Marine and Tropical Sciences Research Facility Final Report

Project 2.5i.1a Milestone 10 June 2010

Title: Project 3DGBR: a high-resolution depth model for the Great Barrier Reef and Coral Sea

Project Leader: Robin Beaman

Institution: James Cook University

Summary of Final Report

This project aimed to develop a new high-resolution digital elevation model (DEM) for the Great Barrier Reef (GBR) and adjoining Coral Sea at a grid pixel resolution of 0.001-arc degree (about 100 m). A high-resolution DEM is a critical 3D dataset required to accurately simulate water mixing and current flow within a whole-of-GBR scale hydrodynamic model. In addition, a new grid is required to improve the geomorphic detail about the location and spatial extent of seabed features for much of the GBR shelf and Coral Sea region. The new grid utilised the latest data sourced from ship-based multibeam and singlebeam echosounder surveys, airborne LiDAR bathymetry surveys, and satellite data.

This report contains an explanation of the various source datasets used in the development of the new grid, and how the data were treated in order to convert to a similar file format with common horizontal (WGS84) and vertical (mean sea-level) datums. Descriptive statistics are presented to show the relative proportion of source data used in the new grid. The report continues with a detailed explanation of the pre-processing and gridding process methodology used to develop the grid. A description is also provided for additional spatial analysis on the new grid in order to derive associated grids and layers.

The results section provides a short overview of the improvement of the new grid over the current Australian Bathymetry and Topography Grid. The report then presents the results of the new grid, called gbr100, and the associated derived map outputs as a series of figures. A table of metadata for the current source data accompanies this report as Appendix 1.

For reference: Milestone extracted from Project Schedule

Project 2.5i.1a ***Date 10 June 2010***

Description

Report the full data sources used in the project, the pre-processing and gridding process methodology.

Present the results of the high-resolution depth model and derived map outputs.

Important Information

Australian Hydrographic Service Notice:

Not to be used for navigation.

Certain material in this product is reproduced under licence by permission of The Australian Hydrographic Service.

© Commonwealth of Australia 2010. All rights reserved.

This information may not be copied, reproduced, translated, or reduced to any electronic medium or machine readable form, in whole or part, without the prior written consent of the Australian Hydrographic Service.

Geoscience Australia (GA) Notice:

This gbr100 DEM incorporates data which is © Commonwealth of Australia (Geoscience Australia) 2010. The Commonwealth gives no warranty regarding the data's accuracy, completeness, currency or suitability for any particular purpose.

Project Results

Description of the results achieved for this milestone

Introduction

A high-resolution digital elevation model (DEM) is a critical 3D dataset required to accurately simulate water mixing and current flow within a whole-of-Great Barrier Reef (GBR) scale hydrodynamic model (see MTSRF Project 2.5i.1). The finer-scale detail of the undersea landscape underpins the ability of the hydrodynamic model to resolve the effects of reefs and inter-reefal passages on water circulation, and hence the predictive ability of such models to simulate changes to the GBR environment under various climate change scenarios.

In addition, there is a critical lack of information about the location and spatial extent of deep-water ecosystems and seabed habitats for about a third of the GBR World Heritage Area (GBRWHA) lying deeper than 200 m. Most of the inter-reefal seabed shallower than 200 m on the GBR shelf, and many of the 2000+ coral reefs themselves, have never been adequately mapped with modern echosounder techniques. Therefore key seabed geomorphic features, such as shoal habitats and submerged reefs, remain largely hidden from view and outside of effective management.

The 3DGBR project aimed to develop a new high-resolution DEM for the GBR and adjoining Coral Sea at a grid pixel resolution of 0.001-arc degree (about 100 m). The geographic coverage ranges from latitude 10° to 29° South; longitude 142° to 160° East. Including the adjacent Queensland coast and hinterland, the new DEM represents an area of about 3,000,000 km^2. The spatial resolution and increased coverage of the data in the new grid is a significant improvement over the detail observed in the current Australian Bathymetry and Topography Grid (Geoscience Australia, 2009) at 0.0025-arc degree (about 250 m).

Further, in recent years there has been a vast increase in the quantity of bathymetric data obtained in the GBRWHA through a series of research vessel mapping expeditions. The new DEM utilised the latest data sourced from ship-based multibeam and singlebeam echosounder surveys, airborne LiDAR bathymetry surveys, and satellite remotely sensed data. The project benefited greatly from the collaborative partnerships between Federal and State Government agencies that provided much of the source bathymetric data.

This report describes the various data sources used in the development of the new grid, and provides a detailed description of the pre-processing and gridding process methodology used to develop the new grid. The report then presents the results of the high-resolution depth model, called gbr100, and the associated derived map outputs as a series of figures. A table of metadata for the current source data accompanies this report as Appendix 1.

Data sources

Multibeam data. Most of the multibeam datasets used in the project were supplied by Geoscience Australia (GA). These datasets were initially processed with multibeam post-processing software by the originating agencies to correct for sound velocity variations within the water column and to remove noise. For the deep-water (>200 m) surveys, it is assumed that no account has been taken of the tidal range during post-processing by these agencies, so all depth data are believed to have a vertical datum of mean sea-level (MSL). All depth data horizontal positions were referenced to a common WGS84 datum (Fig. 1).

The post-processed multibeam files were archived by GA as Generic Sensor Format (GSF) files within Caris™ HIPS and SIPS software. The multibeam data were exported from HIPS and SIPS as full-density resolution, ASCII xyz (longitude, latitude, depth) files and then provided to this project. A number of shallow-water (<200 m) multibeam surveys were also collected by the author.

These surveys were also post-processed within HIPS and SIPS software and a tidal correction applied to reduce the data to a common MSL vertical datum. These data were then exported as full-density xyz data.

In addition, multibeam data were also supplied by the Australian Hydrographic Service (AHS) and provided as Hydrographic Transfer Format (HTF) files. These data have a vertical datum of lowest astronomical tide (LAT) and so a LAT-MSL vertical datum shift was applied to all the AHS data in order to correct the data to the common MSL datum used in the project. HTFBuilder software was used to filter and extract xyz data for further area based editing.

Singlebeam data. Singlebeam echosounder data from the numerous deep-water vessel transits through the region were originally supplied to GA for archive. In most cases, the shiptrack data were simply stored in xyz format with no further attribute data. Thus no account has been taken of the tides and so all deep-water sounding data are assumed to approximate MSL. The shiptrack data were extracted from the archive databases as xyz files at a range of spatial resolutions for input to the next pre-processing phase of area based editing.

The AHS provided the data from a large number of hydrographic surveys conducted in the GBR and Torres Strait shelf. These datasets were supplied in HTF format, from which the xyz data were extracted and a LAT-MSL vertical datum shift applied to reduce the data to MSL. In addition, the AHS supplied older National Mapping Agency surveys over shallow reefs that were sparse in data density but were often the only digital depth data in remote parts of the region and therefore quite useful. Queensland Port Authorities and Maritime Safety Queensland (MSQ) also provided coastal depth data as xyz files, which had a LAT-MSL vertical datum shift applied before area based editing.

LiDAR data. The Royal Australian Navy (RAN) has conducted extensive airborne LiDAR bathymetric surveys over the GBR shelf in support of national charting responsibilities. Due to the depth limitations of the laser penetration into the water column (about 50 m), the effective bathymetric data is restricted to the shallower reef waters, however, the density and spatial coverage is of high quality. The data were supplied by the AHS as HTF files, which were filtered to extract xyz data and then a vertical datum shift applied to correct the data to a common MSL vertical datum.

Satellite bathymetry data. A collaborative pilot project with GA staff using Advanced Land Observing Satellite (ALOS) imagery was conducted to extract bathymetric data over remote coral reefs in the central GBR shelf. The results provided data at 10 m horizontal resolution with depths to about 25 m, derived from a tile size of about 70 km x 70 km. While only experimental within the time frame of the current project, this methodology shows great potential to extend the technique into remote areas that lack the spatial data coverage through traditional methods of data acquisition. The minor satellite data used in this project were converted to xyz data for next pre-processing phase.

Coastline data. In order to pin the coastline at the Australian Height Datum (which approximates MSL) during the gridding process, an accurate polyline shapefile of the Queensland coast was supplied by the GA Law of the Sea department. The coastline was converted into an ESRI™ raster grid with a pixel size of 0.0001-arc degree (~10 m) and with constant depth values of 0 m. The grid node points were then extracted to derive xyz files. These data required no area based editing and were available directly into the gridding process. No accurate polyline shapefiles could be located for the PNG and Solomon Islands land area and so no coastline points were included in the gridding phase.

Satellite elevation data. Shuttle Radar Topographic Mission (SRTM) land elevation data were obtained for the Queensland mainland and near-shore islands at a spatial resolution of 1-arc second (~30 m). The data were supplied to this project by the Defence Imagery and Geospatial Organisation (DIGO) as a collaborative project with GA. The aim was to merge the land elevation data with the gridded DEM output to produce a final grid correct for both land elevation

heights and adjacent ocean depths. The Queensland SRTM data were resampled to 0.001-arc degree (~100m), similar to the pixel size of final grid.

The SRTM land elevation data for the offshore Coral Sea islands, including Papua New Guinea and the Solomon Islands, were downloaded as Binary Interleaved by Line (BIL) format through the U.S. Geological Survey EarthExplorer website (http://edcsns17.cr.usgs.gov/EarthExplorer/). The BIL data were converted to ESRI grids, and as the data have a grid pixel size of 3-arc second (~90 m), it was resampled to 0.001-arc degree (~100m) or the same pixel size of the final grid output. Both the Queensland SRTM and offshore SRTM data were then merged into a single ESRI grid for later overlay in the gridding process to produce the final gbr100 depth model.

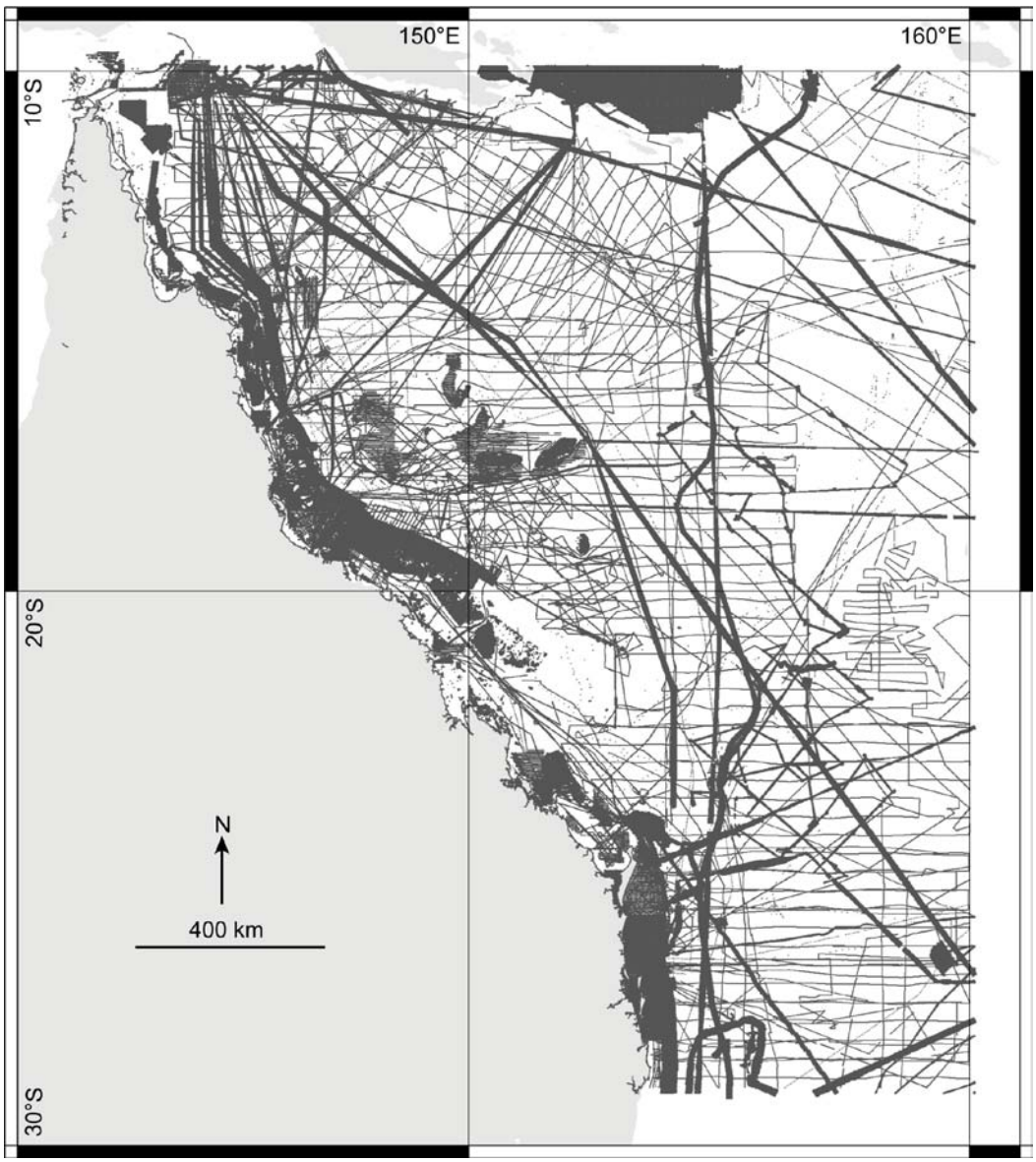

Fig. 1. Mercator projection map showing the spatial data coverage of the combined multibeam, LiDAR, singlebeam, satellite bathymetry and coastline source datasets used to develop the new gbr100 grid.

Source data statistics. As of 10 June 2010, the total number of individual surveys provided as source data to the project were 307 (excluding the coastline data; Table 1 and Fig. 2). Of these, the greatest number of data sources were from singlebeam surveys (176), followed by multibeam (80) and then LiDAR surveys (50). However, the multibeam data provided by far the greatest proportion of xyz data at >94% of the total file size (in bytes), then the singlebeam and LiDAR data at ~2% of the total file size. The satellite bathymetry and coastline data each contributed ~0.2% of the total file size. When taken together, the total source data files approximates >900,000,000 individual xyz records for the project area.

Table 1. Descriptive statistics showing the contribution for the various ASCII xyz data sources used to develop the gbr100 grid, as of 10 June 2010.

	MULTIBEAM	SINGLEBEAM	LIDAR	SATELLITE	COASTLINE	TOTAL
No. Folders (surveys)	80	176	50	1	1	308
File size (bytes)	29,290,288,606	751,682,494	859,586,015	82,698,845	74,377,276	31,058,633,236
Percentage (bytes)	94.31	2.42	2.77	0.27	0.24	100.00
xyz records (approx.)	891,084,033	22,868,067	26,150,762	2,515,906	2,262,743	944,881,512

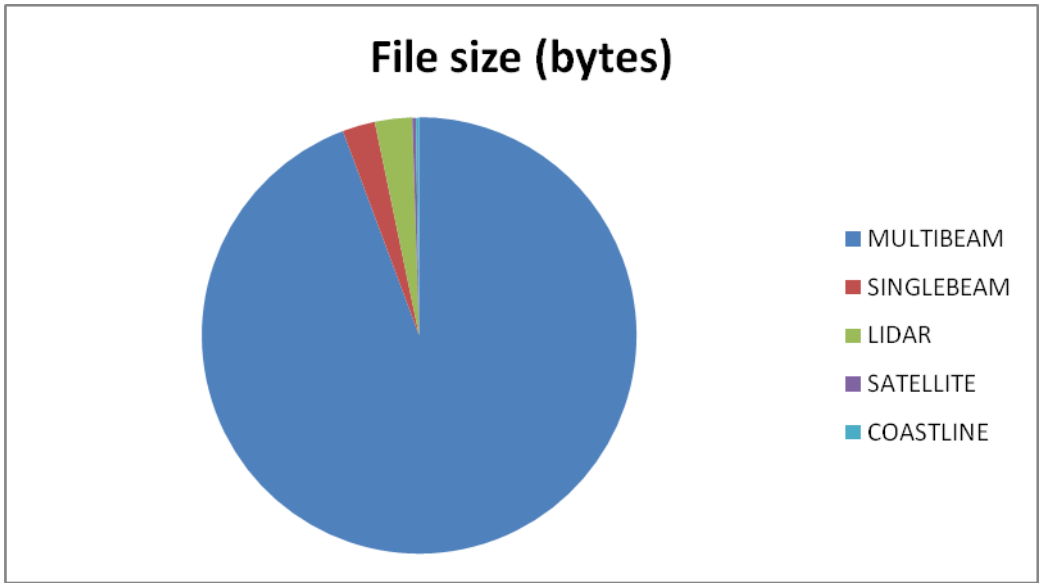

Fig. 2. Pie chart showing the contribution (as a proportion of bytes) for the various data source types used to develop the new gbr100 grid.

Pre-processing and gridding process methodology

Pre-processing. Prior to the pre-processing phase, all xyz source data were brought to a common MSL vertical datum and WGS84 horizontal datum before conducting area based editing to remove noise and errors in the data (Fig. 3). Individual survey xyz files were imported to PFM files using IVS 3D™ Fledermaus PFMDirect software, which generated a gridded 3D surface based upon the combined point cloud. The PFM files could then be edited and cleaned of noise with the Fledermaus 3DEditor tool. 3DEditor makes it possible to edit the underlying data while dynamically updating the 3D surface model representation. Following extensive cleaning of the point cloud for noise and errors, the accepted soundings were exported from the PFM files as the final xyz source files used in the next grid development phase.

Grid development. The next phase of grid development was conducted with Generic Mapping Tools (GMT) software following the methodology used in Becker *et al.* (2009). GMT is a Unix-based gridding and plotting software package that can deal with large datasets. The cleaned xyz data for each survey were decimated using GMT blockmedian into ASCII xyz data representing single node points at 0.0005-arc degree (~50 m) spatial resolution. The decimated data files were then concatenated into one large xyz file, so that there were potentially many depth points for the same location where various surveys had crossed the same geographic area. Next, GMT blockmedian was conducted on the single large file to decimate the data to 0.001-arc degree (~100) resolution in order to produce one valid depth point for each pixel location used in the new grid.

The 100 m blockmedian depth values were then compared with the co-located depths from an underlying base grid, in this case the current Australian Bathymetry and Topography Grid (Geoscience Australia, 2009). This base grid has a pixel size of 0.0025-arc degree (~250 m). The purpose of using a lower-resolution depth grid was firstly to use the base grid as a comparison to flag any new source data that may be greatly in error, and thus be rejected, and secondly to provide additional depth data for areas that lack spatial coverage by the new source data. GMT grdtrack was used to find the comparative depth differences between the co-located new data and the underlying base data.

A temporary grid surface was made with GMT surface, using those difference values between the co-located new data and base data. GMT surface was also used to resample the lower-resolution base grid at a higher-resolution of 0.001-arc degree. The temporary difference grid and the resampled base grid were then added together with GMT grdmath. The output of this process was a network Common Data Form (netCDF) file that was converted into an ESRI raster grid using ArcGIS. Lastly, the 0.001-arc degree SRTM land elevation grid was merged with the new ESRI grid to produce the final grid, called gbr100.

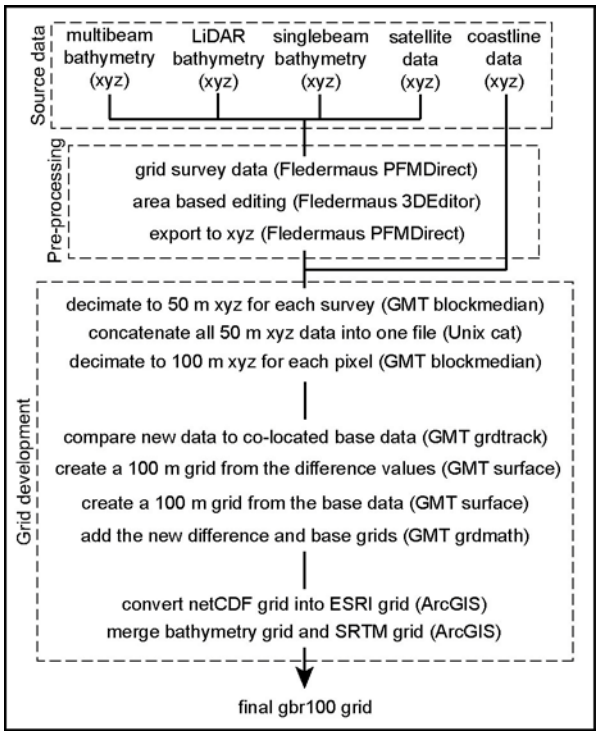

Fig. 3. Processing scheme used to develop the gbr100 grid.

Derived grids and layers. A useful derived grid from continuous data such as a DEM, is a slope model which shows the angular variation in seafloor gradient relative to a horizontal or flat value of 0°. For this project, the final 0.001-arc degree grid was reprojected in ArcGIS to a new Mercator projection (Central Meridian 151°E, Standard Parallel 20°S) grid with a pixel size of 100 m. The slope model was generated utilising the ArcInfo Slope application by fitting a window with a 3 x 3 cell neighbourhood around each processing or centre cell of the 100 m grid. Thus slope was averaged over a distance of 300 m for each cell of the projected grid in order to derive an associated slope grid.

Another useful derived layer is a contour map, used as a traditional means of visualising steep versus relatively flatter areas. Utilising the ArcGIS Spatial Analyst tool, an additional contour map was derived from the final 0.001-arc degree grid at a contour interval of 200 m. For the purposes of this report, the derived contour lines were placed over the DEM, which was coloured using histogram equalise to increase the visual contrast of the background.

Results of the high-resolution depth model and derived map outputs

The new gbr100 grid and associated derived map outputs are shown in Figs. 4, 5, 6 and 7. The new grid significantly improves the finer-scale detail of the GBR shelf and adjacent Coral Sea compared to the current Australian Bathymetry and Topography Grid (Geoscience Australia, 2009) . In particular, the great complexity of the Queensland continental slope is revealed through the numerous submarine canyons and gulleys incising the slope. On much of the continental shelf, the more subtle and finer-scale physiographic features of the inter-reefal seabed are now revealed, such as the extent of vast *Halimeda* bioherms and underwater dune fields. The true geomorphic shapes of many of the coral reefs are also shown, together with their relationships with the older and deeper Pleistocene limestone platforms upon which the modern coral reefs have grown.

In offshore deeper waters, the seafloor of the Coral Sea is revealed as a far more complex environment than previously known. Examples are the clusters of small (<1000 m in relief) seamounts or knolls revealed for the first time next to the Queensland Plateau and lying within Australia's marine jurisdiction. Vast undersea debris flows and submarine canyons generally appear at the edges of submerged platforms or seamounts wherever the slope gradient increases. Even the deep abyssal plain of the Coral Sea Basin, previously thought to be entirely flat, shows a higher physiographic relief not known before. The new multbeam surveys across the Coral Sea have also added more detail to the convergent plate boundary where the Australia Plate meets the Pacific Plate in the vicinity of southern PNG.

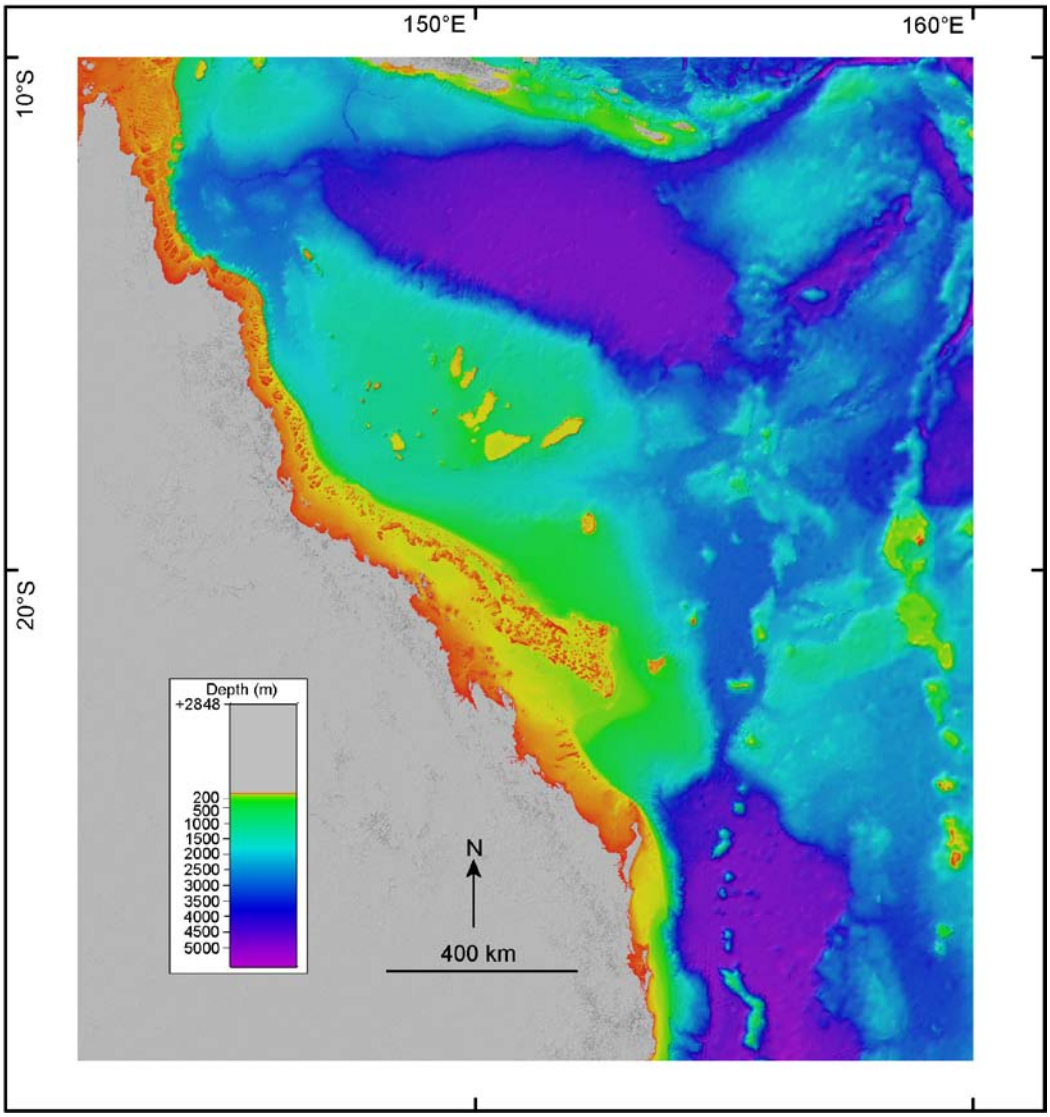

Fig. 4. Mercator projection map of the new gbr100 grid.

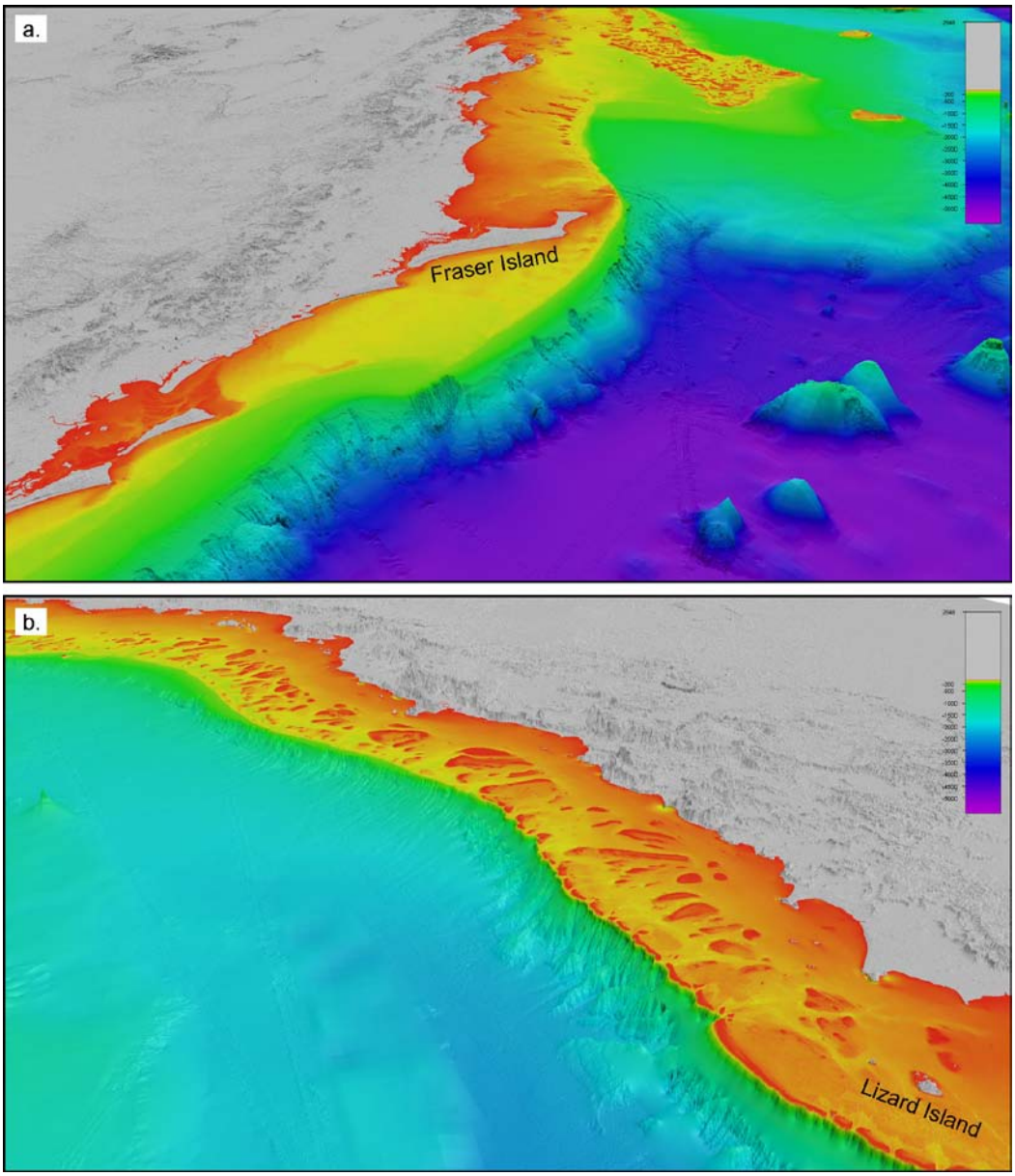

Fig. 5. 3D oblique views of the gbr100 grid showing: **a.** north-westerly perspective of the southern Queensland continental shelf and adjacent seamounts; and **b.** south-westerly view of the northern GBR shelf, submarine canyons and adjacent abyssal plain.

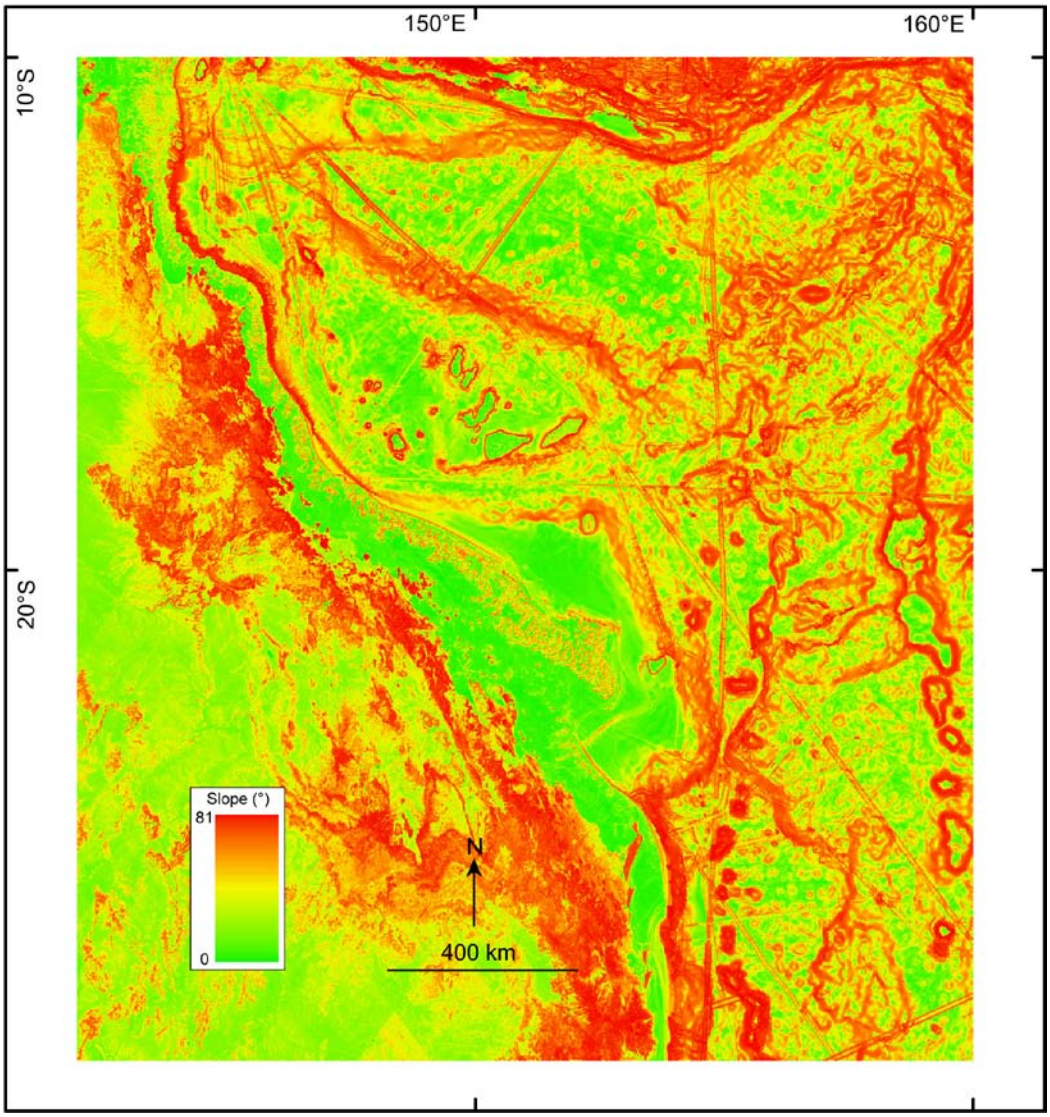

Fig. 6. Mercator projection map of the slope gradient (°) derived from the gbr100 grid. The striping is due to recent deep-water multibeam tracks merging with adjacent areas that are poorly surveyed.

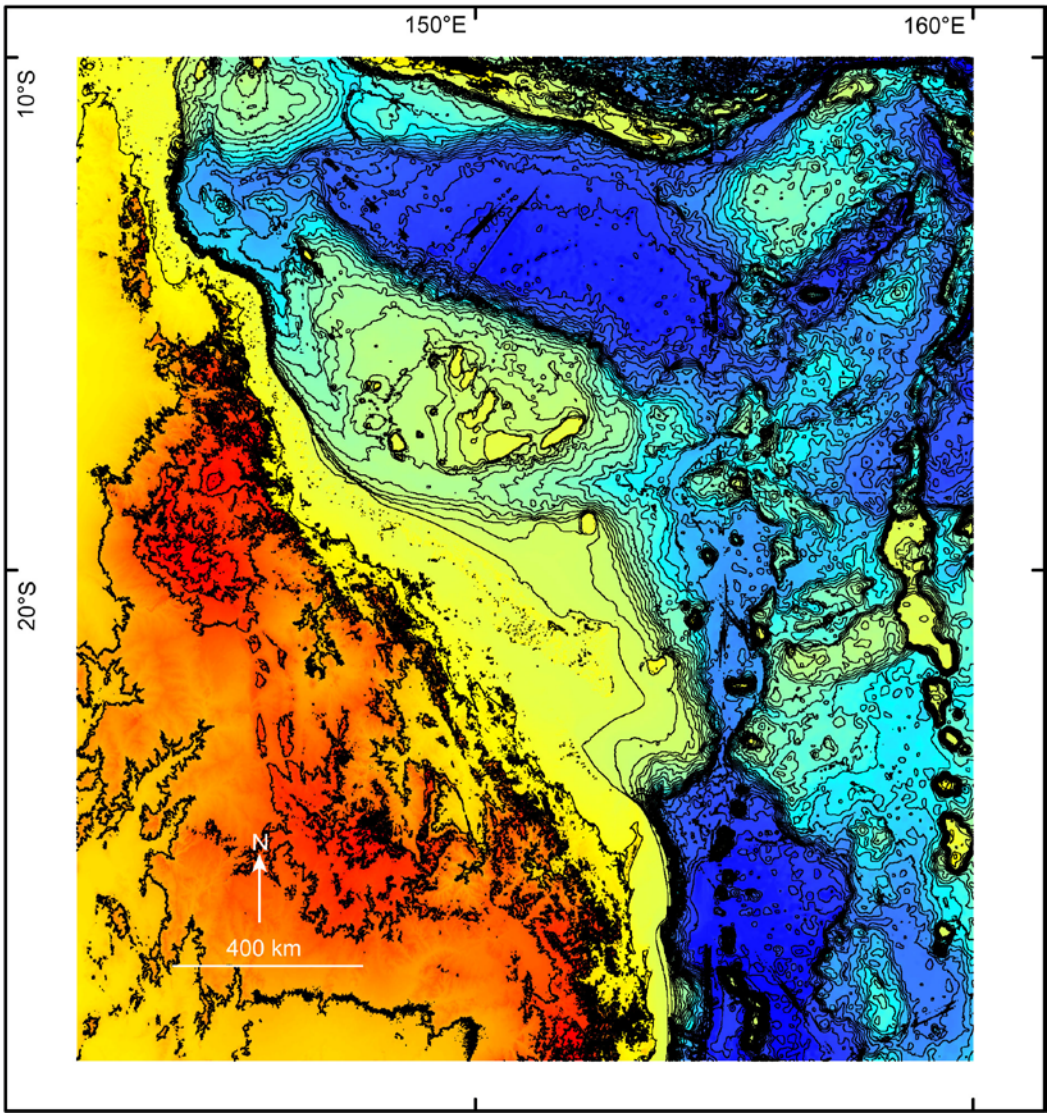

Fig. 7. Mercator projection map of contour lines at 200 m intervals derived from the gbr100 grid and overlaid on the DEM, coloured using a histogram equalisation.

Conclusion

A new bathymetric grid, called gbr100, was created for the Great Barrier Reef and Coral Sea region with a geographic coverage ranging from latitude 10° to 29° South; longitude 142° to 160° East. The new DEM has a grid pixel size of 0.001-arc degree (~100m) with a horizontal datum of WGS84 and a vertical datum of MSL. The grid utilised the latest multibeam, singlebeam, LiDAR and satellite bathymetry source datasets provided by Federal and State Government agencies, in addition to significant new multibeam data collected during research expeditions in the area. The large increase in data added much detail to improving the resolution of the grid compared to the current Australian Bathymetry and Topography Grid. The gbr100 grid provides new insights into the detailed geomorphic shape and spatial relationships between adjacent seabed features.

References

Becker, J.J., Sandwell, D.T., Smith, W.H.F., Braud, J., Binder, B., Depner, J., Fabre, D., Factor, J., Ingalls, S., Kim, S.-H., Ladner, R., Marks, K., Nelson, S., Pharaoh, A., Trimmer, R., Von Rosenberg, J., Wallace, G. and Weatherall, P., 2009. Global bathymetry and elevation data at 30 arc seconds resolution: SRTM30 PLUS. Marine Geodesy, 32(4): 355-371.

Geoscience Australia, 2009. Australian Bathymetry and Topography Grid, June 2009. Record 2009/21, Geoscience Australia, Canberra, Australia.

Appendix 1. Bathymetric survey metadata table for Project 3DGBR as of 10 June 2010[a]. See MTSRF Milestone Report dated 31 March 2010 for an explanation of the IHO S44 Order codes.

SURV_CODE	SURVEY_NAME	DATA_TYPE	VESSEL	START_DATE	END_DATE	START_PORT	END_PORT	DATA_OWNER	IHO S44 Order
SS052004	KennPlateau	multibeam	RV Southern Surveyor	3/05/2004	27/05/2004	Sydney	Noumea	GA	Order 1b
SS022005	MellishRise	multibeam	RV Southern Surveyor	25/01/2005	20/02/2005	Bundaberg	Cairns	GA	Order 1b
CRC012004	FitzroyRiver	multibeam	Rum Rambler	20/09/2004	26/09/2004	Gladstone	Gladstone	Coastal CRC	Order 1b
SS012005	FraserIsland	multibeam	RV Southern Surveyor	7/01/2005	23/01/1900	Brisbane	Bundaberg	UNewcastle	Order 1b
WEST05MV	PapeeteBrisbane	multibeam	RV Melville	19/05/1994	25/06/1994	Papeete	Brisbane	SIO	Order 1b
WEST06MV	BrisbaneNukuAlofa	multibeam	RV Melville	30/08/1994	30/09/2004	Brisbane	Nuku'alofa	SIO	Order 1b
EW9202	EW9202	multibeam	RV Ewing	6/03/1992	14/03/1992	Lyttleton	Gladstone	LDEO	Order 1b
EW9203	WoodlarkBasin	multibeam	RV Ewing	17/03/1992	24/04/1992	Gladstone	Papeete	LDEO	Order 1b
BMRG07MV	PortHedlandSuva	multibeam	RV Melville	19/04/1996	3/05/1996	Port Hedland	Suva	SIO	Order 1b
EW0201	HobartGuam	multibeam	RV Ewing	31/01/2002	14/02/2002	Hobart	Apra, Guam	LDEO	Order 1b
TAN0308	NORFANZ	multibeam	RV RV Tangaroa	9/05/2003	7/06/2003	Wellington	Wellington	NIWA	Order 1b
EW9511	SolomonIslands	multibeam	RV Ewing	16/10/1995	18/11/1995	Honiara	Suva	LDEO	Order 1b
EW9911	WoodlarkBasin	multibeam	RV Ewing	18/09/1999	21/10/1999	Lae	Townsville	LDEO	Order 1b
EW9912	NorthAustTropOceans	multibeam	RV Ewing	27/10/1999	28/11/1999	Townsville	Townsville	LDEO	Order 1b
EW9914	LauBasin	multibeam	RV Ewing	2/12/1999	28/12/1999	Townsville	Lyttleton	LDEO	Order 1b
VANC12MV	VANC12	multibeam	RV Melville	6/08/2003	17/08/2003	Darwin	Cairns	SIO	Order 1b
VANC19MV	VANC19	multibeam	RV Melville	8/01/2004	13/01/2004	Cairns	Port Moresby	SIO	Order 1b
VANC23MV	VANC23	multibeam	RV Melville	1/03/2003	9/03/2003	Port Moresby	Cairns	SIO	Order 1b
VANC24MV	VANC24	multibeam	RV Melville	10/03/2004	20/03/2004	Cairns	Port Moresby	SIO	Order 1b
VANC26MV	VANC26	multibeam	RV Melville	2/04/2004	12/04/2004	Port Moresby	Cairns	SIO	Order 1b
VANC27MV	VANC27	multibeam	RV Melville	16/04/2004	22/04/2004	Cairns	Port Moresby	SIO	Order 1b
VANC30MV	VANC30	multibeam	RV Melville	18/05/2004	27/05/2004	Port Moresby	Cairns	SIO	Order 1b
SS062004	COTROVE	multibeam	RV Southern Surveyor	2/06/2004	27/06/2004	Noumea	Sydney	ANU	Order 1b
SS102004	Tonga	multibeam	RV Southern Surveyor	2/10/2004	26/10/2004	Brisbane	Nuku'alofa	UTAS	Order 1b
GATOPAS	TopasTrial	multibeam	RV Southern Surveyor	9/12/2004	10/12/2004	Brisbane	Brisbane	GA	Order 1b
SS092004	SEQueensland	multibeam	RV Southern Surveyor	15/09/2004	30/09/2004	Brisbane	Brisbane	USydney	Order 1b
EW9910	WoodlarkBasin	multibeam	RV Ewing	30/08/1999	15/09/1999	Agana	Lae	LDEO	Order 1b
VANC22MV	VANC22	multibeam	RV Melville	17/02/2004	1/03/2004	Port Moresby	Port Moresby	SIO	Order 1b
VANC25MV	VANC25	multibeam	RV Melville	20/03/2004	2/04/2004	Port Moresby	Port Moresby	SIO	Order 1b
MANAUTE	ManusBasin	multibeam	N.O. L'Atalante	25/03/2000	19/04/2000	Honiara	Darwin	IFREMER	Order 1b
CRC022004	MoretonBay	multibeam	Tom Marshall	29/08/2004	5/09/2004	Brisbane	Brisbane	Coastal CRC	Order 1b
MD148	PECTEN	multibeam	RV Marion Dufresne	12/06/2005	8/07/2005	Bitung	Darwin	USydney/IPEV	Order 1b
MR03K04L1	TropOceanClimate	multibeam	RV Mirai	3/08/2003	5/09/2005	Brisbane	Papeete	JAMSTEC	Order 1b

MR03K03L2	TropOceanClimate	multibeam	RV Mirai	1/07/2003	30/07/2003	Nakagusuku	Brisbane	JAMSTEC	Order 1b
EW0002	WoodlarkBasin	multibeam	RV Maurice Ewing	5/02/2000	28/02/2000	Lyttleton	Suva	LDEO	Order 1b
EW9510	WoodlarkBasin	multibeam	RV Maurice Ewing	28/09/1995	15/10/1995	Kaohsiung	Honiara	LDEO	Order 1b
MD153	AusfairZoNeco12	multibeam	RV Marion Dufresne	8/02/2006	27/02/2006	Auckland	Sydney	IPEV	Order 1b
KM0505	KM0505	multibeam	RV Kilo Moana	24/03/2005	1/04/2005	Brisbane	Pago Pago	SOEST	Order 1b
SST012006	DarwinSuva	multibeam	RV Southern Surveyor	5/08/2006	17/08/2006	Darwin	Suva	GA	Order 1b
SST022006	NoumeaSydney	multibeam	RV Southern Surveyor	11/09/2006	17/09/2006	Noumea	Sydney	UNSW	Order 1b
SO1902007	DarwinWellington	multibeam	RV Sonne	30/12/2006	7/01/2007	Darwin	Wellington	IFM GEOMAR	Order 1b
KM0702	BrisbaneTownsville	multibeam	RV Kilo Moana	11/03/2007	13/03/2007	Brisbane	Townsville	SOEST	Order 1b
TAN0713	LordHoweRise	multibeam	RV Tangaroa	6/10/2007	22/11/2007	Wellington	Wellington	GA	Order 1b
SST062007	MackayNewcastle	multibeam	RV Southern Surveyor	17/10/2007	22/10/2007	Mackay	Newcastle	CMAR	Order 1b
SST042007	DarwinMadang	multibeam	RV Southern Surveyor	15/07/2007	24/07/2007	Darwin	Madang	CSIRO/ANU	Order 1b
SS072007	GBRMargin	multibeam	RV Southern Surveyor	26/09/2007	16/10/2007	Cairns	Mackay	JCU	Order 1b
SST022008	SuvaCairns	multibeam	RV Southern Surveyor	8/06/2008	18/06/2008	Suva	Cairns	CMAR	Order 1b
SS092008	GBRCO2	multibeam	RV Southern Surveyor	24/07/2008	11/08/2008	Cairns	Gladstone	CSIRO-BOM	Order 1b
SST032008	NextWave	multibeam	RV Southern Surveyor	12/08/2008	16/08/2008	Gladstone	Sydney	UTS/UNSW	Order 1b
SS122008	SEAustMargin	multibeam	RV Southern Surveyor	4/11/2008	21/11/2008	Newcastle	Sydney	Uni of Newcastle	Order 1b
MR0707L1	TropOceanClimate	multibeam	RV Mirai	28/12/2007	25/01/2008	Auckland	Nakagusuku	JAMSTEC	Order 1b
SST022009	NoumeaHobart	multibeam	RV Southern Surveyor	30/07/2009	7/08/2009	Noumea	Hobart	CMAR	Order 1b
SO2032009	TownsvillePNG	multibeam	RV Sonne	27/10/2009	29/10/2009	Townsville	PNG	JCU	Order 1b
PPC1	GuamSydney	multibeam	RV Gelendzhik	20/04/2008	23/06/2008	Guam	Sydney	Tyco Telecom	Order 1b
CDC1999	FlindersPass	multibeam	HMAS Leeuwin	9/11/1999	18/11/1999	Cairns	Cairns	AHS	Order 1a
CDC1999	ShrimpReef	multibeam	HMAS Leeuwin	9/11/1999	18/11/1999	Cairns	Cairns	AHS	Order 1a
HI295	LadyElliotIs	multibeam	HMAS Leeuwin	26/06/2000	1/12/2000	Cairns	Cairns	AHS	Order 1a
HI318	LadyElliotIs	multibeam	HMAS Melville	3/07/2000	18/07/2000	Cairns	Cairns	AHS	Order 1a
HI325_B	CapricornGroup	multibeam	HMAS Melville	16/07/2001	10/08/2001	Cairns	Cairns	AHS	Order 1a
HI369	HeraldPatches	multibeam	HMAS Leeuwin	23/06/2003	27/08/2003	Cairns	Cairns	AHS	Order 1a
HI369	HerveyBay	multibeam	HMAS Leeuwin	23/06/2003	27/08/2003	Cairns	Cairns	AHS	Order 1a
HI369_A	FloraPass	multibeam	HMAS Leeuwin	8/05/2003	26/05/2003	Cairns	Cairns	AHS	Order 1a
HI370	HeraldPatches	multibeam	HMAS Melville	22/04/2003	26/04/2003	Cairns	Cairns	AHS	Order 1a
HI370_B	LadyMusgraveIs	multibeam	HMAS Melville	3/07/2003	6/07/2003	Cairns	Cairns	AHS	Order 1a
HI370_C	CapeMoreton	multibeam	HMAS Melville	11/06/2003	11/06/2003	Cairns	Cairns	AHS	Order 1a
HI421	HerveyBay	multibeam	HMAS Melville	16/06/2006	4/08/2006	Hervey Bay	Hervey Bay	AHS	Order 1a
HI427	EmilyReefSMB	multibeam	HMAS Melville SMB	4/11/2006	14/11/2006	Cairns	Cairns	AHS	Order 1a
HI427	FitzroyIsland	multibeam	HMAS Melville	2/11/2006	2/11/2006	Cairns	Cairns	AHS	Order 1a
HI427	Halimeda	multibeam	HMAS Melville	12/11/2006	12/11/2006	Cairns	Cairns	AHS	Order 1a
HI427	HalimedaSMB	multibeam	HMAS Melville SMB	30/11/2006	30/11/2006	Cairns	Cairns	AHS	Order 1a

HI427_B	CapeBedford	multibeam	HMAS Melville	4/11/2006	5/11/2006	Cairns	Cairns	AHS	Order 1a
HI427_D	CruiserPass	multibeam	HMAS Melville	4/11/2006	10/11/2006	Cairns	Cairns	AHS	Order 1a
JK012005	JohnBrewerReef	multibeam	RV James Kirby	1/08/2005	1/08/2005	Townsville	Townsville	JCU	Order 1b
JK012006	OrchardRocks	multibeam	RV James Kirby	4/07/2005	4/07/2005	Townsville	Townsville	JCU	Order 1b
JK022005	BayRock	multibeam	RV James Kirby	13/10/2005	13/10/2005	Townsville	Townsville	JCU	Order 1b
JK022006	KeeperReef	multibeam	RV James Kirby	27/07/2005	27/07/2005	Townsville	Townsville	JCU	Order 1b
JK032005	Ribbon5	multibeam	RV James Kirby	18/12/2005	18/12/2005	Townsville	Townsville	JCU	Order 1b
JK032006	LodestoneReef	multibeam	RV James Kirby	29/07/2005	29/07/2005	Townsville	Townsville	JCU	Order 1b
JK042006	LodestoneChannel	multibeam	RV James Kirby	31/07/2005	31/07/2005	Townsville	Townsville	JCU	Order 1b
LEEUWIN2000	EscapeReef	multibeam	HMAS Leeuwin	21/08/2000	22/08/2000	Cairns	Cairns	AHS	Order 1a
AMSA96_1	OuterGBRRoute	singlebeam	M/V Cape Grafton	28/11/1996	26/01/1997	unknown	unknown	AHS	Order 2
AUSLIG	BaitReef	singlebeam	unknown	unknown	unknown	unknown	unknown	GA	Order 2
AUSLIG	BellCay	singlebeam	unknown	unknown	unknown	unknown	unknown	GA	Order 2
AUSLIG	BowlingGreenBay	singlebeam	unknown	unknown	unknown	unknown	unknown	GA	Order 2
AUSLIG	BushyReef	singlebeam	unknown	unknown	unknown	unknown	unknown	GA	Order 2
AUSLIG	CayleyReef	singlebeam	unknown	unknown	unknown	unknown	unknown	GA	Order 2
AUSLIG	ChauvelReef	singlebeam	unknown	unknown	unknown	unknown	unknown	GA	Order 2
AUSLIG	ChestermanReef	singlebeam	unknown	unknown	unknown	unknown	unknown	GA	Order 2
AUSLIG	ErskineReef	singlebeam	unknown	unknown	unknown	unknown	unknown	GA	Order 2
AUSLIG	FairfaxIsReef	singlebeam	unknown	unknown	unknown	unknown	unknown	GA	Order 2
AUSLIG	HastingsReef	singlebeam	unknown	unknown	unknown	unknown	unknown	GA	Order 2
AUSLIG	HookIsReef	singlebeam	unknown	unknown	unknown	unknown	unknown	GA	Order 2
AUSLIG	IrvingReef	singlebeam	unknown	unknown	unknown	unknown	unknown	GA	Order 2
AUSLIG	JohnBrewerReef	singlebeam	unknown	unknown	unknown	unknown	unknown	GA	Order 2
AUSLIG	KelsoReef	singlebeam	unknown	unknown	unknown	unknown	unknown	GA	Order 2
AUSLIG	LadyElliotIsReef	singlebeam	unknown	unknown	unknown	unknown	unknown	GA	Order 2
AUSLIG	LadyMusgraveIsReef	singlebeam	unknown	unknown	unknown	unknown	unknown	GA	Order 2
AUSLIG	MastHeadIsReef	singlebeam	unknown	unknown	unknown	unknown	unknown	GA	Order 2
AUSLIG	MyrmidonReef	singlebeam	unknown	unknown	unknown	unknown	unknown	GA	Order 2
AUSLIG	NormanReef	singlebeam	unknown	unknown	unknown	unknown	unknown	GA	Order 2
AUSLIG	NorthWestIsReef	singlebeam	unknown	unknown	unknown	unknown	unknown	GA	Order 2
AUSLIG	PandoraReef	singlebeam	unknown	unknown	unknown	unknown	unknown	GA	Order 2
AUSLIG	PeartReef	singlebeam	unknown	unknown	unknown	unknown	unknown	GA	Order 2
AUSLIG	RibReef	singlebeam	unknown	unknown	unknown	unknown	unknown	GA	Order 2
AUSLIG	SandpiperReef	singlebeam	unknown	unknown	unknown	unknown	unknown	GA	Order 2
AUSLIG	SandshoeReef	singlebeam	unknown	unknown	unknown	unknown	unknown	GA	Order 2
AUSLIG	SaxonReef	singlebeam	unknown	unknown	unknown	unknown	unknown	GA	Order 2

AUSLIG	TernReef	singlebeam	unknown	unknown	unknown	unknown	unknown	GA	Order 2
AUSLIG	TileReef	singlebeam	unknown	unknown	unknown	unknown	unknown	GA	Order 2
AUSLIG	UNReef_17_20	singlebeam	unknown	unknown	unknown	unknown	unknown	GA	Order 2
AUSLIG	UNReef_17_21	singlebeam	unknown	unknown	unknown	unknown	unknown	GA	Order 2
AUSLIG	UNReef_20_103	singlebeam	unknown	unknown	unknown	unknown	unknown	GA	Order 2
GBRSeabed	Biodiversity	singlebeam	RV Lady Basten	17/09/2003	28/11/2005	Townsville	Townsville	CSIRO	Order 1b
HI173	NorthWestIs	singlebeam	HMAS Paluma/Mermaid	22/02/1992	4/05/1992	Cairns	Cairns	AHS	Order 1b
HI220_B	CooksPass	singlebeam	HMAS Paluma/Mermaid	2/12/1995	4/12/1995	Cairns	Cairns	AHS	Order 1b
HI230	FraserIs	singlebeam	HMAS Flinders	15/08/1995	24/09/1995	Cairns	Cairns	AHS	Order 1b
HI230	Gladstone	singlebeam	HMAS Flinders	30/07/1995	9/11/1995	Cairns	Cairns	AHS	Order 1b
HI236	TorresStrait	singlebeam	HMAS Paluma/Mermaid	16/10/1995	4/04/1996	Cairns	Cairns	AHS	Order 1b
HI238	FairwayChannel	singlebeam	HMAS Benalla/Shepparton	6/02/1996	24/04/1996	Cairns	Cairns	AHS	Order 1b
HI247	HookIs	singlebeam	HMAS Paluma/Mermaid	10/07/1996	31/08/1996	Cairns	Cairns	AHS	Order 1b
HI252	HayPoint	singlebeam	HMAS Benalla/Shepparton	13/11/1996	29/04/1997	Cairns	Cairns	AHS	Order 1b
HI255	TorresStrait	singlebeam	HMAS Paluma/Mermaid	12/02/1997	29/04/1997	Cairns	Cairns	AHS	Order 1b
HI258_B	CapeFlattery	singlebeam	HMAS Paluma/Mermaid	9/09/1997	9/09/1997	Cairns	Cairns	AHS	Order 1b
HI259_B	GardnerBanks	singlebeam	HMAS Flinders	6/08/1997	15/08/1997	Cairns	Cairns	AHS	Order 1b
HI261	ShoalwaterBay	singlebeam	HMAS Flinders	30/07/1997	26/07/1997	Cairns	Cairns	AHS	Order 1b
HI265	DoubleIs	singlebeam	HMAS Benalla/Shepparton	15/07/1997	5/09/1997	Cairns	Cairns	AHS	Order 1b
HI270	CumberlandChannel	singlebeam	HMAS Benalla/Shepparton	28/01/1998	5/01/1998	Cairns	Cairns	AHS	Order 1b
HI270_A	HydrographersPass	singlebeam	HMAS Benalla/Shepparton	14/02/1998	17/02/1998	Cairns	Cairns	AHS	Order 1b
HI273	FizroyIs	singlebeam	SMB Duyfken	3/02/1998	10/03/1998	Cairns	Cairns	AHS	Order 1b
HI274	FairwayChannel	singlebeam	HMAS Paluma/Mermaid	2/02/1998	23/04/1998	Cairns	Cairns	AHS	Order 1b
HI274_A	BrothersPatches	singlebeam	HMAS Paluma/Mermaid	27/03/1998	29/03/1998	Cairns	Cairns	AHS	Order 1b
HI276_A	FlindersPass	singlebeam	HMAS Flinders	9/04/1998	10/04/1998	Cairns	Cairns	AHS	Order 1b
HI279_A	BoydongCays	singlebeam	HMAS Benalla/Shepparton	29/04/1998	30/04/1998	Cairns	Cairns	AHS	Order 1b
HI282	Gladstone	singlebeam	HMAS Benalla/Shepparton	2/02/1999	23/04/1999	Cairns	Cairns	AHS	Order 1b
HI282_D	Gladstone	singlebeam	HMAS Benalla/Shepparton	12/03/1999	21/04/1999	Cairns	Cairns	AHS	Order 1b
HI286	BlackwoodChannel	singlebeam	HMAS Benalla/Shepparton	10/11/1998	15/12/1998	Cairns	Cairns	AHS	Order 1b
HI288	InnerGBR	singlebeam	HMAS Flinders	10/08/1998	28/08/1998	Cairns	Cairns	AHS	Order 1b
HI293	TorresStrait	singlebeam	HMAS Paluma/Mermaid	29/01/1999	24/04/1999	Cairns	Cairns	AHS	Order 1b
HI294	Cairns	singlebeam	HMAS Paluma/Mermaid	6/07/1999	10/09/1999	Cairns	Cairns	AHS	Order 1b
HI294_B	Cooktown	singlebeam	HMAS Paluma/Mermaid	24/08/1999	3/09/1999	Cairns	Cairns	AHS	Order 1b
HI294_C	PortDouglas	singlebeam	HMAS Paluma/Mermaid	14/07/1999	15/07/1999	Cairns	Cairns	AHS	Order 1b
HI294_D	WhitsundayIs	singlebeam	HMAS Paluma/Mermaid	17/08/1999	3/09/1999	Cairns	Cairns	AHS	Order 1b
HI296_C	CapeMelville	singlebeam	HMAS Benalla/Shepparton	22/06/1999	22/06/1999	Cairns	Cairns	AHS	Order 1b
HI298	PioneerBay	singlebeam	HMAS Benalla/Shepparton	6/03/1999	26/03/1999	Cairns	Cairns	AHS	Order 1b

HI299	Cairns	singlebeam	HMAS Melville LUB	17/03/1999	24/06/1999	Cairns	Cairns	AHS	Order 1b
HI302_EFG	LeeperShoal	singlebeam	HMAS Benalla/Shepparton	10/10/1999	22/10/1999	Cairns	Cairns	AHS	Order 1b
HI302_M	PakhoiBank	singlebeam	HMAS Benalla/Shepparton	14/10/1999	25/10/1999	Cairns	Cairns	AHS	Order 1b
HI302_R	WhitsundayIs	singlebeam	HMAS Benalla/Shepparton	1/10/1999	3/10/1999	Cairns	Cairns	AHS	Order 1b
HI302_V	WhitsundayIs	singlebeam	HMAS Benalla/Shepparton	23/10/1999	24/10/1999	Cairns	Cairns	AHS	Order 1b
HI302_W	WhitsundayIs	singlebeam	HMAS Benalla/Shepparton	24/10/1999	25/10/1999	Cairns	Cairns	AHS	Order 1b
HI302_Z	WhitsundayIs	singlebeam	HMAS Benalla/Shepparton	20/09/1999	20/09/1999	Cairns	Cairns	AHS	Order 1b
HI305	LloydBay	singlebeam	HMAS Paluma/Mermaid	31/01/2000	18/01/2000	Cairns	Cairns	AHS	Order 1b
HI311_A	CapeMelville	singlebeam	HMAS Benalla/Shepparton	1/03/2000	1/03/2000	Cairns	Cairns	AHS	Order 1b
HI311_B	PiponIs	singlebeam	HMAS Benalla/Shepparton	16/05/2000	16/05/2000	Cairns	Cairns	AHS	Order 1b
HI316	RockinghamBay	singlebeam	HMAS Paluma/Mermaid	31/07/2000	8/09/2000	Cairns	Cairns	AHS	Order 1b
HI316_M	MourilyanHarbour	singlebeam	HMAS Paluma/Mermaid	7/09/2000	7/09/2000	Cairns	Cairns	AHS	Order 1b
HI316_T	FitzroyIs	singlebeam	HMAS Paluma/Mermaid	31/07/2000	31/07/2000	Cairns	Cairns	AHS	Order 1b
HI317	FrederickPatches	singlebeam	HMAS Benalla/Shepparton	14/08/2000	20/08/2000	Cairns	Cairns	AHS	Order 1b
HI325_A	GreatKeppelIs	singlebeam	HMAS Leeuwin SMB	5/04/2001	20/05/2001	Cairns	Cairns	AHS	Order 1b
HI327_C	PortDouglas	singlebeam	HMAS Paluma/Mermaid	26/03/2001	6/04/2001	Cairns	Cairns	AHS	Order 1b
HI334_A	CameronShoal	singlebeam	HMAS Paluma/Mermaid	7/06/2001	8/06/2001	Cairns	Cairns	AHS	Order 1b
HI334_B	LloydBay	singlebeam	HMAS Paluma/Mermaid	8/06/2001	8/06/2001	Cairns	Cairns	AHS	Order 1b
HI334_C	PiponIs	singlebeam	HMAS Paluma/Mermaid	7/06/2001	7/06/2001	Cairns	Cairns	AHS	Order 1b
HI337_E	BouganvilleReef	singlebeam	HMAS Benalla/Shepparton	9/10/2001	10/10/2001	Cairns	Cairns	AHS	Order 2
HI337_F	VigiaShoal	singlebeam	HMAS Benalla/Shepparton	13/10/2001	13/10/2001	Cairns	Cairns	AHS	Order 2
HI337_K	VigiaShoal	singlebeam	HMAS Benalla/Shepparton	25/10/2001	26/10/2001	Cairns	Cairns	AHS	Order 2
HI342_A	MiddleIs	singlebeam	HMAS Paluma/Mermaid	16/10/2001	25/10/2001	Cairns	Cairns	AHS	Order 1b
HI342_B	CapeEdgecumbe	singlebeam	HMAS Paluma/Mermaid	26/11/2001	26/11/2001	Cairns	Cairns	AHS	Order 1b
HI342_Z	06mShoal	singlebeam	HMAS Paluma/Mermaid	30/10/2001	12/11/2001	Cairns	Cairns	AHS	Order 1b
HI346	CowleyBeach	singlebeam	HS White	6/02/2002	7/02/2002	Cairns	Cairns	AHS	Order 1b
HI347_A	SmithsCreek	singlebeam	HMAS Leeuwin LUB	15/01/2001	22/01/2001	Cairns	Cairns	AHS	Order 1b
HI347_B	SmithsCreek	singlebeam	HMAS Leeuwin LUB	23/08/2001	27/08/2001	Cairns	Cairns	AHS	Order 1b
HI350	KeswickIs	singlebeam	HMAS Paluma/Mermaid	8/10/2001	28/11/2001	Cairns	Cairns	AHS	Order 1b
HI352	DecapolisReef	singlebeam	HMAS Benalla/Shepparton	16/02/2002	14/02/2002	Cairns	Cairns	AHS	Order 1b
HI355	Gladstone	singlebeam	HMAS Paluma/Mermaid	20/05/2002	1/07/2002	Cairns	Cairns	AHS	Order 1b
HI355_A	DunkIs	singlebeam	HMAS Paluma/Mermaid	20/05/2002	21/05/2002	Cairns	Cairns	AHS	Order 1b
HI355_B	CapeCapricorn	singlebeam	HMAS Paluma/Mermaid	8/06/2002	8/06/2002	Cairns	Cairns	AHS	Order 1b
HI355_Y	ParkerReef	singlebeam	HMAS Paluma/Mermaid	22/05/2002	22/05/2002	Cairns	Cairns	AHS	Order 1b
HI355_Z	HydroPass	singlebeam	HMAS Paluma/Mermaid	22/05/2002	22/05/2002	Cairns	Cairns	AHS	Order 1b
HI362	TorresStrait	singlebeam	HMAS Benalla/Shepparton	8/10/2002	12/12/2002	Cairns	Cairns	AHS	Order 1b
HI366	ShoalwaterBay	singlebeam	HODSU LUB	18/11/2002	12/12/2002	unknown	unknown	AHS	Order 1b

HI371	Gladstone	singlebeam	HMAS Melville	10/09/2003	11/09/2003	Cairns	Cairns	AHS	Order 1b
HI371_A	TrinityInlet	singlebeam	SMB Geographe	6/08/2003	17/08/2003	Cairns	Cairns	AHS	Order 1b
HI375_C	Gladstone	singlebeam	HMAS Paluma/Mermaid	12/07/2003	12/07/2003	Cairns	Cairns	AHS	Order 1b
HI376	ShoalwaterBay	singlebeam	HMAS Benalla/Shepparton	18/08/2003	2/10/2003	Cairns	Cairns	AHS	Order 1b
HI376_A	MoretonBay	singlebeam	HMAS Benalla/Shepparton	14/09/2003	15/09/2003	Cairns	Cairns	AHS	Order 1b
HI377	HeathReef	singlebeam	HMAS Paluma/Mermaid	8/09/2003	20/11/2003	Cairns	Cairns	AHS	Order 1b
HI379_A	ChevoitIs	singlebeam	HMAS Melville	7/11/2003	7/11/2003	Cairns	Cairns	AHS	Order 1b
HI383_B	CapeDirection	singlebeam	HMAS Benalla/Shepparton	25/04/2004	25/04/2004	Cairns	Cairns	AHS	Order 1b
HI384_A	ScottReef	singlebeam	HMAS Melville	4/04/2004	4/04/2004	Cairns	Cairns	AHS	Order 1b
HI391_A	CapeDirection	singlebeam	HMAS Benalla/Shepparton	22/07/2004	22/07/2004	Cairns	Cairns	AHS	Order 1b
HI398	CowleyBeach	singlebeam	HMAS Kanimbla zodiac	17/05/2004	19/05/2004	Cairns	Cairns	AHS	Order 1b
HI401_D	CalderBank	singlebeam	HMAS Melville	1/04/2005	1/04/2005	Cairns	Cairns	AHS	Order 2
HI427_D	CruiserPass	singlebeam	HMAS Melville	10/11/2006	10/11/2006	Cairns	Cairns	AHS	Order 1b
MSQ	Cairns	singlebeam	unknown	unknown	unknown	unknown	unknown	MSQ	Order 1b
MSQ	Cooktown	singlebeam	unknown	unknown	unknown	unknown	unknown	MSQ	Order 1b
MSQ	Gladstone	singlebeam	unknown	unknown	unknown	unknown	unknown	MSQ	Order 1b
MSQ	GreatSandyStrait	singlebeam	unknown	unknown	unknown	unknown	unknown	MSQ	Order 1b
MSQ	MoretonBay	singlebeam	unknown	unknown	unknown	unknown	unknown	MSQ	Order 1b
MSQ	MourilyanHarbour	singlebeam	unknown	unknown	unknown	unknown	unknown	MSQ	Order 1b
MSQ	SunshineCoast	singlebeam	unknown	unknown	unknown	unknown	unknown	MSQ	Order 1b
PortCairns	TrinityBay	singlebeam	Tribulation/Nyleta	unknown	unknown	Cairns	Cairns	Ports North	Special Order
PortTownsville	ClevelandBay	singlebeam	Seahawk/Brolga	unknown	unknown	Townsville	Townsville	Port of Townsville	Special Order
SD100001221	AshmoreReef	singlebeam	unknown	unknown	1/02/1991	unknown	unknown	AHS	Order 2
SD100001822	DianeBank	singlebeam	unknown	unknown	3/08/1982	unknown	unknown	AHS	Order 2
SD100006328	Rockhampton	singlebeam	unknown	unknown	20/05/1982	unknown	unknown	AHS	Order 2
SD100006329	Rockhampton	singlebeam	unknown	unknown	20/05/1982	unknown	unknown	AHS	Order 2
SD100011744	WideBay	singlebeam	unknown	1/11/1971	4/12/1971	unknown	unknown	AHS	Order 2
SD100012326	WideBay	singlebeam	unknown	1/11/1971	4/12/1971	unknown	unknown	AHS	Order 2
SD100012327	WideBay	singlebeam	unknown	1/11/1971	4/12/1971	unknown	unknown	AHS	Order 2
SD100012328	WideBay	singlebeam	unknown	1/11/1971	4/12/1971	unknown	unknown	AHS	Order 2
SD100012329	BarwonBank	singlebeam	unknown	3/08/1971	18/10/1971	unknown	unknown	AHS	Order 2
SD100012330	BarwonBank	singlebeam	unknown	3/08/1971	18/10/1971	unknown	unknown	AHS	Order 2
SD100012331	BarwonBank	singlebeam	unknown	3/08/1971	18/10/1971	unknown	unknown	AHS	Order 2
SD100012332	Caloundra	singlebeam	unknown	3/08/1971	18/10/1971	unknown	unknown	AHS	Order 2
SD100012333	Brisbane	singlebeam	unknown	3/08/1971	18/10/1971	unknown	unknown	AHS	Order 2
SD100012334	Brisbane	singlebeam	unknown	3/08/1971	18/10/1971	unknown	unknown	AHS	Order 2
SD100012335	Brisbane	singlebeam	unknown	3/08/1971	18/10/1971	unknown	unknown	AHS	Order 2

SD100012336	Brisbane	singlebeam	unknown	3/08/1971	18/10/1971	unknown	unknown	AHS	Order 2
SD100012351	Coolangatta	singlebeam	unknown	3/08/1971	18/10/1971	unknown	unknown	AHS	Order 2
SD100012354	Coolangatta	singlebeam	unknown	3/08/1971	18/10/1971	unknown	unknown	AHS	Order 2
SD100016492	AshmoreReef	singlebeam	unknown	unknown	31/10/1991	unknown	unknown	AHS	Order 2
SD100016554	OrfordBay	singlebeam	unknown	unknown	23/05/1988	unknown	unknown	AHS	Order 2
SD100016569	CapeWeymouth	singlebeam	unknown	unknown	23/05/1988	unknown	unknown	AHS	Order 2
SD100016574	Ebagoola	singlebeam	unknown	unknown	28/06/1990	unknown	unknown	AHS	Order 2
SD100016578	TydemanReef	singlebeam	unknown	unknown	14/11/1991	unknown	unknown	AHS	Order 2
SD100016579	CapeMelville	singlebeam	unknown	unknown	27/03/1991	unknown	unknown	AHS	Order 2
SD100016580	RibbonReef	singlebeam	unknown	unknown	28/03/1991	unknown	unknown	AHS	Order 2
SD100016580	OspreyReef	singlebeam	unknown	unknown	28/03/1991	unknown	unknown	AHS	Order 2
SD100016581	BouganvilleReef	singlebeam	unknown	unknown	24/08/1990	unknown	unknown	AHS	Order 2
SD100016585	Cairns	singlebeam	unknown	unknown	20/06/1990	unknown	unknown	AHS	Order 2
SD100016586	HolmesReef	singlebeam	unknown	unknown	26/03/1991	unknown	unknown	AHS	Order 2
SD100016587	HeraldCays	singlebeam	unknown	unknown	26/03/1991	unknown	unknown	AHS	Order 2
SD100016588	MossReef	singlebeam	unknown	unknown	unknown	unknown	unknown	AHS	Order 2
SD100016589	PotterReef	singlebeam	unknown	unknown	unknown	unknown	unknown	AHS	Order 2
SD100016590	WardleReef	singlebeam	unknown	unknown	unknown	unknown	unknown	AHS	Order 2
SD100016591	DartReef	singlebeam	unknown	unknown	14/11/1991	unknown	unknown	AHS	Order 2
SD100016592	Ingham	singlebeam	unknown	unknown	2/03/1983	unknown	unknown	AHS	Order 2
SD100016594	AbingtonReef	singlebeam	unknown	unknown	29/03/1985	unknown	unknown	AHS	Order 2
SD100016595	Townsville	singlebeam	unknown	unknown	21/09/1984	unknown	unknown	AHS	Order 2
SD100016596	Ayr	singlebeam	unknown	unknown	9/10/1986	unknown	unknown	AHS	Order 2
SD100017140	MagdelaineCay	singlebeam	unknown	unknown	26/03/1991	unknown	unknown	AHS	Order 2
SD100017141	DiamondIslets	singlebeam	unknown	unknown	31/01/1991	unknown	unknown	AHS	Order 2
SD100017142	LihouReef	singlebeam	unknown	unknown	31/01/1991	unknown	unknown	AHS	Order 2
SD100017143	OomReef	singlebeam	unknown	unknown	10/12/1990	unknown	unknown	AHS	Order 2
SD100017144	Proserpine	singlebeam	unknown	unknown	unknown	unknown	unknown	AHS	Order 2
SD100017145	Mackay	singlebeam	unknown	unknown	17/10/1984	unknown	unknown	AHS	Order 2
SD100017146	SouthhamptonReef	singlebeam	unknown	unknown	21/01/1991	unknown	unknown	AHS	Order 2
SD100017147	PercyIsles	singlebeam	unknown	unknown	6/03/1990	unknown	unknown	AHS	Order 2
SD100017149	Capricorn	singlebeam	unknown	unknown	1/01/1987	unknown	unknown	AHS	Order 2
SD100017154	Bundaberg	singlebeam	unknown	unknown	20/05/1986	unknown	unknown	AHS	Order 2
SD100021007	SandyCape	singlebeam	unknown	unknown	unknown	unknown	unknown	AHS	Order 2
SD100022582	MagneticPass	singlebeam	unknown	unknown	21/09/1984	unknown	unknown	AHS	Order 2
SD100022584	GouldReef	singlebeam	unknown	unknown	29/04/1987	unknown	unknown	AHS	Order 2
SD100025560	MalayReef	singlebeam	unknown	unknown	14/11/1991	unknown	unknown	AHS	Order 2

UE012006	OspreyReef	singlebeam	M/V Undersea Explorer	28/05/2006	13/04/2008	Port Douglas	Port Douglas	JCU	Order 2
HI185	FlindersPass	lidar	LADS	7/03/1993	2/12/1993	Cairns	Cairns	AHS	Order 1a
HI193	MidCapeYork	lidar	LADS	2/11/1993	2/12/1994	Cairns	Cairns	AHS	Order 1a
HI193_AT	Pandora	lidar	LADS	26/05/1994	3/06/1994	Cairns	Cairns	AHS	Order 1a
HI199	CapricornGroup	lidar	LADS	24/01/1994	31/03/1994	Cairns	Cairns	AHS	Order 1a
HI206	TorresStrait	lidar	LADS	6/05/1994	1/12/1994	Cairns	Cairns	AHS	Order 1a
HI220	SthRibbons	lidar	LADS	27/04/1995	27/04/1996	Cairns	Cairns	AHS	Order 1a
HI220_3	StCrispinReef	lidar	LADS	26/11/1996	11/12/1996	Cairns	Cairns	AHS	Order 1a
HI221	NthCapeYork	lidar	LADS	15/05/1995	8/12/1995	Cairns	Cairns	AHS	Order 1a
HI221_1	MidCapeYork	lidar	LADS	2/05/1995	15/05/1995	Cairns	Cairns	AHS	Order 1a
HI221_2	MidCapeYork	lidar	LADS	2/05/1995	15/06/1995	Cairns	Cairns	AHS	Order 1a
HI221_9	MidCapeYork	lidar	LADS	29/10/1996	29/10/1996	Cairns	Cairns	AHS	Order 1a
HI241	MidEastRibbons	lidar	LADS	27/04/1995	27/04/1996	Cairns	Cairns	AHS	Order 1a
HI245	CoringaIslets	lidar	LADS	29/03/1996	13/03/1997	Cairns	Cairns	AHS	Order 1a
HI245_2	HolmesReefs	lidar	LADS	29/03/1996	13/03/1997	Cairns	Cairns	AHS	Order 1a
HI245_3	OspreyReef	lidar	LADS	29/03/1996	13/03/1997	Cairns	Cairns	AHS	Order 1a
HI245_3	SharkVemaReefs	lidar	LADS	29/03/1996	13/03/1997	Cairns	Cairns	AHS	Order 1a
HI245_4	FloraReef	lidar	LADS	16/07/1997	15/09/1999	Cairns	Cairns	AHS	Order 1a
Hi245_4	McDermottBank	lidar	LADS	16/07/1997	15/09/1999	Cairns	Cairns	AHS	Order 1a
HI245_6	MarionReef	lidar	LADS	4/08/1997	19/03/1998	Cairns	Cairns	AHS	Order 1a
HI258_5	YuleEntrance	lidar	LADS	12/08/1997	8/12/1999	Cairns	Cairns	AHS	Order 1a
HI258_6	LihouReef	lidar	LADS	4/03/1998	8/03/1999	Cairns	Cairns	AHS	Order 1a
HI258_7	YuleEntrance	lidar	LADS	10/08/2000	7/05/2002	Cairns	Cairns	AHS	Order 1a
HI263	NthRibbons	lidar	LADS	17/02/1997	12/03/1998	Cairns	Cairns	AHS	Order 1a
HI275	SthCapeYork	lidar	LADS	9/02/1998	2/12/1998	Cairns	Cairns	AHS	Order 1a
HI276	LizardIs	lidar	LADS	6/07/1998	16/07/1998	Cairns	Cairns	AHS	Order 1a
HI285_1	SimReef	lidar	LADS	19/10/1999	19/11/1999	Cairns	Cairns	AHS	Order 1a
HI285_3	GreatDetachedReef	lidar	LADS	19/05/1999	9/12/1999	Cairns	Cairns	AHS	Order 1a
HI285_4	JukesReef	lidar	LADS	11/08/2000	18/09/2000	Cairns	Cairns	AHS	Order 1a
HI285_5	AshmoreReef	lidar	LADS	21/06/1999	2/11/2000	Cairns	Cairns	AHS	Order 1a
HI285_N	BlackwoodChannel	lidar	LADS	13/07/1999	23/11/2000	Cairns	Cairns	AHS	Order 1a
HI285_TP	GreatDetachedReef	lidar	LADS	31/08/1999	15/12/1999	Cairns	Cairns	AHS	Order 1a
HI323	MidWestRibbons	lidar	LADS	24/08/2000	30/11/2000	Cairns	Cairns	AHS	Order 1a
HI328	SwainReefs	lidar	LADS	6/12/2000	1/11/2001	Cairns	Cairns	AHS	Order 1a
HI328	MoretonBay	lidar	LADS	26/09/2002	27/09/2002	Cairns	Cairns	AHS	Order 1a
HI328_1	SwainReefs	lidar	LADS	25/10/2001	26/11/2002	Cairns	Cairns	AHS	Order 1a
HI328_2	SwainReefs	lidar	LADS	11/07/2002	22/07/2003	Cairns	Cairns	AHS	Order 1a

HI328_A	NogginPass	lidar	LADS	17/08/2001	12/12/2001	Cairns	Cairns	AHS	Order 1a
HI328_C	WarlandReef	lidar	LADS	29/07/2003	18/10/2003	Cairns	Cairns	AHS	Order 1a
HI328_D	LaunchRocks	lidar	LADS	17/02/2004	17/02/2004	Cairns	Cairns	AHS	Order 1a
HI328_E	OwensShoal	lidar	LADS	26/02/2004	27/02/2004	Cairns	Cairns	AHS	Order 1a
HI344_A	CowleyBeach	lidar	LADS	3/05/2001	4/05/2001	Cairns	Cairns	AHS	Order 1a
HI344_B	PearlBay	lidar	LADS	9/05/2001	9/05/2001	Cairns	Cairns	AHS	Order 1a
HI344_C	FreshwaterBay	lidar	LADS	1/04/2001	1/05/2001	Cairns	Cairns	AHS	Order 1a
HI348	OlindaEntrance	lidar	LADS	16/10/2001	22/11/2002	Cairns	Cairns	AHS	Order 1a
HI357	GeraniumPass	lidar	LADS	8/03/2002	5/09/2003	Cairns	Cairns	AHS	Order 1a
HI357_1	MorrisIs	lidar	LADS	28/02/2002	28/02/2002	Cairns	Cairns	AHS	Order 1a
HI357_2	SalamanderReef	lidar	LADS	19/05/2003	19/05/2003	Cairns	Cairns	AHS	Order 1a
HI381_1	WillisIslets	lidar	LADS	3/02/2004	13/07/2004	Cairns	Cairns	AHS	Order 1a
LADS012008	MooreReef	lidar	LADS	13/03/2009	18/03/2009	Cairns	Cairns	AHS	Order 1a
SRAT153	MooreReefs	lidar	LADS	23/03/2009	30/03/2009	Cairns	Cairns	AHS	Order 1a
ALOS	CentralGBR	satellite	ALOS	unknown	unknown	NA	NA	GA	Order 2

[a]GA = Geoscience Australia; CRC = Cooperative Research Centre; SIO = Scripps Institute of Oceanography; LDEO = Lamont-Doherty Earth Observatory; ANU = Australian National University; UTAS = University of Tasmania; IFREMER = Institut français de recherche pour l'exploitation de la mer; IPEV = L'Institut polaire français Paul-Emile Victor; JAMSTEC = Japan Agency for Marine-Earth Science and Technology; SOEST = School of Ocean and Earth Science and Technology; UNSW = University of New South Wales; IFM GEOMAR = Leibniz Institute of Marine Sciences; CSIRO = Commonwealth Scientific and Research Organization; CMAR = CSIRO Marine and Atmospheric Research; BOM = Bureau of Meterology; JCU = James Cook University; UTS = University of Technology Sydney; AHS = Australian Hydrographic Service.