AIRCRAFT-BASED STUDIES OF KATABATIC WINDS AND BOUNDARY LAYER STRUCTURES OVER THE NOW POLYNYA NEAR GREENLAND DURING SUMMER

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ABSTRACT

The experiment IKAPOS (**I**nvestigation of **Ka**tabatic winds and **Po**lynyas during **S**ummer) focuses on the summertime katabatic wind system and the atmospheric boundary layer (ABL) over the North Water Polynya (NOW) in northwestern Greenland.
For different synoptic situations in June 2010, four flights over the NOW and one flight each over the Humboldt and Steenstrup Glacier were performed using the research aircraft POLAR 5 of Alfred-Wegener-Institute (AWI, Bremerhaven).

Over the glaciers, katabatic winds with up to 14 m/s wind speed were found during conditions of strong synoptic forcing.
Over the NOW polynya, a stable and fully turbulent ABL was present. As a consequence of strong and relatively warm synoptically induced northerly winds distinct temperature inversions in the lowest 100 m – 200 m agl were detected.
At Smith Sound channeling effects leaded to a well-pronounced low-level jet system with wind speed maxima of about 20 m/s.

ACKNOWLEDGEMENTS

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INTRODUCTION

During June 2010, the aircraft based experiment IKAPOS was performed in northwestern Greenland (**Figure 1**). The main goals were studies of the summertime katabatic wind system and of the atmospheric boundary layer (ABL) over the North Water (NOW) Polynya.

Katabatic winds play a key role in exchange processes of energy and momentum between the atmosphere and the underlying surface over the ice sheet of Greenland. On the other hand, the NOW Polynya represents one of the largest polynyas of the Arctic, and the air-sea interaction over the polynya has important consequences for ocean processes, ice formation, gas exchange and biology.

EXPERIMENTAL AREA

For different synoptic situations four flights over the NOW and one flight each over the Humboldt and the Steenstrup Glaciers were performed (**Figure 1**).

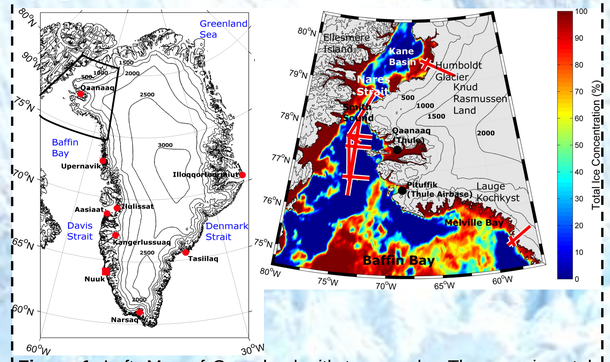

Figure 1. Left. Map of Greenland with topography. The experimental area is indicated by a tetragon. Right. AMSR-E sea-ice concentration on 14 June 2010. Flight patterns are presented by red lines.

REFERENCES

Drüe, C. and G. Heinemann, 2003: Investigation of the Greenland Atmospheric Boundary Layer over Summit 2002 (IGLOS). Field Phase Report. *Reports on Polar and Marine Research 447*.

Heinemann, G.1999: The KABEG'97 field experiment: An aircraft-based study of katabatic wind dynamics over the Greenland ice sheet. *Boundary-Layer Meteorology 93*, 75–116.

METHODS AND MATERIALS

The present study is based on aicraft measurements in the ABL using the research aircraft POLAR 5 (**Figure 2**) of Alfred-Wegner-Institute (AWI, Bremerhaven).

Figure 2. Research aircraft Polar 5 at Kangerlussuaq. Wind, temperature and humidity sensors are marked.

In order to study the turbulence structure and 3D spatial structures of mean quantities POLAR 5 was instrumented with a turbulence measurement system collecting data on a nose boom sampling at a rate of 100 Hz, additional basic meteorological equipment, radiation and surface temperature sensors, laser altimeter, and photo and video cameras.

FIRST RESULTS

Over the glaciers, katabatic winds with up to 14 m/s wind speed were found (**Figure 3**).

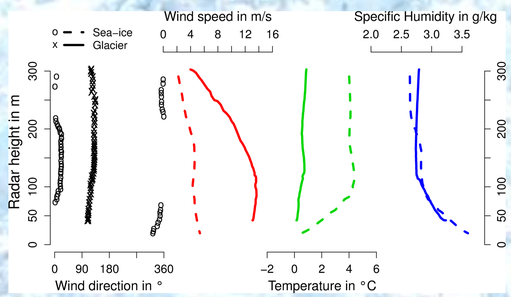

Figure 3. Aircraft temps on 17 June 2010 (around 15 UTC) over Steenstrup Glacier and sea-ice in front of the glacier.

FIRST RESULTS

Over the NOW, a stable, but fully turbulent ABL was present during conditions of strong and relatively warm synoptically induced northerly winds (**Figure 4**). Strong surface inversions were found in the lowest 100–200 m.

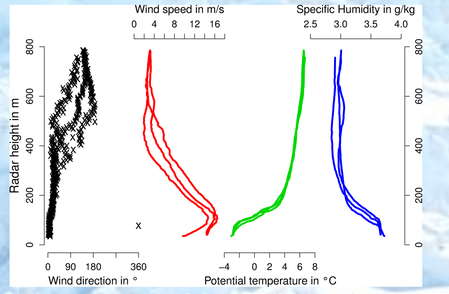

Figure 4. Aircraft temps on 18 June 2010 (around 14.30 UTC) over NOW.

As a consequence of channeling effects at Smith Sound a well-pronounced low-level jet with wind speed maxima of about 20 m/s was detected (**Figure 5**, **6**). Thus wind-induced sea-ice export from the Nares Strait is considerably increased by topographic channelling.

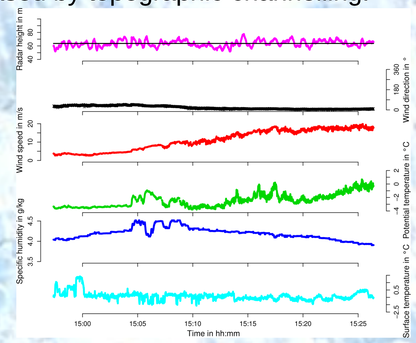

Figure 5. Aircraft leg on 23 June 2010 from Kane Basin to Smith Sound.

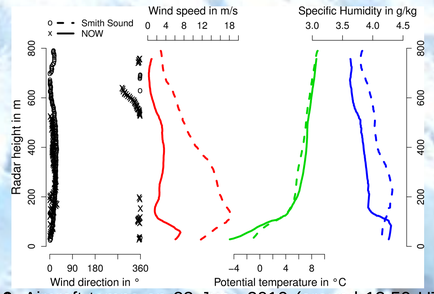

Figure 6. Aircraft temps on 23 June 2010 (around 13.50 UTC) over Smith Sound and NOW.