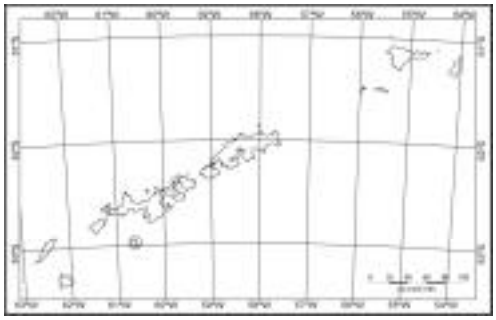
GLASS Newsletter

Glaciology of the South Shetlands Programme (*GLASS*)



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compiled by

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1– INTRODUCTION

This newsletter is a final report on the activities carried out on the ice masses of the South Shetland Islands from 1992 onwards. In that year, during XXII SCAR meeting, the Working Group of Glaciology (WGG), recognising the need for coordination to assist planning and to improve international cooperation of glaciological research in the South Shetland Islands, and aware of the sensitivity to climatic changes of the ice masses in this area, recommended that National Committees of nations acting in the area support the Glaciology of the South Shetlands (GLASS) programme. Since then joined field works have been carried out in this geographical area, improving the quality of the work, reducing costs and avoiding research repetition. Further, as a result of this initiative, several bi-national and international expeditions were carried out on the ice cover of King George and Livingston islands.

This newsletter highlights the main achievements since 1997, list all known bibliography (82 articles/dissertations have been produced since 1993) on the regional glaciology and related studies for the South Shetlands and it also includes an updated mail list for GLASS.

2– HIGHLIGHTS OF GLACIOLOGICAL INVESTIGATIONS ON KING GEORGE ISLAND (GERMAN-BRAZILIAN INVESTIGATIONS)

During the summer seasons 1997/98 and 1999/2000 extensive field surveys were carried out on the King George Island ice cap by joint Brazilian-German expeditions. The research included comprehensive meteorological programs with the operation of several automatic weather stations on the main ice cap for surface energy balance and ablation calculations, ground penetrating and mobile differential GPS surveys to retrieve ice thickness and surface topography, the measurement of glacier velocities as well as snow stratigraphic investigations as ground

truth for the analysis and interpretation of remote sensing data.

Major outcomes are:

- Ablation on the ice cap is strongly dependent on prevailing large-scale atmospheric situation. The comparison of melt rates from different summer seasons indicate a doubling of the ablation rates in the late 1990's in comparison to earlier studies from the 1970's.
- Indications for a rise of the snowline in the 1990's at the end of the summer were based on the analysis of multi-temporal ERS-1/2 SAR time series and comparisons to previously published data.
- Glacier velocities were measured at several locations during the summer field campaigns on Lange Glacier - a major outlet glacier of the main ice cap. The velocities range between 10 m a^{-1} near the ice divide to 120 m a^{-1}, velocities in elevations below 400 m could not been acquired due to the strong crevassing in this area.
- GPR surveys show a surface topography controlled by bedrock elevation. Moreover, strong water inclusions were detected in lower elevations. They are in accordance with the results of a distributed melt model and the analysis of ERS-1/2 time series. Isochrones possibly induced by volcanic ash layers could be followed over large areas and Raymond Bumps where observed under the major ice dome.
- A detailed digital elevation model (DEM) was compiled from various sources including the precise DGPS data. Based on this a new satellite image map was designed and printed based on a SPOT multispectral satellite mosaic and the DEM.
- Analysis of satellite imagery and aerial photography revealed a considerable retreat and mass loss since the 1950's. The large tidewater glaciers seam to have undergone a dynamic adjustment in the period 1956 to 1988 with now more or less stable remaining glacier front positions. Larges ratios between area loss and glacier size where detected for the smallest, non-calving glaciers on the southern coast of the island. Totally, the island has lost about 7% of its ice cover area since 1956. This indicates a direct influence of the observed atmospheric changes on these glacier systems.

Actual research will focus on the retrieval of glacier velocities and surface topography from InSAR analysis, the reconstruction of a mass balance record based on photogrammetric analysis and on ice-dynamic modelling of the ice cap. Furthermore, the good database will favour the King George Island ice cap as a main test site for the CryoSat and IceSat missions.

Prepared by Matthias Braun, Centre for Remote Sensing on Land Applications, University of Bonn, Germany, matthias.braun@uni-bonn.de. J.C. Simões added some details.

3– ICE CORES AND PITS STUDIES IN THE SOUTH SHETLANDS AS A CONTRIBUTION TO ITASE

In the South Shetlands (KGI and Livingston Island) several snow trenches and shallow ice cores were sampled to obtain information on the distribution of stable isotopes ratios, major ions, trace metals, and of the mean annual net accumulation rate. A joint operation by Brazil-Argentina and France recovered of a 49.9 m firn-ice core from KGI ice cap (690 m a.s.l.) in the summer of 1995–96. Chinese scientists also published several papers on cores recovered prior to the implementation of the GLASS programme. Reference values for the region have been determined from these cores Doubts remain about the net accumulation rate in the region, values found in articles varies from 0.60 to

2.48 m water equivalent per year. A general review of the South Shetland snow and ice chemistry data will be published elsewhere as a contribution to the ITASE (International Trans-Antarctic Expedition) project

4– RECENT (POST-1995) NATIONAL ACTIVITIES IN THE SOUTH SHETLANDS

Argentina, Brazil and Germany

In the 1990s, three international expeditions, organized and logistically supported by the Brazilian Antarctic Programme, and in the scope of the SCAR supported GLASS Programme, carried out extensive investigations on the King George Island (KGI) ice cap. Topics include: 1) Mapping and monitoring of glacial drainage basins fluctuations using remote sensing techniques; 2) A shallow firn and ice coring programme; 3) Geophysical surveys to determine ice thickness and internal structure; and 4) Climatology of the ice cap.

Results show an ice cover of 1044 km^2 (91.7% of KGI) that reaches a maximum thickness of 395 m. Concomitantly with a men atmospheric temperature of 1.1 °C from 1947 to 1995, KGI ice cap lost 65 km^2 from 1956 to 2000. Only the upper 2–3 m of the snow pack provides data representative of the original precipitation composition. A Geographic Information System to help monitoring of the ice cap and human activities in KGI is proposed and it will be implemented by the Institut für Physische Geographie, Universität Freiburg (Germany) and the Laboratório de Pesquisas Antárticas e Glaciológicas, UFRGS (Brazil). These expeditions include Argentinean, Chilean, French, German and Russian personnel. Scientists from the ***Instituto Antártico Argentino and Laboratorio de Estratigrafia Glaciar y Geoquímica del Agua y de la Nieve***, Mendoza/Argentina continue to work together with the LAPAG group to analyse the KGI snow and ice cores.

The ***Institut für Physische Geographie/***Freiburg continues to carry out intensive work about the use of the ERS-1 and 2 SAR data for glacio-climatological studies. A full description of the mail achievements is given above in section 2.

Russia

Scientists from the Institute of Geography - Russian Academy of Sciences have carried out several radio echo-sounding surveys on the King George Island ice cap, including a detailed study of the Lange Glacier drainage basin .

More recently, Yuri Macheret has conducted two radar surveys (1999/2000 and 2000/2001) on Livingston Island together with Spanish (F. Navarro and C. Martin, Polytechnic University of Madrid; J. Casas, University of Barcelona) and French (M. Pourchet) colleagues. Studies were mainly on Johnson's and Hurd glaciers and along the main ice divides of the Livingston Island ice cap. Internal reflections, in the form of hyperbolas, are mainly connected with englacial water inclusions. Some of these reflections were associated to well-defined ash layer in ice cores.

France and Spain

The ***Facultat de Geologia, Universitat de Barcelona*** concentrated its studies on remote sensing of the Livingston ice cap. Shallow core studies in the same ice cap are carried out in cooperation with Michel Pourchet (France), radio echo-sounding surveys are a joint Russian-Spanish initiative (see above Russian activities).

South Korea and Uruguay

Uruguay continues to monitor dynamics parameters of the Bellingshausen ice dome (also known as Collins Dome or Collins Glacier) in King George Island. Recently a joint South Korean-Uruguayan GPR survey was carried out on Livingston Island.

Other countries with recent glaciological work in the South Shetlands: Bulgaria, China, Netherlands and Poland.

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