An Overview of the Polar Night Experiment (PONEX) Aircraft Campaign for HAWC and EarthCARE

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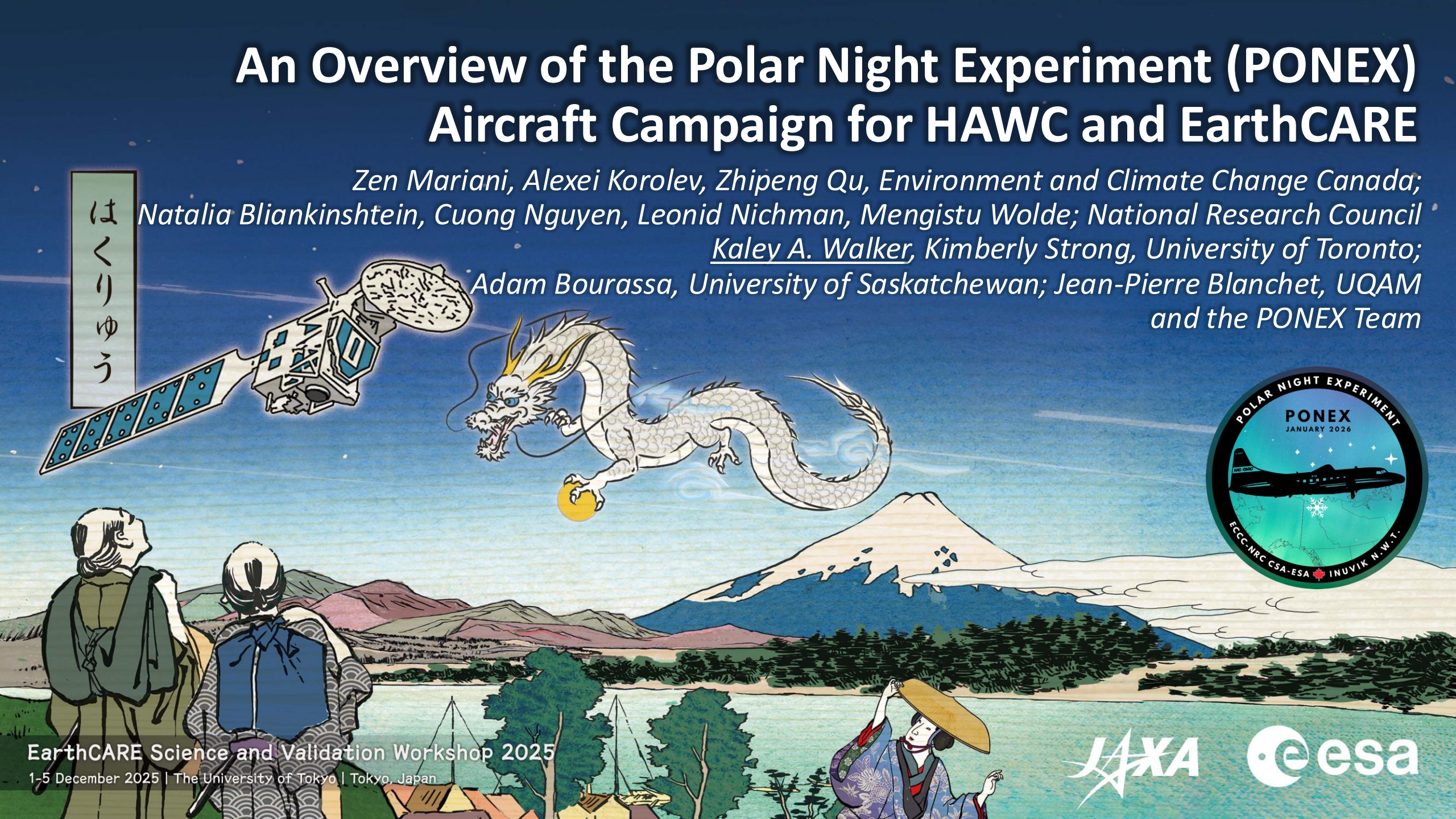

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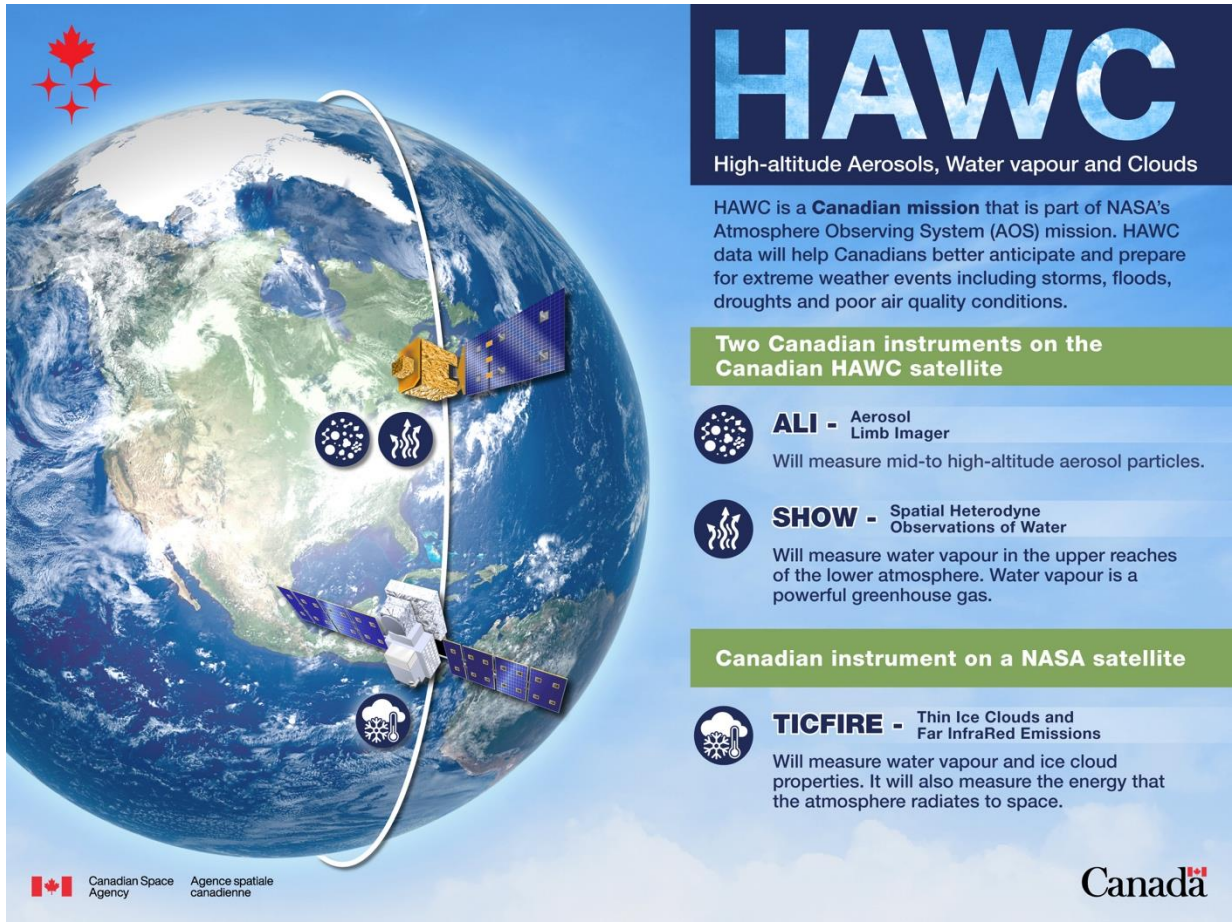
CSA HAWC Satellite Mission: Sub-orbital Plan

- Sub-orbital component of the HAWC mission
  - Development, preparation, and calibration of satellite instruments, data analysis and processing algorithms, and validation of HAWC observations
  - Aircraft and ground-based campaigns for pre-and post-launch calibration/validation
  - All activities in collaboration with NRC, NASA, CSA, JAXA, ESA, and University consortium
    - Arctic identified as significant cal/val gap for HAWC and ESA EarthCARE satellite missions
  - New knowledge acquired on atmospheric properties/processes to become the basis for improvements to NWP, air quality, and climate models
- Similar objectives for ESA EarthCAREcal/val post-launch



Infographic credit: CSA

Motivation for a Polar Night Aircraft Campaign

- Cloud genesis, radiation transfer and chemical processes in the Arctic during polar nights dramatically differ from those during polar days.
- Despite numerous field campaigns in Arctic regions, most of them were conducted during polar days or during polar sunrise or sunset.
- The net radiative feedback of optically thin ice clouds (OTIC) in the Arctic is not well understood (lack of observations). OTICs may accelerate the production of very cold air masses, which is the prime source for intense winter storms
- Polar night weather and chemistry studies are very sparse - none conducted via airplane.
- Transport and life cycle of anthropogenic pollutants during polar night are not explored.
- Cloud physics and chemistry in numerical models can be improved through the acquisition of new knowledge that PONEX is designed to provide

Arctic Polar Night Experiment (PONEX)

Overarching goal:

Acquire new knowledge needed to improve weather and climate forecasts in the polar regions through a better understanding of key physical processes and an improved representation of those processes within numerical weather and climate prediction systems.

PONEX Objectives:

Sub-orbital component

1. **HAWC** (preparatory phase)
   - testing performance of ALI & FIRR-2
   - algorithm development & simulators
2. **EarthCARE** cal/val via satellite under-flights during its post-launch phase
   - validation of cloud and aerosol retrieval algorithms
   - assessment of calculated broadband radiative flux profiles & radiative closure assessment program

Science component

1. Novel observations of Arctic surface emissivity and thermal profiles, radiative fluxes modulation by aerosol and clouds
2. New knowledge on the formation mechanism of optically thin ice clouds (OTIC) & its radiative properties in Arctic region. Explore the effect of OTICs on initiation of Arctic storms during polar night.
3. Statistical characterization of cloud microphysics and aerosol properties (sizes, chemical composition, concentration).
4. Free atmosphere and boundary layer dynamics during polar night.
5. Polar night atmospheric chemistry.
6. Explore transport of air pollutants and aerosol chemistry in Arctic regions during the polar night.
7. LONG TERM: Improve parameterizations suitable for numerical weather and climate prediction models & characterize the role of the polar regions in driving mid-latitude weather and global climate.

Experimental Design

Platform: NRC Convair-580
Location: Inuvik, Northwest Territories, Canada
Timeframe: 8 to 28 January 2026 - ~10 flights, over 21 days


NRC Convair-580

Research flight objectives:

Weather flights

1. polar night cloud microphysics (OTIC)
2. modulation of radiative fluxes by OTICS
3. mechanisms of ice initiation in polar night clouds
4. dynamics of the polar night troposphere

Clear sky flights

1. aerosol composition (natural and anthropogenic)
2. trace gases
3. surface emissivity

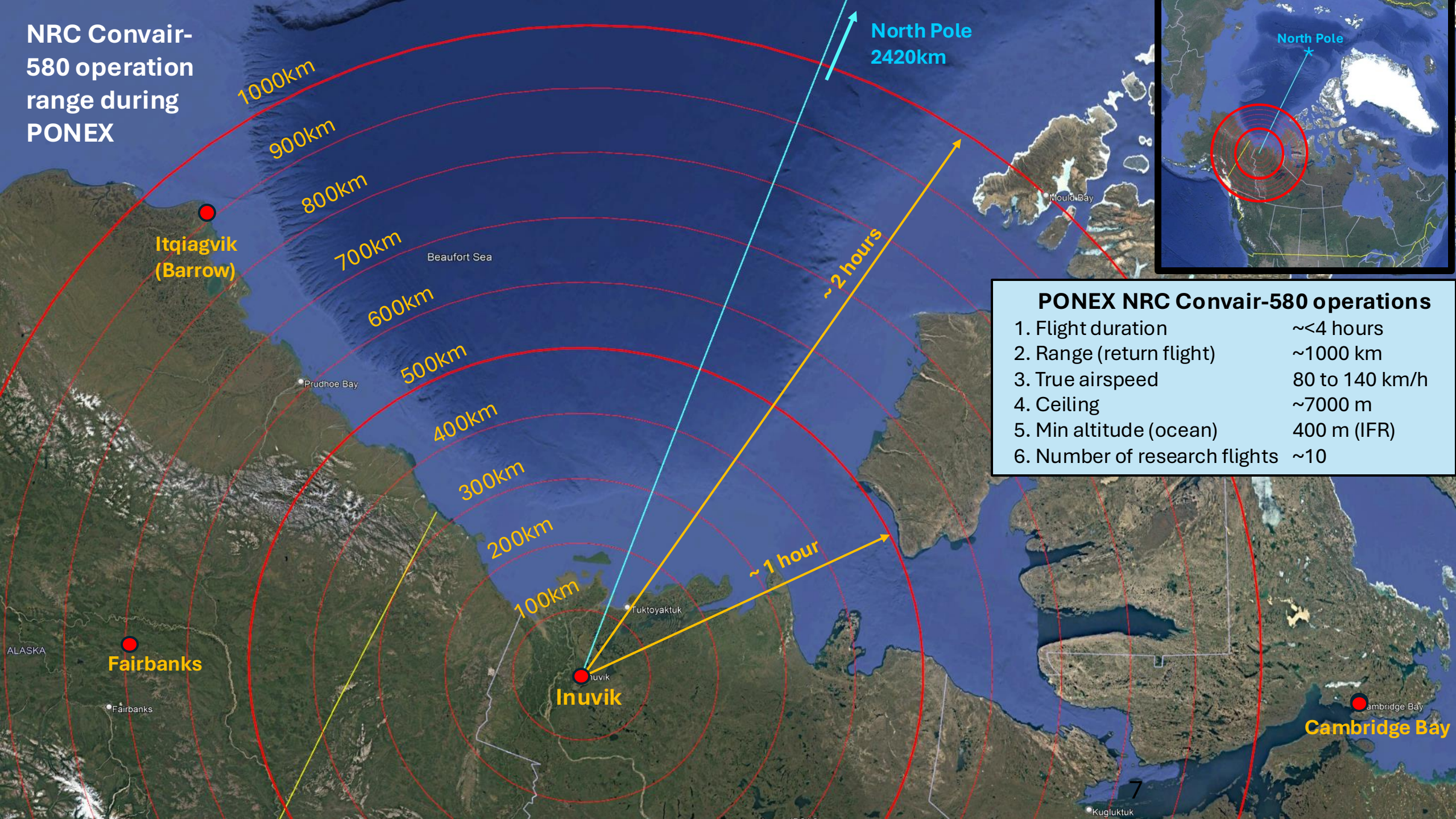
Suborbital flights:

1. **HAWC** remote sensing instruments (**ALI** and **FIRR-2, the TICFIRE precursor**)
2. Cal/val of **EarthCARE**

Aircraft instrumentation:

Far-Infrared radiometer **FIRR-2** & aerosol limb profiler **ALI**
Radars: X, W, Ka-band
Elastic cloud lidar (355 nm)
HiSRAMS (microwave sounder for T and RH)
Aerosol Mass Spectrometer
Aerosol size spectrometers, INP, CCN
Trace gases (O_3, CH_4, CO_2, CO, H_2O)
Cloud microphysical instrumentation

NRC Convair-580 operation range during PONEX



PONEX NRC Convair-580 operations

1. Flight duration	~<4 hours
2. Range (return flight)	~1000 km
3. True airspeed	80 to 140 km/h
4. Ceiling	~7000 m
5. Min altitude (ocean)	400 m (IFR)
6. Number of research flights	~10

EarthCARE in January 2026 – Descending Orbit

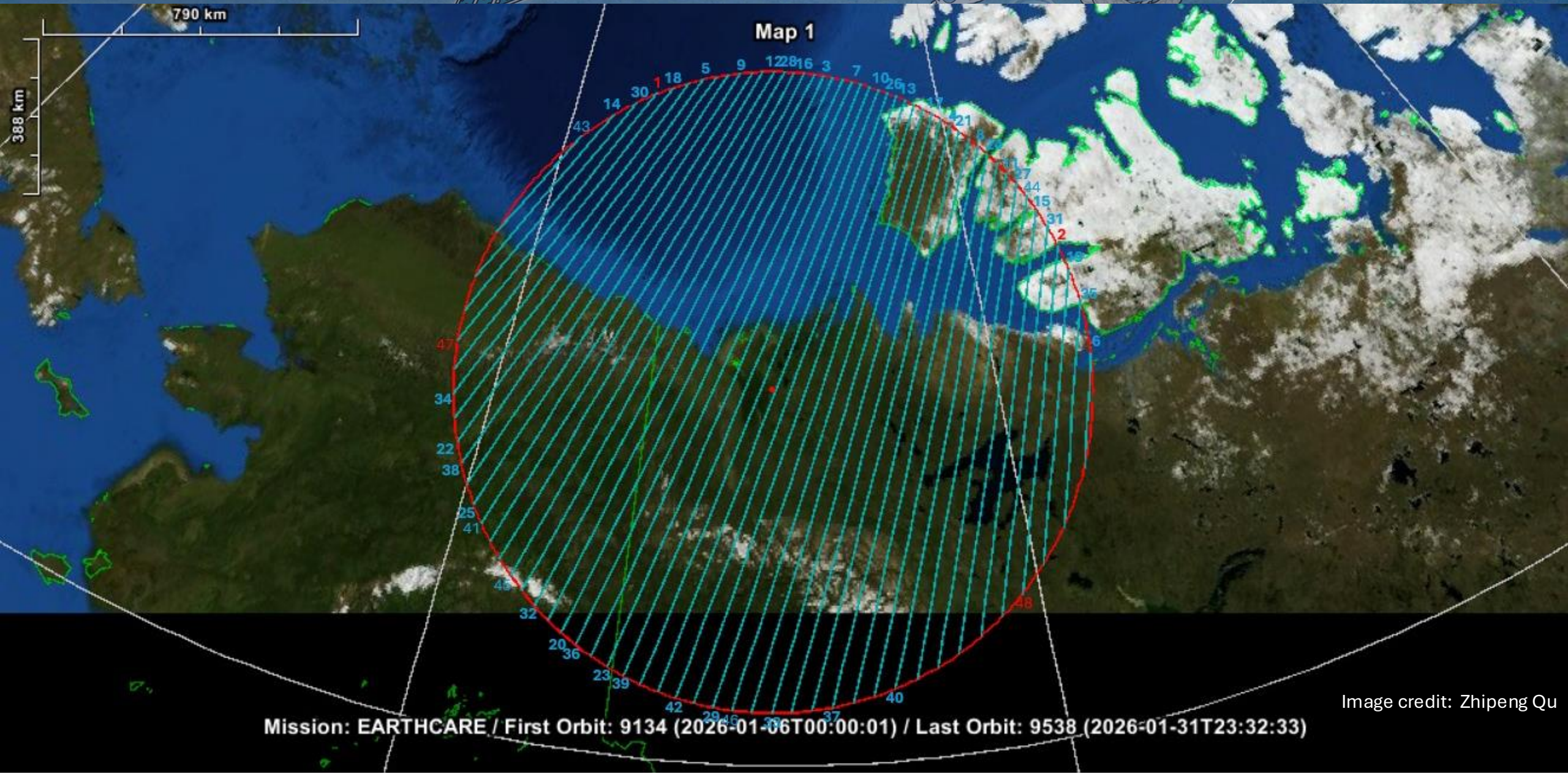
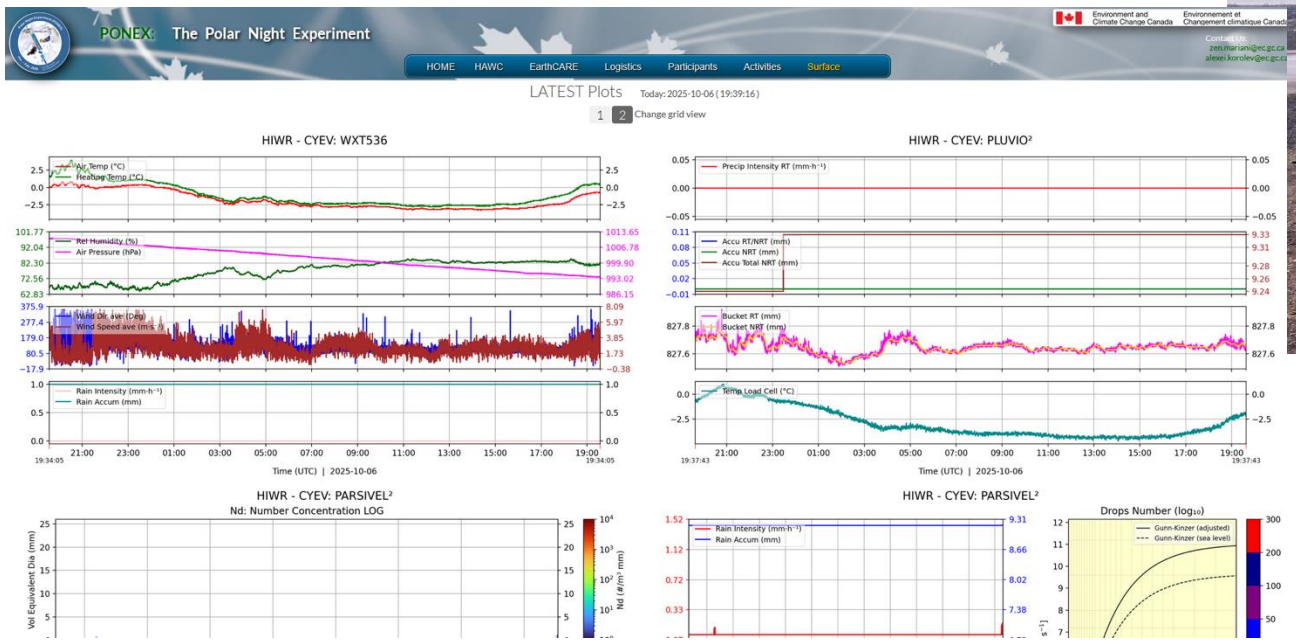


Image credit: Zhipeng Qu

Inuvik Surface Site

- Complement NRC Convair observations, enable calibration and comparisons during targeted overpass flights (e.g., FIRR-2)
- Support PONEX flight operations in real-time with 24/7 data stream (e.g., winds, cloud base, etc.)
- Measurements for rad. closure, simulations
- Complements Trail Valley Creek surface site (50 km North of Inuvik) – mesoscale meteorology



Inuvik surface site with the airport runway and green hangar behind (facing SW)

Access to real-time data:
https://ponex.hiwr.ca/surface.php

Summary

- Polar Night Experiment (PONEX) Campaign will take place in January 2026
  - **The first Polar Night aircraft campaign will support satellite cal/val and advance Arctic science**
  - Led by ECCC and NRC in collaboration with CSA, NASA, ESA, and 14 University partners
  - Based out of Inuvik, Northwest Territories, Canada for ~24 days
  - Obtain novel observations during Polar Night of Arctic surface emissivity and radiation, formation mechanism of thin ice clouds, transport of air pollutants and aerosol chemistry
  - Acquire new knowledge to improve weather and climate model parameterizations and characterize the role of the polar regions in driving mid-latitude weather and global climate
  - Expected outcomes will benefit model improvement at ECCC & improve understanding of Arctic processes
- Calibration/validation of **two** satellite missions
  - **HAWC satellite** (**FIRR** and **ALI** instrument performance, simulators, and algorithm development)
  - **EarthCARE (ESA)** observation and algorithm cal/val during satellite under flights
  - Characterization of satellite observations over Canadian terrain → data users
- Upcoming:
  - **Advance team arrives in Inuvik 6 January 2026** → **Convair arrives 8 January 2026!**

Thank you!

PONEX: Remote sensing instrumentation

	name	parameter	manufact
1	**FIRR-2** Far Infrared Radiometer	8 channels, 7.9-27.5 μm	LR Tech
2	**ALI** Aerosol Limb Imager	retrieved profiles of aerosol extinction, size	USask
3	**NAW** W-band radar	reflectivity, polarization, Doppler velocity	ProSensing
4	**NAX** X-band radar	reflectivity, polarization, Doppler velocity	ProSensing
5	**KPR** Ka-band radar	reflectivity, Doppler velocity	ProSensing
6	**Elastic Cloud Lidar** (355nm)	Lidar surface return, depolarization	Alpenglow
7	**HiSRAMS** High Spectral Resolution Airborne Microwave Sounder	brightness temperature vapor 175.9-184.6 GHz oxygen 49.6-58.3 GHz	Omnisys Instr. NRC, McGill