AIRBORNE INVESTIGATIONS OF SUMMERTIME KARABATIC WINDS AND BOUNDARY LAYER STRUCTURES OVER THE NOW POLYNYA NEAR GREENLAND

T. Ernsdorf, G. Heinemann and C. Drüe
Environmental Meteorology, University of Trier, Germany, ernsdorf@uni-trier.de

Universität Trier
DFG Deutsche Forschungsgemeinschaft

ABSTRACT

For different synoptic situations in June 2010, four flights over the NOW (North Water) Polynya and one flight each over the Humboldt and Steenstrup Glacier were performed using 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 atmospheric boundary layer (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 were detected.
At Smith Sound channeling effects led to a well-pronounced low-level jet system with wind speed maxima of about 20 m/s.

INTRODUCTION

The experiment IKAPOS (**I**nvestigation of **Ka**tabatic winds and **Po**lynyas during **S**ummer, Heinemann et al., 2011) focuses on the summertime katabatic wind system and the ABL over the North Water (NOW) Polynya in northwestern Greenland (**Figure 1**).

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 (Heinemann, 1999). 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 a significant impact on ocean processes, ice formation, gas exchange and biology (Barber et al., 2001).

EXPERIMENTAL AREA

The experimental area is located in northwestern Greenland (**Figure 1**). Qaanaaq airport was the basis of the research flights.

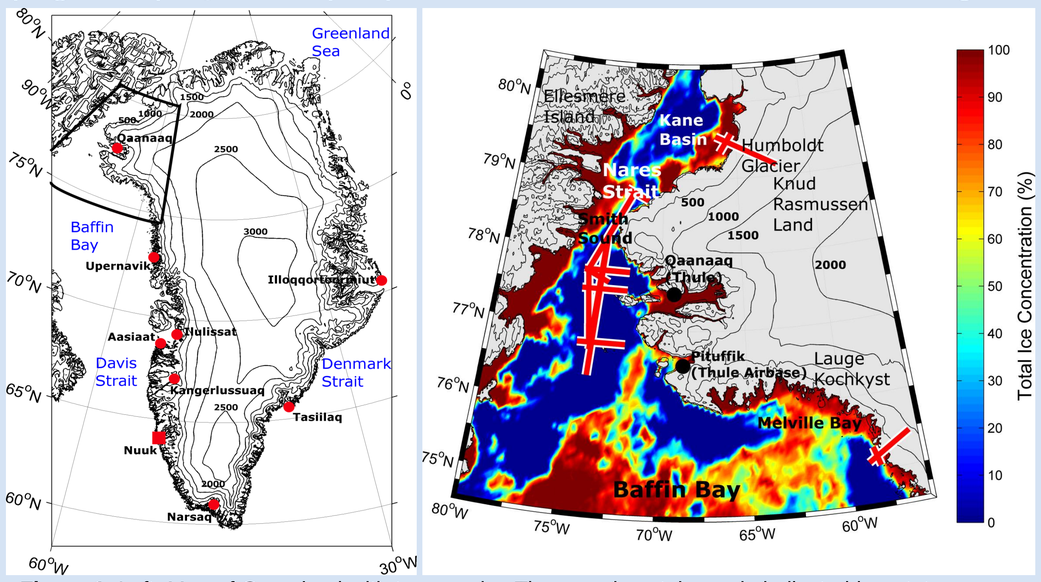

Figure 1. Left. Map of Greenland with topography. The experimental area is indicated by a tetragon. Right. AMSR-E sea-ice concentration on 14 June 2010. Flight patterns are presented by red lines.

METHODS AND MATERIALS

POLAR 5 (**Figure 2**) is a rebuilt DC-3 (Douglas Company) 1942 with two turboprop engines. In order to study the turbulence structure and 3D spatial structures of mean quantities, POLAR 5 was equipped 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.

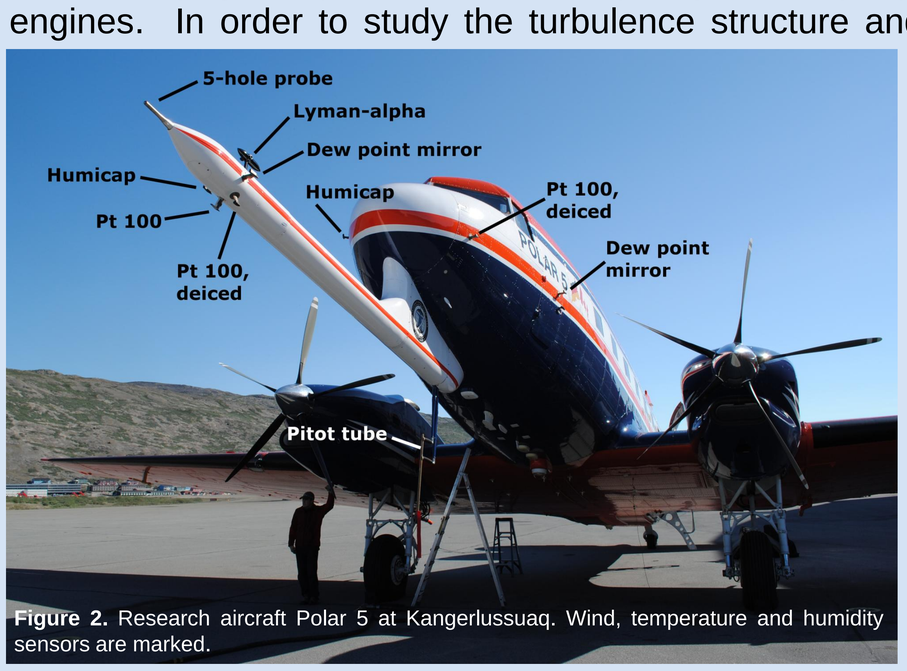

Figure 2. Research aircraft Polar 5 at Kangerlussuaq. Wind, temperature and humidity sensors are marked.

FIRST RESULTS

Over the glaciers, katabatic winds with up to 14 m/s wind speed were found from 40 m (lowest flight level) to 110 m (**Figure 3, 4**). By contrast , over sea-ice in front of the glacier the wind is relatively weak (about 2 m/s to 6 m/s) and its profile shows small gradients.

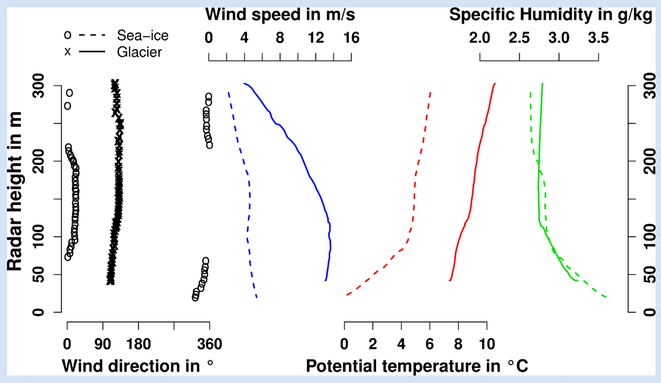

Figure 3. Aircraft temps on 17 June 2010 (around 15 UTC) over Steenstrup Glacier and sea-ice in front of the glacier.

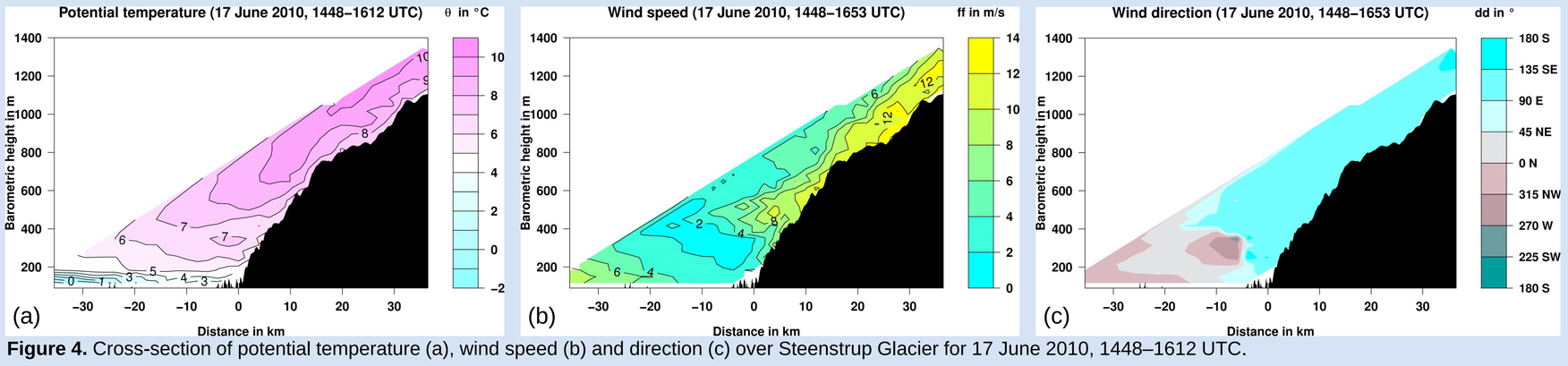

Figure 4. Cross-section of potential temperature (a), wind speed (b) and direction (c) over Steenstrup Glacier for 17 June 2010, 1448–1612 UTC.

In **Figure 5** three aircraft temps over the northern NOW show a stable, but fully turbulent ABL. Interaction processes of relatively warm northerly winds with cold water lead to a surface inversion of about 8 K/100 m. The boundary layer is considerably influenced by channeling effects at Smith Sound (for position see **Figure 1**). A well-developed low-level jet with wind speed maxima of about 20 m/s was detected (**Figure 6**).

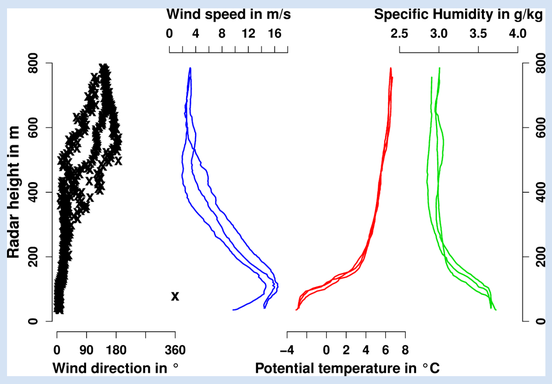

Figure 5. Aircraft temps on 18 June 2010 (around 14.30 UTC) over NOW.

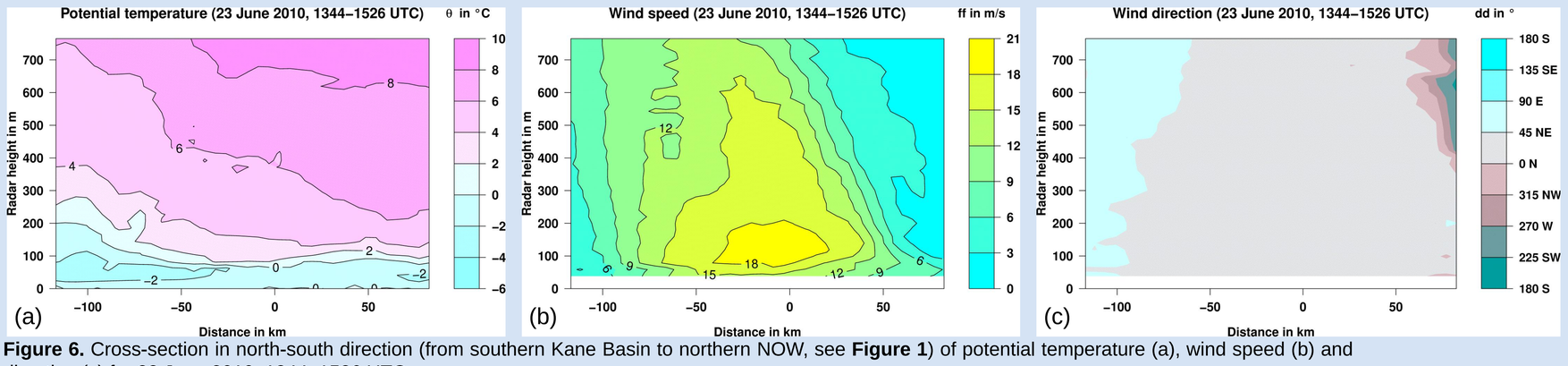

Figure 6. Cross-section in north-south direction (from southern Kane Basin to northern NOW, see **Figure 1**) of potential temperature (a), wind speed (b) and direction (c) for 23 June 2010, 1344–1526 UTC.

ACKNOWLEDGEMENTS

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