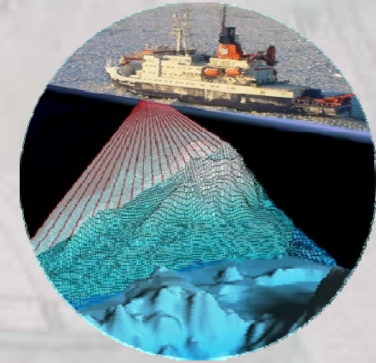


# Polar Ocean Mapping: Significance of Digital Bathymetry in Observing Systems



## ... or what makes the System a System?

Norbert Ott<sup>1</sup>, Hans Werner Schenke<sup>1</sup>  
and the SCAR Expert Group on IBCSO

<sup>1</sup>Alfred Wegener Institute for Polar and Marine Research

SCAR/IASC IPY Open Science Conference  
St. Petersburg, Russia, 8 – 11 July 2008





# Significance of Bathymetric Data

- **Echo soundings – more than ‘pings’**
  - provide DEM derivatives for modeling
  - additional system input parameters
- **Digital data processing**
  - GIS modeling, analysis, visualization
  - enables supervised classification
- **Full spectrum of applications**
  - crustal dynamics, tectonic pattern
  - ocean circulation, ocean mixing models
  - description and conservation of biodiversity



# IBC of the Southern Ocean

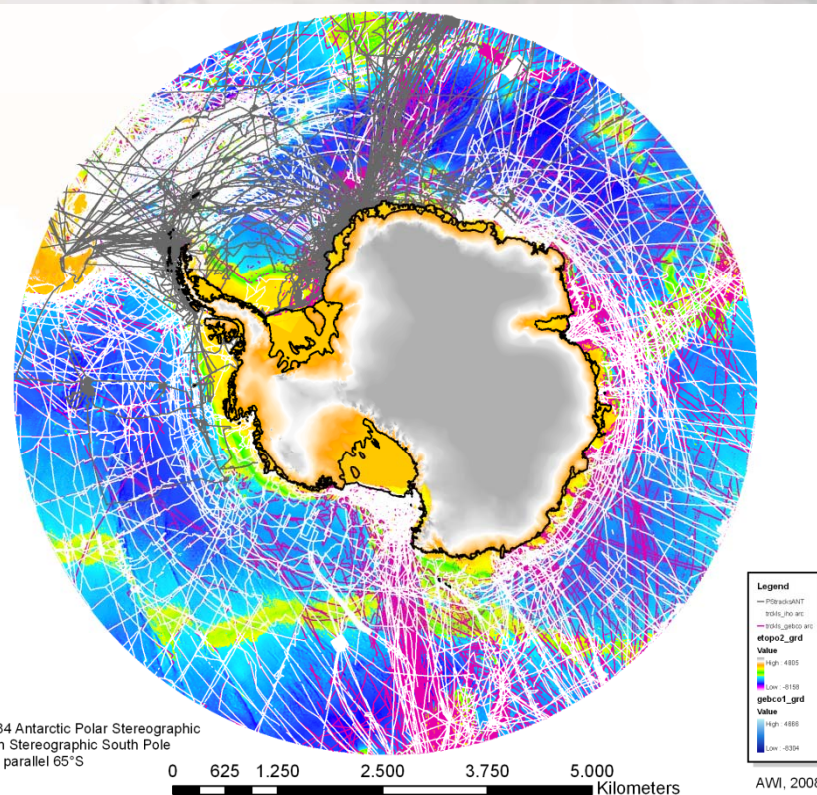
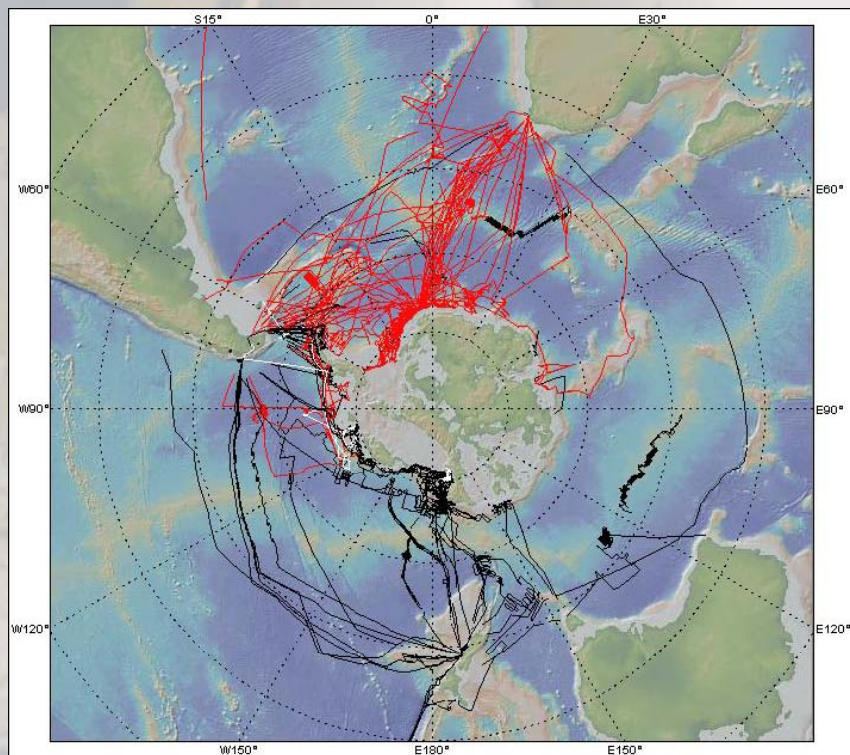
- **No bathymetric chart available**
  - Data resides in many archives
  - No coordinated effort until 2006
- **Ocean mapping program IBCSO**
  - IBC of the IOC
  - SCAR SSG-GS Expert Group
  - Contributor to GEBCO
- **Group infrastructure**
  - Editorial Board (management)
  - Advisory Board (stakeholder)
  - IBCSO Board (communication)





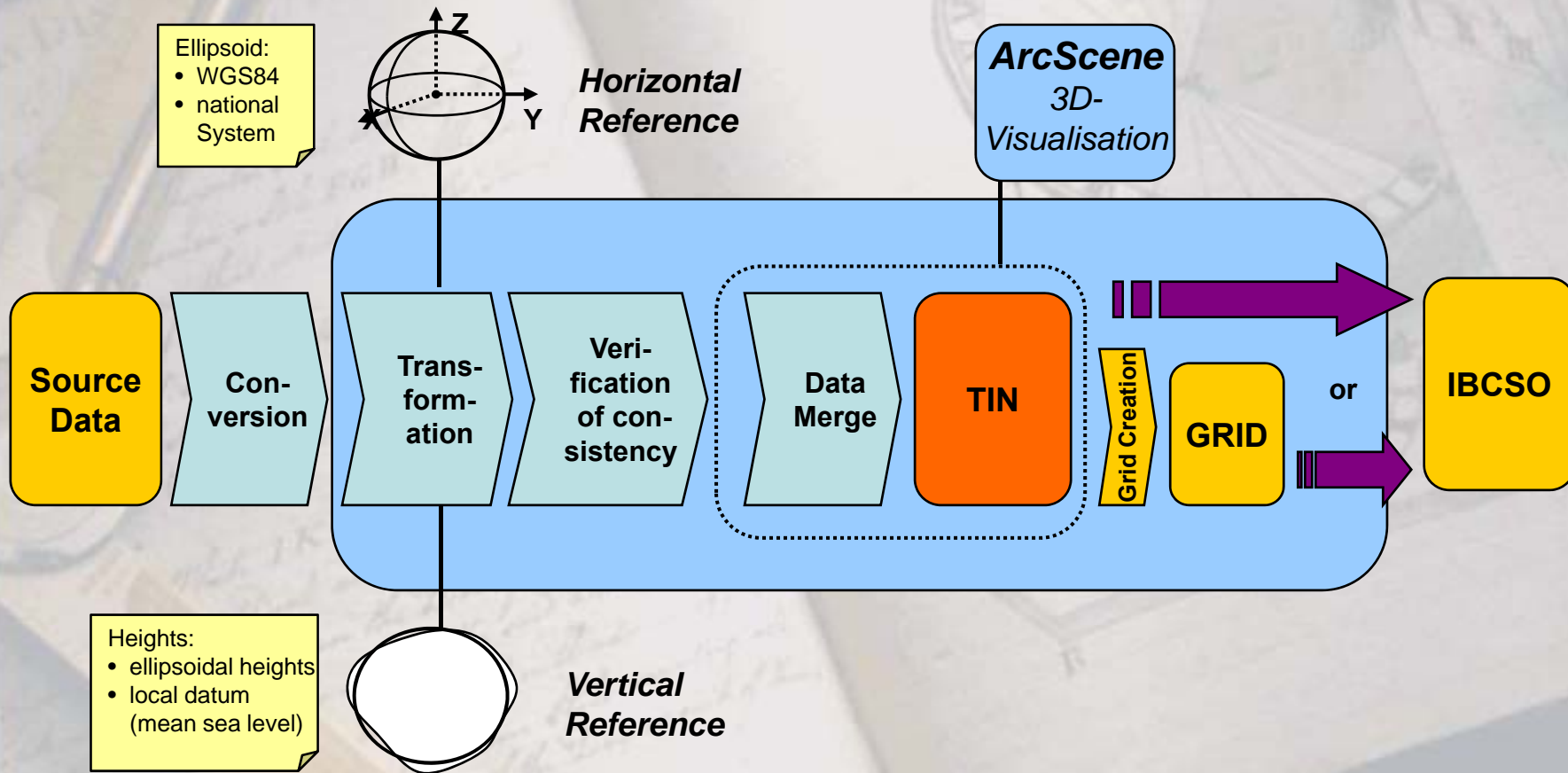


# Echo Sounding Patchwork





# Data Merge Work Flow



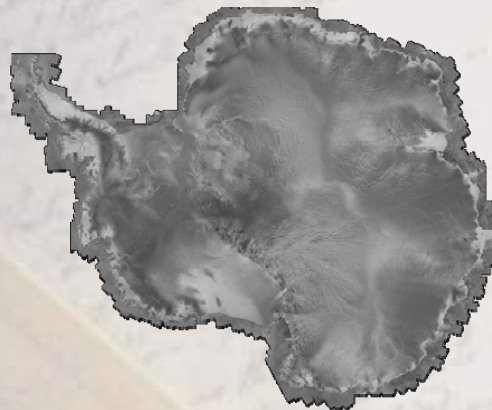
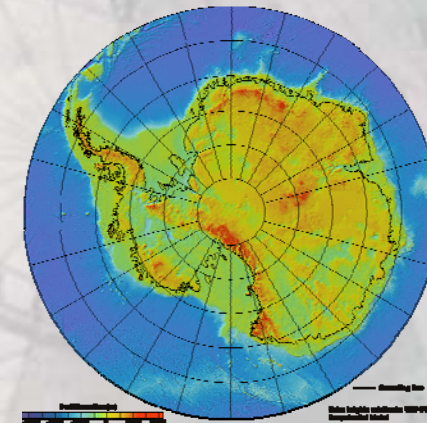




# The IBCSO Database



- **Bathymetric data of the SO**
  - raw data, grids, contours, charts, etc.
- **Topographic data of Antarctica**
  - DEM, bedrock topography
  - coastline, grounding line, ice front

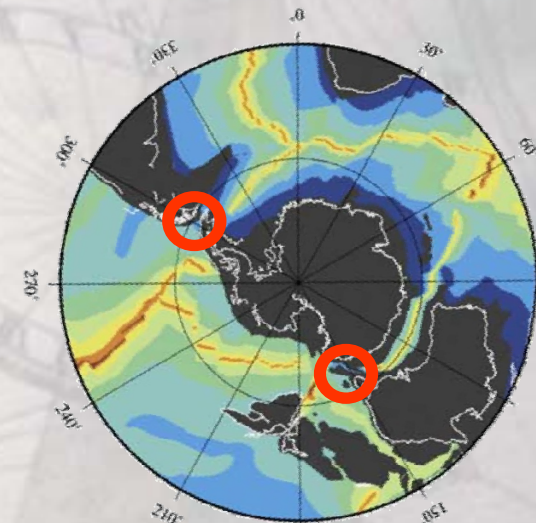


- **Additional data**
  - satellite imagery
  - limits of the sea
  - nomenclature
  - metadata

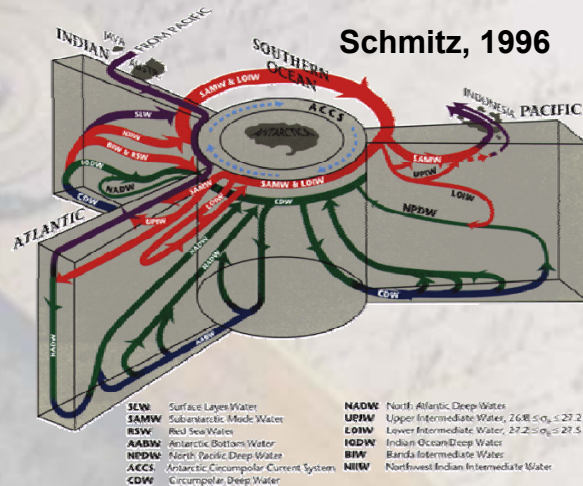


# Why Polar Bathymetry

- Defines gateways and barriers
  - e.g. Drake Passage, Tasman Gateway
- Drives currents and gravity waves
  - e.g. Antarctic Circumpolar Current



Brown et al., 2006



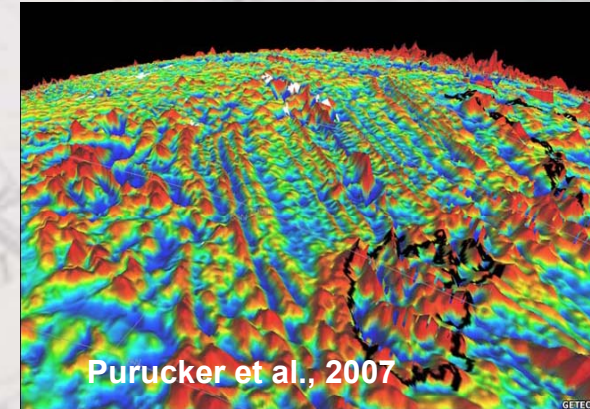
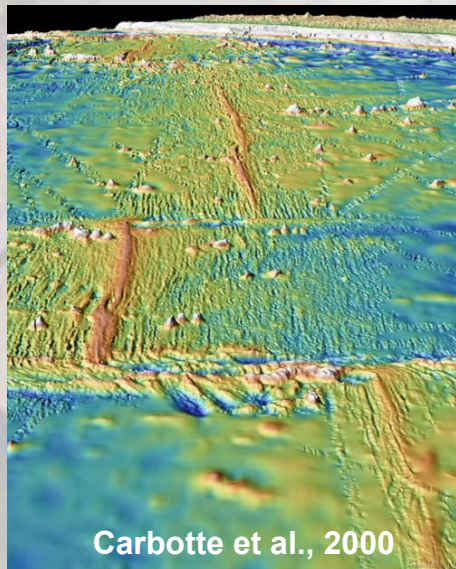
- Controls thermohaline circulation
  - e.g. Antarctic bottom water formation
- Influences global climate
  - e.g. Antarctica's glaciation





# Sea Floor in Geosciences

- **Ocean-continent boundary**
  - tectonic and igneous activities
  - sedimentation processes
- **Crustal heterogeneity**
  - variations in geophysical anomalies

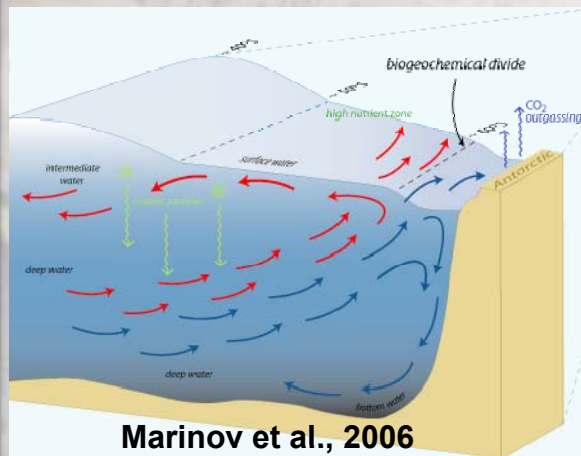
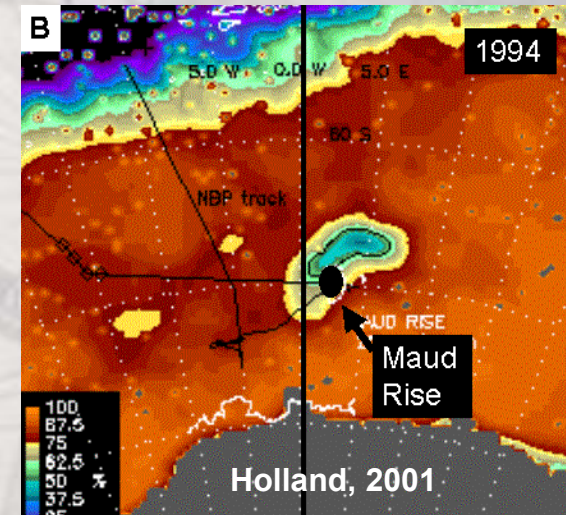


- **Crustal behavior - seismicity**
  - faults, earthquakes and landslides
- **Tsunami warning systems**
  - water depth and wave scattering
  - crucial input parameters



# Sea Floor in Physical Sciences

- **Topographic steering of ocean flows**
  - major currents respond to bathymetry
- **Sea floor barriers and gaps**
  - influence mixing and transport of waters  
e.g. Weddell Gyre

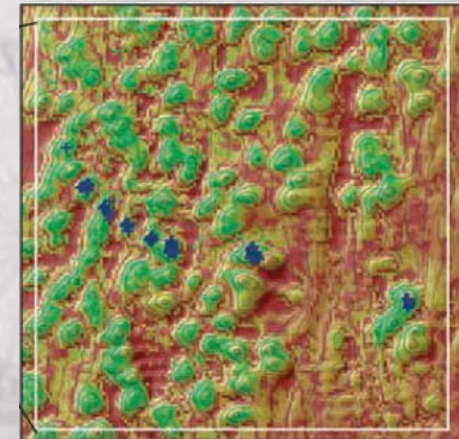


- **Models are sensitive to bathymetry**
  - specifications for accuracy and resolution (propagation speed related to  $\sqrt{\text{depth}}$ )
- **Limiting factor for new progress**
  - improvements by accurate bathymetry

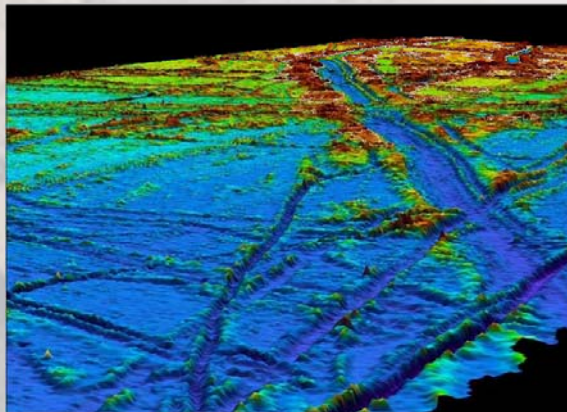


# Sea Floor in Life Sciences

- **Multi-scale terrain analysis**
  - Slope, aspect, curvature, variability
- **Bathymetric Position Index (BPI)**
  - Predictive habitat modeling



Wilson et al., 2007

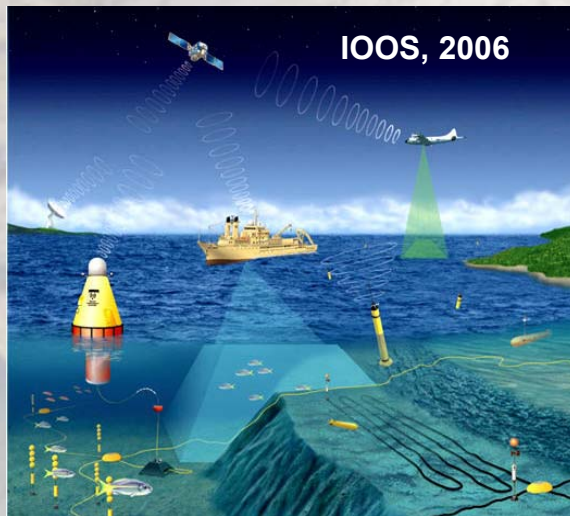


- **Terrain Ruggedness Index (TRI)**
  - Characterization of habitats
- **Description of marine ecosystems**
  - Habitat suitability (BTM Tool)



# Sea Floor in Observing Systems

- **Special features of the SO**
  - severe climate conditions, limited access
  - unique ecosystems and biodiversity
  - ‘canary’ for global climate change



- **Realistic portrayal of the seafloor**
  - ocean model input parameters
  - limitations in accuracy and resolution
- **Interaction of system domains**
  - sea floor as boundary layer
  - essential system variables





## Conclusions and Outlook

A continuous **data transfer** to the IBCSO database is crucial for the production of the bathymetric chart.

Expansion of **collaboration** with other SO efforts enables the integration of sensitive indicators for climate change and ocean ecology.

Provision of consistent **products** to the scientific community is of great importance for improved ocean modeling.

By providing new system domains and variables, the IBCSO expert group may give impetus to planned **observing systems** like SOOS.

*“Only by integrating all geosciences  
we can hope to discover the truth,  
i.e. to find the picture  
which represents the total of known facts in the greatest order  
and hence deserves the claim for highest likelihood, ...”*

**Alfred Wegener**

Preface to the 4th edition of his ‘Origin of continents and oceans’, 1929

