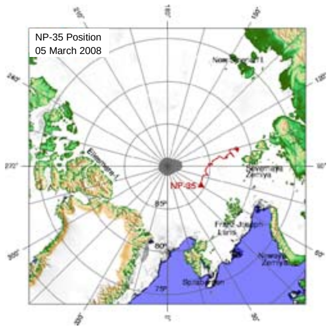
Tethered Balloon Measurements on the North Pole Drifting Ice Station NP-35

M. Maturilli, J. Graeser, M. Mielke, A. Rinke
Alfred-Wegener-Institut für Polar- und Meeresforschung, Potsdam

Project Description

The 'Atmospheric Circulations' group at the Alfred Wegener Institute (AWI) in Potsdam took advantage of the International Polar Year 2007/2008 to investigate the atmosphere in hardly accessible regions of the Arctic ocean. The close cooperation with the *Arctic and Antarctic Research Institute* (AARI), St. Petersburg, made it possible to participate in the 35th Russian North Pole Ice Drifting Station (NP-35) with own experiments. The coupling of sea ice cover and atmosphere, radiative coupling of clouds and aerosols, the coupling of the planetary boundary layer with cyclones, and the annual and inter-annual variability of the ozone layer are among the important questions addressed by the project.
By end of September 2007, the AWI technician Jürgen Graeser arrived as only international member of the 21-headed overwintering team on the roughly 3x5 km large ice floe. From its initial position at 81° N und 103° E, north of Severnaya Zemlya, the ice floe drifted northward in the Arctic ocean during winter. In this otherwise inaccessible region, the Russian colleagues investigate the upper sea layer, the sea ice and the snow cover, and provide meteorological standard observations on ground and by radiosonde. The AWI technician Jürgen Graeser performs tethered balloon measurements and ozone soundings to provide information on different parts of the atmosphere.



Tethered Balloon Measurements

Here, the focus aims at the state and variability of the planetary boundary layer (PBL), and its connection with mesoscale cyclones and storm tracks. During the drift of NP-35, the dynamics and structure of the PBL is detected by tethered balloon measurements. As the analyses focus on the spatial and temporal characterization of the Arctic PBL, up to 6 tethersondes are mounted along the tether, measuring a meteorological profile over several hours. Data interpretation is supported by model simulations with the regional climate model HIRHAM. Mesoscale pressure, temperature, and wind fields are generated to identify cyclones and storm tracks. Special emphasis is put on the connection of cyclogenesis and different surface conditions (e.g. sea ice cover).

Example 1: Developing Temperature Inversion

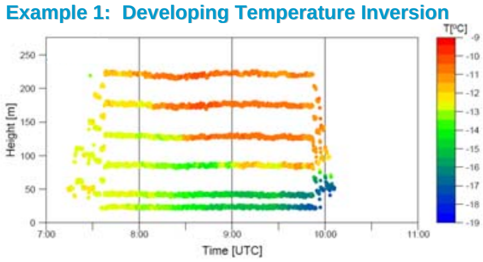


Figure 1a: *Temperature evolution as measured by tethersondes on 28 October 2007.*

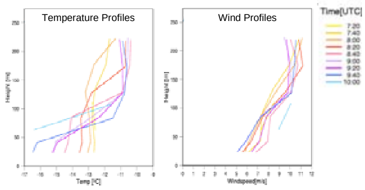


Figure 1 b+c: *Tethersonde measurement on 28 October 2007, shown as vertical temperature and wind profiles (left and right, respectively) in steps of 20 minutes.*

Model and Observations

To understand the issues involved in detecting Arctic changes in the climate system, it is necessary to reproduce local and regional climate conditions i.e. inversions in the PBL. For this reason, a regional climate model like HIRHAM, with a higher horizontal and vertical resolution, is imbedded within global climate models. A first step for the comparison of HIRHAM and NP-35 observations is the analysis of surface inversions as important indicators of the local climate.

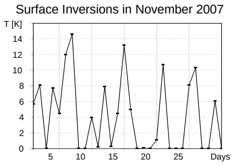
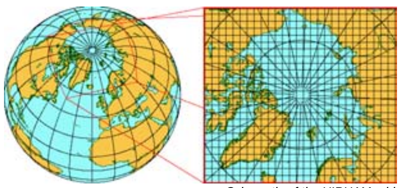


Figure 4: *The temperature difference in surface inversions found by midday radiosondes on NP-35 in November 2007.*



Schematic of the HIRHAM grid.

Example 2: Expanding Dry Layer

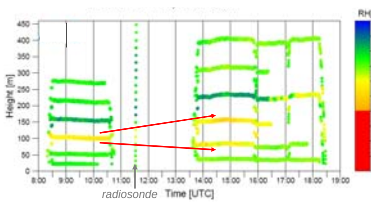


Figure 2a: *Temporal evolution of relative humidity as measured by tethersondes and radiosonde on 31 January 2008.*

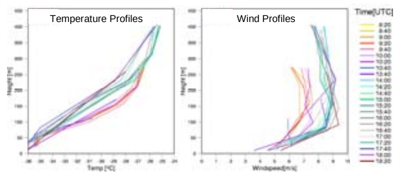


Figure 2b+c: Vertical temperature and wind profiles (left and right, respectively) from tethersonde measurements on 31 January 2008.

Example 3: Strong Inversion

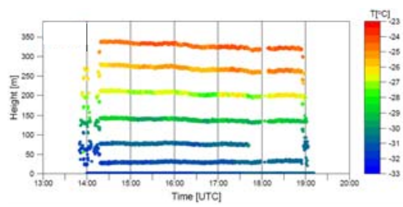


Figure 3a: *Temperature evolution as measured by tethersondes on 3 February 2008.*

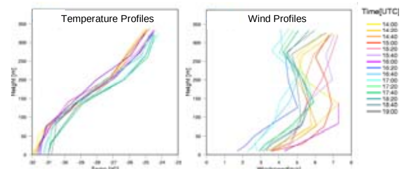


Figure 3b+c: Vertical temperature and wind profiles (left and right, respectively) from tethersonde measurements on 3 February 2008.









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contact: marion.maturilli@awi.de