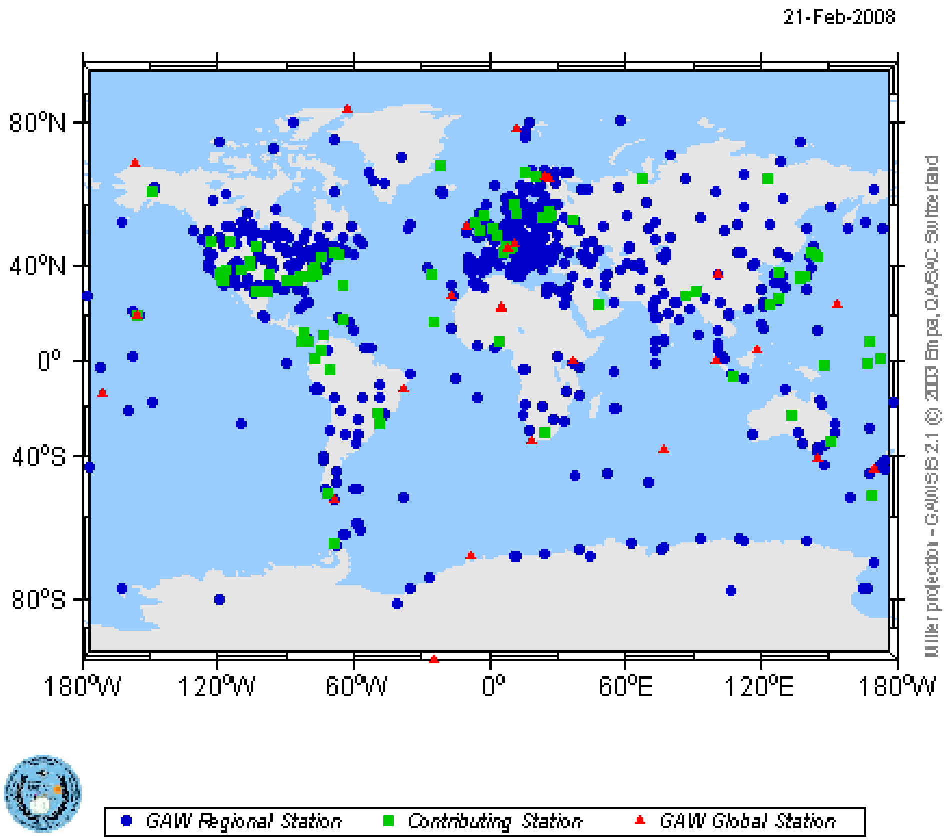
Pallas-Sodankylä GAW site (global)

Pallas-Sodankylä twin site is a global sites in WMO GAW network. **Pallas** is the clean air site for background air chemistry observations. **At the surface** the twin site belongs to the huge **boreal pine forest region**, known also as ”Taiga”, extening from the Pacific to Atlantic. The upper air monitoring and O3/UV observations are performed at **Sodankylä** at the auspices of Arctic Research Center of Finnish Meteorological Insitute (FMIARC). **Upper atmospheric layers** at Sodankylä represent **genuine Arctic circumstances (polar vortex, aurora)**



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FMI Arctic Research Center_ Observation program at Sodankylä

Observation	Starting year
Ground weather observations (Automated since 2004)	1908
Radiosondes (Automated 2006)	1949
Solar radiation observations , SO_2	1957
Radioactivity	1960
Total Ozone observations	1988
Ozone sondes	1988
UV spectrum, NO2 column	1990
Aerosol backscatter profile 490 nm and 940 nm from backscatter sondes	1994
Meteorological Mast Experiment ✓ Soil parameters ✓ Snow parameters ✓ Flux measurements, ✓ Solar and IR radiation ✓ Bio-fluorescence	1999

Stratospheric water vapour profile from frost point hygrometer and Alpha-Lyman hygrometer	2002
Finnish Ultaraviolet Research Centre (FUVIRC) ✓ UVB, UVA, air and soil temperature measurements from FUVIRC ambient UV modulation field for bio-effects of added UV	2002-2004
Satellite validation/calibration pixel (new instrumentation) ✓ Continuous reflectance monitoring on a high resolution spectrometer (340 -2400 nm) from the 30 mtower for satellite image validation (pine forest; lichen covered bare land; snow surface) ✓ Atmosphere optical depth in five wavelengths ✓ Broad band albedo at variable heights,UValbedo ✓ Cloud camera ✓ Ground moisture grid ✓ GPS Intergrated water vapour column ✓ MW Temperature and RH profiler ✓ Lidar for cloud layer heights and fractional coverage ✓ Mobile radiosounding station ✓ FTIR for GHG columns (2009)	2005-2007

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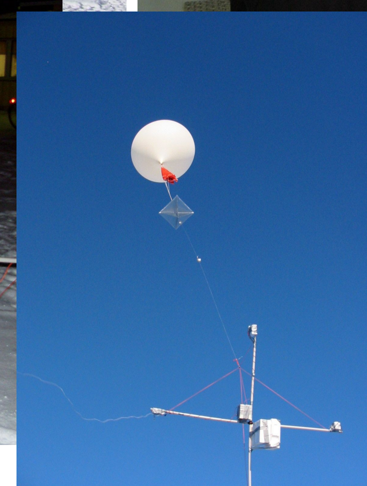
LapBIAT
EU transnational acces site





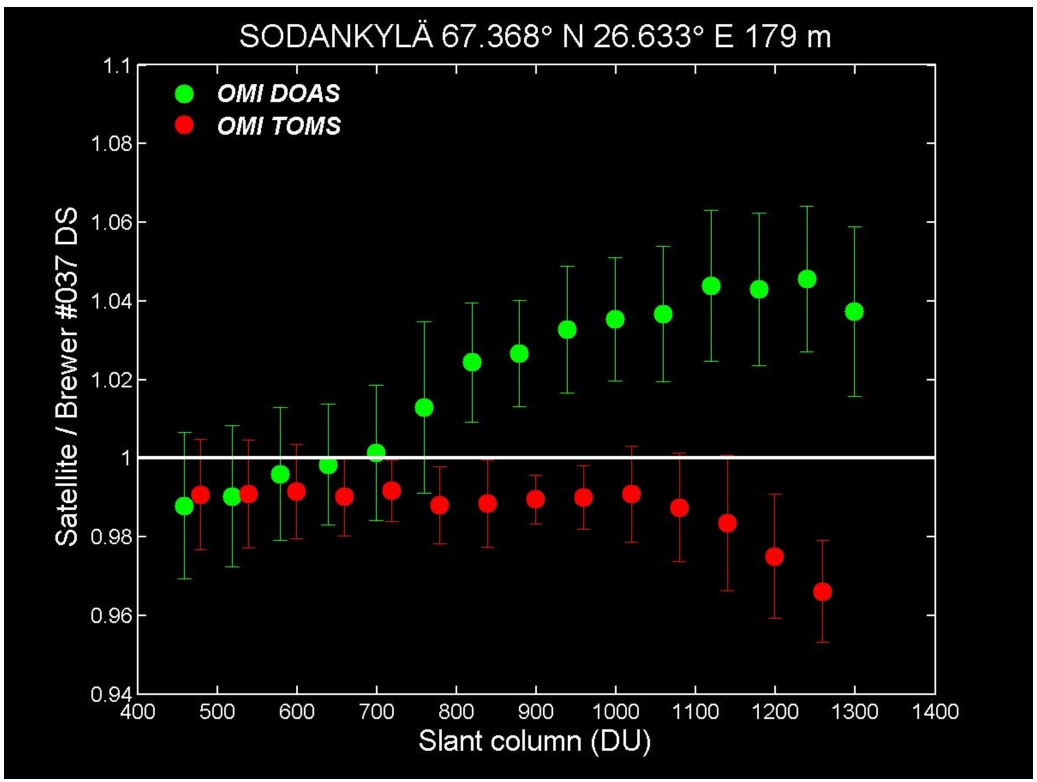

Hygrometer Intercomparison Campaign at Sodankylä, LAUTLOS 2004

Esko Kyrö, Rigel Kivi, Juha Karhu, Timo Turunen, Tuomo Suortti, Timo Sukuvaara, Ari Paukkunen, Paul Ruppert, Rolf Maag, Thomas Brossi, Ulrich Leiterer, Tatjana Naebert, Gisela Peters, Vladimir Yuskov, Alexander Lukyanov, Alexander Katz, Sergey Khaikin, Leonid Korshunov, Daria Vasilyeva, Holger Vömel, Roland Neuber, Marion Müller, Niklaus Kämpfer, Beat Dauber, Alexander Häfele, Dietrich Feist

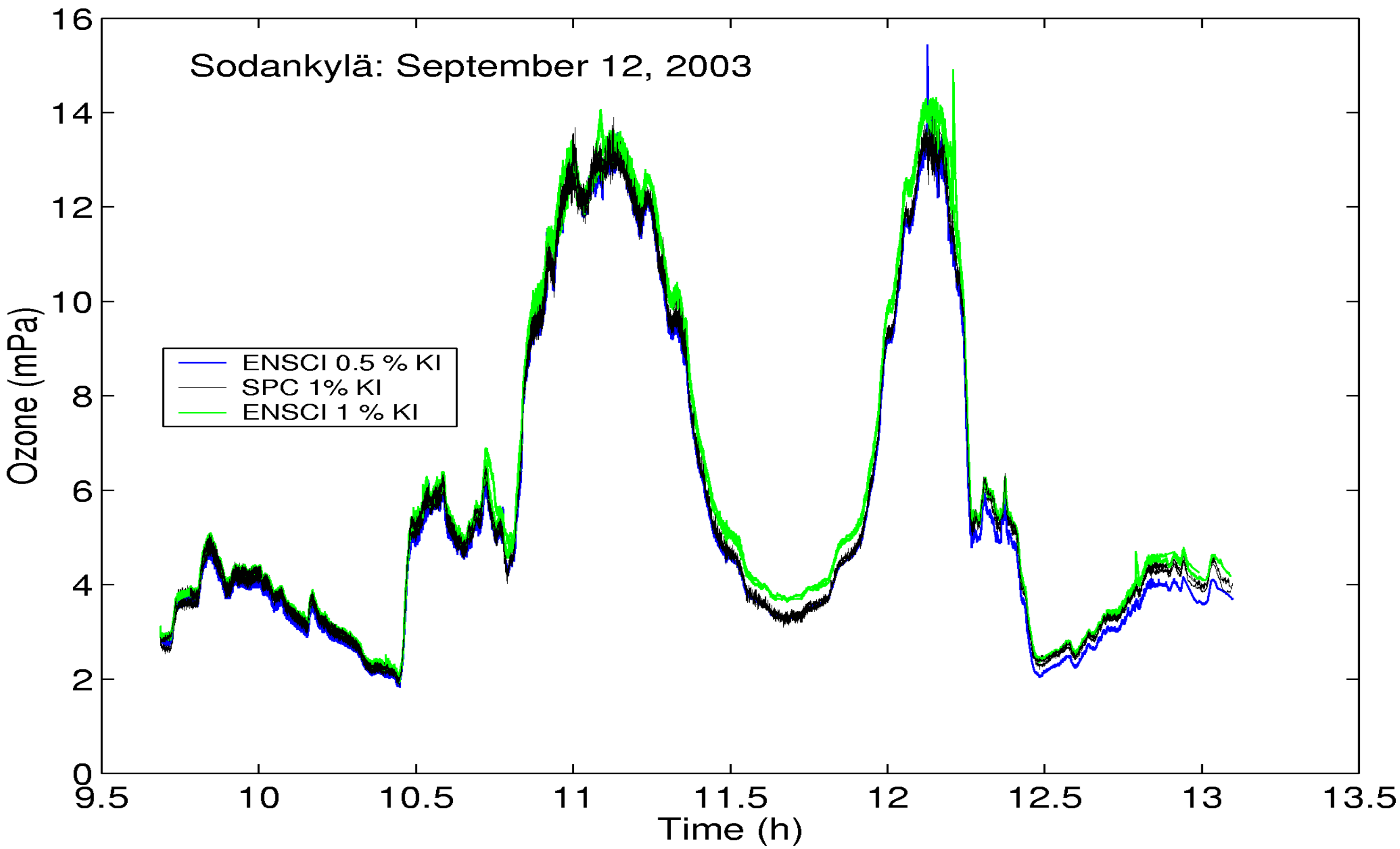
Arctic Research Centre (FMI/ARC), Sodankylä, Finland
German Weather Service, Meteorological Observatory Lindenberg, Germany
Central Aerological Observatory Moscow, Russia
Alfred Wegener Institute for Polar and Marine Research Potsdam, Germany
Meteolabor AG, Switzerland
Vaisala Oyj, Helsinki, Finland
University of Colorado, Boulder, USA
University of Bern , Switzerland

SAUNA campaign 2006-2007: Extremely accurate total ozone measurements (< 1%) are important in monitoring the Montreal protocol influences globally, as well as in developing tropospheric ozone retrievals from satellites.

NASA-led campaign to compare space (OMI) and ground based measurements of ozone: KNMI,BIRA,ESA,DWD,CMI,NOOA,IZA,FMI



ENSCI-2Z and SPC-6A sonde comparison flights,



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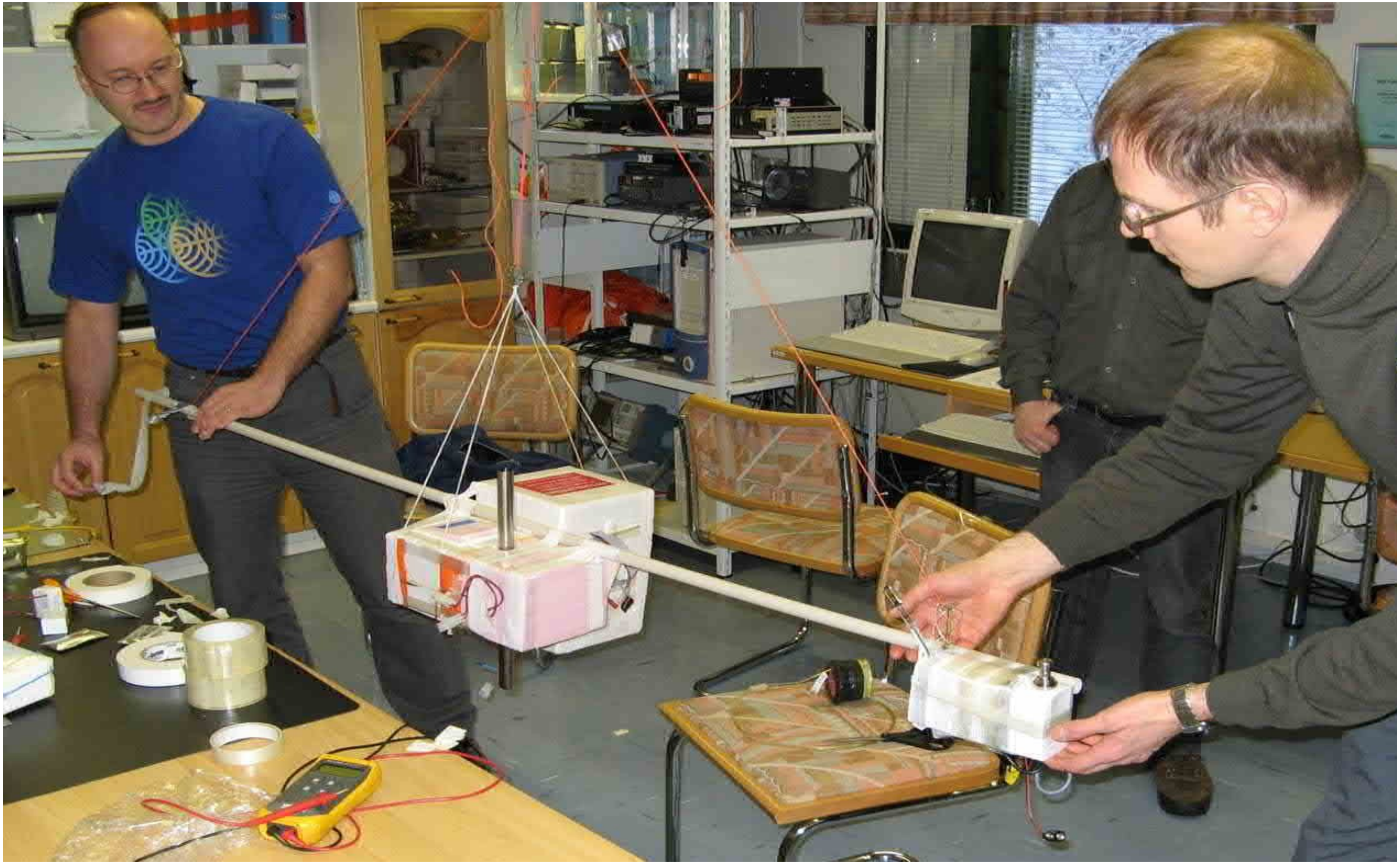
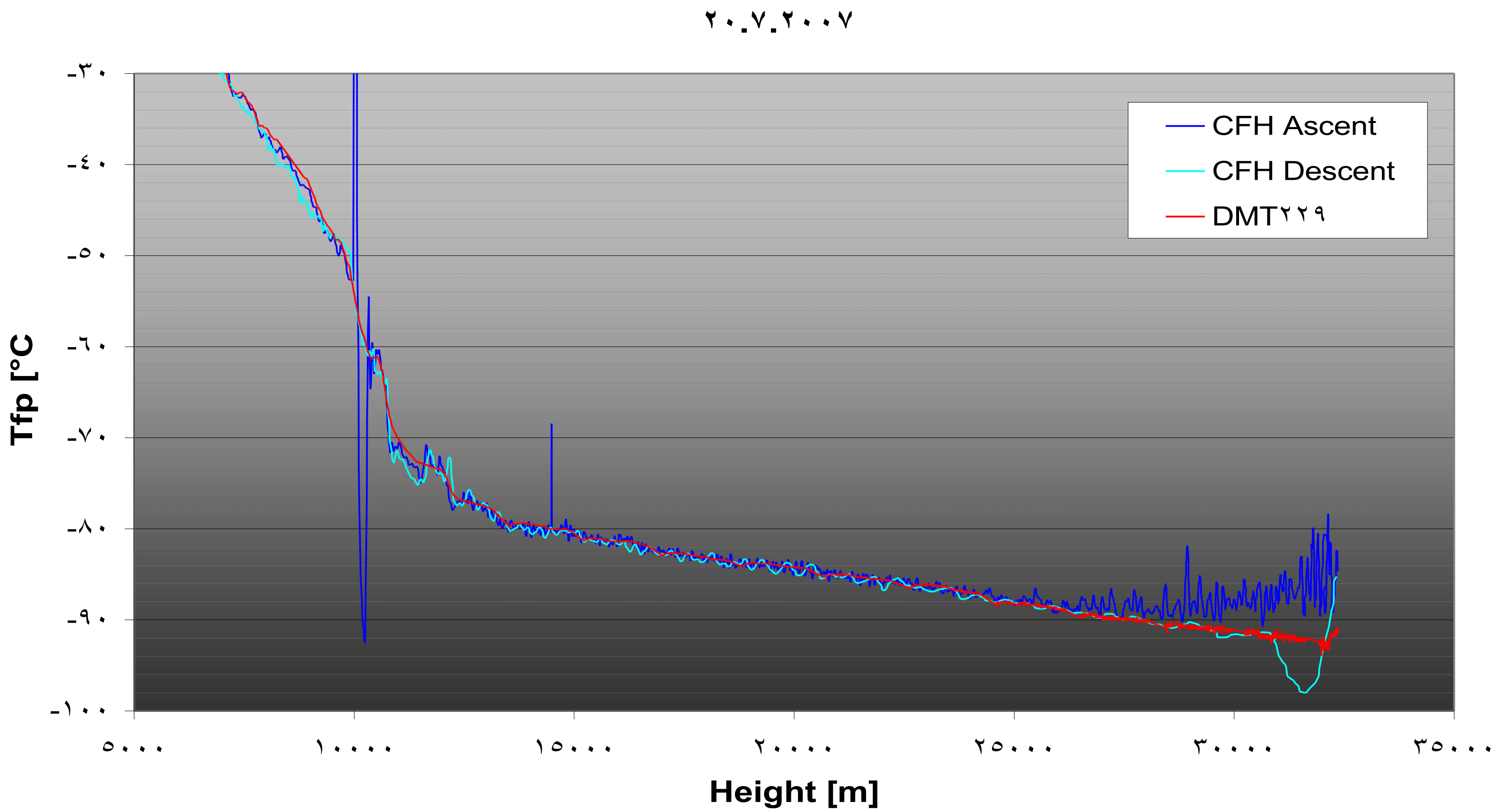
Vaisala DryCap campaign in 2007

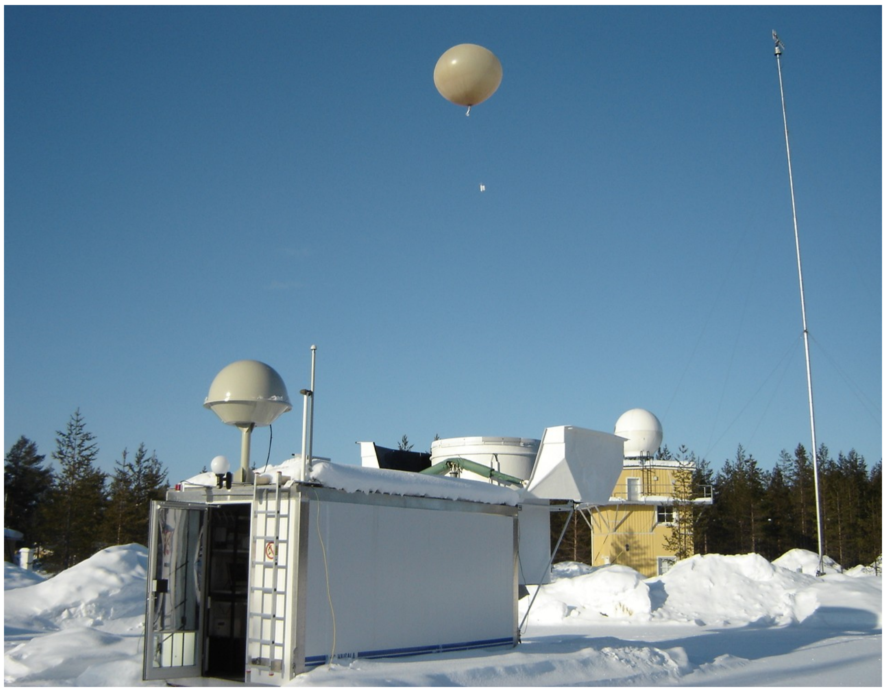


Drycap-U performance in sounding trials Sodankylä 13.- 25.8.2008



EUMETSAT

EPS campaign 2007



To validate IASI instrument onboard Metop satellite

- *Radiosoundings*
- *AWS surface weather*
- *The total ozone*
- *ozone soundings*
- *Stratospheric H2O*
- *FGI-GPS reference site for the total H2O column*
- *MW profiler H2O profiler*

CFH vs RS-92 models

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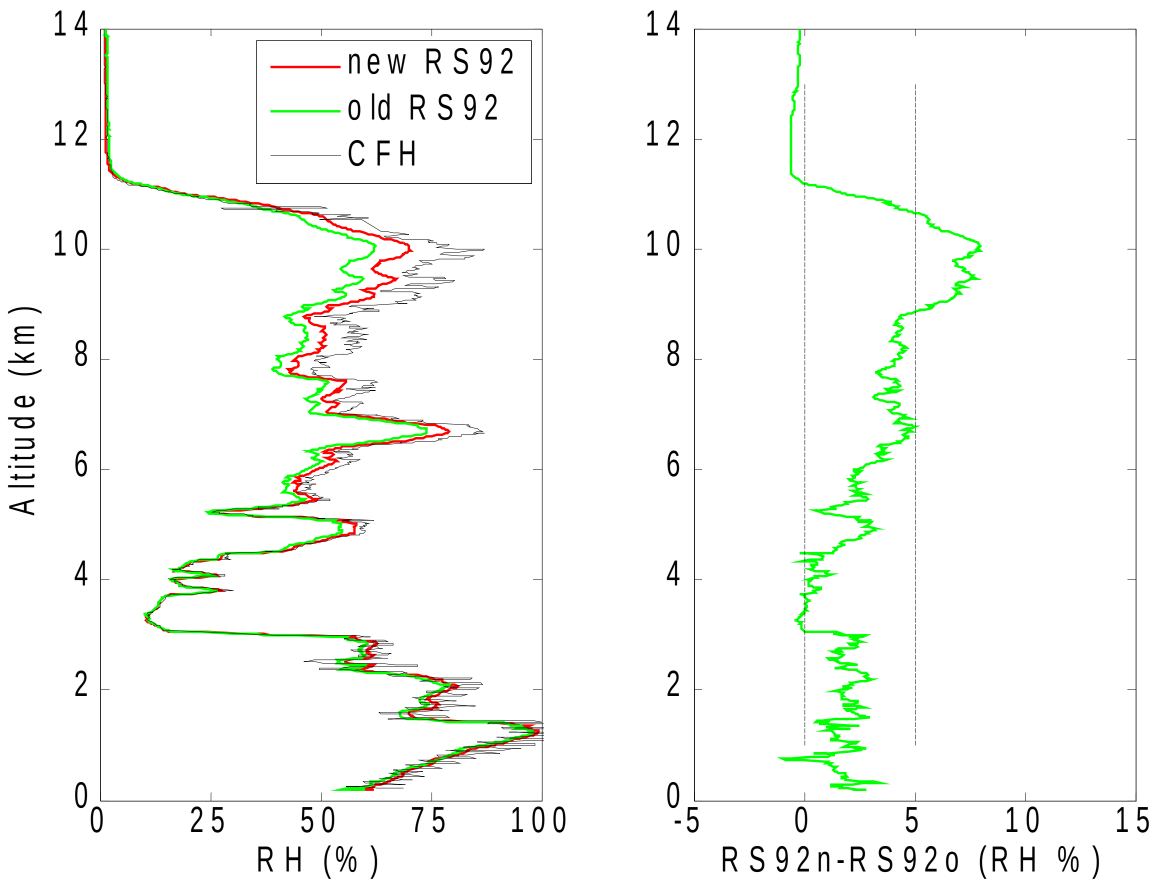

An example of a simultaneous measurement by CFH (cryogenic frostpoint hygrometer) and the two RS92 models. Left: relative humidity profiles by 3 intruments in the same payload. Right: difference between the new and the old model of the RS92. *From Kivi et al., 2008.*

The Boulder workshop focus areas for the GRUAN

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- Monitoring and detecting climate variability and change: Both climate variability and long-term climate change need to be well-characterized in order to unambiguously assess the ability of our climate models, and to understand the physical processes underlying recent climate changes (CCSP, 2006);
- Understanding the vertical profile of temperature trends: Uncertainties remain large, particularly within the tropics (CCSP, 2006);
- Understanding the climatology and variability of water vapour, particularly in the upper-troposphere and lower stratosphere, and changes in the hydrological cycle: Changes in the upper troposphere and lower stratosphere are very important to assessing climate sensitivity, but have as yet been inadequately characterized. Hydrological cycle changes are also important for, e.g., understanding changes in the frequency of floods and droughts, and assessing rainfall efficiency, and need to be better quantified;
- Understanding and monitoring tropopause characteristics: The tropopause is a sensitive indicator of changes in the properties of the troposphere and stratosphere (Santer et al., 2003; Seidel and Randel, 2005);
- Monitoring ozone, trace gases and aerosols: There is a need for much better understanding and monitoring of the vertical profile of ozone, aerosols and other constituents that are important climate forcing agents, but have been poorly quantified and characterized to date. A variety of new satellite instruments can be used, but they require ground-truth data to be effective for climate monitoring. For ozone monitoring, consideration of results from NDACC, SHADOZ, and recent tests, such as IONS04 and IONS06, could prove useful in ascertaining optimal instrumentation;
- Prediction of climate variations: There is emerging evidence that at least sub-seasonal and potentially seasonal-to-decadal predictions require an accurate characterization of initial boundary conditions. This is particularly so in mid-latitude winter seasons, with the possibility of strong stratosphere-troposphere interactions (Scaife et al., 2005);
- High-quality reanalyses of climate change: Reference sites will prove essential for helping to characterize observational biases and the impact of observing system changes, as well as to understand model errors, all of which are important aspects in creating high-quality reanalyses (Schubert et al., 2006);
- Understanding climate processes and improving climate models: Understanding and constraining climate change predictions requires better understanding and improved simulation of climate processes, and not simply changes in a single metric, such as temperature. Improved understanding of changes across a broad range of variables is therefore required. Such an approach can also usefully be applied in constraining model predictions (Forest et al., 2002);
- Satellite calibration and validation: Satellite radiances require calibration against a ground truth to unambiguously remove non-climatic influences, in order to be useful for climate monitoring (Ohring et al., 2005; GCOS, 2006). The GRUAN network proposed in this document, and the GSICS (Global Space-Based Intercalibration System) are complementary in meeting this need. Both are required if the future observing system is to prove adequate for climate monitoring (see section 9).