



## A new satellite image map for King George Island, Antarctica

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### ABSTRACT

A new satellite image map, in the scale of 1: 100,000 of King George Island, Antarctica, is presented. A heterogeneous data set composed of differential GPS surveys, obtained during two Brazilian-German expeditions in 1997/98 and 1999/2000. Digitized contour lines from existing maps and data from the Antarctic Digital Database (ADD) have been combined to compute a digital elevation model. The derived contour lines have been superimposed onto an up-to-date SPOT satellite mosaic, which visualizes the topographic settings and forms the base of the map. In addition, a comprehensive selection of place names following international standards and other thematic information is included. Detailed meta information on data origin, map compilation and estimated precision is offered in a four-language legend.

**Key words:** King George Island, satellite image map, topography.

King George Island is one of the most visited sites in Antarctica. In total, 9 permanent research stations are in operation and several research refuges have been constructed. Due to the easy access via the Chilean airstrip, the number of inhabitants on the island rose to more than 500, in the summer of 1989–1990, and at least 85 people passed the winter there, that same year (Harris 1991). Numerous research projects, in many fields and by many nations, are carried out on the island. Furthermore, the rich wildlife in the permafrost areas attracts an increasing number of tourists. Records from the International Association of Antarctic Tour Operators (IAATO 1999) show an increase in tourist visits to the island. Activities, scientific research and tourism, call for up-to-date mapping. Despite this need, there is still a lack of an accurate topographic

database for many parts of the island. Cartographic work started with the discovery of the island in 1819 by William Smith, resulting in some sketches of the area. The first Argentinean aerial survey was undertaken in 1952, covering almost the entire island. Ground surveys by the Falkland Island Dependency Survey accompanied by aerial photography, in 1956, led to the first detailed maps of King George Island. In recent years, large-scale maps have been published by various nations for the ice-free areas of the island (e.g. for Fildes Peninsula, Admiralty Bay, Potter and Barton Peninsula, as well as Lions Rump). However, updating is needed for a digital topographic database of the entire island, especially for the main ice field, at a scale larger than 1: 200,000.

This study presents a short review of the compilation of a satellite image map, in a scale of 1: 100,000, for the entire King George Island. A

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more detailed description can be found in Braun et al. (2001).

A SPOT satellite image mosaic was compiled from 3 SPOT scenes from different dates. About 95% of the island is covered by a shifted scene, from February 23, 2000 (Figure 1). All data have been geo-referenced to UTM projection, using reference points from GPS measurements and high-resolution maps. Subsequently, the mosaic was reprojected to the final Lambert reference system.

The improved topographic information is based on a very heterogeneous data set comprising of mobile surveys with differential global positioning system (DGPS), digitized contour lines from various existing large-scale maps and data from the Antarctic Digital Database (Table I). All data have been converted to the same reference system within Arc info GIS. In areas where information overlaps, preference was given to the more accurate data set. The present-day coastline was derived from the above-mentioned SPOT satellite mosaic, which was also used to increase the topographic information content and to distinguish between ice and permafrost areas. All data sets were used to compile a digital elevation model, 100 m raster, with the Arc info TOPOGRID routine. Subsequently, contour lines were generated, slightly smoothed out and superimposed on the geo-referenced satellite image mosaic. The final map layout was done in a standard DTP programme. The central northwestern part of the island's ice cap is covered by very reliable topographic data. However, according to the precision of the primary data on the eastern parts of the island, the accuracy of the digital elevation model (DEM), consequently, map precision is lowest in this area. More precise data from ground surveys or radar interferometry are needed to overcome this problem.

Special attention was given to user-access, relating to data accuracy and compilation. Hence, the map contains a detailed plan of the various data layers and their location on the island (Figure 2). It can be combined with a table on vertical precision of the different data sets to construct a precise map (Table I). This enables the user to judge the reli-

ability of the map. Furthermore, full reference to all input data sets is given. Image identification, satellite image coverage and information on the accuracy of the geo-rectification of the satellite image mosaic are placed in the map annotations. To meet the requirements of users from various nations the map legend and annotations are given in four languages (English, German, Portuguese and Spanish). The recommendations on map projection and place names of the SCAR working Group on Geodesy and Geographic Information were strictly followed.

Thematic information on the map comprises the location of the permanent research stations, refuges, airstrip near Frei station, the major gravel roads and important place names. Multi-naming is a very frequent practice on King George Island. Thus, in order to avoid confusion, only one place name per feature was selected in accordance with the suggestions of Sievers and Thompson (1995). They gave priority to the first recorded name. The Gazetteer Antarctica (Working Group on Geodesy and Geographic Information 1999) is the reference for formal approval. The history of place names was mainly obtained from Hattersley-Smith (1991). Additional thematic information, e.g. surface coverage in a recently published map by Rau et al. (2000), was not included, due to the fact that no data were available on such parameters, for all ice free areas.

A significant improvement of the topographic database of King George Island could be achieved by integrating the satellite image mosaic and elevation information from various sources. The compilation in a Geographic Information System enables an easy update and the new data set will have a wide range of potential applications; from simple navigation and orientation, to administrative purposes like the delineation and location of protected areas and historical sites or environmental modeling. In particular, for those studies that require a database for spatially distributed modeling and environmental management, the new printed map and the digital data sets will be more than suitable. The topographic data and thematic information form a first base for the King George Island GIS (KGIS), Vogt

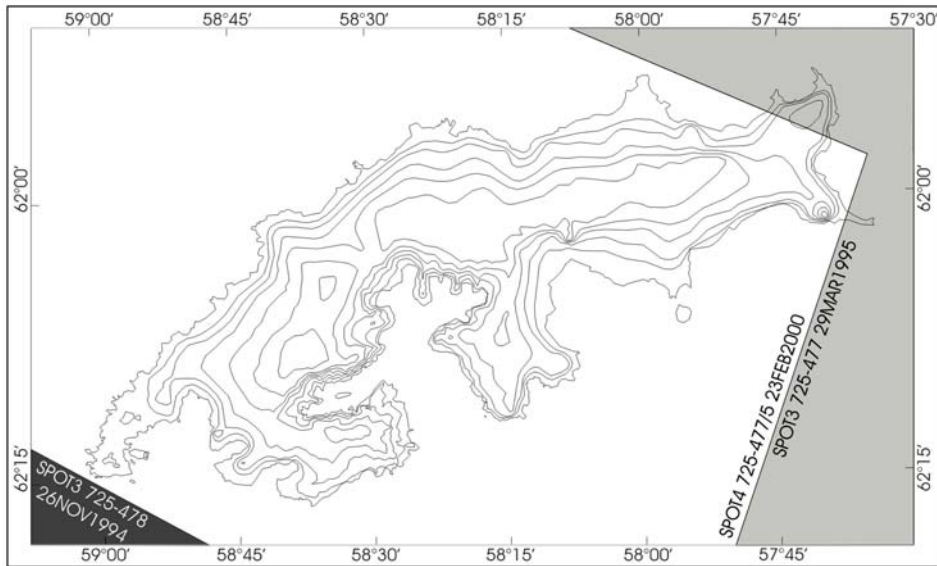


Fig. 1 – Composition of the SPOT satellite mosaic; the satellite images used for the generation of the satellite mosaic.

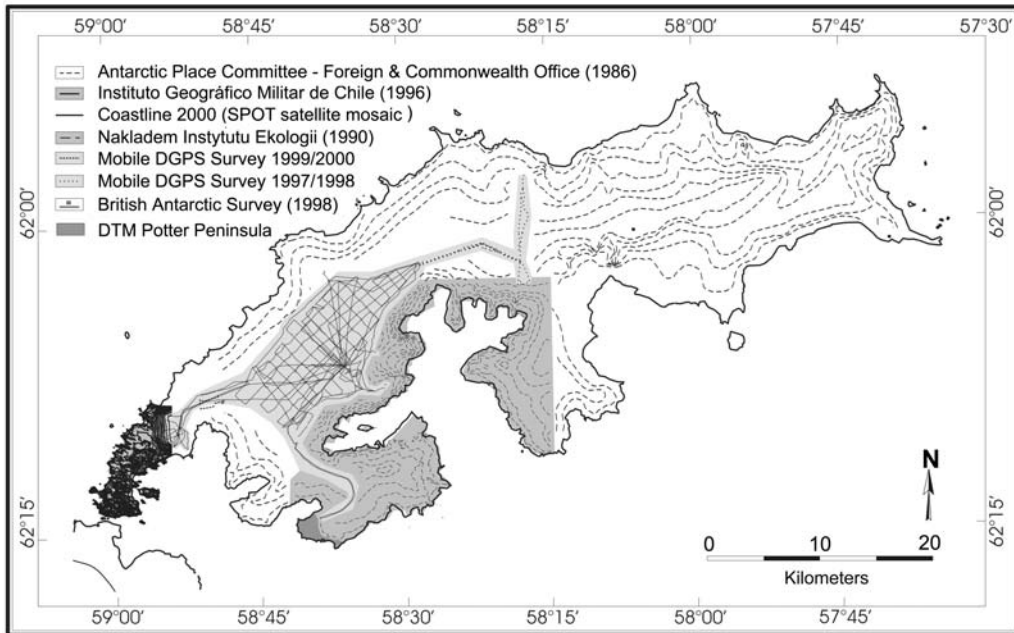


Fig. 2 – Spatial coverage of the data layers used for DEM generation. Estimated elevation accuracies of the different layers are given in Table 1 and can be combined with this figure for a quality map. Note the scarce data coverage on the eastern part of the island.

**TABLE I**  
**Data source and estimated precisions of the different data layers used to compute the digital elevation model for the King George Island satellite image map.**

ID in Figure 1	Reference	Estimated precision
1	Antarctic Place Names Committee of Foreign and Commonwealth (1986): APC Misc 64, South Shetland Islands, Sheet 1 King George Island, 1: 100,000, 10 <sup>th</sup> edition.	100 m
2	British Antarctic Survey (1998): Antarctic Digital Database, Version 2.0. Manual and bibliography. Scientific Committee on Antarctic Research, Cambridge.	100 m
3	Mobile DGPS measurements acquired during the joint Brazilian-German expedition on King George Island 1997/98. (Inst. Geophys, Univ. Münster; Institut f. Phys. Geogr., Univ. Freiburg; Lab. Pesq. Ant. Glac., Univ. Fed. Rio Grande Sul, Porto Alegre).	2 m
4	Mobile DGPS measurements acquired during the Brazilian-German Glaciological Expedition on King George Island 1999/2000. (Institut f. Phys. Geogr., Univ. Freiburg; Lab. Pesq. Ant. Glac., Univ. Fed. Rio Grande Sul, Porto Alegre).	2 m
5	DEM Potter Peninsula: FH Karlsruhe, Germany (photogrammetric analysis of FIDASE aerial photography).	10 m
6	Instituto Geográfico Militar de Chile (1996): Isla Rey Jorge Península Fildes. (Sheet 1 and 2, 1: 10,000).	10 m
7	Nakladem Instytutu Ekologii (1990): Admiralty Bay, King George Island, 1: 50,000, Warszawa.	30 m
8	Coastline from SPOT satellite mosaic.	20 m

et al. (2004, this volume). It will be made available to the public, via web interface.

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#### RESUMO

Uma nova carta imagem satelital, na escala 1: 100.000 é apresentada para a ilha Rei George, Antártica. Um conjunto de dados heterogêneo composto de levantamentos por GPS diferencial, obtido durante duas expedições brasileiro-germânicas, em 1997/98 e 1999/2000. Curvas de nível digitalizadas a partir de mapas preexistentes e informações do Banco de Dados Digital Antártico (*Antarctic Digital Database – ADD*) foram integrados para computar

um modelo de elevação digital. As curvas de nível foram superpostas a um mosaico de imagens SPOT atualizado. Isto permitiu a visualização das condições topográficas e das formas da base do mapa. Adicionalmente, é incluída uma seleção ampla da toponímia seguindo padrões internacionais e outras informações temáticas. A meta informação detalhada sobre a origem dos dados, compilação dos mapas e a precisão estimada são apresentadas em uma legenda em quatro idiomas.

**Palavras-chave:** Ilha Rei George, mapa imagem satelital, topografia.

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