THE NATIONAL POLICIES FOR THE INTEGRATION OF LAND AND SEA: A CASE OF INDONESIA

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OUTLINE

1. Background
2. Urgencies of Integration of Land and Sea Geospatial Data
3. Policies and Regulation on Integrating Land and Sea Geospatial Data in Indonesia
4. Challenges
5. Closing Remarks

BACKGROUND

Indonesia is an archipelagic country with more than 17,000 islands. It is a challenging issue to integrate land and sea geospatial data for sustainable development planning purposes in Indonesia.

Urgencies of Integrating Land and Sea Geospatial Data

Climate Changes Adaptation

Integrated Coastal Management

A holistic approach is required to overcome various problems in coastal areas by integrating land and sea geospatial data.

Sea Level Rise and Land Subsidence Monitoring

Disaster Risk Reduction

URGENCIES OF INTEGRATING LAND AND SEA GEOSPATIAL DATA

Example of the tidal inundation in homes: 50 cm of inundation (a); and 20 cm of inundation (b)

Coastline dynamic changes (2013, 2017, 2018, 2021, 2024) in City of Semarang, Central Java (BIG, 2024)

Marfai, M. A., King, L., Sartohadi, J., Sudrajat, S., Budiani, S. R., & Yulianto, F. (2008). The impact of tidal flooding on a coastal community in Semarang, Indonesia. *The Environmentalist*, *28*, 237-248.

POLICIES ON INTEGRATING LAND AND SEA GEOSPATIAL DATA IN INDONESIA

Law Number 4 Year 2011 regarding the Geospatial Information as amended by Law Number 6 Year 2023 (Omnibus Law)

2. Ketentuan Pasal 7 diubah sehingga berbunyi sebagai berikut:

Pasal 7

(1) Peta dasar sebagaimana dimaksud dalam Pasal 5 huruf b terdiri atas:
   a. garis pantai;
   b. hipsografi;
   c. perairan;
   d. nama rupabumi;
   e. batas wilayah;
   f. transportasi dan utilitas;
   g. bangunan dan fasilitas umum; dan
   h. penutup lahan.

(2) Peta dasar sebagaimana dimaksud pada ayat (1) berupa Peta Rupabumi Indonesia.

(3) Peta Rupabumi Indonesia sebagaimana dimaksud pada ayat (2) mencakup wilayah darat dan wilayah laut, termasuk wilayah pantai.

Indonesia Topographic Basemaps covers land and sea as well as coastal areas seamlessly..

Government Regulation Number 45 Year 2021 regarding the Geospatial Information Management

Pasal 6

(1) Peta dasar sebagaimana dimaksud dalam Pasal 4 huruf b terdiri atas unsur:
   a. garis pantai;
   b. hipsografi;
   c. perairan;
   d. nama rupabumi;
   e. batas wilayah;
   f. transportasi dan utilitas;
   g. bangunan dan fasilitas umum; dan
   h. penutup lahan.

(2) Peta dasar sebagaimana dimaksud pada ayat (1) berupa Peta Rupabumi Indonesia.

(3) Peta Rupabumi Indonesia sebagaimana dimaksud pada ayat (2) mengintegrasikan seluruh unsur peta dasar sebagaimana dimaksud pada ayat (1) yang terletak di wilayah darat, pantai, dan laut.

Indonesia Topographic Basemaps integrates all basemap features in land and sea as well as coastal areas.

POLICIES ON INTEGRATING LAND AND SEA GEOSPATIAL DATA IN INDONESIA

BIG's Regulation Number 18 year 2021 regarding Procedures for Organizing Geospatial Information

Pasal 10

(1) Hipsografi sebagaimana dimaksud dalam Pasal 5 ayat (1) huruf b merupakan garis khayal untuk menggambarkan semua titik yang mempunyai ketinggian yang sama di permukaan bumi atau kedalaman yang sama di dasar laut.

(2) Hipsografi sebagaimana dimaksud pada ayat (1) meliputi:
a. titik ketinggian dan titik kedalaman; dan
b. kontur ketinggian dan kontur kedalaman.

(3) Hipsografi sebagaimana dimaksud pada ayat (2) mencakup wilayah darat, pantai, dan laut secara terintegrasi.

(4) Hipsografi sebagaimana dimaksud pada ayat (3) mengacu pada *geoid*.

Hypsography refers to the Geoid and covers land, sea and coastal areas in an integrated manner (seamlessly)

Presidential Regulation Number 9 Year 2016 as Amended by Presidential Regulation Number 23 Year 2021 regarding Acceleration of One Map Policy Implementation

*Geodetic Control Network and Indonesian Topographic Basemaps has to be used **as a single reference** for the creation of geospatial information in Indonesia*

POLICIES ON INTEGRATING LAND AND SEA GEOSPATIAL DATA IN INDONESIA

BIG's Regulation Number 13 year 2021 regarding Indonesian Geospatial Reference System (IGRS)

BADAN INFORMASI GEOSPASIAL

PERATURAN BADAN INFORMASI GEOSPASIAL
REPUBLIK INDONESIA
NOMOR 13 TAHUN 2021
TENTANG
SISTEM REFERENSI GEOSPASIAL INDONESIA

Vertical Reference System used in Indonesia:

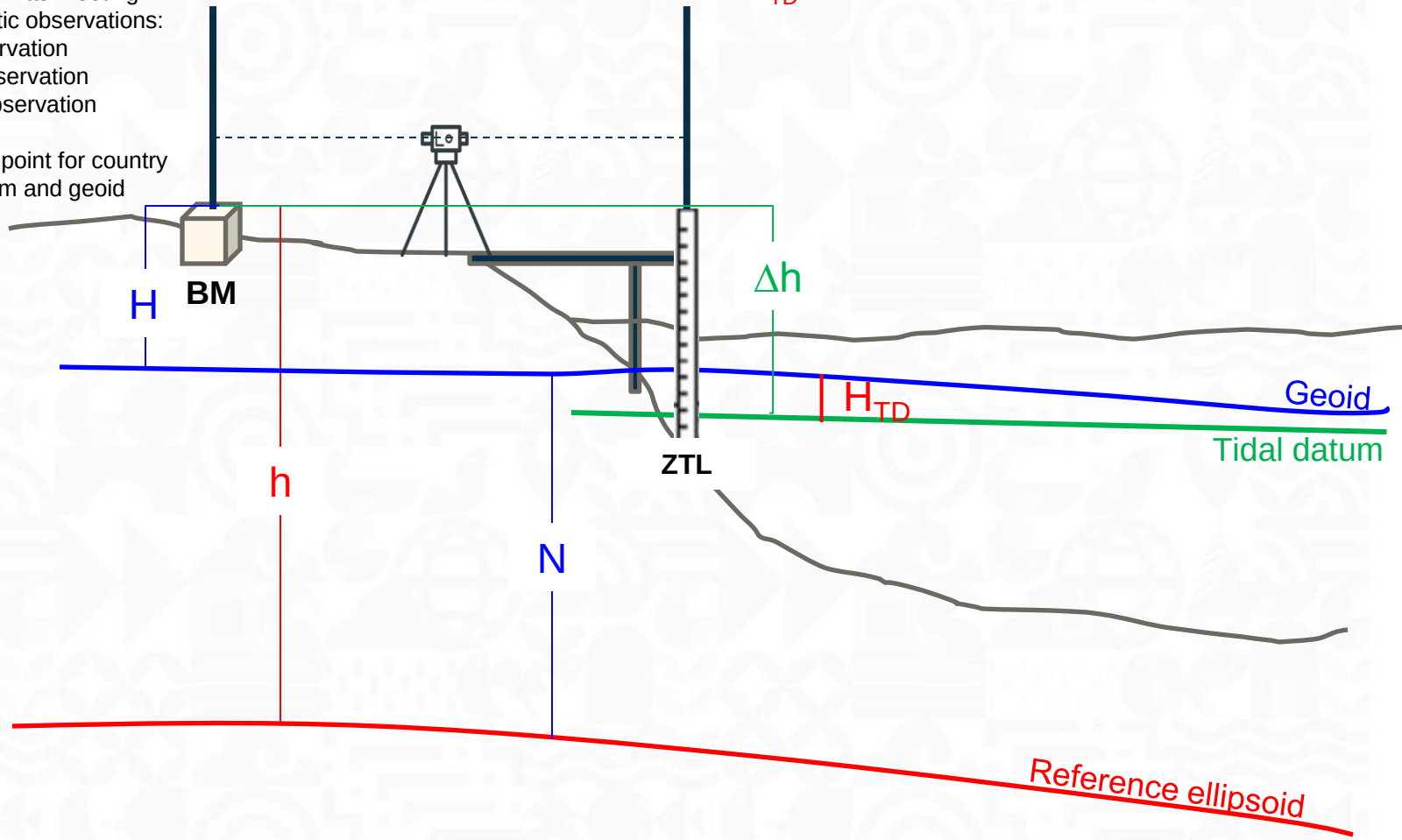
1. **Geoid or Geoid Undulation (N)** is vertical distance from the Geoid perpendicular to the reference ellipsoid surface → reference for Orthometric Height
2. **Tidal Datum (HAT, MHWS, MSL, MLWS, LAT)** is a vertical reference of local height for particular purposes which is produced based on tides observations. Tidal datums refer to Geoid.
3. **Referenced Ellipsoid of WGS'84** is used as vertical reference for geodetic height.

Tide Benchmark as meeting point of geodetic observations:
1. Tide Observation
2. GNSS Observation
3. Gravity Observation

→ Used as tie point for country wide tidal datum and geoid model

$H = h - N$

$H_{TD} = H - \Delta h$



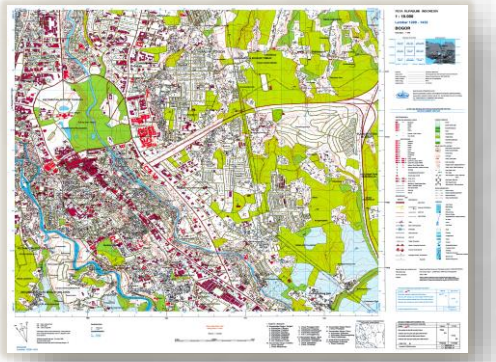
A Single Basemap For Land and Sea

UN-GGCE International Workshop
JOINING LAND AND SEA
The Integration of Terrestrial, Maritime, Built, and Cadastral Domains

Land Basemap of Indonesia:

- Covers land area only
- **Coastline** is defined as Mean Sea Level (MSL).
- Mean Sea Level (MSL) is defoned as coastline as well as height reference.
- Map Scale: 1:1.000K; 1:500K; 1:250K; 1:100K; 1:50K; 1:25K; 1:10K; 1:5K; 1:2.5K; 1:1K.

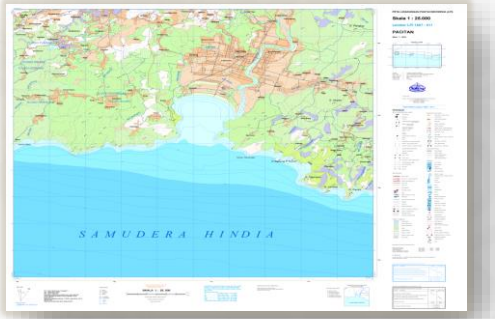
Land Basemap



Coastal Basemap of Indonesia:

- Covers coastal area with proportion of 60% - 70% land area and 30% - 40% sea area.
- Lowest Astronomical Tide (LAT) is defined as coastline as well as depth reference on sea area.
- Mean Sea Level (MSL) is defined as height reference on land area.
- Map Scale: 1:250K; 1:50K; 1:25K; 1:10K;

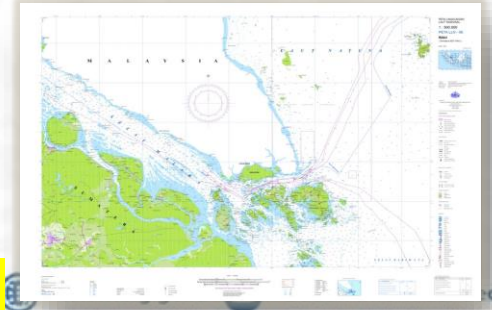
Coastal Basemap



Sea Basemap of Indonesia:

- Mostly covers sea area (features in land area is display for orientation purposes).
- Mean Sea Level is defined as coastline, height reference on land area as well as depth reference on sea area.
- Map Scale: 1:500.000; 1:250.000; 1:50.000;

Sea Basemap



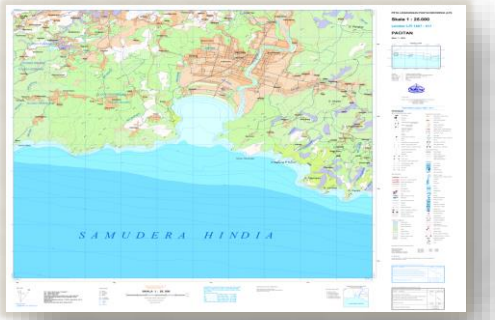
BEFORE Amandement of Law Number 4 Year 2011 by Law Number 6 Year 2023

Peta Rupabumi Indonesia (RBI) or Indonesia Topographic Basemap covers land, sea, and coastal area seamlessly.

Basemap features:

Coastline – Hipsography – Hydrography – Geographical Names - Boundaries - Transportation and Utilities – Buildings and Public Facilities – Land Covers

Topographic Basemap of Indonesia



Topographic Basemap of Indonesia:

- Covers land, sea as well as coastal area seamlessly.
- Define 3 (three) type of coastlines of Mean High Water Spring (MHWS), Mean Sea Level (MSL), and Lowest Astronomical Tide (LAT)
- **Geoid** is defined as a single height reference for land, sea, as well as coastal areas of the whole country of Indonesia that consist of more than 17,000 islands.
- Map Scales:
  - ✓ Countrywide: 1:5K; 1:25K; 1:50K; 1:250K; 1:1.000K;
  - ✓ Selected area of priority: 1:1K.

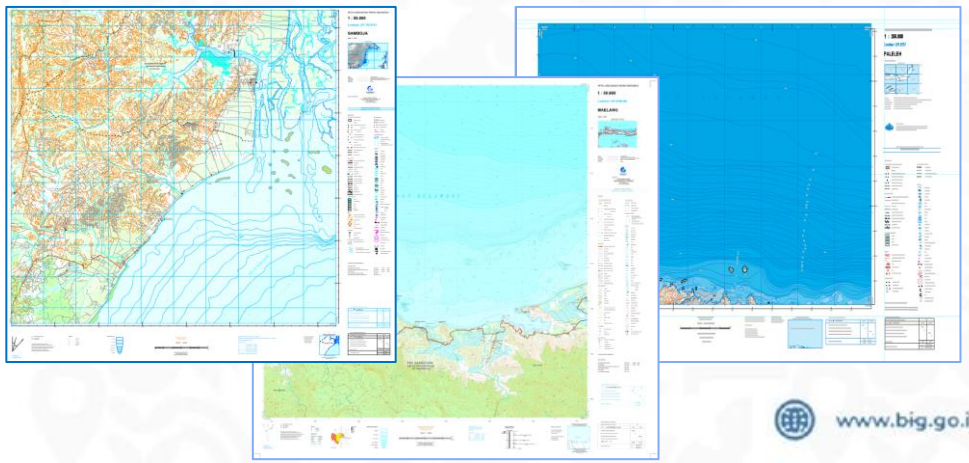
AFTER Amandement of Law Number 4 Year 2011 by Law Number 6 Year 2023

CHALLENGES

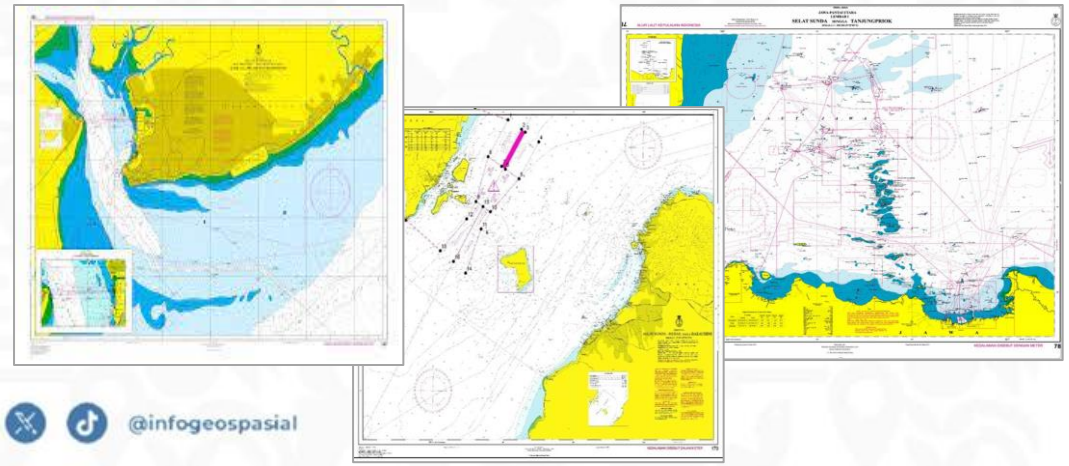
1. Different applications used different technical specifications.
2. Different applications requires different vertical reference system.
3. What should be integrated?

Different Applications Requires Different Technical Specifications

No	Item	Indonesian Topographic Basemap	Nautical Chart
1	**Horizontal Ref. System**	SRGI 2013 (ITRF 2014)	WGS'84
2	**Vertical Ref. System**	Geoid (InaGeoid 2020)	LAT (Depth) and MSL (height)
3	**Projection System**	Transverse Mercator	Mercator
4	**Grid System**	Geographic and UTM	Geographic
5	**Main Used**	Mainly used as national basemap for land and/or marine applications or applications that requires integration of land and sea.	Mainly used for marine navigation or marine applications that do not require integration of land and sea.
6	**Feature Layers**	Basemap feature layers that are required for land, marine, and coastal applications	Feature layers that are required for marine navigation



Integration can be done at **data level** *(land elevation and bathymetric data)* instead of **end product level** *(maps)* to create seamless land and sea geospatial data.



Different Applications Requires Different Vertical Reference System

- **A single reference system is required for applications that needs to integrate land and sea geospatial data** such as *integrated coastal management, disaster risk management, sea level and land subsidence, marine/coastal spatial planning, climate changes adaptation, environmental monitoring and conservation, infrastructure development, etc.*
- **Some applications do not require integration of land and sea geospatial data**, such as *marine navigation, fisheries management, marine habitat conservation, oceanographic research, aquaculture development, etc.*
- Regardless of the vertical reference system used by an application, **its geospatial data must be able to be integrated** into a single vertical reference system.

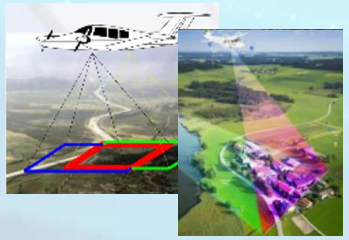
What Should Be Integrated?

In Indonesia case, integration of land and sea geospatial data requires:

- a single reference system for land and sea, either horizontal or vertical:
  - ❑ Horizontal Reference System: **IGRS 2013$_{(2021)}$ (ITRF 2014)**
  - ❑ Vertical Reference System: **Geoid**
- use the same standard of feature, especially for objects that are available on land and sea, such as coastline, contours (height and depth).

Data Integration General Workflow – Data Acquisition

Land Area



Aerial Photogrammetry and Lidar Survey

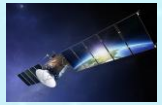
Output:
- Orthorectified Aerial Photo
- Mass points of height data
- DSM/DTM

Airborne Interferometric SAR Survey and Satellite Imageries

Output:
- Orthorectified Radar Image (ORI/CORI)
- DSM/DTM

Intertidal Area and Clear Shallow Water Area

UAV Mapping



Satellite Derived Bathymetry (SDB)

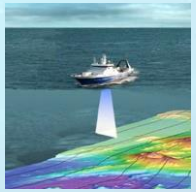
USV Bathymetric Survey

Lidar Bathymetric Survey

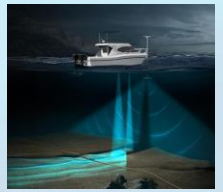
Output:
- Orthorectified aerial photo/Imageries
- Mass points of height and bathymetric data
- DSM/DTM

Output:
- Mass points of bathymetric data
- DSM/DTM

Sea Area



Multibeam Echosounding



Singlebeam Echosounding

Output:
- Mass point of bathymetric data
- DSM/DTM

Land Area Orthorectified Imageries

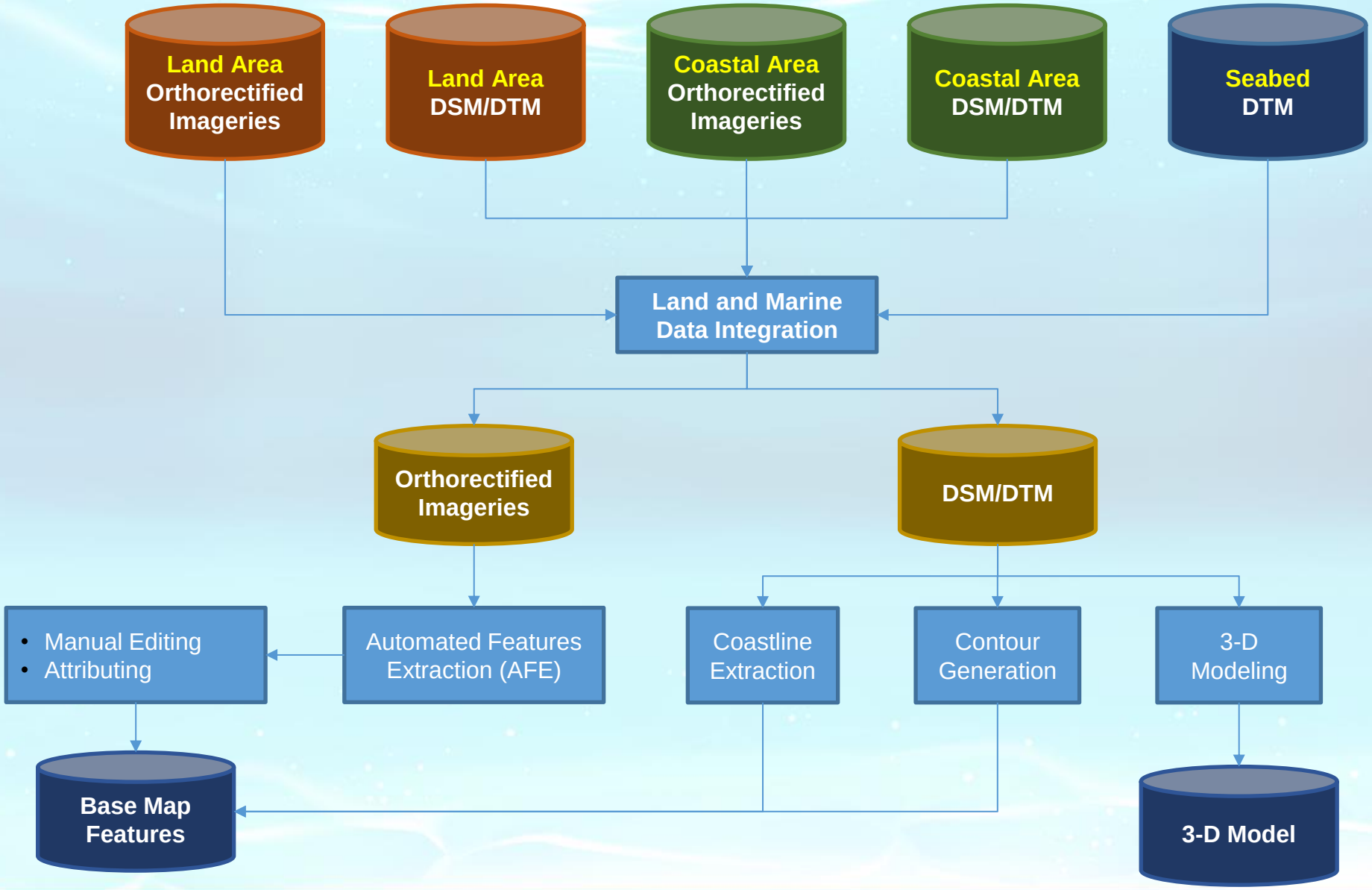
Land Area DSM/DTM

Coastal Area Orthorectified Imageries

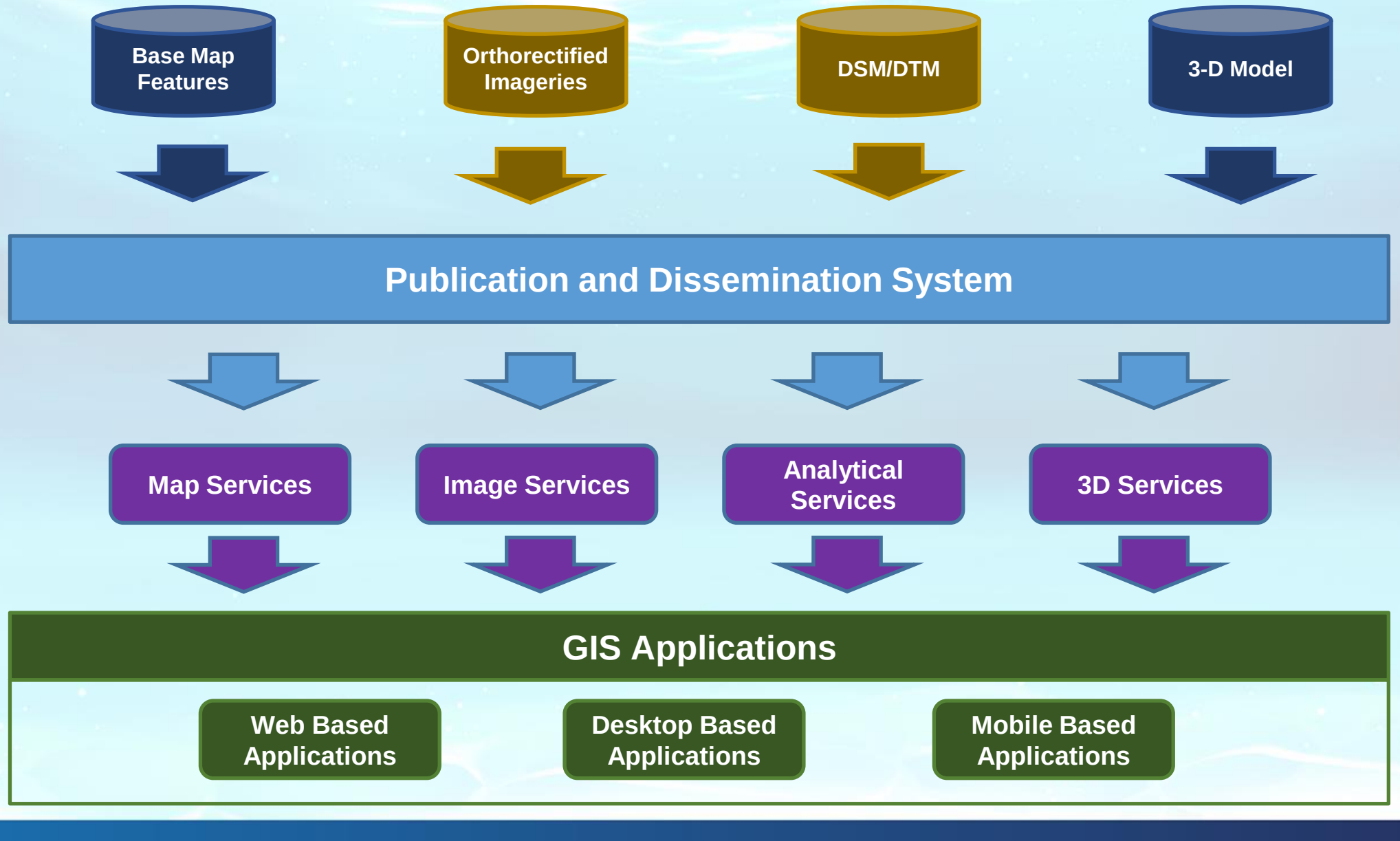
Coastal Area DSM/DTM

Seabed DTM

Data Integration General Workflow – Base Map Production

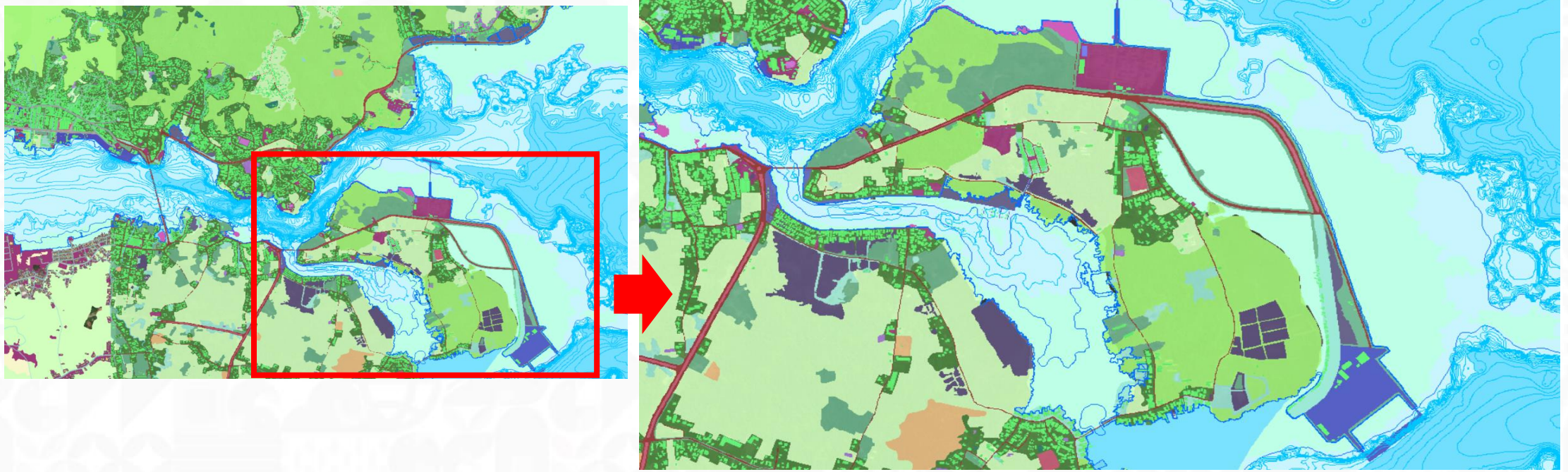


Data Integration General Workflow – Management And Publications



Integration of land and Sea Geospatial Data

Integrated land and sea topography data of Kendari, Southeast Sulawesi (2024)



Closing Remarks

1. Indonesia has adequate policies and regulations for land and sea geospatial data integration.
2. BIG is mandated by regulation to provide geodetic control network and basemaps as a single reference in Indonesia.
3. The use of a single reference system is the key to integrate land and sea geospatial data
4. The geospatial reference system for national use in Indonesia are:
   - Horizontal Reference System: **Indonesia Geospatial Reference System 2013 (IGRS 2013)** – ITRF 2014
   - Unified Vertical Reference System: **Indonesian Geoid 2020 (InaGeoid 2020)**
   - Tidal Datum: **HAT, MHWS, MSL, MLWS, LAT**
   - Coastlines: **MHWS, MSL, LAT**
5. Different geospatial reference system may be used for specific applications, such as marine navigation that use LAT and MSL for depth and height reference system respectively. However, its geospatial data (i.e. bathymetric data) should be able to be integrated into a single vertical reference system (geoid) for use in land and sea geospatial data integration.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