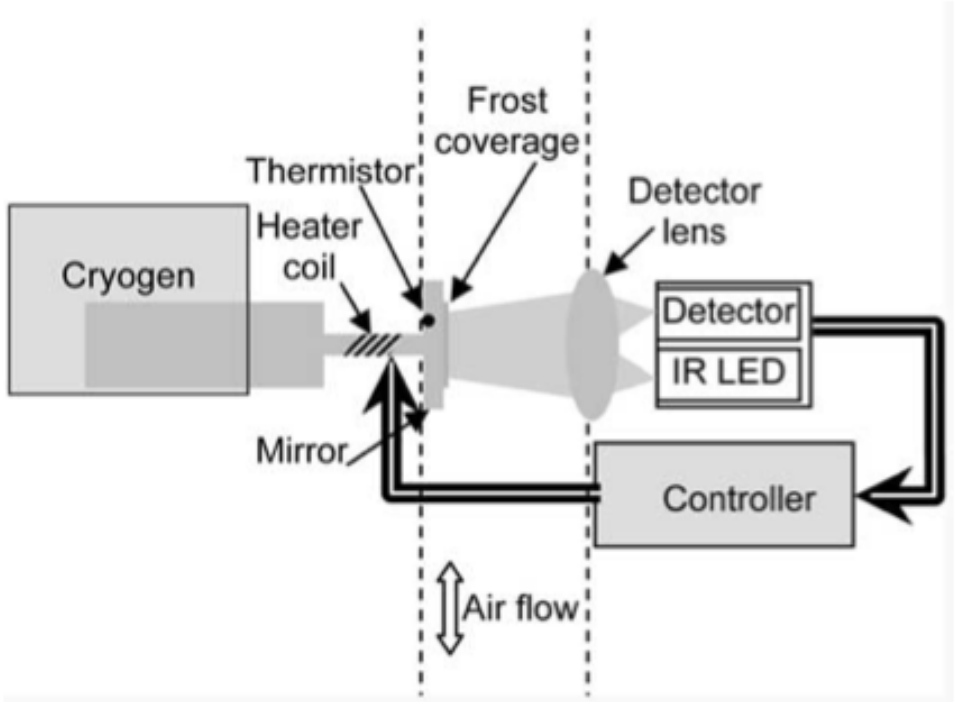
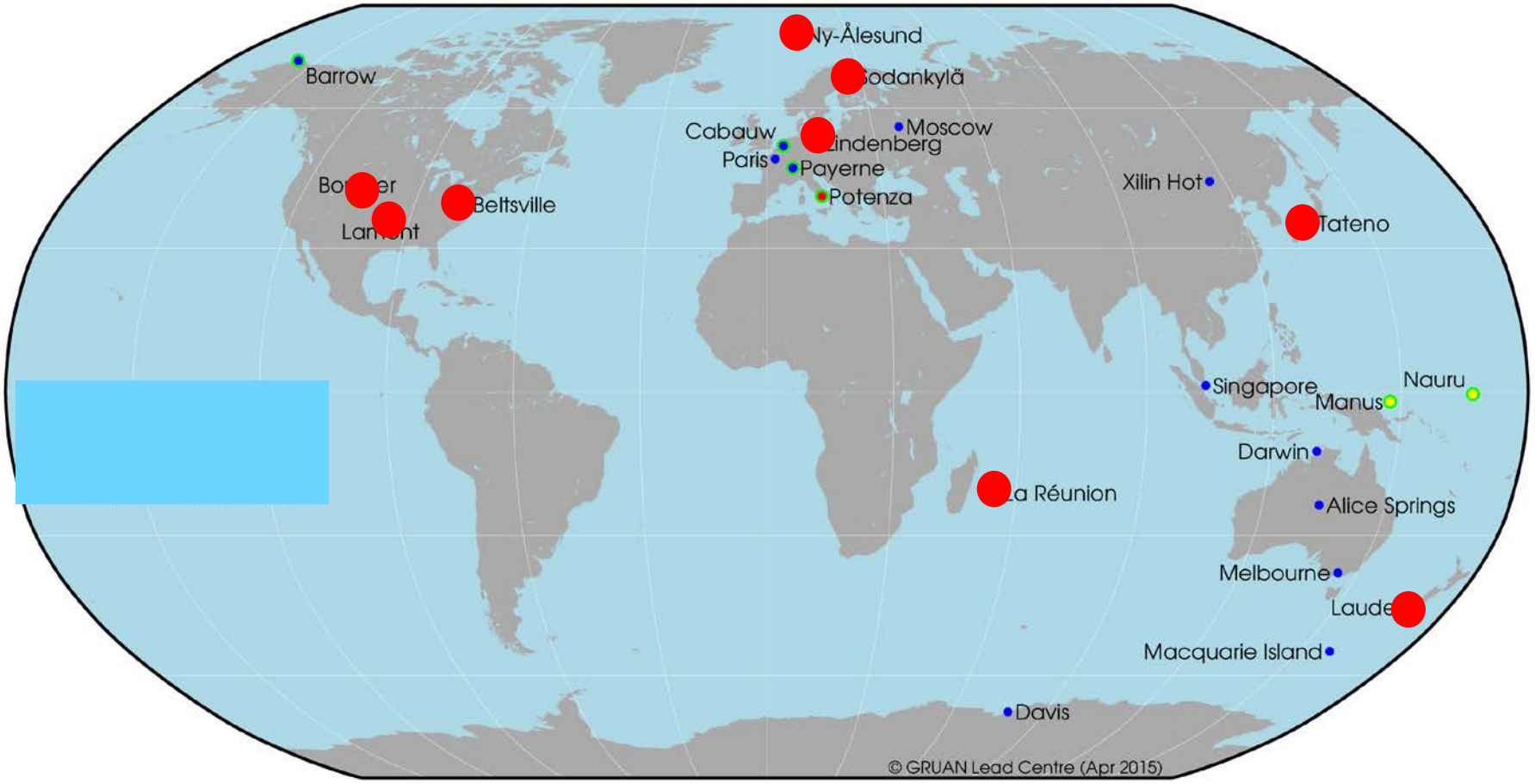
CFH operating principle



- Measurement of physical quantity (FP-temperature)
- “Reference” instrument
- Temperature measurement
- Reliable up to 27km
- Sensitivity 1-10^5 ppmv
- Small time-lag (~20s)

Voemel et al., JGR2007

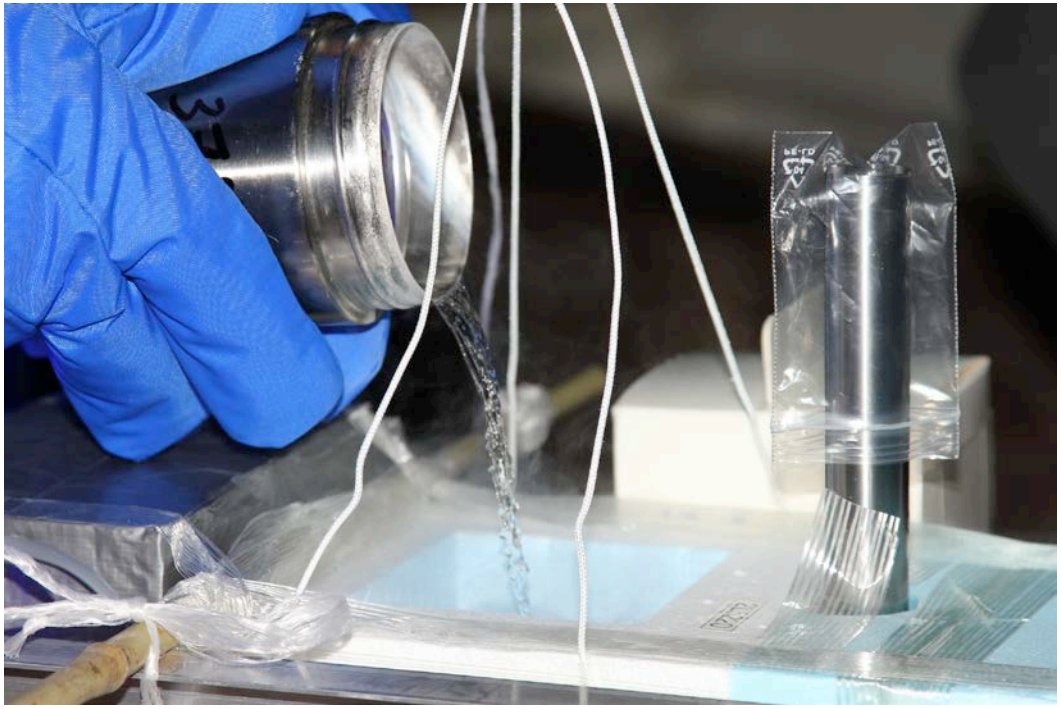
GRUAN sites with CFH/FPH soundings



FPH = Frost point hygrometer
CFH = Cryogenic frost point hygrometer

CFH-issue

- Affordability: cost increases annually >5%, current price $2950
- Manufacturer-monopoly by EnSci
- In the near future: ban on cryogen (R23 - CHF_3)



Instruments for water vapor profiling stratosphere

Currently available:

- CFH
- FPH
- FLASH-B (Alexey Lykov)
- Snowwhite (performance limited to troposphere)

Future

- P-CFH (ETH Zürich)
- TDL (?)

PCFH

Double stage Peltier cooling. No cryogen required.

Cost ~CHF 1800

Lowest possible T_{fp} vs $T_{ambient}$:

-110° C at -75° C (ΔT = 35 K),

-92 ° C at -38° C (ΔT = 54 K)

-59 ° C at 27° C (ΔT = 86 K).

Operating range: up to 20 km altitude in mid-lat and tropics.

PhD project, under development. Thermocouple wires selected. Computer modeling of air flow in tube.

Goal: operational prototype in 2019

Alternative cryogens

- Liquid nitrogen - freezes at 120 hPa ✗
  - Pressurized container for liquid nitrogen?
- Liquid oxygen - freezes at 1.5 hPa ✗
  - L-O_2 + styrofoam: fire hazard
- Liquid air?

- Involve manufacturers in the search for alternatives?