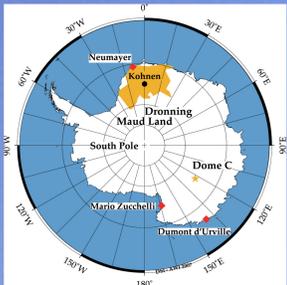


Snow-stake measurements in the surroundings of Georg von Neumayer and Neumayer II stations during the years 1982-2008

Figure 1: Map of Antarctica. The location of the Neumayer stations on Ekströmisen is shown. The yellowish colour indicates the area of the pre-site survey for the European Project for Ice Coring in Antarctica (EPICA).



The data

Snow accumulation in the surroundings of the two wintering-over bases on Ekströmisen, Georg von Neumayer (GvN, 1981-1992) and Neumayer II (1992-2008) (Figure 1), was determined by means of two stake arrays. Neumayer II station was built approximately 6 km south of GvN station. These arrays have been maintained by the meteorologists who wintered over at the Neumayer stations. One of the arrays was located close to the base. Thus, it was possible to make weekly readings. In 1991 another stake array was established 15 km south of the base GvN. Since then it was not relocated. It has been visited once in a month for stake readings. The density values needed to calculate accumulation rates were taken from snow pit studies. Usually a density value of 350 kg/m^3 was used. However, this value may be discussed. In addition, the results of two shallow firn cores were available for comparison with the stake readings. The first core was drilled on Dec. 12, 1989 approximately at that location (70.658610°S , 8.25250°W), where it was planned to construct the Neumayer II station two years later. The core contains the annual snow layers from 1975-1988. The second firn core (Figure 3) was drilled on Jan. 03, 2002, adjacent to the stake array of the Neumayer II station at 70.6555700°S , 8.25363°W . This core contains the annual layers from 1980-2001. The firn cores were mainly dated by the seasonal cycles of the content of the stable isotope ^{18}O .

Figure 2: Snow height change (red curves) at the stake arrays adjacent to Neumayer II station and approximately 15 km south of Georg von Neumayer (GvN) station. The stake arrays consist of 5×5 and 4×4 stakes, respectively, with a spacing of 5 metres. At Neumayer II the array was visited once in a week, the southern array was visited only once in a month. The blue lines show a linear fit through the data. No trend can be recognized. Positive values indicate accumulation and negative value indicate erosion of snow since the previous measurement.

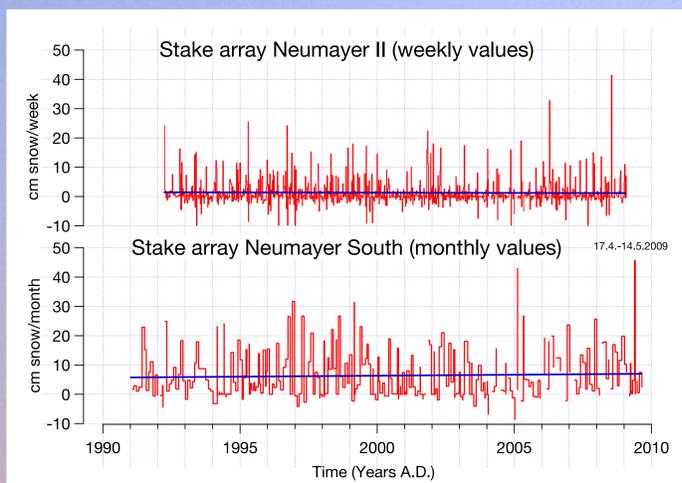


Figure 3: Firn core FB0202, drilled at Neumayer II station. Shown is the profile of the stable isotope ^{18}O (red) which was used to date the firn core. The calculated annual accumulation rates for the period 1981-2001 are plotted in blue colours.

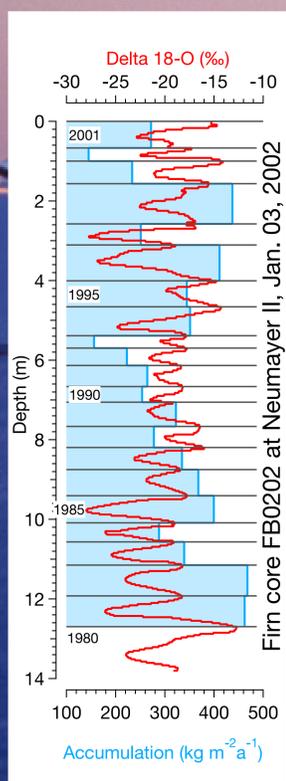
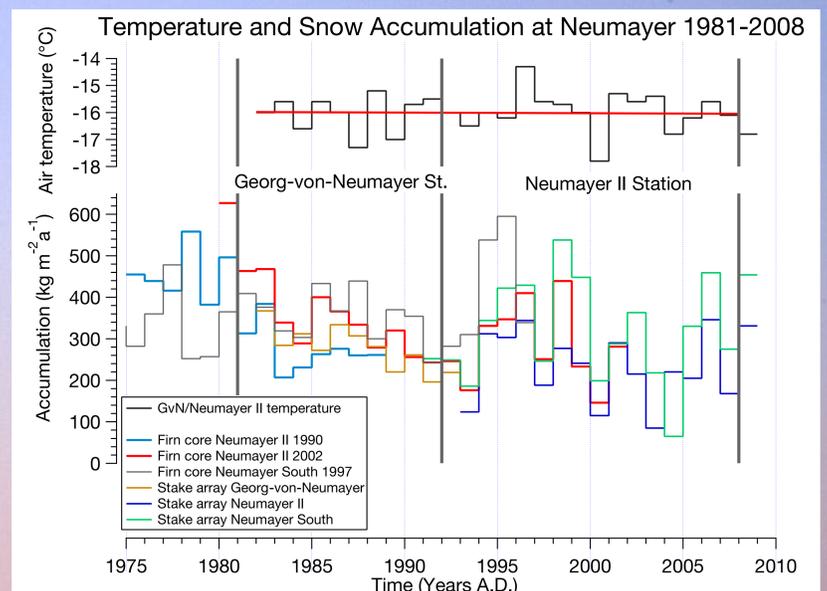


Figure 4: Air temperature at Neumayer stations (G. König-Langlo; www.awi.de). The mean annual temperature for the years 1992-2008 is $-16.0 \pm 0.7^\circ\text{C}$. No trend can be recognized. Mean annual accumulation rates calculated from snow height-change data at three stake arrays and from three firn cores. The firn cores were dated mainly by seasonal variations of the stable isotope ^{18}O (see Figure 3). The grey vertical bars indicate the periods during which GvN and Neumayer II stations, respectively, had been in operation. For comparison also the data from firn core FB9801, drilled in Dec. 1997, are shown (light grey curve).



Diskussion

Figure 4 shows the accumulation data resulting from the three stake arrays and from the two firn cores. The absolute values of the different time series differ from each other. However, in the coinciding periods the patterns are very similar. It is remarkable that in the period 1980-1994 all time series show declining accumulation rates. For the period 1992-2008, in which Neumayer II had been in operation, no trend of the accumulation rates can be observed. Only strong interannual variations can be seen.

For the three stake arrays and the two firn cores the following annual mean values and standard deviations were calculated:

Stake array GvN (1982-1992):	$277 \pm 52 \text{ kg/(m}^2 \text{ a)}$
Stake array Neumayer II (1993-2008):	$235 \pm 84 \text{ kg/(m}^2 \text{ a)}$
Stake array Neumayer South (1991-2008):	$320 \pm 122 \text{ kg/(m}^2 \text{ a)}$
Firn core from 2002 (1981-2001):	$329 \pm 109 \text{ kg/(m}^2 \text{ a)}$
Firn core from 1989 (1975-1988):	$353 \pm 109 \text{ kg/(m}^2 \text{ a)}$

It can be observed that the accumulation rates are lower in the surroundings of the bases than at the array located further south and at a greater distance to the coast.

The values calculated by means of stake readings are lower than those calculated from firn cores.

Acknowledgements:

The work of the wintering-over teams at Neumayer stations reading the stake arrays through all the years is gratefully acknowledged.