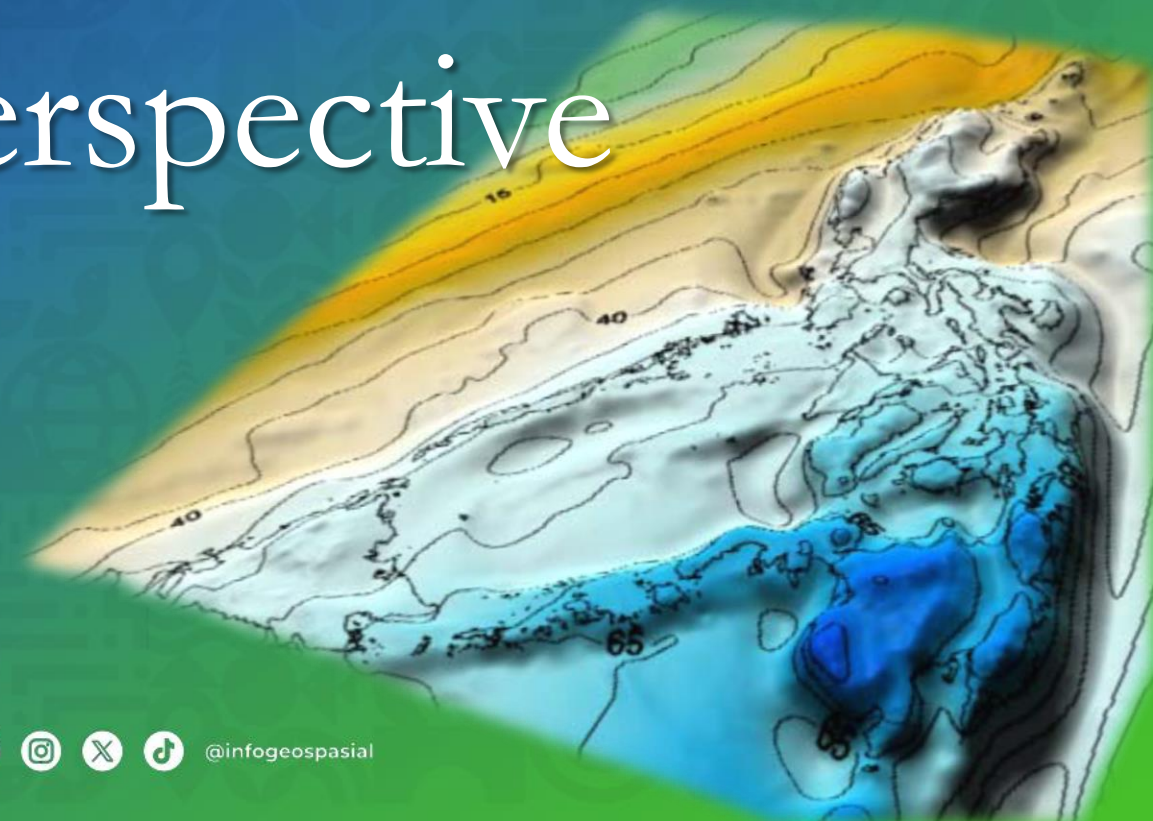




# *Joining Land and Sea* The Philippines Perspective

Charisma Victoria de la Cruz-Cayapan  
National Mapping and Resource Information Authority  
PHILIPPINES





# Talking Points

- Introduction
- Situationer
- Towards a Seamless Connection Between Land and Sea
- Challenges and Way Forward





# The Philippines

## *At A Glance*



**7,100+ islands**  
*and counting*



**109,053,343**  
*(2020 Census)*



**300,000 km<sup>2</sup>**  
*total land area*



**1,634 local gov't. units**  
*60% - coastal communities*



**17,500 km**  
*length of coastline*



**5.7% GDP**  
*(Q1 of 2024)*



Source: Geoportals Philippines (NAMRIA)





# The Philippines

## At A Glance

- Ranked 1<sup>st</sup> in the 2024 World Risk Index



**20 earthquakes per day<sup>1</sup>**  
*100 to 150 quakes felt per year (>M4.0)*



**average of 20 typhoons per year**  
*and counting*

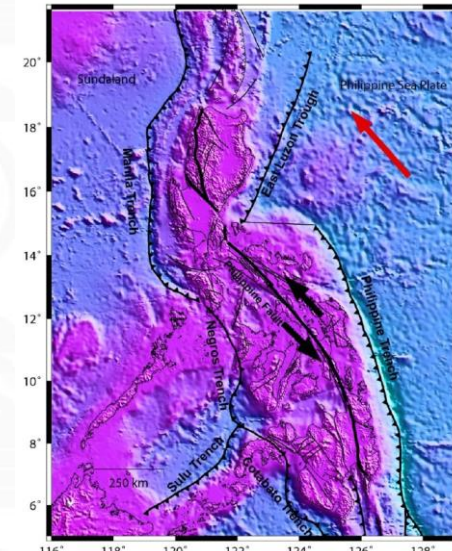


**average of 14.40 mm/year SLR<sup>2</sup>**  
*based on 1965-2022 Manila tide station data*

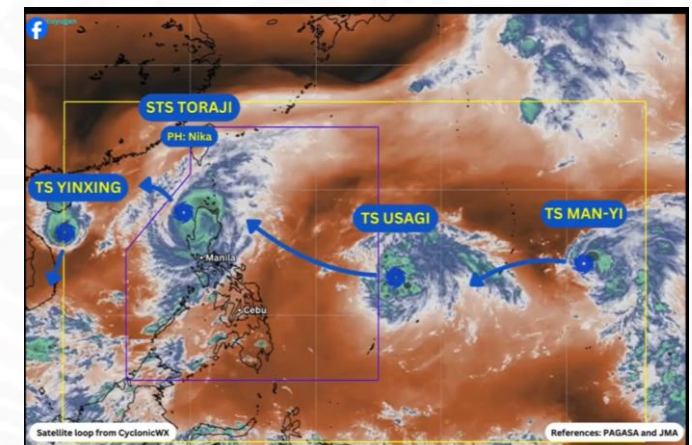
Rank	Country	WorldRiskIndex	Exposure	Vulnerability	Susceptibility	Lack of Coping Capacities	Lack of Adaptive Capacities
1.	Philippines	46.91	39.99	55.03	51.16	58.07	56.10
2.	Indonesia	41.13	39.89	42.40	32.37	51.01	46.17



Source: NOAA/NWS/PacificTWC



Source: Bacolcol, T. (PHIVOLCS)



Source: Westernpacificweather.com

WorldRiskReport 2024 (<https://reliefweb.int/report/world/worldriskreport-2024-focus-multiple-crises>)

<sup>1</sup> PHIVOLCS

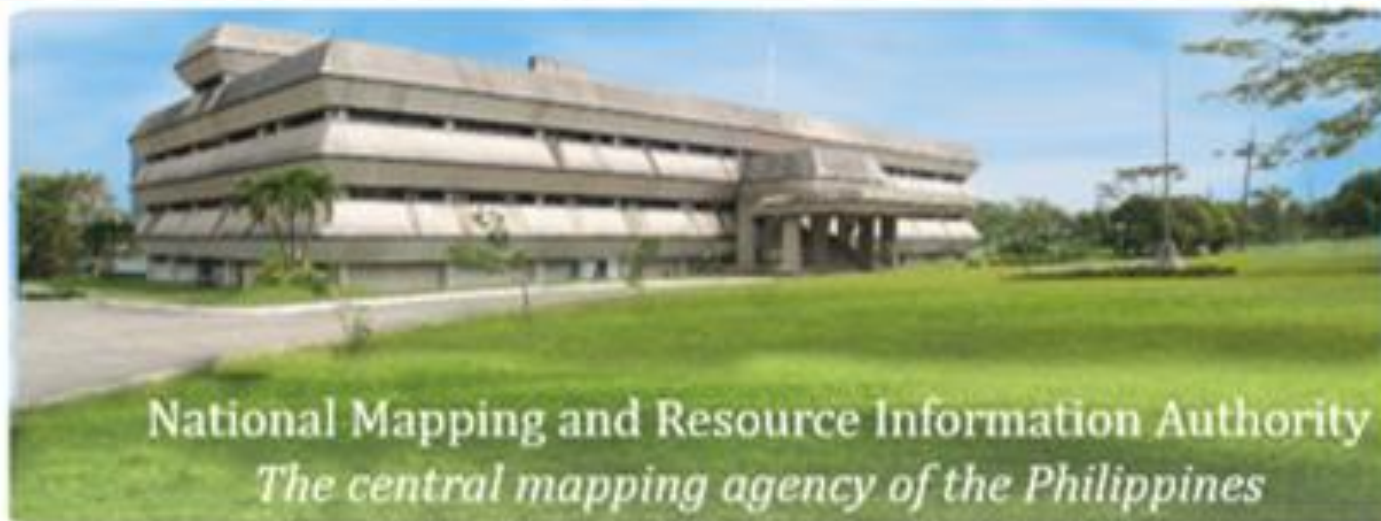
<sup>2</sup> NAMRIA



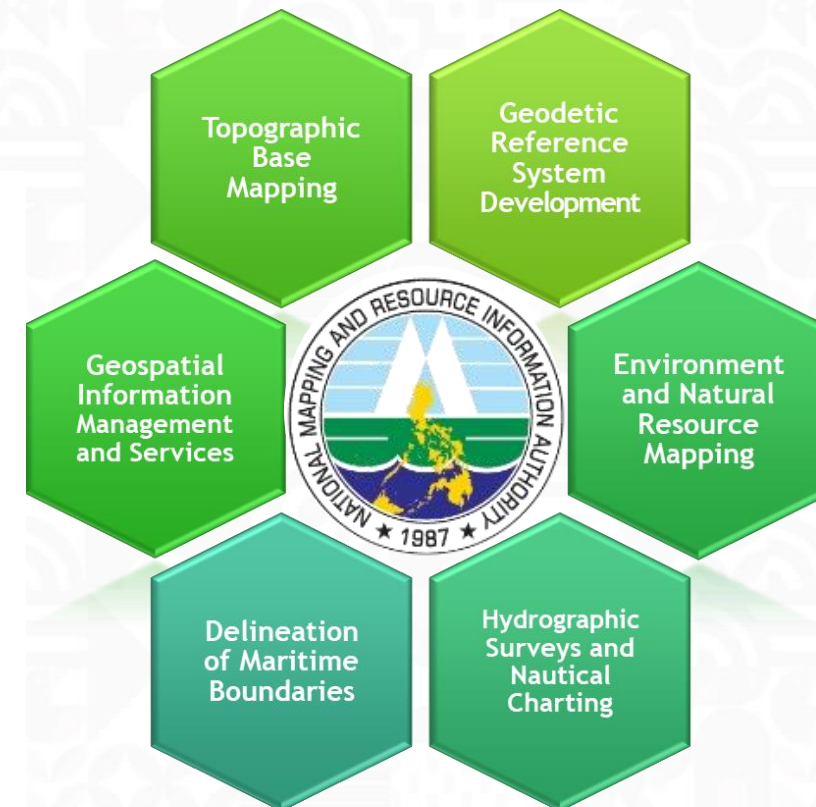


# NAMRIA

## *Mapping the Land and Charting the Seas*



Source: NAMRIA



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# Situationer

## *IGIF Philippines National Report (Baseline Assessment)*

- Conducted by World Bank from 2019 to 2024\*, with technical inputs from key geospatial-based mapping and surveying agencies, non-government organizations, and civil society groups
- Based on the Integrated Geospatial Information Framework (IGIF) adopted by UN member states in 2018
- The first study of its type to specifically address the interface between land and marine geospatial domains

\* Paused due to the pandemic

World Bank. IGIF Philippines: National Report (Baseline Assessment). January 2024



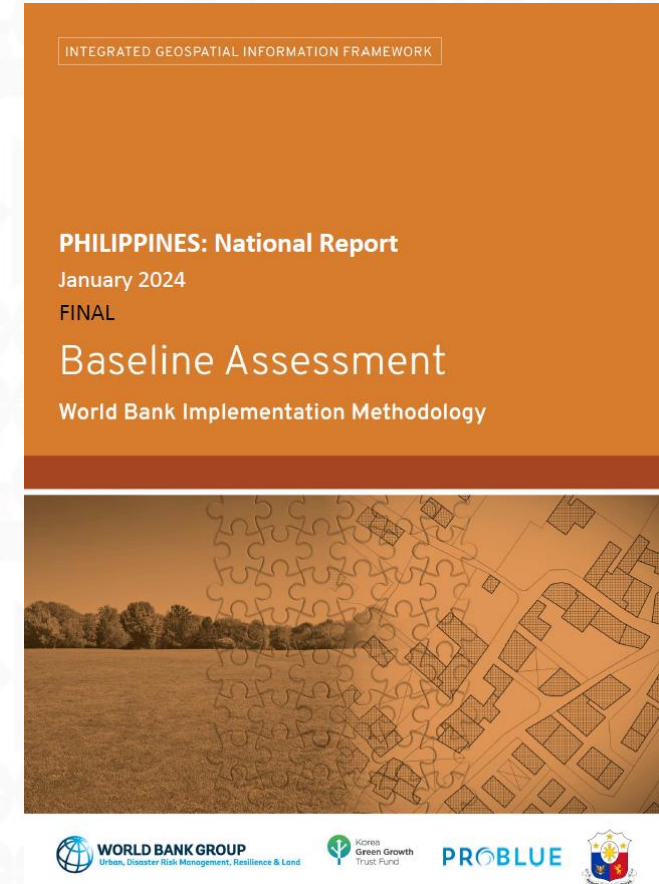
[www.big.go.id](http://www.big.go.id)



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Source: World Bank





# IGIF Philippines National Report (Baseline Assessment)

## *Inventory of Global Fundamental Geospatial Data Themes*

													
Geodetic Reference Frame	Geographical Names	Addresses	Functional Areas	Buildings and Settlements	Land Parcels	Transport Networks	Elevation and Depth	Population Distribution	Land Cover	Geology and Soils	Physical Infrastructure	Water	Orthoimagery
NAMRIA	NAMRIA PSA	NAMRIA PSA LGUs	NAMRIA DENR DA LGUs DHSUC	NAMRIA DPWH DHSUD LGUs BLGF	LRA DENR LGUs BLGF NAMRIA	DoTr LGUs LTFRB NAMRIA CAAP DoA	NAMRIA DENR PhilSA DPWH PCG	PSA	NAMRIA DENR DHSUD DA-BSWM DILG LGUs PSA	MGB PHIVOLCS DA-BSWM	DHSUD DPWH LGUs MMDA NAMRIA	NAMRIA DENR NWRB PAGASA RBCO BFAR NIA LWUA LGUs DILG DoTr PCG	PhilSA NAMRIA DENR DOST PAGASA





# IGIF Philippines National Report (Baseline Assessment)

## *Summary of Key Findings*

- Increasing demand and growing effort by national agencies to develop, generate and utilize land and marine geospatial information (GI)
- Absence of a national spatial data infrastructure (NSDI) policy and governing body impact all other strategic pathways
  - Lack of systematic socio-economic impact assessment and national investment plan on GI leading to limited buy-in among decision makers
  - Siloed development of GI systems and platforms resulting to redundancy of efforts, as well as interoperability and sustainability issues (data, standards)
  - No NSDI education and communication strategy plans





# IGIF Philippines National Report (Baseline Assessment)

## *Land vs. Marine Domains Current State Scores*

- Marine lags behind land domain in all strategic pathways except for policy and standards (compliance with IHO and IMO standards).
- Limited appreciation of the blue economy so not much investment in developing marine GI
- Unclear mandates among government agencies, especially along the coastal zones
- Recognizes the modernization of the Philippine Geodetic Reference System (PGRS) as vital to the seamless development of land and marine SDI

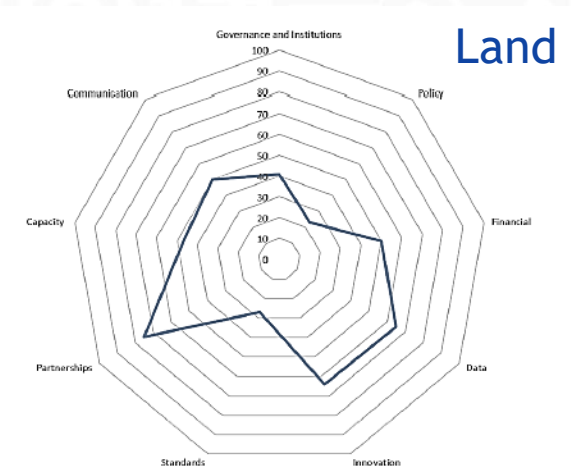


Figure 53: Graphical Representation of Land DT Results

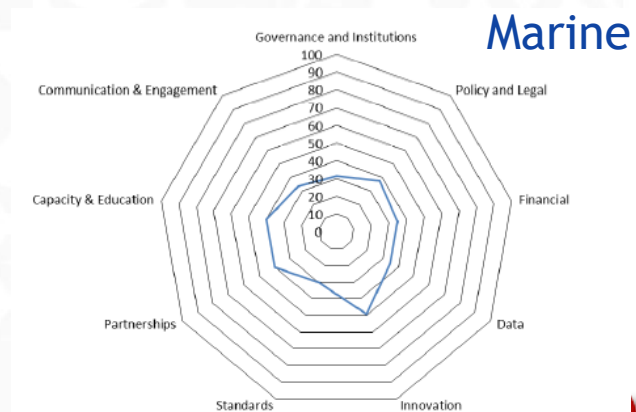
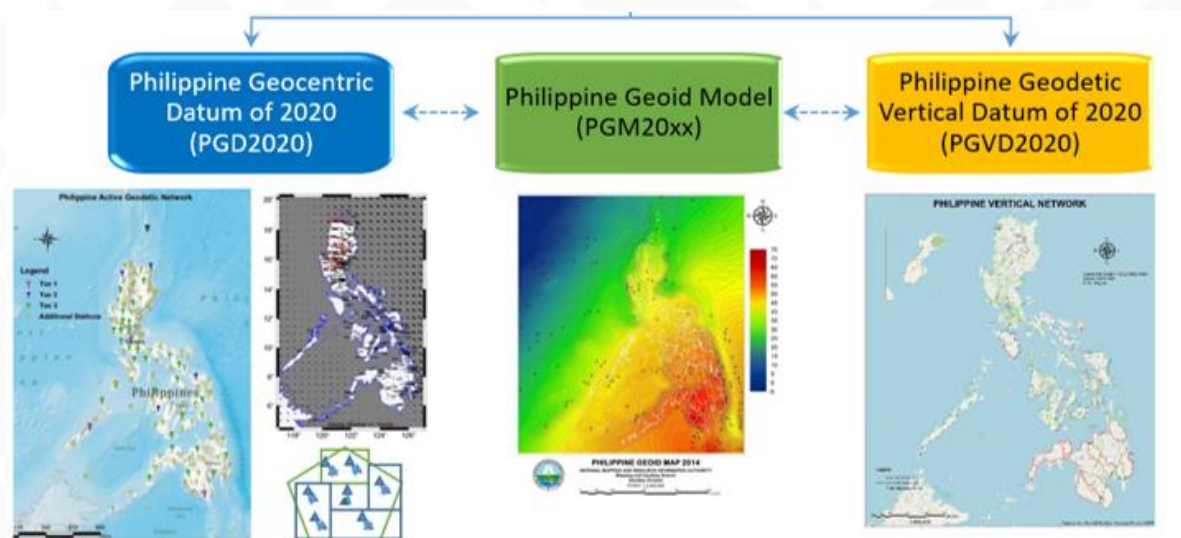


Figure 6: Graphical Representation of Marine Results by Strategic Pathway

# Modernization of the PGRS



## Geometric RF:

**Name:** PGD2020

**Type:** Semi-dynamic and Geocentric

**Realized in** ITRF2014 (reference epoch 16 January 2020)

## Vertical RF:

**Name:** PGVD 2020

**Type:** MSL-fitted geoid

**Will be connected** to the IVRF (WHS)

**Comes with** a National Geoid, Deformation Model and Distortion Grid

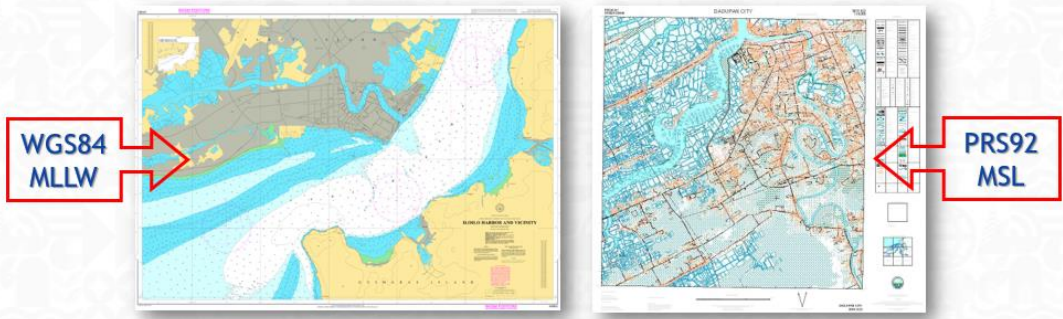
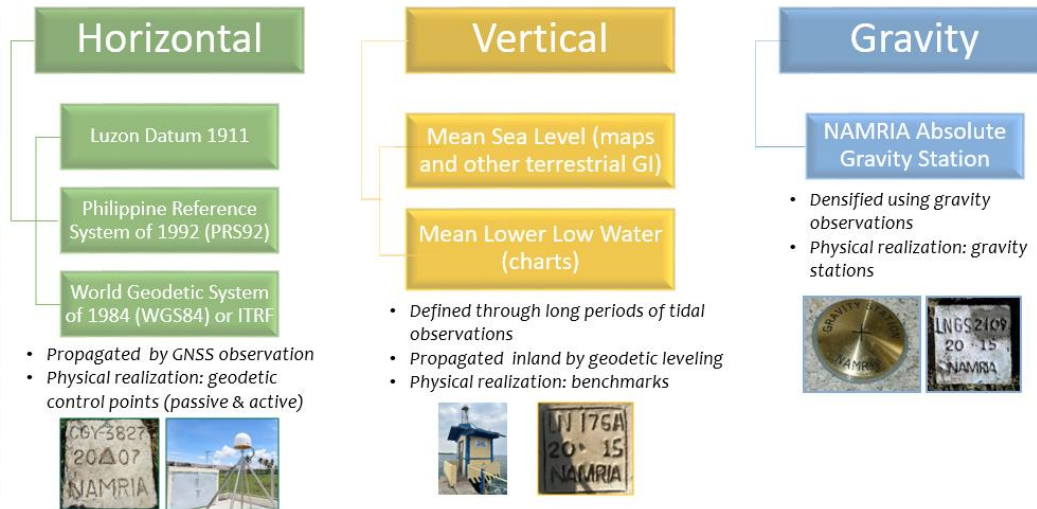


Source: NAMRIA



# Modernization of the PGRS

## Current Frames in Use



Source: NAMRIA

	Accuracy Standard	Spacing	Number
<b>Horizontal</b>			
AGS	1 ppm	70 km	63 + 1 (shared)
Active Geodetic Station	Zero order	70 km	60
Active Geodetic Station	1 <sup>st</sup> order	50 km	314
Geodetic Control Point	2 <sup>nd</sup> order	20 km	2,449
Geodetic Control Point	3 <sup>rd</sup> order	10 km	28,027
Geodetic Control Point	4 <sup>th</sup> order	5 km	32,021
Proposed 200 Active Geodetic Stations			
<b>Vertical</b>			
1 <sup>st</sup> order	4√K (mm)	1 km (national roads)	19,934
2 <sup>nd</sup> order	8√K (mm)	0.5 km (city streets)	3,296
<b>Gravity</b>			
1 <sup>st</sup> order		Provincial	158
2 <sup>nd</sup> order I		Municipal	1,528
2 <sup>nd</sup> order II		2 - 3 km	9,161
<b>International Collaborations</b>			
IGS sites	4 (PIMO, PTAG, PPPC, PGEN)		
DORIS site	1 (Manille)		
APREF / APRGP	PTAG / All PAGeNet AGS		
MGM-Net	2 (PLUZ, PMIN)		
REGINA	1 (PTGG)		



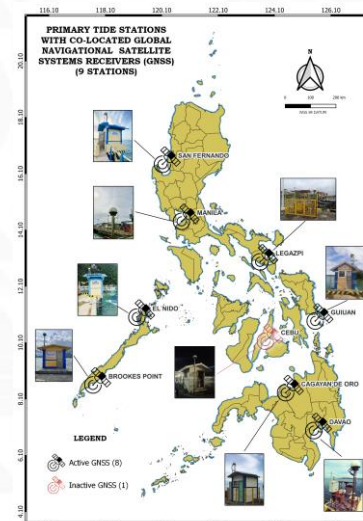
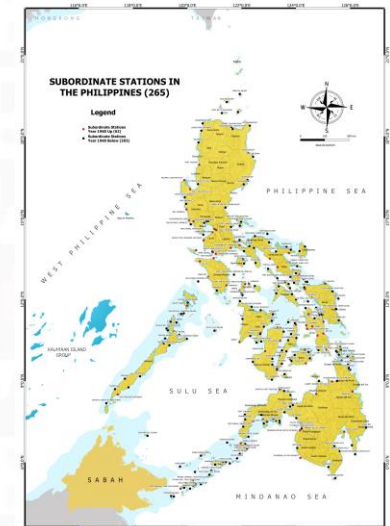
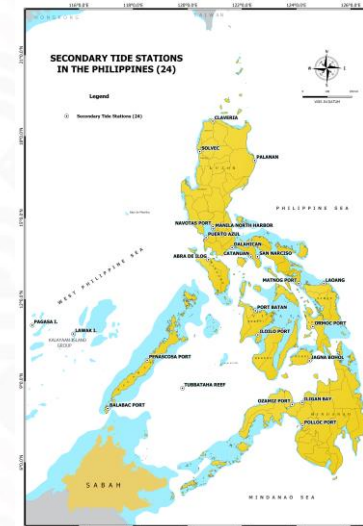
# Modernization of the PGRS

## *On Tides and Water Levels*

- Tide Gauge Network

Type	Number	Datums
Primary Tide Stations	60	HAT MHHW
<i>Collocated with GNSS</i>	9	MHW
<i>GLOSS Station</i>	4	MTL MSL
Secondary Tide Stations	24	MLW MLLW
Subordinate Stations	265	LAT

- Mixture of analogue and digital gauges, some transmitting in real time
- Operated in accordance with NOAA and UNESCO's IOC tidal observation standards



Source: NAMRIA

Source: <https://psmsl.org/gloss/>

# Modernization of the PGRS

## *Philippine Geoid Model*

- Developed in partnership with DTU-Space and US-NGA
- Input data:
  - Airborne gravity data (2014)
  - Land gravity from NAMRIA
  - DTU10 global gravity anomalies from multi-mission satellite altimetry
  - SRTM 15" DEM data for the region
  - EGM08 and GOCE RL5 satellite data
- Comparison with GPS data showed relatively large error relative to the geoid, likely due to geodynamic effects and levelling or GPS errors
- Ongoing refinement and validation (latest version PGM2018)

Forsberg, R., Olesen, A., Gatchalian, R., Carmelita, C., & Ortiz, C. (2014). Geoid model of the Philippines from airborne and surface gravity.

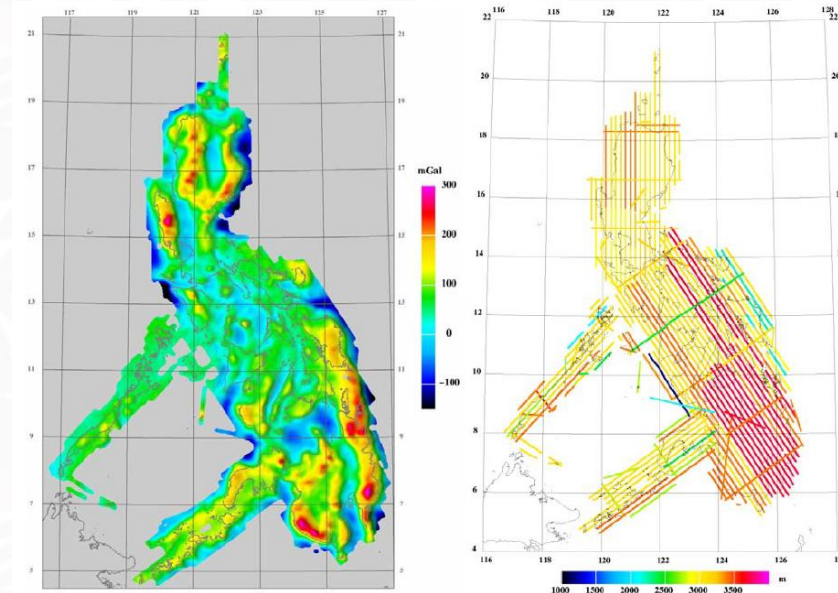


Fig. 1. Airborne survey free-air anomalies (left) and flight track elevations (right)

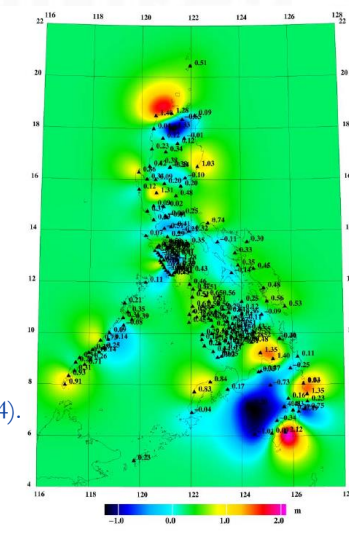
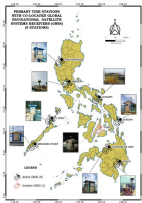

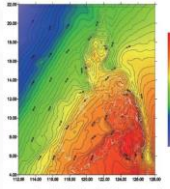
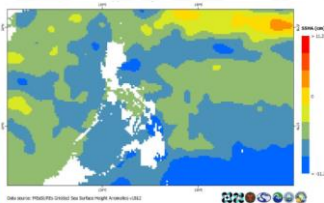


Fig. 8. Location of GPS-levelling data. Colour show the correction surface for the fitted geoid.

# Joining Land and Sea

## *Realizing a Seamless Connection of Land and Marine Domains in PH*

				
Requirements	Tidal data	Geodetic Levelling	Geoid Model	Marine Gravity Model Mean Sea Surface
Challenges	<ul style="list-style-type: none"> <li>- Limited competency on hydro-dynamic modelling</li> <li>- Infrastructure affected by natural hazards</li> </ul>	<ul style="list-style-type: none"> <li>- Erroneous level lines found</li> <li>- Limited resources for troubleshooting</li> <li>- Almost 50% of BMs lost due to development in the area</li> <li>- Network adjustment (tied to single or multiple TGBMs?)</li> </ul>	<ul style="list-style-type: none"> <li>- Epoch difference between levelling and gravity observation</li> <li>- Capacity building on geoid and gravity</li> </ul>	<ul style="list-style-type: none"> <li>- Existing studies focused on geologic applications</li> <li>- No effort yet to define a marine geoid</li> <li>- Inadequate in-house competency</li> </ul>



# Way Forward

- Submission of the IGIF Philippines National Report / Country Action Plan to senior decision-makers
- Preparation of roadmap for the integration of land and marine domains
- Continue work on the PGRS Modernization (transition to ITRF2020)
- Policy development:
  - Executive Order on Philippine Integrated Geospatial Information Management (PIGIM)
  - DENR Memorandum Circular on the Development of the Modern PGRS
- Capacity Building
  - Enhancing partnership with the academe (reach out to other geoscience experts)





## *Acknowledgement:*

Many thanks to the World Bank Geospatial Team for their work on the preparation of the Philippines IGIF Baseline Assessment and Country Action Plan.

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

*Maraming salamat!*

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