Geophysical Research Abstracts, Vol. 8, 01400, 2006
SRef-ID: 1607-7962/gra/EGU06-A-01400

Geophysical and glaciological investigations on the accumulation rate in Central Dronning Maud Land, East Antarctica

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Interactions of the Antarctic ice sheet with atmosphere, oceans, and the solid Earth are fundamental processes in global climate. Thus the detailed knowledge of the recent changes of the Antarctic ice sheet and its mass balance are of vital importance. In this research field the accumulation rate and its variation throughout Antarctica play a major role. Accumulation data derived from firn cores, snow pits or stake readings provide only selective information about the mean annual accumulation rate at the point of probing. GPR is capable to map large areas and give information about internal reflection horizons. Dating of those horizons by a reliable age-depth-relation yields accumulation values.

In this presentation we will show data and results from the Antarctic expedition VISA-Ground 2003/2004. This expedition was carried out within the VISA project that aims to validate and interprete new satellite data by the retrieval of airborne and ground data; e.g., gravity data can be validated by mass changes from accumulation measurements. For this purpose investigations of the recent accumulation pattern were undertaken on Potsdam Glacier in Central Dronning Maud Land, Antarctica, in the Antarctic summer season 2003/2004. GPR profiles of a total length of ca. 100 km were carried out on the main flow line of the glacier and perpendicular to it. A 500 MHz antenna was used and traces were recorded each 0.5 m in a 400 ns time window, thus mapping the upper ca. 40 m of the snow pack. At five selected locations of the GPR profiles shallow firn cores (12 m deep) were drilled and snow pits were digged (2 m deep, 40 samples per pit). The goal of these geophysical and glaciological field work was the detection of internal reflection horizons in the subsurface, usually stemming from density contrasts. From the density variations with depth the cumu-

lative mass of these horizons could be calculated and from their mass difference and respective age difference the accumulation was derived.

The firn cores were analysed in the cold laboratory in AWI Bremerhaven. Analysis covered dielectric profiling (DEP), density measurements, and determination of the content of oxygen isotope 18O. From the density data a mass-depth-relation was established. The velocity distribution of the radar waves with depth was derived from the DEP data. With these models the picked horizons were converted from travel time to depth and to cumulative mass, respectively. Counting of 18O peaks (i.e. summer maxima) yielded an age-depth-relation that was used for dating the horizons. Combining these data sets the mean annual accumulation rate and its variation in the investigation area was calculated.

The accumulation rate shows a high spatial variability with pronounced maxima and minima. These features can at least partly be explained by the surface topography and the surface slope. The mean accumulation in the area mapped by GPR is 144 kgům-2ůa-1 with a onefold standard deviation of 46% of the mean value which is less than the value of 250 kgům-2ůa-1 reported by Korth and Dietrich (1996) in this area. Generally the accumulation decreases along the main flow line in the direction of glacier flow, indicating an ablation area further downwards. The temporal variations in the time span observed (1970-2004) are small and the accumulation pattern seems to be locally stable.