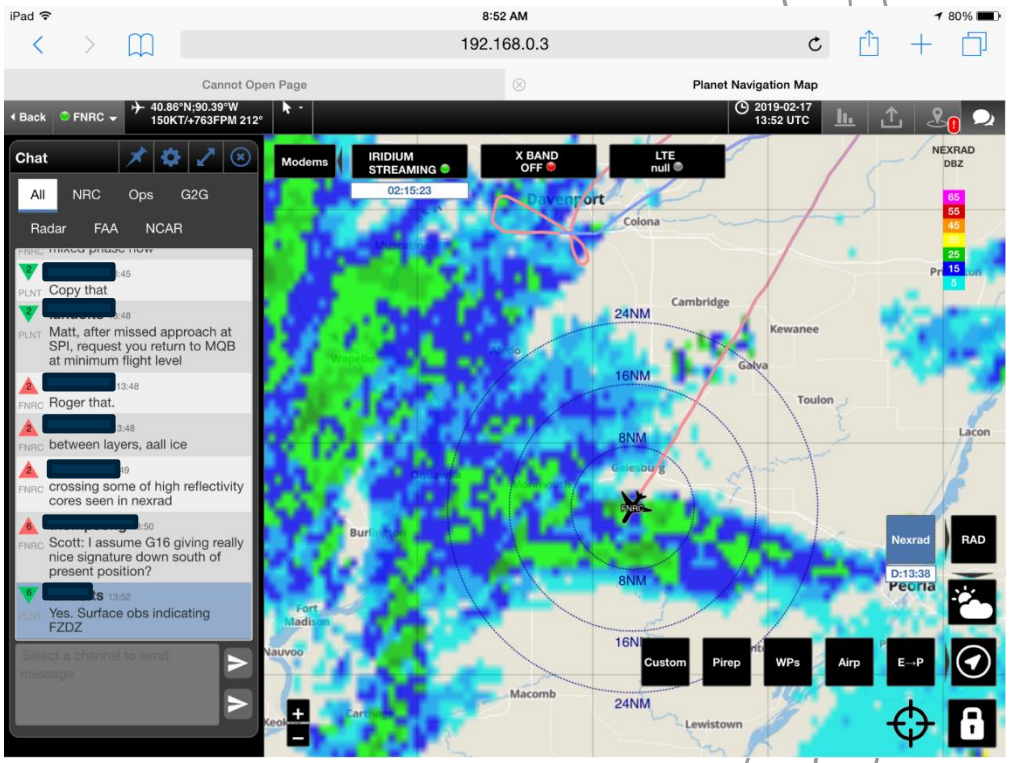


Flight crew:

- **2 pilots**
- **9 seats + 1 jump seat**
- **Single or double monitors in all stations except the student seat**
  - 2 NSF: FD + Student
  - 7 NRC staff – researchers and engineers
  - NSF FD - 2DS, PIP/HVPS, NAWX, time series plots of atmospheric and aircraft states, bulk and other measurements – using QM, PLANET – chat and data

PLANET | ATMOSPHERE (https://www.atmosphere.aero): Main ground-aircraft communication system





Can be configured to receive data from sensors

Measurement readings and time series of selected parameter

NRC will create accounts for all users – PIs please submit names that need access of real time tracking and data

URL: https://planet.atmosphere.aero

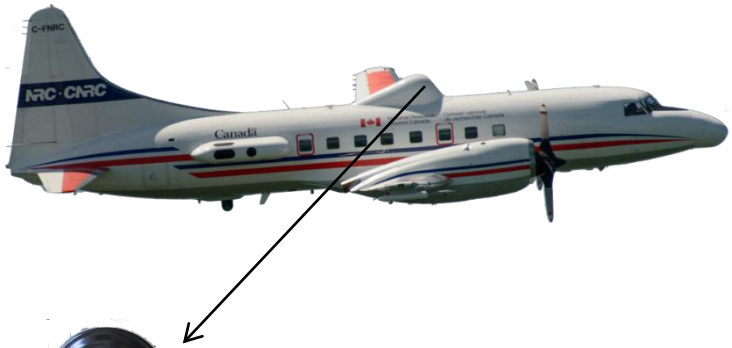
Chat b/n Grounds Ops Center (green) and flight crew and real time radar data and flight track seen both on aircraft and ground ops center

Status: Being configured with new ground server

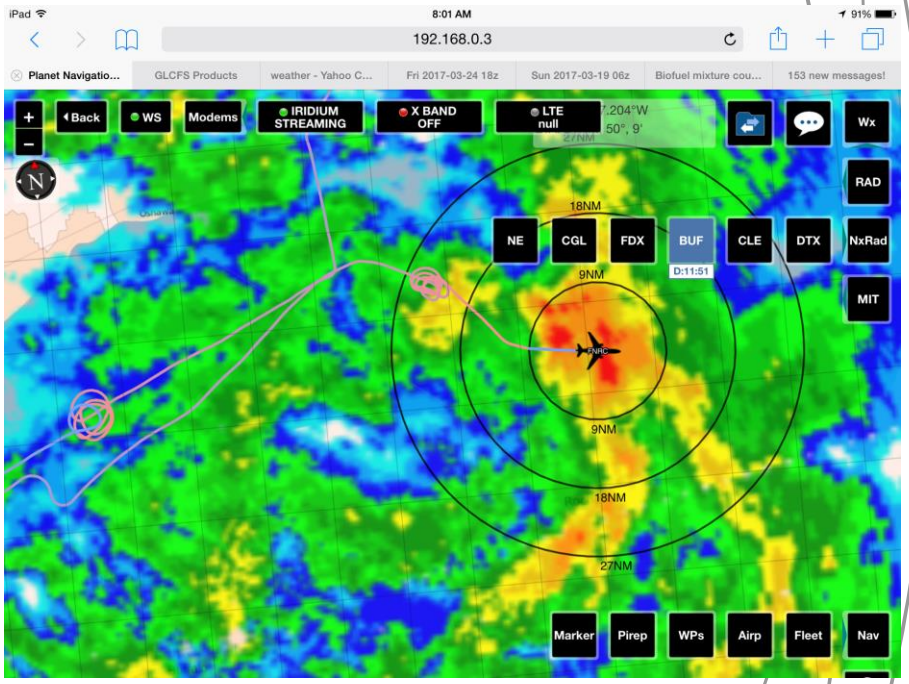
PLANET Real-time broadcast

- **Core sensor 1Hz data**
- Aircraft states
  - Latitude, Longitude, Height…
- Atmospheric state
  - T, Td, Ps, winds…
- Basic cloud microphysics
  - CDP
  - Nevzorov
  - Rosemount Icing Detector

Convair High-band width Satcom system



- X-band high-band width Satcom system

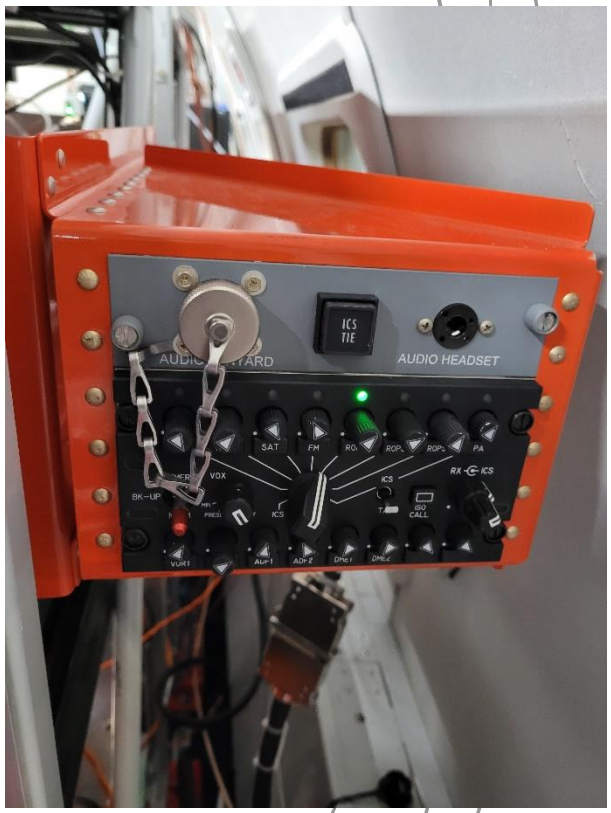


Status: Application submitted for high band width datalink

In-flight communication

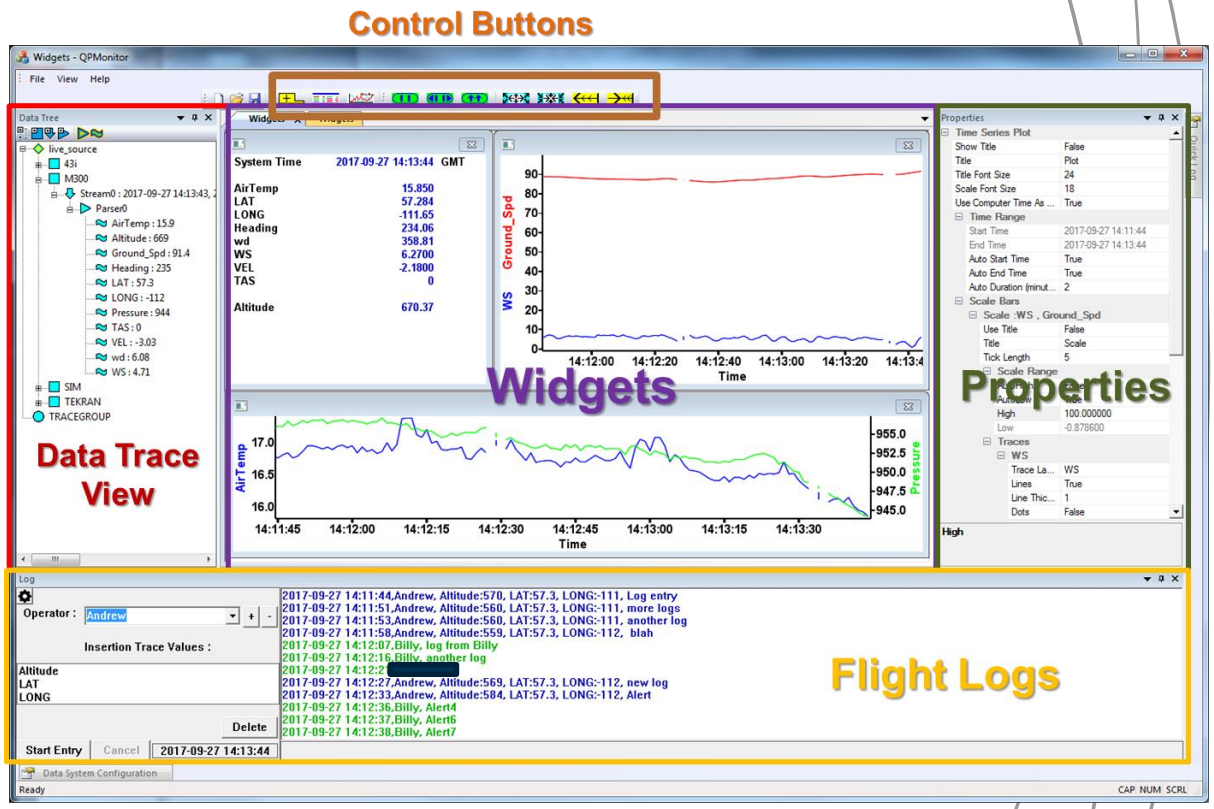
Convair has programmable multi-channel audio system

- **NRC FTE/Navigator servers as a primary contact with pilots relaying decisions / observations from FD and co-FD or any other crew**
- **NSF PI: Flight Director**
  - In-flight decisions - flight maneuvers, instrument configurations / modes
  - Relay decisions / requests to NRC FTE allowing enough time to get clearance from ATC
  - Communication and coordination with ground team using PLANET chat
- **NRC co-FD:**
  - Consult / work closely with NSF FD
  - Substitute NSF PI when/if there is a need for portion of the flight
  - Decision/coordination for non-science/sampling flight segments



QP Monitor / Logger – Aircraft data display

- Flight log from crew
- Display of basic time series and histograms
- Developed by ECCC Air Quality group



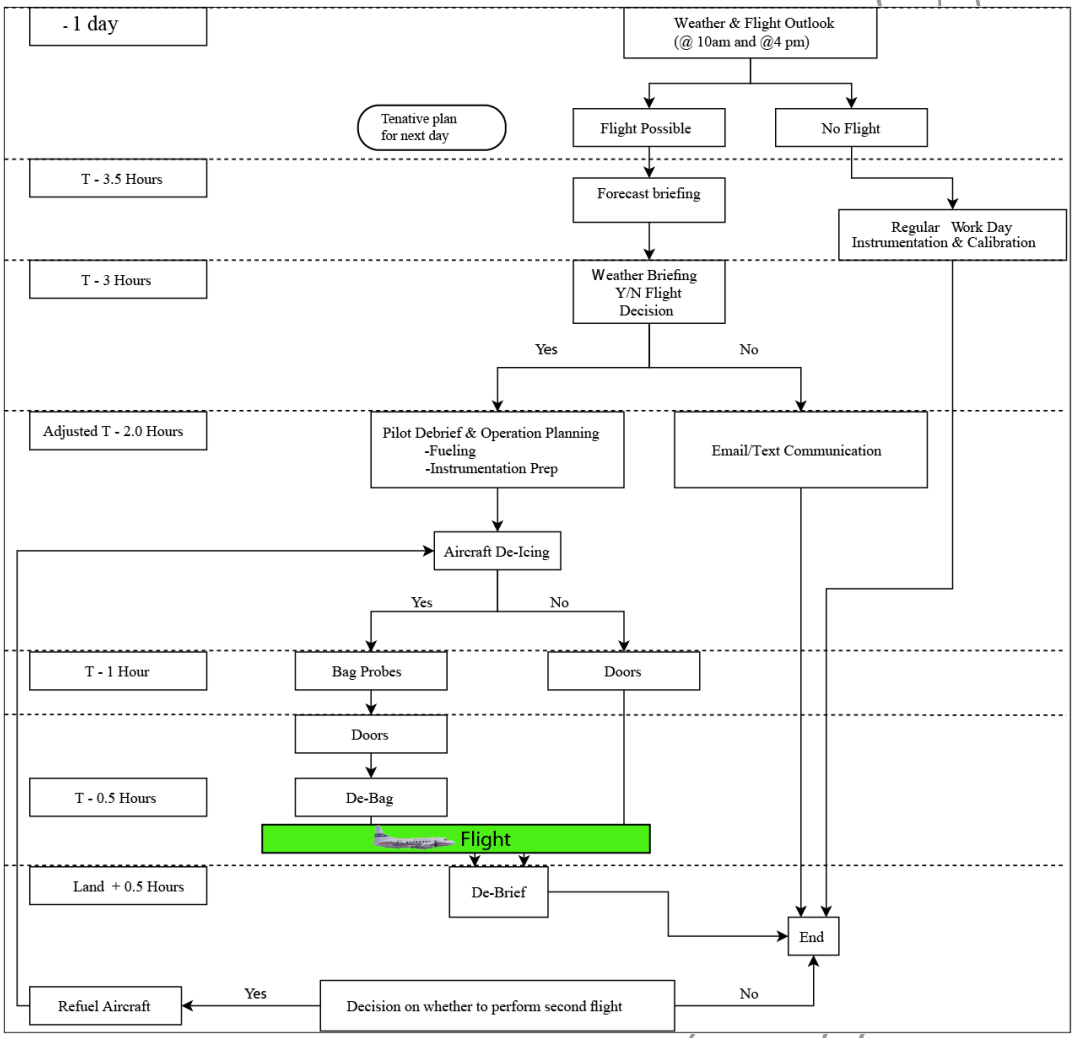
QP Monitor

Flight Operations / Decisions

Flights:

M-F:

- 9 am – 4 pm: 3 hours
- Night and early morning flights: > 5 hours
- **Saturday and Sunday**
- 12+ hours
- **NRC Crew and ground support:**
- 2 pilots (3 staff)
- 1 AME (2)
- 7 (10) Research & Instrumentation
  - Core/minimum crew: 4



Pilot Duty Hours considerations

- **Duty hours max – 13 hours**
- **Minimum of 10 hours before next flight**
- **Maximum of three flight days in a row. After 3 consecutive flight duty, pilots are required to be off duty for at least 36 hours.**
- **NRC has three Convair qualified pilots**
- Each of them support other aircraft operations
- At all times, the lab will allocate two pilots on duty to support wintre-mix. Other assignment will factor duty-hour implications
- Other factors: Family and other personal commitments:
  - One of the pilot will be off work for a week in March

THANK YOU