

# Instrumentation

## HAIC-HIWC field campaign in Cayenne

Alexei Korolev<sup>1</sup> and Mengistu Wolde<sup>2</sup>

<sup>1</sup>*Environment Canada*

<sup>2</sup>*National Research Council*

HAIC-HIWC Science Team Meeting,  
Manhattan, 10-March-2015



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# NRC Convair-580





NRC Convair-580





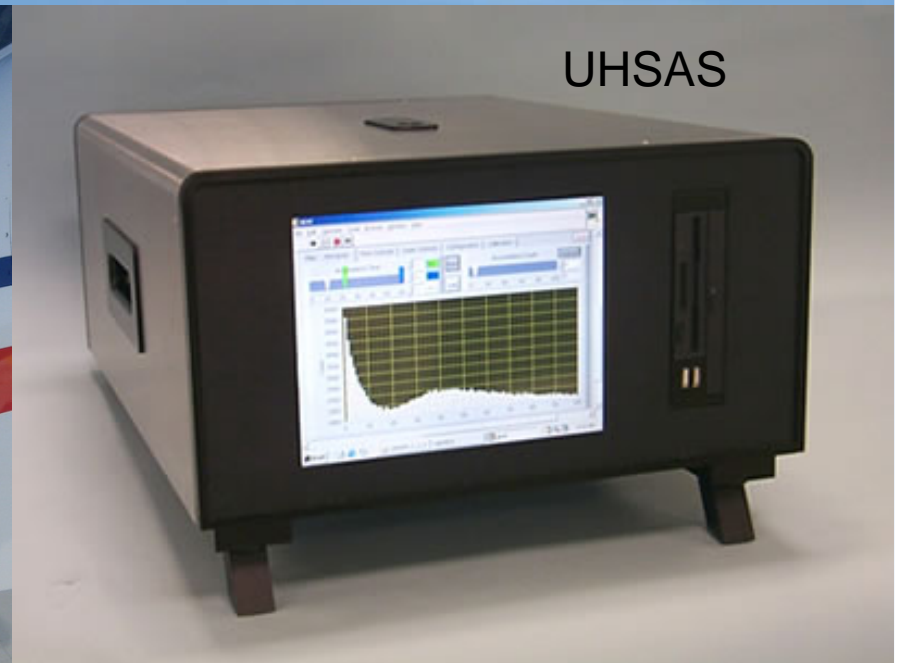
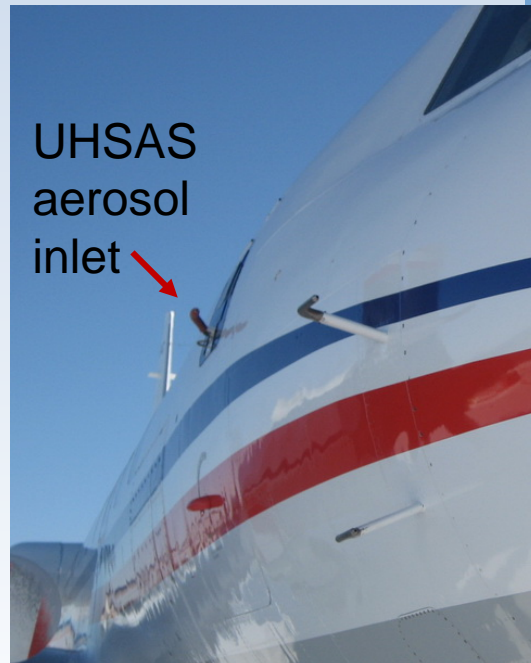
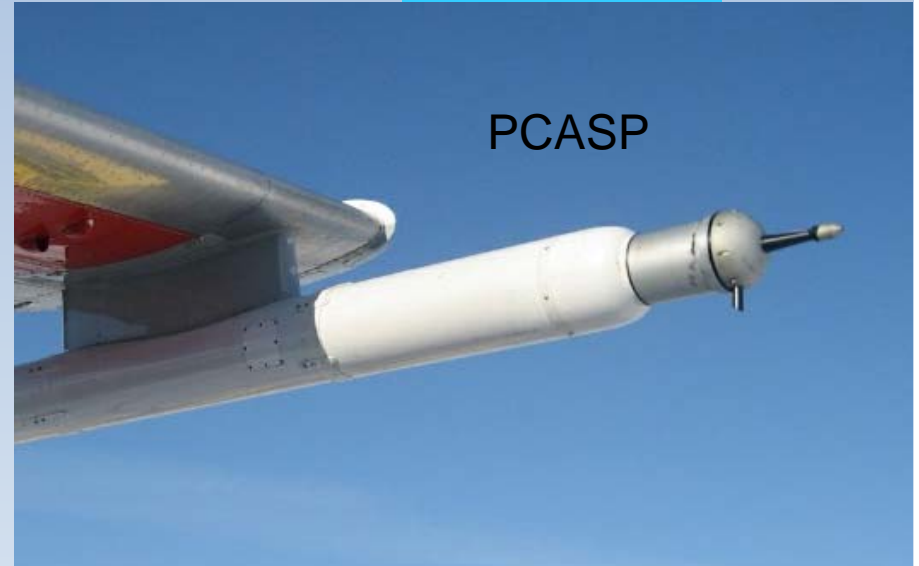
NRC Convair-580



# Convair-580 EC/NRC instrumentation for Cayenne

## Aerosol probes

- UHSAS      65 nm - 1  $\mu\text{m}$
- PCASP      0.1 - 3  $\mu\text{m}$

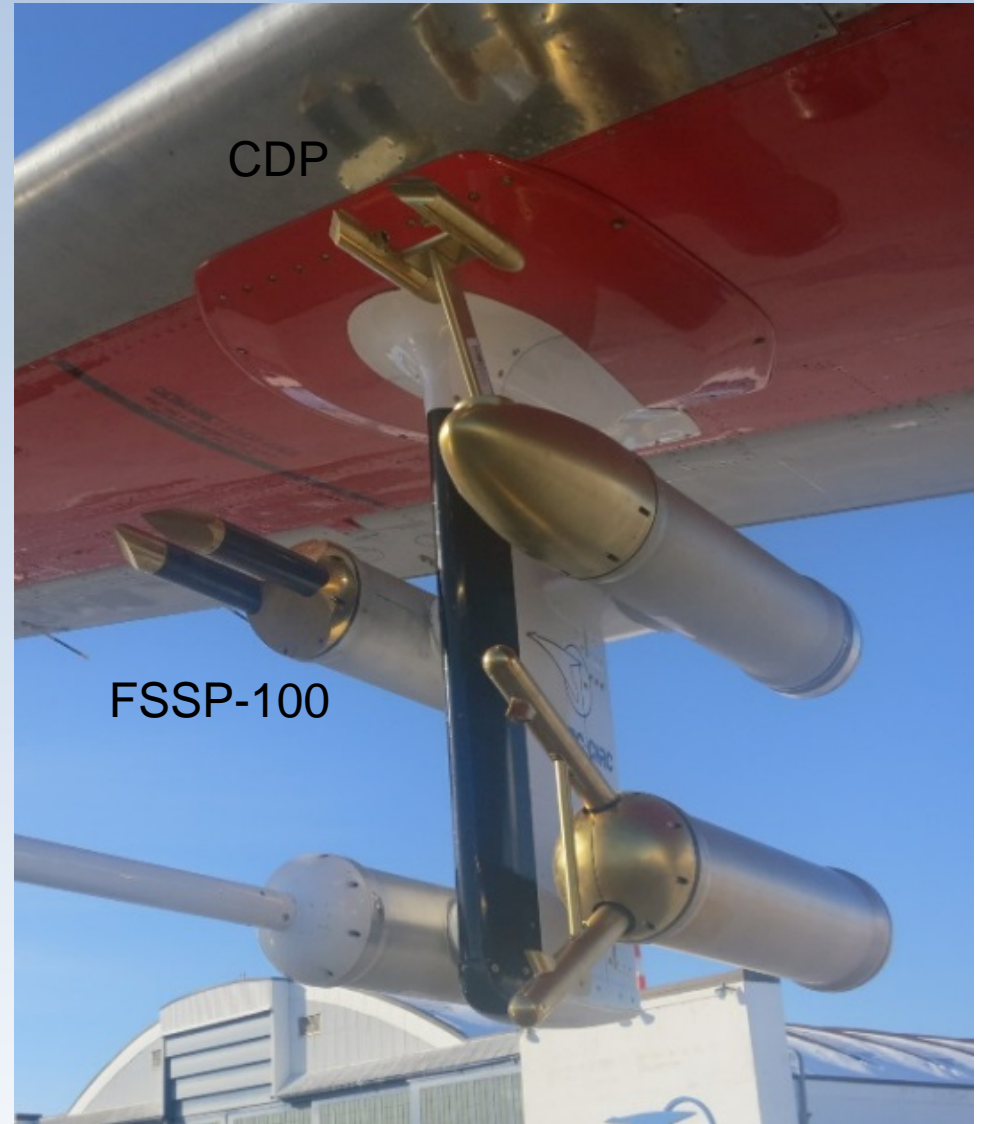




# Convair-580 EC/NRC instrumentation for Cayenne

## Cloud droplet probes

- FSSP-100 2 - 47  $\mu\text{m}$
- CDP 1 - 50  $\mu\text{m}$



# Convair-580 EC/NRC instrumentation for Cayenne

## 2D imaging particle probes

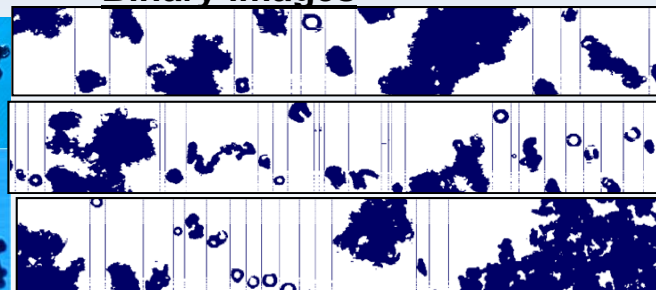
- CIP 25 - 1600  $\mu\text{m}$
- PIP 200 - 6400  $\mu\text{m}$
- 2D-S 10 - 1280  $\mu\text{m}$
- CPI 2.3 - 2300  $\mu\text{m}$
- 2D-C 50 - 1600  $\mu\text{m}$
- 2D-P 200 - 6400  $\mu\text{m}$



## Morphology of ice particles



## Binary images



# Convair-580 EC/NRC instrumentation for Cayenne

## 2D imaging particle probes

### **under consideration**

- HVPS 150 - 19200  $\mu\text{m}$   
(instead of 2DP)
- HSI 5 – 2500  $\mu\text{m}$   
(instead on PCASP)





# Convair-580 EC/NRC instrumentation for Cayenne

## Bulk parameters

- SEA Robust probe
- SEA IsoKinetic Probe (IKP-2, NASA owned)
- SPT Nevzorov hot-wire probe (high power)
- Goodrich Rosemount Icing Detector

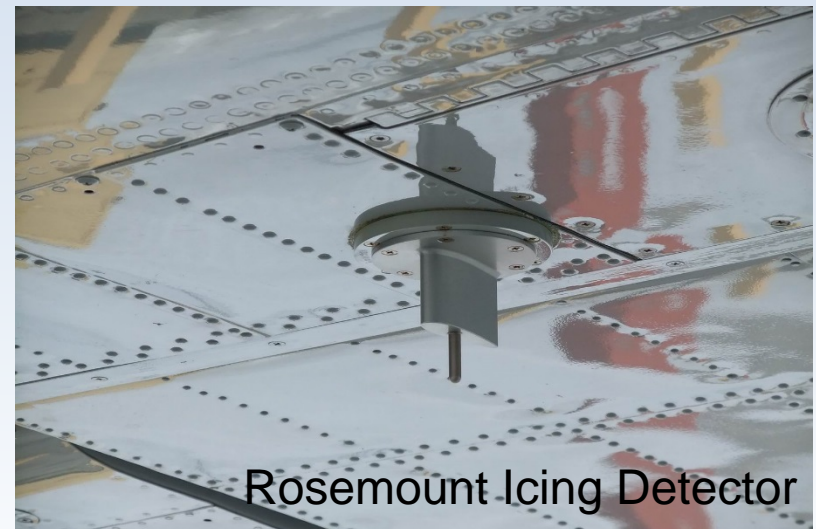
Nevzorov hot-wire probe



Isokinetic Probe



Rosemount Icing Detector



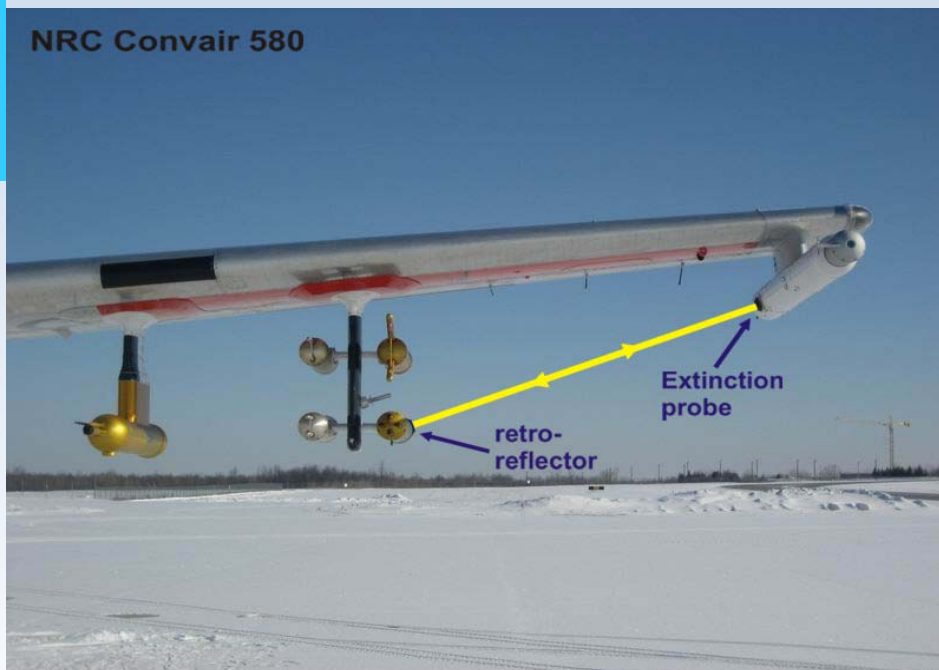
# Convair-580 EC/NRC instrumentation for Cayenne

## Bulk parameters

EC Cloud Extinction Probe

Deck identification of HIWC environment

$$D_{\text{eff}} = k * \text{IWC} / \text{Extinction}$$





# Convair Instrumentation – Aircraft and Atmospheric state parameters

## ❖ Atmospheric and Aircraft state parameters

- WV (Licor 6202/7000, 840A, Chilled mirror)
- Temperature (x 3)
- Pressure (x 3) – One new transducer (Mar 15)
- 3D-wind (AIMMS-20 & Rosemount 858)
- IMU (x 3)
- GPS (x 2) – one new unit (Mar 15)



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# Convair Remote Sensing Systems during HAIC-HIWC Cayenne Campaign

- ❖ Radar (X, Ka and W-bands) - Installed
  - EC Ka-band radar (Up and Down looking – Reflectivity only)
  - NRC W and X-band Radar System (NAWX)
  - Pilot X-band Radar
- ❖ Alpenglow Airborne Elastic Cloud Lidar (355 nm) – Installed and Tested
  - Zenith looking (NRC)
  - Nadir looking (EC)
- ❖ ProSensing Inc. 183 GHz Radiometer - GVR - Under contract process



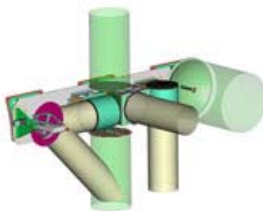
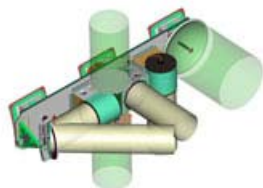
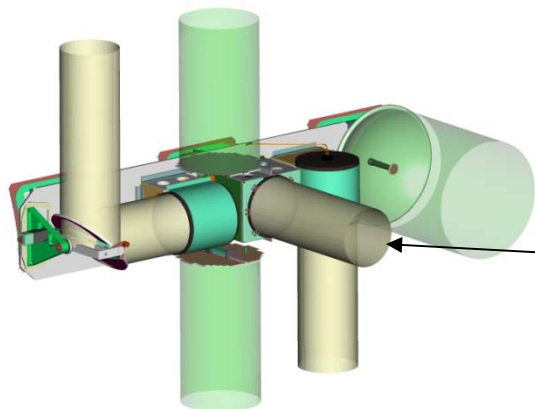
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# NRC Airborne W and X-bands radar (NAWX)

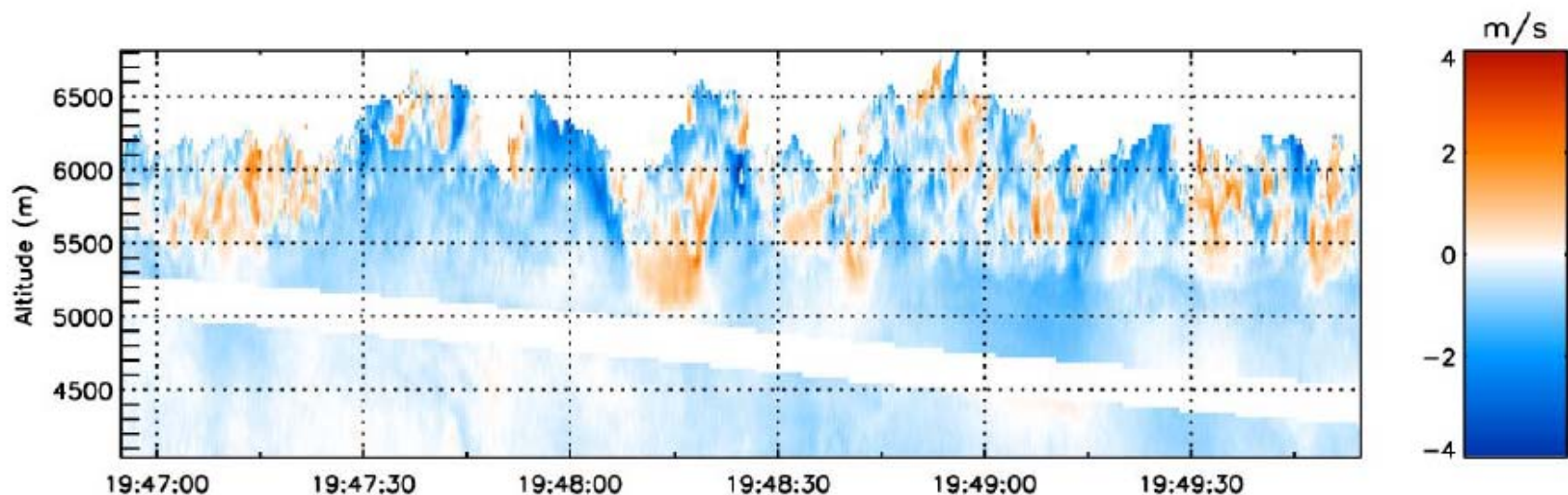


NAWX	W-band	X-band
Transmitted Frequency (GHz)	94.05	9.41
Peak Tx Power (KW)	1.7 - typical	25 (split b/n two ports)
Polarization	Co and Cross	Simultaneous H and V
Doppler	Pulse Pair and FFT	Pulse Pair and FFT
Pulse Duration ( $\mu$ s)	0.1 - 10	0.11-1
Max PRF (KHz)	20	5
Ant. 3 dB BW ( $^{\circ}$ )	0.75	3.5
Antenna ports	5	4
View direction	Up, down and side	Up, down and side

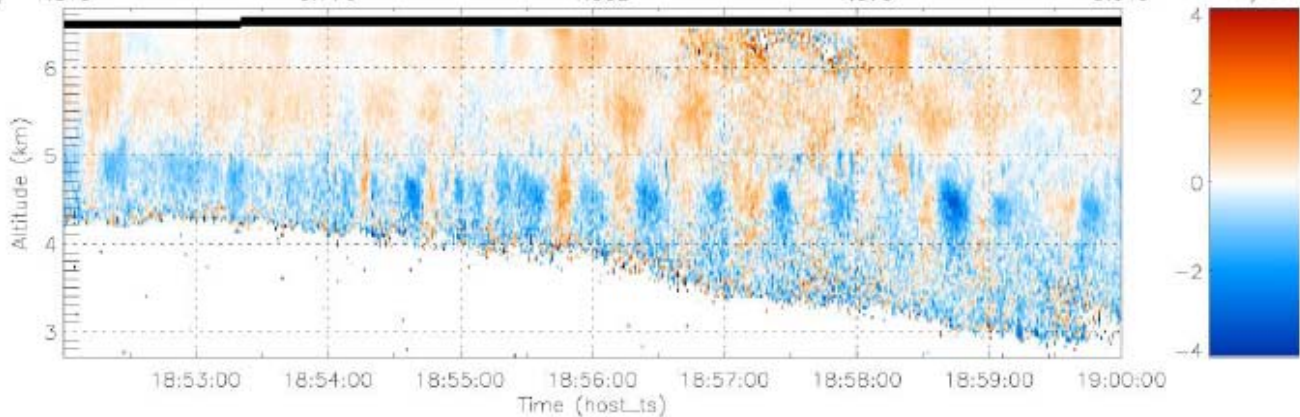
<http://www.nawx.nrc.gc.ca>



# NAWX – Doppler



Thu Mar 1 2007  
NAWX: Band: W Variable: Vd Port: Nadir Mode: PP10  
Pitch (deg) 2.789 2.239 2.308 2.123 2.308  
Roll (deg) 1.819 0.776 -1.352 -1.579 0.649

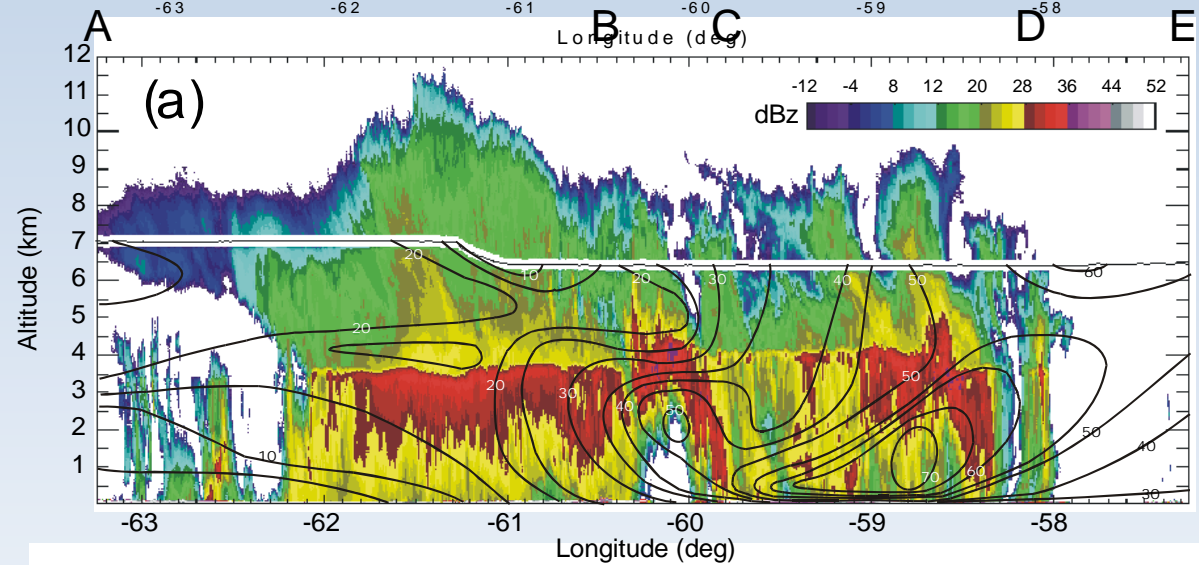
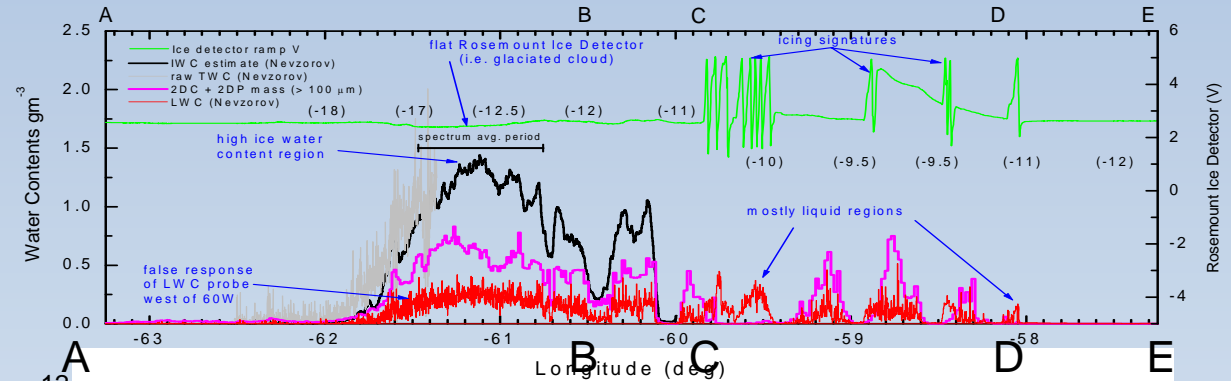
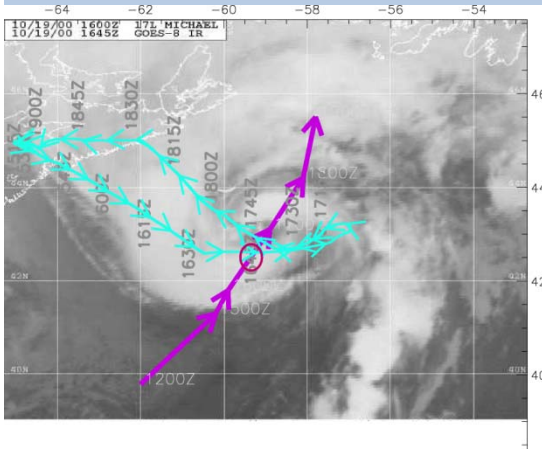


Doppler – Cloud Dynamics





# EC Ka-band Hurricane Michael 19-Oct-2000



❖ Vertical Z and dropsonde wind cross-section

❖ Correlation with cloud microphysics

Credit: Walter Strapp (ref: Abraham et. al., 2004 BAMS)

Surface pressure	987.5	985.2	985.3	982.8	982.8	n/a	975.9	978.4	985.6	989.1
Dropsonde #	1	2	3	4	5	6	7	8	9	10



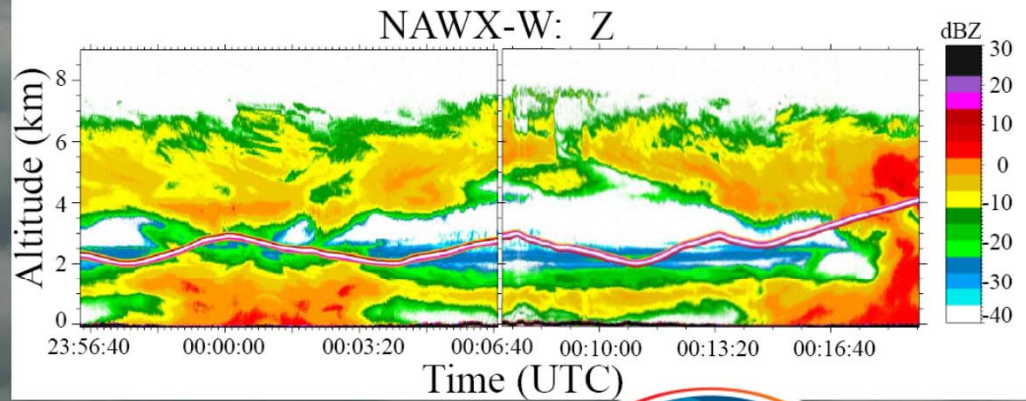
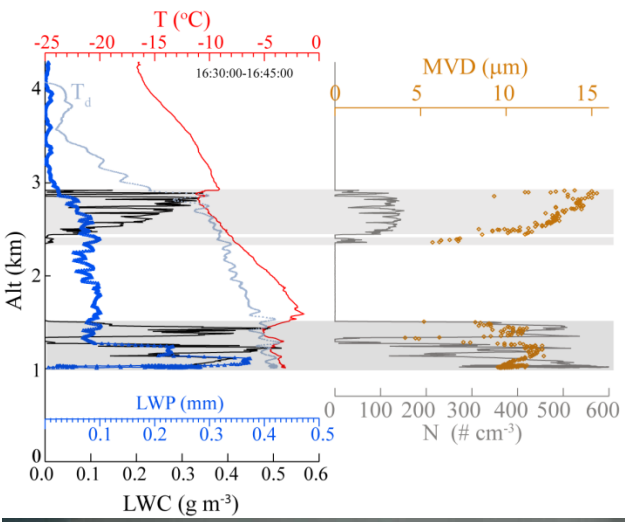
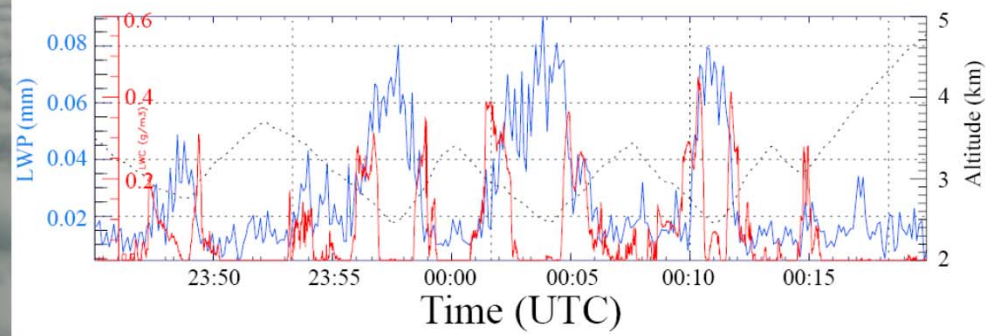
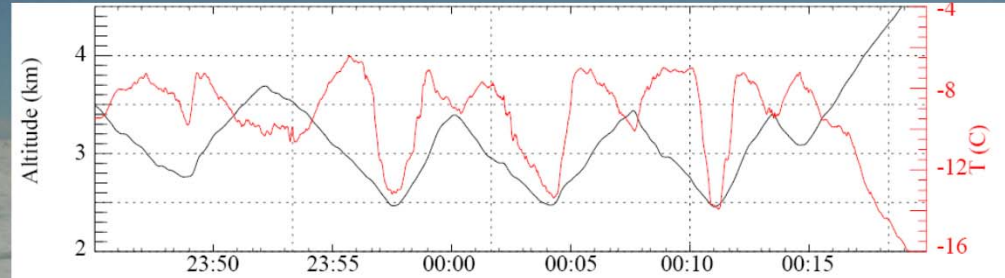
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Installed on the aircraft – 27-Feb-2015

# G-band (183 GHz) water Vapor Radiometer

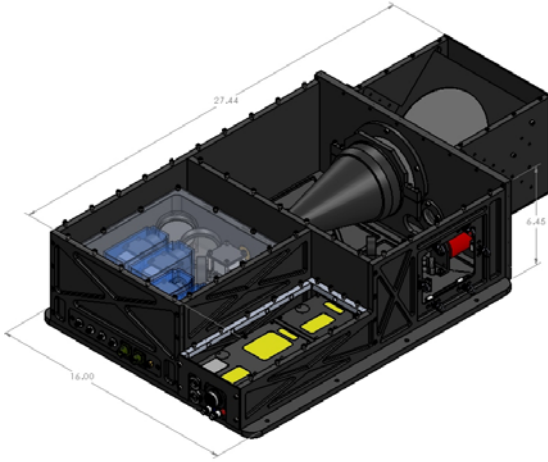


LWP from ProSensing inc. G-band Radiometer

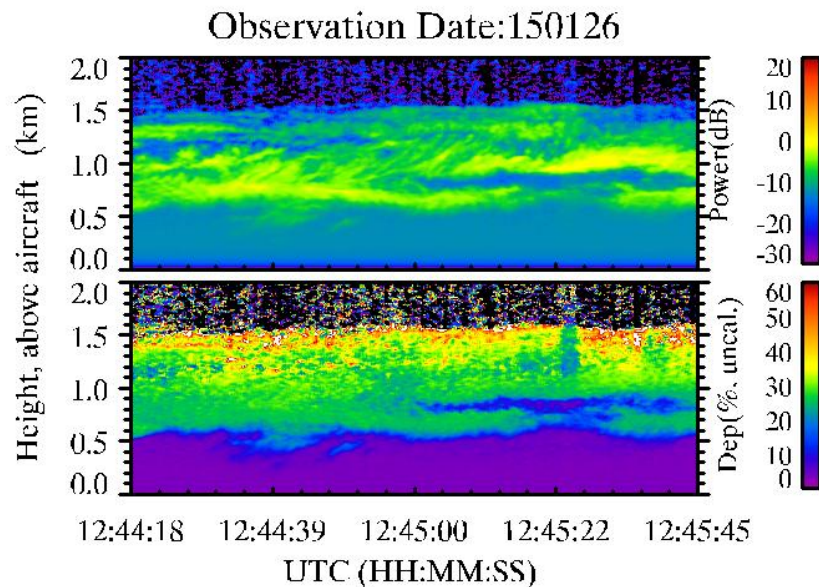




# Nadir (EC) and Zenith (NRC) Cloud Lidar



- Wavelength: 355 nm, for eye safe operation.
- Horizontal resolution: 20 profile per second.
- Vertical resolution: up to 0.75 m (200MHz sampling rate).
- Depolarization measurements: supercooled water and ice separation.
- High and low gain channels: to avoid in cloud signal saturation.
- Measurements extend close to aircraft.



# Communication links

- ❖ Iridium – Skytrack (voice, data – web based flight tracking)
- ❖ PLANET:
  - ❖ PO issued to ATMOSPHERE – Feb 2015
  - ❖ System delivery to NRC by March 31<sup>st</sup>
  - ❖ Dual-channel installation design completed
  - ❖ Integration and Flight test – April 2015



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# Lighting Detection, Pilot Radar and Camera

- ❖ STORM scope
  - ❖ BF Goodrich WX5000 (L3)
  - ❖ Garmin Apollo MX20 – display
- ❖ Pilot Radar
  - ❖ Rockwell Collins WX RTA -858 Receiver 622-8441-004
  - ❖ Can record data (needs check of system and some programming work)
- ❖ Cameras
  - ❖ Prosilica GE1910C (forward and downward)
  - ❖ Contour+ model 1529 (built in GPS)
  - ❖ Exploring more option suitable for Cayanne operations



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