International Bathymetric Chart of the Southern Ocean (IBCSO)

SOGIS: The Southern Ocean Geographic Information System for Data Integration

AWI Alfred-Wegener-Institut für Polar- und Meeresforschung in der Helmholtz-Gemeinschaft

Project Background

Introduction

At present, two international initiatives are compiling polar bathymetric data for use in construction of seafloor topography. These are the ocean mapping groups on the International Bathymetric Chart of the Arctic Ocean (IBCAO) and the International Bathymetric Chart of the Southern Ocean (IBCSO). The IBCSO group focuses on the buildup of an updated digital bathymetric database for the entire Southern Ocean with additional data derived from radar satellite imagery, altimetry, magnetic, and gravity. Data sets are provided by a great number of facilities and data centers. Data management and data processing is conducted by use of proprietary **Geographic Information Systems** (**GIS**). This approach assures interoperability for data exchange and allows production of cartographic paper products and digital web maps.

Sketch of Antarctica surrounded by the Southern Ocean. It covers the southern parts of the Atlantic Ocean, the Indian Ocean, and the Pacific Ocean. The fifth ocean is oceanographically delimited by the Antarctic Circumpolar Current. It is one of the main drivers of ocean systems - and global climate.

Framework

The IBCSO program was adopted as an International Bathymetric Chart mapping project in 2004. The following groups and subcommittees set up the IBCSO in an official frame:

- the SCAR Geosciences Standing Scientific Group (GSSG)
- the IOC Consultative Group on Ocean Mapping (CGOM)
- the Hydrographic Committee on Antarctica (HCA) of the IHO

IBCSO has liaisons per membership with:

- the GEBCO Sub-Committee on Digital Bathymetry (SCDB)
- the SCAR/SCOR Expert Group on Oceanography
- the SCAR SC on Antarctic Geographic Information (SC-AGI)

After a break in 2004, the IBCSO mapping program restarted at the end of 2006 and is based at the Alfred Wegener Institute for Polar and Marine Research in Bremerhaven, Germany.

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Information about IBCSO: www.ibcso.org

GIS architecture of the IBCSO

- High end GIS by use of proprietary software
- Full data capabilities and exceptional functionality
- Desktop GIS tools for authoring, editing, and analysis
- Server GIS for dynamic spatial data management
- Internet map server for the provision of web maps
- File serving via Network Attached Storage (NAS) with RAID

Hardware information of the GIS environment at AWI Bremerhaven. Workstations and PC's are connected with several types of servers: license and application server, web server, and geodatabase server. A Citrix meta-server allows additional platforms to access the GIS software. Data storage is realized by a disk array (gross capacity: 24 TByte).

SOGIS - GIS based data compilation

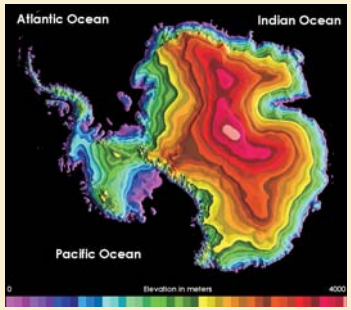
The technological strategy implies collection and integration of existing geophysical and geological data sets together with topographic and bathymetric data for Antarctica and the entire Southern Ocean. Geophysical data from marine gravity acquired by satellite altimeter and mapping of lithospheric magnetic anomalies provide subsurface information of predominant tectonic structures and magnetic spreading anomalies. The potential field anomalies are highly correlated with morpho-structural features of the oceanic crust.

Integrated studies for deeper insights

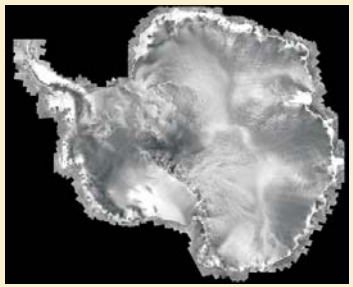
Analysis and modeling of the SOGIS data sets enables us to generate paleobathymetric maps with special emphasis on submarine gateways and barriers for an updated plate tectonic reconstruction of the Southern Ocean. Another application is the correlation between variations in gravity anomalous roughness and topographic lineaments in the abyssal plains. This relationship could be diagnostic for the tectonic heterogeneity of the oceanic crust, because transform faults can not be identified primarily by echo sounding data due to marine sediment coverage. The knowledge of fault pattern assists the estimation of crustal behavior e.g. localization of potential earthquake hypocenters for use in Tsunami early warning systems. GIS based analysis of bathymetric data does not only provide water depth information, but also derived digital terrain model parameters, e.g. slope, aspect, curvature, and terrain variability. Multi-scale terrain analyses of multibeam data are important descriptors for benthic habitat mapping.

Geoscientific Data Compilation

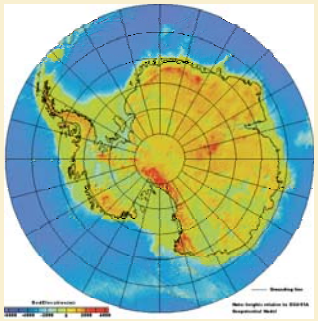
Topographic Features



Color-coded Antarctica digital elevation data plus shaded relief image. The Antarctica DEM is part of the GTOPO30 data available from the EROS Data Center of the USGS.

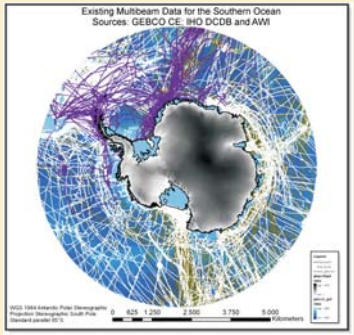


Radarsat image of entire Antarctica from the revised Radarsat Antarctic Mapping Project (RAMP, 2007). Swath images have been assembled into an image mosaic with a spatial resolution of 25m.

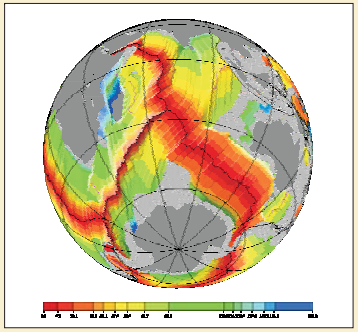


Subglacial topography and grounding line of the Antarctic calculated by the BEDMAP Consortium (2000). The updated BEDMAP2 datasets (2007) are provided by BAS.

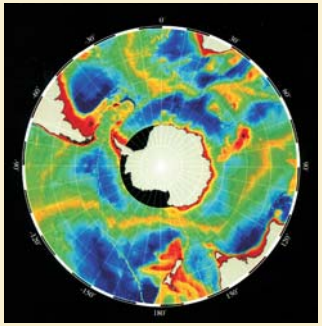
Seafloor Features



Ship tracks with bathymetric data provided by GEBCO CE, IHO DCDB and AWI for the IBCSO map compilation.

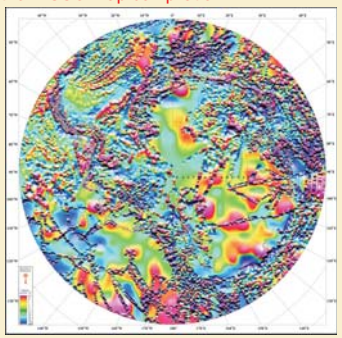


Digital age grid of the ocean floor derived from isochrons of the Southern Ocean floor. The isochrons are based on marine magnetic anomaly data, satellite altimetry, and a plate motion model. Image courtesy: POMP (1992).

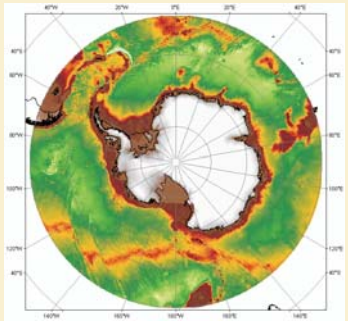


Predicted bathymetry resulting from dense satellite gravity data and sparse ship depth measurements by Smith & Sandwell (1997). Digital data is available from the NGDC.

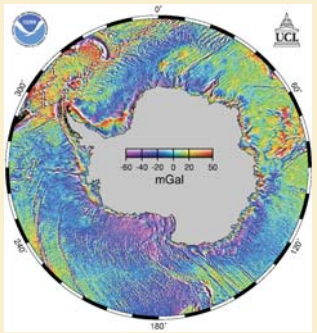
Subsurface Features



Lithospheric magnetic anomalies generated by the ADMAP project from near-surface compilation, Orsted and CHAMP satellite total intensity anomaly data (2007). Resulting anomaly grids are important tools for geological mapping.



2-Minute Gridded Global Relief Data (ETOPO2v2, 2006). Land topography has been resampled from the GLOBE project. Ocean bathymetry is based on the Sandwell & Smith grid derived from satellite altimetry of the sea surface.



ERS-1 and Geosat marine gravity field of the Southern Ocean. The gridded gravity data from Laxon & McAdoo (1997) have a spatial resolution of 20km and 30km in ice-covered seas.