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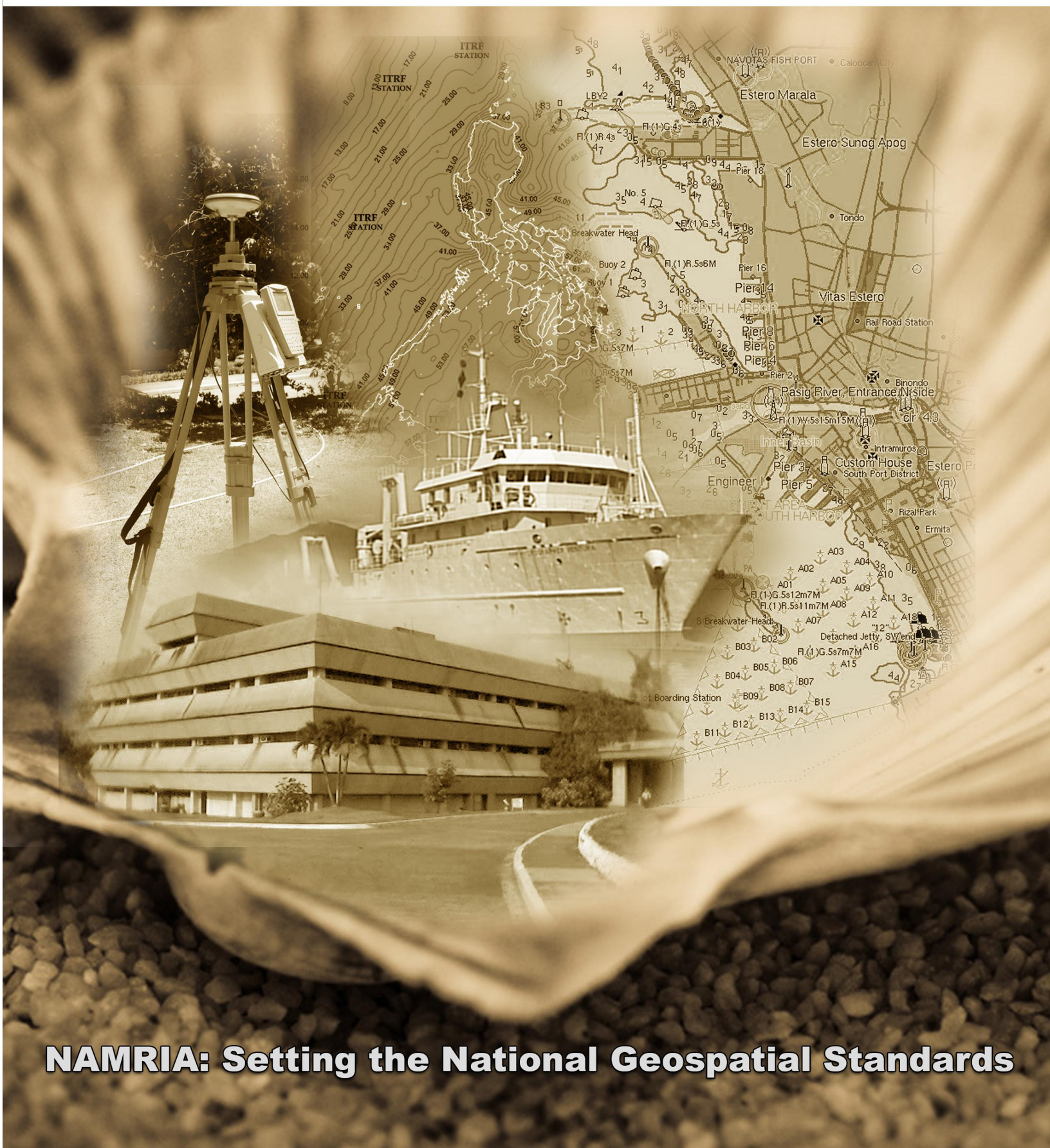

NAMRIA: Setting the National Geospatial Standards

Editorial

NAMRIA at 30: Harnessing Geospatial Technology and Setting National Standards

Changes in technology usually go hand-in-hand with changes in standards, and vice-versa. Merriam-Webster defines standard as "something set up and established by authority as a rule for the measure of quantity, weight, extent, value, or quality." It likewise defines technology as "a manner of accomplishing a task especially using technical processes, methods, or knowledge."

To set a standard reference for all mapping and surveying activities in the country, NAMRIA spearheaded the establishment of the Philippine Reference System 1992 where multisectoral programs can be interrelated geographically. However, in July 2014, the United Nations Global Geospatial Information Management (UN-GGIM) encouraged all Member States to adopt and sustain a common geodetic reference frame called Global Geodetic Reference Frame (GGRF), which uses the International Terrestrial Reference Frame (ITRF) as the foundation reference frame. The PRS92 is a static and local system and not aligned with the ITRF.

The Ground Control Points (GCP) re-observation revealed that the PRS92 geodetic control network is slowly being degraded because of the effects of geodynamics. Moreover, the re-computation of the Philippine Geoid Model (PGM) 2014 to PGM 2016 showed a 0.30m difference in most parts of the country. The re-observations and the use of the PGM both confirm the need to modernize the current reference system.

After the American occupation, the Bureau of Coast and Geodetic Survey (BCGS) maintained the standards used by its predecessor, the Philippine Coast and Geodetic Survey (PC&GS). In 1955, the Philippines joined the International Hydrographic Bureau (IHB) which was later renamed the International Hydrographic Organization (IHO). The Hydrography Branch (HB) of NAMRIA, which assumed the functions of BCGS, adopted the international standards set by IHO in hydrography, nautical charting, production of nautical publications such as the List of Lights and Notices to Mariners, and the transition from nautical charts to electronic navigational charts (ENC). The maritime industry is now transitioning to the use of electronic chart display and information system (ECDIS). ENCs are used as reference charts by ECDIS, which may result in a higher demand for ENCs in the future.

The use of remote sensing technology has been proven to be an efficient and cost-effective method in mapping natural resources. Landsat 8, the latest free data available from United States Geological Survey (USGS), has been used in both Coastal Resource Mapping and Land Cover Mapping. Recent advances in image data analysis technology improved the 2010 land cover classification accuracy of 81.82% to 93.64% in 2015.

The maximum potential of technology and standards is only as good as the competency of the people who harness and sustain it. To date, the agency reached Maturity Level II of the Program to Institutionalize Meritocracy and Excellence in Human Resource Management (PRIME-HRM), a program of the Civil Service Commission. It was a long journey catalyzed by the NAMRIA's thrust to empower its people to help create a geospatially-empowered Philippines while collaborating with different organizations and government entities.

Information derived from technology and standards are rendered useless if these are not used to change people's lives for the better. In 2015, the United Nations Committee of Experts on Global Geospatial Information Management (UN-GGIM) elected the Philippines and Jamaica to be the co-chairs of the Working Group on Geospatial Information and Services for Disasters. The Philippines, through NAMRIA, drafted the strategic framework that will serve as a guide for all Member States to make available, accessible and usable all quality geospatial information and services before, during, and after disaster events. Locally, the framework is being implemented through the creation of the Information Management – Technical Working Group under the National Disaster Risk Reduction and Management Council.

Data sharing is a byword nowadays. For NAMRIA, geospatial data sharing is connected with the Philippine Geoportal. The system was launched to provide a platform to share and disseminate geospatial information produced by stakeholder agencies. The trend of globalization requires interoperability of data and use of technology. This compels NAMRIA and other organizations to utilize technologies that comply with international standards.

The growing interdependence among countries necessitate the need to perform processes globally. Through the use of technology, taking advantage of data sharing, and improving its human resource, NAMRIA can rise above the growing challenge of globalization.

For this issue, the evolution of nautical charts is highlighted. NAMRIA is witness to the important transition, advancement and various milestones of nautical chart production which can contribute significantly to the improvement in maritime industry and safety in navigation. In observance of the World Hydrography Day (21 June), NAMRIA celebrates with the rest of the world this important milestone in hydrography!

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Nautical Charting Through the Years

by Ltsg. Bai Dyanna G. Sinsuat[*] and Ltsg. Aaron Andro V. Ching [**]

May 1, 1898 marked the day when Americans gained a new territory in Southeast Asia–the Philippines. United States Admiral George Dewey received the surrender of the Spanish Colonial Navy after the Battle of Manila Bay. Since the Americans knew little about the Philippines then, the event caused a flurry of search for information, especially by US government departments, about this former Spanish colony.

The Philippine nautical charts published during the Spanish Era were found to be inaccurate, and thus posed too many risks for navigation. The lack of accurate nautical charts placed a heavy strain on military operations of the United States of America (USA) that LtCdr. Richard Lukens, one of the first officers of the Coast and Geodetic Surveys in Manila, reported that "gunboats and transports were piling up." His report mentioned that the cruiser CHARLESTON, the only US naval casualty during the Filipino-American War, got lost upon hitting an uncharted rock at a Northern Luzon coast.

The immediate need for accurate nautical charts necessitated the creation of a coast and geodetic survey office in Manila in December 1900. American officers and Filipino hires conducted bathymetric surveys and laid down the triangulation networks throughout the country, which established the Luzon Datum in the island of Marinduque.

From 1900 until the granting of Philippine independence from the USA on 04 July 1946 through the Treaty of Manila, the Philippine Coast and Geodetic Surveys (PCGS) published nautical charts that are still in use as base maps of the new and revised nautical charts of NAMRIA.

The Old Nautical Charting Standards

Prior to the 20th century, each nation used its own techniques and standards in the production of nautical charts. France and Great Britain used the metric system while the USA used the imperial system.

Aside from the use of various measurement systems, nations are free to use their own local datums. The same is true with the vertical datum wherein each nation can choose various sea-level datums such as the mean lower-low water and the lowest astronomical tide.

The Philippines inherited the standards used by the PCGS. The first nautical charts produced during the American period used fathoms and feet for depths, feet for heights of features above the sea, mean lower-low water as chart datum, and the Luzon Datum as the reference datum. The use of the aforementioned standards continued even after the period of Philippine independence from American rule and the creation of the Bureau of Coast and Geodetic Survey (BCGS) as the successor of the PCGS. During the presidency of Corazon Aquino, the BCGS merged with other mapping agencies of the government to form NAMRIA. The Hydrography Branch, under NAMRIA, assumed the functions of the BCGS.

New Nautical Charting Standards

After the First World War, maritime nations realized that the use of different standards in hydrography and nautical charting proved to be untenable for globalizing maritime trade. Thus, in June 1919, the British Admiralty hosted the first International Hydrographic Conference, in which 24 nations participated. One result of the conference was the proposal for the creation of the International Hydrographic Bureau (IHB) that aimed to ensure effective and continuous cooperation among hydrographic offices.

The IHB was formally founded on 21 June 1921 and was renamed in 1970 as the International Hydrographic Organization (IHO). The Philippines joined the IHO in 1955. It is the IHO which sets the international standards in hydrography, nautical charting, production of nautical publications such as the *Philippine List of Lights* and the *Philippine Notices to Mariners*, and in the issuance of electronic navigational charts (ENCs). The ENC is a digital version in vector format of the paper nautical chart. The IHO set of standards is one of two sets which has been triggering the continuous updating of nautical charting standards. The other set of standards, the ones used by the PCGS, has to be followed in relation to the technological advances in nautical charting.

IHO Standards

IHO publications that are important in the production of nautical charts are the following: *S-4: Regulations for International (INT) Charts and Chart Specifications of the IHO INT-1: Symbols, Abbreviations and Terms used on Charts*; and *S-11: Guidance for the Preparation and Maintenance of International Chart Schemes and Catalogue of International (INT) Charts*. Since NAMRIA's adoption of the standards set by the IHO, there had been notable changes in the new nautical charts published by the agency

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[**]*Officer in Charge, Maritime Research and Database Management Section, Maritime Affairs Division-HB*

when these are compared with the old Philippine nautical charts. The newly published Philippine nautical charts use the metric system for depths and heights of features above the sea. International chart symbols, in accordance with the *IHO S-4 Publication*, are also used.

Aside from adopting the standards set by the IHO, NAMRIA also embarked on the improvement of its own nautical charting standards. Newly published nautical charts are now referred to the WGS-84 Datum to meet the demands of mariners, who are now using the Global Navigational Satellite System (GNSS), such as GPS, during navigation. Philippine nautical charts are now in color unlike the old monochrome charts that used the Luzon Datum.

NAMRIA is also migrating to a new scheme for nautical charts, wherein general sailing and coastal nautical charts will be of uniform scale. The new scheme for general sailing charts will be at 1:500,000 scale covering 15 charts for the whole country. Four special-purpose General Sailing Charts at 1:1,250,000 scale will also be published to cover the Exclusive Economic Zones and the Extended Continental Shelf. The coastal charts will be at 1:150,000 scale covering 65 charts for the whole country. Figures 1 and 2 show the old and new schemes, respectively.

In connection with the updating of standards for nautical charts, the publication of the *Philippine Notices to Mariners* was also improved to be in consonance with the standards set forth in the IHO S-4 publication. Starting in 2017, the *Philippine Notices to Mariners* will include the pictorial representation of symbols for the convenience of mariners, who will be tasked to correct the nautical charts aboard their vessels.

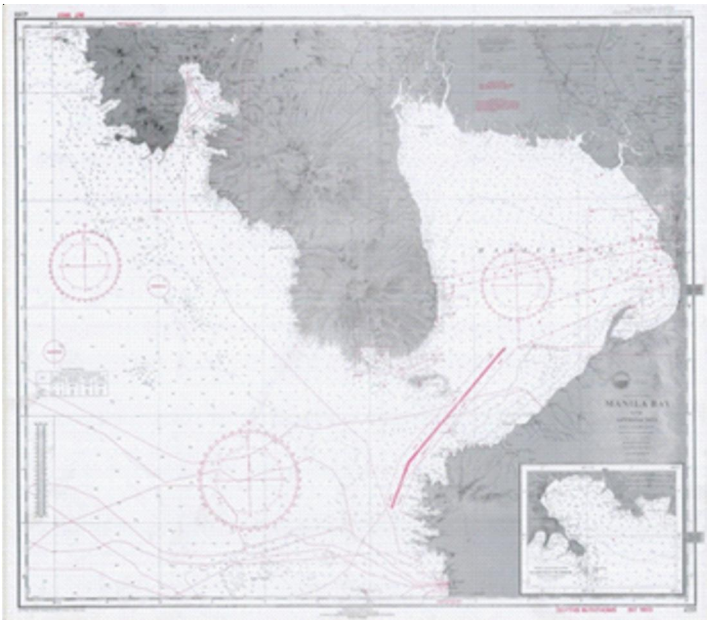

Figure 1: (old scheme) Manila Bay and Approaches scaled at 1:125,000

Technology and the Evolution of Nautical Charting Standards

Technology has revolutionized navigation in several aspects. Paper nautical charts were compiled by manually laying hydrographic survey data over topographic data to create a map. Over time, different GIS software made it easier for cartographers to compile nautical charts. The shipping industry is quickly transitioning to the use of the Electronic Chart Display and Information System (ECDIS). Some mariners have abandoned the use of paper nautical charts and are now totally relying on ECDIS during navigation.

The ECDIS is a system that can integrate GNSS, radar, and ENC in one display. It allows mariners to create the ship's route and display the ship's position in real time. The equipment has a feature that alerts mariners on the presence of navigational hazards such as obstructions and shoals, as well as navigational aids like buoys and beacons. The ENC is uploaded to the ECDIS as its base map. An ENC is compiled according to the IHO standards set in the publication *S-57 Transfer Standard for Digital Hydrographic Data*. Objects depicted on an ENC can be queried for information such as a light's color, characteristics, and range. Figures 3-A and 3-B show a portion of the publication, *PH5MHR40 (Fairways and Anchorages of Manila ENC)*, featuring a buoy and its attributes; and a light and its attributes, respectively.

Safety of Life at Sea (SOLAS) Chapter V, Regulation 19/2.1.4 states that: *"All ships, irrespective of size, shall have nautical charts and nautical publications to plan and display the ship's route for the intended voyage and to plot and monitor positions throughout the voyage. An Electronic Chart Display and Information System (ECDIS) is also accepted as meeting the chart carriage requirements of this subparagraph. Ships to which paragraph 2.10 applies shall comply with the carriage requirements for ECDIS detailed therein."*

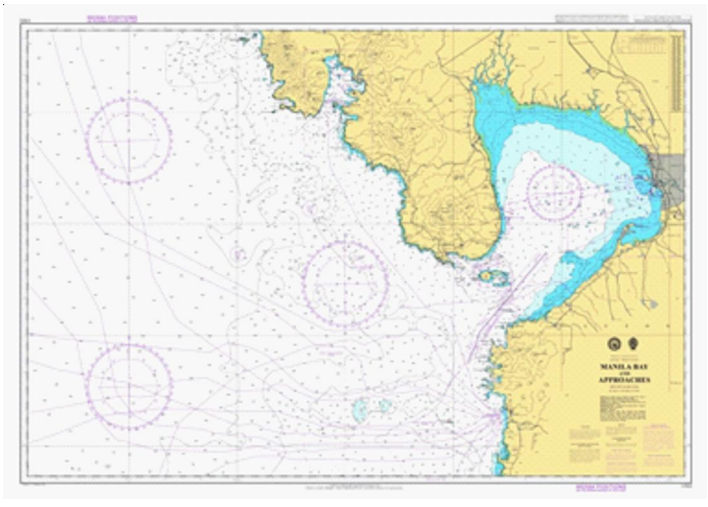

Figure 2: (new scheme) Manila Bay and Approaches scaled at 1:150,000

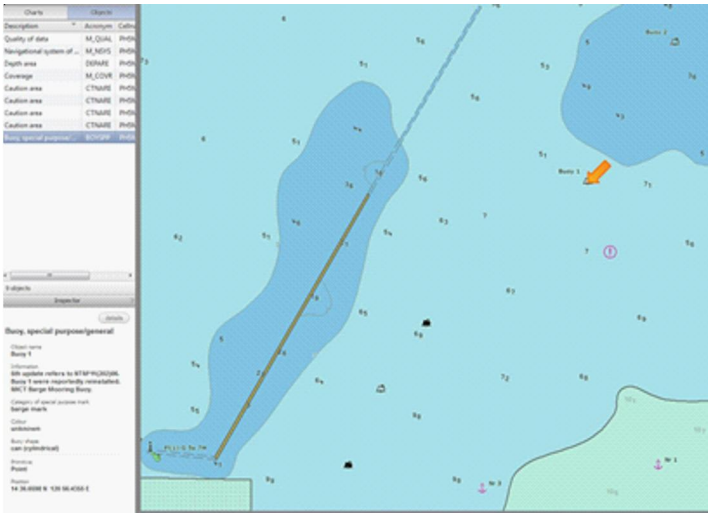

Figure 3-A: A portion of PH5MHR40 (Fairways and Anchorages of Manila ENC) featuring a buoy and its attributes

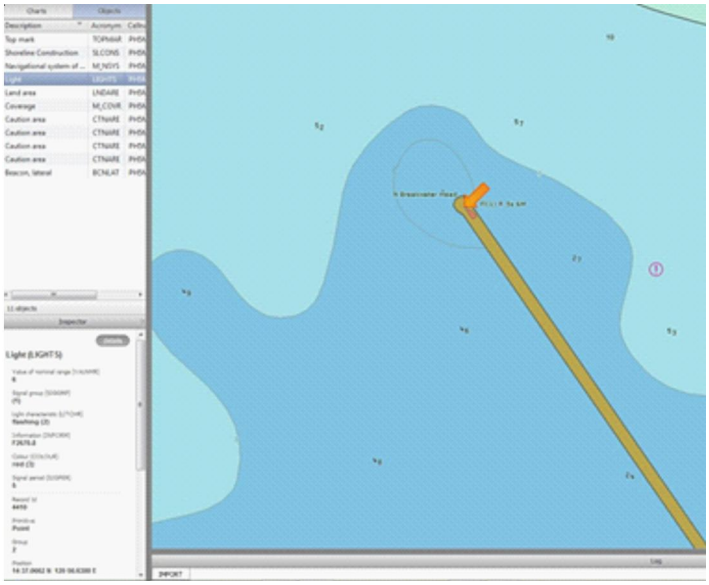

Figure 3-B.: A portion of PH5MHR40 (Fairways and Anchorages of Manila ENC) featuring a light and its attributes

Table 1 shows the corresponding implementation dates for ECDIS fitting

TYPEE	SIZE (Gross Tonnage)	NEWLY-BUILT	EXISTING
Passenger ship	>500	July 2012	July 2014
Tanker	>3000	July 2012	July 2015
Cargo ship	>3000	July 2014	---
	>10000	July 2013	July 2018
	>20000	July 2013	July 2017
	>50000	July 2013	July 2016

Table 1: Implementation dates for ECDIS fitting

This regulation implies that since ECDIS has become a mandatory requirement for navigation, there will be a much greater demand for ENC production. The Worldwide Electronic Navigational Chart Database principles define the responsibilities of hydrographic offices in the production and distribution of ENCs. One such responsibility for hydrographic offices is to ensure that mariners across the globe are able to get fully updated ENCs for all shipping routes and ports. NAMRIA publishes its ENCs internationally through the International Centre for Electronic Navigational Charts (IC-ENC). IC-ENC is a low-cost, non-profit organization established in 2002 which aims to assist hydrographic offices in harmonizing the production and distribution of high-quality ENCs. Based on the IC-ENC 2016 Annual Report, there has been a steady increase in sales volume since 2012.

It is evident that upsurge of ENC sales began as a result of the implementation of the mandatory carriage requirements of ECDIS in 2012. The strong growth demonstrated in Table 2 is in line with the forecasts and corresponds with the number of vessels, by class, falling within the schedule by compliance date.

Benefits of New Nautical Charting Standards

Globalized maritime trade requires the smooth movement of ships bringing cargo and people across national boundaries. The smooth movement of ships requires similar standards for all nautical charts produced by coastal nations. The adoption of standards set by the IHO and other improvements to the nautical charting process aim to fulfill such requirements.

The most notable benefit of the migration to new standards is the added convenience for mariners using the

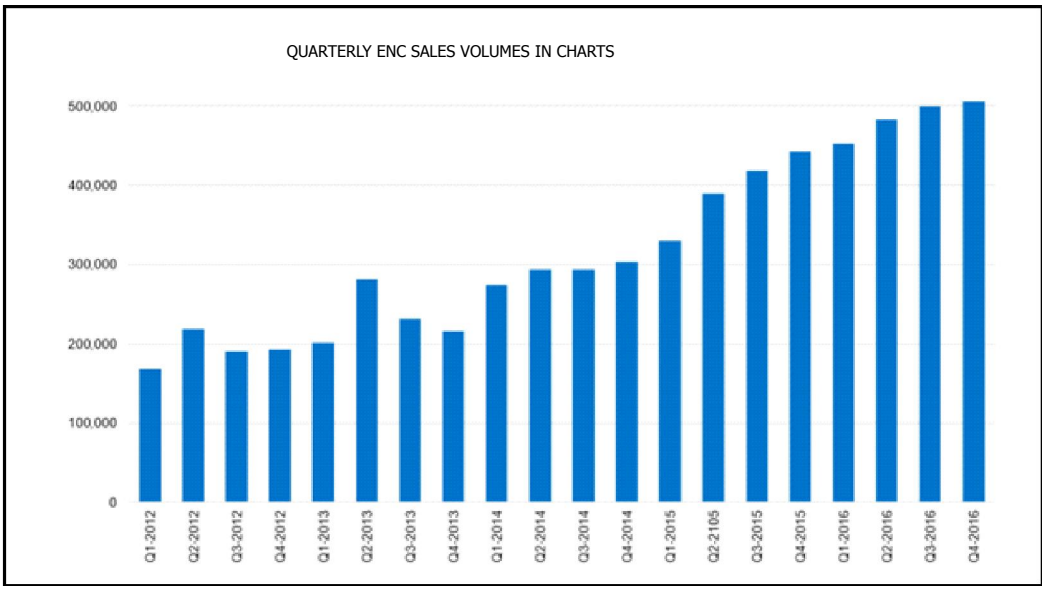

Table 2: IC-ENC Sales Volume growth from 2012 to 2016

Philippine nautical charts. International vessels using GNSS during navigation need not worry about an incorrect position due to an incorrect datum since the newly published nautical charts are now referred to the WGS-84 Datum. This means lesser confusion for mariners and lesser risks of having marine accidents.

The indirect benefit to the maritime industry is the efficient flow of goods and people. This means more earnings for shipping companies, the port authorities, and the businesses catering to tourists. In short, the improvement of standards and processes contributes to the advancement of the Philippine economy.

Ltjg. Lew Anthony A. Quincena, Navigation Officer of BRPH Presbitero, planning the vessel's route for its upcoming survey using a Tokimec ECDIS

Future Trends and Challenges

The IHO has been working on the development of a new standard, *S-100: The IHO Universal Hydrographic Data Model*. This will provide a contemporary hydrographic geospatial data standard that can support a wider scope of hydrographic-related digital data sources, products, and customers. This will allow the development of new applications such as seafloor classification and marine GIS. The development and maintenance process allows non-IHO stakeholders to directly share their data to the general public, thereby maximizing the data's potential use. NAMRIA ENCs currently in S-57 format will then be converted into the S-100 format.

Nautical charting standards will eventually gear up towards fully automated digital navigational systems. However, paper nautical charts and publications will still certainly be necessary as backup supplemental systems for safety of navigation.

NAMRIA has been and will always be at the forefront of Philippine hydrography. The agency will continue to keep pace with current demands for fast and accurate navigational information, and the ever-progressing standards in nautical charting. •

Data Sources:

IHO Publications - https://www.iho.int/iho_pubs/IHO_Download.htm

Naval History - http://www.navy.mil/submit/display.asp?story_id=2676

IHO History - https://www.iho.int/iho_pubs/misc/HistoryIHBrevisedJan%2005.pdf

NOAA History - http://www.history.noaa.gov/stories_tales/lukensphil.html

2016 IC-ENC Annual Report

PGM2016: A New Geoid Model for the Philippines

*by Ronaldo C. Gatchalian**

Vertical coordinates (i.e., heights) of points are referred to a coordinate surface called *vertical datum*. The universal choice of a vertical datum is the *geoid*, which is the reference surface for orthometric and dynamic heights (Vanicek, 1991). The geoid is an equipotential level surface of the oceans at equilibrium (Hofmann-Wellenhof, 2005).

The use of the Global Navigation Satellite System (GNSS) has made it much easier to estimate mean sea level (MSL) elevations using a geoid model. Applying a geoid model in GNSS surveys eliminates the conduct of leveling. A geoid model is a surface (N) which describes the theoretical height of the ocean and the zero-level surface on land. In a modern vertical reference system, the geoid is required to obtain orthometric height H ("height above sea level") from GNSS by $H = h^{GPS} - N$ where h^{GPS} is the GNSS ellipsoidal height, and H the levelled (orthometric) height.

In the Philippines, the determination of elevation H of points and Benchmarks (BMs) is normally conducted through geodetic leveling, a tedious process that hinders the densification of BMs.

From 2007 to 2010, during the Philippine Reference System 1992 (PRS92) Campaign, 22,851 BMs were established along major roads nationwide with a standard divergence of $4.0mm\sqrt{K}$ (first-order, class II accuracy) between two level runs (FGCC, 1984). Figure 1 shows the network of level lines with their corresponding tide-gauge stations.

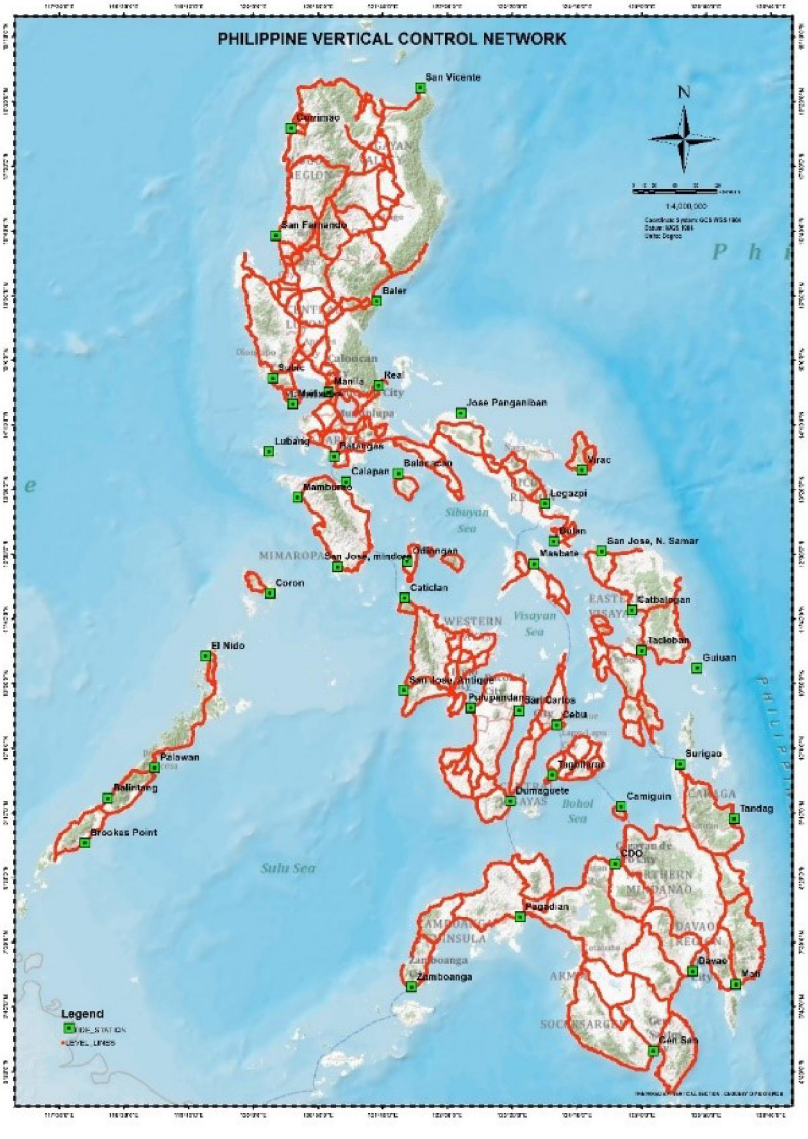

Figure 1. Philippine Vertical Control Network established by Levelling

Efforts to compute for a geoid model can be traced back to 1991. The first attempt at computing a gravimetric geoid for the Philippines was through the Natural Resources Management Development Project

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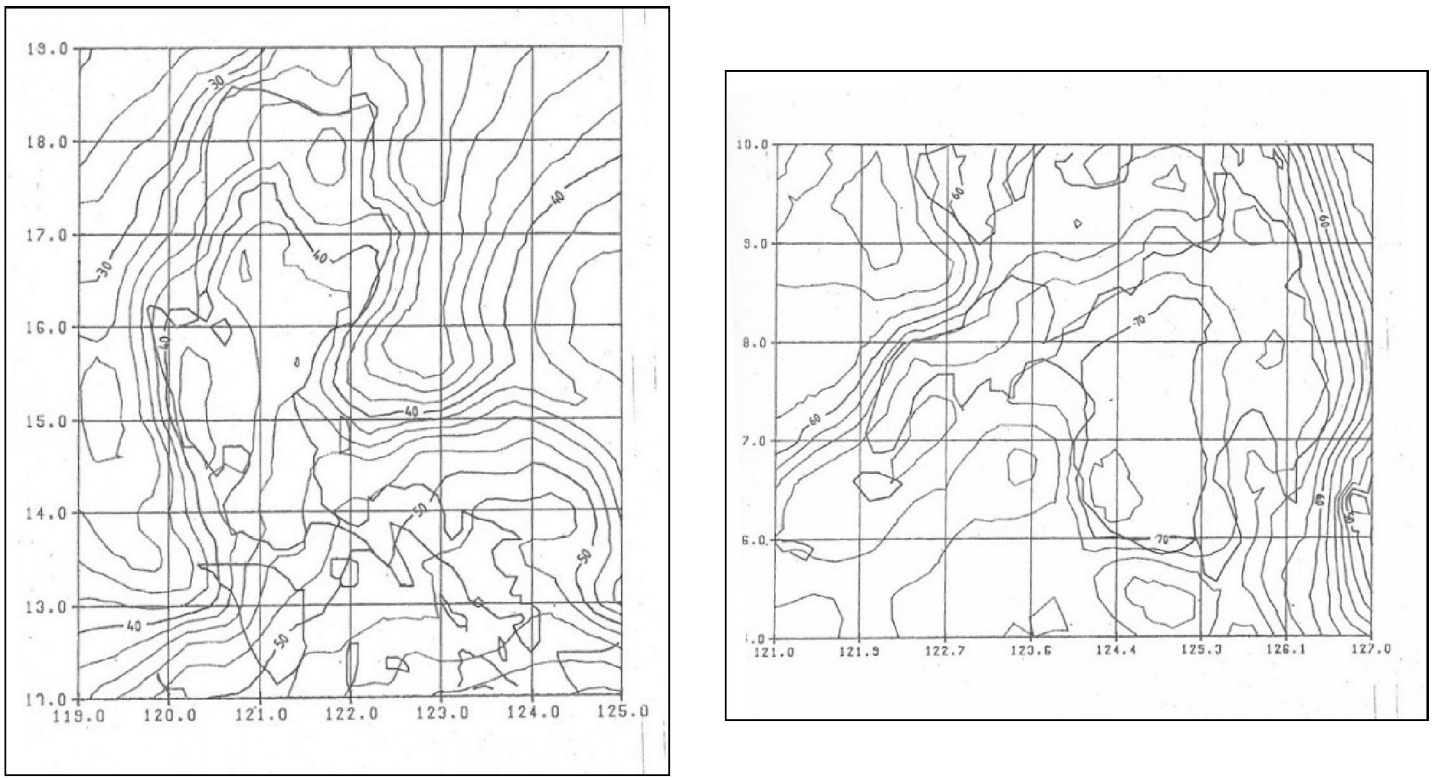

Figure 2. Detailed geoids of Northern (left) and Palawan with South West Philippines (right)

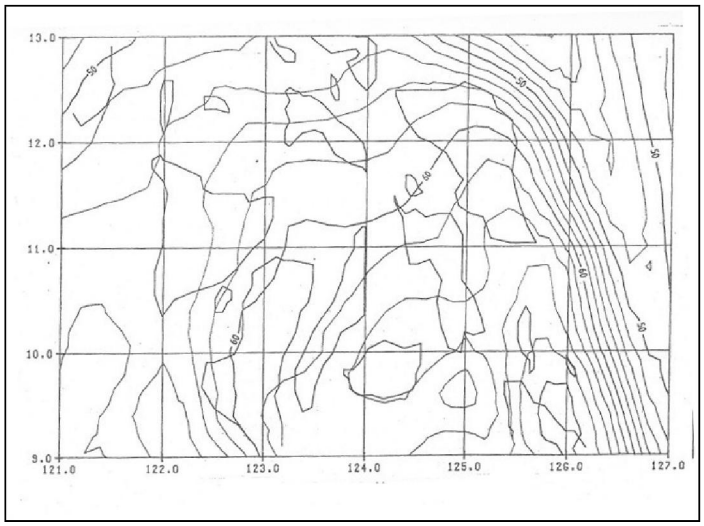

Figure 3. Detailed geoid of Visayas

(NRMDP). Figures 2 and 3 show the computed detailed geoids of the Philippines.

PGM2016 in the Making

Significant strides were made toward a Philippine Geoid Model (PGM) in October 2014. With assistance from Denmark Technical University (DTU-Space) and National Geospatial Intelligence Agency (NGA), a preliminary geoid model, i.e., Philippine Geoid Model 2014 (PGM2014) was computed for the country using the data from land gravity, airborne gravity, marine satellite altimetry, and the newest satellite gravity data from the Gravity Field and Steady-State Ocean Circulation Explorer (GOCE) mission release 5 with an accuracy of 0.30 meter.

This project is aligned with United Nations (UN) Resolution number 266 (UN, 2015). UN Resolution number 266 recognizes the growing demand for an accurate and stable global geodetic reference frame for the earth, allowing the interrelationship of measurements that can combine geometric positioning and gravity field-related observations (e.g., GNSS and Geoid), which form the basis and the reference used in location and height for geospatial information. For this article, the computation of PGM2014 will be discussed first, followed by the re-computation of the Philippine geoid.

The Airborne Gravity Survey

The success of the first long-range airborne gravity survey in Greenland 1991-1992 by a group from the US Naval Research Laboratory, in cooperation with the

continued on next page

National Oceanic and Atmospheric Administration (NOAA), the National Imagery and Mapping Agency (NIMA), and the Danish National Survey paved the way for the use of airborne gravity in filling the intermediate wavelength bands between satellite gravity, e.g., Gravity Recovery and Climate Experiment (GRACE) and GOCE (R. Forsberg & Olesen, 2010) for accurate geoid modelling.

After the successful airborne gravity campaigns in the other regions of the world, DTU-Space conducted the airborne gravity survey in the Philippines from March until May of 2014 using a Cessna Caravan aircraft. This was part of a project to improve the global gravity field model, i.e., Earth Gravitational Model 2008 (EGM2008). The mean altitude for all flights was 3,185 meters (m.) with a terrain clearance of 545 m. above mountains and 3,760 m. in lowlands. GNSS reference stations which operated in all airports together with the active geodetic stations of NAMRIA, were used as base stations in computing the position of the aircraft. Figure 4 shows the color-coded flight elevations.

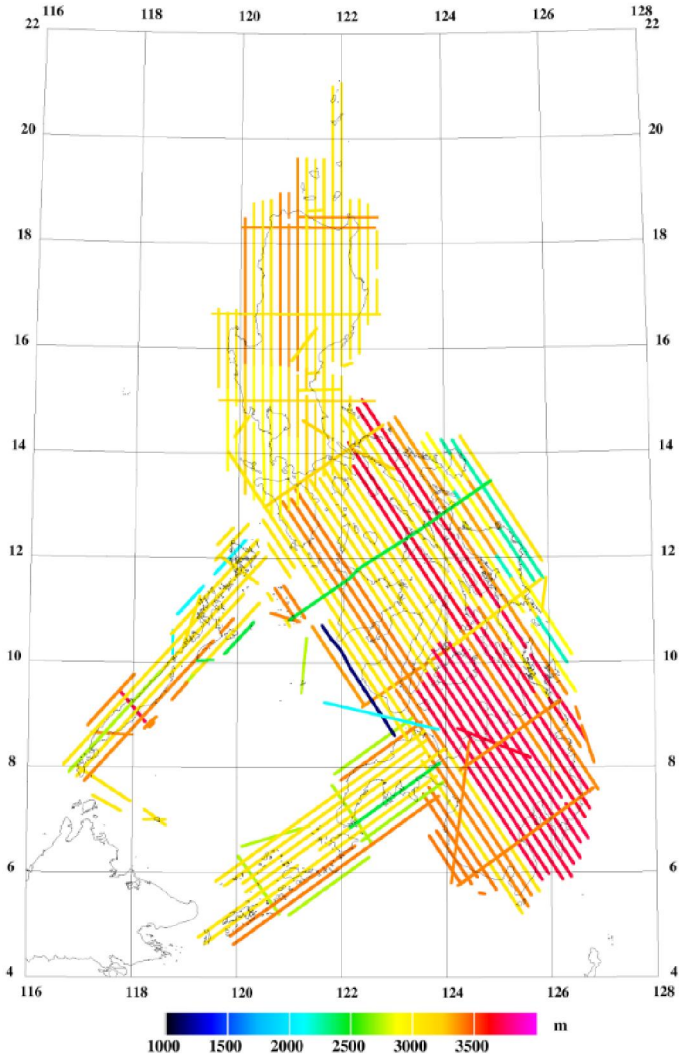

Figure 4. Flight track elevations of the airborne gravity survey

Free–air gravity anomalies at aircraft level are obtained from:

$$\Delta_g = f_z - f_{z0} - \ddot{h} + \delta g_{eotvos} + \delta g_{tilt} + g_0 - \gamma_0$$

$$- \left(\frac{\partial \gamma}{\partial h}(h-N) + \frac{\partial^2 \gamma}{\partial h^2}(h-N)^2\right)$$

The definition for the formula can be found in (Moritz, 1980) and the platform off-level correction g_{tilt} is based on a platform modelling approach described in Olesen, 2002. All altitude-dependent atmospheric corrections were applied (see Hintze, et al., 2005). All data were filtered with a symmetric second-order Butterworth filter with a half-power point at 170 seconds, corresponding to a resolution of six kilometers (half-wavelength).

Figure 5 (left) shows the acquired free-air anomalies (FAA) at flight altitude. Color agreement at cross lines indicate consistent data. Closer examination of the misfit in the 289 line intersections shows a 3.7 milligal (mGal) RMS error indicating 2.6 mGal average noise level. Figure 5 (right), comparison with EGM08 shows significant differences in many places amounting to more than 130 mGal over Southeast Mindanao.

Computation of PGM2014

The PGM2014 was computed by the *GRAVSOFT* system, a set of Fortran routines developed by DTU-Space and Niels Bohr Institute, University of Copenhagen (Forsberg R, 2008). The computation though this system forms the base of major geoid computation projects in Europe (R. Forsberg, D. Solheim & J. Kaminskis, 1996), (R. Forsberg et al., 2002). The "remove-restore" technique, as described in Pahlevi, et al., 2015 was used in computing the geoid, where a spherical harmonic earth geopotential model (EGM/GOCE combination) was used as a base, and the geoid was computed from the global contribution N_{egm}, a local gravity-derived component N_2, and a terrain part N_3: $N_{grav} = N_{egm} + N_2 + N_3$ Details of the spherical harmonic computations can be found in R. Forsberg, D.

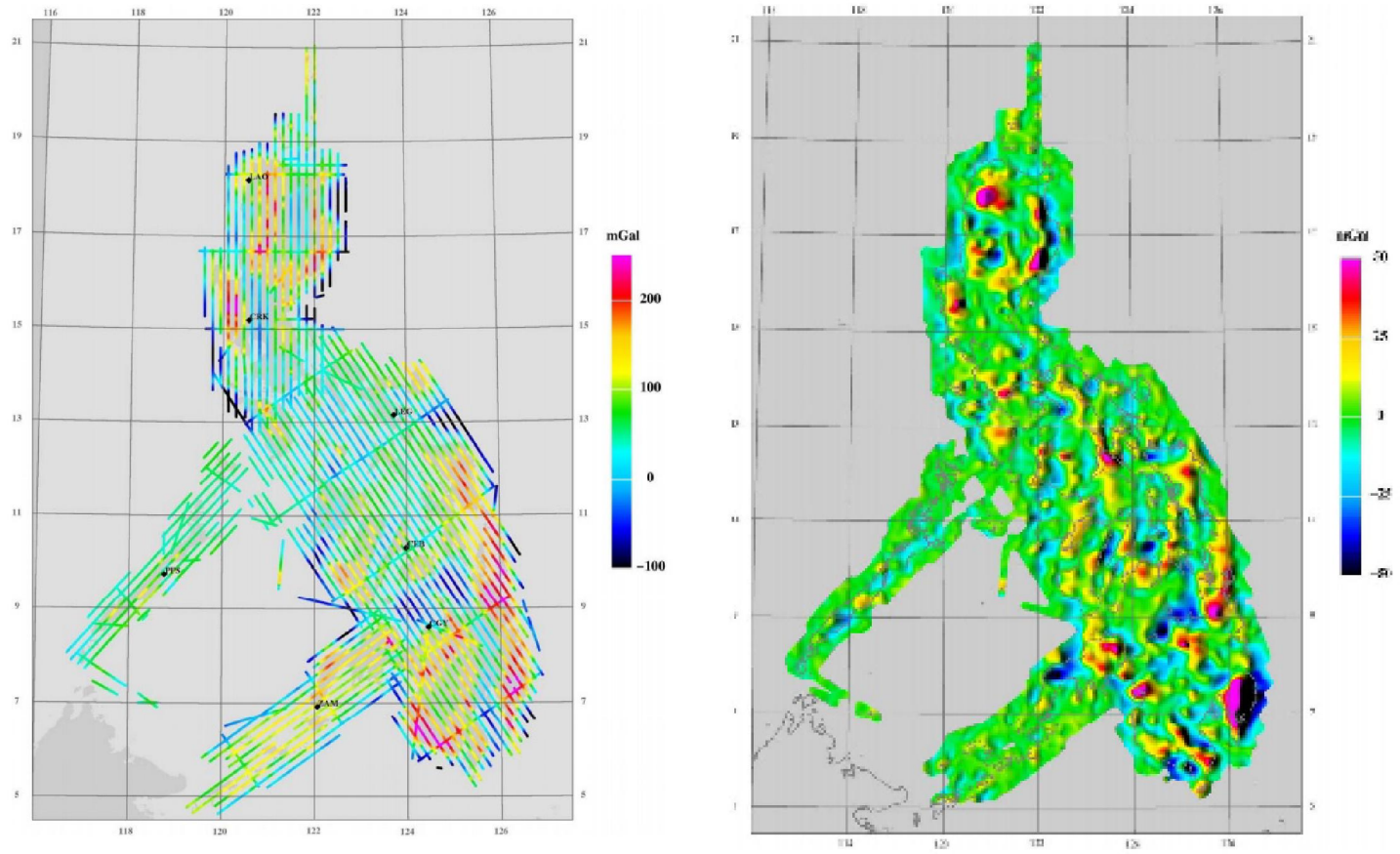

Figure 5. Free air anomalies at altitude (left) and Airborne - EGM08 residuals at altitude (right).

Solheim & J. Kaminskis, 1996; R. Forsberg & Olesen, 2010; R. Forsberg et al., 2002.

The geoid was computed on a grid of 0.025° x 0.025° resolution corresponding to roughly 2.7 x 2.5 km grid. The area of computation was 04°-22°N and 112-128°E, covering the Kalayaan Islands of West Philippine Sea as seen in Figure 6.

The final gravimetric geoid solution was computed using the following steps: *subtraction of EGM08GOCE spatial reference field (in a 3-D "sandwich mode")*; *residual terrain model (RTM) terrain reduction of surface gravimetry, after editing for outliers*; *RTM terrain reduction of airborne gravimetry*; *reduction of DTU-10 satellite altimetry in ocean areas away from airborne data*; *downward continuation to the terrain level and gridding of all data by least-squares collocation using a 1° x 1° moving-block scheme with 0.6° overlap borders*; *Spherical Fourier Transformation from gravity to geoid;*

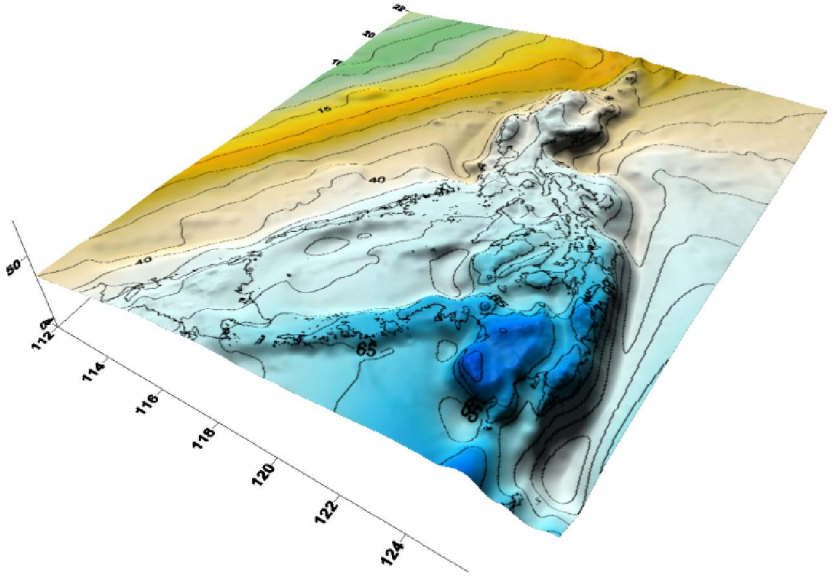

Figure 6. The Preliminary Philippine Geoid Model 2014. Contour interval 5m.

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restoration of RTM and EGM08GOCE effects on the geoid; *correction for the difference between quasigeoid and geoid (using a Bouguer anomaly grid)*; and *shifting of the computed geoid by +80 centimeter (cm.) to approximately fit to Manila tide gauge datum.*

Data Used and Quality Control for the geoid computation

PGM2014 is based on the following data: airborne gravity data; land gravity from NAMRIA, reformatted to GRAVSOFT with minor edits; DTU10 global gravity anomalies from multi-mission satellite altimetry; selected only in the open ocean area, away from the airborne gravity; SRTM 15" DEM data for the region; and EGM08 and GOCE RL5 satellite data.

The available data from the airborne and surface sources (1261 pts) were quality controlled through plotting of the EGM08/GOCE and terrain reduction residuals, showing a few (< 1%) obvious surface gravity outliers that were deleted in the final geoid processing. These obvious surface gravity outliers were likely due to a combination of geodynamic effects, and leveling and GNSS errors. The Quality Control (QC) Plot of the processed data is shown in Figure 7.

Geoid Processing Results

The final geoid, computed with full three-dimensional modelling, going via the quasigeoid to the classical geoid, covers the region 4-22°N, 112-128°E, and has a resolution of 0.025° x 0.025°. Figure 8 shows the bouguer anomaly grid done for the geoid-quasigeoid

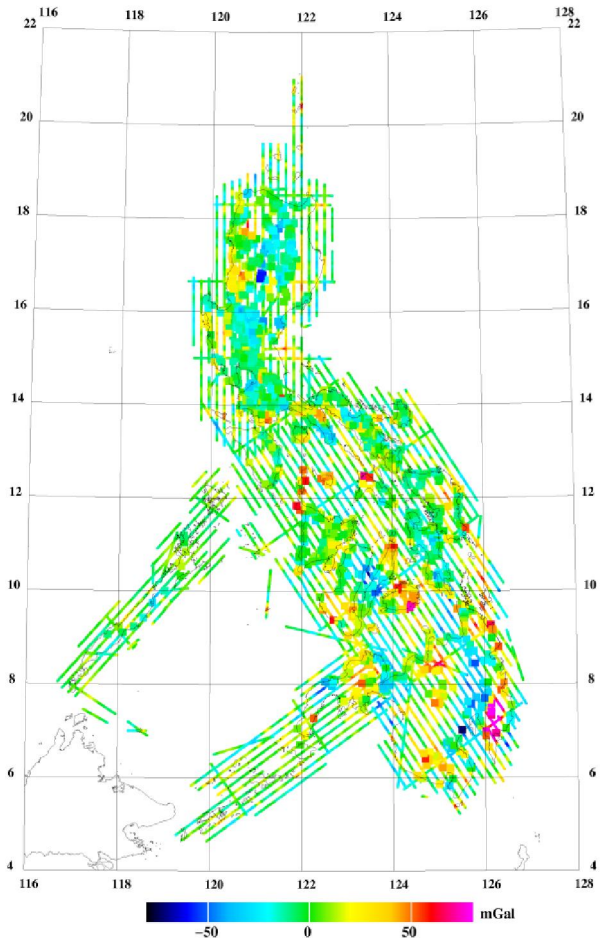

Figure 7. NAMRIA land gravity data (circular dots) and the airborne gravity data after terrain and EGM-reduction.

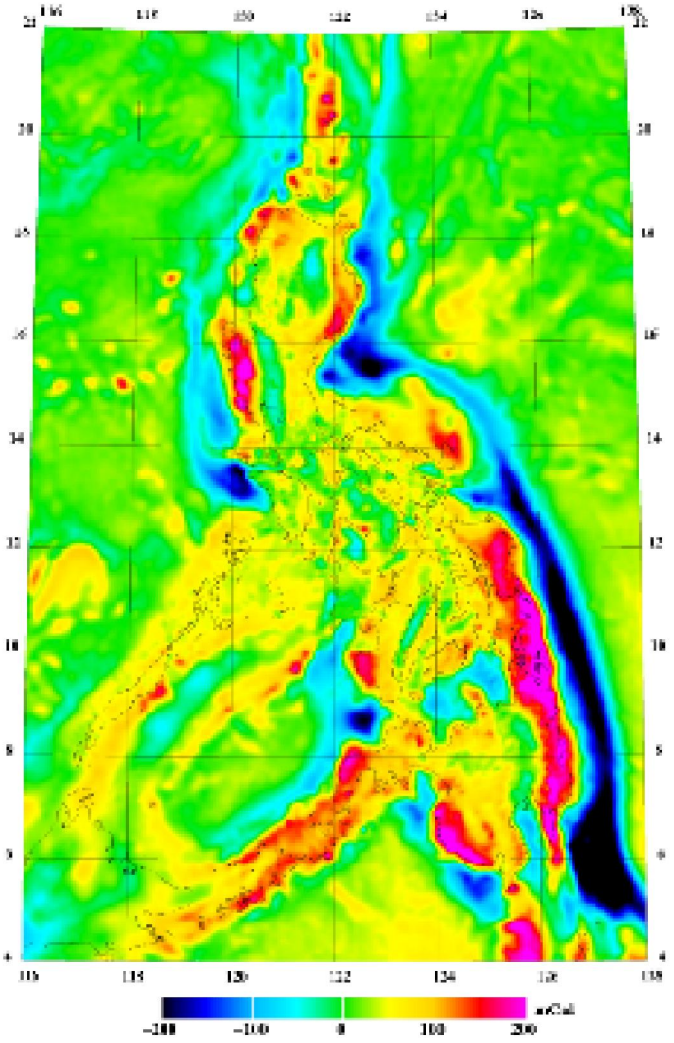

Figure 8. Bouguer anomaly grid, derived from the reduced data.

estimation. The final geoid "restoration" statistics show a 25-centimeter geoid in the following table.

Unit: meters	Mean	Std.dev.	Min.	Max.
Reduced geoid (after spherical FFT)	0.00	0.25	-1.61	2.88
RTM restore effects (computed by FFT)	0.00	0.04	-0.23	0.74
Final gravimetric geoid statistics	39.06	18.36	-9.02	76.43

GNSS/Leveling Data Comparison and Fitted Geoid

A set of 190 GNSS data in ITRF2005 leveling benchmarks was used to compare with the final geoid. These GNSS data showed large errors relative to the geoid, with large outliers in some regions. The RMS fit is 0.50 m. Figure 9 shows the offset values and the comparison of PGM2014 to EGM2008 showing large improvements in Southern Philippines.

Re-computation of the Geoid (PGM 2014 to 2016)

In 2015, NAMRIA started the re-computation of the Philippine geoid with the help of Professor Rene Forsberg of DTU SPACE, Technical University of Denmark. To further enhance and refine the geoid, the densification of land gravity stations is being conducted in some major cities of the country (2443 points to date). Also, to improve the geoid, the GNSS/leveling data was re-analysed and outliers deleted as recommended in a paper prepared by Professor Forsberg in 2003.

New Gravity and GNSS/Leveling Data

In this re-computation, the airborne and satellite data processing results were left as they are. Only the densified land gravity data were reprocessed and quality controlled. The GNSS/leveling data was also cleaned

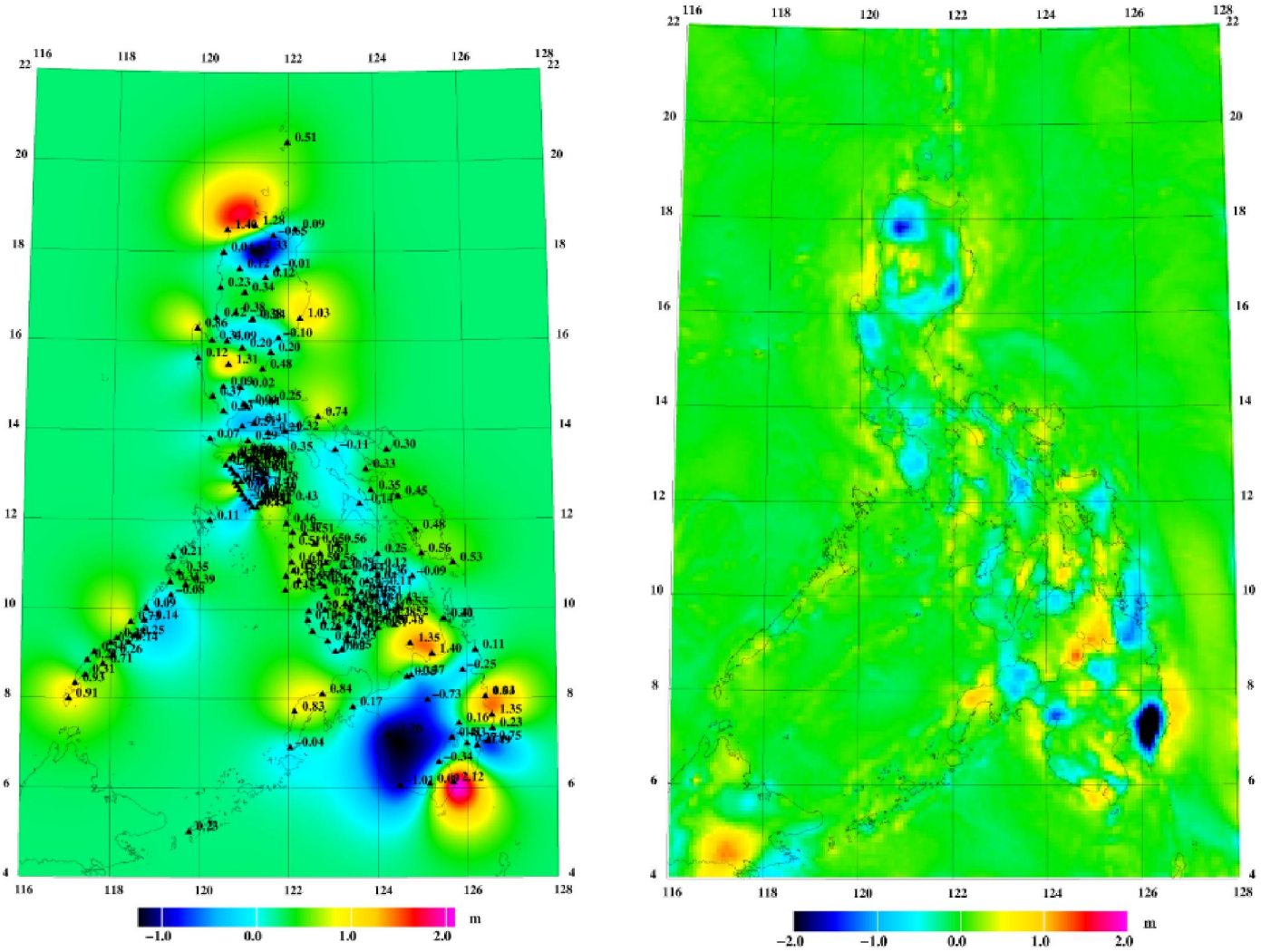

Figure 9 (left) - Location of GPS/Leveling data. Color shows the correction surface; (right) - difference between PGM2014 and EGM2008

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PGM 2016...
from page 13

up for outliers and the RMS fit is now 0.040 m. Figure 10 shows the new plots of the land and airborne gravity data together with the new correction surface.

The PGM2014 was re-computed as the new PGM2016 by using additional land gravity stations and corrected GNSS/leveling data combined with the same airborne and satellite gravity data. More land gravity data (up to 41,000) will be added from 2017 until 2025 in order to further refine the Philippine geoid. Figure 11 shows the new PGM2016 and its plotted differences with PGM2014. There are differences in most parts of the country as big as 0.30 m.

Conclusion

A new geoid model (PGM2016) has been computed based on reprocessed and densified land gravity and GNSS/leveling data, airborne and satellite gravity, and satellite altimetry from the previous geoid (i.e., PGM2014). PGM2016 has an accuracy of 0.022 m., i.e., equivalent to three-centimeter accuracy class of the new standards of FGDC for Vertical Controls (https://www.fgdc.gov/standards/projects/FGDC-standards-projects/accuracy/part2/chapter2, 1998). This is a modern and efficient way of conducting topographic and engineering surveys, and can mostly replace the need for leveling surveys.

The geoid model in *.ggf* format can be incorporated into Trimble Business Center (TBC) Software to generate MSL elevation in GNSS data processing. The *.ggf* file can also be entered into a Real Time Kinematic (RTK)-enabled receiver to compute for MSL elevations during RTK surveys in various applications such as thematic, topographic, and all types of mapping that requires elevation. The PGM 2016 and an interpolation program is available for download through the NAMRIA Website in *.gri* format. NAMRIA, through its Mapping and Geodesy Branch, is working towards adopting the

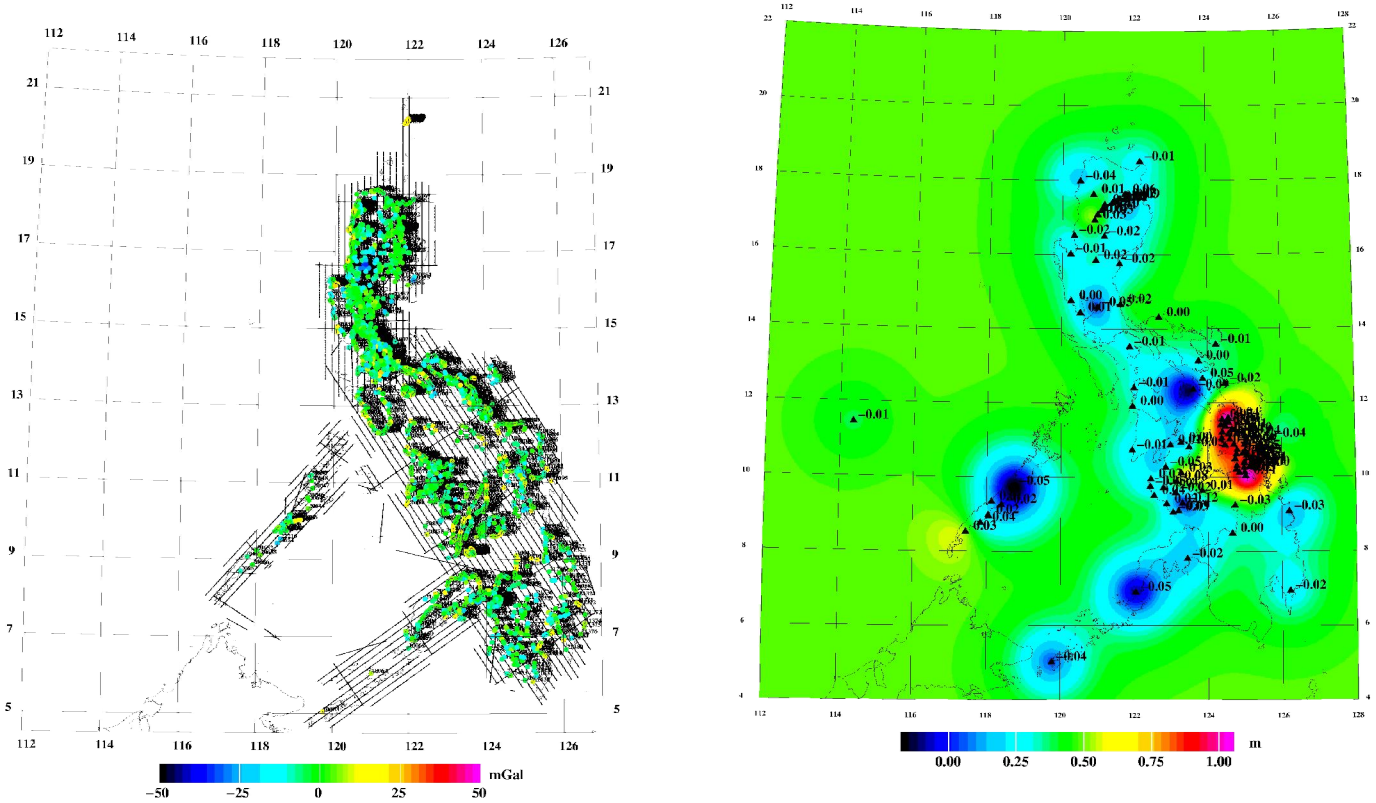

Figure 10 - (left). Land gravity data after reprocessing and densification. Most differences are below 25mGals, some points exceeds 35mGals in mountainous regions. Figure 10 – (right). The new corrector surface.

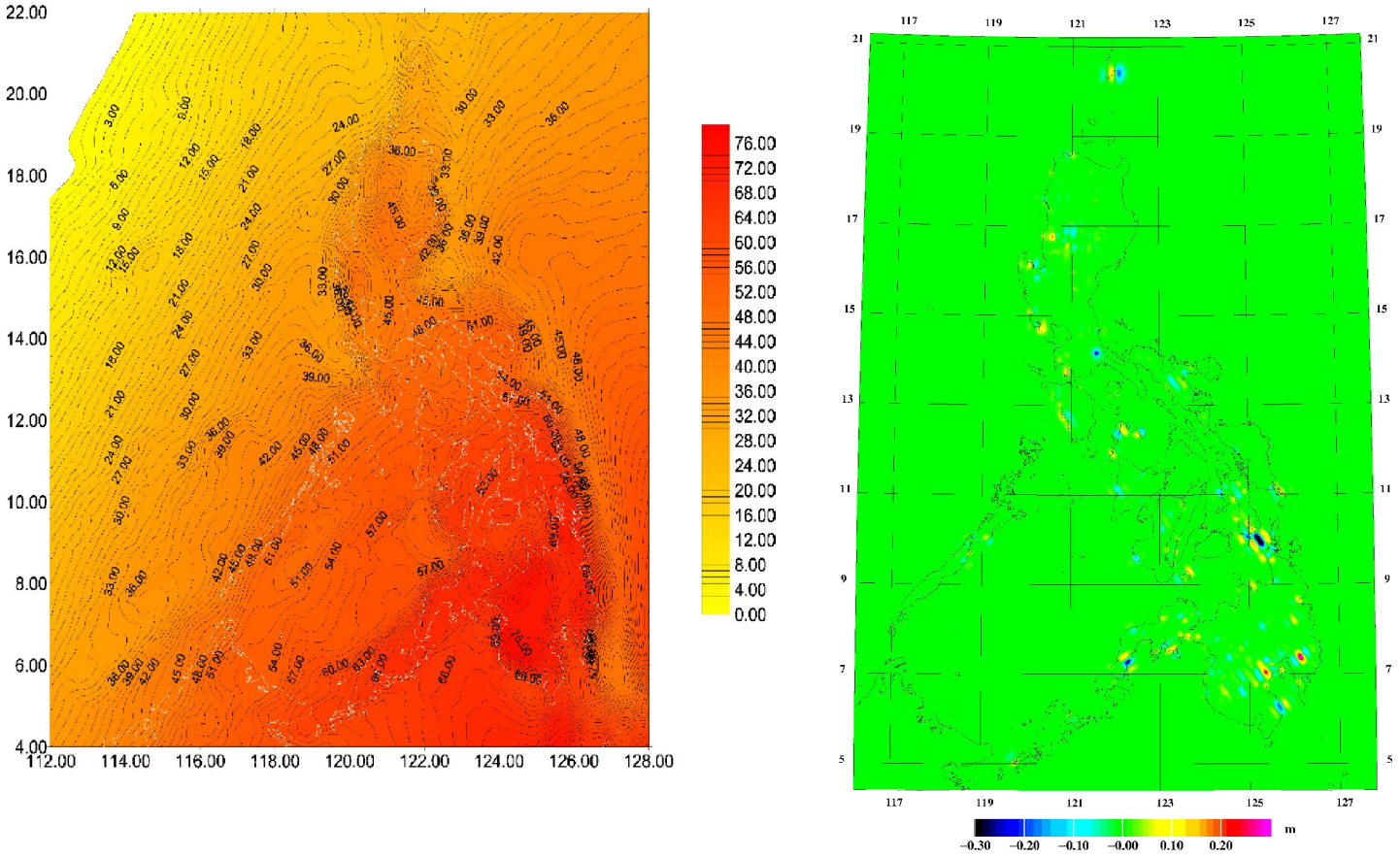

Figure 11-(left). The new geoid model PGM2016, Contour interval 1m (left). Figure 11-(right). The difference between PGM2014 and 2016.

Philippine Geodetic Vertical Datum 2020 (PGVD2020) to replace the current height reference (i.e., local MSL) as the official vertical datum of the country, and using the Philippine Geoid Model as the standard in estimating elevation of points using GNSS. The application of the geoid model in GNSS surveys is the new trend in determining elevations. The challenge now is how to maintain and update our geoid model. The earth is constantly changing, so is the geoid.•

References

Dr. Bernhard Hofmann-Wellenhof, D. H. M. (2005). Physical Geodesy (pp. 46).

FGCC. (1984). Standards and Specifications for Geodetic Control Networks *Specifications* (pp. 3-7). Maryland: Federal Geodetic Control Committee.

Forsberg, R. (2003). *Towards a cm-geoid for Malaysia.* Paper presented at the geoid computation workshop in Kuala Lumpur.

Forsberg R, C. C. T. (2008). Overview manual for the GRAVSOFT Geodetic Gravity Field Modelling Programs (Technical Report, 2nd ed.): DTU-Space.

Forsberg, R., D. Solheim & J. Kaminskis. (1996). *Geoid of the Nordic and Baltic area from gravimetry and satellite altimetry.* Paper presented at the Symposium on Gravity, Geoid and Marine Geodesy, Tokyo, 1996.

Forsberg, R., & Olesen, A. V. (2010). Airborne gravity field determination *Sciences of Geodesy-I* (pp. 83-104): Springer.

Forsberg, R., Strykowski, G., Iliffe, J., Ziebart, M., Cross, P., Tscherning, C. C., . . . Finch, O. (2002). OSGM02: A new geoid model of the British Isles. *Gravity and geoid, 3*.

https://www.fgdc.gov/standards/projects/FGDC-standards-projects/accuracy/part2/chapter2. (1998). Part 2: Standards for Geodetic Networks. *FGDC-STD-007.2-1998* FGDC-STD-007.2-1998. Retrieved February 17, 2017

Moritz, H. (1980). Advanced physical geodesy. *Advances in Planetary Geology, 1*.

Olesen, A. V. (2002). *Improved airborne scalar gravimetry for regional gravity field mapping and geoid determination.* Faculty of Science, University of Copenhagen.

Pahlevi, A., Pangastuti, D., Sofia, N., & Kasenda, A. (2015). *Determination of Gravimetric Geoid Model in Sulawesi–Indonesia.* Paper presented at the FIG Working Week.

UN. (2015). A Global Geodetic Reference Frame for Sustainable Development *UN Resolution No. 69/266* (69th Session ed.).

Vanicek, P. (1991). Vertical datum and NAVD88. *Surveying and Land Information Systems, 51*(2), 83-86.

NAMRIA HRM at its PRIME: Human Resources for a Geospatially- Empowered Philippines

*by Xenia R. Andres**

NAMRIA Administrator Peter N. Tiangco (third from left) receives from CSC the PRIME-HRM award at the Luxent Hotel in Quezon City. With him is Administrative Division Chief Concepcion A. Bringas (second from left). The milestone achievement was made more remarkable with the contribution of the 882-strong human resources of the agency, NAMRIA's most significant assets, bedrocks of ideas and execution, and pillars of excellent public service.

On 07 March 2016, NAMRIA was awarded a Certificate of Recognition for having met Maturity Level-II indicators for four core HR systems of the Program to Institutionalize Meritocracy and Excellence in Human Resource Management (PRIME-HRM). The four core HR systems are Recruitment, Selection, and Placement (RSP); Performance Management; Learning and Development (L&D); and Rewards and Recognition. The Civil Service Commission (CSC) PRIME-HRM program is "a mechanism to continuously capacitate agencies in the performance of their HRM functions, recognize best practices in the various areas of HRM, and serve as a venue of exchange and development of expertise in HRM in the Philippine public service."

This is the story of how strategic HRM became fundamental to the Philippines' central mapping and geospatial information management agency.

Personnel and Manpower Development

NAMRIA has a personnel complement of civilian employees, commissioned officers, enlisted personnel, and job-order employees. Since the agency's creation in 1987,

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HRM encompassing personnel and training functions have been delegated to the Administrative Division-Personnel and Manpower Development Section (PMDS). The PMDS has the following administrative service functions: (1) Formulate and continuously upgrade personnel programs and policies, which include personnel staffing requirements, qualification standards (QS), system of ranking positions, personnel compensation package, and relevant policies on personnel management and administration; (2) Conduct recruitment and placement activities; (3) Process and attend to all matters regarding employee benefits, appointments, promotions, transfers, attendance, leave of absence, and other personnel transactions; and (4) Develop, implement, and periodically evaluate manpower policies and initiate and make plans to meet manpower requirements.

Strategic HRM Beginnings

NAMRIA's journey from transactional to strategic HRM began in 2005 through a technical cooperation program between the Government of the Republic of the Philippines (GOP) and the Government of Japan (GOJ). The shift from transactional to strategic HRM entailed discerning, clearing, and reaching standards. GOP was represented by NAMRIA while GOJ was represented by the Japan International Cooperation Agency (JICA).

JICA Findings

The three-year program was entitled S*tudy for Mapping Policy and Topographic Mapping for Integrated National Development Plan in the Republic of the Philippines*. The study aimed to strengthen NAMRIA in maintaining and managing geographic information and to formulate an implementation plan for the agency to promote nationwide deployment of 1:50,000-scale topographic maps.

Requiring institutional improvement and organizational development, the study surfaced organizational issues which included "keeping and improving technical capabilities as a specialized organization of mapping and surveying" and "systemization of human resource development (HRD)." The results showed that "it is necessary to strengthen the function for HRD, because at present, the unit only does filing job and the weakness of the function is ruining performance management" and "a program for strategic HRD for technical improvement is not fundamentally improved as a whole in NAMRIA."

Enhancing PMDS Competency

The JICA organizational assessment was validated in 2008 by the Philippines-Australia Human Resource Development Facility (PAHRDF) which sent two scholars from PMDS, Ms. Agnes G. Radam and Ms. Florence N. Manangu, to study for a master's degree in HRM in Australia. Upon the scholars' return in 2009, they implemented a re-entry action plan (REAP) on enhancing the competency of PMDS. Their REAP aimed to train the HRM officers to utilize the HR Information System (HRIS) on time and attendance; establish well-defined functions and accountabilities of each PMDS staff; align the section work plans and programs with NAMRIA plans and programs; and optimize and develop PMDS staffers' potentials and involve them strategically in the agency plans and projects (Radam & Manangu, 2009).

Strengthening Middle Management

Also in 2009, NAMRIA and Geoscience Australia (GA) inked a memorandum of understanding (MOU) to strengthen spatial data development and delivery in the Philippines. Identification of engagement areas for spatial data management was a result of the GA scoping mission. The mission was part of the Australian Government's commitment for an enhanced natural hazard identification and risk modelling capacity in the Philippine Government. The MOU provided for the development of an internal spatial data infrastructure (SDI) or NAMRIA SDI (nSDI) strategic and implementation plan; the improvement of data validation systems; the piloting of a small, 1:50,000-scale topographic data spatial database; and a simple Intranet web-map interface for it.

In 2010, NAMRIA was a recipient of a PAHRDF training program on Strengthening Leadership of Middle-Level Management. The three-month program had *The Five Practices of Exemplary Leadership* by Kouzes and Posner as model and nSDI as case example.

Forty-seven participants completed the program facilitated by Bridgeworth Consulting Co. and PeopleSparx Incorporated (PSI). They developed and implemented REAPs that demonstrate their acquired leadership behavior and learning to ensure NAMRIA buy-in and institutionalization of nSDI. The expected outcome was a pool of trained leaders who could readily assume high-level responsibilities.

Organizational Assessment

From 2011 to 2012, the Philippines Australia Human Resource and Organisational Development Facility (PAHRODF) conducted an organizational assessment of NAMRIA as a partner agency for the Collective Strengthening of Community Awareness for Natural Disasters Project. NAMRIA's change agenda on disaster-risk reduction and management (DRRM) was to fast-track the production of topographic maps to better address geohazard mapping needs. The assessment focused on the agency's change readiness and organizational capacities. The findings showed that "NAMRIA is poised to contribute significantly to the DRRM

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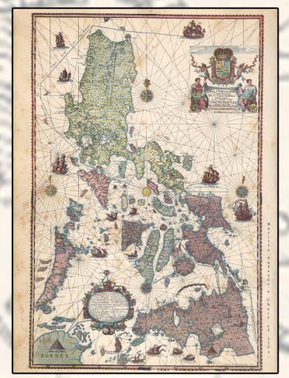
NAUTICAL CHARTING THROUGH THE YEARS



1734 – MURILLO – VELARDE MAP, ALSO KNOWN AS THE "MOTHER OF ALL PHILIPPINE MAPS IS PUBLISHED

1565-1815 – THE GALLEON TRADE CONNECTS MANILA AND MEXICO

1900 – US COAST & GEODETIC SURVEYS (USCGS) MANILA OFFICE IS ESTABLISHED

1988 – US ADMIRAL GEORGE DEWEY'S VICTORY IN BATTLE OF MANILA MARKS THE END OF SPANISH RULE IN THE PHILIPPINES

1911 – LUZON DATUM IS ADOPTED AS REFERENCE DATUM FOR ALL PHILIPPINE NAUTICAL CHARTS

1921 – INTERNATIONAL HYDROGRAPHIC BUREAU (IHB), WHICH IS THE INTERNATIONAL ORGANIZATION OF HYDROGRAPHIC OFFICES, IS ESTABLISHED IN LONDON

1939-1945 – SECOND WORLD WAR

1950 – THE BUREAU OF COAST AND GEODETIC SURVEY (BCGS) REPLACES THE USCGS

1955 - THE PHILIPPINES JOINED THE IHB

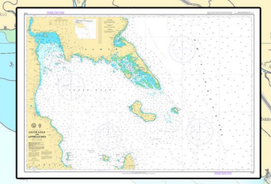
1970 - THE IHB WAS RENAMED AS THE INTERNATIONAL HYDROGRAPHIC ORGANIZATION (IHO)

1988 – BCGS IS PLACED UNDER THE NEWLY ESTABLISHED NAMRIA

EARLY 2000s– NAMRIA STARTED TRANSFORMING NAUTICAL CHARTS FROM LUZON DATUM TO WGS-84 DATUM.

2003 – NAMRIA PUBLISHED ITS FIRST ELECTRONIC NAVIGATIONAL CHART (ENC)

2012 – NAMRIA STARTED MIGRATING TO THE NEW SCHEME OF NAUTICAL CHARTS WHEREIN GENERAL SAILING AND COASTAL NAUTICAL CHARTS WILL BE AT UNIFORM SCALES OF 1:500,000 AND 1:150,000 RESPECTIVELY.



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program of the Philippine Government as far as the change agenda is concerned" (PAHRODF, 2012). However, reinforcement mechanisms and tools for the change agenda implementation were still inadequate and reinforcement structures such as rewards and incentives and sustainability mechanisms were not yet fully in place.

Most employees were observed in the assessment as possessing the required job skills; however, the manifestation of commitment by some employees was wanting as evidenced by the high incidence of absences and tardiness. In addition, managers were observed as being equipped with the appropriate technical skills for their respective jobs but their abilities to coach, mentor, motivate, and evaluate the performance of employees more objectively were improvement areas. The middle managers were understandably in transition and currently trying to apply at this point the concepts they had learned from the training program on Strengthening Leadership of Middle-Level Management.

The training of leaders and managers in strategic planning, monitoring and evaluation, and coaching and mentoring was also seen as important. In the assessment was also presented the need to elevate the capacity of the HRMD function in order to be efficient in transactions and to move to strategic and developmental roles if reasonable and practical, given that the HR unit in the NAMRIA PMDS had some organizational limitations in terms of its size and staffing (PAHRODF, 2012).

CBS Development

Also from 2011 to 2012, NAMRIA embarked on an agencywide International Organization for Standardization (ISO) 9001:2008 certification for its core process of mapping and geospatial information management. The quality management system (QMS) general requirement on human resources was that "personnel performing work affecting conformity to product requirements shall be competent on the basis of appropriate education, training, skills, and experience." In response to the ISO QMS requirements, NAMRIA implemented the Competency-Based System (CBS) Project in 2012. The project aimed to design an organizational core competency model to clearly define the required knowledge, skills, abilities, and behaviors needed by the agency's personnel for high-level performance and achievement of organizational success.

The developed competency model was to be used in position competency requirement descriptions, RSP, professional development programs, self-appraisal and career development, and performance management. NAMRIA eventually adopted the competency-based HRM approach with the approval of the CBS Manual in 2013. The CBS now serves as the foundation of NAMRIA HR programs.

Representatives from the Philippine National Police (PNP) and PAHRODF visited NAMRIA to conduct benchmarking activity held at the NAMRIA Board room on 02 December 2016. The activity served as an avenue to build network and gain further learning through the sharing of strategies and best practices in the HR field.

Strategic HR

Strategic Performance Management

Since 2014, the NAMRIA Strategic Performance Management System (SPMS) has been in use for the assessment and improvement of employee performance; and the effectiveness of the agency's programs and projects. With the SPMS, the agency has focused on how individual performance contributes to organizational performance.

The agency pushes forward the importance of performance management not only in organizational performance but also in the attainment of its vision. Its performance management brand states that *performance management is the key to attaining the NAMRIA vision.*

Strategic Planning

With assistance from the Facility and PSI, NAMRIA undertook the Strategic Planning Project in 2013 to define the agency's vision, mission, core values, and strategic initiatives and to validate and align them with operational, unit, and individual plans. The project resulted in NAMRIA realizing its True North, which is a geospatially-empowered Philippines by 2020, and outlining its Strategy Map and Plan from 2013 to 2020. The True North is also an unwavering commitment to always do the right thing for the agency's people and clientele (NAMRIA, 2013c).

One of NAMRIA's strategic objectives in the Strategy Map is *to develop and maintain a sufficient pool of competent human resource* which results in the agency's having an enhanced organizational capacity. Three of the 12 strategic initiatives in the Strategic Plan pertain to HRM, namely, *Organizational Performance Management*, *Strategic HR*, and *Morale and Welfare*. The REAP objective for Strategic HR initiative was to develop and implement by 2014 a Strategic HR Program which would map out the long-term NAMRIA HR directions, plans, and programs. The flagship HR program involved CBS, RSP, L&D, and Career Pathing and Succession Planning.

Strategic HRD Planning

In 2014, technical assistance from the Facility was obtained to develop the NAMRIA Strategic HRD Plan 2015-2019. The plan drives and supports the agency's institutional strategies and integrates the various HRD initiatives for a more coherent and effective approach to HRM (NAMRIA, 2015). While the Strategic Plan directs NAMRIA towards the pursuit of the agency's True North, the Strategic HRD Plan is the agency's people development and OD compass. The people and OD roadmap builds individual competencies and agency capabilities in pursuit of organizational performance excellence.

The three-pronged strategic HRD objectives are to ensure leadership development and continuity, develop individual and organizational competencies, and develop the HRD system and its processes into a strategic level of effectiveness. The strategic programs to achieve the objectives are the (1) Development of a Coaching and Mentoring Culture; (2) Development and Installation/Implementation of a Leadership Development and Succession Planning System; (3) Institutionalization of Organizational Capabilities in NAMRIA; (4) Implementation of the Learning and Development Curriculum; (5) Implementation of the Morale and Welfare Program; (6) Alignment and Improvement of HR Processes and Practices according to the CSC PRIME-HRM; (7) Strengthening of the HR Organization; (8) Evaluation of HR Effectiveness; and (9) Alignment of the NAMRIA Organization Structure with the Institutional Strategy.

The Strategic HRD Plan was implemented in 2015 with NAMRIA's top managers at the helm. A Strategic HR Technical Working Group and Leadership Planning Board was created to spearhead the implementation and monitoring of milestones and accomplishments; and evaluation and continuous enhancement of the Strategic HRD Plan.

Engaging Employees

Also in 2014, the agency carried out a project with the objective of initiating improvement in organizational and employee performance through the implementation of employee engagement mechanisms. The Employee Engagement Project generated baseline data on the drivers of employee engagement in NAMRIA using the Generation 5 Investors in People (IiP) Framework; gained for line leaders and managers their appreciation of their HRM roles; developed the awareness and competence of NAMRIA leaders and managers on employee engagement and coaching and mentoring; and recommended strategies to institutionalize employee engagement in NAMRIA.

This undertaking paved the way for the agency's formulation of a People Management Strategy Plan (PMSP), development of organizational and leadership brand statements, and creation of the Morale and Welfare Committee (MWC). The PMSP provides NAMRIA top and middle managers with the technology to link people management processes and organizational priorities. The agency's organizational brand is *NAMRIA: We show the way* while the leadership brand is *NAMRIA leaders are enablers, credible, technically capable, and socially responsible*. The MWC was constituted to integrate, institutionalize, implement, and coordinate the various activities of the Morale and Welfare strategic initiative.

Building HR Business Partnership

Through the Strategic HRD Planning Project, the Strategic HR Business Partnering (HRBP) concept was introduced to the line managers. The concept was drawn out

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NAMRIA HRM ...

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from a study of the Ateneo Center for Organization Research and Development on the line managers' willingness and ability to perform HR functions as organizations transition into strategic HR (Tolentino & Angeles, 2012). As strategic HR business partners, line managers are operation managers, strategic partners, employee mediators, and emergency responders.

PRIME-HRM

In 2012, CSC promulgated a circular adopting the PRIME-HRM implementation guidelines. In the years 2013 and 2014, CSC enhanced PRIME-HRM and developed the HR maturity level indicators that are aligned with global standards on good people management practices (CSC, 2015). At the end of 2014, it issued a circular adopting the HR maturity level indicators for public sector HRM, namely, Level 1-Transactional HRM, Level 2-Process-Defined HRM, Level 3-Integrated HRM, and Level 4-Strategic HRM.

The components of the circular comprised the processes of Assessment, Assistance, and Recognition. The first process covers the assessment of the four core HRM systems using the HR maturity level indicators and the following lenses: *Competencies*, *Practices*, and *Systems*. The *Competencies* lens is categorized into Level 1-Basic, Level 2-Intermediate, Level 3-Advanced, and Level 4-Superior. The second PRIME-HRM process involves the provision of continuing assistance and review for excellent HRM based on the gaps or developmental opportunities identified in the assessment process. The final process gives agencies a certain degree of autonomy through accreditation and/or deregulation and confers on them the Center of HR Excellence or the Seal of HR Excellence award.

In 2014, NAMRIA underwent self-assessment and maintained its Level-II accreditation status. As such, the agency would be subjected to onsite assessment within two years using the Maturity Level II standards. Compliance with PRIME-HRM Maturity Level II means that an agency is no longer doing merely transactional HR processes but is moving toward more integrated and mature HR systems (CSC, 2015). Since then, compliance with the enhanced PRIME-HRM has become one of the activities under the NAMRIA Strategic HR initiative.

In 2015, the CSC National Capital Region-Development Bank of the Philippines Field Office discussed with NAMRIA the PRIME-HRM self-assessment observations and gaps on the *Competencies* lens and the *Systems* lens. NAMRIA addressed the gaps, strengthened the HR mechanisms, and implemented action steps to fulfill the PRIME-HRM requirements on the identified lenses. Validation through the use of the *Practices* lens was also conducted to complete the assessment through an undertaking with IiP Philippines.

IiP: International Standard for People Management

NAMRIA joined the *Working with the Standards* program of IiP Philippines in 2014. The membership was in line with the agency's initiatives to effectively implement HRM systems and programs in accordance with the enhanced PRIME-HRM. The enhanced program has since adopted IiP standards in assessing the HRM systems of government agencies. In 2016, NAMRIA continued its step towards excellence in people management through the conduct of the Levelling Up for PRIME-HRM Assessment. The assessment aimed to strengthen the *Practices* lens of NAMRIA and to prepare the agency towards compliance with higher levels of HR standards as defined in the PRIME-HRM maturity level indicators. IiP Philippines facilitated the activity through employee focus group discussions (FGDs) and managers' workshop. The FGDs aimed to verify NAMRIA's position in relation to the PRIME-HRM *Practices* lens while the workshop gave an in-depth view of the leadership and management practices of managers and how the employees understand the HR systems in place based on the FGD findings. The activity outputs were HR organizational assessment data and action plans on further improving and aligning HR processes and practices with PRIME-HRM standards.

Other Steps in the Journey and Beyond PRIME-HRM

The years 2015 and 2016 were marked with other turning points in the NAMRIA strategic HR journey. In 2015, first was the agency's continuing implementation of the Morale and Welfare Program, the NAMRIA Grievance Machinery, and the NAMRIA SPMS. Second was the crafting of the Individual Development Plan to effectively address the development priorities and performance goals of employees. Third was the crafting of the NAMRIA Career Development Program to develop retention and succession strategies that would facilitate the creation of a pool of leadership talent and high potential successors. Fourth was the revision of the NAMRIA Merit and Selection Plan into the NAMRIA Recruitment and Placement System (NRPS) incorporating the uniformed service in the policy. This called for the reviewing of the QS for enlisted personnel. Fifth was the approval by the CSC of the NRPS with *"Map your future with us!"* as the NAMRIA recruitment brand. Finally for 2015, sixth was the revision during the year of the NAMRIA Program on Awards and Incentives for Service Excellence and its approval in 2016. Seventh was the formulation in 2016 of the NAMRIA Coaching Guidelines and Norms as learning application output of the series of coaching skills development workshops for leaders, managers, and supervisors. This was likewise approved for implementation in 2016.

In support of existing HR interventions, work began in the same year to develop a curriculum, i.e., a process and

system for continuous learning, assessment, and measurement (Galvez, 2016). The agency is in effect setting up a ladderized learning curriculum that will result in a more organized sequence of learning and provide a complete set of learning necessary for a job or role.

Since 2013, with the approval of its rationalization plan, the agency has been operating on a rationalized structure. It also has a Medium-Term Staffing Plan for its job-order employees and applies the CBS in their RSP. The efforts in Organization Design, Workforce Planning, Employee Relations, and Career Development show that NAMRIA is going beyond the PRIME-HRM requirements.

NAMRIA has adopted the CSC Strategic HR Framework which dichotomizes HR into HRM and HRD and places competent performance at the core. HRM covers the following HR systems: Organization Design, Workforce Planning, RSP, and Rewards and Recognition; while HRD covers the following HR systems: Performance Management, L&D, Employee Relations, and Career Development. With the aforementioned HR systems in place, NAMRIA has been able to expand its strategic HR horizon beyond PRIME-HRM.

NAMRIA HR Transformation: Lessons Learned and Way Forward

In the journey of the NAMRIA HRM towards being strategic, the agency shifted its focus not on technology and methods but on its people as the most important resource and driver of organizational success. The journey also changed the leaders and managers from being authoritative to being transformational. From just operating on an annual work plan, the agency is now guided by a Strategic Plan with people at the business core. Unlike before when HR was seen as merely an administrative support function, HR is now a strategic and integral partner of the organization. HR business partnership is being fostered among leaders, managers, employees, and stakeholders.

NAMRIA continues to build on the gains it has achieved and the partnerships it has built and strengthened in its journey towards strategic HRM, given the future geospatial information management trends in skills base, skills requirements, and training mechanisms. To date, the agency has beefed up and upgraded its HR infrastructure by including the whole gamut of functions in the HRIS. The agency is revising its Scholarship Policies into L&D Policy, and reviewing its CBS to ensure relevance and enhance clarity and usefulness.

The following are being looked into: (1) HR outsourcing; (2) migrating to ISO 9001:2015 QMS standards, which emphasize people engagement initiatives and enhanced leadership requirements; and (3) revisiting the NAMRIA Strategic Plan. In the near future, the agency aims to be accredited with the IiP Generation 6 Standard and to be awarded under the PRIME-HRM enhanced maturity-level indicators.

The NAMRIA journey from transactional to strategic HR is a journey of transformational change, a change in mindset and paradigm, a shift in the status quo that is irreversible. An engaging work environment will help NAMRIA remain steadfast in its goal towards a geospatially-empowered Philippines.•

References:

Andres, X. (2014). *Implementing employee engagement mechanisms in NAMRIA* [Re-entry project report]

_____. (2010). nSDI: towards better geoinformation service for good governance. *Infomapper*, pp. 8-9, 21&23

Baltazar, C. (2014). *Strategic HR business partnering workshop* [PowerPoint slides]

Bringas, C. (2016). *NAMRIA HROD journey towards CSC PRIME-HRM* [PowerPoint slides]

Carandang, E. (2016). *NAMRIA's HROD journey: putting HR strategy on the map* [PowerPoint slides]

Civil Service Commission. (2016). *Program to institutionalize meritocracy and excellence in human resource management (PRIME-HRM) enhanced maturity level indicators* [Memorandum circular]

_____. (2015). PRIME-HRM's maturity level 2: process-defined HR. *CS Reporter*, p. 33.

_____. (2014). *Adoption of HR maturity level indicators for the human resource management systems in the public sector* [Memorandum circular]

_____. (2012). *Program to institutionalize meritocracy and excellence in human resource management (PRIME-HRM)* [Memorandum circular]

Galvez, J. (2016). *HR curriculum development programs* [PowerPoint slides]

Gutierrez, D. (2017). *Human resource information system* [PowerPoint slides]

National Mapping and Resource Information Authority. (2015). Strategic HRD plan

_____. (2013a). Competency-based system documents

_____. (2013b). Strategic performance management system (SPMS) guidelines

_____. (2013c). Strategic planning manual: towards the pursuit of our true north

_____. (1987). Operations manual

Norris, J. (2015.) Future trends in geospatial information management: the five to ten year vision. United Kingdom: United Nations Committee of Experts in Global Geospatial Information Management

Pasco Corporation. (2008). Study for Mapping Policy and Topographic mapping for integrated national development plan in the Republic of the Philippines. [Project report]

Pe Benito, M., & Peralta L. (2013). NAMRIA strategic planning: finding its direction, finding its true north. *Infomapper*, pp. 4-5.

Philippines Australia Human Resource Facility. (2012). REAP Template for Short Courses

_____. (2010). Strengthening Leadership of Middle Level Management HR/Training Activity Specification Profile

Philippines Australia Human Resource and Organisational Development Facility. (2012). NAMRIA Strategic Partner Organisation Program Profile Program Year 2011-2012

Radam, A., & Manangu, F. (2009.) REAP institution storyboard [Manuscript]

Santos, C., & Peralta, L. (2013). The Strategic Performance Management System: From 1963 through 2013. *Infomapper,* pp. 8-9.

Tolentino, E., & Angeles, M. (2012). Building partnerships between HR, line managers. Retrieved at http://business.inquirer.net/94997/building-partnerships-between-hr-line-managers

Geospatial Data Sharing: The NAMRIA Experience

*by Rosal H. Dolanas**

The Concept of Geospatial Data Sharing

Data sharing is not an entirely a new concept. It has been a subject of discussion, among many others, in government, academia and the research community in an attempt to promote transparency and foster collaboration. It, however, gained much attention in recent years with the advent of the information revolution brought by the digital age. Geospatial data sharing, more specifically, is the practice of making geospatial information available to other users for further analysis and processing. This could be through physical transfer of data or providing access to geospatial databases. In the geospatial information sector, data sharing is motivated by the advances in geospatial information technology. As the technology became more popular, its use began to extend beyond the exclusive domain of environmental management, land use planning, and the like. To date, it is widely used in disaster management, health applications, transportation, communication, and even in the creative arts. One could imagine the volume of geospatial data layers that are created and accumulated over time so that the potential of repeatedly creating the same information is significantly high.

The value of geospatial data sharing cannot be overestimated. Many argue that the benefit of sharing geospatial information far outweighs the perceived advantages, if any, of keeping geospatial data within the confines of the data producer. Advanced economies such as the United States, Canada, Australia, New Zealand and the United Kingdom attest to the cost effectiveness of sharing geospatial information. Geospatial data sharing promotes openness thus reducing redundancies in data collection and processing. It is also said to increase utilization of data, improve data quality, increase efficiencies, reduce costs, and increase public access to valuable assets.

Environment of Geospatial Data Sharing

Geospatial data sharing in NAMRIA can be viewed in the context of internal data sharing and external data sharing. Internal data sharing refers to the availability and accessibility of the agency's geospatial data resources among the different units of the agency whereas external data sharing refers to the availability and accessibility of the agency's geospatial resources to external clients, stakeholders, and partners. This could take the form of sharing individual thematic layers or sharing complete databases.

NAMRIA generally has well defined external data sharing policy and procedures. About 30 years ago, since its creation from the merger of four governments agencies, NAMRIA merely known as a provider of topographic maps and nautical charts, established Map Sales Offices (MSOs) in Binondo and Fort Bonifacio. The MSOs served as the marketing arm for the dissemination of the agency's products and services. To this day, analog or paper maps still remain viable geospatial information products of NAMRIA. The agency's 17 MSOs spread across the country still serve the needs of its clients.

Organizational reforms, such as the establishment of One-Stop-Shop (OSS) and later the Branch Information and Client Service Units (ICSUs), were envisioned to improve the agency's geospatial data provision services. The ICSUs serve the digital geospatial data needs and special or customized geospatial information products requirements of the different units within the agency, and external clients and stakeholders as well.

NAMRIA has been constantly instituting measures to improve geospatial data sharing and dissemination to keep up with the demands of its multitude of public and private clients. It has leveraged the convergence of information and communication technologies (ICT) and geospatial technologies to institute efficient and effective geospatial data sharing services. The Internet technology was adopted to serve as channel for data sharing and establish the agency's web presence (*http://www.namria.gov.ph*) to cater to clients elsewhere in the world.

Currently, NAMRIA is taking advantage of the technology infrastructure of the Philippine Geoportal. The Philippine Geoportal is the realization of the National Spatial Data Infrastructure (NSDI) that envisions to create a coordinated environment for sharing and access to geospatial information through the use of existing common technologies (Rajabifard and Pedro Francisco, 2016). Taking the lead in promoting geospatial data sharing in the country, the agency

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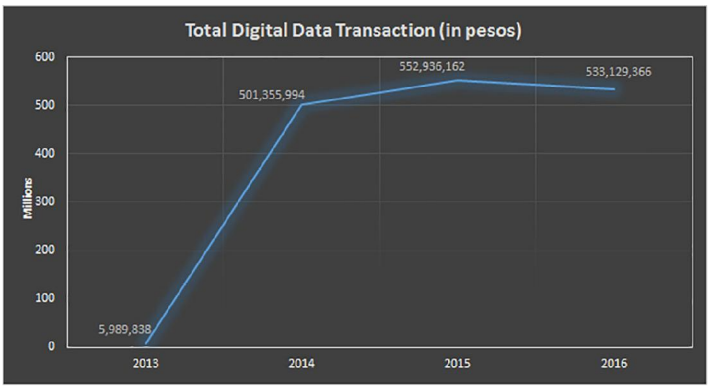
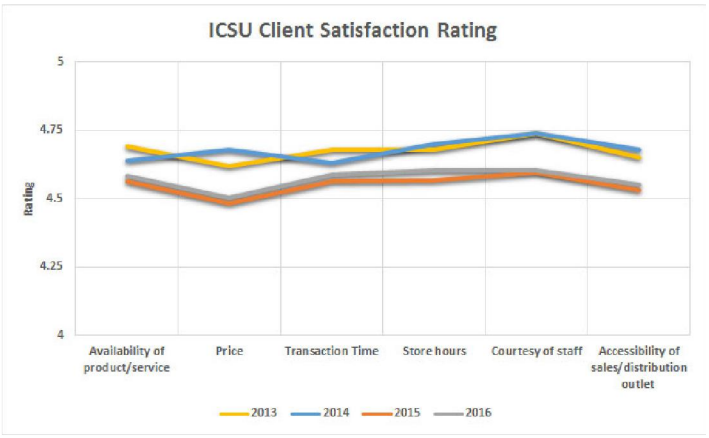
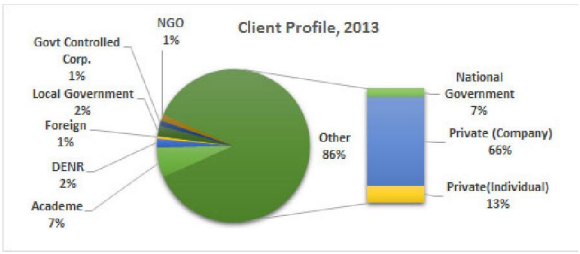
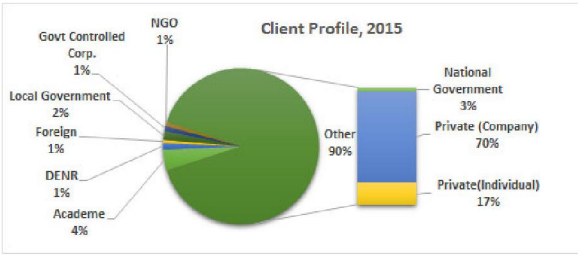
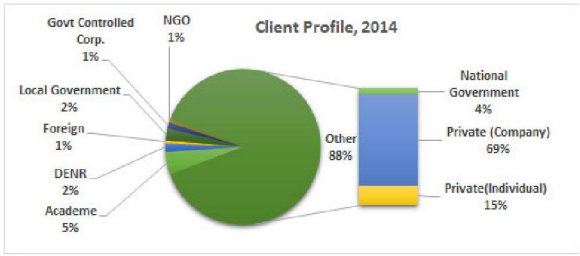
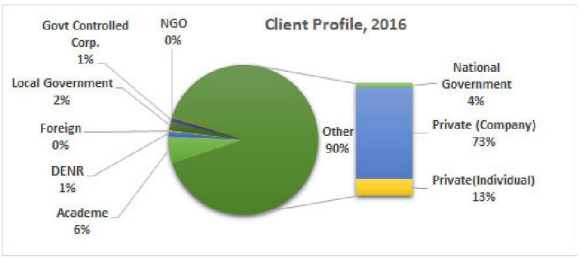




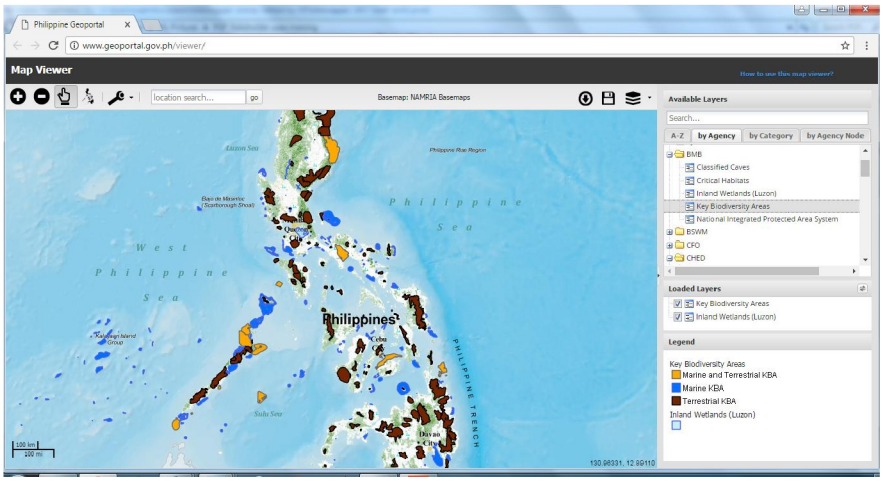








NAMRIA's digital data transactions soared in 2014 and remained stable in the succeeding years. Its clients, majority of whom are from private companies and individuals as well as the national government, regard the agency's client services as deserving of a highly satisfactory rating.



Screenshot of Philippine Geoportal

shares and serves its topographic maps as a web map service that can be accessed and used as base map where other thematic layers can be overlaid. The Philippine Geoportal serves as a vehicle for sharing other thematic layers, elevation models, imageries, and other geospatial resources available within the agency. It also allows downloading of geospatial data by authorized users. As the lead in the establishment of the Philippine Geoportal, NAMRIA is responsible for the maintenance and enhancement of the service to include the development of specific use cases.

NAMRIA's client services enjoy a generally high satisfaction rating following the organizational reforms, technological updates, fostering of linkages, and aggressive campaigns in advancing the use of geospatial information. ICSU records also showed a surge in geospatial transactions in the year 2014 estimated at about PhP500M, a relatively huge variation from the previous year, while remaining stable in the succeeding years.

Approach to Geospatial Data Sharing

Geospatial data sharing and transfer are usually described and written in agreements and other similar instruments. The

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Geospatial Dat Sharing ...

continued from page 25

execution of Memorandum of Agreement (MOA), Memorandum of Understanding (MOU), and Data Sharing Agreement are currently practiced in NAMRIA.

NAMRIA acts as the Data Owner and Custodian of its own geospatial datasets. Under the agency's policy, the MOA, and the MOU are the preferred instruments used to evidence arrangement between NAMRIA and another party to exchange geospatial information. Both instruments subject the requesting party to respective data restrictions as indicated in the agreement. Internal data requests, on the other hand, are endorsed by the Branch Director of the requesting unit for approval by the Administrator.

NAMRIA similarly acts as the Data Custodian of geospatial datasets or thematic layers entrusted by other geospatial agencies to the Philippine Geoportal. As data custodian, the agency is party to the Data Sharing Agreement which allows NAMRIA to publish the geospatial dataset, allow downloading in GIS or machine-processable format, or subject to other conditions imposed by the dataset owner.

Strengthening Geospatial Data Sharing in NAMRIA

As a major user of geospatial information and earth observation technologies, NAMRIA creates and accumulates many types of datasets over time. These datasets have different data contents, are derived from different data sources, and may be expressed in some spatial data models. These are typically the following: (1) Vector datasets derived from scanned maps, orthorectified satellite imageries or aerial photographs, and data from digital surveys; (2) Image data, whether satellite imageries or aerial photographs that are in raster format; and (3) topographic data which include contour lines, TIN, or grid format. All these information are valuable assets of the government. In order that the government and the public and private sectors can take full advantage of these resources, NAMRIA must manage these assets and promote openness and interoperability.

NAMRIA as the country's central mapping agency has undertaken initiatives to rationalize its geospatial information management activities—from data acquisition and production to maintenance, integration, and finally dissemination. The agency's plans and programs are in fact oriented towards the establishment of an internal spatial data infrastructure (SDI).

As early as 1993, the agency came up with its Information Technology Strategic Plan (ITSP) which in 2010 eventually became the NAMRIA Spatial Data Infrastructure (nSDI). The nSDI introduced the concept of corporate/organizational databases which are accessible to the different units within the agency thus encouraging sharing of resources. The plan also centered on the establishment of technical infrastructure, process improvement, and development of digital corporate databases. These plans served as the bases of the agency's Information Systems Strategic Plan (ISSP), a regularly updated three-year ICT initiatives and resource investment plan reviewed and approved by the Department of Information and Communication Technology (DICT).

Gradually, NAMRIA made progress in improving its technology infrastructure with the acquisition of the necessary hardware and software. The agency also carried out retooling programs for its human resources to keep up with the current trends and standards in ICT and geospatial technology.

Alongside NAMRIA's technological progress, certain institutional concerns need to be addressed. Recently, the agency implemented Memorandum Circular (MC) 2016-002, a policy providing for geospatial information management in NAMRIA. It puts in place an overarching policy that will govern the geospatial information management activities of the agency. MC 2016-002 clarifies institutional as well as technical guidelines in support of the agency's commitment to provide accurate and reliable geospatial information to its clients and stakeholders for planning, project development, operations, decision-making, and governance. As such, the policy addresses issues on data custodianship, data availability, quality, completeness, currency, accessibility, sharing and transfer, among others by (1) clarifying the current roles and responsibilities of work units and individuals in the geospatial information process; (2) ensuring quality of data produced and that the production process conforms to the established quality management system; (3) harmonizing the content of geospatial data holdings using standard data models and metadata; (4) regularly conducting data audits, inventory, and client demand surveys; (5) employing data transfer, sharing, and access arrangements; (6) designating organizational units and/or technical and user groups to determine access control and security measures; (7) enhancing existing ICT resources, enterprise environment, personnel competence; and (8) supporting the open data policy of the government.

As a general guideline, the MC 2016-002 prescribes the development of internal standards through the institution of relevant detailed processes and procedures that will form part of the NAMRIA Quality Management and Operations Manual. This ensures compliance as the different units will be audited based on their respective quality management and operations manual.

MC 2016-002 also highlights guiding principles geared towards strengthening the agency's data sharing capacity and promoting interoperability. It specifically supports adherence to Open Data Philippines, adaption of data content and quality standards, metadata creation, and leveraging data sharing and transfer technologies as most relevant to geospatial information sharing.

Open Data Philippines

The Open Data Philippines is a program that aims to make government data accessible to the public. Joint Memorandum Circular 2015-01, which contains open data's implementing guidelines, directs that government datasets shall be published in machine-readable formats, open formats, and released with open licenses.

In keeping with the open data policy and at the same time complying with geospatial standards, NAMRIA geospatial data products are available in specific open formats such as shapefile for vector data, Geotiff for raster data, and ASCII grid for grid or surface data.

Data Content and Data Quality Standards

Standardization organizations such as the Open Geospatial Consortium (OGC), the International Organization for Standardization (ISO), the Federal Geographic Data Committee (FGDC), and the International Hydrographic Organization (IHO) are among the major sources of geospatial information standards. These organizations are all working for the promotion of geospatial data sharing and interoperability through the development of appreciable standards.

NAMRIA ensures adherence to internationally accepted data and data quality standards. The agency adopts the standards of the following: IHO for nautical charts, US Defense Mapping Agency for topographic maps, and the Food and Agriculture Organization 2009 Land Cover Classification for land cover mapping.

Metadata

Metadata provides description on what the data is all about, the data lineage or processing history, the data owner and custodian, the date of collection, and other information that will help interested users evaluate the fitness of data for a particular purpose. Metadata also promotes the discovery of geospatial data, reduces redundancies in the creation of data, and supports interoperability. Without metadata the geospatial data itself is of little value. Similarly metadata without accepted metadata standards is of no use (Ali and Ahmad, 2013). For these reasons, NAMRIA highly encourages the use of geospatial information metadata following ISO 19115 (Metadata- Geospatial Information). Currently, metadata creation is done in ArcCatalog following the Federal Geographic Data Committee (FGDC) standard. The agency may well transition to its own metadata profile based on the ISO 19115 standard.

Data Sharing and Transfer

The main trend in serving geospatial data to interested users is via the Web. The convergence of two technologies, ICT and the geospatial information technology, presented opportunities to advance geospatial information sharing. The OGC and ISO/TC211 both worked together to promote standards on geospatial data sharing and interoperability specifications based on Web Services such as Web Map Service Specification, Web Feature Service Specification, Web Coverage Service Specification, and Geography Markup Language. These standards have gained the support of GIS manufacturers and have provided solutions to the issue of spatial data sharing in all types of network (Gong, et al., 2004).

The web-based technology was used in the establishment of the Philippine Geoportal which was developed using open-source OGC-compliant software. It takes advantage of the Web Map Service Specification, supported by GeoServer, a map server for sharing and serving geospatial information over the Web. NAMRIA is similarly adopting an Intranet-based technology for its internal implementation.

While NAMRIA is in the process of laying down its own technology and data infrastructure, internal data sharing in NAMRIA is anchored on the Philippine Geoportal, the same portal used by external stakeholders and partners wishing to share geospatial information.

The importance of geospatial information sharing is well documented. For a national mapping organization, it is something that should not be taken for granted to ensure and maintain its relevance as an authority in geospatial information and related technologies. However, its implementation is not without any issues—technological, institutional, and organizational, to name a few. NAMRIA's plans and programs endeavor to overcome these barriers in keeping with the needs of its clients and stakeholders. As NAMRIA transitions from a disparate to a coordinated environment, it is well positioned to support the exponential growth of business use cases in geospatial information and related technologies. •

References:

Ali, Asmat and Ahmad, Munir (2013). "Geospatial Data Sharing in Pakistan: Possibilities and Problems". Conference Paper.

Andres, Xenia R (2000). "InfoDev/World Bank-NAMRIA/IATFGI: Towards a Framework for Managing Geographic Information in the Philippines". Infomapper Volume 7 No. 1. pp. 3.

Fabic, John SF (2005). "NSDI and NCSD: Back to Back". Infomapper Volume XII. pp. 4-6.

Gong, Jianya, et al. (2004). "Technologies and Standards on Spatial Data Sharing". International Society for Photogrammetry and Remote Sensing. Volume XXXV Part B4, pp. 135-140.

https://www.iso.org/standards.html. accessed March 2017.

Joint Memo Circular 2015-01 (Guidelines for Open Data Policy) PHILIPPINES

MC-2016-002: A Policy Providing for Geospatial Information Management (GIM) in NAMRIA

Rajabifard, Abbas and PedroFrancisco, Ana Priscila. (2016). An SDI Model to Spatially Enable Peri-Urban Areas in Mozambique". Coordinates. pp 19-26.

[1]*Updated coordinates of GCPs in the province of Bohol are now available at NAMRIA's Geodetic Network Information System (GNIS).*

News

Geodetic Control Network Re-observation: Geodetic control points displacements highlight the need to modernize the PGRS

by Charisma Victoria D. Cayapan[1]

In 2015, NAMRIA, through its Geodesy Division-Mapping and Geodesy Branch, completed the nationwide re-observation of zero-order geodetic control points (GCPs). These GCPs are the highest in the hierarchy of GCPs with one part per million (PPM) allowable error between baselines.

The GCP re-observation is a component of the agency's ongoing modernization of the Philippine Geodetic Reference System (PGRS) which aims to migrate the current geodetic reference datum to an Earth-centered (geocentric) and dynamic datum. This move is in accordance with the United Nations General Assembly Resolution A/Res/69/266 which recommends the use of a global geodetic reference frame in support of sustainable development. The re-observation will update the coordinates and quantify the change in position of GCPs caused by the dynamic Earth movements such as plate tectonics and earthquakes. Results of the re-observation will be used in part to compute the velocities of the GCPs for the realization of a dynamic datum.

The zero-order geodetic control network was first established from June 2008 to May 2010 as part of the Philippine Reference System of 1992 (PRS92) Project. A total of 59 stations nationwide were observed for 18 hours (two nine-hour sessions) using dual frequency Global Navigation Satellite System (GNSS) receivers. The 2015 re-observation campaign, conducted from March to September 2015, comprised of 66 GCPs observed for 12 hours per session. Only 48 GCPs are common to both the 2008-2010 and 2015 zero-order campaign since some monuments have been lost or were not accessible during the recent campaign. These points were further filtered to retain only the stations with complete data from both campaigns for reprocessing. In addition, stations from the Philippine Active Geodetic Network (PageNET) were also included in the processing *(see Figure 1)*. Two sets of coordinates were generated: one in the latest realization of the International Terrestrial Reference Frame (ITRF)[2] and the other in the local definition of World Geodetic System of 1984 (WGS84) (local WGS84). The ITRF coordinates of the PageNET stations are based on the results of the Asia Pacific Regional Geodesy Project annual GNSS campaigns, while the rest of the zero-order GCPs were processed by AUSPOS, Geoscience Australia's on-line GPS positioning service using the nearest

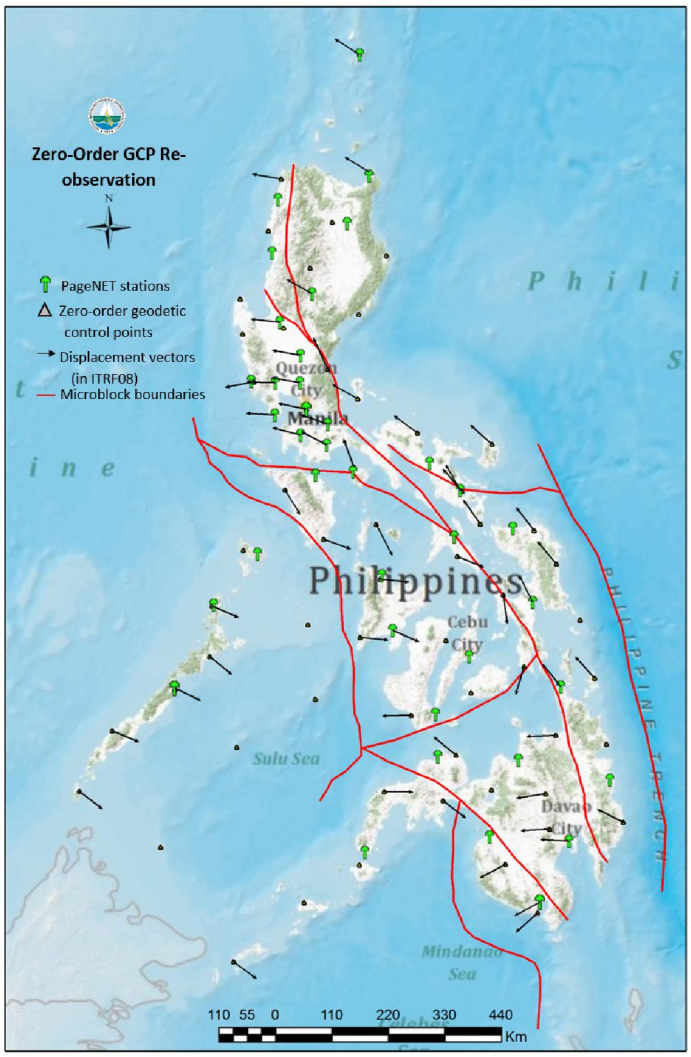

Figure 1. Displacements of Zero-Order GCPs Overlaid onto Major Tectonic Boundaries and Active Micro-blocks

Asia Pacific Reference Frame sites as constraints. The local WGS84 coordinates were computed with respect to the PageNET stations.

The ITRF results showed that MMA 1[1] in Taguig City indicated a 12.6-centimeter (cm.) (Northwest [NW]) displacement[2] from 2009 to 2015. This is significant since MMA 1 was the reference in processing the local WGS84 coordinates of the first six (6) PageNET stations. In terms of the rate of displacement, the GCPs in the Eastern Luzon block

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[2]*Latest realization as of processing is ITRF2008*

showed the consistently fastest trend[3], while the ones in the Western Visayas cluster showed the slowest.

On the other hand, the local WGS84 displacements showed minimal shift in the Luzon Island. These displacements were observed to increase as the distance from MMA 1 increased. BHL 94[4] in the province of Bohol showed the highest displacement at 0.42 meter (m.) (NW) which is mainly due to the magnitude 7.2 earthquake in 2013. This result is consistent with the post-earthquake assessment of the Philippine Institute of Volcanology and Seismology (PHIVOLCS) which showed a maximum of 0.55 m. co-seismic displacement when they re-occupied their campaign sites a week after the earthquake[5]. In 2014, NAMRIA conducted the re-observation of all GCPs in Bohol which showed that a number of GCPs, mostly located along the North Bohol Fault where the source of the ground movement is, failed to meet their published accuracy standard due to the displacements after the earthquake (see Table 1 and Figure 2).

On the zero-order GCP re-observation, it is interesting to note that GCPs were moving at varying magnitudes and directions. However, when the GCPs were clustered based on the distribution of major tectonic boundaries and active microblocks in the Philippines (as provided by PHIVOLCS), it was found that GCPs located within the same microblock showed a generally consistent trend (see Table 2). The differing directions of the GCP displacements within the same microblock, such as in Central Mindanao, suggests the presence of "structure" between these GCPs that is causing the inconsistent trend.

Order	Accuracy Standard	No. of GCPs Re-observed	Affected GCPs	No. of Failed Baselines / Total No. of Baselines
2nd	20 PPM	26	BHL-73, BHL-68, BHL-76, BHL-94	16/325
3rd	50 PPM	99	BHL-7, BHL-27, BHL-29, BHL-30, BHL-31, BHL-33, BHL-34, BHL-37, BHL-39, BHL-40, BHL-47, BHL-48, BHL-3005, BHL-3016, BHL-3059, BHL-3060, BHL-3066, BHL-3069, BHL-3075, BHL-3079, BHL-3081, BHL-3086, BHL-3094, BHL-3095, BHL-3096, BHL-3099	287/4,851
4th	100 PPM	158	BHL-3847, BHL-3848, BHL-3849, BHL-3850, BHL-3859, BHL-3860, BHL-3861, BHL-3862, BHL-3863, BHL-3864,BHL-6001, BHL-6006, BHL-6007, BHL-6008, BHL-6009,	251 /12,403

Table 1: GCP re-observation in Bohol

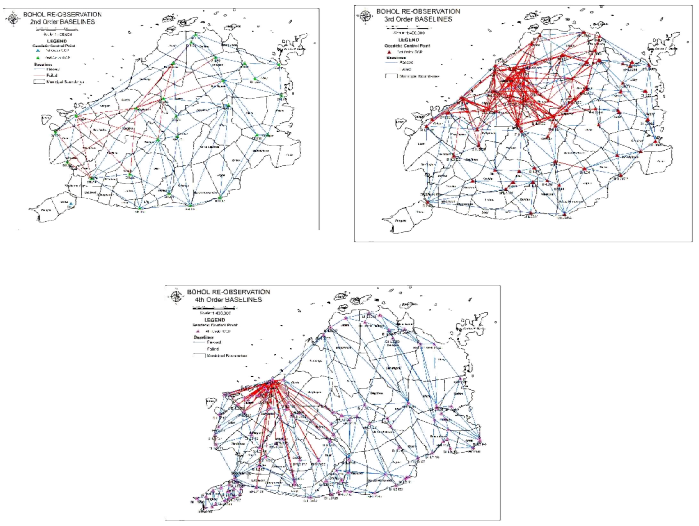

Figure 2: Failed baselines after the magnitude 7.2 Bohol earthquake for 2nd-order, 3rd-order, and 4th-order GCPs

Cluster	ITRF08		Local WGS84	
	Annual Rate (cm.)	*Direction*	*Annual Rate (cm.)*	*Direction*
Eastern Luzon	3.89	NW	2.11	NW
Northwestern Luzon	4.80	NW	1.28	NW
Western Luzon	2.64	NW	0.44	SW
Southern Luzon	2.15	NW	1.53	NE
Bicol	4.00	NW	2.11	NW
Western Visayas	0.74	SE	2.57	SE
Eastern Visayas	3.00	NW	1.17	NW/NE
Central Mindanao	2.01	SW/NW	1.70	SW/SE
Eastern Mindanao	3.05	NW	1.57	NW
Southern Mindanao	1.59	SW	2.51	SW
Western Mindanao	1.45	SE	2.04	SE
Palawan	2.64	SE	4.28	SE

Table 2: Annual rate of displacement per cluster

The results of the GCP re-observation show that the integrity of the PRS92 geodetic control network has degraded due to the effects of geodynamics. A geocentric dynamic datum aligned to the ITRF is needed to account for geodynamics in future surveys, and in accurately transforming the old datasets into the modern system.

Displacements of the GCP re-observation confirm the need to modernize the PGRS into a geocentric dynamic datum. Re-observation of the lower order GCPs (from first to second order) are also currently ongoing to provide a more detailed look into the deformation of GCPs throughout the country.[1] •

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[1] *Original observation data used is not part of zero-order establishment campaign, but is based on a three-hour observation in 2009.*

[2] *2D displacements only*

[3] *Only one GCP was located in the Northwestern Luzon block as compared to five in the Eastern Luzon block*

[4] *Original observation data from zero order establishment campaign were not available so it was not possible to get ITRF coordinates. Only the WGS84 (original) coordinates from the original processing were available.*

[5] *Bacolcol, T., et. al. Geologic impacts of the 15 October 2013 Mw 7.2 North Bohol Fault earthquake,Bohol Island Philippines, Geocon 2013 presentation, 03-04 December 2013, Dusit Thani Hotel, Makati City*

News

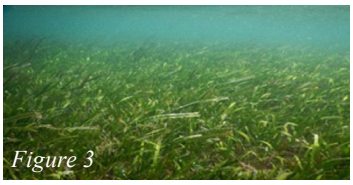
Coastal Resource Mapping Project of NAMRIA

by Rijaldia N. Santos[1], Benjamin P. Balais[2], Federico D. Macareg[3], and Sylvia L. Esperanza[4]

The Philippines is surrounded by extensive mangrove forests, coral reefs and seagrass beds (Figures 1-3), which form part of the most diverse and productive coastal ecosystems in the world. Despite their economic and ecological values, these resources continue to encounter great pressure from human activities and changing climate patterns. In order to regulate the impacts of such activities and events to coastal habitats, sustainable management is necessary. To achieve this, information on the spatial location of these resources are important.

The Coastal Resource Mapping Project being implemented by NAMRIA aims to map the location and extent of mangroves, corals and seagrasses within the coastal zone, including Tubbataha, Apo and Cagayancillo Reefs.

Landsat 8 (Figure 4) imagery is the main data source for the project. It is a multi-temporal satellite data consisting of 11 bands, eight of which are the multispectral (MS) bands at 30-meter pixel resolution. MS band 1, which is the coastal band, is capable of up to 30 meters water depth penetration under clear water condition. This band, together with the other MS bands, was used to classify the coastal resources into mangrove, corals, and seagrasses using remote sensing techniques.



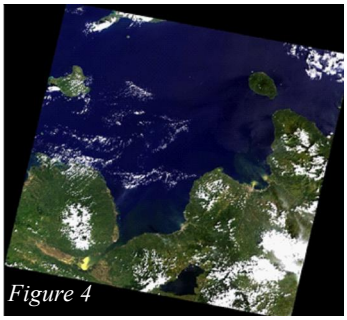


Figure 1: Mangrove forest
Figure 2: Coral reefs
Figure 3: Seagrass beds
Figure 4: True-color image of a Landsat 8 scene

Mapping Process

This activity includes data gathering, pre-processing, image classification, field survey, presentation to stakeholders, and final mapping. Accuracy assessment using confusion matrix is applied to measure the quality of the map output.

Data Gathering

Recent LANDSAT 8 imageries with less than 10% cloud covering the areas of interest are downloaded which serve as the primary data for the project. Ancillary data and other documents from different government agencies, local government units, and various offices are also collected and analyzed as additional information in the implementation of the project activities.

Pre-Processing

Preliminary processing of Landsat 8 is required to make the data suitable for image classification. The first step involves atmospheric correction to reduce inconsistencies in image brightness values that affect the interpretability and analysis of the satellite image. The next step is image masking to separate land from water. This will also facilitate image enhancement and reduce processing time and data volume during image classification.

Image Classification

[1]*Director II, NAMRIA Resource Data Analysis Branch (RDAB) and holds a Master's degree in National Security Administration from the National Defense College of the Philippines in Camp Aguinaldo, Quezon City and a Doctorate degree in Peace and Security Administration from Bicol University Extension in Legazpi City, Albay*
[2]*Officer in Charge Assistant Director, NAMRIA RDAB and holds a Master of Science degree in Remote Sensing and GIS from the University of the Philippines (UP) in Diliman, Quezon City (QC)*
[3]*Chief, Physiography and Coastal Resource Division (PCRD)-NAMRIA RDAB and holds a Professional Masters degree in Forest Survey from the International Institute for Geo-Information Science and Earth Observation in Enschede, The Netherlands*
[4] *Supervising Remote Sensing Technologist,PCRD-NAMRIA RDAB and holds a Master in Science and Technology degree from the University of New South Wales in Sydney, Australia*

Digital extraction of corals and seagrasses is performed on the masked image of Landsat 8 through the object-based image analysis (OBIA) eCognition software. OBIA is carried out using multiresolution segmentation which divides the image into homogenous objects based on the scale parameters of color (spectral reflectance), shape, and texture information. Once the optimal scale for image segmentation is attained, a supervised classifier using nearest neighborhood algorithm is applied. The output is a classified raster image of corals, seagrass, mangroves, and water areas (Figure 5) which is then converted to vector (shapefiles) and overlaid to the Landsat image to check for misclassifications through on-screen visual editing using GIS tools. Smoothing process is applied for better visual appearance (Figure 6).

Field Survey

Field survey is conducted to collect additional data and validate accuracy of image classification. Sampling points are randomly selected prior to actual field survey and tracked on the field using handheld GPS and underwater camera as applicable. To facilitate data collection, SCUBA diving is employed in deeper areas (Figure 7) while snorkeling is used in shallow waters (Figure 8). In addition, secondary data are collected from the local government units (LGUs) and local DENR offices as reference. The NAMRIA Teams, together with local counterparts from the DENR and LGUs, undertake the field survey activities.

Accuracy Assessment

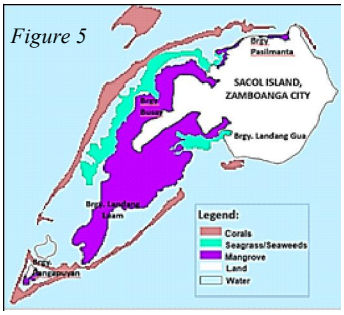
Validated sampling points are used as reference data in the accuracy assessment. Sampling points that were not ground validated are verified using Google Earth images and secondary data collected from LGUs and local DENR. Coastal resource classifications are cross-checked with the reference data. The overall classification accuracy of the map is computed using confusion matrix.

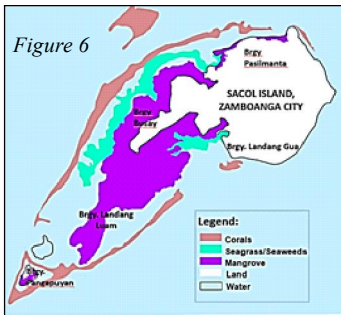
Sample Coastal Resource Map Output

The output for this initiative is a Coastal Resource Map (CRM) showing the extent and spatial location of mangroves, corals and seagrasses. Based on the results of satellite imageries interpretation covering Zamboanga City, there are about 4,181 hectares of mangroves; 7,585 hectares of corals; and 982 hectares of seagrasses.

Presentation to Stakeholders

The presentation of the preliminary output to concerned LGUs, DENR, other government agencies and stakeholders is undertaken to solicit their comments and recommendations. Data editing is performed, as applicable, based on the comments given during the presentation prior to the preparation of the final CRM and its eventual distribution.





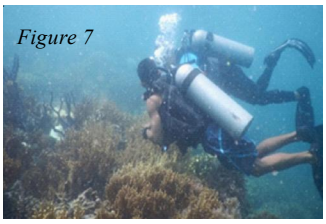


Figure 5: Preliminary map of mangrove, corals, and seagrasses (raster)
Figure 6: Preliminary map of mangrove, corals, and seagrasses (smooth)
Figure 7: Data collection through SCUBA diving
Figure 8: Data through snorkelling at shallow water

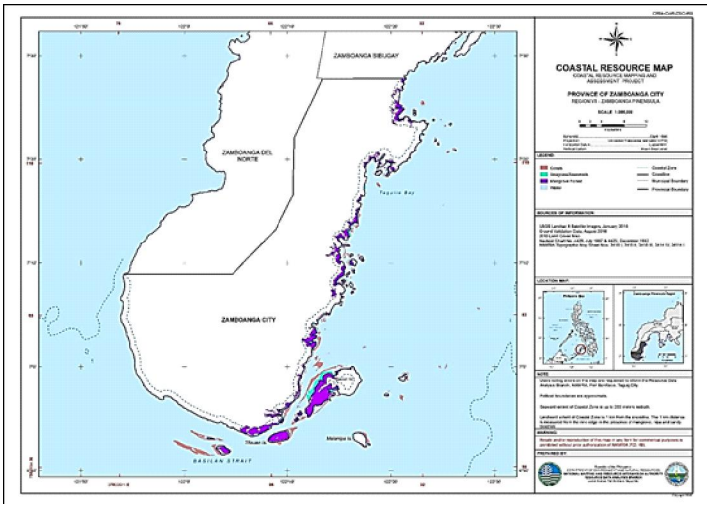


Figure 9: Provincial Coastal Resource Map of Zamboanga City

Project Status

As of end of May this year, preliminary and validated coastal resource maps covering 67 coastal provinces or 100% of universe have been completed. Final mapping is currently ongoing. It is expected that the nationwide results will be published by the third quarter of 2017. It is planned that the project will be continuously implemented on a regular four-year cycle program.•

News

Enhancing the Land Cover Mapping Methodology

by Dr. Rijaldia N. Santos[1], Benjamin P. Balais[2], Raul T. Magabo[3], and Margie T. Parinas[4]

Land cover mapping involves the delineation and classification of the physical features that cover the ground, i.e., vegetation, bare soil or concretes. Land cover map information are essential for sustainable land resource management to address environmental issues and formulate climate-change related policies.

The first nationwide Land Cover Map was generated in 2003 from LandSat TM imageries (30-meter resolution) through visual interpretation without ground validation. This was updated by the 2010 Land Cover Map based mostly on Advanced Land Observing Satellite Advanced Visible and Near Infrared Radiometer type-2 (ALOS AVNIR-2) (10-meter resolution) with Satellite Pour l'Observation de la Terre (SPOT) 5 and LandSat 7 ETM to fill in the gaps. Visual interpretation was employed, complemented with ground validation.

NAMRIA is currently implementing the 2015 Land Cover Mapping project. This will update the 2010 Land Cover Map following a four-year update cycle. As part of technological upgrade, digital image processing through Object Image-Based Analysis (OBIA) was adopted using LandSat 8 (30-meter resolution) satellite imageries taken from 2015 to 2016 as the main data source.

LandSat 8 data consists of 11 bands which are capable of detecting land and water features. The OBIA method treats each picture element (pixel) of an image as point data with a set of attributes. Neighboring pixels with the same attributes are grouped together to form *segments*. Each segment is assumed to have a homogenous land cover type. By applying the known spectral signature of a feature, the land cover type of the image can be classified. The OBIA classification process is shown in Figure 1. The preliminary classification result is then overlaid to Google Earth image for visual counter checking and editing. Misclassifications found are then subjected to classification modification to ensure accuracy. A smoothing algorithm was applied to produce a natural appearance of the land cover features. The land cover categories used in this mapping project are shown in Table 1.

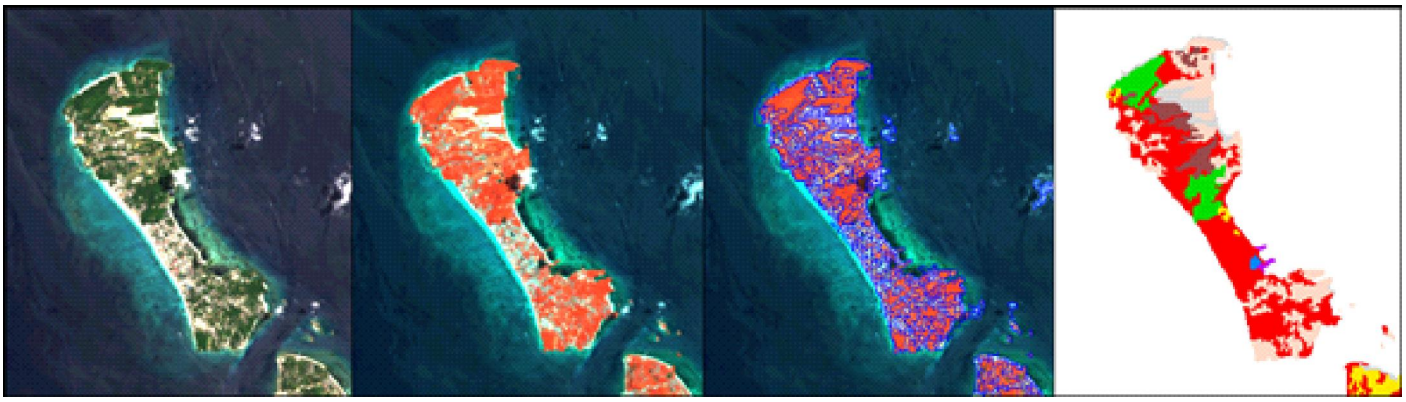


Figure 1: LandSat 8 band combinations in (a) true color image - bands 4,3,2 and (b) false color image - bands 5,4,2; and the OBIA classification outputs – (c) segmented image and (d) preliminary classified image of Boracay Island

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Land Cover Categories
Based on Food and Agriculture Organization

2003: 21 Categories	2010: 14 Categories	2015: 12 Categories
Closed forest, broadleaved	Closed Forest	Closed Forest
Closed forest, mixed		
Closed forest, coniferous		
Open forest, broadleaved	Open Forest	Open Forest
Open forest, mixed		
Open forest, coniferous		
Forest plantation, broadleaved	* depends on the present land cover feature	
Forest plantation, coniferous		
Mangrove forest	Mangrove Forest	Mangrove
Other wooded land, shrubs	Shrubs	Shrubs
Other wooded land, fallow	Fallow	
Other wooded land, wooded grassland	Wooded grassland	
Other land, natural, grassland	Grassland	Grassland
Other land, natural, pastures		
Other land, cultivated, annual crop	Annual Crop	Annual Crop
Other land, cultivated, perennial crop	Perennial Crop	Perennial Crop
Other land, natural, barren land	Open/Barren	Open/Barren
Other land, built-up area	Built-up	Built-up
Other land, natural, marshland	Marshland/Swamp	Marshland
Other land, fishpond	Fishpond	Fishpond
Inland water	Inland Water	Inland Water

Table 1: Land cover categories based on FAO classification

After the preliminary classification, validation sample points per land cover class were generated automatically using the stratified random sampling method. Field validation was conducted to verify the accuracy of initial interpretation. From this, a confusion matrix was generated to determine if the overall map accuracy meets the required standard of at least 85%. Furthermore, comments from the local DENR office, local government units, non-government organizations, state universities and colleges, and other stakeholders during provincial/regional presentations were incorporated in the final editing process. A sample 2015 Land Cover Map of Zamboanga Sibugay is shown in Figure 2 with corresponding statistics in Table 2.

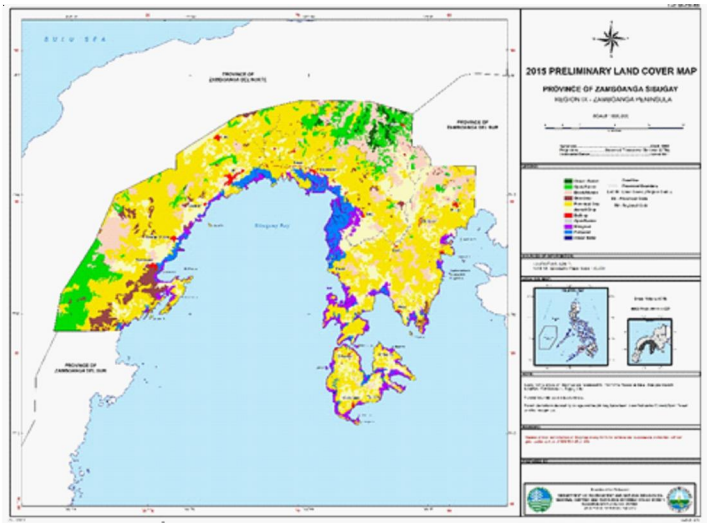

Figure 2: Final map layout for the province of Zamboanga Sibugay

2015 PRELIMINARY LAND COVER STATISTICS
ZAMBOANGA SIBUGAY

LAND COVER CLASSIFICATION	AREA IN HECTARES	PERCENTAGE
Closed Forest	2,669	0.94
Open Forest	25,236	8.86
Mangrove	13,631	4.79
Brush/Shrubs	23,299	8.18
Grassland	13,565	4.76
Annual Crop	32,424	11.38
Perennial Crop	158,737	55.73
Open/Barren	35	0.01
Built-up	3,176	1.12
Fishpond	10,230	3.59
Inland Water	1,815	0.64
Grand Total	**284,816**	**100.00**

Table 2: Land cover statistics of Zamboanga Sibugay

Of the 81 provinces nationwide, 51 provinces (or 63%) are already completed. The rest are undergoing final editing and mapping. The 2015 Land Cover Map for the whole country will be available by the third quarter of 2017. •

News

NAMRIA's Quality Management System Re-certified

by Cherylin D. Mendoza[1] and Joseph C. Estrella[2]

NAMRIA continued to be re-certified to ISO 9001-2008 based on the findings of the seventh surveillance audit conducted on 22-23 August 2016. The seventh surveillance audit was the first audit after the agency's application for continued Quality Management System (QMS) re-certification.

Certification International Philippines, Inc. (CIP) made the pronouncement during the closing meeting held at the NAMRIA Boardroom on 23 August 2016. Meanwhile, Deputy Administrator Jose C. Cabayan, Jr., on behalf of Administrator Peter N. Tiangco, thanked the CIP auditors, NAMRIA officials, and employees for the support extended during the surveillance audit.

NAMRIA Quality Management Representative and GISMB Director John S. Fabic welcoming the participants of the orientation

The CIP auditors, namely, Mr. Justo Batoon, Jr. and Mr. Marlon Campued audited the following areas: (1) Hydrography Branch - Survey Support Division (SSD), Nautical Charting, Physical Oceanography, and Maritime Affairs Divisions, *Barko ng Republika ng Pilipinas* HYDROGRAPHERS PRESBITERO and VENTURA; (2) Mapping and Geodesy Branch – Geodesy Division (GD), Cartography, Photogrammetry, and Reprography and Printing Divisions; (3) Resource Data Analysis Branch - Land Resource Data Analysis and Land Classification Divisions; (4) Geospatial Information System Management Branch - Geospatial Database Management and Geospatial System Development Divisions; (5) Support Services Branch - Property and Supply Management Section (PSMS), Human Resource Development Section (HRDS), Financial Management Division (FMD), and Policy and Planning Division (PPD); (6) Verification of previous non- conformities; (7) Internal Audit Correction, Corrective/Preventive Action; and (8) Management Review on Use of Logo and Validation of Scope.

At the closing meeting, the CIP auditors reported that the audit plan was fully covered and majority of the areas verified were found to have high levels of compliance to QMS standards. However, they raised two new minor Non-Conformities (NCs) in PSMS and its survey vessels. The three minor NCs reported during the sixth surveillance and reassessment audit were also verified. The observed NC at the FMD was closed but the two other minor NCs were still open because the same issues were still seen during verification.

NAMRIA was first certified for ISO 9001:2008 on 02 October 2012 with a validity period of three years and was re-certified in 05 October 2015 for a validity period of another three years. The agency is next aiming for transition to the current version of ISO 9001 which is ISO 9001:2015. An orientation on ISO 9001:2015 QMS was held in the agency on 27 May 2016 with the key officials of NAMRIA as participants. The Development Academy of the Philippines conducted the orientation which aimed to explain the difference between ISO 9001:2015 and ISO 9001:2008 standards, and discuss steps for adopting the new requirements. The conduct of the activity was a preparatory step for the upgrading of the agency's certification to the revised ISO 9001 QMS standard. Organizations certified to ISO 9001:2008 have until 14 September 2018 to migrate to the 2015 version.•

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News

NAMRIA leads in the formulation of the UN-GGIM Strategic Framework on Geospatial Information and Services for Disasters (2016-2030)

*By: EnP. Annrou R. Ramos**

During the Fifth Session of the United Nations Committee of Experts on Global Geospatial Information Management (UN-GGIM) in August 2015, the Philippines, through NAMRIA, together with Jamaica was elected as co-chair of the Working Group on Geospatial Information and Services for Disasters (WG-Disasters). The working group, which is composed of senior officials and technical experts from around 50 UN Member States, is primarily responsible for the integration of geospatial information in disaster risk reduction and management (DRRM). It has established two task teams (Task Teams 1 and 2) to fulfill this objective. NAMRIA Administrator Dr. Peter N. Tiangco was selected as chair of Task Team 1, which was assigned to develop a strategic framework that will make available and accessible all quality geospatial information and services before, during, and after disaster events.

The need for a framework was determined based on the results of a fact-finding analysis commissioned by the UN-GGIM. The results revealed that geospatial data and information necessary to support decision-making are generally not in place among UN Member States. Based on these results, NAMRIA formulated the Draft Strategic Framework on Geospatial Information and Services for Disasters (2016-2030). The prescribed timeline is in consonance with the implementation of the Sendai Framework for Disaster Risk Reduction 2015-2030. NAMRIA made use of the following instruments while drafting the framework: 2030 Agenda for Sustainable Development, International Strategy for Disaster Reduction, Global Geospatial Statistical Framework, Open Data Policy, and other relevant instruments.

In writing the framework, NAMRIA employed both participatory and consensus-based approaches to be able to take in consideration the unique situations of the 50 UN Member States. The writing of the framework required a series of global and regional presentations and online discussions in late 2015 and early 2016 to solicit the comments and inputs from UN Member States and other key partners. To ensure its effective implementation across

various levels of decision-making, the framework has defined five priorities for action, namely (a) Governance and Policies; (b) Awareness Raising and Capacity Building; (c) Data Management; (d) Common Infrastructure and Services; and (e) Resource Mobilization. Each priority provides a listing of specific activities for implementation at the local, national, regional, and global levels. Most of these activities are anchored on efficient data sharing standards and procedures for geospatial information, and their roles in managing disaster risks. Case examples include the role of crowd-sourced or volunteered geospatial information (VGI), interoperability of administrative boundaries, laws and policies on Spatial Data Infrastructure (SDI), and the collaboration between government and non-government actors.

...continued on next page

**Information Systems Analyst III, Geospatial Database Management Division-NAMRIA Geospatial Information System Management Branch*

NAMRIA leads...
from page 35

NAMRIA officials led by Administrator Peter N. Tiangco, and other WG-Disaster members during the International Forum on Geospatial Information and Services for Disasters in Bridgetown, Barbados

In the forthcoming Seventh Session of the UN-GGIM in August 2017, NAMRIA will endorse the latest draft of the framework to the UN-GGIM Bureau and the UN Economic and Social Council (ECOSOC). While waiting for its adoption, NAMRIA has already initiated its local implementation in the Philippines. The agency has presented the framework to the Information Management – Technical Working Group (IM-TWG) of the National Disaster Risk Reduction and Management Council (NDRRMC); member-agencies, in turn, are benchmarking the framework. Particular initiatives towards the local implementation include the multihazard mapping for the Greater Metro Manila Area (GMMA) Ready Project, the development of Common and Fundamental Operational Datasets (CAFOD) for disaster use, and the establishment of an Operations Center by the Office of the Civil Defense (OCD).

To facilitate implementation, NAMRIA has initially developed a survey tool that will assess the progress made by DRRM organizations with the activities pertinent to the framework. Results from the survey will provide the necessary inputs for the crafting of a local implementation plan for the Philippines. These, among other initiatives, will better position NAMRIA as a lead agency in geospatial information and disaster management.•

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