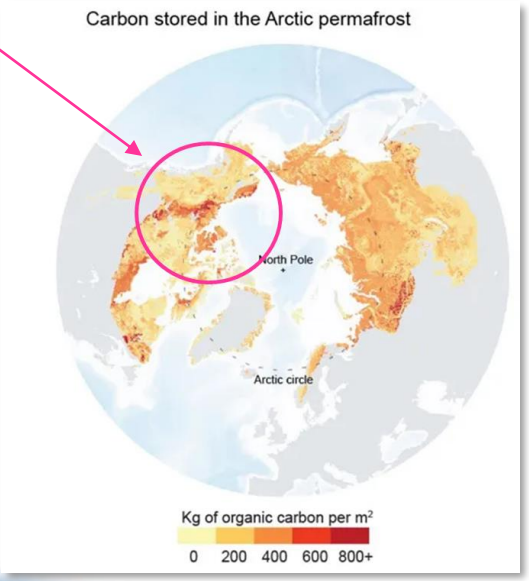
# CoMet 2.0 Arctic

*(Carbon Dioxide and Methane Mission for HALO)*

**When: August/September 2022**
**Where: Boreal Canada/Alaska**


- → airborne case study to pioneer the separation of natural and anthropogenic fluxes with $CO_2$ and $CH_4$ aircraft data and inverse modelling systems
- → unravel the methane and carbon dioxide budget of the permafrost and boreal Arctic region (measurements and models)
- → support current and upcoming satellite missions (e.g. MERLIN, CO2M)
- → advance the synergistic effects of active and passive remote sensing (CHARM-F + MAMAP2D) plus in-situ instrumentation

| Aircraft Instrumentation | Active Remote Sensing/Lidar | Passive Remote Sensing | In-Situ |
|---|---|---|---|
| Core Instruments | CHARM-F<br>CO2 and CH4 lidar | MAMAP2D<br>imaging CH4 and CO2 spectrometer | CRDS, air sampler<br>CO2, CH4, ethane, isotope analysis |
| Ancillary Instruments | | specMACS<br>hyperspectral imager | Attitude, p, T, rel. hum. |

Embedded into **AMPAC** (the ESA-NASA Arctic Permafrost and Methane Challenge) and coordinated with the **ABoVE** field experiment (NASA-JPL)

DLR

CoMet 2.0 ARCTIC

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# CoMet 2.0 Arctic: Project Summary

The overarching goal of the CoMet 2.0 Arctic mission is to provide *measurements of the most important greenhouse gases $CO_2$ and $CH_4$* from Arctic regions. This will be done using a suite of *sophisticated scientific remote sensing and in-situ instrument*s onboard the German research aircraft HALO.

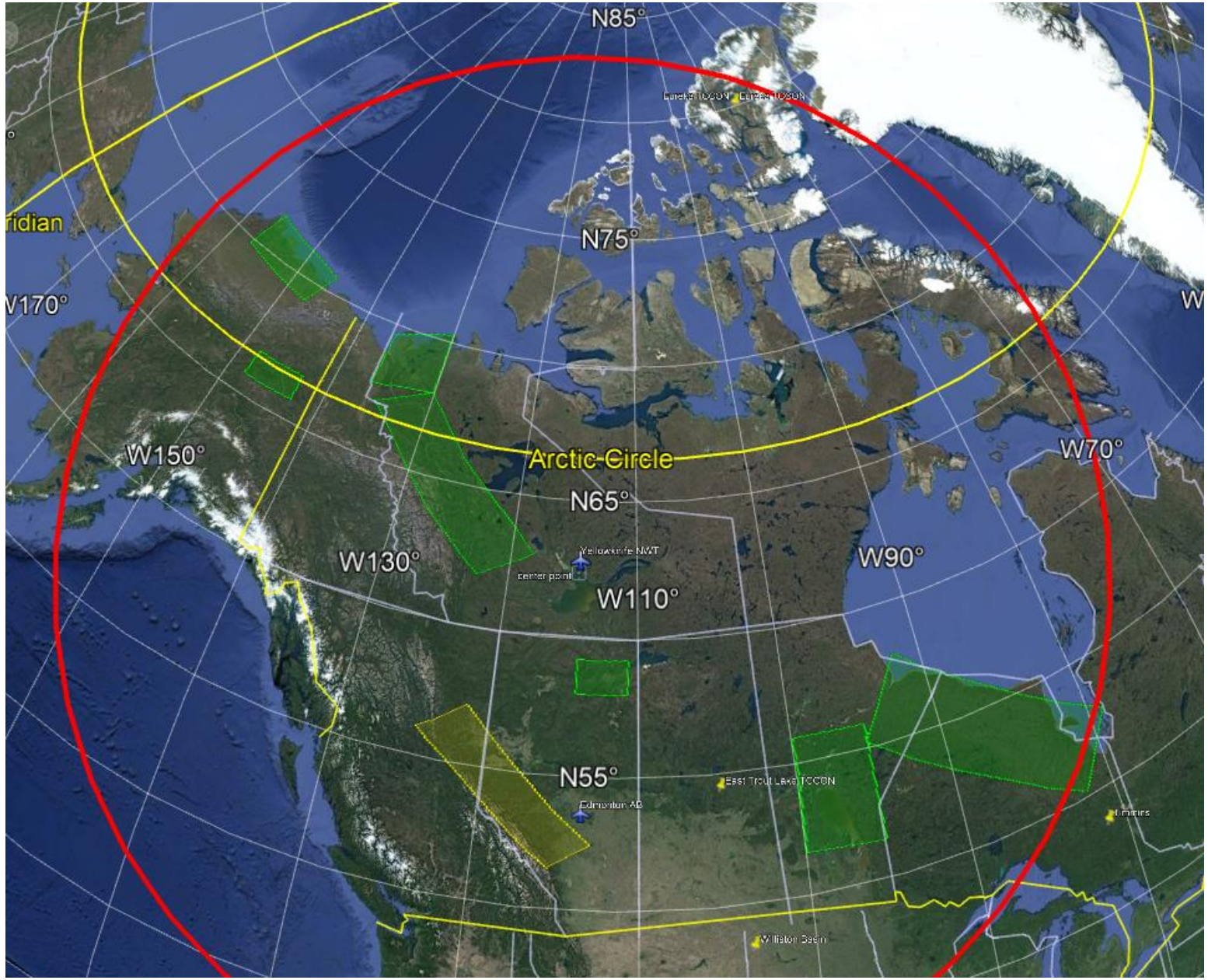
This data will support state-of-the-art Earth system models and will *increase our understanding of climate change* at regional level in the Arctic boreal region. At the same time, CoMet 2.0 also intends to *support and improve current and future satellite missions* to monitor climate change. The results shall help to *better predict future effects on ecosystems* and allow policymakers to make informed, fact-based decisions.

Thus, CoMet 2.0 complies with the cross-cutting themes of Northwest Territories Knowledge Agenda with respect to climate change, but also to innovative and emerging technologies as it will *support access to earth observation data through remote sensing*.

# Overall operation area

The overall operation area covers a circle around the campaign base.

The main target areas are indicated In green, yellow and by pins.



# Tentative Environmental Impact of CoMet 2.0 Arctic

The following issues are identified that may have an environmental impact:

1. **Dropsondes:**
   In order to better constrain the meteorological parameters that are needed to retrieve greenhouse gas data from remote sensing instruments, a total of approximately 20 dropsondes shall be launched from the aircraft.

2. **Low Flights:**
   The vast majority of research flights during CoMet will be carried out at flight altitudes > 5-6 km altitude. Nevertheless, some low flights are required in the planetary boundary layer to infer greenhouse gas fluxes from wetlands using the in-situ instruments onboard the aircraft.

# Dropsondes

In order to better constrain the meteorological parameters, that are needed to retrieve greenhouse gas data from remote sensing instruments, a total of approximately 20 dropsondes shall be launched from the aircraft.

These dropsondes are of type RD41 (manufacturer: Vaisala) and are similar to the radiosondes launched by ECCC more than 60 times each day from 31 launch sites across Canada as part of the national weather prediction program.

The dropsondes are not recovered. They weigh 350g and have a length and diameter of 41 cm and 7 cm, respectively. They are equipped with two small lithium cells.

In the Northwest Territories, ECCC radiosondes are launched twice a day from Inuvik (YVQ) and Norman Wells (YEV). Therefore, the number of 20 sondes launched over the campaign period of six weeks and over a large area spanning entire Northern Canada beyond NWT is small vs the standard radiosonde program.

Presumably there are regions which are more vulnerable than others and may have to be excluded from dropping. We are ready to do this, of course, and have done it for projects in other countries (e.g. in the area between Argentina and Antarctica) in the past. The usual procedure is to mark these areas plus buffer zones in our planning maps and include trajectory forecast to make sure that dropped sondes will not drift into these region. These procedures can be adapted based on specific requirements, of course.

https://www.vaisala.com/sites/default/files/documents/RD41-Datasheet-B211706EN.pdf

# Low Flights

- The vast majority of research flights during CoMet will be carried out at flight altitudes > 5-6 km altitude meeting the requirements of the remote sensing instruments. Nevertheless, some low flights are required in the planetary boundary layer to infer greenhouse gas fluxes from wetlands using the in-situ instruments onboard the aircraft.
- Typically, for safety reasons these flights are limited to flight altitudes of 600 m above ground (2000 ft AGL). In cases of favorable weather condition and flat terrain and at the discretion of the pilots, the flight level may be slightly lower. Typical aircraft speeds are 220 m/s.
- Tentative areas for low flight operation have been identified. These areas together with the potentially affected settlement regions are depicted on the following slides. Low flights shall for example be carried out in the vicinity of measurements towers to link the local scale measured by the ground based instruments to the regional scale. The exact choice of target area is depending on weather conditions.
- Usually, one flight leg of ~10-20 min will be performed in the upwind direction of targeted wetland areas while 2-3 legs will be performed downwind. As this will happen up to two times only over a specific single target area (2500 $km^2$), no more than ~2h of low flight operation will be performed over such dedicated areas during the entire campaign period of 6 weeks.
- Additionally, a few (~10) single profiles will be flown preferably, but not limited to the vicinity of airports adding a few minutes to low flight operations.

# Tentative Areas for low flights

# Western Arctic Communities potentially affected

Inuvialuit communities:

- Aklavik
- Inuvik
- Paulatuk
- Sachs Harbour
- Tuktoyaktuk
- Ulukhaktok

Gwich‘in communities:

- Aklavik
- Inuvik
- Fort McPherson
- Tsiigehtchic

# Sahtu and South Slave Communities potentially affected

Sahtu communities:

- Colville Lake
- Déljne
- Fort Good Hope
- Norman Wells
- Tulita

Salt river communities:

- Fort Smith
- Hay River