Summary

The Sørsdal Glacier, located in the vicinity of the Davis Station, Antarctica is one of the key polar outlet glaciers that contributes to the drainage of the East Antarctic ice sheet. An investigation is currently being undertaken to identify and monitor zones of fast flowing ice and relate these to the development of crevasse fields.

Objectives

(1). Establish ice movement, strain rates, surface elevation changes and relationship to basement topography within the Sørsdal Glacier system.
(2). Analyse the ductile flow, fracture patterns and relationship of fabric and textural characteristics to the ice-steam and establish how these change with time.
(3). Determine the mechanisms involved in the variation of ice flow rates within the Sørsdal Glacier, especially the controls on long-term and seasonal variations.

Scientific relevance

To significantly advance our understanding of glacier dynamics the Sørsdal Glacier and its drainage basins offers an ideal region to study. The discharge of ice from the Antarctic Ice sheet in Princess Elizabeth and Wilhelm II Land into Prydz Bay is largely through a number of ice streams, the largest being the Sørsdal Glacier.

From the Sørsdal Glacier there is no base-line historical data to make comparative and controlled analyses of the ice dynamics in this area. Reconnaissance work of Andrew Ruddell (Australian Antarctic Division) using three fixed GPS station over 1997/98 summer suggest that there is localisation of deformation into internal ice streams with surface velocities of up to 500 Ma^{-1}. However, in this ~1000 metre deep ice stream, the bedrock perturbations identified by preliminary ice-radar observations (Australian Antarctic Division, unpublished data) have enormous effects on ice velocities and the distribution of the crevasse fields. Similarly there are probably long term and local seasonal variations in the ice surface velocities as described by Marmo & Wilson (1998) that have not been identified.

Field activities

Year 2000/01: Initial fieldwork was undertaken from December 2000 to February 2001 and was concentrated in the central portion of the Sørsdal Glacier, upstream from the floating frontal section, with major ground-based fieldwork to relate fracturing and flow line development to movements established using GPS data collection. Flow rates on the northern half of the glacier were approximately 80 Ma^{-1}. These have to be reconfirmed next summer when the grids are resurveyed.

The ice flow is currently monitored by deploying surface strain markers (grids) and analysing the ice fabrics across regions that show differing flow characteristics.

Measurement of ice movement provides the basic data from which strains and strain rates can be computed across the ice mass. In this project, a range of grid designs will be used that depend on the actual ice surface characteristics identified from the photography and the ground surveys. It is envisaged that strain markers of the type used by Marmo & Dawson (1996) will be deployed in a grid pattern over selected areas and their position will be accurately identified using differential GPS techniques and tied into reference markers in the basement rocks of the Vestfold Hills.

Year 2001/02: Summer measurements of strain markers and analysis of ice fracture and fabric pattern will continue.

Year 2002/03: Repeat of previous year's program. As a refinement to previous work, it is hoped that re-measurements of the strain grids will be performed using dual frequency GPS receivers to assist in compensating for ionosphere effects.

Proposed use of DORIS system

If a DORIS ground station were available it would be incorporated into the present Sørsdal project. We would establish at least three semi-permanent sites that would be tied into our GPS network on the ice sheet during the summer field campaigns to allow for continuous monitoring and the determination of variations in the rate of ice movement. Over the rest of the year (~ March to November) we would leave the ground station at one site. Batteries for this ground station could be changed periodically by personnel from the Davis station.

References

Marmo, B. A. & Dawson, J. 1996 Movement and structural features observed in ice masses, Framnes Mountains, MacRobertson Land, east Antarctica. Annal Glaciol. 23 , 388-395.

Marmo, B.A. & Wilson,C.J.L. 1998 Strain localisation and incremental deformation within ice masses, Framnes Mountains, east Antarctica. *J. Struct. Geol.* 20 (2-3), 149-162.