



ILMATIETEEN LAITOS
METEOROLOGISKA INSTITUTET
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Field experiments at Sodankylä

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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; station's WMO number is 02836. Participates in GRUAN, GAW, NDACC, TCCON, AERONET, EUBREWNET, etc.

GCOS Reference Upper-Air Network





Outline

- Overview of the observations
- CFH, RS41, RS92 flights
- Stratospheric ozone and water vapor in spring 2016
- AirCore flights to measure profiles of CH₄, CO₂, other gases
- Solar radiation



Sonde observations at Sodankylä: 1

- Twice daily 00/12 UT: RS92 radiosondes launched on regular basis, software v. 3.66 in operational and research soundings. Operational soundings are made using the Vaisala autsonde system. Near simultaneous manual and autsonde soundings have been performed. Soundings have been submitted to the GRUAN database. Altogether 52 manual RS92 soundings and 970 autsonde launcher soundings have been submitted using the GRUAN operating procedures. The manual sounding dataflow includes also the Internet IMET-1 and Vaisala RS80. The data have been transmitted using the RsLaunchClient software.
- Flights of RS41 versus CFH and RS92 continued in 2015.
- ECC ozonesondes were launched on regular basis once per week and additional ozonesondes have been included in other soundings, for example CFH soundings and ozone campaign soundings. Ozone soundings have been submitted to GRUAN database using the GRUAN RsLaunchClient software. WMO O3 sonde-DQA is an ongoing activity. Large ozone depletion found in the stratospheric vortex of 2016.



Sonde observations at Sodankylä: 2

UTLS water vapor :

- Cryogenic Frostpoint Hygrometer, CFH (6-12 /year), Vortex dehydration event in 2016.
- Fluorescent Advanced Stratospheric Hygrometer FLASH, including experimental versions of the instrument
- Flights of the Vaisala climate research sonde RR01

Aerosol backscatter:

- Cloud and aerosol detection by COBALD sondes. CFH/COBALD flights have been performed.

CO₂, CH₄ profiles:

- Flights since September 2013



RS41 observations



RH twin-sensor

Radiosonde	RS92-SGPD	RS41-SG
Sensor type	Thin-film capacitor, heated twin sensor	Thin-film capacitor, integrated T sensor, heating functionality
Uncertainty in sounding	5 %RH	4 %RH
Response time (63 %)	< 20 s (T=-40 °C)	< 10 s (T=-40 °C)
Ground check	Corrected against 0%RH humidity generated by desiccants	Corrected with RS41 in-built Physical Zero Humidity Check



RH sensor

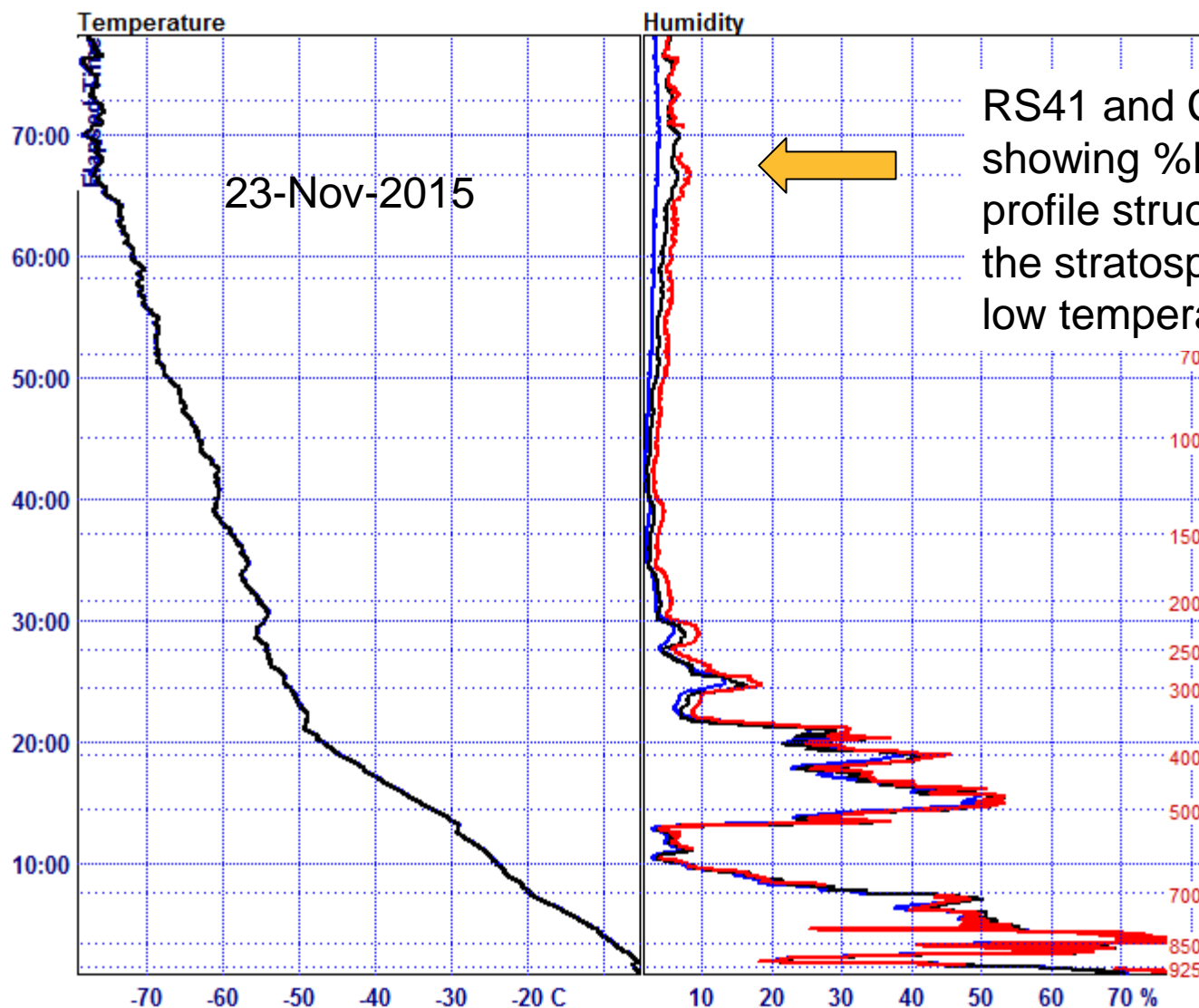
From Survo et al., 2015



RS92

RS41

CFH





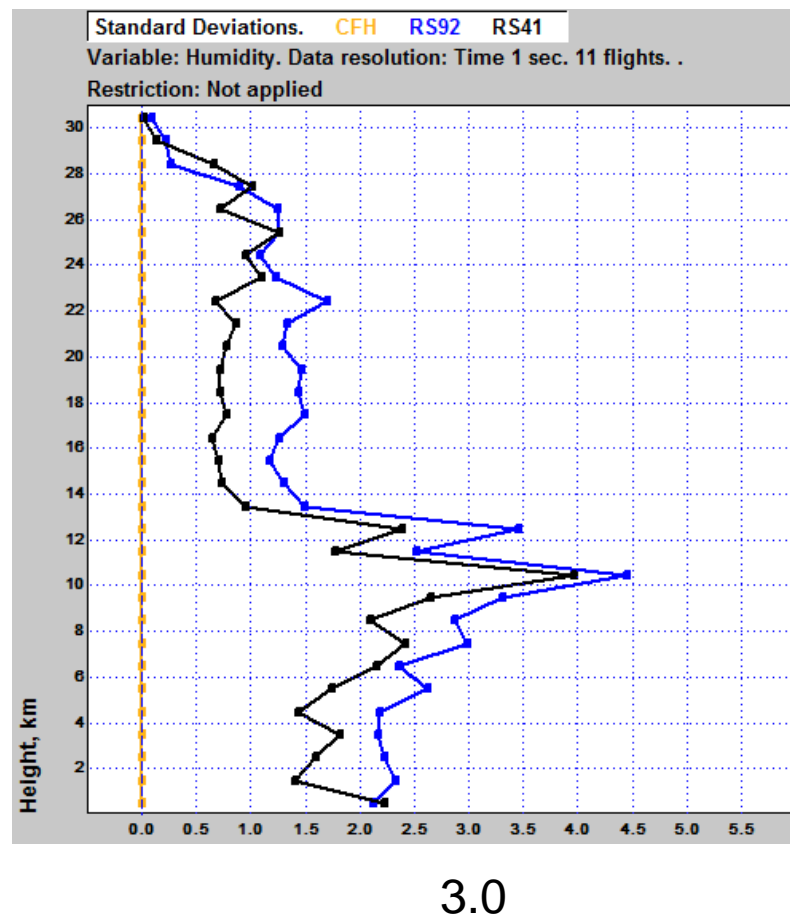
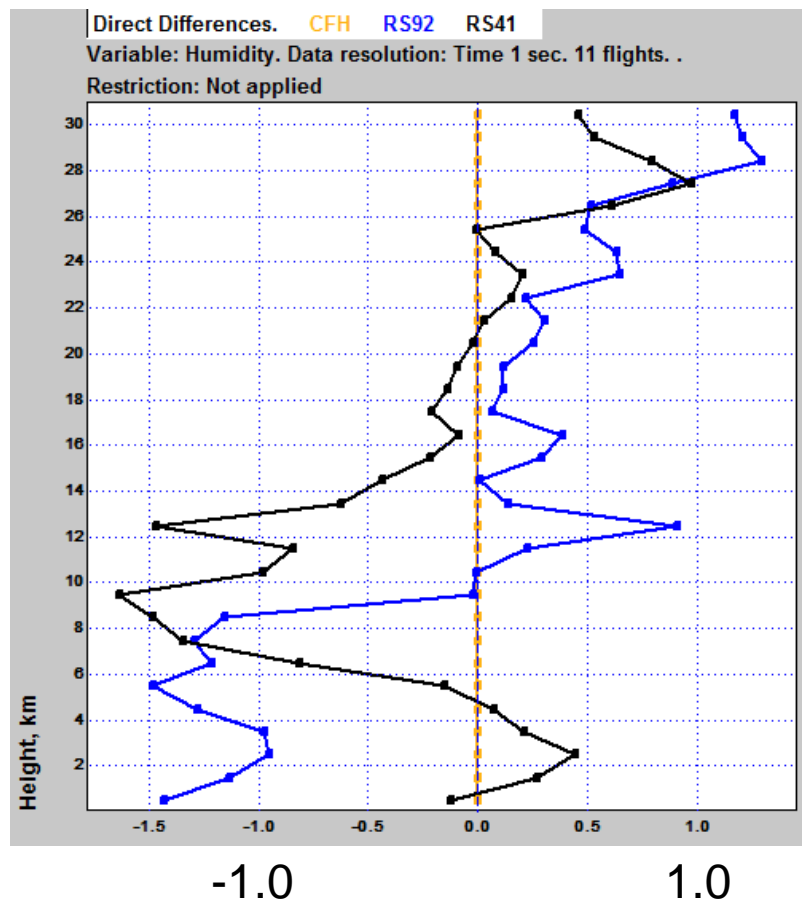
Humidity statistics (2014-2015)

Direct differences

standard dev

30
km

20
km

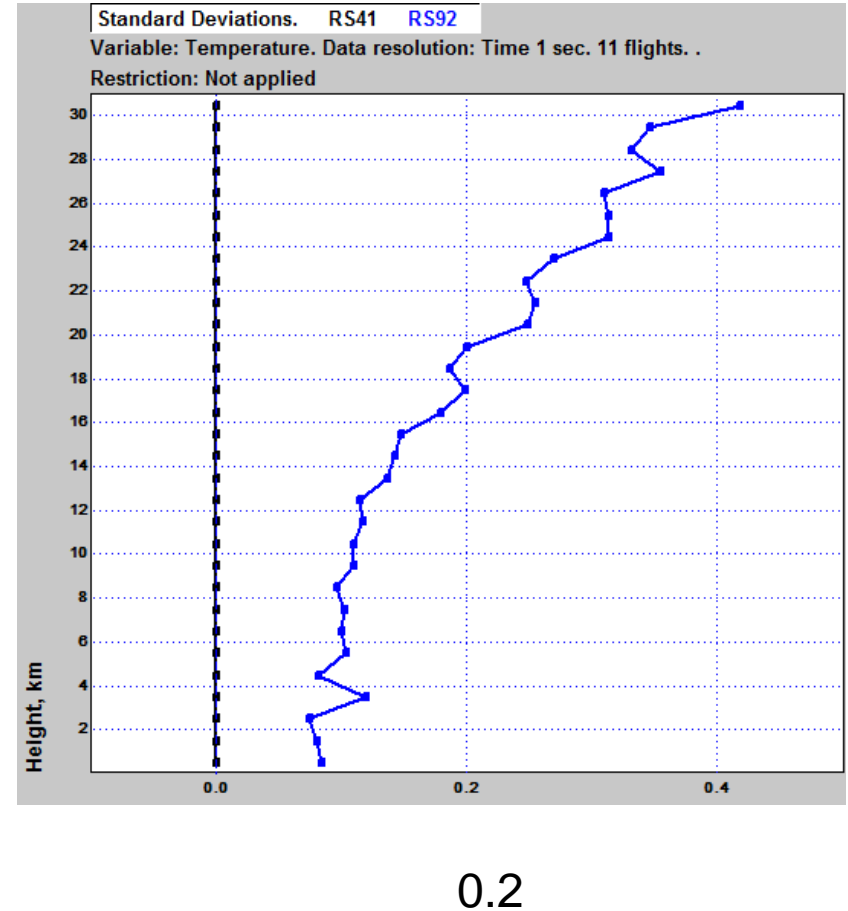
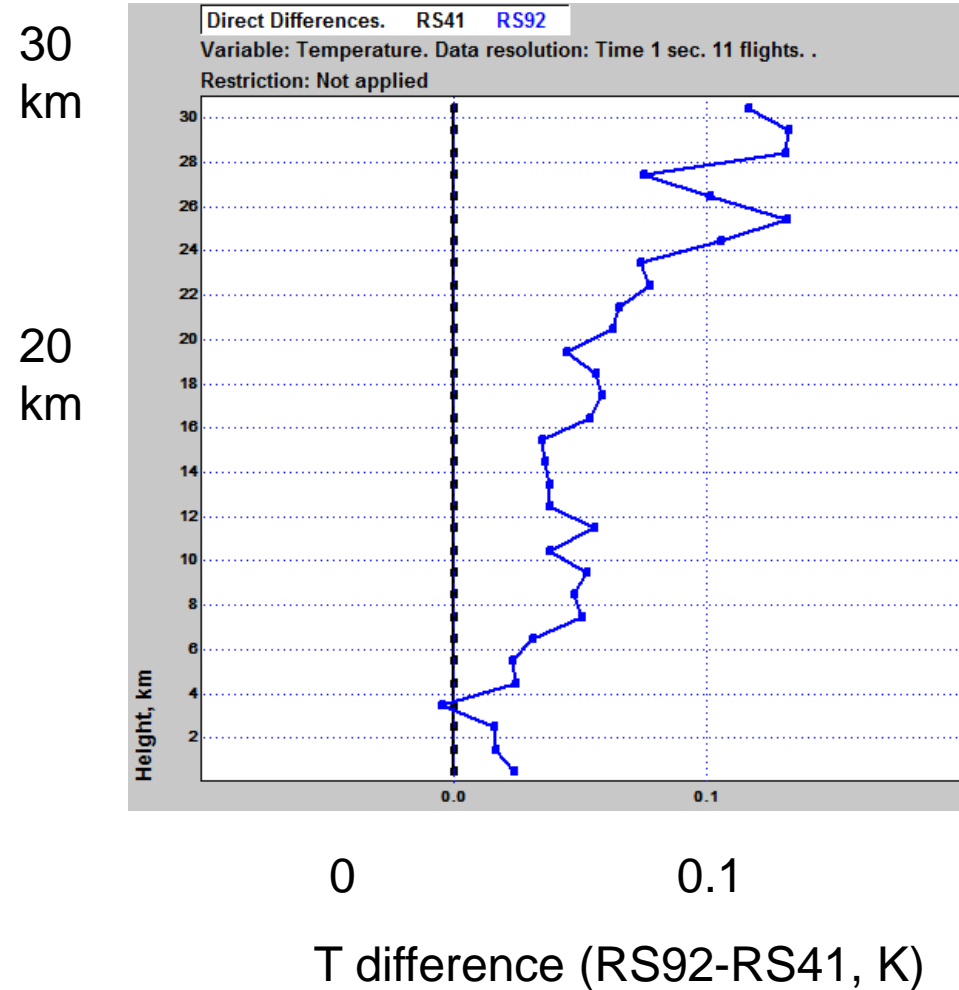


RH difference (RH %)



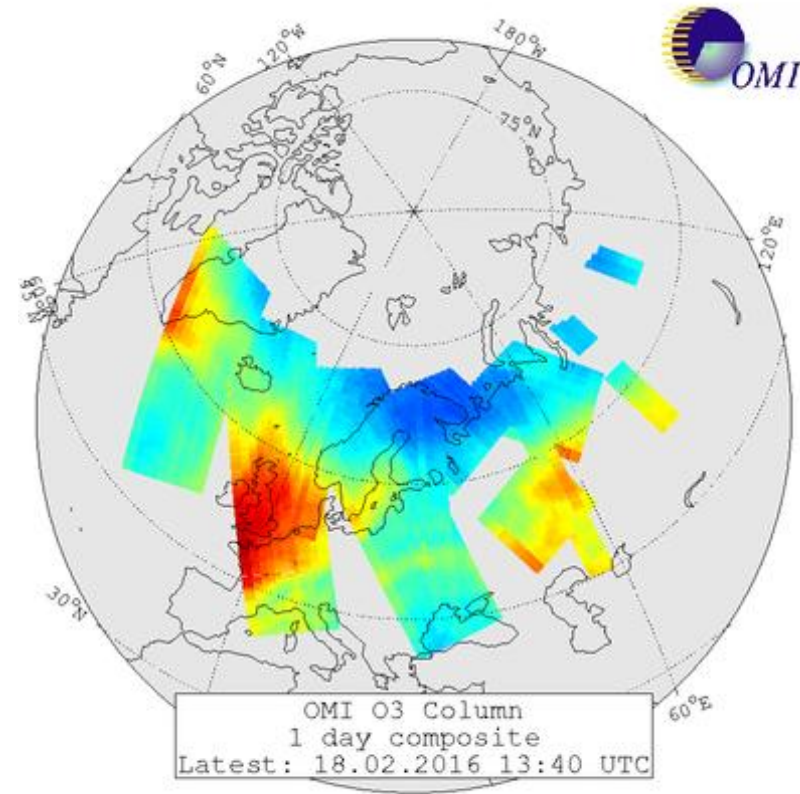
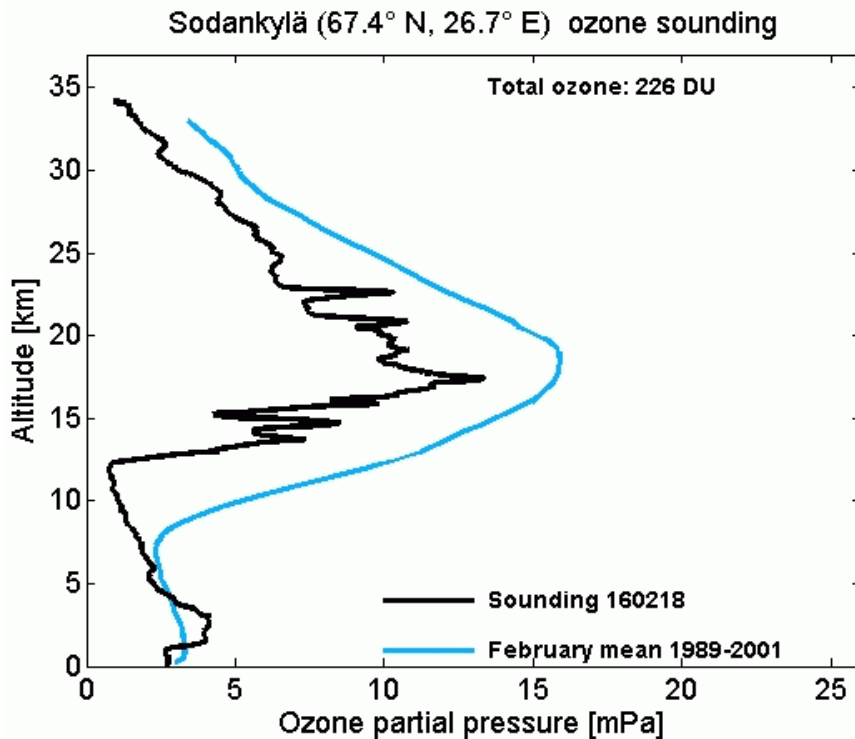
Temperature statistics (2014-2015)

Direct differences standard dev





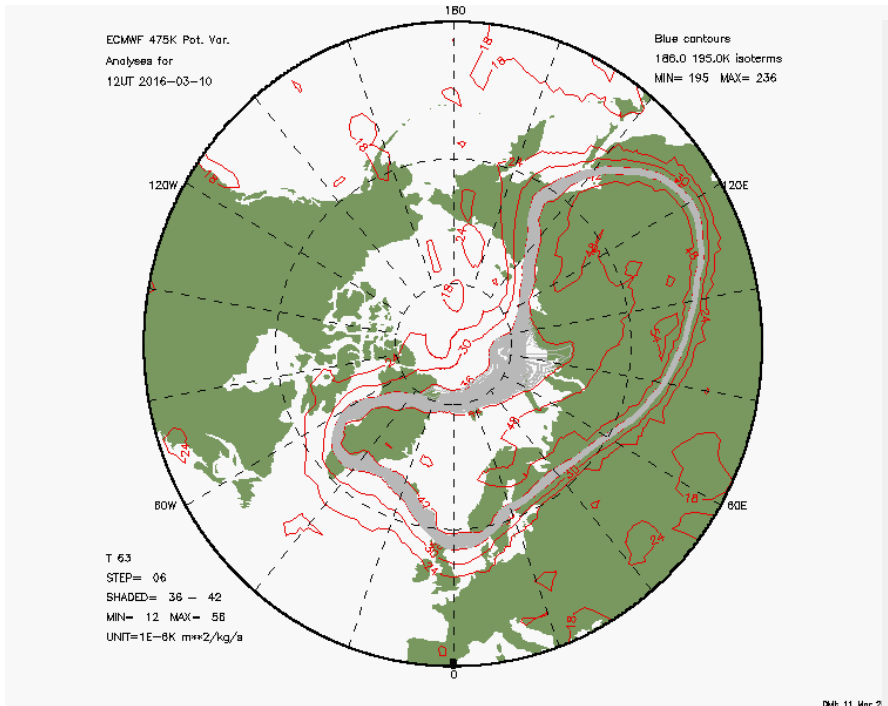
226 DU measured by an ozonesonde on February 18, 2016
The sonde was launched from Sodankylä and drifted NE



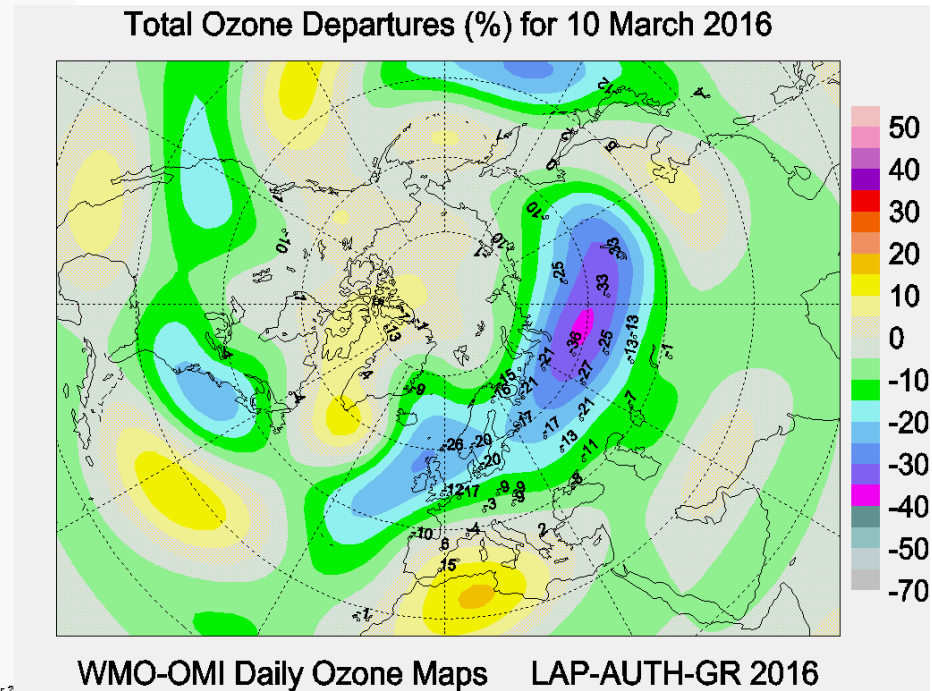
FMI-KNMI-NASA-NSO



Vortex at 475K, 10 March 2016



Dirk 11 Mar 2...



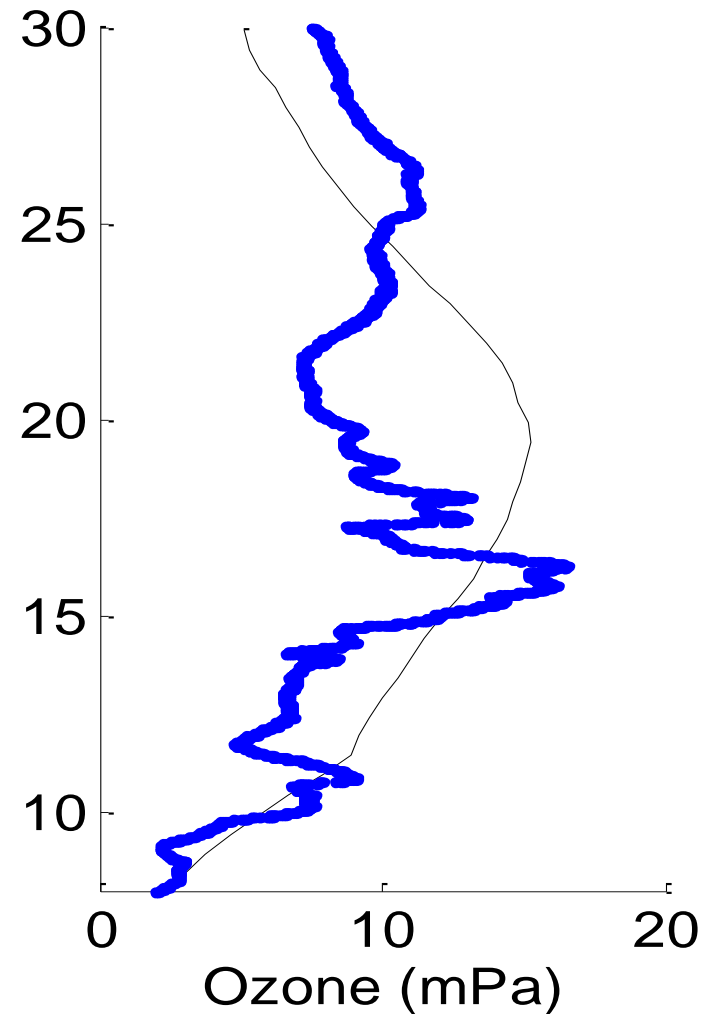
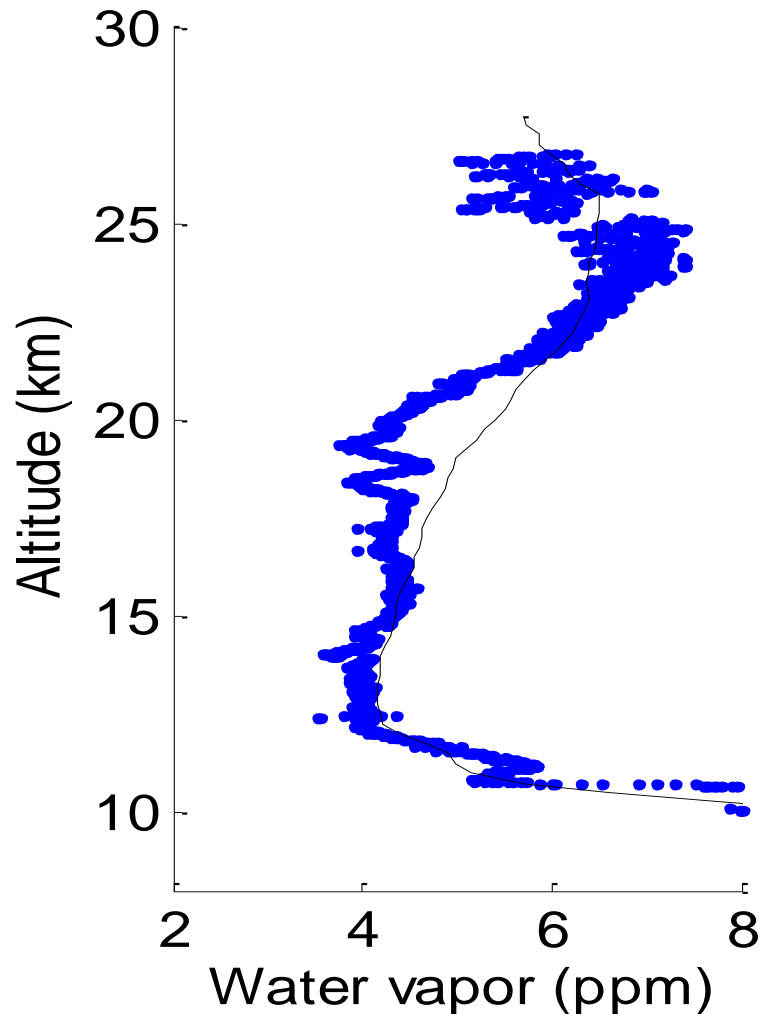
psc.dmi.dk

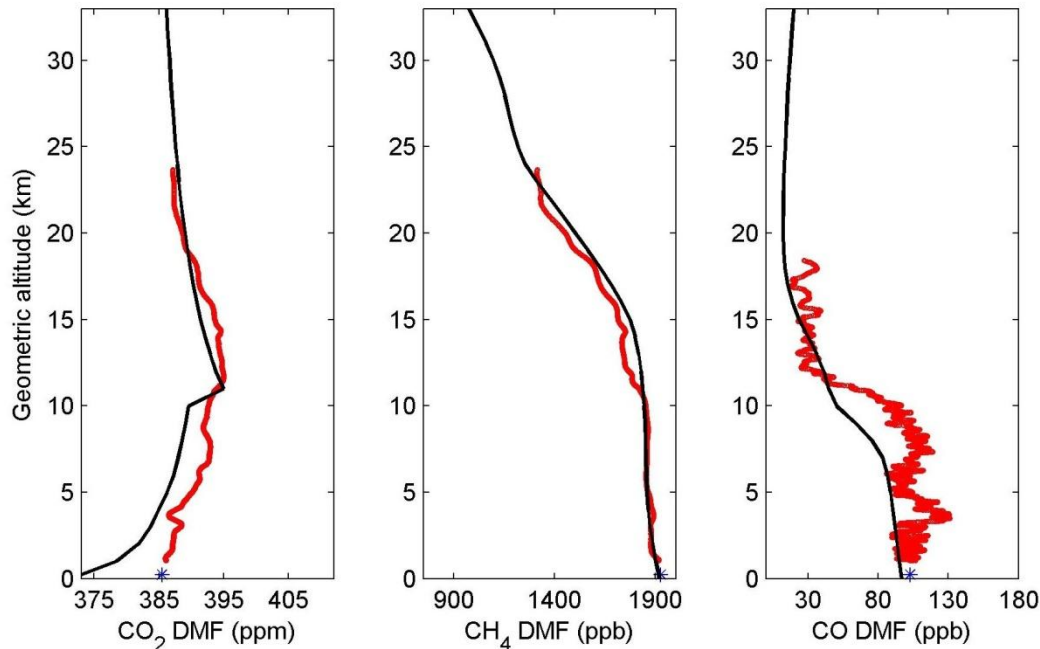
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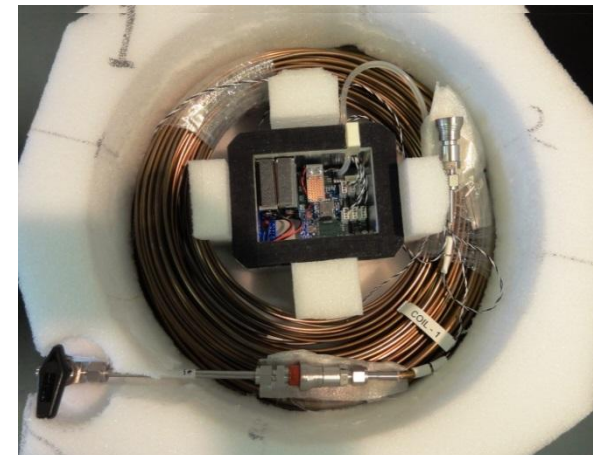
H₂O and O₃ in the vortex

March 10, 2016





- At Sodankylä we have performed AirCore observations since September 2013. The measurements cover all seasons. An example of AirCore profiles of CO₂, CH₄ and CO is shown above (from September 3, 2013). AirCore profiles are in red and the TCCON a priori profiles in black. Blue star corresponds to tower measurements at Sodankylä.
- The AirCore system at Sodankylä is built as a stainless steel tubing of about 100 m long, consisting of ~40 m of 1/4" and ~60 m of 1/8" tube. This configuration makes it possible to measure profiles with vertical resolution of 5 mb in the stratosphere and 15 mb in the troposphere.
- The system also involves a data acquisition unit to store pressure and temperature during an AirCore flight, a RS92 radiosonde and a positioning device.
- AirCore is lifted to the stratosphere using a meteorological balloon. After the landing we have analysed the sample using the Picarro G2401 gas analyser.



AirCore instrument with an open cover



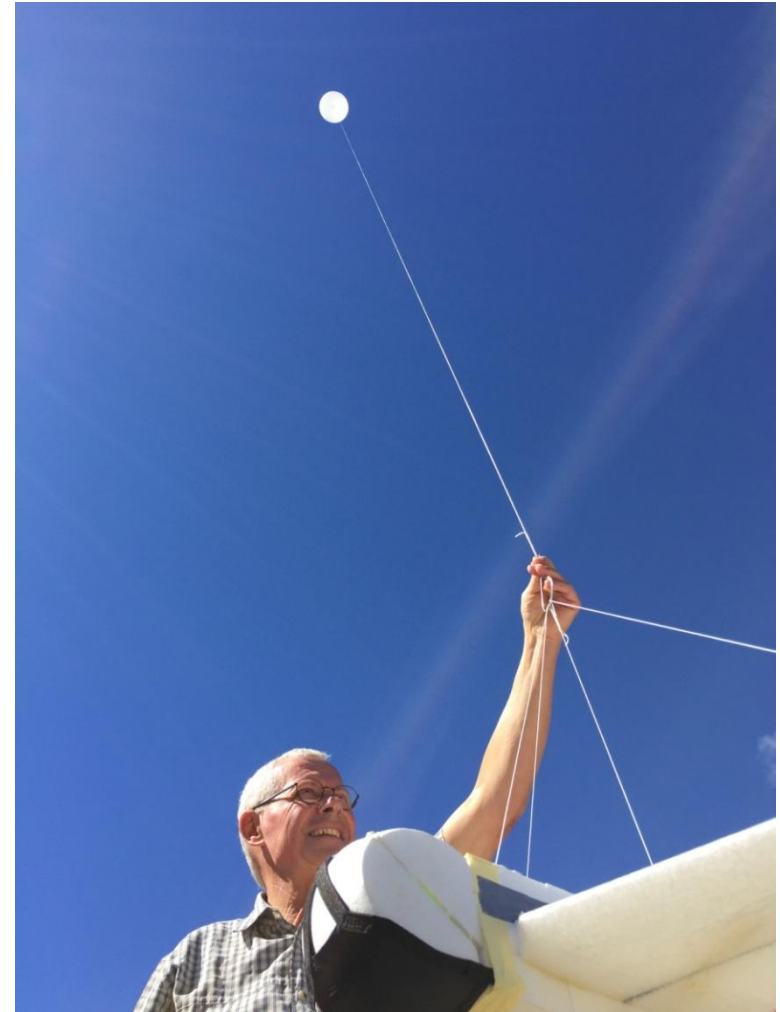
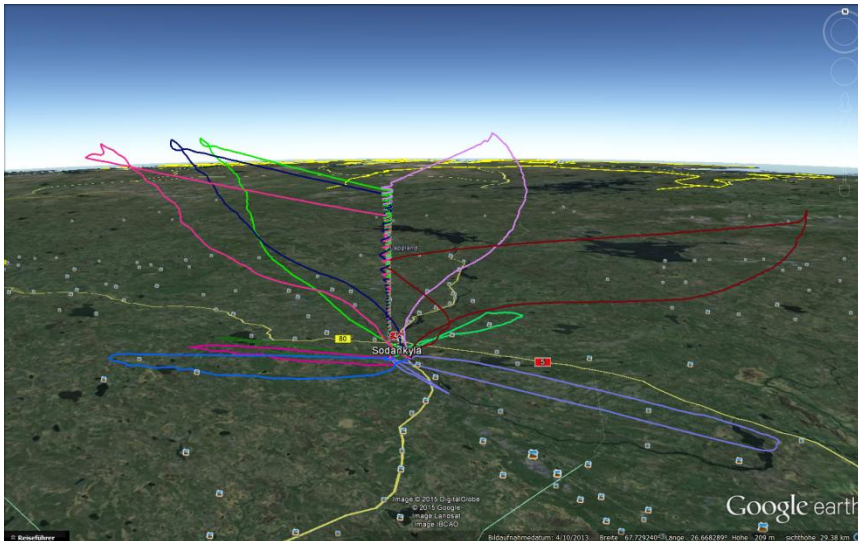
- **AirCore/FTS campaign in Sodankylä June 2015**
- Participants: FMI, University of Groningen, BIRA, NOAA, University of Wollongong, Bern University, KIT, Lund University. Campaign was organised by the FMI and Groningen University.
- **Achievements of the campaign include:**
 - Test of the new developments
 - AirCore comparisons
 - Improved AirCore profiles
 - In total 10 flights, including 4 dual AC flights
 - TCCON (FMI) and EM27/SUN (BIRA, KIT) measurements
 - Aircraft flights at low altitude (Sky Arrow, Lund).





Solar radiation

Glider flights in July 2015 to measure profiles of solar radiation (MeteoSwiss and FMI). Altogether we made 7 flights. Lightweight glider was used. The glider was lifted to the stratosphere using a meteorological balloon. Flight trajectories are shown below, regarding last 5 flights.





Summary and outlook

- CFH, RS41, RS92 comparisons were performed in year 2014-2015 during all seasons.
- RH differences ((RS92 or RS41) -CFH) smaller than 1.5 % RH.
- Temperature differences (RS92-RS41) smaller than 0.13 K.
- Ozone and water vapor measurements in the LS during spring 2016.
- AirCore measurements were continued in 2015-2016.
- Over the coming year we expect to improve some of the instrumentation at the site and participate in the GRUAN task team activities.
- One of the new developments within GRUAN would be the planned start of RS41 as a radiosonde interfaced to the CFH. Other planned GRUAN radiosonde activities in 2016-2017 include experiments with controlled descent, gliders etc.