R23 replacement (HP-2)

Ruud Dirksen
GRUAN Lead Centre, DWD

15th GRUAN Implementation and Coordination Meeting (ICM-14)
Bern, Switzerland
11-15 March 2024

Chilled mirror instruments - GRUAN

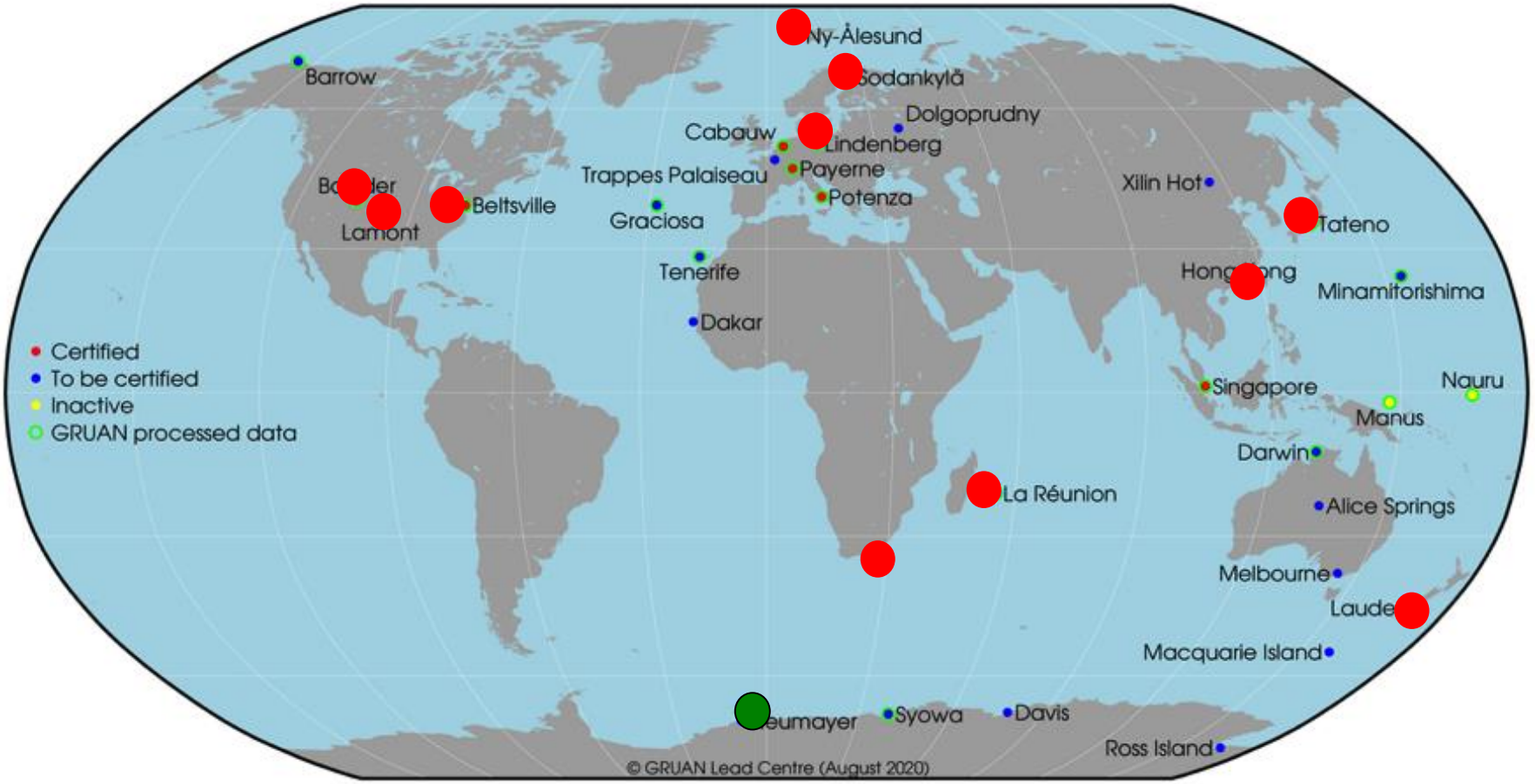
Employed within GRUAN (since networks early days)

- CFH – EnSci
- FPH – NOAA
- R23 cryogen (CF_3)
  - Ideal thermodynamic properties for CFH/FPH application
  - GWP ≈ 14,000
  - Restrictions: sales ban EU & Japan

- Transition to another cooling method necessary

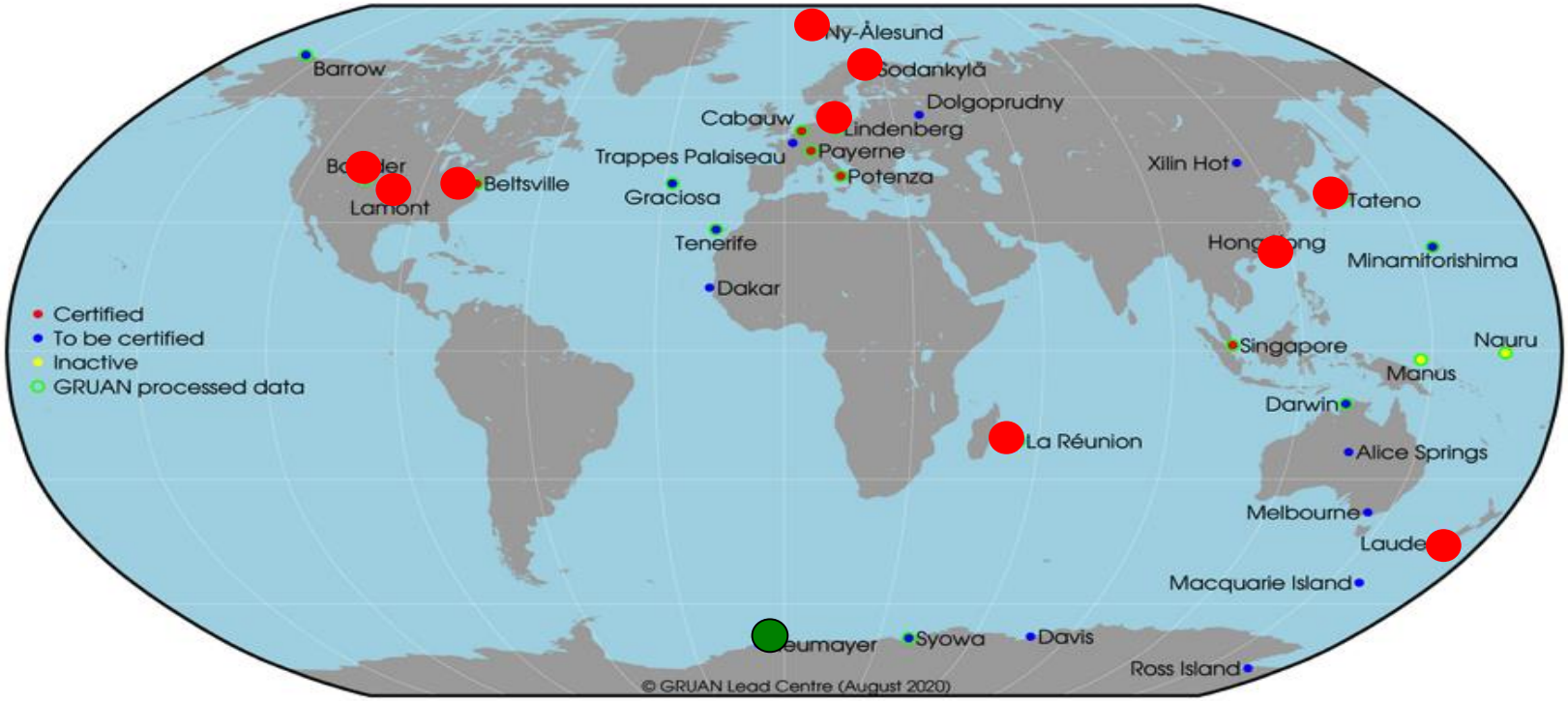
11 Sites with stratospheric hygrometer soundings

- GRUAN Manual: monthly H_2O measurements to ~30km



Current R23 CFH/FPH soundings

- EU/JPN sites
  - Halted
- US-sites/LAU/HKO
  - Ongoing (no issues)

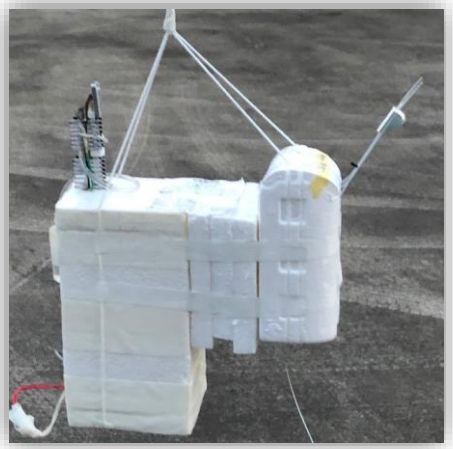


Alternatives

- Alternative cryogen
  - Dry ice/ethanol – NOAA FPH
    - Tropical and mid-lat sites
  - Liquid N_2 – CFH
    - Lindenberg, Jülich, Sodankyla

- Peltier-based instruments
  - Meisei Skydew, commercially available
    - Tateno, Lindenberg
  - PCFH, in development (pres. S. Brossi)

PCFH



Skydew

NOAA FPH Dry Ice and Ethanol Update

NOAA/GML/OZWV

Emrys Hall, Lizzy Asher, Nicolas Mastromonaco, Alex Fritz

CIRES

GRUAN ICM-15
March 11-15, 2024

Photo: Patrick Cullis

Dry Ice and Ethanol NOAA FPH

- First dry ice and ethanol launch in Boulder 2/21/2020
  - 10 flights in Boulder (4 in 2023)
  - 2 flights in Costa Rica (April 2023)
  - 1 flight in La Reunion Island (June 2023)
  - 1 flight in Hilo (Dec 2023)

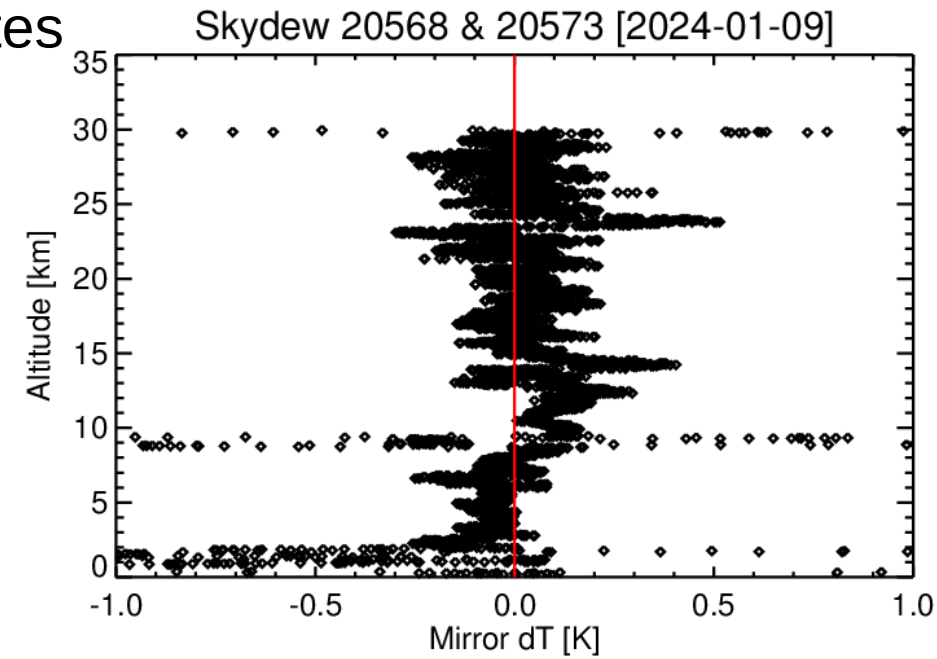
Future DIA FPH flight plans

- 1 flight planned for Lauder in May 2024
- 1 DIA FPH flight along with a coordinated R23 FPH flight in Kiruna, Sweden - June 2024 (ATMOSFER campaign)
- Continued flights in Boulder and Hilo in 2024

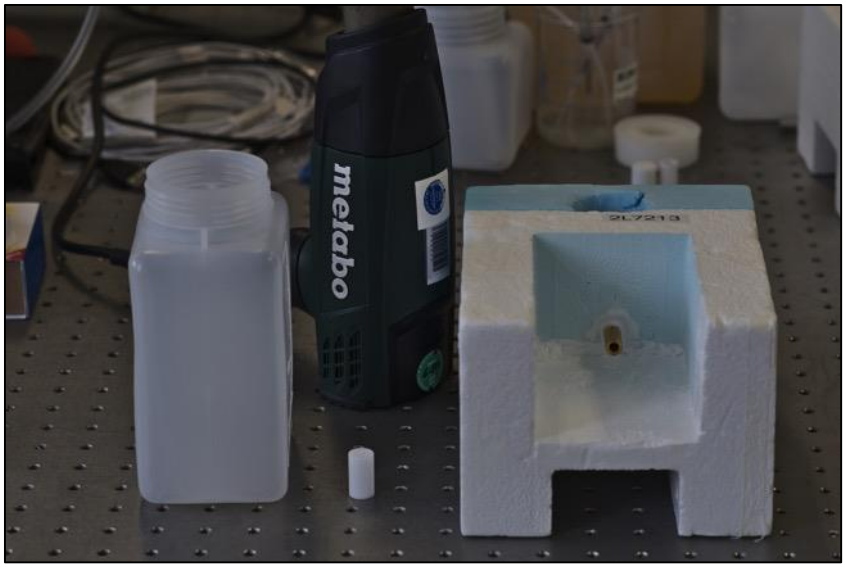
Photo: Patrick Cullis

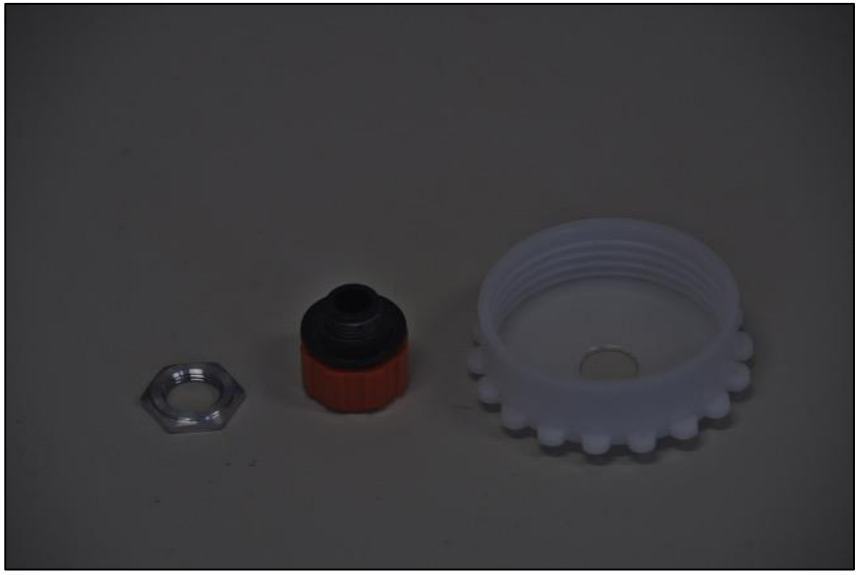
Skydew – status overview

- Summary
  - Employed at Tateno (JMA) and Lindenberg (11 twinsoundings)
  - Reproducibility <0.2K (previous differences due to contamination?)
  - Night 30km, day ~25km
  - Dewpoint depression up to 45K (nighttime)
- Planned: testing at other GRUAN sites
  - Sodankyla, Ny Alesund, Potenza
- Sugidachi et al. submitted to AMT

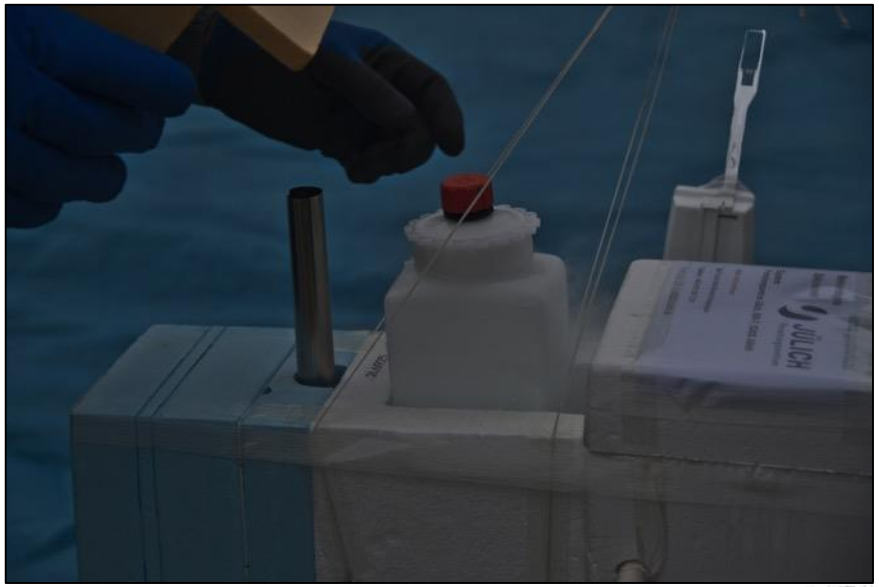


N_2-CFH conversion kit





- Pressure-relieve valve
  - ~200 hPa
- Light-weight (PE bottle)
- Capacity: 1 liter
- Developed by C. Rolf (FZ-Jülich)



Tests of LN2 CFH

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National Center for Atmospheric Research, Boulder, CO, USA
Christian Rolf
Research Center Jülich, Germany
Ruud Dirksen
GRUAN Lead Center, DWD Meteorological Observatory Lindenebrg
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12 March 2024, GRUAN ICM-15

NCAR

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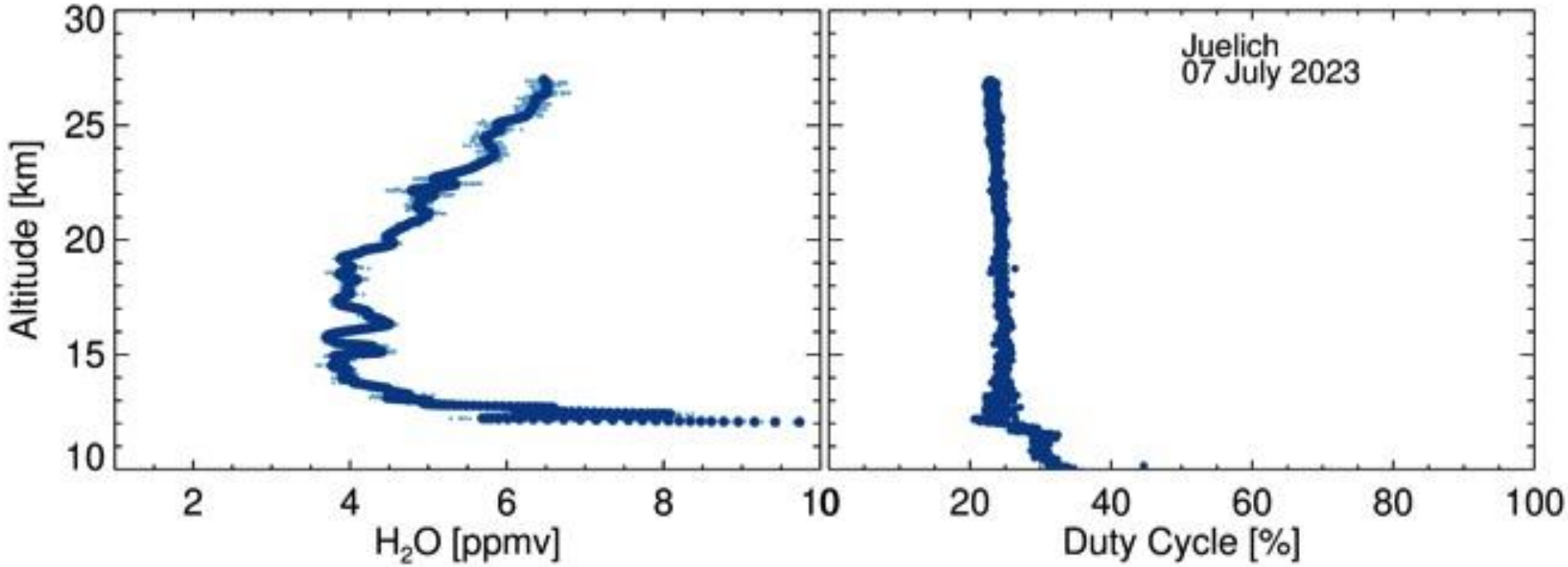
Activities since last ICM

- Tests of liquid nitrogen cooled instruments by Christian Rolf at Jülich
- Significant firmware and electronics update

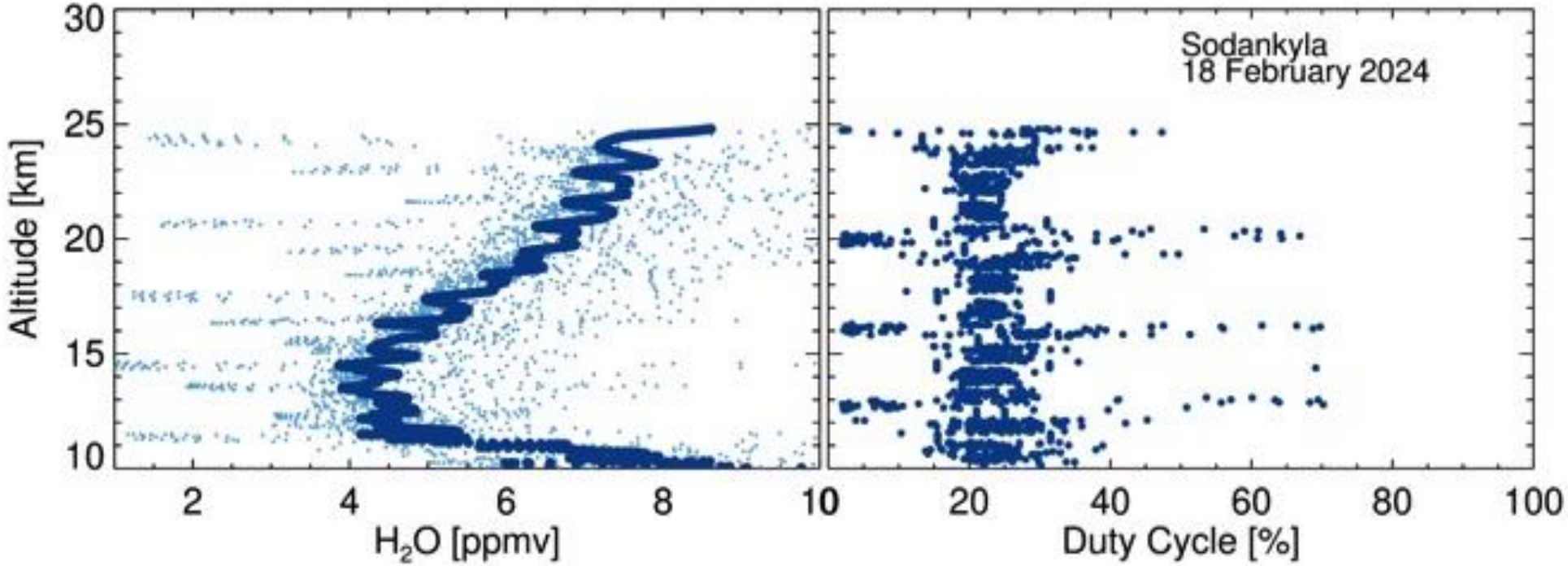
- Tests of liquid nitrogen cooled instruments at Lindenberg

- Test of EnSci produced instrument LN2 at Sodankyla

Jülich, July 2023



Sodankyla, 18 February 2024



Progress

- Additional flights in South Africa (Christian) and Lindenberg (Ruud)

- Cooling power with LN_2 is sufficiently controlled
- Significant progress in update of electronics and firmware
- First prototype of LN_2 CFH built by EnSci launched at Sodankyla
- Additional prototype test in Costa Rica next week

- Furthermore, some tests of dry ice version by Michel Cartier

Summary

- DIA-FPH
  - testing ongoing
- N_2-CFH
  - Design adopted by EnSci. Prototype used in test flights
  - Testing/PID-optimizing ongoing
- Skydew
  - Commercially available
  - Night 30km, day ~25km
  - Dewpoint depression up to 45K (nighttime)
  - Tests at arctic sites outstanding; performance in Arctic summer?