Mass Balance measurements and Energy Balance Modelling at Jan Mayen
Outlook of a PhD-project

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Motivation
Jan Mayen is a volcanic island in the Northern Atlantic Ocean, situated 71°N and 8°W (Fig 1). 20 glaciers dominate the northern part of the island with the central crater of Beerenberg in the middle (Fig 2).

There are three main aspects why Jan Mayen is an interesting area for glaciological research:

1) Jan Mayen is located in an unstudied area between Iceland, Greenland, Svalbard and the Norwegian Coast and will provide new information on glacier mass balance in the Arctic. The climate is highly effected of the warm and cold ocean currents around the island and the climate maybe sensitive to changes in these currents.

2) A long meteorological series from the Norwegian Meteorological Institute is available from Jan Mayen for the period 1921 to present. The climate is classified as polar marine and the annual sea level temperature is 0.8°C and the annual precipitation is 660 mm.

3) Earlier mass balance measurements in the 1970s show abnormal patterns with decreasing ablation in the lower part of Sørbreen (Fig 3). This is likely a result of inversion layers that are common in the early summer, giving complex energy balance conditions in the ablation area (Hagen, 2004).

Method

- An automatic weather station was placed on Sørbreen in October 2007 (Fig 4) to measure meteorological data for calculation of the energy balance of the ablation zone. This data will be analyzed together with radiosonde data (Fig 5) and measurements from the meteorological station at Jan Mayen.

- In spring 2008, ablation stakes will be installed on the glaciers to measure the mass balance of Sørbreen, Kerckhoffbreen, Peter senbreen and Kronprins Olavs Bre.

- The mass balance data will further be used for calibration of a degree day model in an attempt to re-construct the mass balance for the last century. It will be evaluated if the meteorological data from 1921 to present could be useful for this model.

- Since the island and the glaciers are in-accessible, it is important to develop methods to automatically measure the mass balance. A low-cost ultrasonic distance sensor with a small solar panel and a micro computer will register snow depth and ice melt changes. The device is under development and will be tested and evaluated during the winter 2007/08.

Fig 1. Jan Mayen is situated at 71°N and 8°W in the Northern Atlantic Ocean.

Fig 2. The glaciers of Jan Mayen with the volcano crater and Beerenberg in the center. (Modified from Orheim, 1993)

Fig 3. Mass balance measurements on Sørbreen from 1973/74. The curves show summer balance (bs), winter balance (bw) and net balance (bn) relative to the elevation. Notice the abnormal ablation pattern at 200-400 m asl. (Modified from Orheim, 1976)

Fig 4. An automatic weather station was placed on the ablation zone of Sørbreen in October 2007. The station measures air temperature (2m, 5m), relative humidity (2m, 5m), wind speed and direction (5m), long and short wave radiation (5m), snow depth, ice melt, snow temperatures (0m to 2,5m) and ice temperatures (0m to -15m).

Fig 5. Radiosonde data from Jan Mayen meteorological station, 1st of June 2007. Extreme inversion that are common at Jan Mayen in early summer (Anda, 1980). Radiosonde data will be used to derive the daily laps rate and cloud height and thickness as input to the energy balance model. (Data from Met.no)

References: