AUSSEABED: A NATIONAL PROGRAM OF COLLABORATION TO MAXIMISE AUSTRALIA'S SEABED MAPPING EFFORTS

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SEABED DATA ARE FUNDAMENTAL FOR AUSTRALIA

High quality seabed data are fundamental to a wide range of engineering, management and science research applications stretching from shallow-water coastal environments, across the shelf and out on to the abyssal sea floor. Coastal applications require high-resolution, quality bathymetry data to support models for understanding currents and waves, sediment transport and erosion, hazard and risk assessment as well as ensuring safe navigation and informing development associated with infrastructure and commercial projects. Combined with other seabed data types, the information supports research around changing climate and marine biodiversity and provides development opportunities associated with energy and food production in support of the Blue Economy.

Australia's marine jurisdiction, including the Antarctic territory, covers over 10 million square kilometers. A 2021 economic analysis indicated that bathymetry data used operationally added $16 Bn of value and 93,000 jobs to the Australian Economy[1]. This value is largely attributed to coastal activities including tourism, defence, water transport and fishing. Additionally, bathymetry data is fundamental to protecting and managing Australia's oceans and coasts which by 2025 will provide an estimated $25 Bn worth of ecosystem services, such as carbon dioxide absorption, nutrient cycling, and coastal protection.

Australian citizens also identify strong value and connection to the coastline and seabed. First Nations Australians have a deep cultural and spiritual connection to Sea Country[2]. They have cared for Sea Country for thousands of years and they hold tremendous knowledge of the coastal zone. Their ancestors have preserved knowledge on what is now the seafloor through ancient song lines formed on lived experiences. For the wider Australian community, the coastal ocean holds societal value that cannot be ignored, with 85% of Australians living within 50 km of the ocean, relying on it for recreational and lifestyle benefits[3].

Despite this value, only 12.5% of the coastal zone (< 500 m) is mapped with high-resolution bathymetry (based on AusSeabed Data Hub holdings[4], freely available to download and use via the AusSeabed Data Portal). Working with these bathymetry data sets can be difficult for users, as they need to be compiled into a single gridded product for ingestion into models; a process which requires a high level of technical skill and understanding. Additionally, more bathymetry data exists but is fragmented across institutional data holdings which are yet to be consolidated into an open-access, national data collection. This issue was recognized in the National Marine Science Plan[5] for 2015-2025 which identifies bathymetry data as a priority knowledge gap and its collection as fundamental for adequate management of Australia's marine estate.

To close the gap and unlock seabed data for coastal applications, targeted acquisition efforts, nationally integrated open access data holdings and new tools enabling easier gridding capabilities are essential.

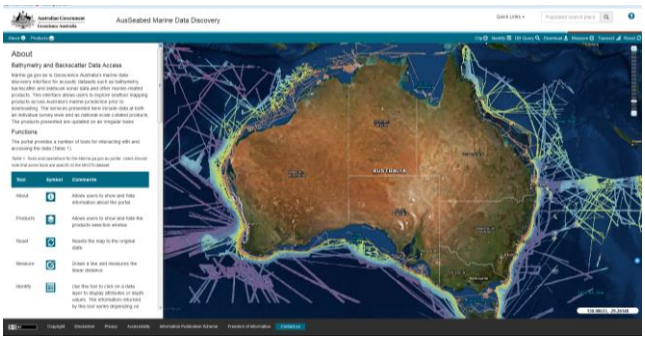

Figure 1. The AusSeabed Data Discovery Portal for public access to the national bathymetry and seabed mapping data archive.

THE SEABED INFORMATION ECOSYSTEM

Data underpins the end-to-end capability for seabed mapping activities; from planning new acquisition to delivering derived products to users. At the national scale, a range of organizations, institutions and programs are committed to understanding the Australian marine environment by mapping the seabed and providing open data to the community. Those involved currently perform multiple functions, such as data capture, management, and analyses, to build knowledge and capacity related to the seabed environment (Table 1).

While seabed mapping surveys have historically focused on bathymetry, the collection of seabed and water-column backscatter, as well as other data (sediment samples, sub-bottom profiles) is important so that acquisition benefits a broader range of users to provide for a wider range of applications.

Table 1. Functions undertaken by national entities and program operating within the Australian seabed data community.

Function	Description
Survey Collaboration	Facilitates survey collaboration by connecting users with similar interests or enabling resource sharing.
Data Capture	Conducts surveys and collects primary sea floor and/or water column data directly.
Data Processing	Processes raw data for various applications.
Community Data Collation and Management	Holds an organised store of data products from third parties and actively manages the growth and distribution.
Open Data Delivery	Provides data products for use under creative commons license.
Product development for users	Provides data tools, visualisations, and high-level products suitable for decision making.

THE AUSSEABED PROGRAM

Until recently, there has been limited coordination of seabed mapping activities within Australia. This has resulted in duplication of effort, lack of consistency, loss of efficiency and limited use of data by users. To address these issues and contribute to the international effort to map the global ocean (GEBCO 2030), AusSeabed, a National Seabed Mapping Coordination Program, was initiated by Geoscience Australia in 2018. Twenty-eight organizations actively participate in the program by co-investing, contributing to program activities, sharing resources, and collaborating to solve common problems.

The AusSeabed mission is to 'Improve the awareness, coverage, quality, accessibility and usability of seabed mapping products in the Australian region through coordination, collaboration, and innovation.' Driven by the principle 'collect once, use many times', AusSeabed aims to collate and liberate seabed data that are underpinned by quality standards. The program aims to deliver new products through a federated data platform, to increase data coverage by breaking data silos and supporting coordinated acquisition, and to raise awareness of the value of seabed mapping to the Australian community.

The vision is that seabed mapping products within the Australian region are readily and openly available, widely understood, and easily used. The Australian seabed information ecosystem delivers maximum benefits to Australian Governments and users, supporting sustainable use of the marine environment and growth of the Blue Economy. This vision will facilitate collaborations between government, research institutions and the private sector to drive innovation for the benefit of the nation.

To this end, AusSeabed plays a niche role within the Australian seabed information ecosystem. The program operates to:

- connect stakeholders across all sectors, and support complementary initiatives
- liberate seabed data and products for users
- guide the sector towards quality standards and consistency
- raise awareness of the importance of seabed mapping in the wider community

By functioning within these bounds, AusSeabed aims to achieve three key outcomes:

1) Coordinated seabed mapping activities across Australian Governments and the marine community to reduce duplication of effort
2) Improved quality of data acquisition through the adoption of common standards and tools
3) Seabed mapping products support improved decision making within Australian Governments and the community

With this AusSeabed Strategy, a cohesive community has been formed who can work together towards achieving a mapped and accessible Australian seabed.

SEABED DATA COVERAGE

AusSeabed aims to ensure that seabed data coverage in the Australian region provides maximum benefit to users. This includes describing legacy data holdings, enabling stakeholders to shape new coverage, increasing seabed mapping capability, and ensuring quality standards are applied. The coordination of organizational activities in this space is imperative to minimize effort and deliver increased seabed data coverage efficiently.

The Australian government invests significantly in seabed mapping capability to gather new seabed data. This includes through the RV Investigator and the icebreaker RV Nuyina as national facilities. These vessels have both shallow and deep water multibeam capabilities and actively collect data while undertaking scientific programs and during transits, progressively building across gaps in national coverage particularly on the continental slope and deeper waters. Generally, however, our nation's access to smaller dedicated coastal research and survey vessels with shallow water (<200 m) mapping capabilities are limited. An increase in near-shore airborne LiDAR surveys is starting to help fill these gaps, however institutions struggle to gain funds for these surveys. Shallow water mapping was identified as a gap in our national capability within the National Marine Science Plan[5]. Without which we are limited in our ability to fully characterize the large unmapped areas over the continental shelf particularly across northern Australia and the Great Australian Bight.

To start filling some of the major gaps in coverage within shelf waters, the Commonwealth government initiated the HydroScheme Industry Partnership Program (HIPP) in 2020

to undertake the acquisition of hydrographic data for unmapped and high-risk areas of national significance. The program, managed by the Australian Hydrographic Office (AHO) provides an annual allocation of funds, with areas for mapping prioritized based on a risk assessment of incomplete areas and submissions from government and industry with specified criteria and a sound business case. Surveys are then tendered for by pre-qualified industry partners for completion under contract within a 12-month period. These surveys are multi-use, providing not just hydrographic information for safety of navigation but also systematically acquiring backscatter and sediment samples for seabed characterization and validation.

To co-ordinate priorities on national acquisition activities and maximize national benefit, AusSeabed and the National Environmental Science Program recently developed the National Areas of Interest Tool through consultation with stakeholders from across the seabed community. The tool works within a GIS-framework allowing users to actively map areas to a geodatabase and provide background metadata information to support collaboration and coordination across seabed data acquisition. These priority areas can be used to support business cases for proposed activities and will be considered by the HIPP when undertaking its annual planning.

SEABED DATA AND PRODUCTS

AusSeabed is striving to ensure that all seabed mapping data and products in the Australian region are guided by F.A.I.R. principles (findable, accessible, interoperable, and reusable) and meet the needs of users. In addition to data curation, AusSeabed are working to user needs with the development of tools to improve data collection and uptake including a data quality assurance tool (known as QAX), user customized gridding capability, a morphology classification tool, and data visualization through the Data Portal. Most notably for coastal applications, a 12-month pilot project co-funded by the Australian Research Data Council to enable user customized gridding capability has recently been completed and will become operational in the next 1-2 years.

Currently, the AusSeabed program is focused on developing a federated Data Hub, a distributed cloud-based infrastructure to enable the discoverability and accessibility of consistent quality-controlled data. All data and products available via the Data Hub are accessible under creative commons licensing, enabling full access to all users. Most of the data holdings within the AusSeabed Data Hub are bathymetry data, with efforts being made to expand to holdings on sediment samples, sub-bottom profiles, and water-column backscatter data. AusSeabed also seeks to value add to traditional data delivery by providing derived products including geomorphological classifications of seabed features.

To date, AusSeabed community members have provided archives of existing data coverage, posting completed surveys as well as their plans for upcoming ones. Additional capabilities for data submissions into the AusSeabed Data Hub are currently under development, including persistent connections to larger archives that will connect directly to data providing institutions and share coverages and/or data through live links. The Australian Hydrographic Office, Australian Antarctic Division, Marine National Facility and Western Australia's Department of Transport will trail these connections in 2022-2023, paving the way for more organizations to plug-in to the national initiative.

RAISING AWARENESS

AusSeabed aims to ensure that seabed mapping and AusSeabed is widely understood, valued, and used across Australian Governments and the community. This is only possible by fostering an inclusive, connected, and informed community. The program also works to support training programs to increase capacity, including the S-5B Hydrographic Surveyor qualification, and supporting new capability through innovation and emerging technologies.

An innovative Citizen Science program underway at James Cook University in Queensland is using reef charter vessels to collect quality-controlled single-beam bathymetry. The data have been filling gaps and identifying previously unmapped features and improving coverage and the digital elevation model for these sections of the reef. GEBCO are now also supporting this initiative by offering additional loggers for registered users to further acquire data and help map the gaps to 2030.

Promoting the uptake of AusSeabed products, tools, guidelines, and standards is a community effort. Fostering institutional change requires targeted communication and outreach from both within organizations and across the wider community. Outreach champions lead this effort within AusSeabed, collaborating with the Steering Committee to develop strategies to ensure program uptake and encourage the breakdown of data silos.

CONCLUSION

AusSeabed is optimizing seabed mapping resources for the nation's benefit through collaboration, coordination, and innovation by working to achieve three strategic goals centered around products, coverage, and awareness. AusSeabed is a valuable program for coastal applications for which seabed data is foundational. The inclusive program seeks active engagement, feedback and input from users and stakeholders to achieve these goals, inviting new initiatives from the community.

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