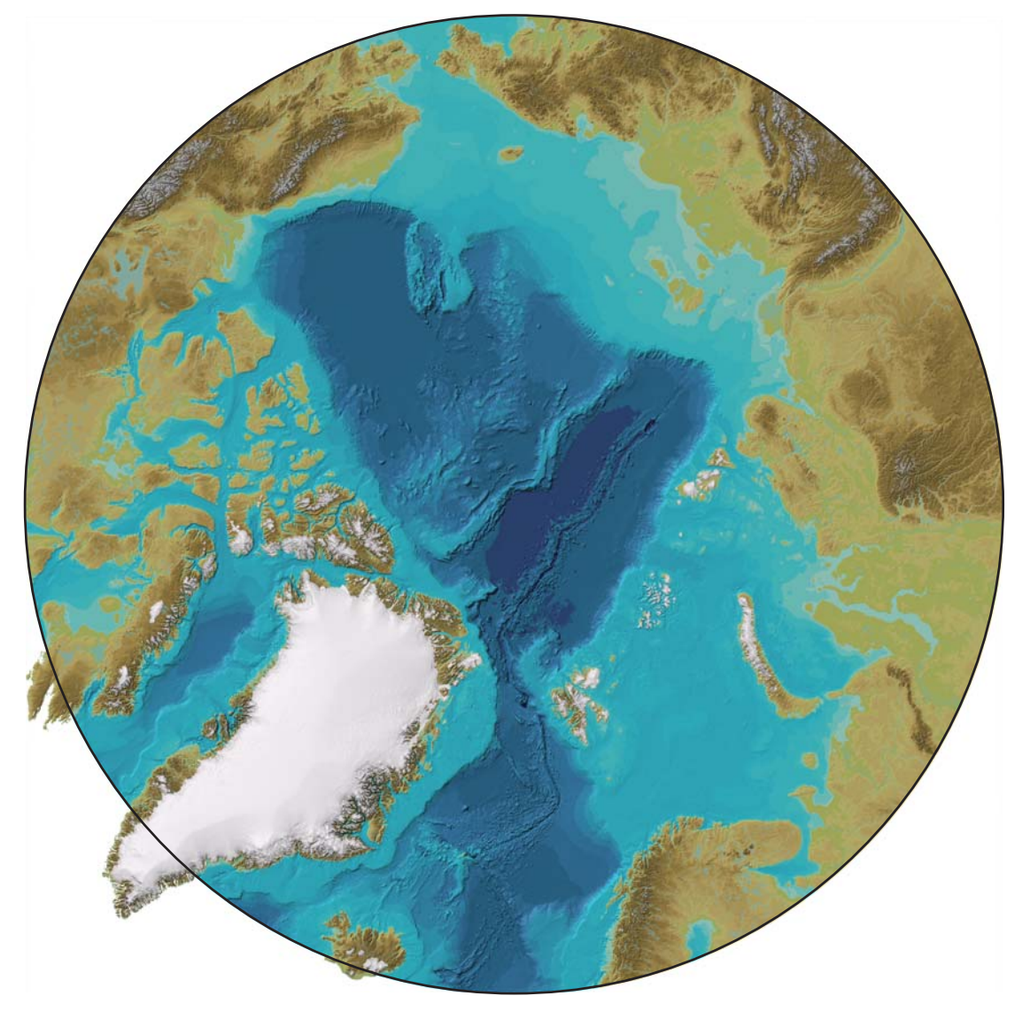


International Bathymetric Chart of the Arctic Ocean IBCAO

The IBCAO Compilation Team Introduces the Upcoming Version 3.0

1999 — 2008 — 2011 — 2012

Summary

The International Bathymetric Chart of the Arctic Ocean (IBCAO) was initiated 1997 in St Petersburg, Russia. An Editorial Board was established consisting of representatives from the circum Arctic Ocean nations plus Germany and Sweden. The objective of the Editorial Board was to collect available bathymetry data to create a map of the Arctic Ocean seafloor. An unstated, but widely recognized, goal was to create a map that supports testing of hypotheses about the formation and geologic history of the Arctic Ocean.

In 1997, the General Bathymetric Chart of the Oceans (GEBCO) Sheet 5.17 published in 1979 was still the authoritative Arctic bathymetric portrayal. While the contours agreed with the older, sparse underlying data, new soundings indicated that some major bathymetric features of Sheet 5.17 were poorly located and defined. Soon after the St Petersburg meeting in 1997, soundings collected by US and British Royal Navy nuclear submarines were declassified. Concurrently, capable icebreakers with modern mapping systems began collecting critical and accurate soundings. These new data were brought into the IBCAO project together with digitized depth contours from the Russian bathymetric map published by Head Department of Navigation and Hydrography 1999 . A first IBCAO compilation was released after its introduction at the AGU Fall Meeting in 1999 (**Figure 1**). This first IBCAO consisted of a Digital Bathymetric Model on a Polar stereographic projection with grid cell spacing of 2.5 x 2.5 km (Jakobsson et al., 2000). In 2008, IBCAO Version 2.0 was completed with a grid spacing of 2 x 2 km (**Figure 2 and 3;** Jakobsson et al., 2008). This new version had numerous new multibeam data sets included that were collected by ice breakers.

In May of this year, the "First Arctic-Antarctic Seafloor Mapping Meeting" was held at Stockholm University for the purpose of bringing together key participants involved in bathymetric mapping in Arctic and Antarctic waters, to improve the IBCAO and move forward towards a bathymetric compilation of the International Bathymetric Chart of the Southern Ocean (IBCSO). The meeting attracted participants from 15 countries. A new IBCAO Editorial Board was established (**Table 1**). A wealth of new data were brought to the table during the meeting including huge areas mapped with multibeam sonar systems outside the ice covered central Arctic Ocean, vast amounts of single beam data collected by fishing boats using the OLEX seabed mapping system, and a new batch of declassified US submarine soundings. Future cruises, also discussed at this meeting, promise more data to come. **Figure 4** shows a snapshot of new data incorprorated at this stage.

These data warrant an updating of IBCAO . We believe the increased data density will support a new version with grid cell size of as small as 500 m. Here we present a preview of this new IBCAO 3.0, which will soon be released for public use. Not all the submitted data is at this stage included. On a broader scale IBCAO 3.0 provides a substantially improved insight into the geological processes involved to form the Arctic Ocean basin. The new compilation is being assembled using an algorithm that grid at multiple resolutions, dependent on data density. Where the data density does not support a 500 m cell size, the algorithm develops bathymetric estimates on a coarser grid (**Figure 5**; Hell and Jakobsson, 2011).

Figure 1: *IBCAO was first released in 2000 as a Beta version with an accompanying article in EOS. This release was preceded by a presentation at the AGU Fall Meeting in San Francisco 1999.*

(This image of the article is from the AGU online archive of EOS back issues)

IBCAO Version 2.0

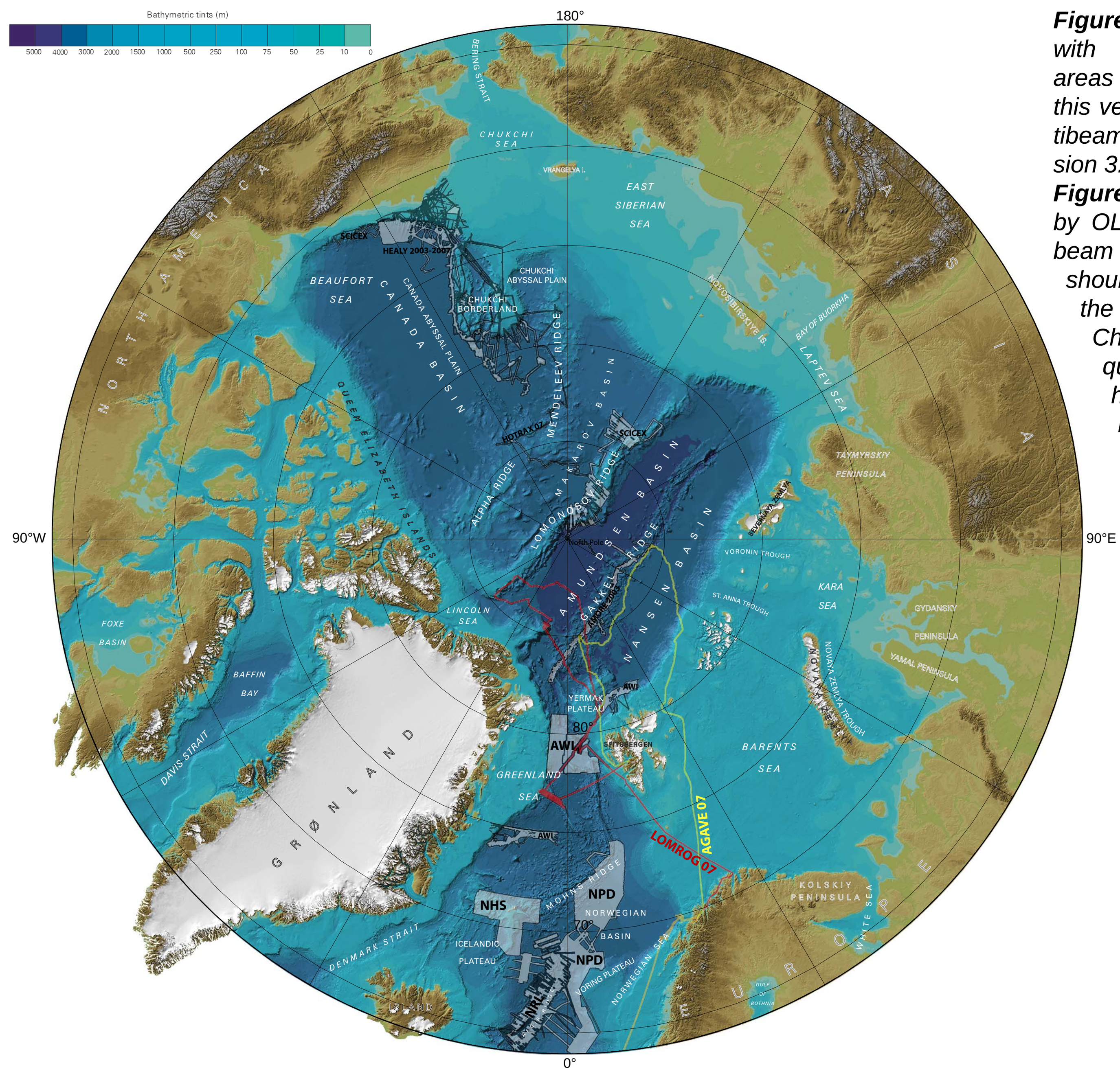


Figure 2: *IBCAO Version 2.0 with the multibeam mapped areas shown that were new to this version. The additional multibeam surveys included in Version 3.0 are shown in the map in **Figure 4** where areas covered by OLEX and additional single beam tracks also are shown. It should be noted that some of the multibeam data from the Chukchi Borderland area acquired with USCGC Healy have been re-imported at a higher resolution for Version 3.0. These are also shown in **Figure 4.***

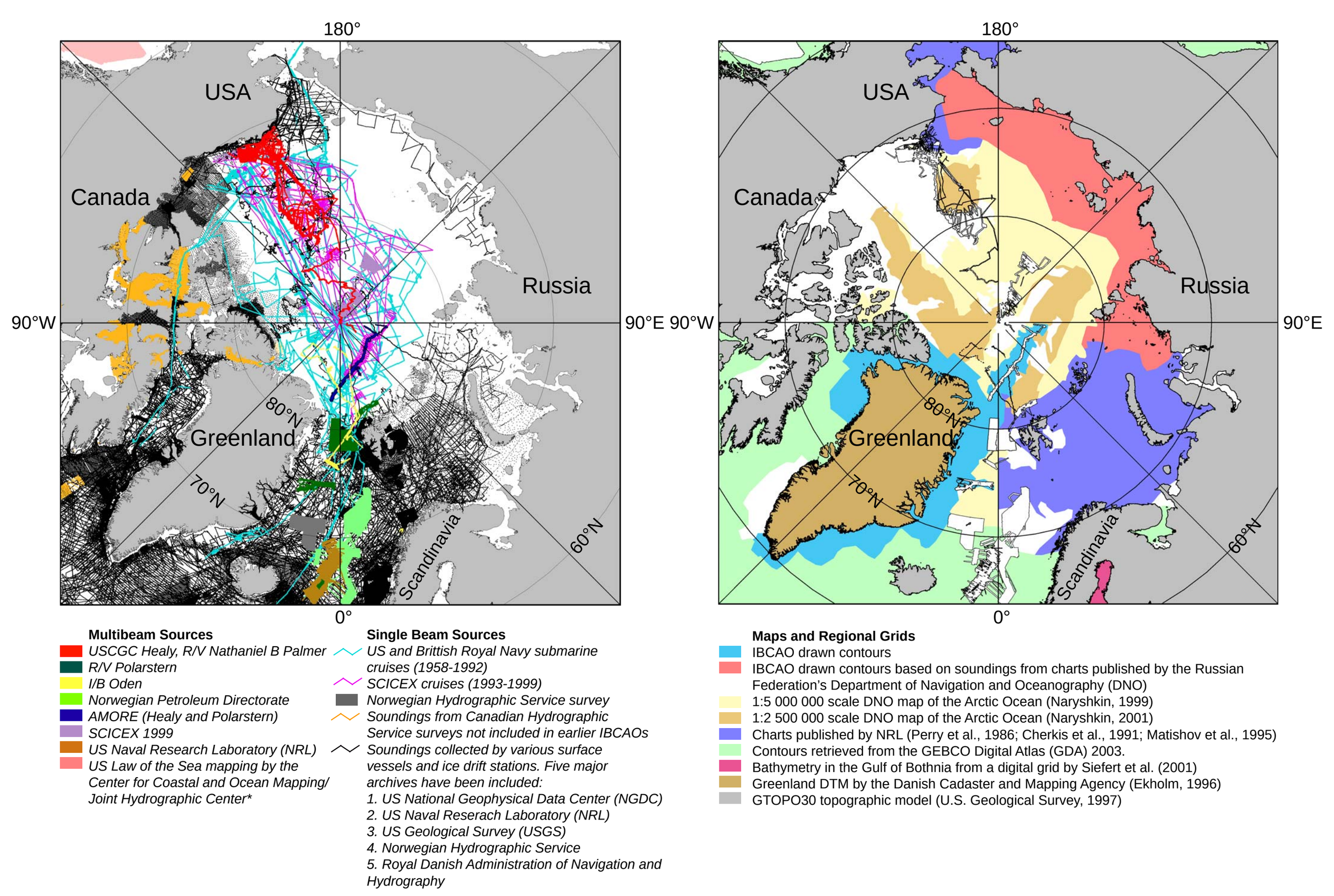


Figure 3: *IBCAO Version 2.0 comprised a significant update from Version 1.0. For the first time multibeam were incorporated on a broader scale. These two source distribution maps were presented in Jakobsson et al. (2008) when IBCAO 2.0 was released. The map in **Figure 4** shows some of the new bathymetric data that so far have been added to the sources shown in the two maps to the left in order to compile Version 3.0. The new data allow a substantial amount of contours from digitized maps to be removed from the gridding procedure.*

IBCAO 3.0: What is the difference?

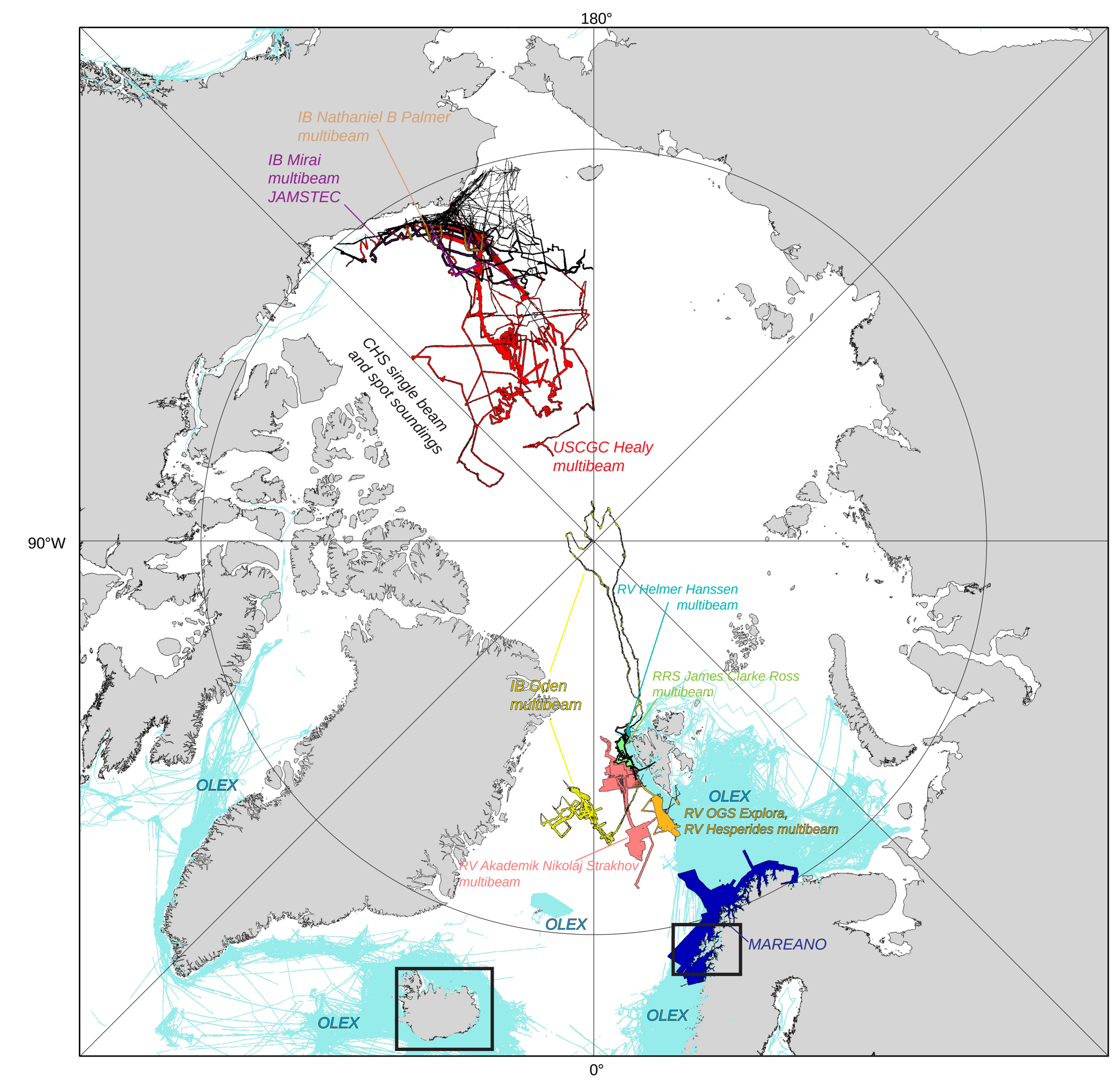


Figure 4: *Bathymetric data to-date incorporated in the compilation process of IBCAO Version 3.0. Sounding data submitted, but not yet incorporated include: Multibeam surveys with Canadian Research Icebreaker Amundsen and British RRS James Clarke Ross, single beam and multibeam soundings provided by the Danish Maritime Safety Administration and the Geological Survey of Denmark and Greenland (GEUS), soundings collected with the research hover craft RH Sabvabaa, and recently released US Navy submarine soundings. Areas within bold boxes are subjected to comparison between IBCAO 2.0 and 3.0 in **Figure 6**.*

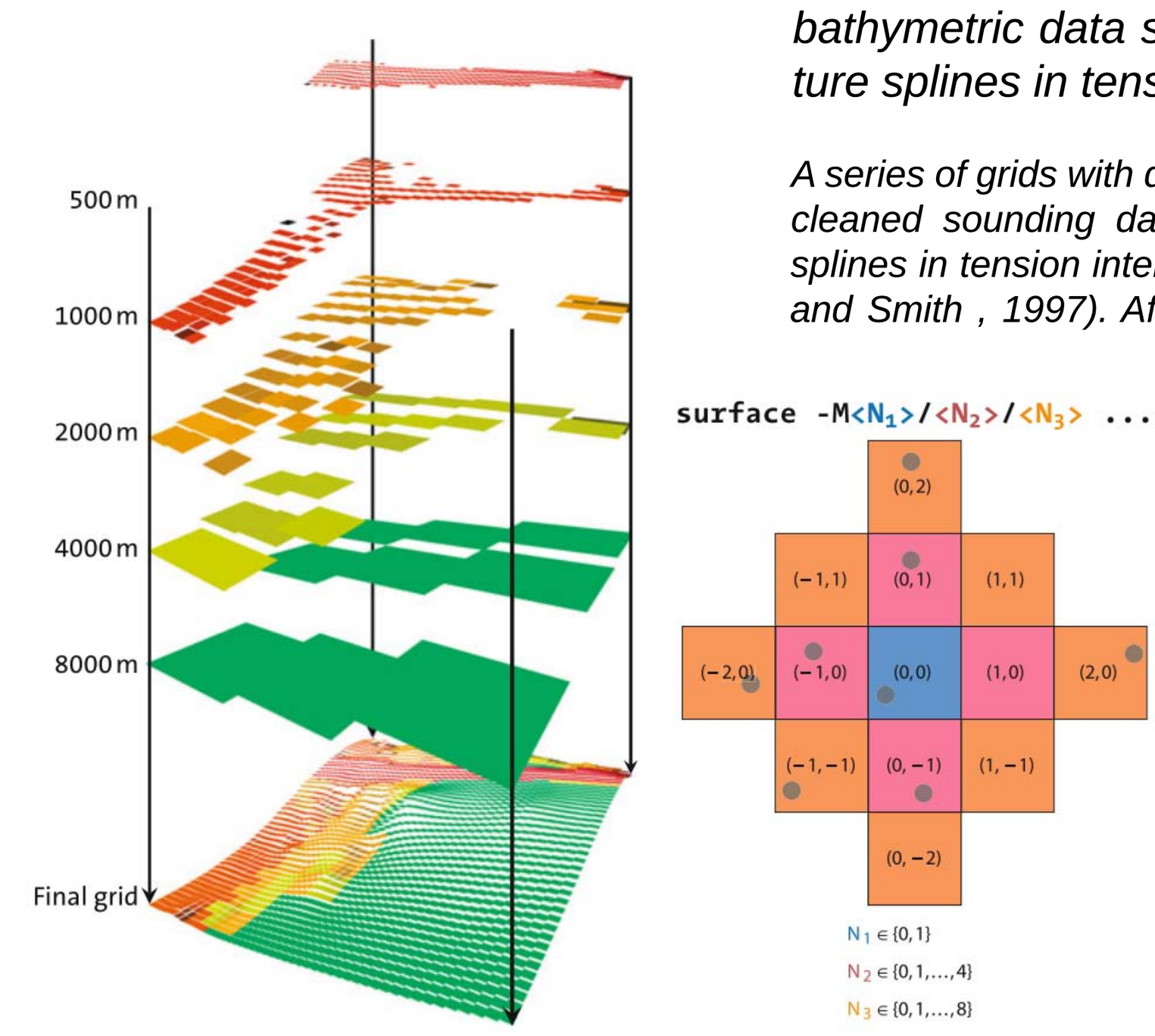
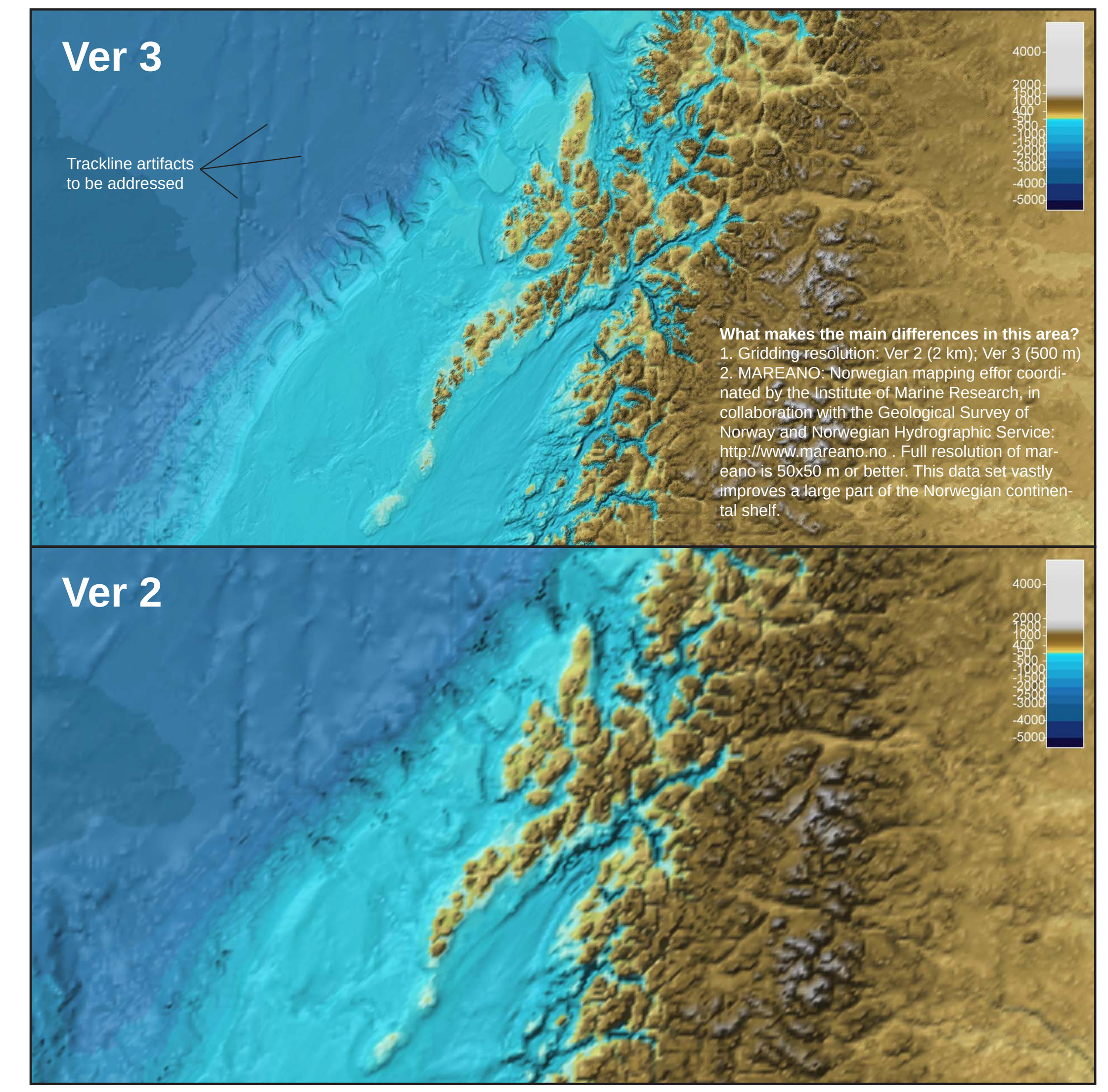


Figure 5: *The concept of gridding heterogeneous bathymetric data sets with stacked continuous curvature splines in tension (Hell and Jakobsson, 2011).*

A series of grids with different resolutions are computed from the cleaned sounding database using median block filtering and splines in tension interpolation using the GMT software (Wessel and Smith , 1997). After the interpolation, each grid is masked out in areas not sufficiently constrained by the source data using the masking algorithm shown in (b). The masking function allows specifying how many grid cells of each sort must be constrained by source data. If this constraint is not fulfilled, the interpolated value of the central cell will be discarded, i.e. set to NaN. In the example shown the default setting of -M1/3/5 is too strict to keep the interpolated value at (0,0). With a setting of e.g. -M1/2/4, the cell would be kept. Once the grids are masked (a) they are merged to one coherent grid, which has the resolution of the highest input grids.

IBCAO 2.0 versus 3.0



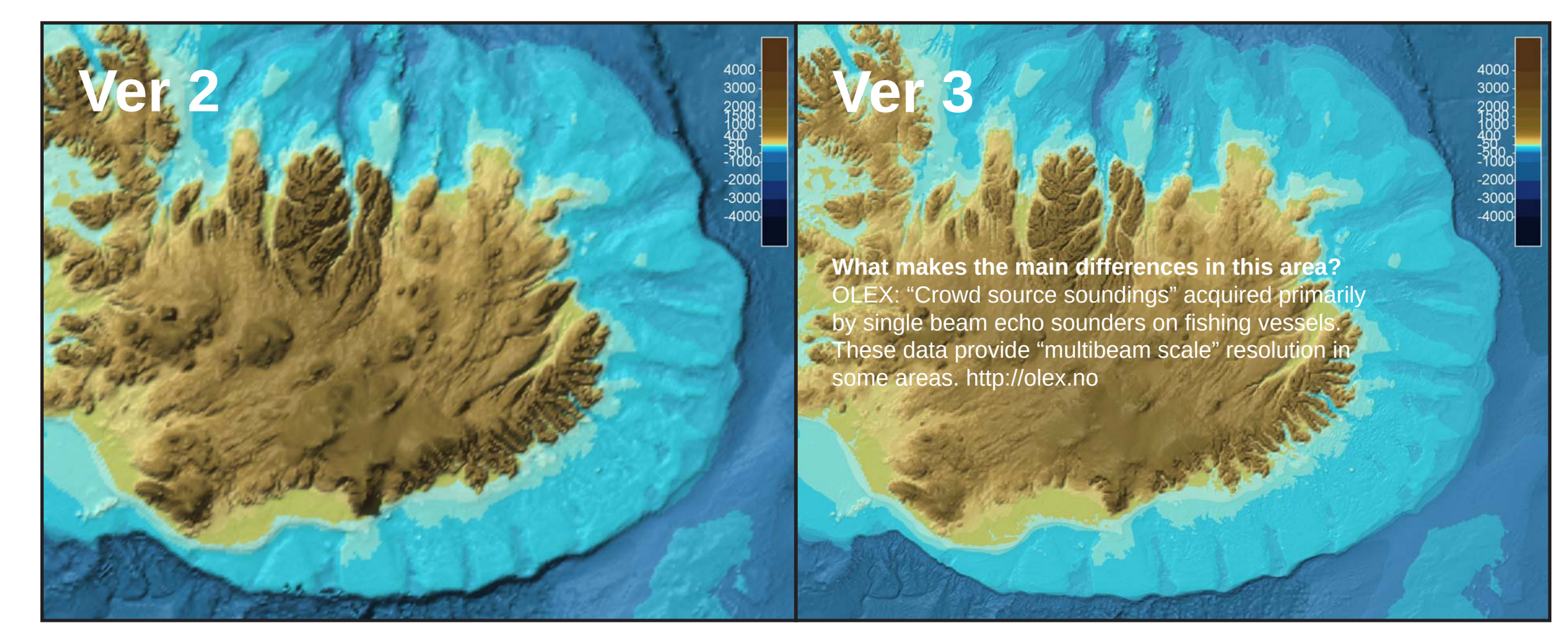


Table 1: IBCAO Compilation Team

IBCAO Editorial Board Established in Stockholm May 4, 2011

Denmark:	Richard Petersen, Danish Maritime Safety Administration (DaMSA)
Canada:	Steve Forbes, Canadian Hydrographic Service
Germany:	Hans-Werner Schenke, Alfred Wegener Institute of Marine and Polar Research (AWI)
Italy:	Michele Rebesco, Istituto Nazionale di Oceanografia e di Geofisica Sperimentale (OGS)
Norway:	Hanne Hodnesdal, Norwegian Mapping Authority, Hydrographic Service
Rus. Fed.:	Yulia Zarayskaya, Geological Institute of Russian Academy of Science
	Boris Fridman, North-West center of geoinformation
Svalbard:	Riko Noormets (Norway/Svalbard), University Centre in Svalbard (UNIS)
Sweden:	Martin Jakobsson (Interim Chairman), Stockholm University, Sweden
UK:	Julian Dowdeswell, Scott Polar Research Institute,University of Cambridge
USA:	Bernard Coakely, University of Alaska Fairbanks
	Larry Mayer, Center for Coastal and Ocean Mapping, University of New Hampshire

Several Editorial Board Members remains to be assigned,for example from from Iceland, Rep. of Korea, PR China, and Japan

Included in the Compilation Team are in addition to the Editorial Board Members numerous individuals that contributed, or facilitated contributions of, bathymetric data to IBCAO. So far these are:
Angelo Camerlenghi, Universitat de Barcelona; Benjamin Hell, Stockholm Univ./Intergraph; Christian Marcussen, Geological Survey of Denmark and Greenland; Ian Church, Ocean Mapping Group, Univ. of New Brunswick ; John Hughes Clarke, Ocean Mapping Group, Univ. of New Brunswick; Norman Cherkis, Five Oceans Consultants; Ole B. Hestvik, OLEX; Rezwan Mohammad, Stockholm Univ; Son V Nghiem, NASA Jet Propulsion Laboratory, California Institute of Technology

This team will likely be expanded during the progression of the IBCAO project.
The compilation work of IBCAO 3.0 is carried out at the Department of Geological Sciences, Stockholm University