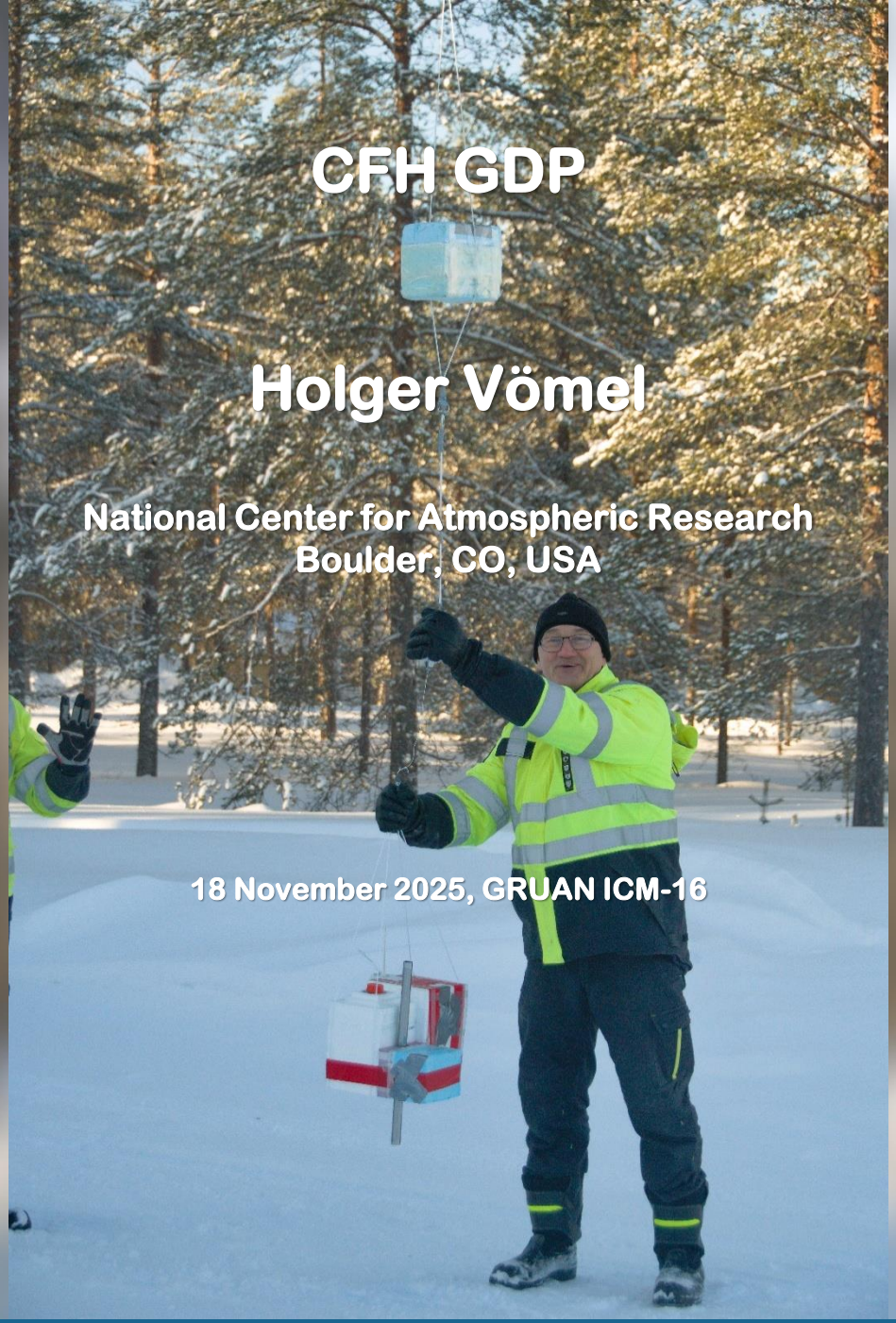
CFH GDP



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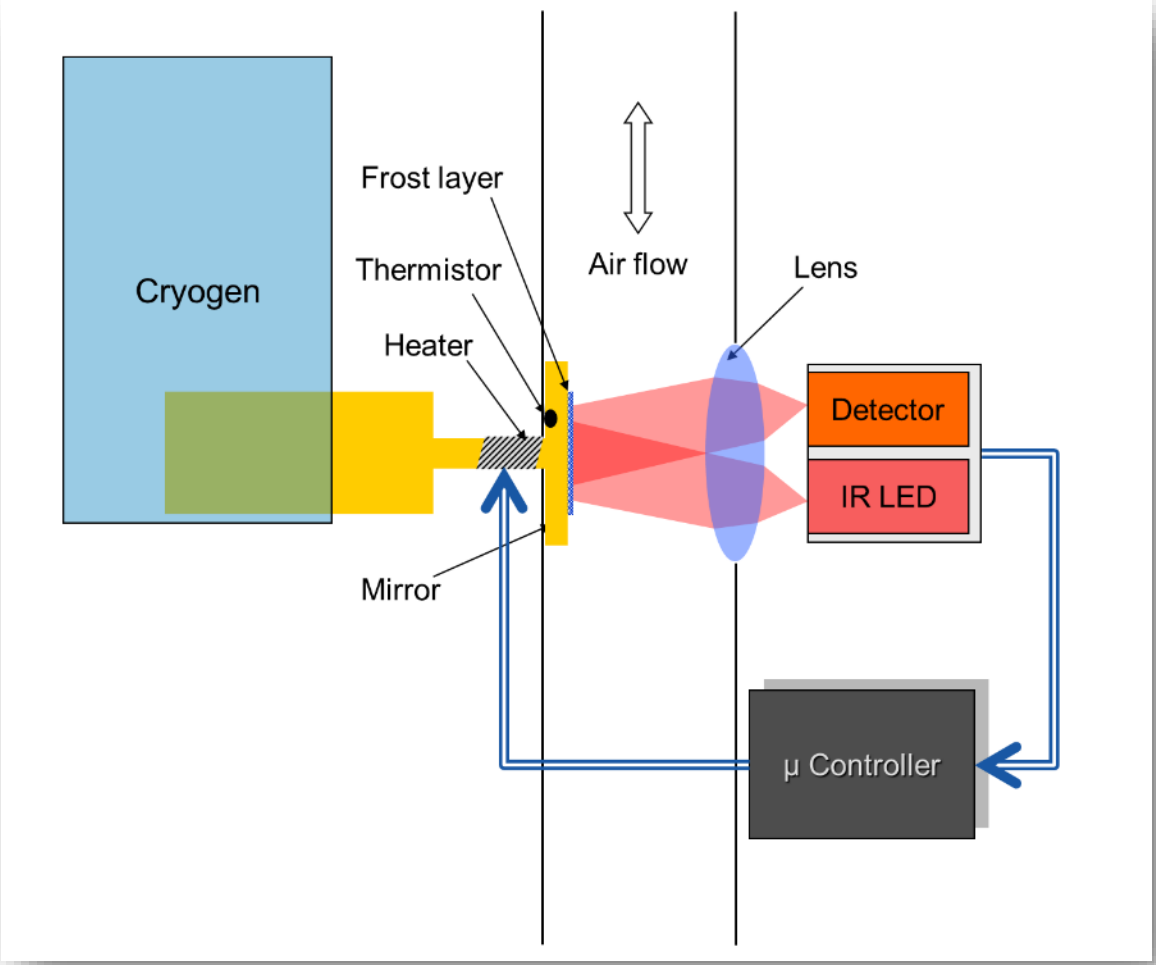
Frostpoint GRUAN Data Product

1) Description of uncertainties
2) Ground check
3) Documentation

Frostpoint Hygrometery



CFH and FPH use liquid cryogen
PCFH and Skydew use Peltier cooling

Uncertainty terms

- Calibration of mirror temperature measurement
- Controller stability

- Uncertainty of vapor pressure equation

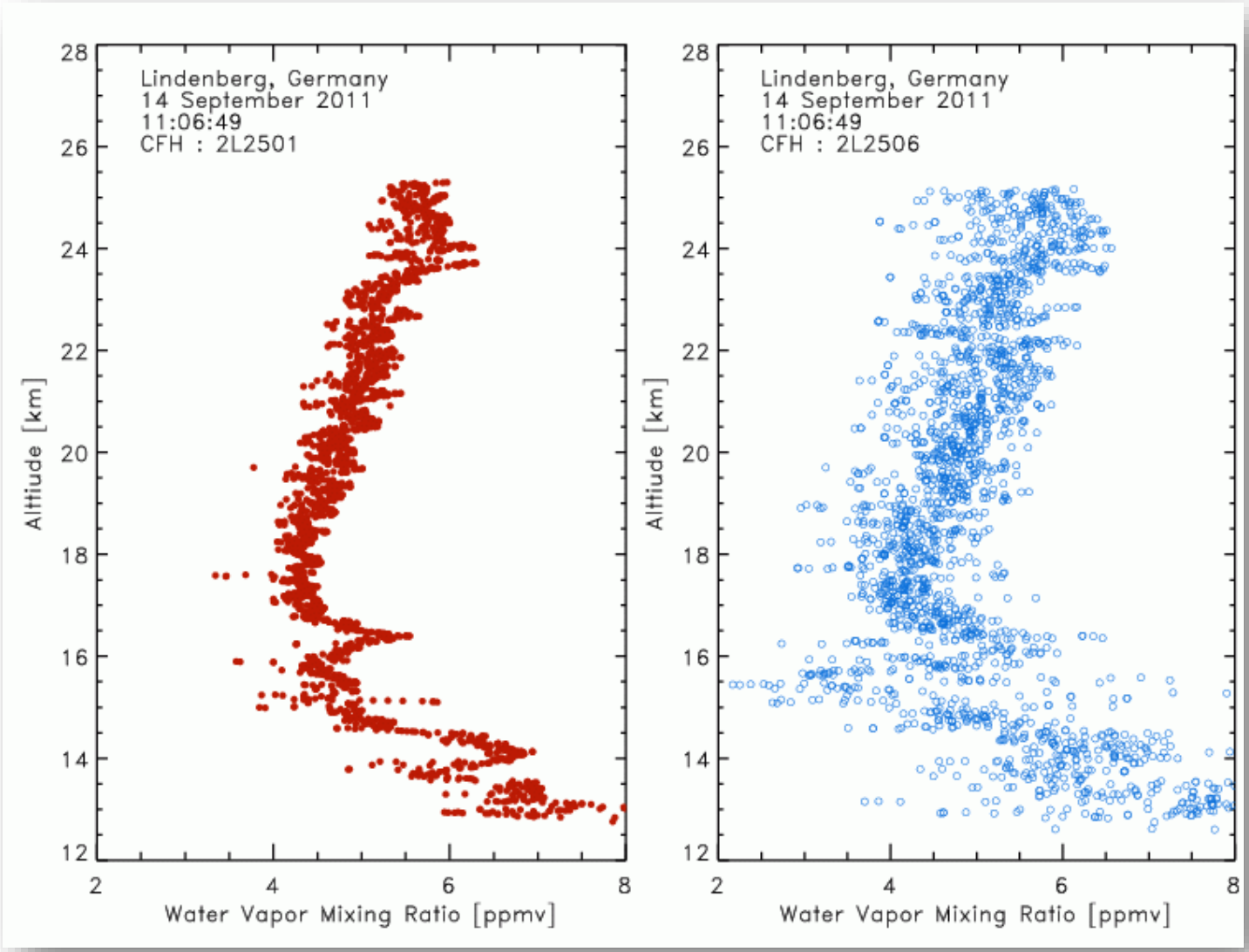
- Pressure uncertainty (mixing ratio)
- Air temperature uncertainty (relative humidity)

CFH uncertainty budget

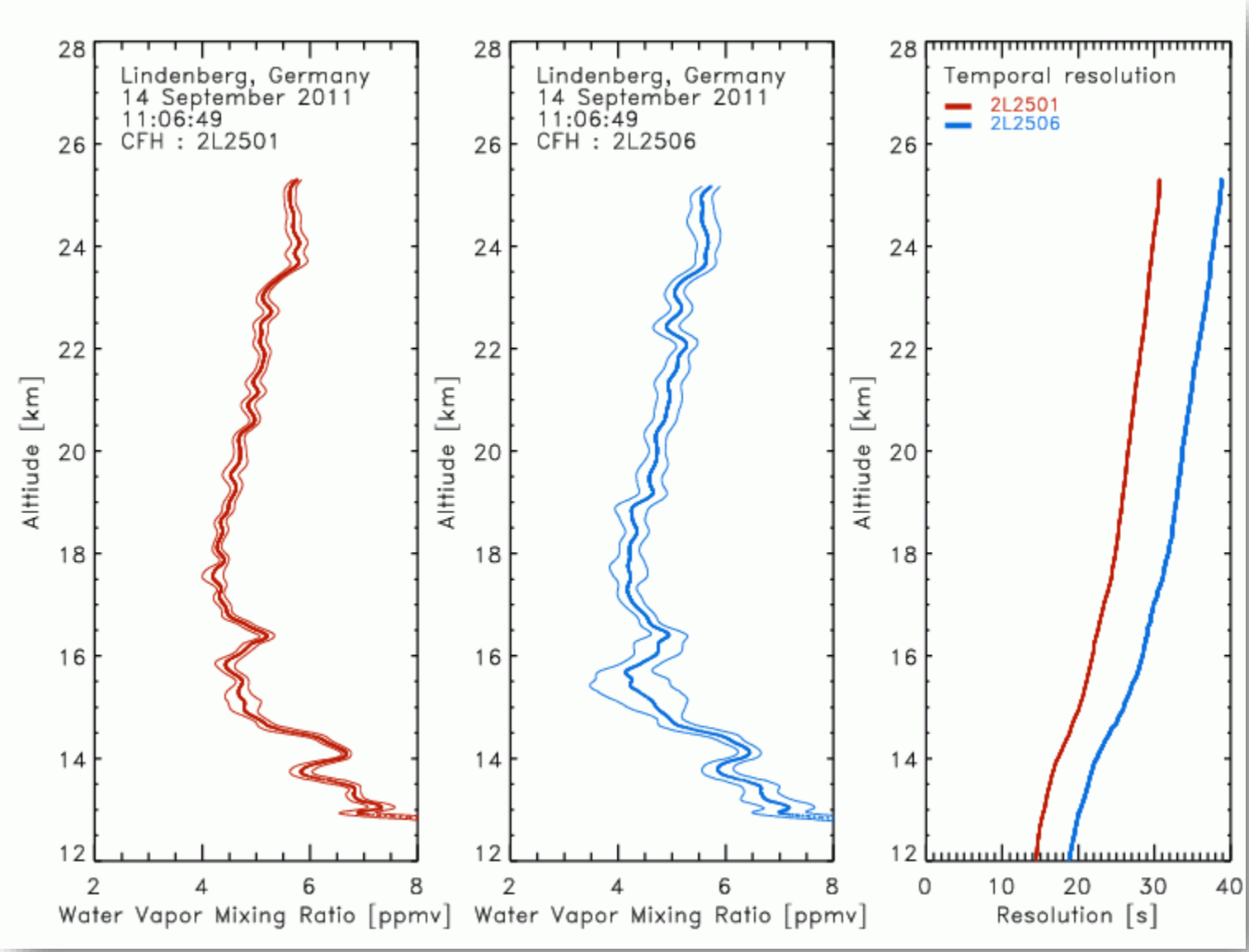
Thermistor calibration :	<0.05 K	(<1% mixing ratio)
systematic in profile		
systematic in time series		
Controller stability :	0.1 K … 0.5 K	(2% to 10% mixing ratio)
random in profile		
random in time series		

Contamination : Can be large. Is manually flagged out in processing

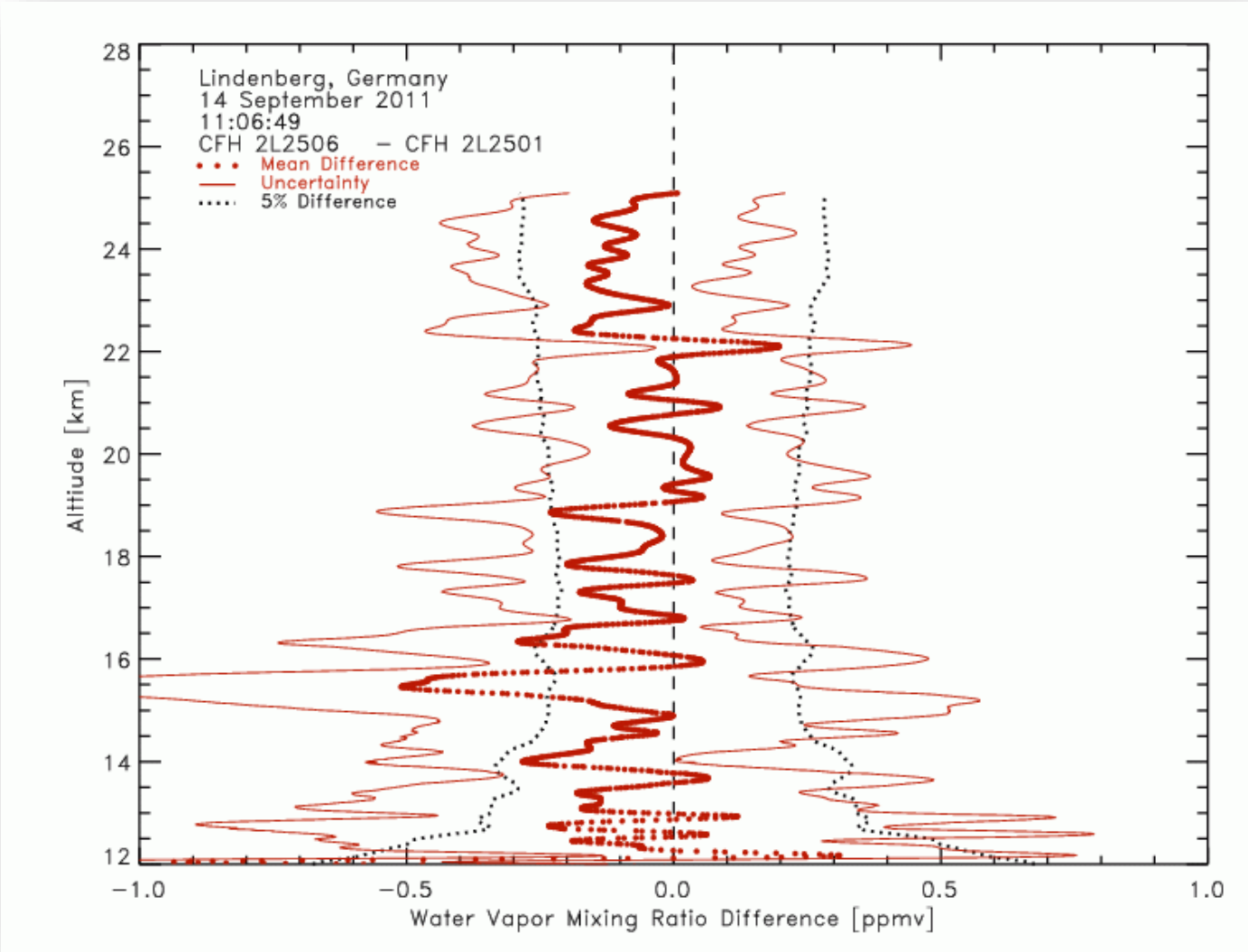
Sonde uncertainty and comparison (stratosphere)



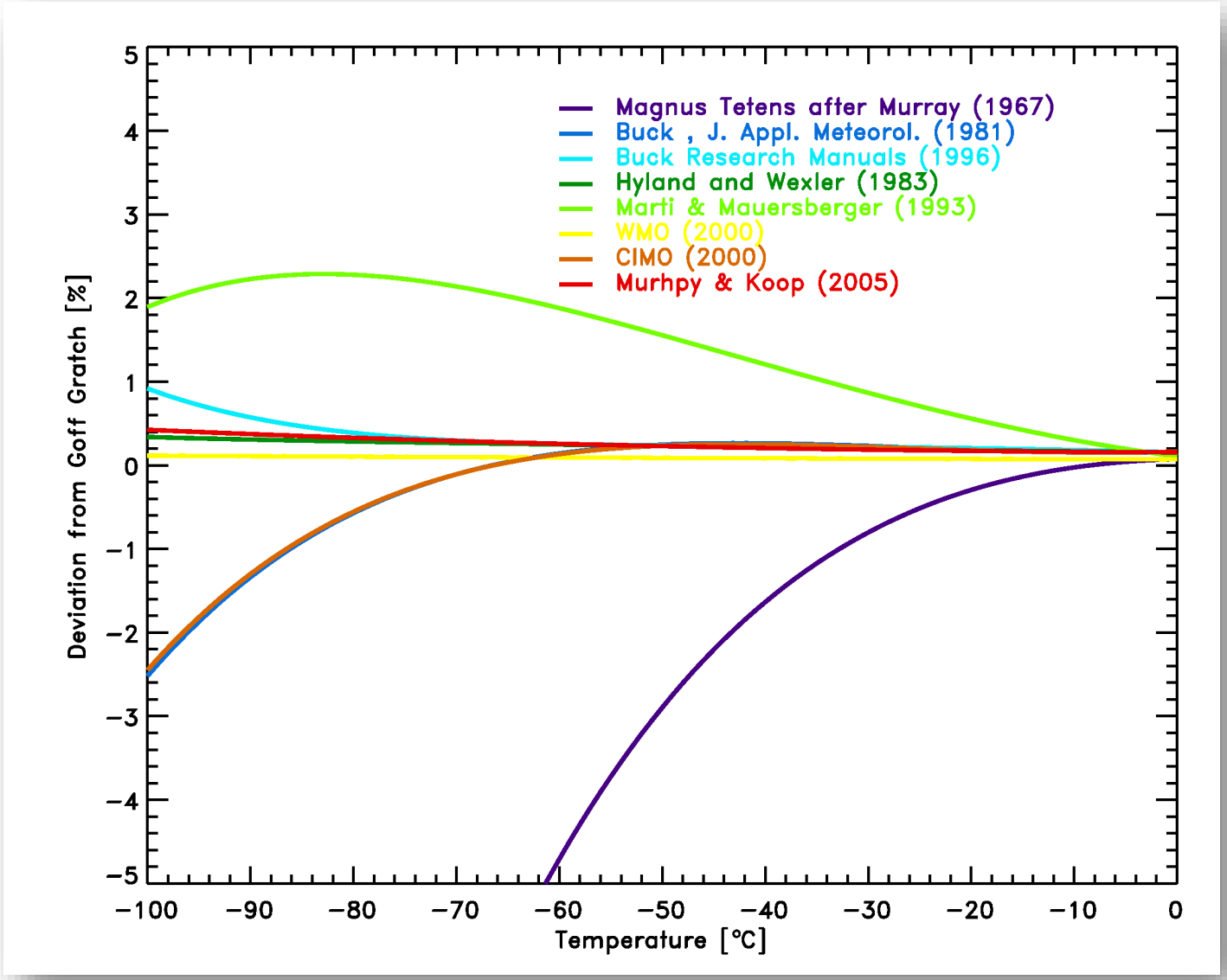
Sonde uncertainty and comparison (stratosphere)



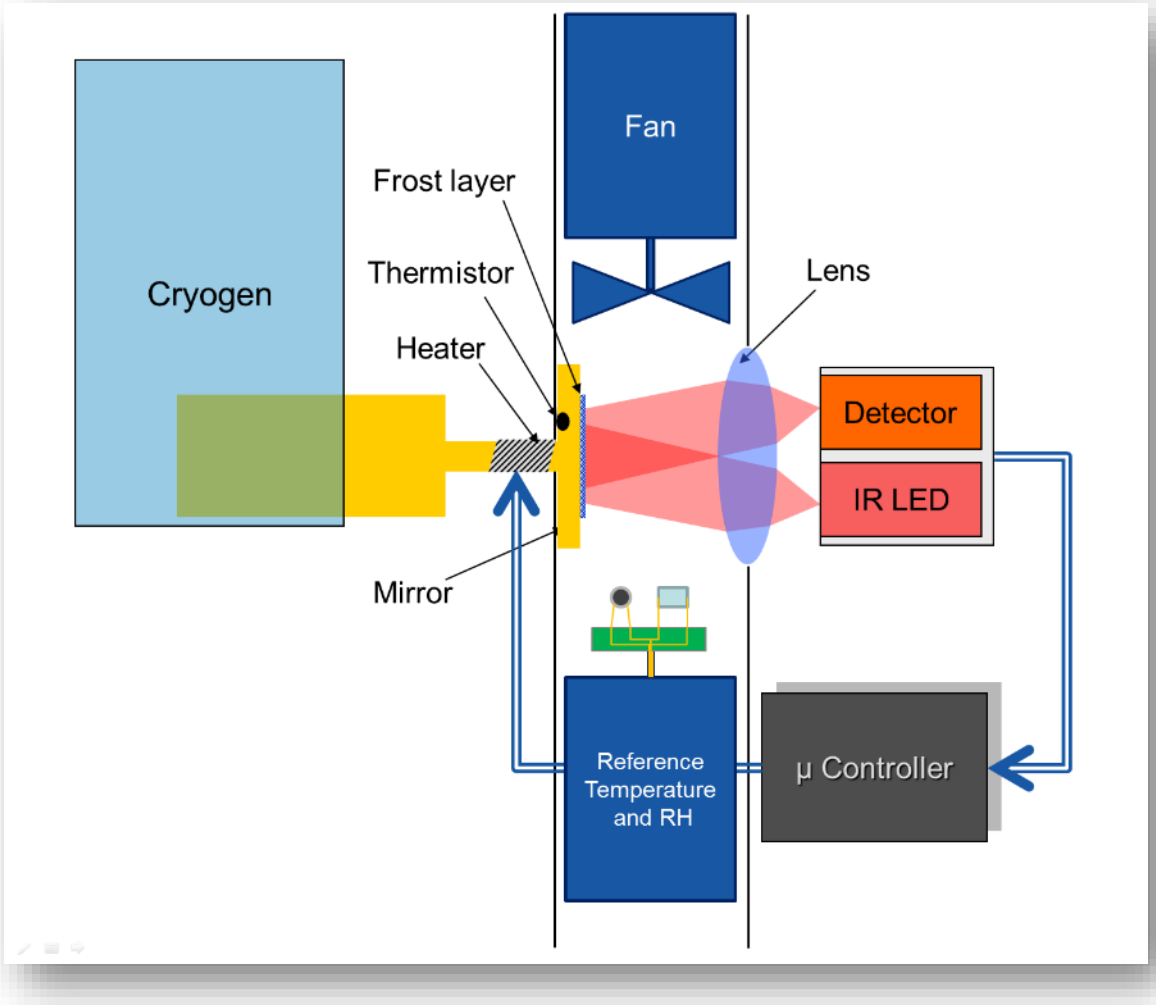
Sonde uncertainty and comparison (stratosphere)



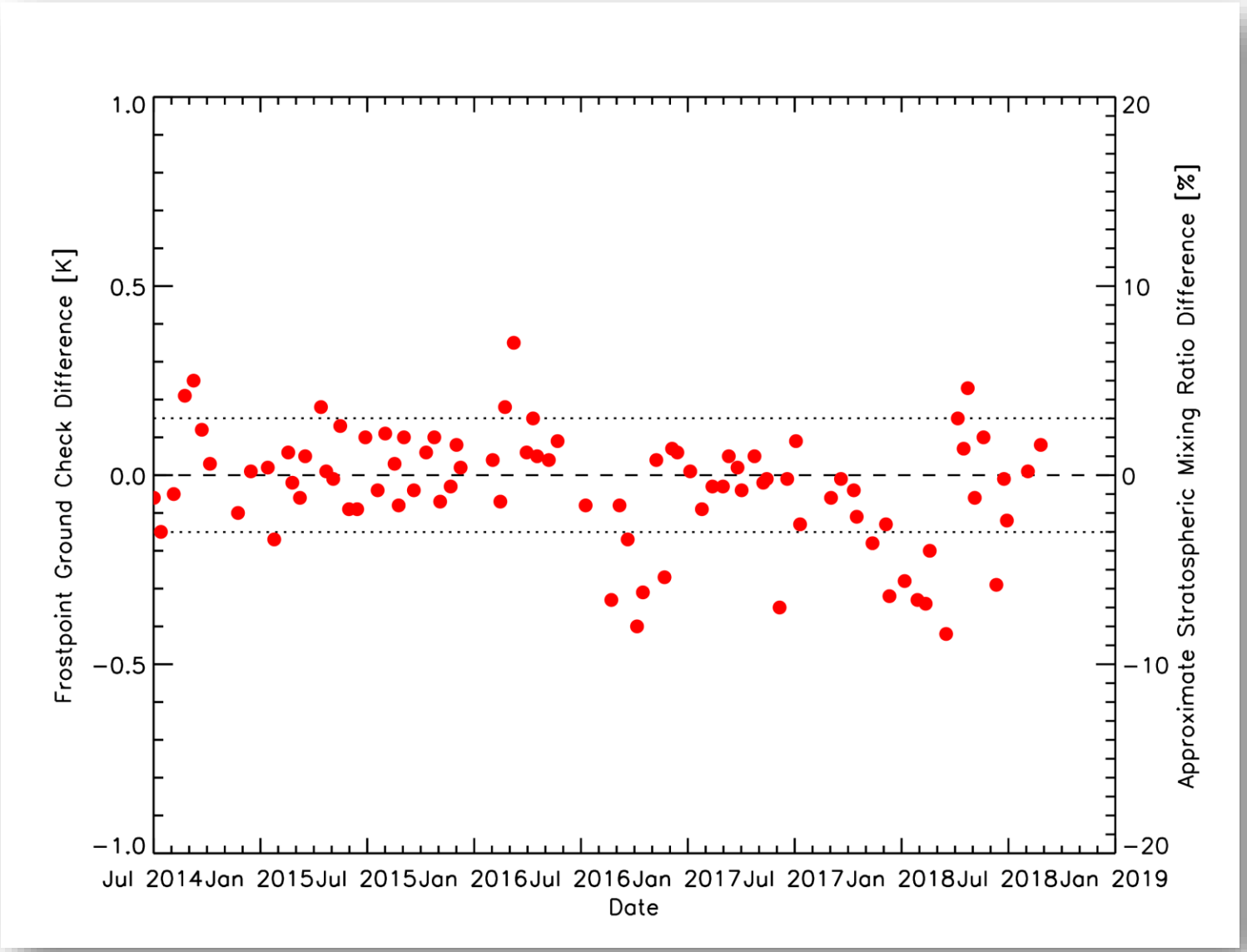
Comparison of vapor pressure equations



CFH Ground Check



Ground Check Lindenberg



Documentation

- Vömel, H., T. Naebert, R. Dirksen, and M. Sommer, (2016): An update on the uncertainties of water vapor measurements using Cryogenic Frostpoint Hygrometers, Atmos. Meas. Tech., 9, 3755-3768, doi:10.5194/amt-9-3755-2016.

- Vömel, H., D. E. David, and K. Smith (2007): Accuracy of tropospheric and stratospheric water vapor measurements by the cryogenic frost point hygrometer: Instrumental details and observations, *J. Geophys. Res., 112,* D08305, doi:10.1029/2006JD007224.

- Hall, E. G., A. F. Jordan, D. F. Hurst, S. J. Oltmans, H. Vömel, B. Kühnreich, and V. Ebert (2016): Advancements, measurement uncertainties, and recent comparisons of the NOAA frostpoint hygrometer, Atmos. Meas. Tech., 9, 4295-4310, doi:10.5194/amt-9-4295-2016.

Network for the Detection of Atmospheric Composition Change (NDACC)

NDACC is a GRUAN cooperating network

https://www-air.larc.nasa.gov/missions/ndacc/data.html#

NDACC has more than 1400 frostpoint profiles including uncertainty estimates

- Beltsville
- Boulder
- Costa Rica
- Lauder
- Lindenberg
- Ny.Alesund
- Sodankyla

Next steps

- Work with Lizzy Asher on harmonizing CFH and FPH uncertainty estimate

- To keep data series comparable it will be essential to use the same method to estimate uncertainties for the same technology
- Golden points do not provide uncertainties or vertical resolution and are not a suitable approach