



ILMATIETEEN LAITOS
METEOROLOGISKA INSTITUTET
FINNISH METEOROLOGICAL INSTITUTE

Soundings at GRUAN station Sodankylä, Finland

Rigel Kivi (1), Pauli Heikkinen (1), Petteri Survo (2), Hannu Jauhiainen (2), Raisa Lehtinen (2), Huilin Chen (3, 4), Juha Hatakka (1), Tuomas Laurila (1)

(1) Finnish Meteorological Institute, Sodankylä and Helsinki, Finland, (2) Vaisala Oyj, Helsinki, Finland, (3) Center for Isotope Research, University of Groningen, Groningen, Netherlands, (4) Cooperative Institute for Research in Environmental Sciences, University of Colorado, Boulder, Colorado, USA



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 etc.

GCOS Reference Upper-Air Network





Outline

- Status of the observations
- CFH, RS41, RS92, RR01 comparisons
- Ozonesonde comparisons
- AirCore flights
- Upcoming activities



Sonde observations at Sodankylä

- 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 61 manual RS92 soundings and 722 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.
- Historically more than **50 000 sonde launches** have been performed at Sodankylä since October 1949.
- Flights of RS41 versus CFH and RS92 continued in 2014.
- 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.



Sonde observations at Sodankylä

UTLS water vapor :

- Cryogenic Frostpoint Hygrometer, CFH (6-12 /year)
- Fluorescent Advanced Stratospheric Hygrometer FLASH, including experimental versions of the instrument
- Flights of the new Vaisala climate research sonde RR01, which is currently in the development phase. This activity has been ongoing in 2014.

Aerosol sondes:

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

AirCore system:

- Flights since September 2013



RS41 observations

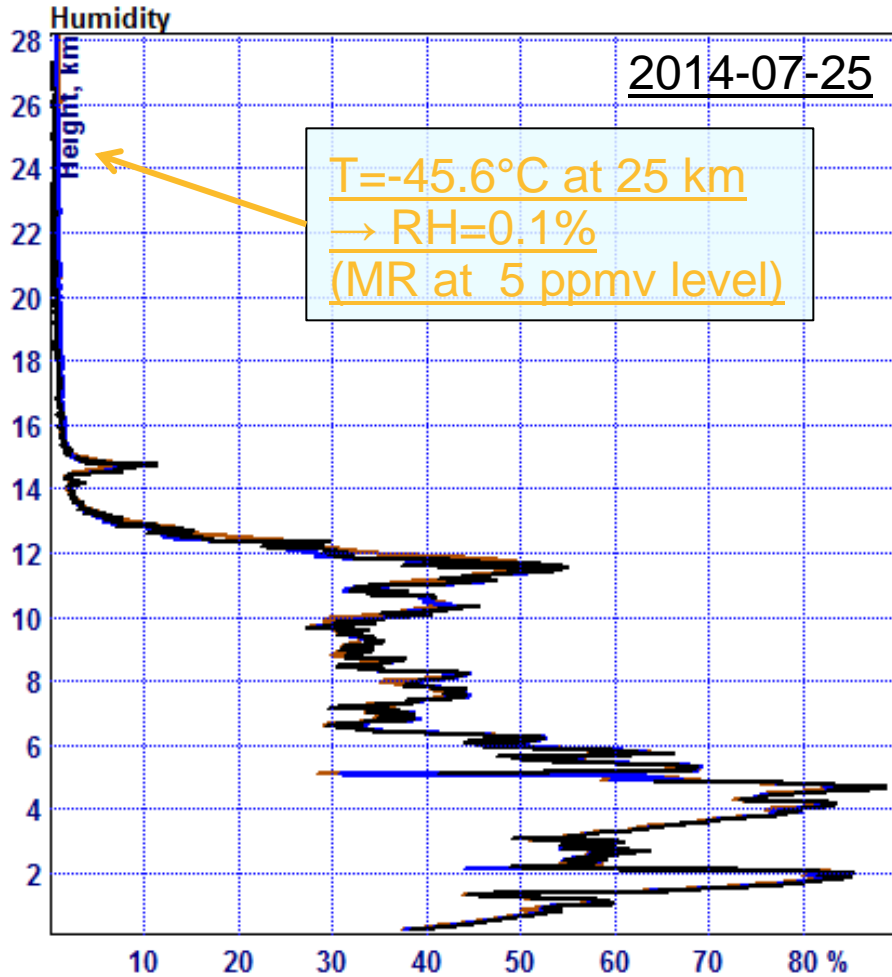
Radiosonde	RS92-SGPD	RS41-SG
Sensor type	Thin-film capacitor, heated twin sensor	Thin-film capacitor, integrated T sensor, heating functionality
Uncertainty in sounding	5 %RH	4 %RH
Response time (63 %)	< 20 s (T=-40 °C)	< 10 s (T=-40 °C)
Ground check	Corrected against 0%RH humidity generated by desiccants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



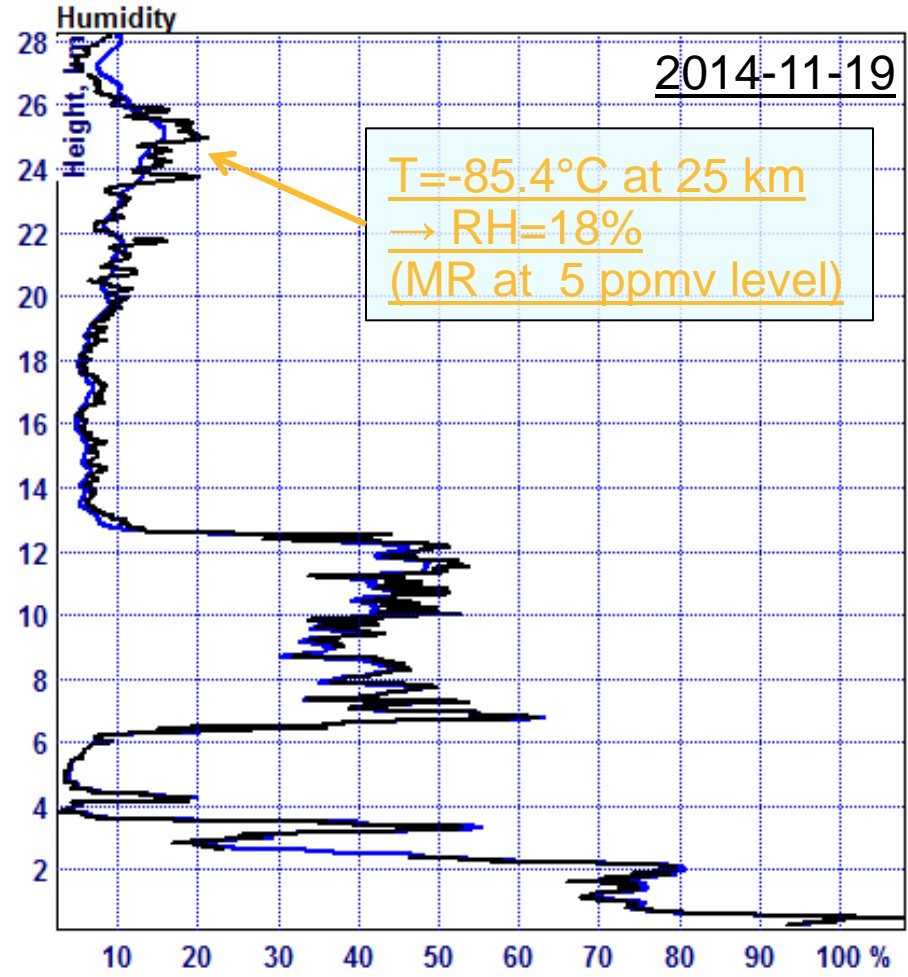
From Survo et al., 2015

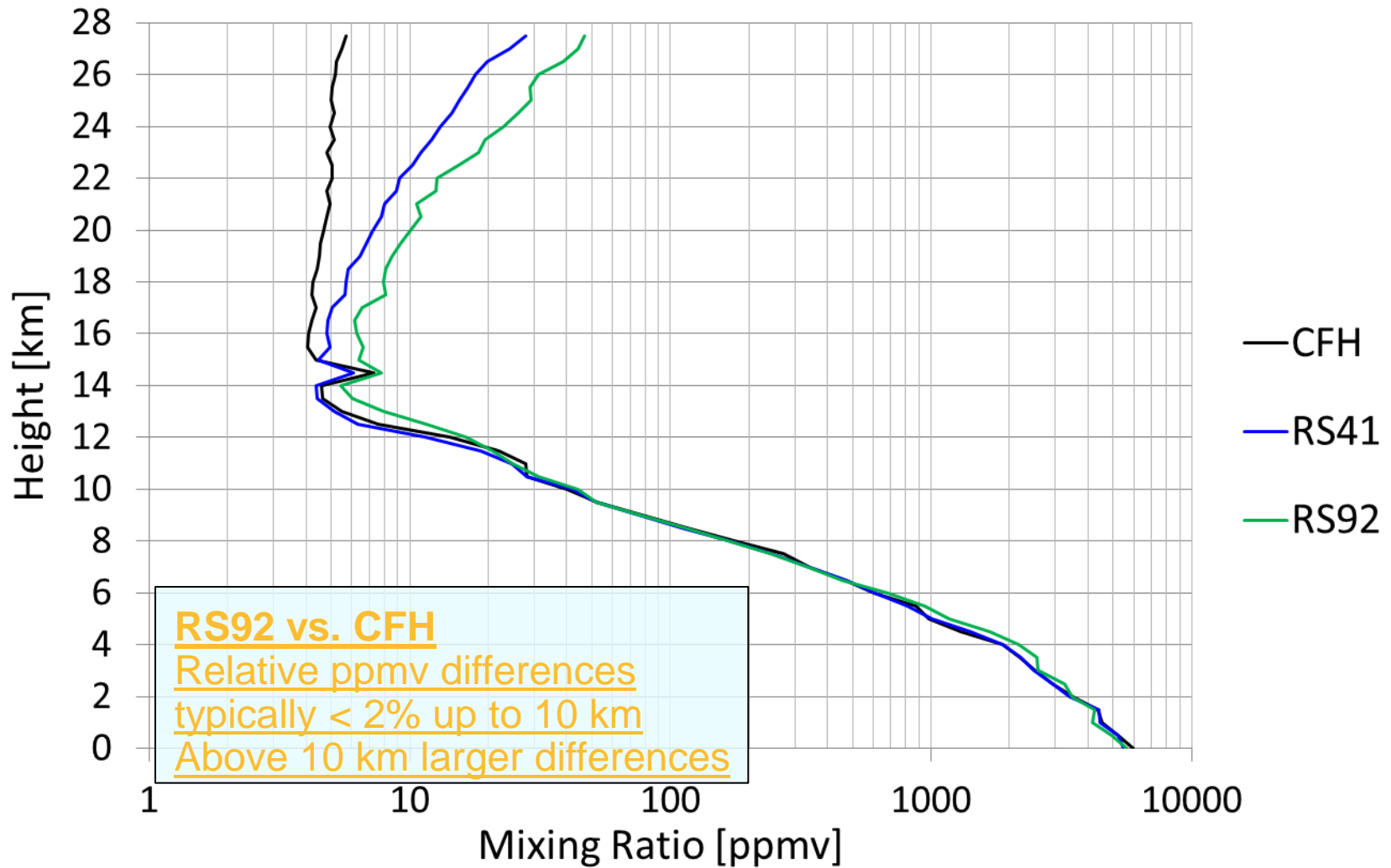


Flight 4. RS92 RS41 CFH



Flight 6. RS41 CFH



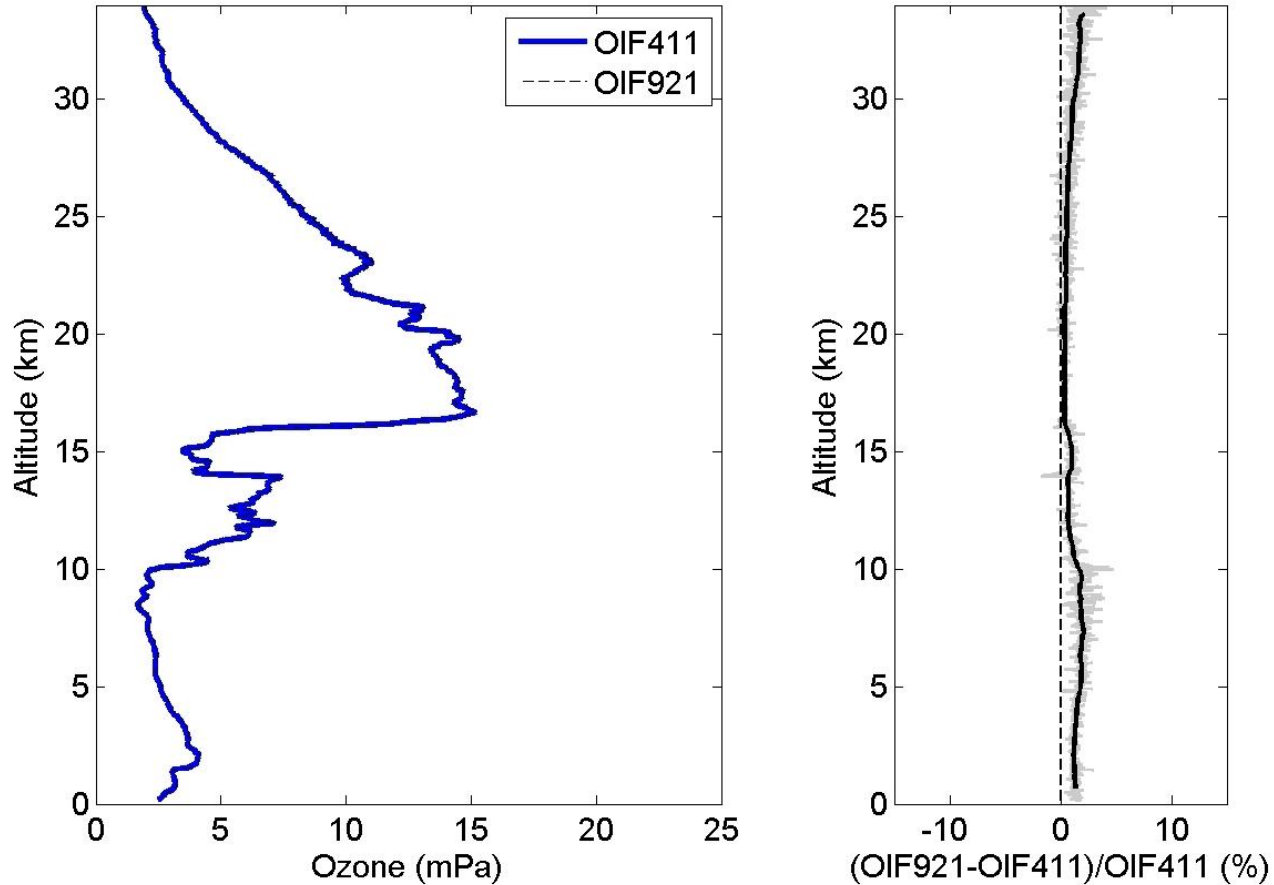


Tropospheric and stratospheric comparisons of water vapor mixing ratio, average of six flights in 2014 over Sodankylä, from Survo et al., 2015

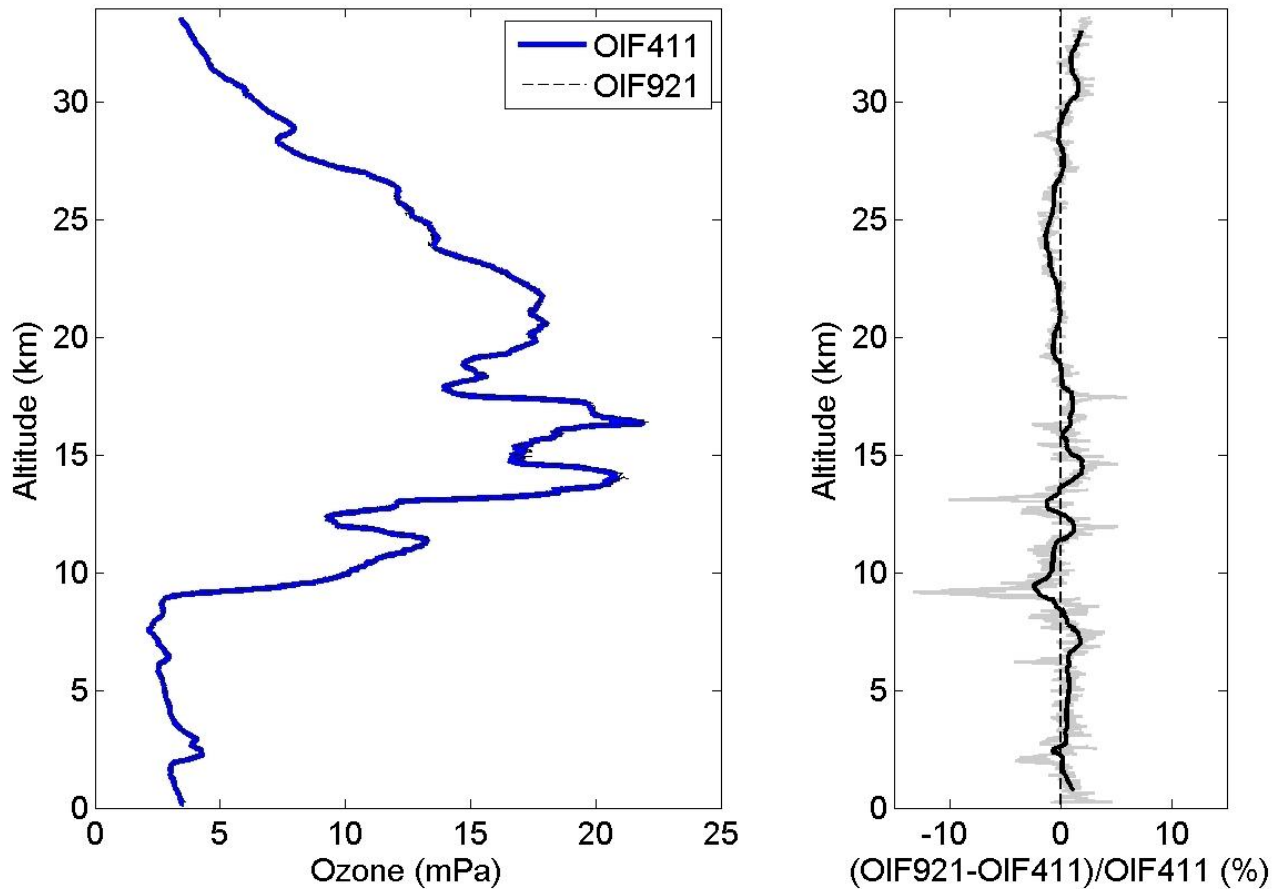


Ozone soundings using RS41





A test flight at Sodankylä using a common ozone sensor and two different ozone interfaces (OIF921 and OIF411). The receiving ground station was MW41. Left: profiles of ozone partial pressure measured by two systems from surface to the stratosphere. Right: relative differences in percent between the two systems $(OIF921 - OIF411) / OIF411$. Black curve represents medium averaged differences, while each single data point comparison, with 1 second time resolution, is shown by the grey line in the background. From Kivi et al., 2014



A test flight at Sodankylä using separate ozone sensors. In each dual sensor flight we had the first ENS-SCI ECC type of ozonesonde attached to an RS92 radiosonde and the data were received via the OIF921 interface and the MW31 system; the second ozonesonde of the same type and production batch was attached to the RS41 radiosonde and the data were received via the OIF411 interface and the MW41 system. Left: profiles of ozone partial pressure from surface to the stratosphere. Right: relative differences in percent between the two systems $(\text{OIF921} - \text{OIF411}) / \text{OIF411} (\%)$. Black curve represents medium averaged differences, while each single data point comparison, with 1 second time resolution, is shown by the grey line in the background. From Kivi et al., 2014

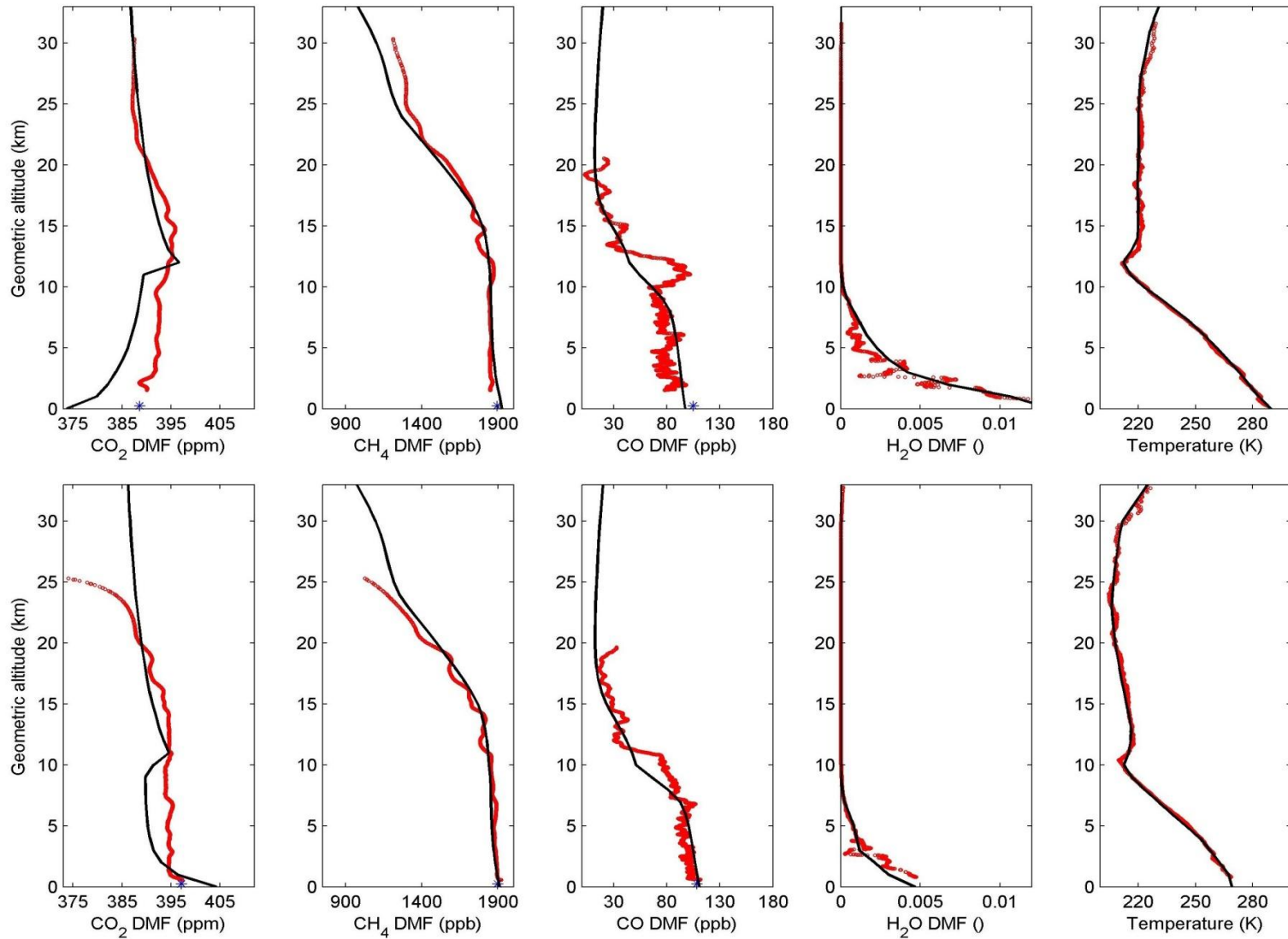


Ozone soundings using RS41

Total ozone comparisons					
Sonde launch time	OIF411 (DU)	OIF921 (DU)	Brewer or SAOZ (DU)	GB/OIF411	GB/OIF921
February 6, 2014 8:43 UT	283.0	284.3	287.3	1.02	1.01
February 6, 2014 12:47 UT	273.4	278.7	287.3	1.05	1.03
April 8, 2014 9:00 UT	425.6	421.4	422.8	0.99	1.00
April 8, 2014 13:00 UT	427.7	429.5	425.7	1.00	0.99
April 9, 2014 12:37 UT	360.6	368.8	373.0	1.03	1.01



AirCore flights





Upcoming activities

- Series of soundings in Sodankylä with the MeteoSwiss system (Rolf Philipona)
- Tests of controlled descent using valved balloons (Dale Hurst)
- CFH, RS41, RS92, RR01 comparisons
- Autosonde work within the GRUAN Task Team
Radiosonde
- AirCore/radiosonde flights during 2015 summer campaign



Summary

- Status of the observations, balloonborne observations (RS92, ozone, CFH, RS41), new developments at the station.
- CFH, RS41, RS92 comparisons were performed in year 2014 during all seasons. In average good agreement in troposphere between RS41 and CFH (differences smaller than 2 %). In the stratosphere mixing ratio comparison showed higher differences. However in relative humidity scale the wintertime profile showed the capability of the RS41 to measure layers of increased relative humidity.
- In 2014 ozonesonde flights were performed using the RS41 radiosonde, dual flights showed no significant differences in ozone profiles as a result of the change in radiosonde type.
- AirCore measurements started in late 2013 and were continued in 2014.
- Planned GRUAN radiosonde activities in 2015 include experiments with controlled descent.
- 50 000 balloon launches have been completed at Sodankylä by January 21, 2015.