New ice-thickness maps of Filchner-Ronne Ice Shelf, Antarctica, with specific focus on grounding lines and marine ice

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Abstract

For Filchner-Ronne Ice Shelf we have compiled measurements of meteoric ice thickness from many institutions, and several different techniques (e.g. radar and seismic sounding) to produce an improved digital map of meteoric ice thickness. It was produced by a direct interpolation of the meteoric ice-thickness data onto a regular horizontal grid. The final computation was performed with a geostatistical gridding method (kriging), which takes account of the relationships evidence through the use of a semivariogram. A grid spacing of 1.67 km was chosen to provide an acceptable resolution, ensuring representation of even comparatively small topographic features, such as the Kershaw Ice Rumples ($\sim 80 \, km^2$) or the Hemmen Ice Rise ($\sim 75 \, km^2$). This gridding procedure could, however, not be accomplished in the central Filchner Schelfeis, due to the lack of meteoric ice thickness data.

We have also produced a map of the thickness of marine ice bodies beneath the ice shelf by using borehole density data to calibrate an ice-thickness to surface-elevation relation, and then comparing maps of ice-surface elevation and meteoric ice-thickness to infer marine ice thickness. For the location of the grounding lines position on the southern Ronne Ice Shelf the data were supplemented with barometric determination of surface elevation. The final delineation of the grounding line position was confirmed by reference to satellite imagery.

For further information please see:

Basic data sets used to derive the digital meteoric ice thickness model of FRIS. (*AWI*: Alfred-Wegener-Institut für Polar- und Meeresforschung; *BAS*: British Antarctic Survey; *DPG*: Department of Physical Geography and Quaternary Geology, Stockholm University; *IGM*: Institut für Geophysik der Universität Münster; *SG*: Sevmorgeologija of the Ministry of Geology (of the former USSR); *SPRI*: Scott Polar Research Institute, University of Cambridge; ESAMCA: Exploitation of satellite altimetry for the monitoring of climate-related change of Antarctic ice shelves) (Source data references: [1] Hempel & Oerter 1995, Lambrecht *et al.* 1995, 1999, Lambrecht 1998; [2] Robin *et al.* 1983, Crabtree & Doake 1986, Vaughan *et al.* 1991; [3] Johnson & Smith 1997; [4] Homlund 1992; [5] Thyssen 1988, 1991, Thyssen *et al.* 1992, Grosfeld *et al.* 1998; [6] Blindow 1994; [7] Pozdeev & Kurinin 1987; [8] Sievers *et al.* 1995, Mantripp *et al.* 1996, Wingham *et al.* 1997)

Source location	Data type	Date	Data points	
AWI, Bremerhaven, Germany	Airborne RES	1994/95	22 627	[1]
AWI, Bremerhaven, Germany	seismic reflection	1995	106	[1]
BAS, Cambridge, UK	Airborne RES	1974/75 - 1987/88	13 665	[2]
BAS, Cambridge, UK	seismic reflection	1994/95	131	[3]
DPG, Stockholm, Sweden	Airborne RES	1991/92	19	[4]
IGM, Münster, Germany	Airborne RES	1985/86, 1989/90	10 352	[5]
IGM, Münster, Germany	ground-based RES	1989/90	314	[6]
SG, St. Petersburg, Russia	seismic reflection	1976 -1986	308	[7]
SPRI, Cambridge, UK	Airborne RES	1977/78, 1978/79	3 081	[2]
SG, St. Petersburg, Russia	digitised thickness contour lines	1987	413	[7]
ESAMCA Project	ERS-1 radar-altimeter data	1993	1 239	[8]

FRIS_THICK_INFO

Files: FRIS_THICK_TOT.dat   total ice thickness
FRIS_THICK_MET.dat   meteoric ice thickness
FRIS_THICK_MAR.dat   marine ice thickness

Each file has 384120 lines, with x (km), y (km), H (m). For unknown H, the value 9999 is used.
(x, y) are points of a continous grid with:

$$-660.000 \text{ km} \le x \le 438.333 \text{ km}$$
$$-80.000 \text{ km} \le y \le 888.333 \text{ km}$$
$$\Delta x = \Delta y = 1.667 \text{ km}$$
$$N_x = 660$$
$$N_y = 582$$

For the x,y-coordinate system following projection is used:

Polar stereografic projection
Ellipsoid: World Geodetic System 1984 (WGS84)
Latitude of origin: 71°S
Central meridian: 52,5°W
(x=0,y=0) = (83°S, 52,5°W)

Figure: FRIS_meteoric_ice-thickness.pdf, FRIS_marine_ice-thickness.pdf, FRIS_total_ice-thickness.pdf