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
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

<table>
<thead>
<tr>
<th>Parameters</th>
<th>Sensors</th>
</tr>
</thead>
<tbody>
<tr>
<td>Aircraft state</td>
<td>Inertial Navigation Systems (4), and GPS (2)</td>
</tr>
<tr>
<td>Atmospheric state</td>
<td>Rosemount Temperature Sensors (4), Licors (2) – Dew point, Chilled Mirror, Multiple pressure transducers including 3 5-hole probes</td>
</tr>
<tr>
<td>Aerosol (size and concentrations)</td>
<td>UHSAS, SP2, CCN Counter, CPC</td>
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<tr>
<td>Bulk microphysical measurements (IWC, LWC)</td>
<td>Nevzorov, SAE Icing Detector</td>
</tr>
<tr>
<td>Icing</td>
<td>Goodrich Icing Detector (2)</td>
</tr>
<tr>
<td>Cloud Particles (Size and concentrations)</td>
<td>FCDP, CDP</td>
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<tr>
<td>Cloud Imaging Probes</td>
<td>2D-S CIP, 2D-C, Particle-I, CPI</td>
</tr>
<tr>
<td>Precipitation Imaging Probes</td>
<td>PIP, HVPS-3</td>
</tr>
<tr>
<td>Radars</td>
<td>NRC Airborne W and X (NAWX) radar, Pilot X-band Radar</td>
</tr>
<tr>
<td>Lidar</td>
<td>355 nm - Zenith</td>
</tr>
<tr>
<td>Communication</td>
<td>PLANET – Ground – Aircraft data exchange and flight coordination</td>
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<tr>
<td>Communication</td>
<td>In-flight – QP Monitor Satellite phone option</td>
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## 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

<table>
<thead>
<tr>
<th>Month</th>
<th>Instrumentation Details</th>
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<tbody>
<tr>
<td>November</td>
<td>All core sensors are installed and shakedown flight planned for this week (Wed/Thursday)</td>
</tr>
<tr>
<td>December</td>
<td>Jan: Aerosol sensors and CVI – Up to four flights (AW, calibration and shakedown flights)</td>
</tr>
<tr>
<td>January</td>
<td></td>
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<tr>
<td>February</td>
<td></td>
</tr>
<tr>
<td>March</td>
<td></td>
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<table>
<thead>
<tr>
<th>Instrumentation</th>
<th>January</th>
<th>February</th>
<th>March</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sensor Installation</td>
<td>NA</td>
<td>N/A</td>
<td>N/A</td>
</tr>
<tr>
<td>Engine</td>
<td>N/A</td>
<td>N/A</td>
<td>N/A</td>
</tr>
<tr>
<td>Aircraft Flight Hours</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Aircraft Calibration</td>
<td>N/A</td>
<td>N/A</td>
<td>N/A</td>
</tr>
</tbody>
</table>

**Note:** The table provides a summary of the instrumentation status and plan for the specified months. Additional details and specific tasks related to sensor installation, engine work, and aircraft flights are indicated in the table.
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
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