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# GRUAN site: Sodankylä, Finland

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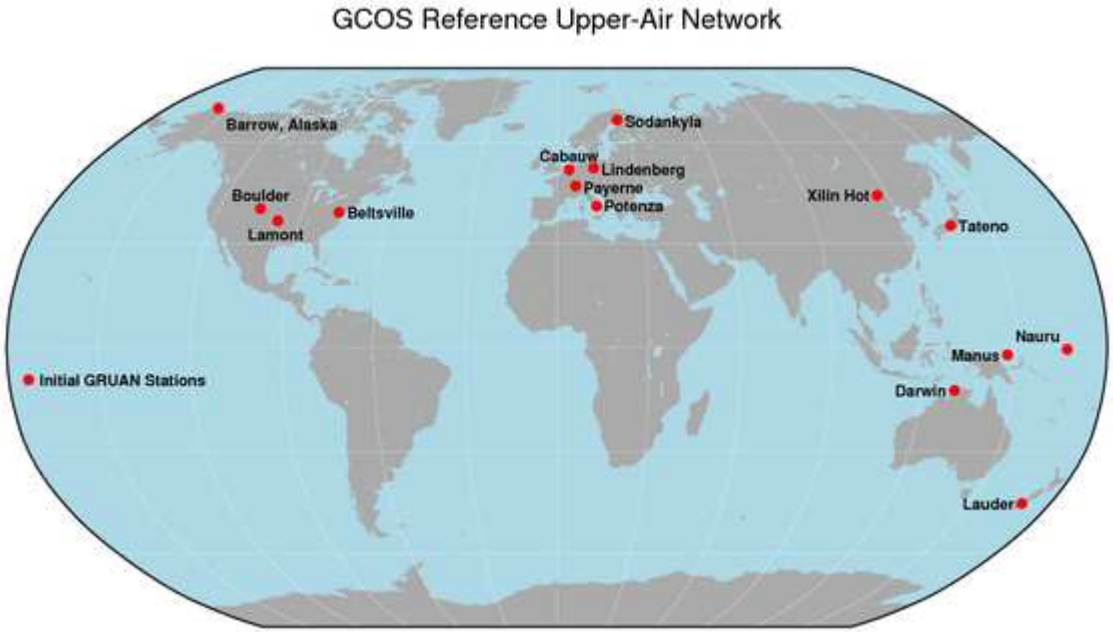
# Outline

- Sounding program (CFH, RR01, FLASH-B)
- GB observations (FTS, GPS, MW, Lidar)
- Plans and perspectives

Photo by Matias Takala

# Location

Sodankylä site is operated by the Finnish Meteorological Institute Arctic Research Centre (FMI-ARC). Location of the site is 67.4 °N, 26.6 °E, 179 m above mean sea level; WMO station's number is 02836

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# Sonde observations at Sodankylä

- Twice daily 00/12 UT: RS92 radiosondes launched on regular basis, software v. 3.62 at present in operational mode and 3.64 for research soundings
- Ozonesondes are also launched on regular basis once per week and additional ozone sondes have been included in other soundings. Ozone soundings have been submitted to GRUAN database using the GRUAN RS Launch client software developed by Michael Sommer at the GRUAN Lead Centre.

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# Sonde observations at Sodankylä

UTLS water vapor :

- Cryogenic Frostpoint Hygrometer (CFH)
- Fluorescent Advanced Stratospheric Hygrometer (FLASH)
- Stratospheric sondes have been flown mainly during winter/spring period in order to sample air in the Arctic vortex. During the recent years we have flown the stratospheric sondes also during other seasons related to various campaigns. Stratospheric water vapor sondes since 2004 have always included comparison with the RS92 models. Thus we have six years of CFH/RS92 comparisons covering the production upgrades of the RS92.
- Tests of the new Vaisala climate research sonde RR01, which is currently in the development phase. This activity started in 2007 at FMI Sodankylä (first prototypes of the instrument), consistent results during LAPBIAT in 2010, campaign ongoing in 2011.
- Also several experimental versions of the FLASH-B sonde have been flown in Sodankylä.

Aerosol sondes

- Cloud and aerosol detection by COBALD sondes, and by BKS sondes

# LAPBIAT Atmospheric Sounding Campaign

## main phase in January- June 2010, soundings in January-March 2010

**1. Balloon borne sondes (18 +15 payloads altogether; 119+53=172 individual instruments)**

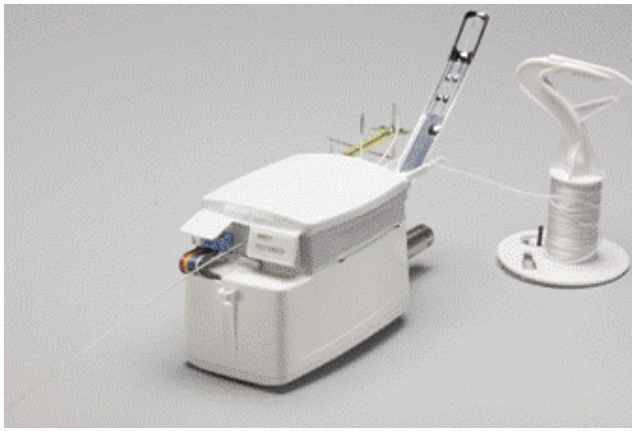
Vaisala RR01 (21); InterMet (17) ; Vaisala RS92 (47) ; GRAW (11)

FLASH-B/RS92 (12); CFH/ozonesonde/InterMet/RS80 (19 sondes)

ETHZ COBALD aerosol sonde (13); BKS aerosol sonde /ozonesonde/RS80 (2)

**2. Remote sensing**
MIAWARA-C radiometer;
FTIR, GPS, Lidar; Satellite instruments: MLS, IASI

# RR01, Vaisala Reference Radiosonde prototype



Vaisala has launched a program to develop an operational reference grade radiosonde for climate studies. Program focuses first on UTLS humidity measurements. This is targeting the needs of GRUAN network.

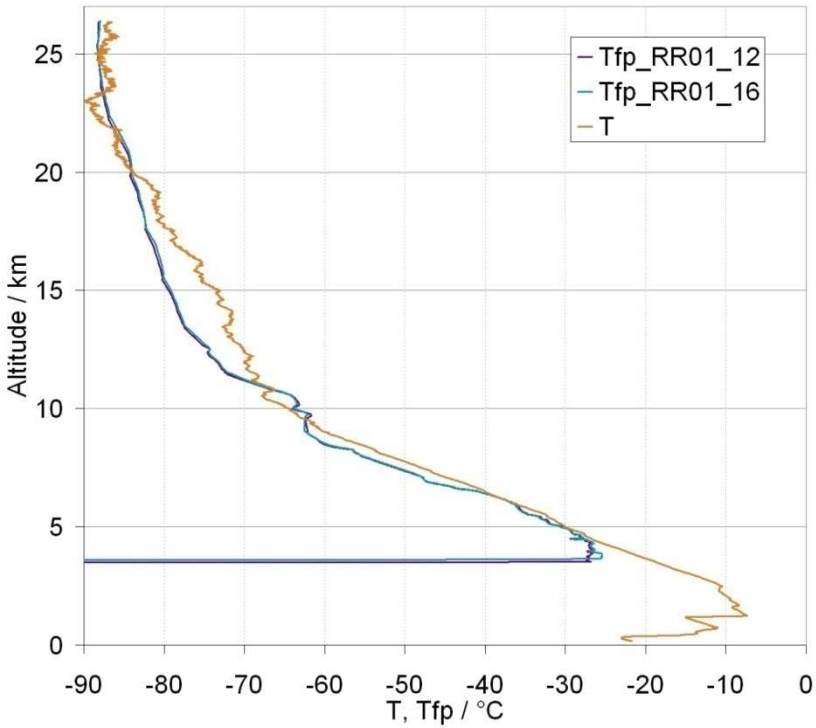
- RS92 radiosonde+DRYCAP® sensor module
- DRYCAP® capacitive thin film sensor
- Frost point temperature range -30..-90 ℃
- Operated at constant temperature
- Response time is not temperature dependent, thus temperature correction is not needed
- Sensor drift is reduced by autocalibration

During LAPBIAT campaign in January-March 2010 three different wind shield designs and radiation shield was tested.

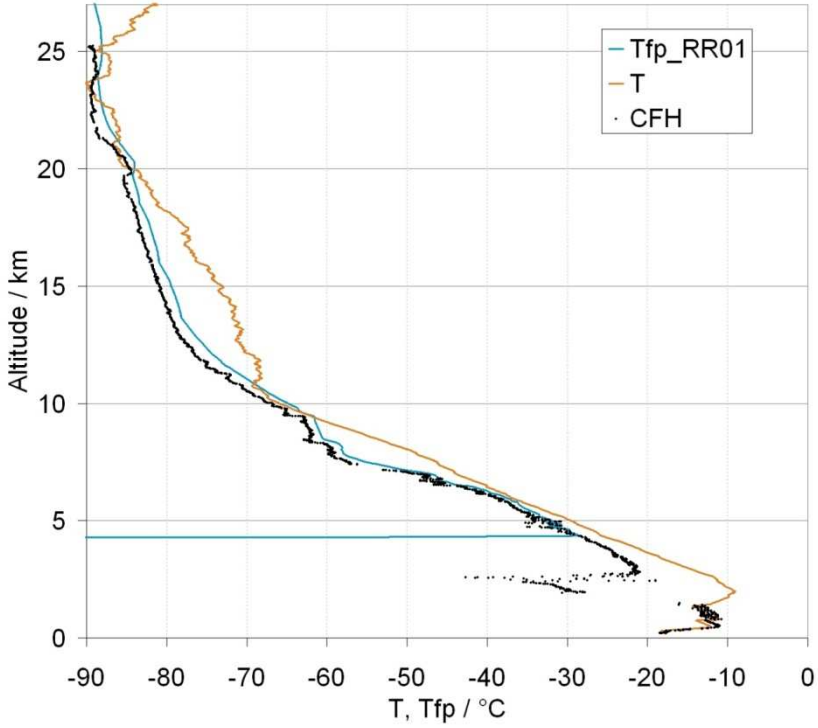
Comparisons with CFH cryogenic frost point hygrometer.

# RR01, Vaisala reference radiosonde prototype

A



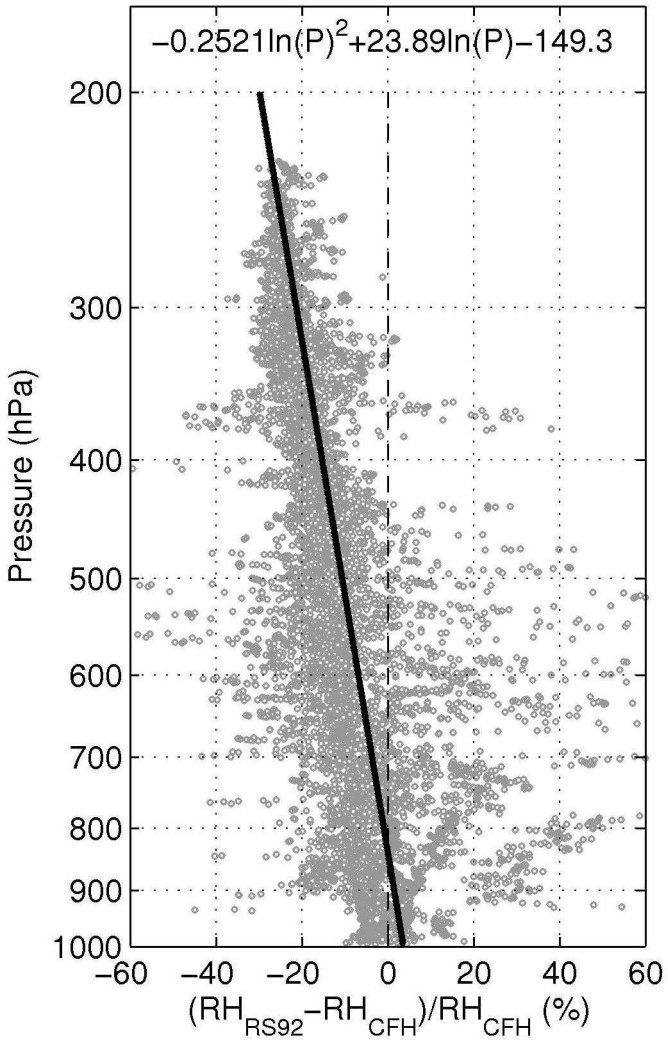

B




RR01_16 with radiation shield and
RR01_12 without radiation shield

Comparison with the CFH

*From: Lehtola et al., 2010*




Day

## RS92 vs. CFH

Relative difference between RS92 and the CFH humidity profiles during daytime flights in Sodankylä from May 17, 2009 until August 13, 2010. The RS92 sondes had a modified type of coating of the sensor arm. These sondes have been produced since June 2008 (Vaisala, (2010) Data continuity, available at http://www.vaisala.com/weather/products/ datacontinuity. html). Can the same corrections be applied to earlier RS92 versions?

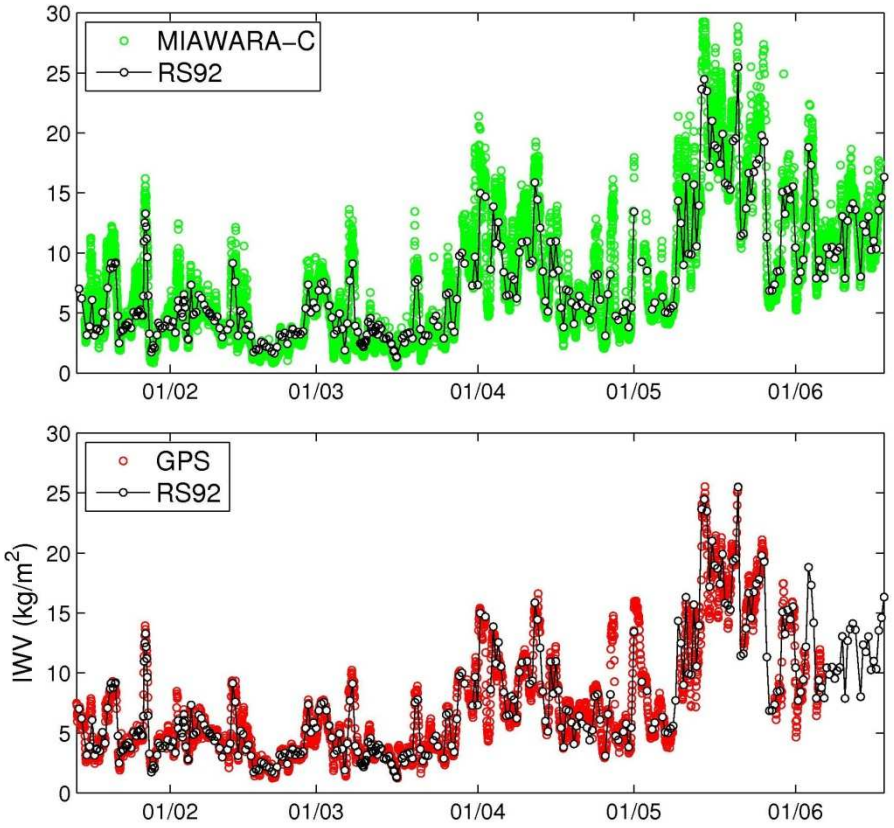
Changes that can be identified with the help of the radiosonde serial number

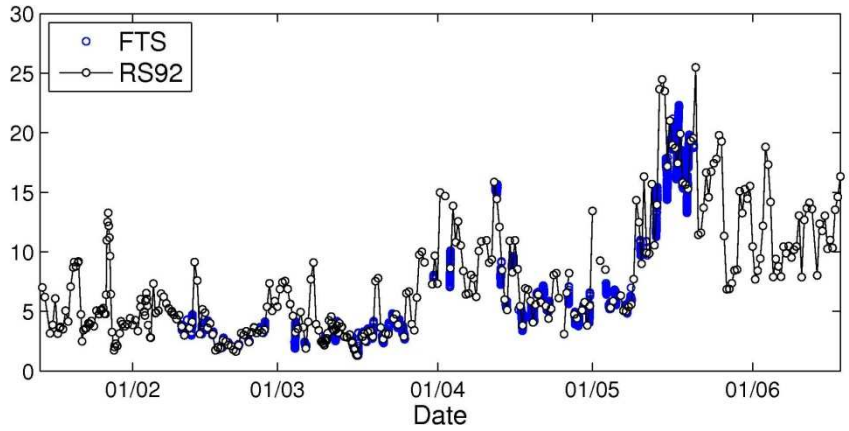
| Time | Model | Description | Parameter | No data continuity effect |
|---|---|---|---|---|
| Apr 2004 | RS92 | Fine tuned humidity sensor temperature dependency correction | U | |
| Mar 2005 | RS92-SGP | Pulse heating of humidity sensors continued down to -80°C | U | |
| Sep 2006 | RS92 | Improved coating of humidity sensor contacts | U | |
| Mar 2007 | RS92 | Reinforced temperature sensor | T | |
| Jun 2008 | RS92 | Sensor boom coating modification | U, T | X |

Changes that can be identified with the help of the DigiCORA® sounding software version and/or a user setting

| Time | Description | Parameter | No data continuity effect |
|---|---|---|---|
| Nov 2005 | Revised solar radiation correction table for temperature sensor | T | |
| Jun 2006 | Extending reported TEMP humidity measurements to -100°C | U | X |
| Aug 2008 | Filtering algorithm modified in order to take into account requirements for temperature measurement above 10 hPa in ozone soundings and soundings in heavy test flight rig | T | |
| Dec 2010 | Humidity Measurement Improved Algorithm | U | |
| Dec 2010 | Revised Solar Radiation Correction Table RSN2010 | T | |

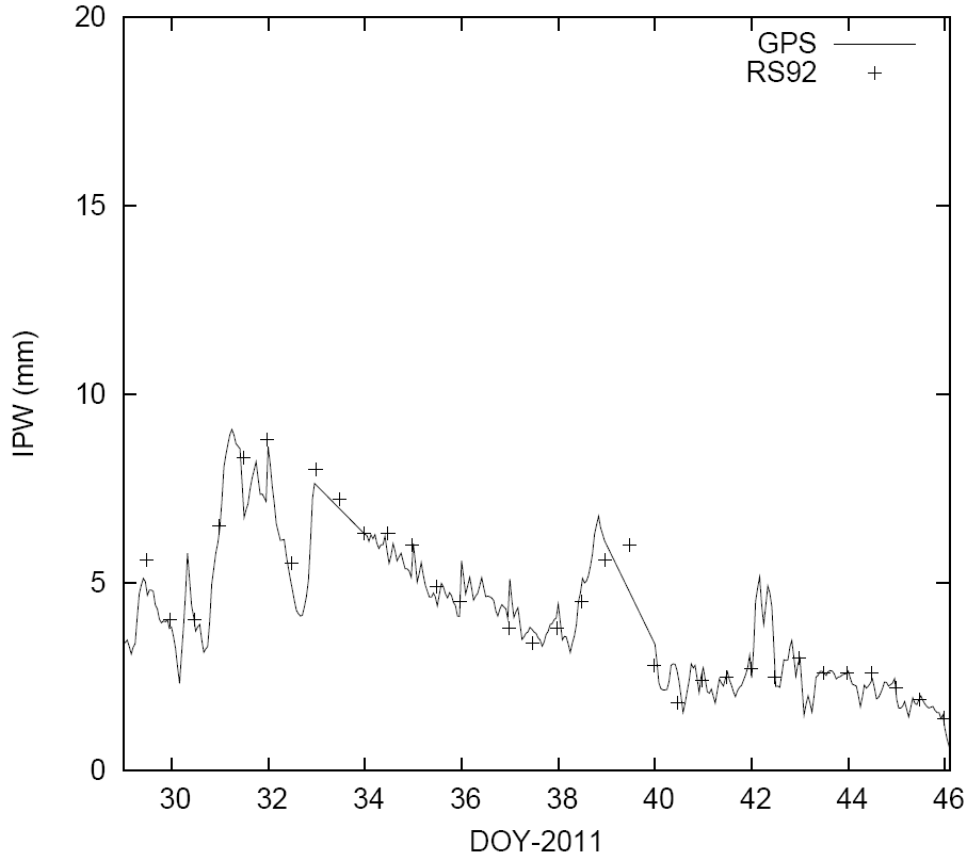
# IWV comparisons during LAPBIAT campaign in 2010



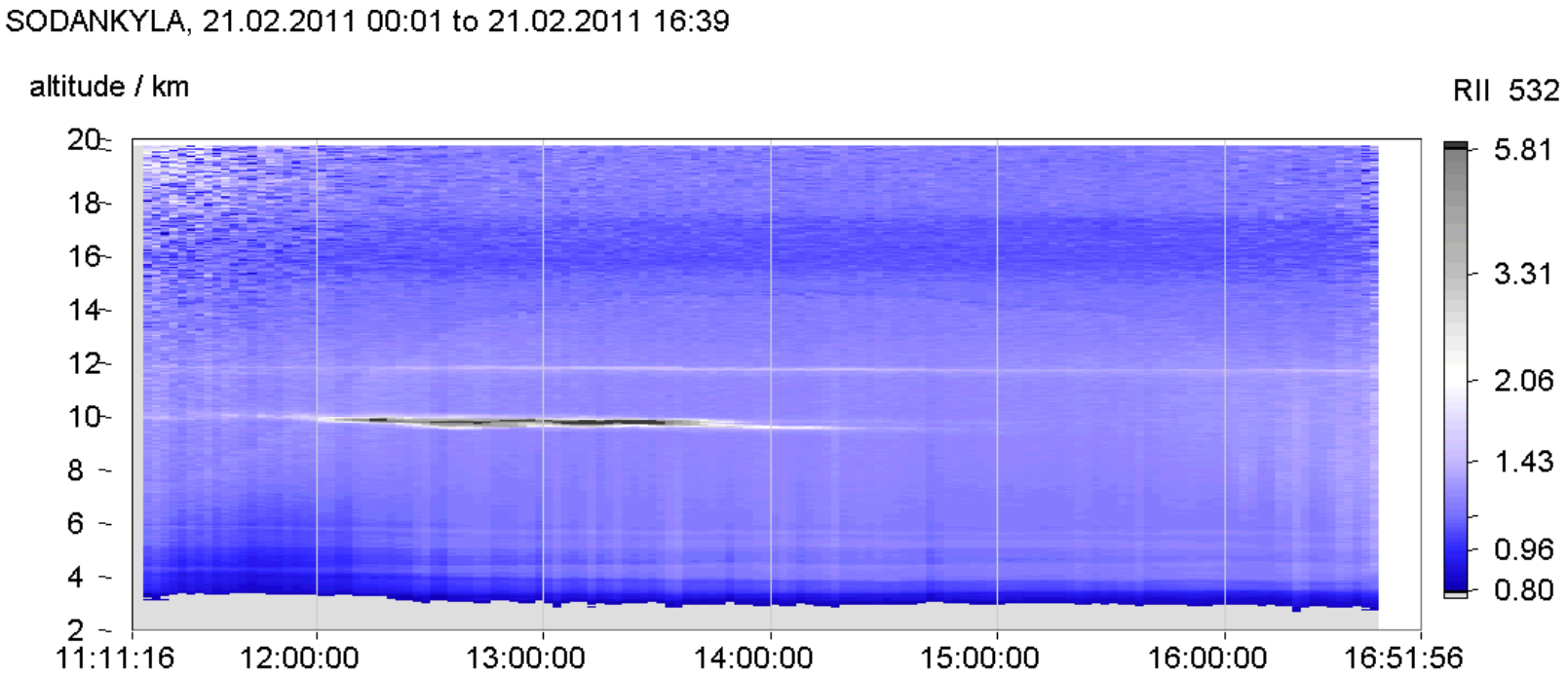




| | MIAWARA-C | GPS | FTS |
|---|---|---|---|
| Difference to sonde (%): | -0.6 | 2.9 | 5.2 |
| Standard deviation (%) : | 21.5 | 14.0 | 5.5 |
| Number of pairs : | 309 | 293 | 53 |

# A new GPS receiver at the sounding facility installed in January 2011




Receiver: JAVAD TRE -3GT, Javad Dorne-Margolin Choke ring antenna
(*figure courtesy Kalev Rannat)*



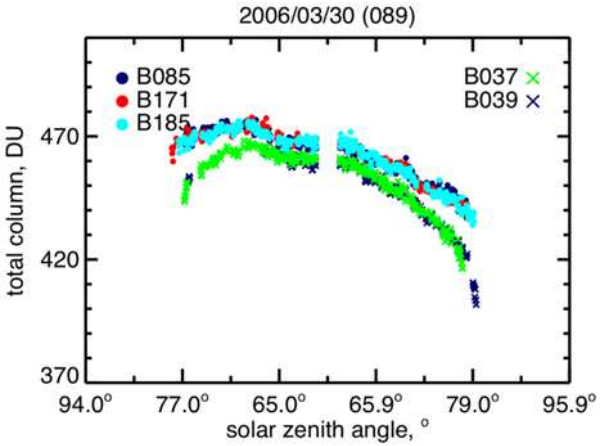

MARL LIDAR (Alfred Wegener Institute, Germany) started aerosol, cloud and water vapor research measurements in Sodankylä in autumn 2010. MARL participates in both GRUAN and LAPBIAT projects, it is operated by the FMI Arctic Research (Figure courtesy Franz Immler, DWD; photo by Matias Takala, FMI). LIDAR; COBALD/CFH measurements have continued in 2011.

## Plans and perspectives

- LAPBIAT data analysis
- RS92/CFH data since 2004, bias corrections for the RS92 humidity
- RR01 test flights in Sodankylä
- IWV comparisons:  GPS, MW, FTS, sondes
- COBALD /BKS flights
- Long-term ozonesonde data
- Submissions to the GRUAN database

# CEOS Intercal Ozone campaign March 4 - 25, 2011

(1) seasonal differences between Dobson and Brewer, (2) stray light in single monochromator Brewers, (3) algorithm differences and (4) ozone cross section effects (http://fmiarc.fmi.fi/Ceos_Nordic.htm)





Thanks !