Contributions to DEEPWAVE-NZ from the DLR

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DLR contribution integrated in the BMBF Research Initiative:

Role of the Middle atmosphere In Climate (ROMIC)

by the project „Investigation of the life cycle of gravity waves (GW-LCYCLE)“

ROMIC - Field Campaigns

(1) GW-LCYCLE I

- 2 – 14 December 2013, Kiruna, Sweden
- DLR Falcon
- simultaneous 3 hourly radiosonde launches along a West-East section from Andøya (N), Esrange (S) to Sodankylä (FIN) during 3 IOPs
- ground-based observations at ALOMAR (radars, lidars) and at Esrange (Lidar)

(2) DEEPWAVE-NZ (DLR contribution)

- total period: 6 June – 22 July 2014, New Zealand
- DLR Falcon participation: 22 June – 14 July 2014
- ground-based observations (Na-Lidar, radiosondes)

(3) POLSTRACC/GW-LCYCLE II

- winter 2015/2016, Kiruna, Sweden
- coordinated flights of HALO and Falcon
- simultaneous 3 hourly radiosonde launches along a West-East section from Andøya (N), Esrange (S) to Sodankylä (FIN)
- ground-based observations at ALOMAR (radars, lidars) and at Esrange (Lidar, radar)

(1) Scientific Interest in DEEPWAVE-NZ

- gravity excitation by the flow over the New Zealand mountain range
- gravity wave propagation from the troposphere to the mesosphere
- gravity wave modification across the tropopause
- dynamical and chemical processes in the upper troposphere lower stratosphere (StratTrop exchange)

(2) Specific DLR contributions

(a) Falcon observations

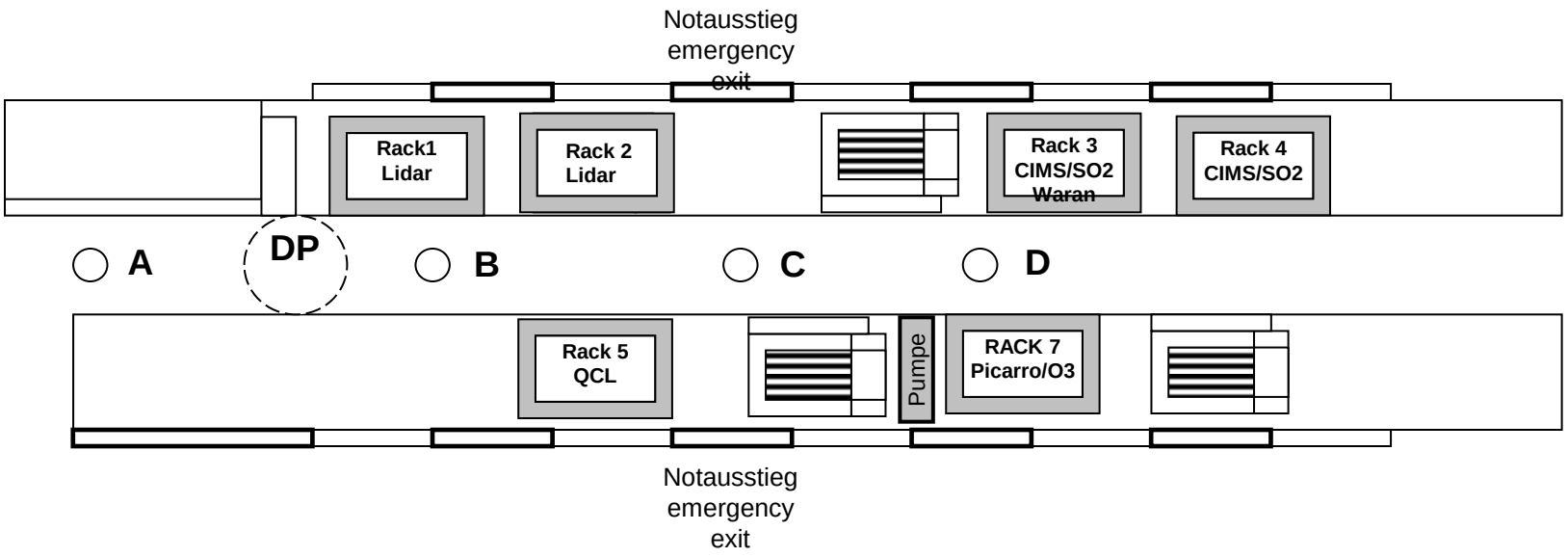
- deployment from June 22 until July 14 2014
- about 60 h for research flights
- combined remote-sensing and in-situ payload of wind, temperature and various trace gases (H_2O, O_3, CH_4, CO, CO_2, N_2O, SO_2)

(b) Ground-based observations

- Sodium-Rayleigh-Brillouin-Raman Lidar (Na-RBR Lidar) at Lauder
- radiosonde launches in the lee of the southern Alps at Lauder

(c) Forecast support (ECMWF-IFS, WRF driven by ECMWF-IFS)

Falcon observations - Payload



Rack 1	**Doppler Wind Lidar (Backscatter, Wind)**
Rack 2	**Doppler Wind Lidar**
Rack 3	**CIMS (SO_2) + Waran/CR2 (H_2O)**
Rack 4	**CIMS**
Rack 5	**QCL (CO, N_2O)**
Rack 7	**Picarro (CH_4, CO_2) + O_3**

Flugrichtung
flight direction

Falcon 20

D-CMET

Falcon observations - Contributions

Flight level measurement of vertical momentum and energy flux and of various trace gases (H_2O, O_3, CH_4, CO, CO_2, N_2O, SO_2)

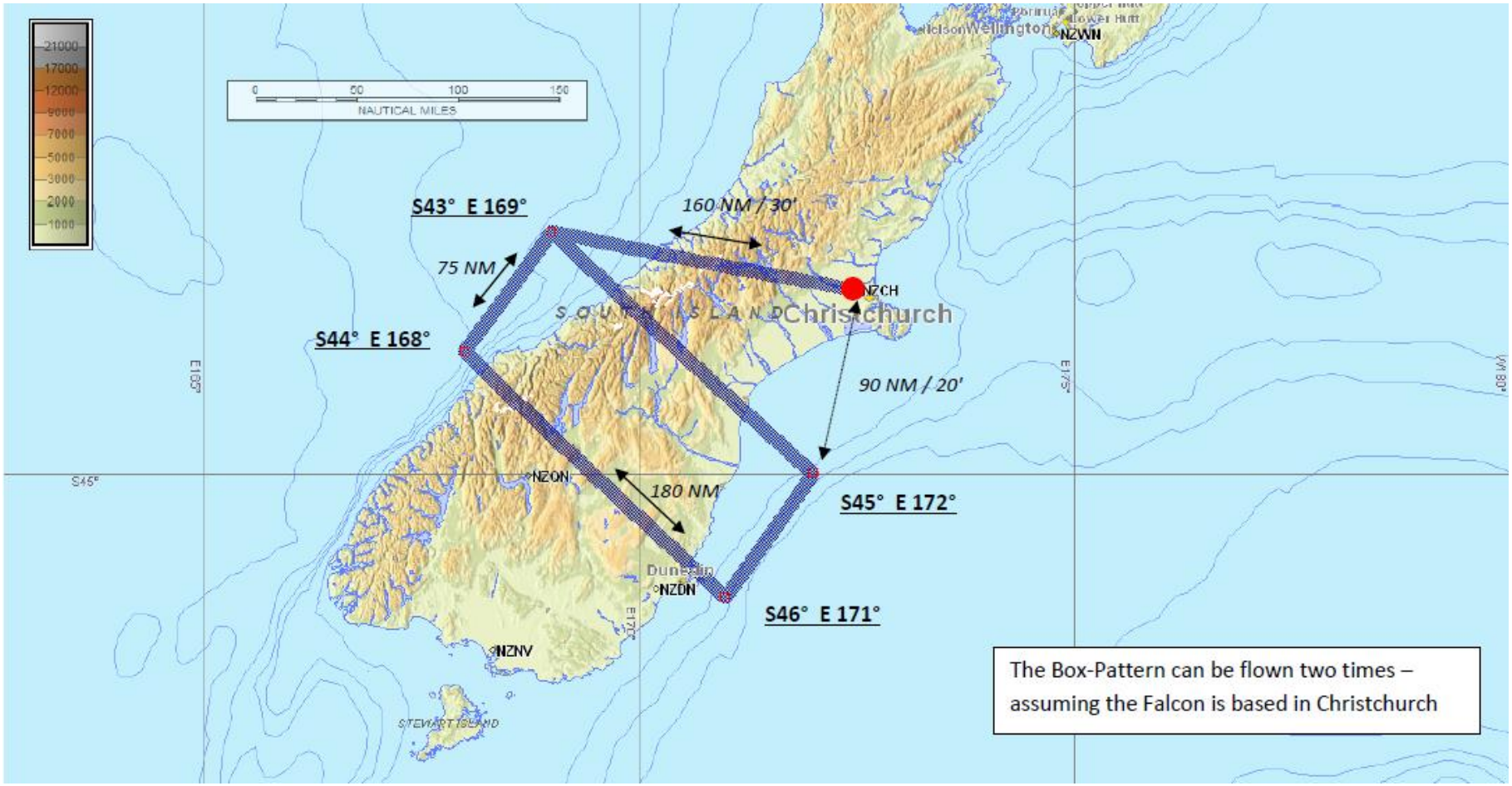
- at altitudes from 4 to 11 km, below the NG V,
- on parallel tracks to the NG V tracks, and
- on shorter tracks than the long 400 km NG V tracks.

Disturbed wind field and gravity waves over the S. Alps terrain
using the 2 μm Doppler wind lidar system underneath the Falcon

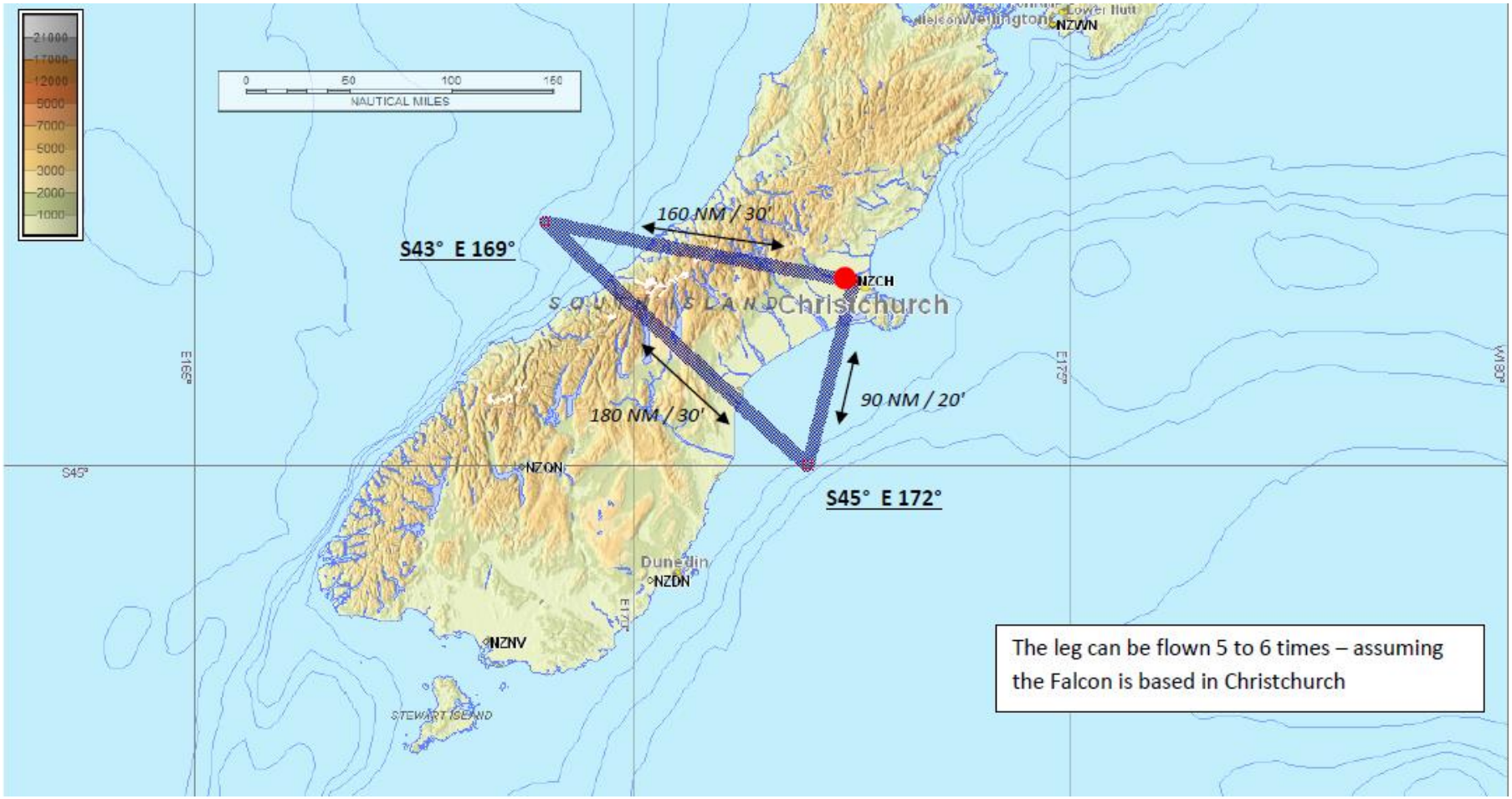
Mapping out the cloud field over the S. Alps using the backscatter intensity of the down-looking lidar. Cloud mapping is important as clouds may alter the generation of vertically propagating gravity waves. Expected cloud types include

- Lenticular (liquid or ice) clouds
- Undulating alto-stratus
- Shallow convective clouds

Falcon observations - Contributions

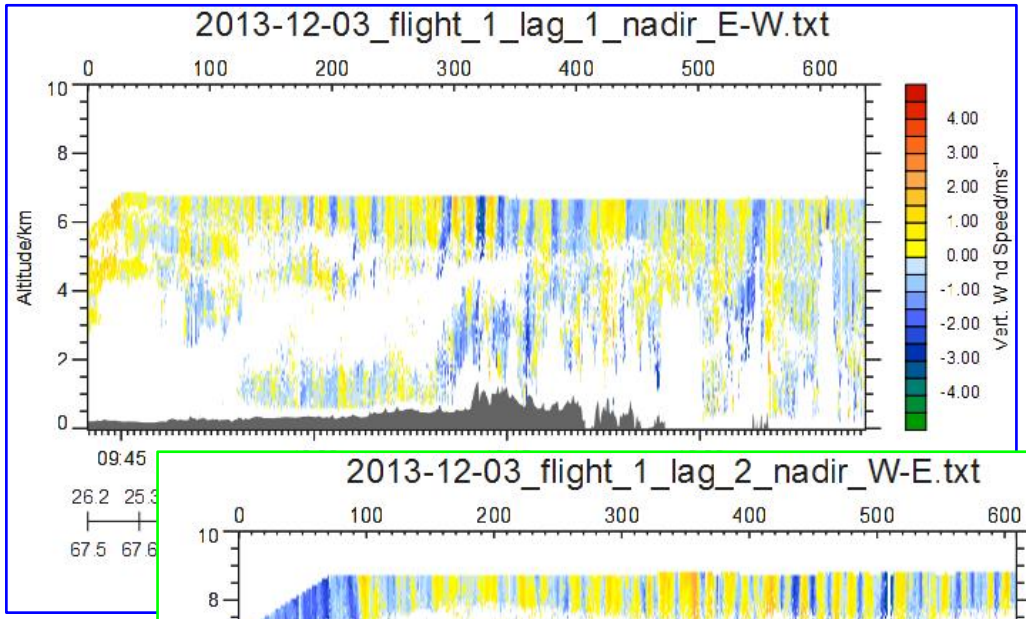


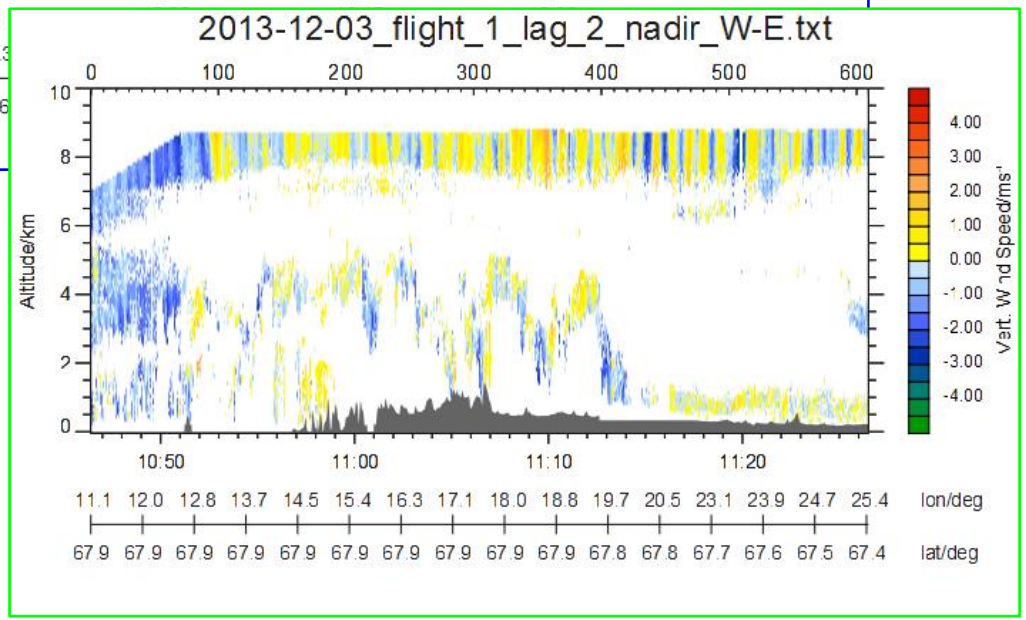
Falcon observations - Contributions

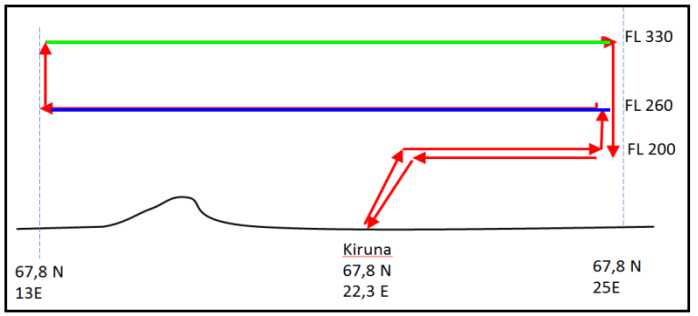


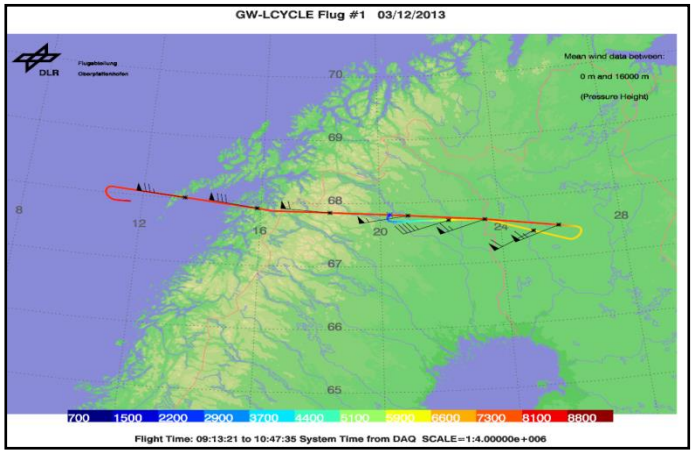
2µ Wind Lidar data 03.12.13

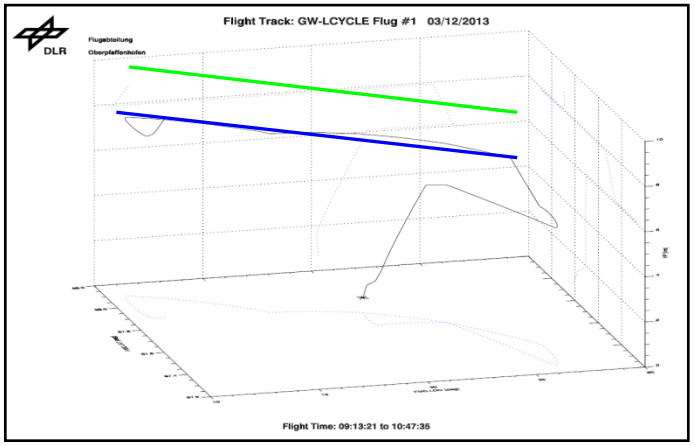
Flight 1





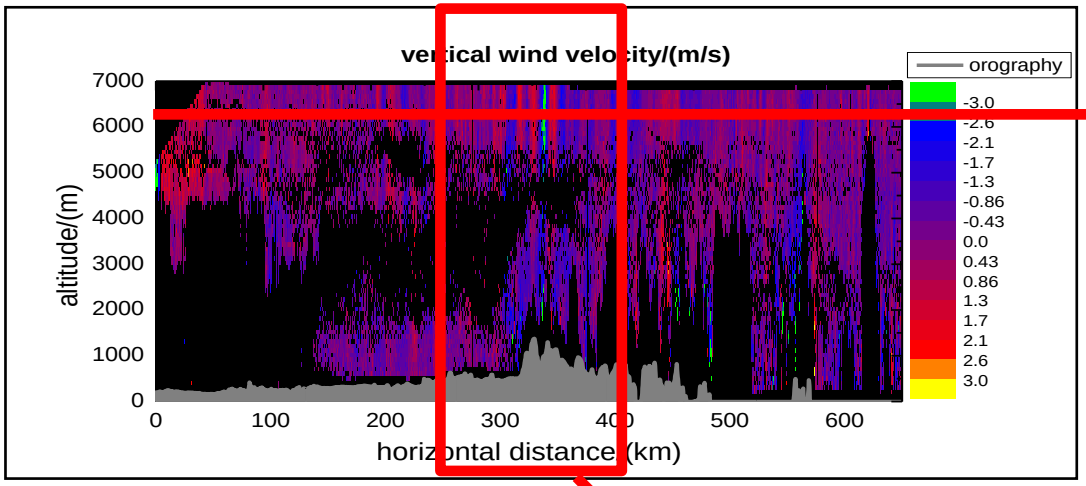


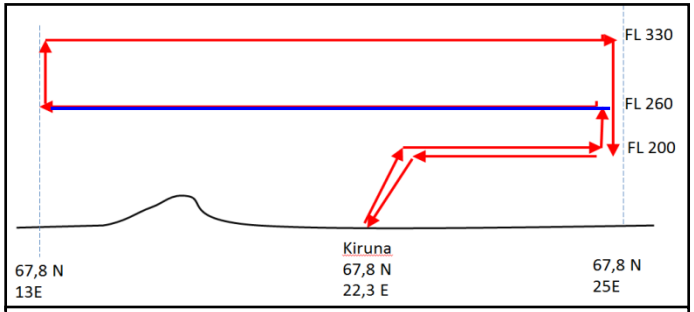


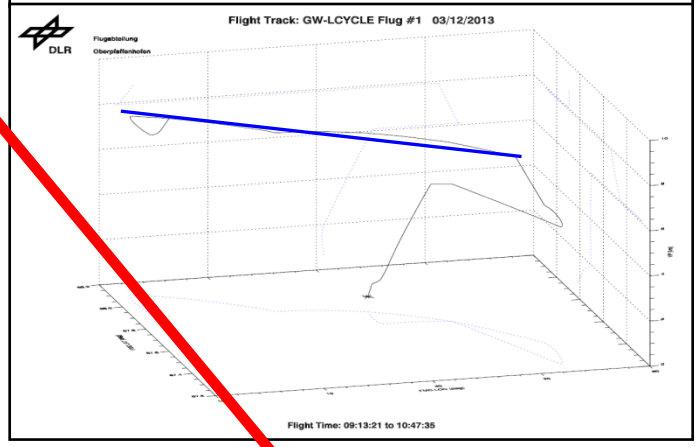


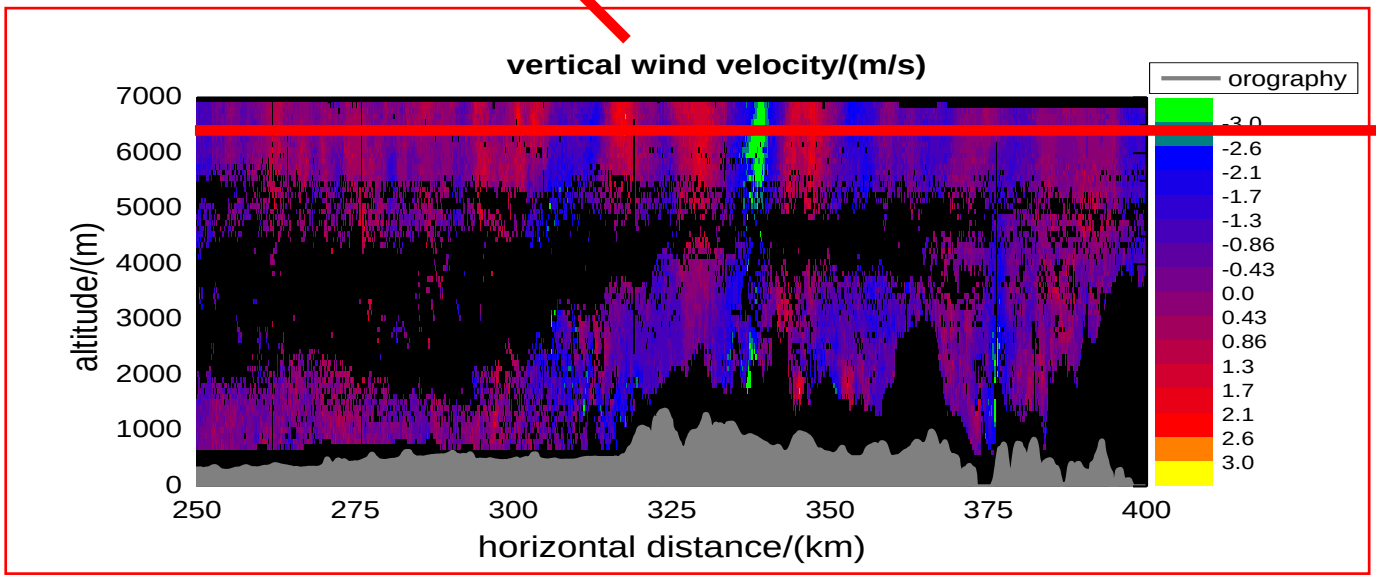
2µ Wind Lidar data 03.12.13

Spectral analysis of vertical wind



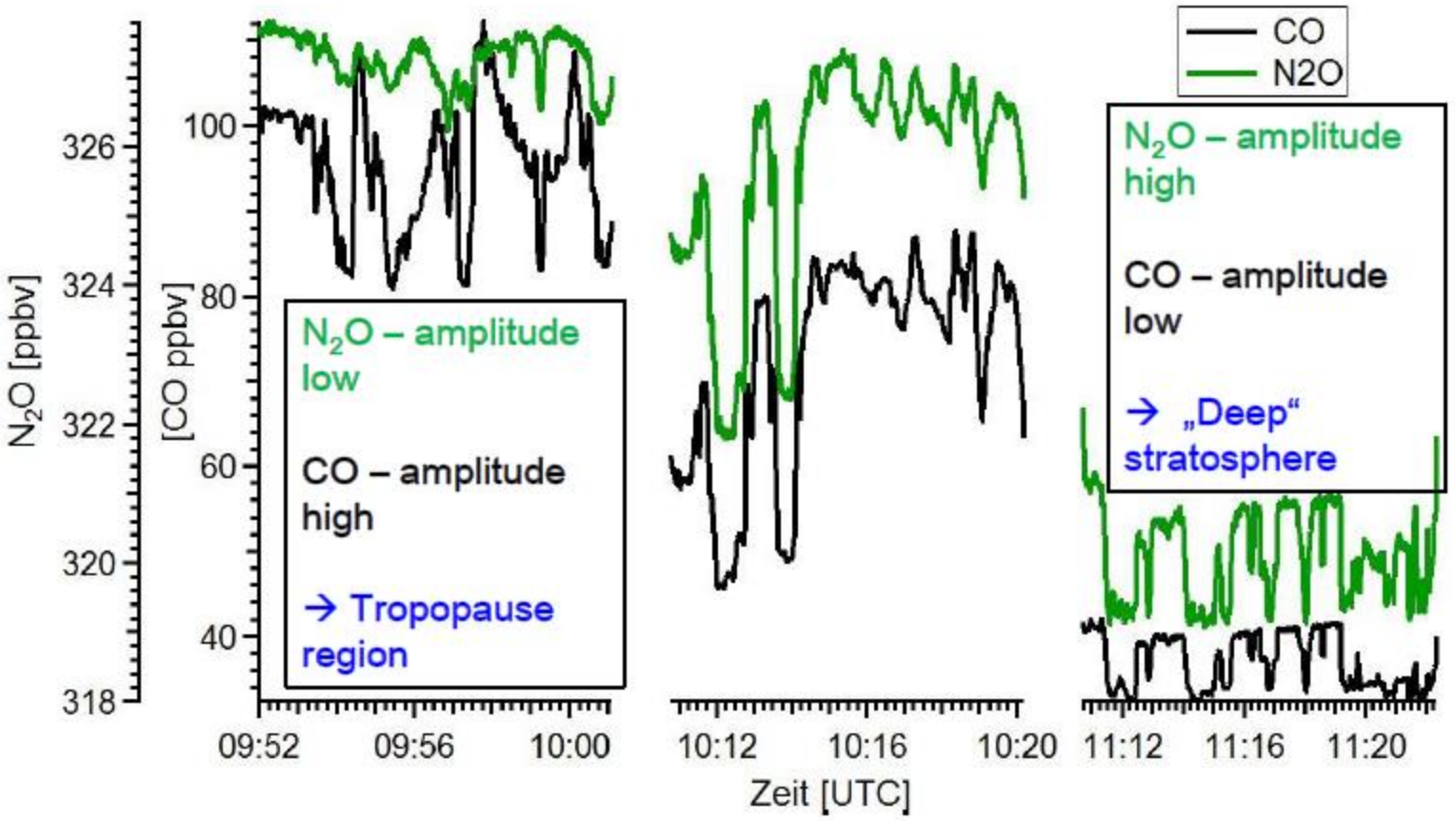






A spectral analysis of the measured LOS wind speed is exemplarily performed in an altitude of 6500 km

Amplitudes – Flight 1



Radiosonde Launches from Lauder

DLR, LMU Munich, Innsbruck University

(1) Väisälä radiosonde station of the LMU Munich
60 .. 80 sondes with 600 g balloons

(2) GRAW radiosonde station of the University of Innsbruck
20 sondes with 600 g balloons

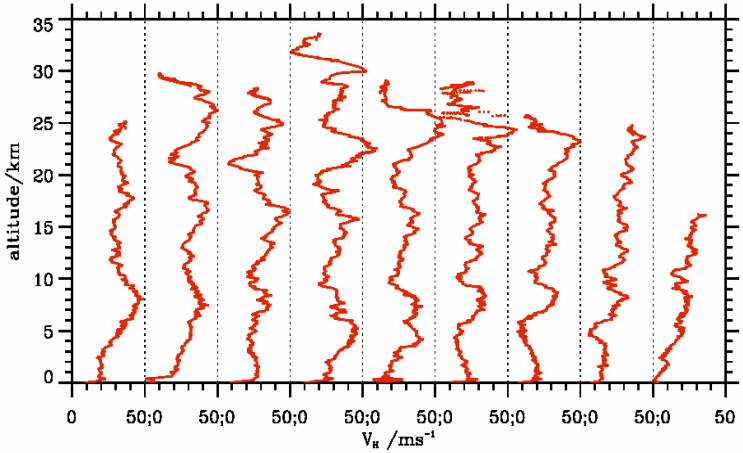
Purposes:
- the determination of wind, temperature and humidity from the surface up to about 30 km altitude
- the determination of the tropopause height
- the characterization of gravity waves in the troposphere and stratosphere

Different **launch techniques** can be applied in coordination with the other Radiosonde stations deployed during DEEPWAVE-NZ

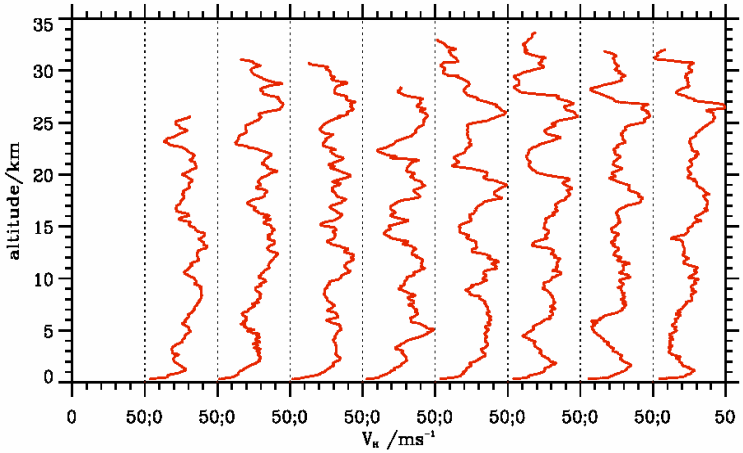
- simultaneous launches of two balloons with different gas fillings
- series of balloon launches every 90 min or 180 min during IOPs

3 Dec 2013 06 09 12 15 18 21 00 03 06 UTC 4 Dec 2013

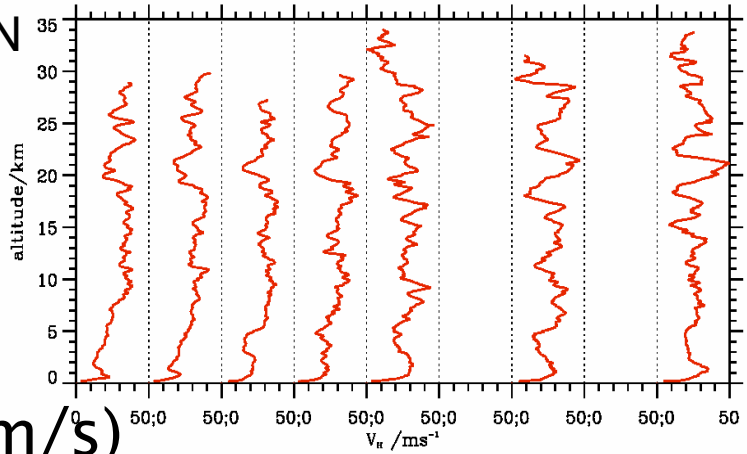
Andøya, N



Esrange, S



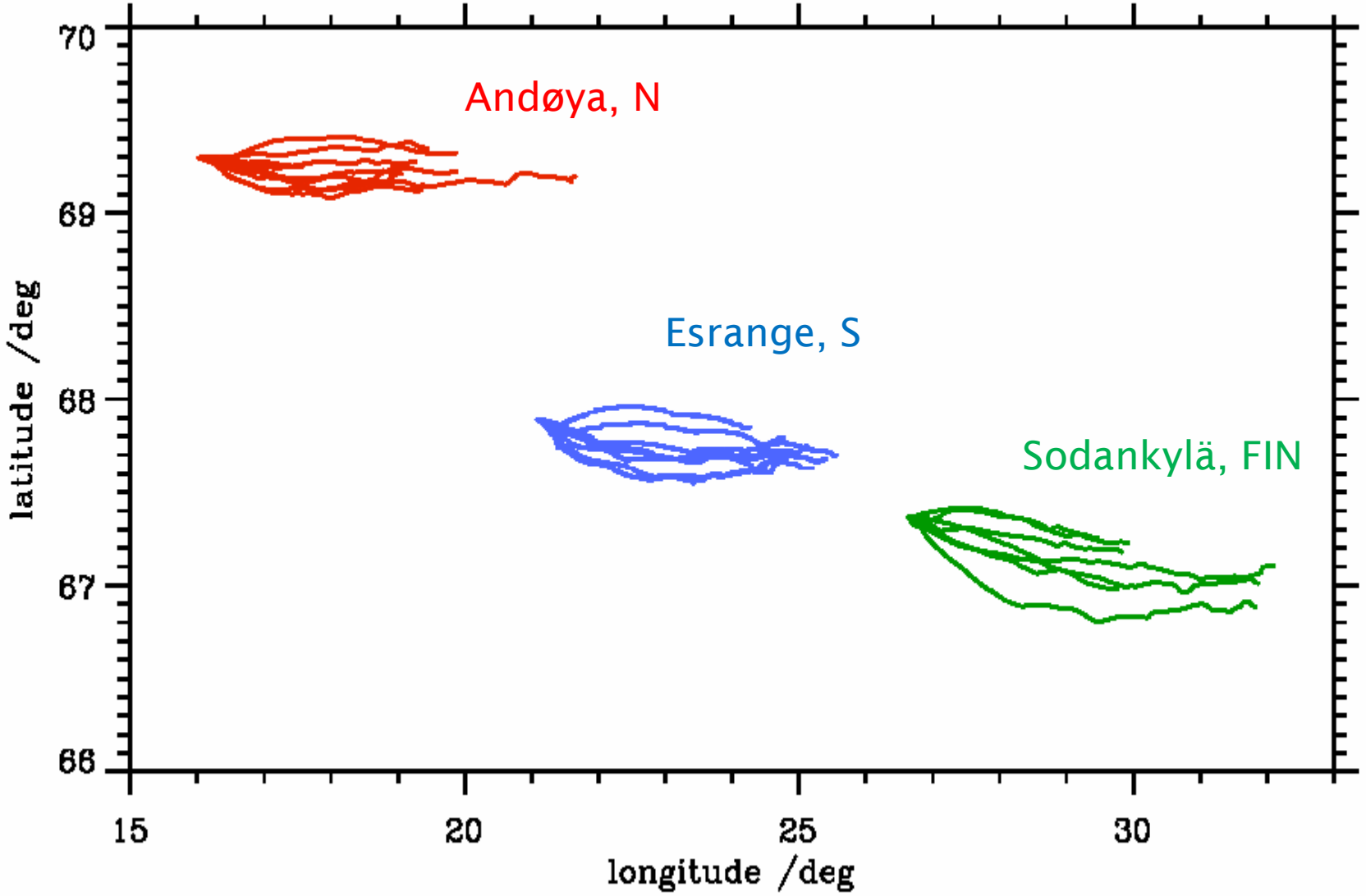
Sodankylä, FIN



Horizontal Wind (m/s)

IOP 1 Simultaneous Radiosonde Launches every 3 h

3 December 2013 06 UTC - 4 December 2013 06 UTC



Sodium-Rayleigh-Brillouin-Raman Lidar (Na-RBR)

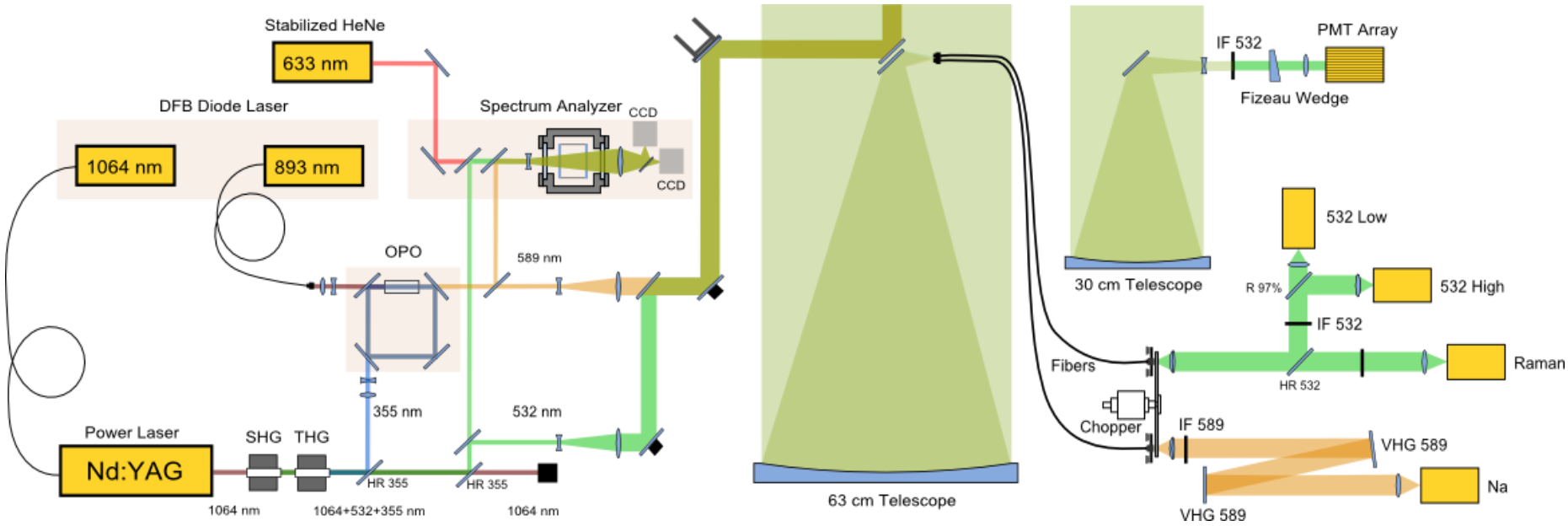
Transmitter

0.5 W at 589 nm (Sodium resonance)
10 W at 532 nm

100 Hz reprate
Bandwidth <100 MHz

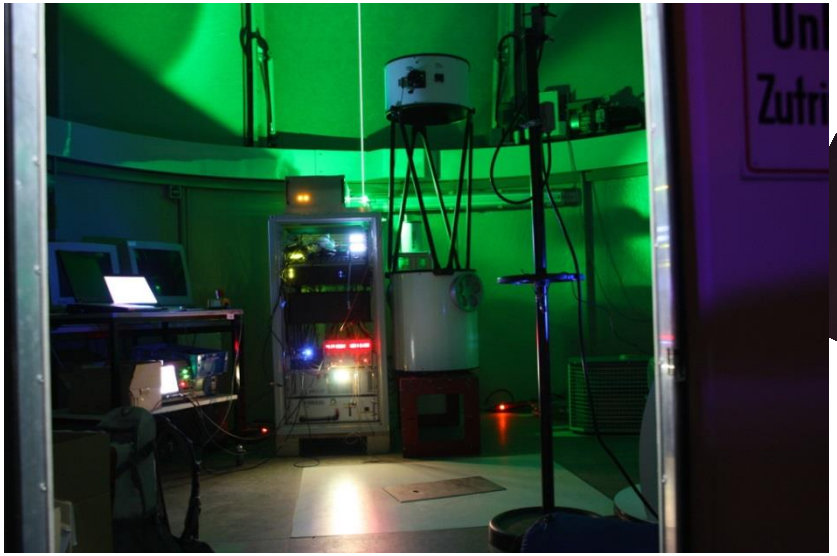
Receiver

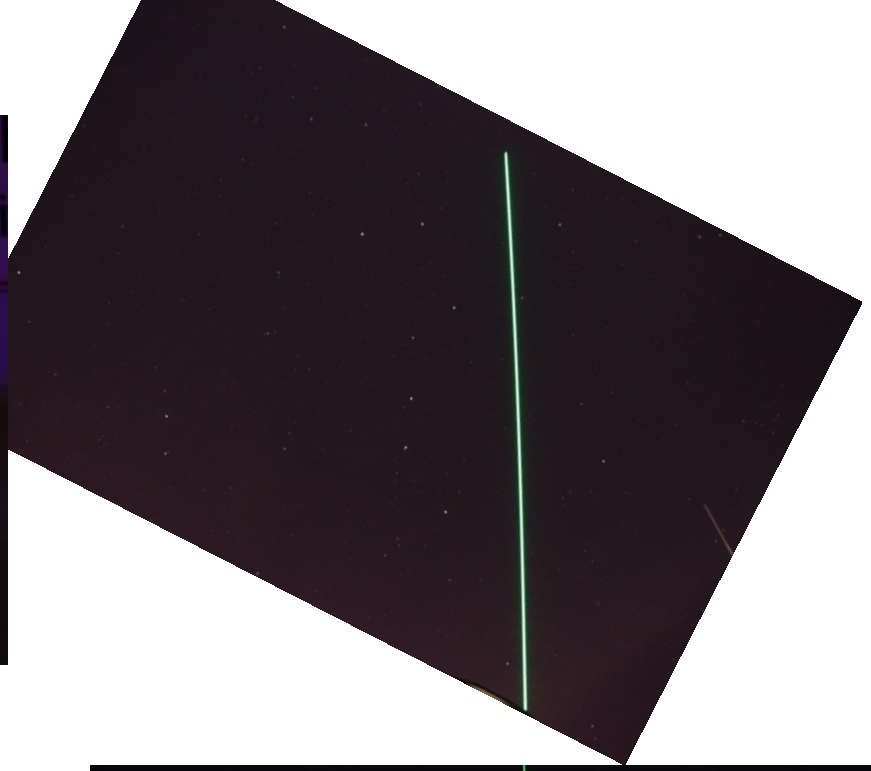
1 Channel at 589 nm
1 Raman channel at 608 nm
2 Channels at 532 nm
1 Rayleigh-Brillouin channel

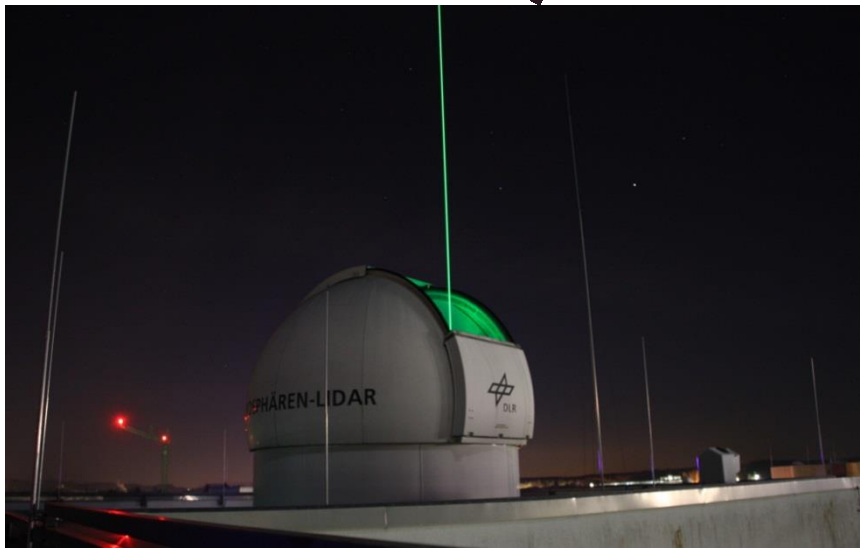


Na-RBR Lidar

Operation	Ground based system; remote/autonomous operation Real-time data analysis, quicklook plots on webpage
Metal	Sodium (589 nm wavelength)
Measurements	Temperature (5-105 km) Sodium density (80-105 km) One horizontal wind component (80-105 km) Aerosol (5-35 km)
Resolution	2 km, 15-60 min depending on altitude; 1-2 km, 20 min within metal layer
Observations in daylight	Currently not planned, degraded performance in daylight conditions
Output power	0.5 W at 589 nm, 10 W at 532 nm
Telescope aperture	63 cm
Field of view	365 microrad (sodium), 200 microrad (Rayleigh/Raman)






PHÄREN-LIDAR

Modelling/Forecast Capabilities

(1) ECMWF IFS (provided by DLR)

- two runs 00 UTC and 12 UTC available, 1 hourly forecasts until lead time +72 h, 3 hourly fcs afterwards until +240 h
- 137 layers up to 0.01 hPa, ~16 km horizontal resolution
- various fields (U, V, W, T, RH, PRECIP, DIV, VOR, PV maps,…) on pressure levels and on selected vertical cross-sections visualized on: www.pa.op.dlr.de/missionsupport/classic/forecasts

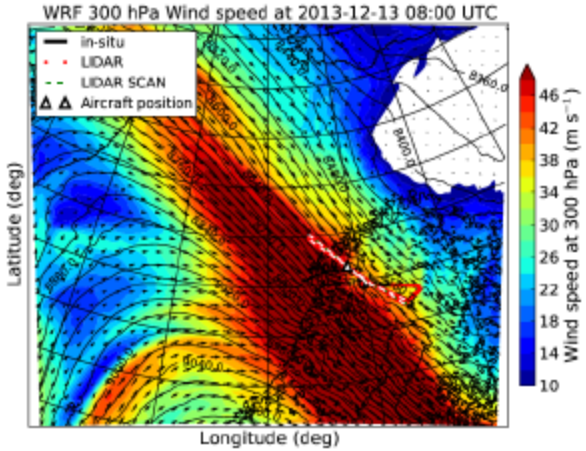
(2) WRF driven by ECMWF IFS (Innsbruck University)

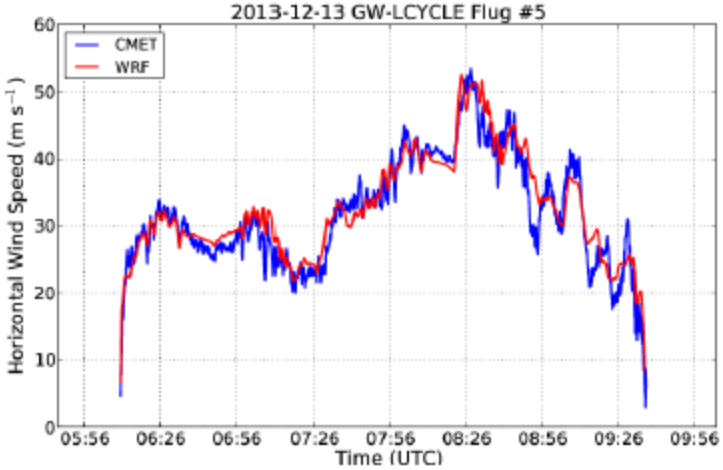
- two runs driven by 00 UTC and 12 UTC IFS forecasts
- nested simulations with 6 km resolution and z_{TOP} ~ 50 km
- similar fields as ECMWF IFS plus TKE and non-hydrostatic vertical wind visualized on: www.pa.op.dlr.de/missionsupport/classic/forecasts

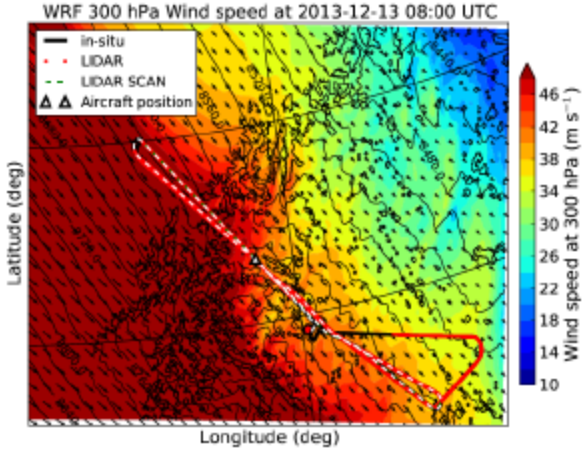
(3) COSMO (Bundeswehr Geoinformation Service, Rene Heise)

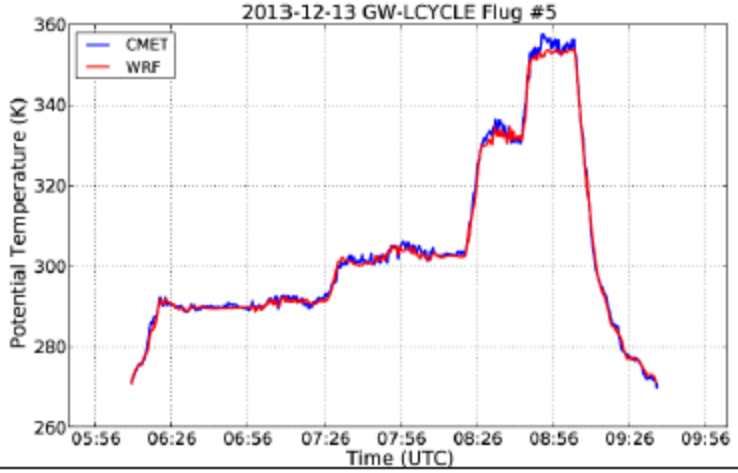
- 2.8 km runs to provide vertical wind, eddy dissipation rate and TKE

IOP5 Flight 1: in-situ ⇔ WRF









Stratospheric „Wave Soup“ only occassionally excited by flow over topography

(Examples from GW-LCYCLE 2013)