



Overview of situation regarding R23

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2.2. A fully equipped GRUAN site shall make at least double, and preferably triple, redundant measurements of all GRUAN priority 1 and 2 ECVs³ and, specifically:

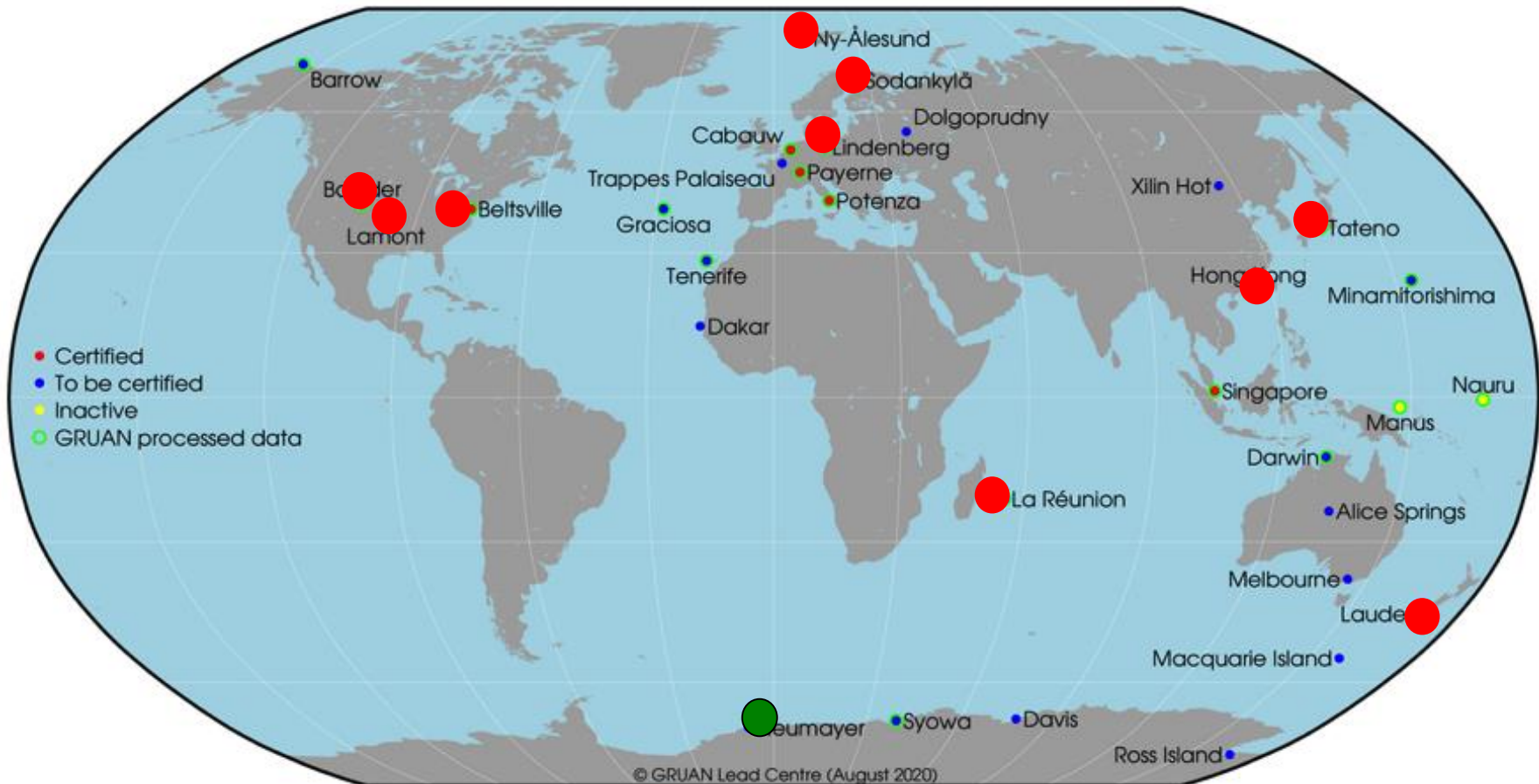
- i) Four times daily radiosonde measurements of temperature and pressure to 30 km, and water vapour in the troposphere, also submitted in NRT to the WMO Information System (WIS);
- ii) Weekly ozone profile measurements;
- iii) Monthly water vapour profile measurements to ~30 km; and
- iv) Hourly observations of integrated precipitable water vapour.

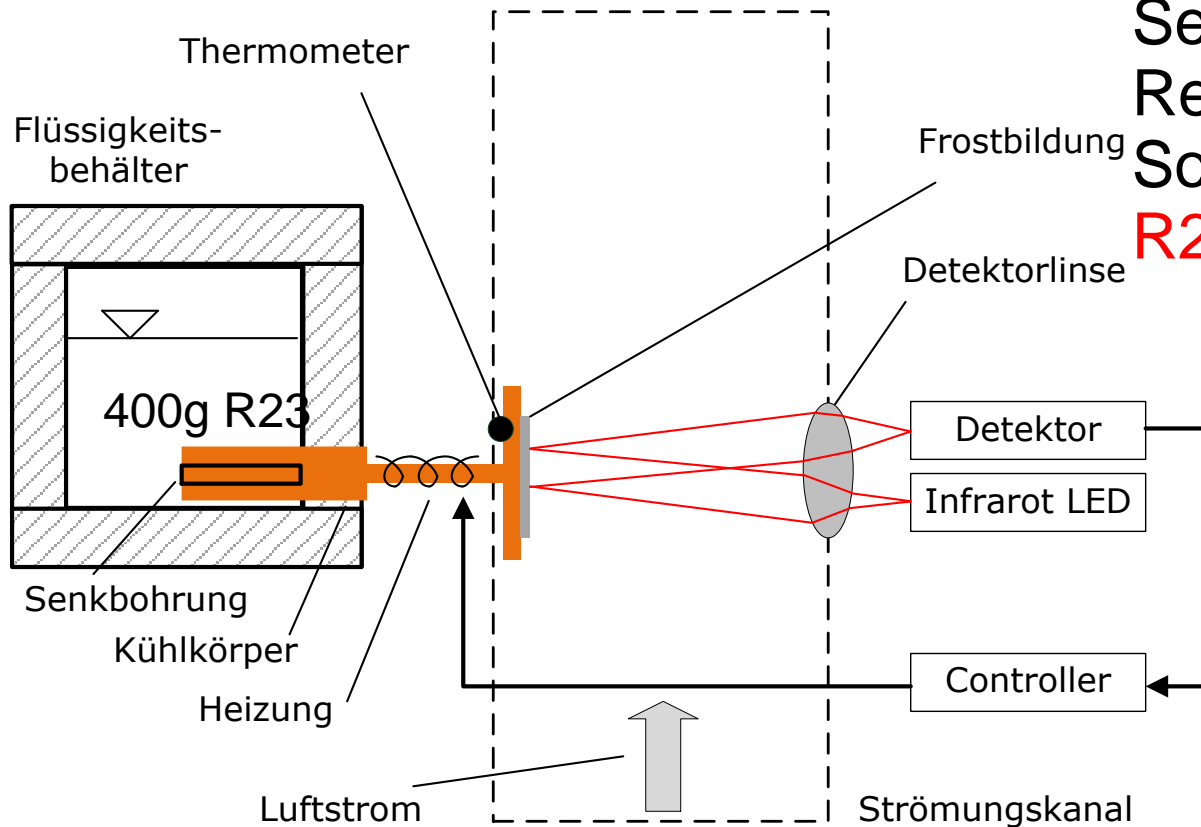
2.3. Minimum requirements for a GRUAN site include:

- i) Weekly radiosonde measurements of temperature and pressure to 30 km and humidity in the troposphere; and
- ii) Monthly water vapour profile measurements to ~30 km. Where several GRUAN sites are located sufficiently close to each other, where the sufficiency shall be guided by scientific studies, individual site flight schedules should be coordinated to share the burden of making these measurements.
- iii) At least twice daily observations of integrated precipitable water vapour.

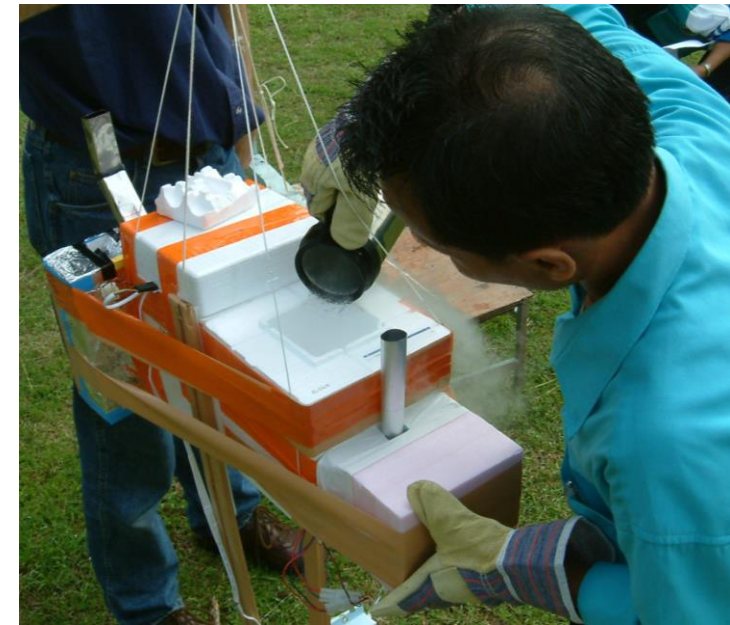
GRUAN Manual (GCOS-170)

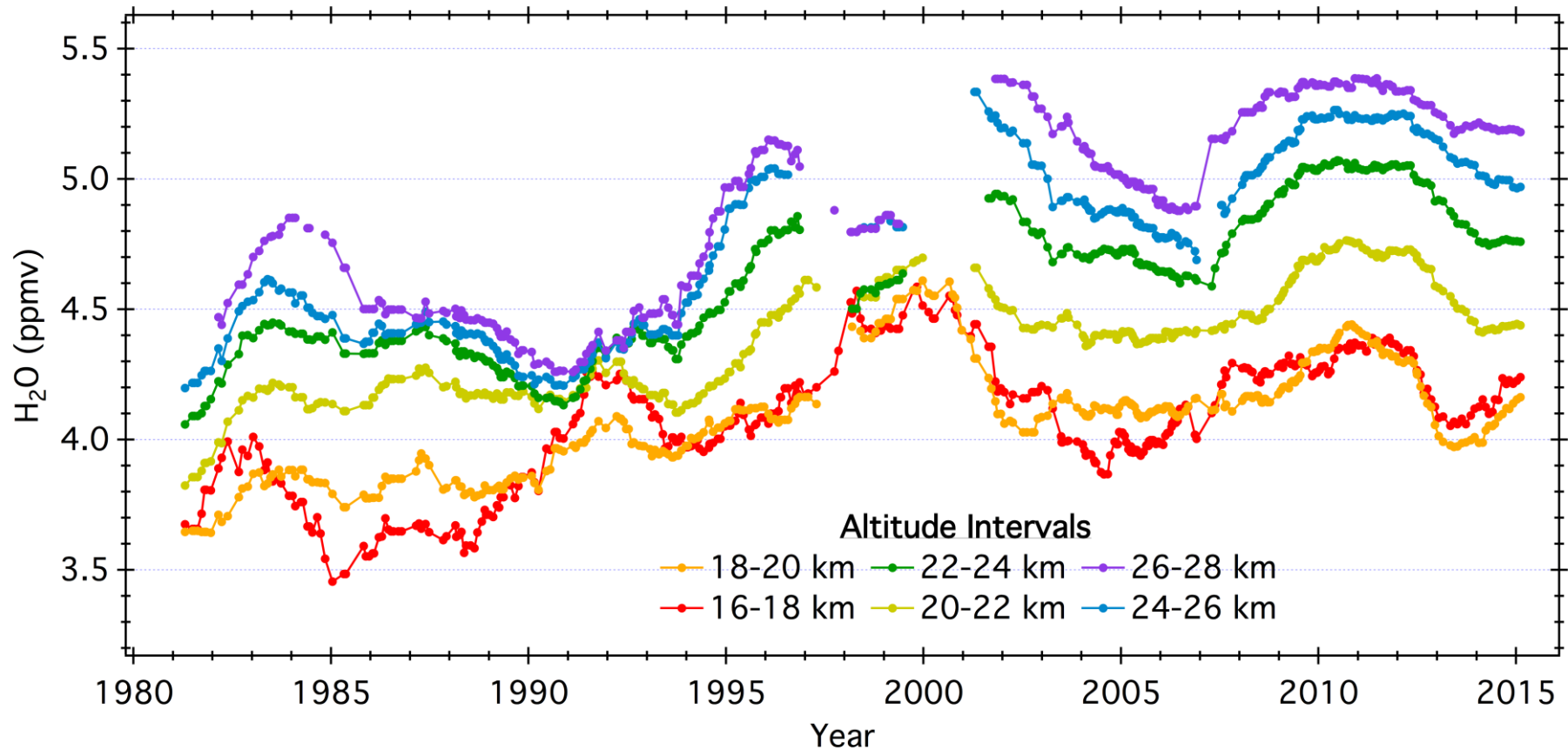
Sites with strat. hygrometer soundings





Frostpoint: H_2O partial pressure
Sensitivity $1\text{-}10^5$ ppmv
Response time $\sim 20\text{s}$ (strat.)
Sophisticated controller
R23 cryogen (CF3)

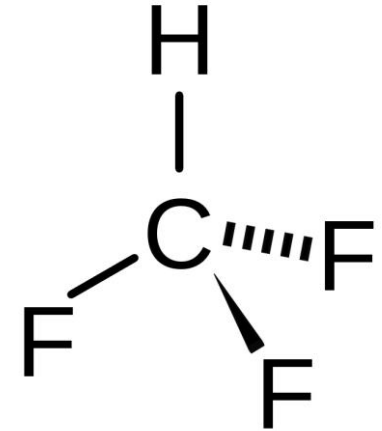




Updated from *Hurst et al. (2011)*

Average 35-year net increase of 0.7 ppm ($\sim 0.5\%$ yr⁻¹)

- R23 – Fluoroform
- Boiling point -82°C
- P_{trip} 5 hPa
- Heat of evaporation 230 kJ/kg
- Inflammable, non-toxic
- **Ideal thermodynamic properties for CFH/FPH application**
- **GWP $\approx 14,000$**



- EU regulation 517/2014, reduction of f-gases
 - Ban on R23 starting 2020
- Reduced availability
 - sales ban EU & Japan
 - Import restrictions
- Increased costs?

➤ USA

- No availability issues; stockpiling (BOU)
- Modify FPH for dry ice

➤ EU

- Stockpiling (LIN, NYA, REU [25])
- Alternatives: dry ice, other instrument

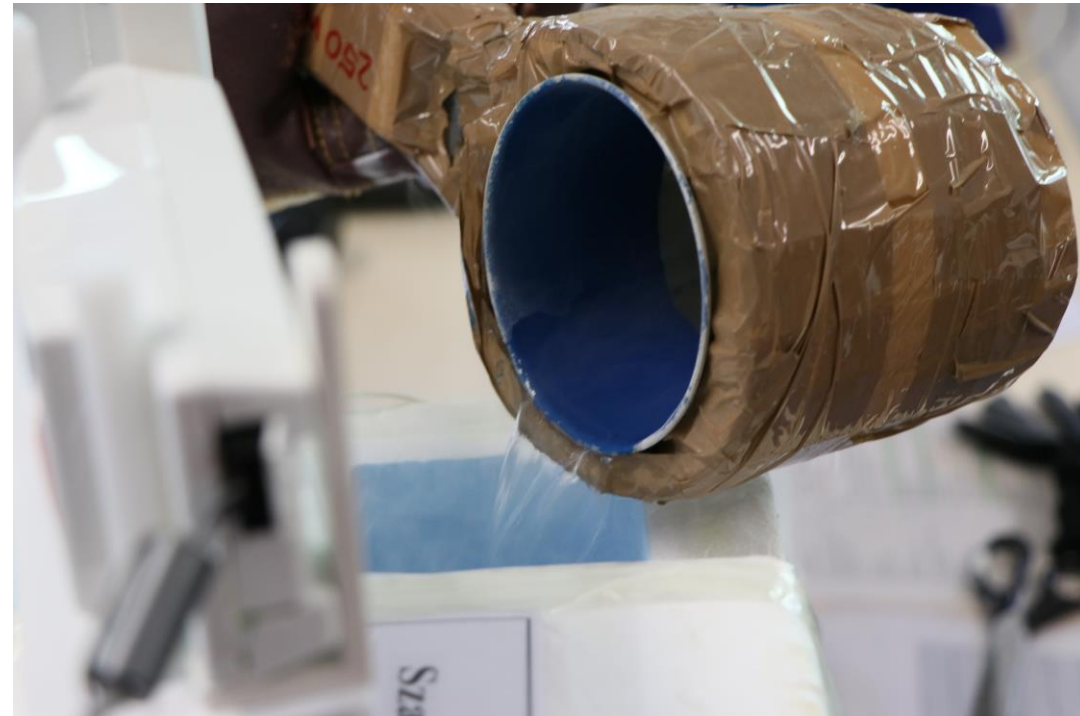
➤ NZ

- Restrictions foreseen, preemptive stockpiling

➤ Asia

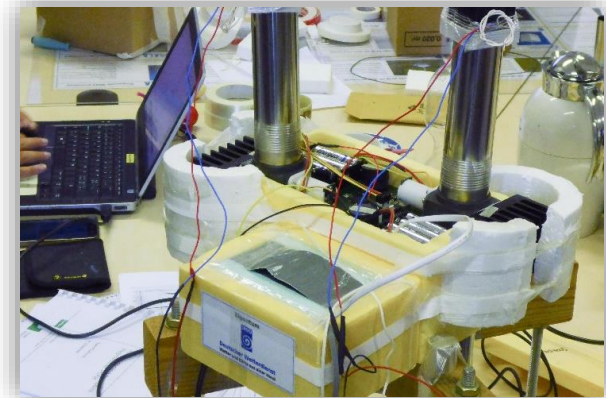
- Japan
 - Not available, limited amount in stock TAT (1)
 - Switch to Skydew
- Hong Kong - No issues, stockpiling if necessary

- Alternative cooling method
 - LC – TU Dresden cooperation (Ethanol, N₂)
 - FZJ: Dry ice/ethanol
 - CFH manufacturer: no statement
- Alternative instruments
 - Skydew, PCFH, FLASH-B

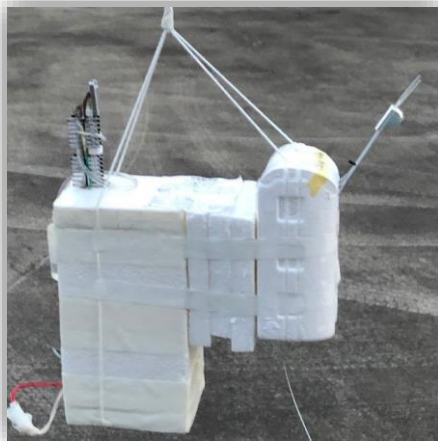




FPH/CFH



PCFH



Skydew



FLASH-B

Sites with CFH/FPH soundings

Deutscher Wetterdienst
Wetter und Klima aus einer Hand

