Tethered Balloon Measurements
(KOP 94)

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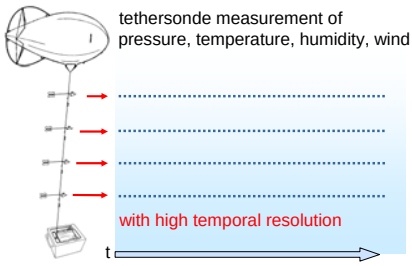
The Arctic Planetary Boundary Layer

The planetary boundary layer (PBL) is the lowest part of the atmosphere, where exchange processes of momentum and heat occur between the Earth's surface and the atmosphere. In the Arctic, the boundary layer is characterized by a frequent occurrence of temperature inversions, thus being a stable layer that effectively suppresses the vertical motion of air. The Ny-Ålesund environment, with its semi-permanent snow cover in the vicinity of glaciers and mountainous orography, sets up special atmospheric boundary layer conditions.

Our analyses focus on the spatial and temporal characterization of the Arctic PBL, therefore we implement tethered balloon measurements with up to 6 tethersondes mounted along the tether, measuring a meteorological profile over several hours. The results are used e.g. to validate the boundary layer representation in the regional climate model HIRHAM under different atmospheric stability conditions. In order to analyse the correlation between cyclogenesis and boundary layer conditions, storm tracks and the strength of cyclones are identified in the simulated mesoscale pressure, temperature, and wind fields, and the model results support the interpretation of the tethered balloon measurements.

Set-Up of the Tethered Balloon System

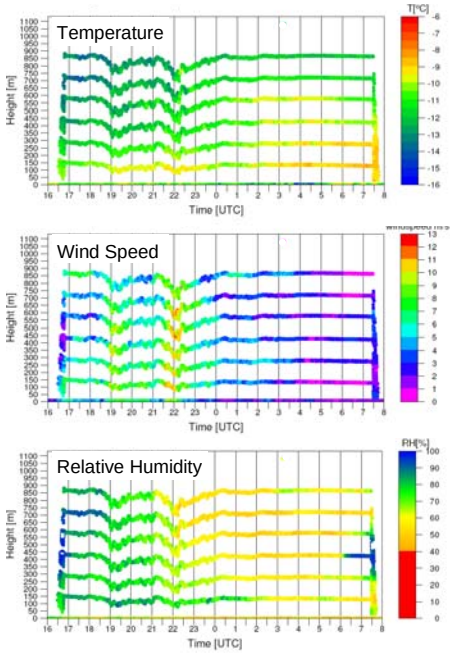


Measurement Days so far

Spring 2005	Autumn 2005	Spring 2006	Spring 2008
10.03.2005	30.08.2005	03.05.2006	02.04.2008
11.03.2005	01.09.2005	09.05.2006	03.04.2008
12.03.2005	02.09.2005	10.05.2006	04.04.2008
15.03.2005	05.09.2005	16.05.2006	05.04.2008
16.03.2005	06.09.2005		09.04.2008
23.03.2005	07.09.2005		10.04.2008
25.03.2005	23.09.2005	**Spring 2007**	14.04.2008
28.04.2005	29.09.2005	07.04.2007	15.04.2008
06.05.2005	10.10.2005	11.04.2007	10.04.2008
11.05.2005			19.04.2008
			23.04.2008
			24.04.2008
			25.04.2008
			27.04.2008

The operation of the tethered balloon is limited by the meteorological conditions.
(e.g. too much wind or danger of icing)

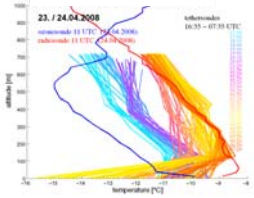
Example: 23 / 24 April 2008



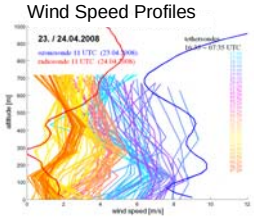
Figures 1-3: Temperature, wind speed and relative humidity evolution as measured by tethersondes on 23 and 24 April 2008.

Example: 23 / 24 April 2008

Temperature Profiles



Wind Speed Profiles



Figures 4 + 5: Profiles of temperature and wind speed as measured once per day by regular radiosonde (red and blue lines) and continuously by tethersondes. The color-coded tethersonde profiles each refer to an average over 5 minutes.

The temporal resolution of the tether measurements delivers insight into the dynamical evolution of the ground-based inversion layer.

While the two radiosonde profiles seem to show a rapid change in wind speed below 700m, the tethersonde observations indicate quasi stepwise changes.

Tethersonde Sensors (Vaisala TTS111)

Parameter	Measuring range	Resolution
Temperature	-50 … +60 ºC	0.1 ºC
Pressure	500 … 1080 hPa	0.1 hPa
Relative Humidity	0 … 100 % RH	0.1 % RH
Wind Speed	0 … 20 m/s	0.1 m/s
Wind Direction	0 … 360º	1º

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