German contribution to ITASE in recent years

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Abstract:
Spatio-temporal variations of the recently determined accumulation rate are investigated using ground-penetrating radar (GPR) measurements and firn-core studies. The study area is located on Ritscherflya in western Dronning Maud Land, Antarctica, at an elevation range 1400-1560 m. Accumulation rates are derived from internal reflection horizons (IRHs), tracked with GPR, which are connected to a dated firn core. GPR-derived internal layer depths show small relief along a 22 km profile on an ice flowline. Average accumulation rates are about 190 kg m^{-2} a^{-1} (1980-2005) with spatial variability (1 σ) of 5% along the GPR profile. The interannual variability obtained from four dated firn cores is one order of magnitude higher, showing 1 σ standard deviations around 30%. Mean temporal variations of GPR-derived accumulation rates are of the same magnitude or even higher than spatial variations. Temporal differences between 1980-90 and 1990-2005, obtained from two dated IRHs along the GPR profile, indicate temporally non-stationary processes, linked to spatial variations. Comparison with similarly obtained accumulation data from another coastal area in central Dronning Maud Land confirms this observation. Our results contribute to understanding spatio-temporal variations of the accumulation processes, necessary for the validation of satellite data (e.g. altimetry studies and gravity missions such as Gravity Recovery and Climate Experiment (GRACE)).

The second part of the talk will show examples of ASIRAS data (Airborne SAR Interferometric Radar Altimeter System) measured in DML in 2007. This new high resolution Radar system has potential to map spatio-tempor al variations of accumulation rates at larger scales.

1. Expeditions

The German activities have been concentrating on the western part of Dronning Maud Land. For the past few years they included snow pit and shallow firn core studies as well as snow radar measurements. This method is a strong tool to reconstruct accumulation changes in the topmost 100 m of the snow cover.

Areas of investigation had been Potsdam glacier (VISA campaign 2003/04; Anschütz et al., 2006 & 2007), Ritscherflya north of Kottasberge, Heimefrontfjella (VISA campaign 2004/05; Anschütz et al., 2008), the surroundings of the EDML drilling site (Eisen et al., 2005) and 280 km upstream (mainly 2005/06 season) and the hinterland of Neumayer station, on Halvfarryggen and Søråsen (Pre-IPICS campaign 2006/07; Fernandoy et al., 2008; Oerter et al., 2008).

2. Data and evaluation

2.1 Firn cores and pits

The metadata for the firn cores and snow pits sampled during the above mentioned expeditions are compiled in Table 1 attached to this abstract. The document also contains the doi for the published data sets.

2.2 Snow radar profiles

The measured snow radar profiles are attached to this abstract as Table 2 (TBD).

2.3 Data storage and evaluation

The primary data repository for AWI is the PANGAEA data base (www.pangaea.de), which provides metadata and a description of the method by which data were determined. Published data are freely available. With respect to Ice-Reader the data may either by import from PANGAEA or just linked to it.

Data of the German ITASE work during the past years are included in a review of Antarctic surface snow isotopic composition (Masson-Delmotte, V. et al., J. Climate in press). The paper presents observations and atmospheric circulation and isotopic modelling. This was a task discussed during the Hobart ITASE meeting.

Experience in accumulation studies by various means are in included in a review on ground-based measurements of spatial and temporal variability of snow accumulation in East Antarctica (Eisen et al., 2008).

Data of the ice core B04 drilled in at Georg-von-Neumayer station were used by Divine et al. (submitted). Data from firn cores on the plateau of the ice sheet in Dronning Maud Land were used as a stack record for this region to investigate the change in Antarctic snowfall since the International Geophysical Year. No significant change was found (Monaghan et al. 2006)

3. Publications

Anschütz, H., Eisen, O., Rack, W., Scheinert, M. (2006a). Periodic Surface Features in Coastal East Antarctica, Geophysical research letters, 33, L22501.

Anschütz, H. (2006b). Variability of the recent accumulation rate in coastal Dronning Maud Land, Antarcica, Dissertation Universität Bremen, Fachbereich Geowissenschaften, 2006, Universität Bremen.

Anschütz, H., Eisen, O., Steinhage, D., Oerter, H., Scheinert, M. (2007). Investigating small-scale variations of the recent accumulation rate in Coastal Dronning Maud Land, East Antarctica, Annals of Glaciology 46, 14-21.

Anschütz, H., Steinhage, D., Eisen, O., Oerter, H., Horwarth, M., Ruth, U. (2008). Small-scal e spatio- temporal characteristics of accumulation rates in western Dronning Maud Land, Antarctica, Journal of Glaciology 54 (185), 315-323.

Divine, D. V., Isaksson, E., Kaczmarska, M., Godtliebsen, F., Oerter, H., Schlosser, E., Johnsen, S. J., Van den Broeke, M., Van de Wal, R. S. W. (2009). Tropical Pacific - High Latitude South Atlantic Teleconnections as seen in the d18O Variability in Antarctic Coastal Ice Cores., Journal of Geophysical Research – Atmosphere (submitted).

Eisen, O., Rack, W., Nixdorf, U., Wilhelms, F. (2005). Characteristics of accumulation in the vicinity of the EPICA deep- drilling site in Dronning Maud Land, Antarctica, Annals of Glaciology, 41,41-46.

Eisen, O., Frezzotti, M., Genthon, C., Isaksson, E., Magand, O., van den Broeke, M.R., Dixon, D.A., Ekaykin, A., Holmlund, P., Kameda, T., Karlöf, L., Kaspari, S., Lipenkov, V., Oerter, H., Takahashi, S., Vaughan, D. (2008). Ground- based measurements of spatial and temporal variability of snow accumulation in East Antarctica, Reviews of Geophysics, 46, RG2001. doi: 10.1029/2006RG000218

Fernandoy, F., Oerter, H., Meyer, H. (2008). Spatial variability in isotope signatures of precipitation around Neumayer station, East Antarctica, Poster at SCAR IASC IPY Open Science Conference, St Petersburg, Russia. 9-11 July 2008.

Masson- Delmotte, V., Hou, S., Ekaykin, A., Jouzel, J., Aristarain, A., Bernardo, R. T., Bromwhich, D., Cattani, O., Delmotte, M., Falourd, S., Frezzoti, M., Gallée, H., Genoni, L., Isaksson, E., Landais, A., Helsen, M., Hoffmann, G., Lopez, J., Morgan, V., Motoyama, H., Noone, D., Oerter, H., Petit, J. R., Royer, A., Uemura, R., Schmidt, G. A., Schlosser, E., Simões, J. C., Steig, E., Stenni, B, Stievenard, M., Broeke, M., Wal, R., Berg, W. J., Vimeux, F., White, J. W. C. (2007). A review of Antarctic surface snow isotopic composition: observations, atmospheric circulation and isotopic modelling., Journal of Climate.

Monaghan, A. J., Bromwich, D. H., Fogt, R. L., Wang, S.-H., Mayewski, P. A., Dixon, D. A., Ekaykin, A., Frezzotti, M., Goodwin, I., Isaksson, E., Kaspari, S.D., Morgan, V. I., Oerter, H., Ommen, T. D. van, Veen, C. J. van der, Wen, J. (2006). Insignificant change in Antarctic snowfall since the International Geophysical Year, Science, 313(5788), 827-831. doi: 10.1126/science.1128243

Oerter, H., Fernandoy, F., Meyer, H., Wilhelms, F., Graf, W., Stichler, W. (2008). Accumulation and stable-isotope content in the hinterland of Neumayer station, Antarctica, since the IPY 1957/58., SCAR-IASC Open Science Conference, St. Petersburg, Russia, 9.-11. July 2008.

Rotschky, G., Eisen, O., Wilhelms, F., Nixdorf, U., Oerter, H. (2004). Spatial distribution of surface mass balance on Amundsenisen plateau, Antarctica, derived from ice-penetrating radar studies, Annals of Glaciology, 39, 265-270.

Rotschky, G., Rack, W., Dierking, W., Oerter, H. (2006). Retrieving Snowpack Properties and Accumulation Estimates from Combination of SAR and Scatterometer Measurements, IEEE Transactions on Geoscience and Remote Sensing, 44(4), 943-956. doi: 10.1109/TGRS.2005.862524

Rotschky, G. (2007). Spatial distribution of snow accumulation and snowpack properties in Dronning Maud Land, Antarctica : observational techniques and methods for surface mass-balance assessments of polar ice sheets = Räumliche Verteilung von Schneeakkumulation und Schneedeckeneigenschaften in Droning Maud Land, Antarktis : Observationstechniken und Methoden der Netto-Massenbilanzbestimmung polarer Eisschilde, Berichte zur Polar- und Meeresforschung = Reports on polar and marine research, 552, 90 pp., Bremen, Univ., Diss. Full-text at hdl: 10013/epic.27430.d001

Rotschky, G., Holmlund, P., Isaksson, E., Mulvaney, R., Oerter, H., Van den Broeke, M.R., Winther, J.-G. (2007). A new surface accumulation map for western Dronning Maud Land, Antarctica, from interpolation of point measurements, Journal of Glaciology, 53 182, 385-398. Primary data: http://www.pangaea.de/search?q=@ref27068

Appendix 1:

AWI-Publications with ice-core data archived in the PANGAEA repository

Peer-reviewed AWI-Publications

2007

Rotschky, G., Holmlund, P., Isaksson, E., Mulvaney, R., Oerter, H., Van den Broeke, M.R., Winther, J.-G. (2007). A new surface accumulation map for western Dronning Maud Land, Antarctica, from interpolation of point measurements, Journal of Glaciology, 53 182, 385-398.
hdl:10013/epic.27788
Full-text: hdl:10013/epic.27788.d001
Primary data: http://www.pangaea.de/search?q=@ref27068

Wesche, C., Eisen, O., Oerter, H., Schulte, D., Steinhage, D. (2007). Surface topography and ice flow in the vicinity of the EDML deep-drilling site, Antarctica., Journal of Glaciology, 53(182), 442 - 448.
hdl:10013/epic.27641
Primary data: 10.1594/PANGAEA.611331

2006

EPICA, community members, Fischer, H., Freitag, J., Frenzel, A., Fritzsche, D., Fundel, F., Gersonde, R., Hamann, I., Huybrechts, P., Kipfstuhl, S., Lambrecht, A., Meyer, H., Miller, H., Oerter, H., Ruth, U., Rybak, O., Schmitt, J., Valero-Delgado, F., Wegner, A., Wilhelms, F. (2006). One-to-one coupling of glacial climate variability in Greenland and Antarctica, Nature, 444, 195-198.
hdl:10013/epic.25448
Full-text: hdl:10013/epic.25448.d001
doi:10.1038/nature05301
Primary data: 10.1594/PANGAEA.586834

Fundel, F., Fischer, H., Weller, R., Traufetter, F., Oerter, H., Miller, H. (2006). Influence of large-scale teleconnection patterns on methane sulfonate
ice core records in Dronning Maud Land, Journal of geophysical research-atmospheres, 111, D04103.
hdl:10013/epic.22493
Full-text: hdl:10013/epic.22493.d001
doi:10.1029/2005JD005872
Primary data: 10.1594/PANGAEA.407362

2004

Fischer, H., Traufetter, F., Oerter, H., Weller, R., Miller, H. (2004). Prevalence of the Antarctic Circumpolar Wave over the last two millenia recorded in Dronning Maud Land ice, Geophysical research letters, 31, L08202.
hdl:10013/epic.20381
Full-text: hdl:10013/epic.20381.d001
doi:10.1029/2003GL019186
Primary data: http://www.pangaea.de/search?q=@ref28598

Oerter, H., Graf, W., Meyer, H., Wilhelms, F. (2004). The EPICA ice core from Dronning Maud Land: first results from stable-isotope measurements, Annals of Glaciology, 39, 307-312.
hdl:10013/epic.19577

Full-text: hdl:10013/epic.19577.d001
Primary data: http://www.pangaea.de/search?q=@ref26491

Ruth, U., Wagenbach, D., Mulvaney, R., Oerter, H., Graf, W., Pulz, H., Littot, G. (2004). Comprehensive 1000 year climatic history from an intermediate depth ice core from the south dome Berkner Island, Antarctica: methodics, dating, and first results, Annals of Glaciology, 39, 146-154.
hdl:10013/epic.19579
Full-text: hdl:10013/epic.19579.d001
Primary data: 10.1594/PANGAEA.400910

Schlosser, E., Reijmer, C., Oerter, H., Graf, W. (2004). The influence of precipitation origin on the d18O-T relationship at Neumayer Station, Ekströmisen, Antarctica, Annals of Glaciology, 39, 41-48.
hdl:10013/epic.19542
Full-text: hdl:10013/epic.19542.d001
Primary data: http://www.pangaea.de/search?q=@ref28395

Traufetter, F., Oerter, H., Fischer, H., Weller, R., Miller, H. (2004). Spatio-temporal variability in volcanic sulphate deposition over the past 2 kyr in snow pits and firn cores from Amundsenisen, Dronning Maud Land, Antarctica, Journal of Glaciology, vol. 50, no. 168, 137-146.
hdl:10013/epic.19312
Full-text: hdl:10013/epic.19312.d001
Primary data: 10.1594/PANGAEA.601853

2002

Graf, W., Oerter, H., Reinwarth, O., Stichler, W., Wilhelms, F., Miller, H., Mulvaney, R. (2002). Stable-isotope records from Dronning Maud Land, Antarctica, Annals of Glaciology, 35, 195-201.
hdl:10013/epic.15025
Full-text: hdl:10013/epic.15025.d001
Primary data: http://www.pangaea.de/search?q=@ref23079

Göktas, F., Fischer, H., Oerter, H., Weller, R., Sommer, S., Miller, H. (2002). A glacio-chemical characterisation of the new EPICA deep-drilling site on Amundsenisen, Dronning Maud Land, Antarctica., Annals of Glaciology, 35, 347-354.
hdl:10013/epic.15201
Full-text: hdl:10013/epic.15201.d001
Primary data: 10.1594/PANGAEA.407362

Mulvaney, R., Oerter, H., Peel, D.A., Graf, W., Arrowsmith, C., Pasteur, E.C., Knight, B., Littot, G.C., Miners, W.D. (2002). 1000-year ice core records from Berkner Island, Antarctic, Annals of Glaciology, 35, 45-51.
hdl:10013/epic.15147
Primary data: http://www.pangaea.de/search?q=@ref26340

Schlosser, E., Oerter, H. (2002). Shallow firn cores from Neumayer, Ekströmisen - A comparison of accumulation rates and stable isotope ratios, Annals of Glaciology, 35, 91-96.
hdl:10013/epic.15148
Full-text: hdl:10013/epic.15148.d001
Primary data: 10.1594/PANGAEA.690398

2000

Oerter, H., Wilhelms, F., Jung-Rothenhäusler, F., Göktas, F., Miller, H., Graf, W., Sommer, S. (2000). Accumulation rates in Dronning Maud Land, Antarctica, as revealed by dielectric-profiling measurements of shallow firn cores, Annals of Glaciology, 30, 27-34.
hdl:10013/epic.12891
Primary data: http://www.pangaea.de/search?q=@ref22233

Sommer, S., Appenzeller, C., Röthlisberger, R., Hutterli, M.A., Stauffer, B., Wagenbach, D., Oerter, H., Wilhelms, F., Miller, H., Mulvaney, R. (2000). Glacio-chemical study covering the past 2 kyr on three ice cores from Dronning Maud Land, Antarctica 1. annually resolved accumulation rates, Journal of Geophysical Research, Vol. 15, No. D24, pages 29,411-29,421.
hdl:10013/epic.14639
doi:200JD900449
Primary data: http://www.pangaea.de/search?q=@ref22286

1999

Gerland, S., Oerter, H., Kipfstuhl, J., Wilhelms, F., Miller, H. (1999). Continuous density log of a 181 metre long ice core from the summit of Berkner Island, Antarctica, Annals of Glaciology, 29, 215-219.
hdl:10013/epic.11514
Primary data: http://www.pangaea.de/search?q=@ref26339

Graf, W., Oerter, H., Mayer, C., Lambrecht, A. (1999). Surface accumulation on Foundation Ice Stream, Antarctica, Annals of Glaciology, Volume 29, 23-28.
hdl:10013/epic.11648
Primary data: http://www.pangaea.de/search?q=@ref27412

Oerter, H., Graf, W., Wilhelms, F., Minikin, A., Miller, H. (1999). Accumulation studies on Amundsenisen, Dronning Maud Land, by means of tritium, DEP and stable isotope measurements: first results from the 1995/96 and 1996/97 field seasons, Annals of Glaciology, 29, 1-9.
hdl:10013/epic.12892
Primary data: http://www.pangaea.de/search?q=@ref22234

1994

Graf, W., Moser, H., Reinwarth, O., Kipfstuhl, J., Oerter, H., Minikin, A., Wagenbach, D. (1994). Snow-accumulation rates and isotopic content (2H, 3H) of near-surface firn from the Filchner-Ronne Ice Shelf, Antarctica, Annals of Glaciology, 20, 121-128.
hdl:10013/epic.11645
Full-text: hdl:10013/epic.11645.d001
Primary data: http://www.pangaea.de/search?q=@ref27426

Wagenbach, D., Graf, W., Minikin, A., Trefzer, U., Kipfstuhl, J., Oerter, H., Blindow, N. (1994). Reconnaissance of chemical and isotopic firn properties on top of Berkner Island, Antarctica, Annals of Glaciology, 20, 307-312.
hdl:10013/epic.15271
Full-text: hdl:10013/epic.15271.d001

Primary data: http://www.pangaea.de/search?q=@ref27427

Peer-reviewed not-AWI-Publications

1988

Graf, W., Moser, H., Oerter, H., Reinwarth, O., Stichler, W. (1988). Accumulation and ice core-studies on Filchner-Ronne Ice Shelf, Antarctica, Annals of Glaciology,11,23-31.
hdl:10013/epic.25953
Full-text: hdl:10013/epic.25953.d001
Primary data: http://www.pangaea.de/search?q=@ref27430