Capacity Building for coastal mapping and monitoring with Satellite-Derived Bathymetry

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Defintion

“Satellite-Derived Bathymetry (SDB) is the calculation of shallow water depth from active or passive satellite sensors.”

IHO publication B-13

International Hydrographic Organization

Satellite-Derived Bathymetry

Common questions on Satellite-Derived Bathymetry

- Will it replace acoustic surveys?
- Does is align to Order 1a?
- How deep can I map?
- Can I use SDB for charting?
- Can it be applied to riverbeds?
- What are characteristics of different SDB solutions?
- Are all satellite sensors the same?

…

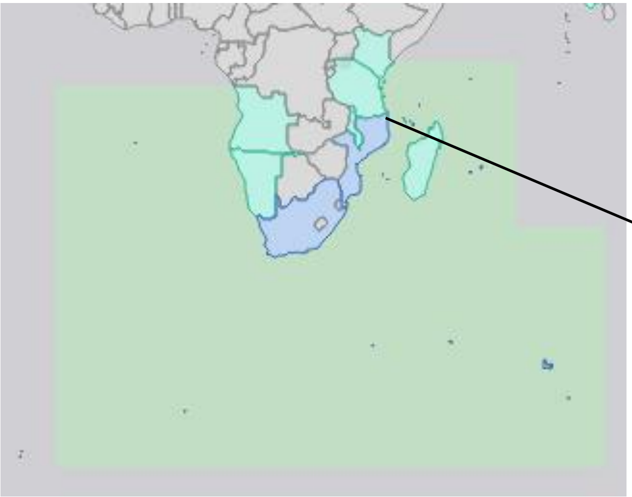
Satellite-Derived Bathymetry (SDB) – General benefits and expectations

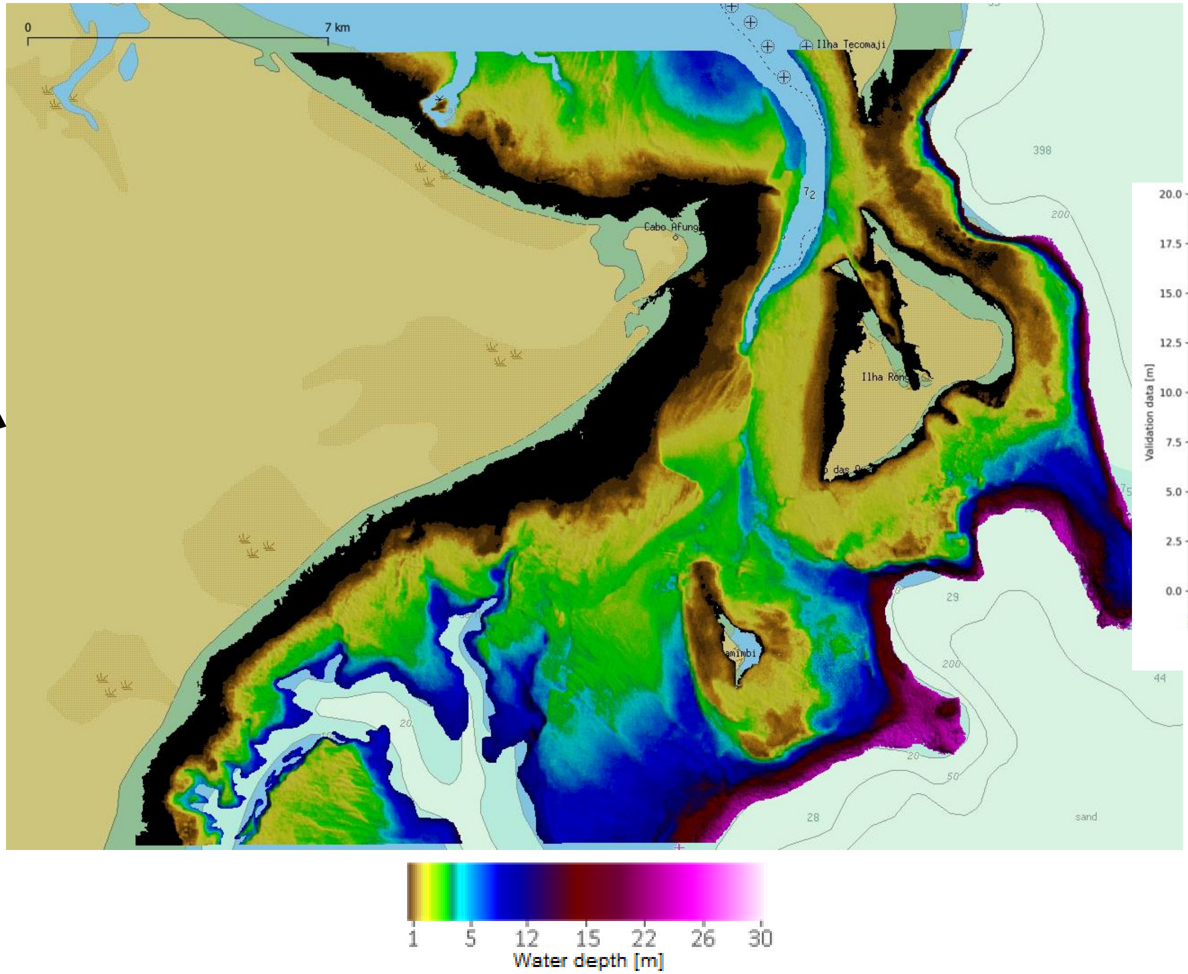
*"…plays an important role in the mapping and monitoring of coastal zones. Unlike other methods, it enables the **collection of bathymetric survey data from a desktop**, entirely remotely from the survey location. This attribute is of particular importance for areas that are either **physically inaccessible or difficult to reach**, or those **that require frequent updates**. It represents a potentially **cost-efficient solution for covering very shallow waters**. While SDB will not replace accurate acoustic or lidar surveys due to its known limitations, it can be used with great effect if those uncertainty constraints are well understood and managed, offering a valuable addition to the toolbox of the hydrographic community."*

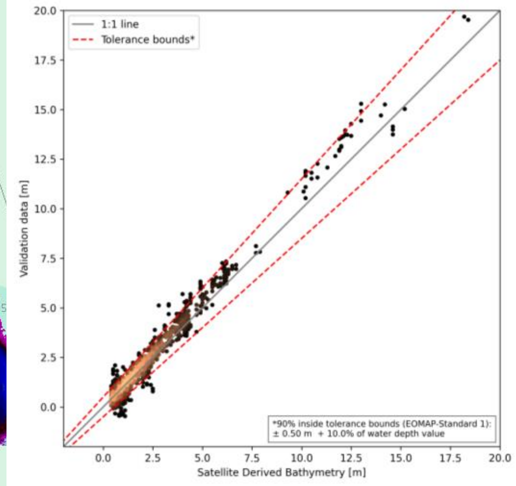
IHO publication B-13 forword of Mathias Jonas, Secretary General

Example of Palma Bay, Mozambique

Satellite-Derived Bathymetry derived from multispectral satellite data and physics based approach, and verified with Satellite-Lidar

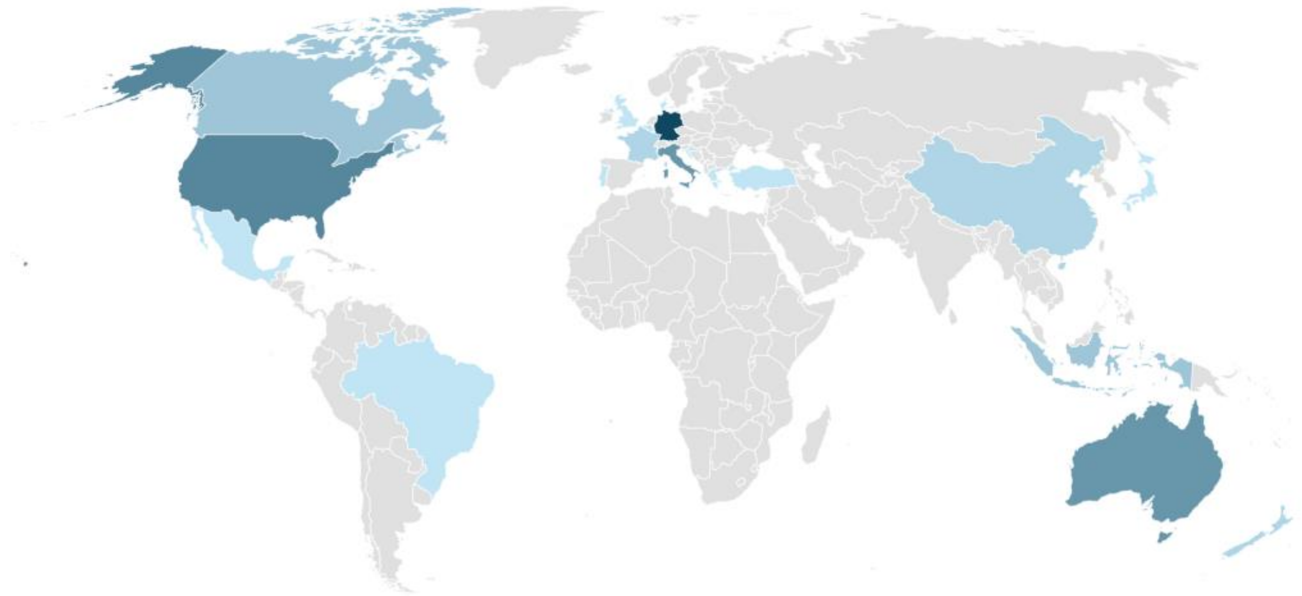






SDB Best Practice Project Team (SDBPT)

SDBPT is a project team of IHO‘s Hydrographic Surveys Working Group (HSWG), 53 members from 20 countries and 35 entities (HO, navy and industry), established 2021.



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Operations Manager, Fugro

Objectives of SDBPT

- Maintaining an **SDB Best Practice Document (B-13),** preparing and proposing revisions and amendments to reflect changes in the demands of hydrographic and other SDB data users, particularly those pertaining to data quality and standards;
- **Supporting IHO's Hydrographic Surveys Working Group** (HSWG) in all aspects of SDB;
- **Supporting Capacity Building** and promoting benefits/opportunities on SDB worldwide;
- Identifying new concepts, technologies and methodologies on SDB and exchange experience, best practice and challenges amongst the members;

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Release of publication B-13

[…] *The objective of this document is to provide background information on SDB techniques, and a framework for collecting, processing, analysing, interpreting, and sharing SDB data.*

It is intended to foster the best practices of SDB and provide important background information to SDB users. […]

Chapter 1: Satellite sensors and satellite data recording provides information on the satellite sensors and its recorded data.

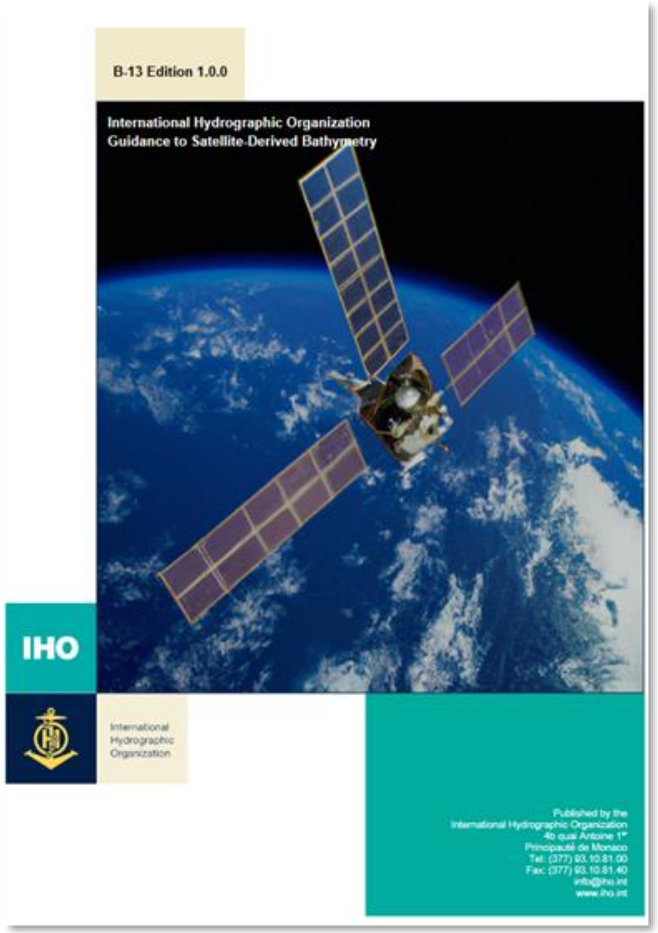
Chapter 2: SDB concepts and methods describes current SDB concepts, methods and their assumptions and capabilities.

Chapter 3: Uncertainty delves into data quality issues and discusses how end-users can better understand the impact of various factors on the reliability of a dataset.

Chapter 4: Metadata describes the importance of data and metadata and details the information that is mandatory for documenting SDB results.

Chapter 5: SDB coverage and feasibility describes the potential of SDB analysis on a global scale and describes the regional potentials and environmental limitations.

Chapter 6: Applications of SDB discusses applications of SDB data and additional considerations.

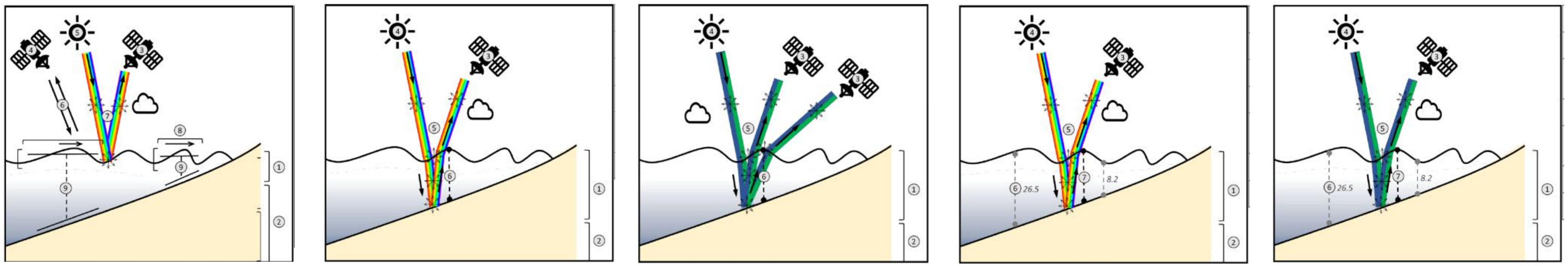


https://iho.int/uploads/user/pubs/bathy/B_13_Ed100_032024.pdf

Key info

„SDB“ can be many things

- Different methods from wave kinematics to physics modelling, from 100m‘s to <2m spatial resolution outputs, from local trained to global modells, etc.
- Different solutions and algorithms from IHO GEBCO cookbook to commercial software or service providers



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Multiple applications for SDB

- **Charting** - updates of dynamic sites, providing data to poorly surveyed areas (not in harbour sites or shipping lanes)
- **Hydrodynamic modelling –** e.g. input to storm surge models
- **Integrated surveying with acoustic surveys** – pre-planning to adjust line planning, filling shallow water data gaps of surveys,
- **Environmental characterization** – e.g. to support ecological studies
- **Coastal engineering** – e.g. for estimating dredge materials
- **Coastal zone management** – Base information

SDB vs. S44 (example for very high res. SDB on multispectral satellite data)

Reference	Criteria	Order 2	Order 1b	Order 1a	Special Order	Exclusive Order	
Chapter 1	**Area description** (Generally)	Areas where a general description of the sea floor is considered adequate.	Areas where underkeel clearance is not considered to be an issue for the type of surface shipping expected to transit the area.	Areas where underkeel clearance is considered not to be critical but features of concern to surface shipping may exist.	Areas where underkeel clearance is critical	Areas where there is strict minimum underkeel clearance and manoeuvrability criteria	
Section 2.6	**Depth THU** [m] + [% of Depth]	20 m + 10% of depth *Ba5, Bb2	5 m + 5% of depth *Ba8, Bb3	5 m + 5% of depth *Ba8, Bb3	2 m *Ba9	1 m *Ba10	*Depending on sensor, processing level*
Section 2.6 Section 3.2 Section 3.2.3	**Depth TVU** (a) [m] and (b)	a = 1.0 m b = 0.023 *Bc7, Bd4	a = 0.5 m b = 0.013 *Bc8, Bd6	a = 0.5 m b = 0.013 *Bc8, Bd6	a = 0.25 m b = 0.0075 *Bc10, Bd8	a = 0.15 m b = 0.0075 *Bc12, Bd8	*Depending on site, sensor, method, QaQc*
Section 3.3	**Feature Detection** [m] or [% of Depth]	Not Specified	Not Specified	Cubic features > 2 m, in depths down to 40 m; 10% of depth beyond 40 m *Be5, Bf3 beyond 40m	Cubic features > 1 m *Be6	Cubic features > 0.5 m *Be9	
Section 3.4	**Feature Search** [%]	Recommended but Not Required	Recommended but Not Required	100% *Bg9	100% *Bg9	200% *Bg12	*Limited to spatial resolution and depth*
Section 3.5	**Bathymetric Coverage** [%]	5% *Bh3	5% *Bh3	≤ 100% *≤ Bh9	100% *Bh9	200% *Bh12	*Limited to depth and water clarity*

Typically met *Depending on several factors* *Not met*

Three capacity building pillars for SDB capabilities

1. Skill Development

- Training and support of staff
- Workshops and remote support

Is SDB useful for the task? What is the potential and what are the options?

2. Technology Development

- Provision of software and materials
- Provision of databases

How can I create or access SDB data and use them for my purposes?

3. Institutional Development

- Integration of SDB in survey and mapping strategies
- Establishment of monitoring routines

How to make best use in survey campaign, monitoring or coastal management strategies?

Germany

Australia

Indonesia

Denmark

Summary

- *"Satellite-Derived Bathymetry (SDB) plays an important role in the mapping and monitoring of coastal zones", f*orword of the B-13 document, Dr. M. Jonas
- Satellite-Derived Bathymetry is there to stay and is a tool of the hydrographer's toolbox. As with every survey method it needs to be understood and used correctly.
- Understanding of limitations, methods and uncertainty is crucial, especially when it comes to charting applications
- Building in-house capacity requires personal, solutions and institutional aspects.