Modernization of the Philippine Geodetic Reference System

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44th Annual Regional Convention
Geodetic Engineers of the Philippines, Inc. Regional Division III
Otel Pampanga, San Fernando City
16 – 17 March 2018

Outline of Presentation

- Position and its importance
- Reference Systems and Frames
- Global Geodetic Reference Frames
- Modernizing the PGRS
- Modern PGRS and the GE

How important is position in your life?

Position and its importance

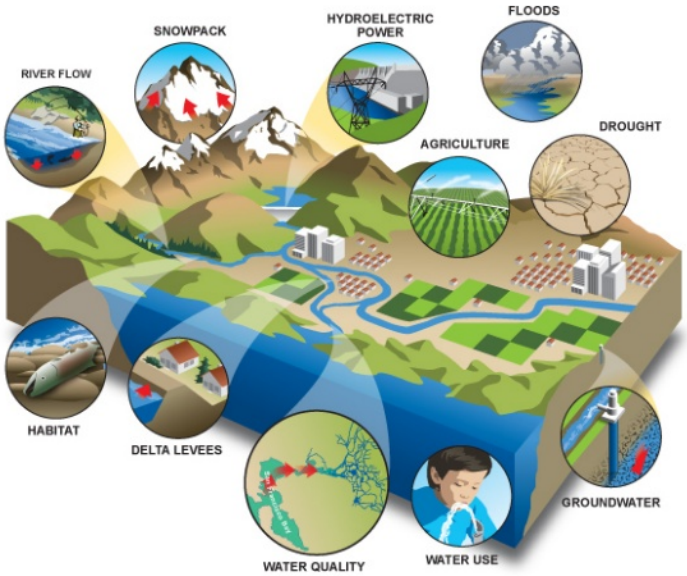
"Everything that happens, happens somewhere." *

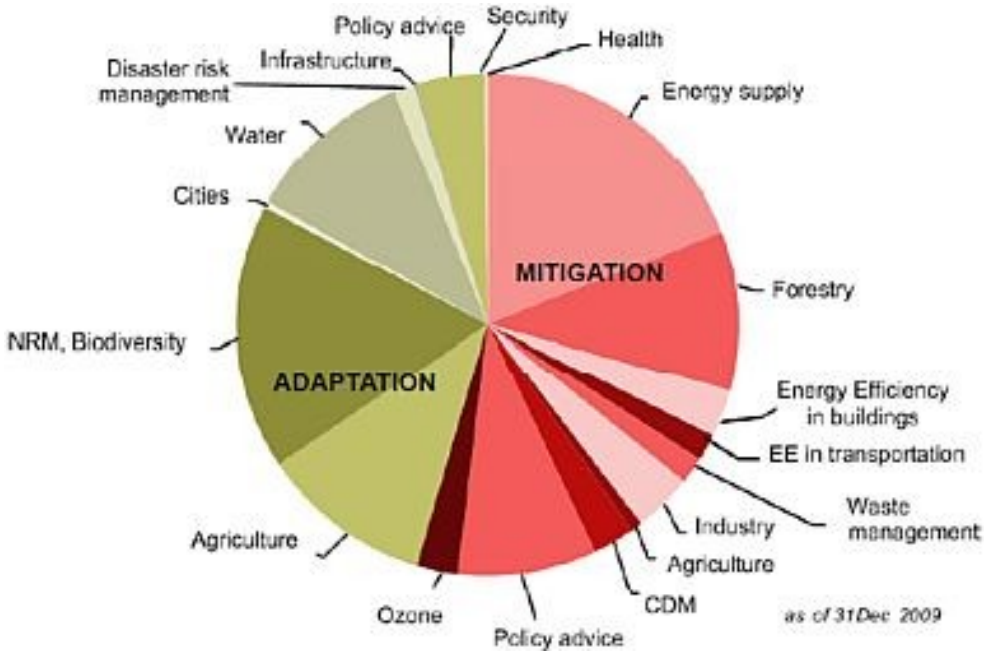
* *UN-GGIM infomercial on Geographic Information*

Position and its importance

Accurate Position = Better Decision

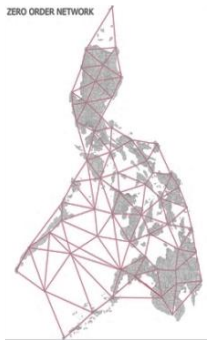
= Proper Response & Mitigation

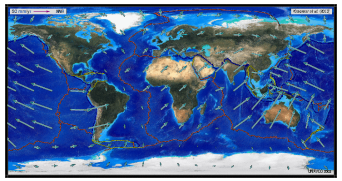




Position and its importance

Position accuracy requirement depends on application





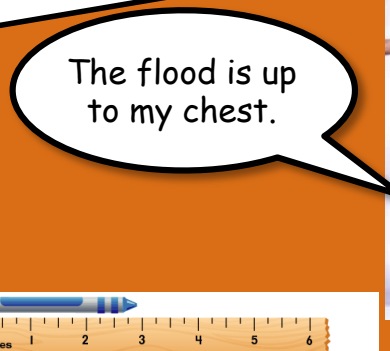
mm

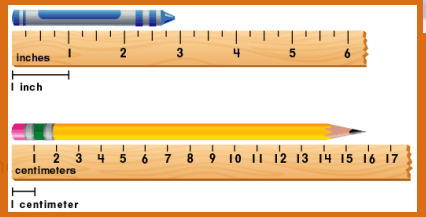
cm

dm

m

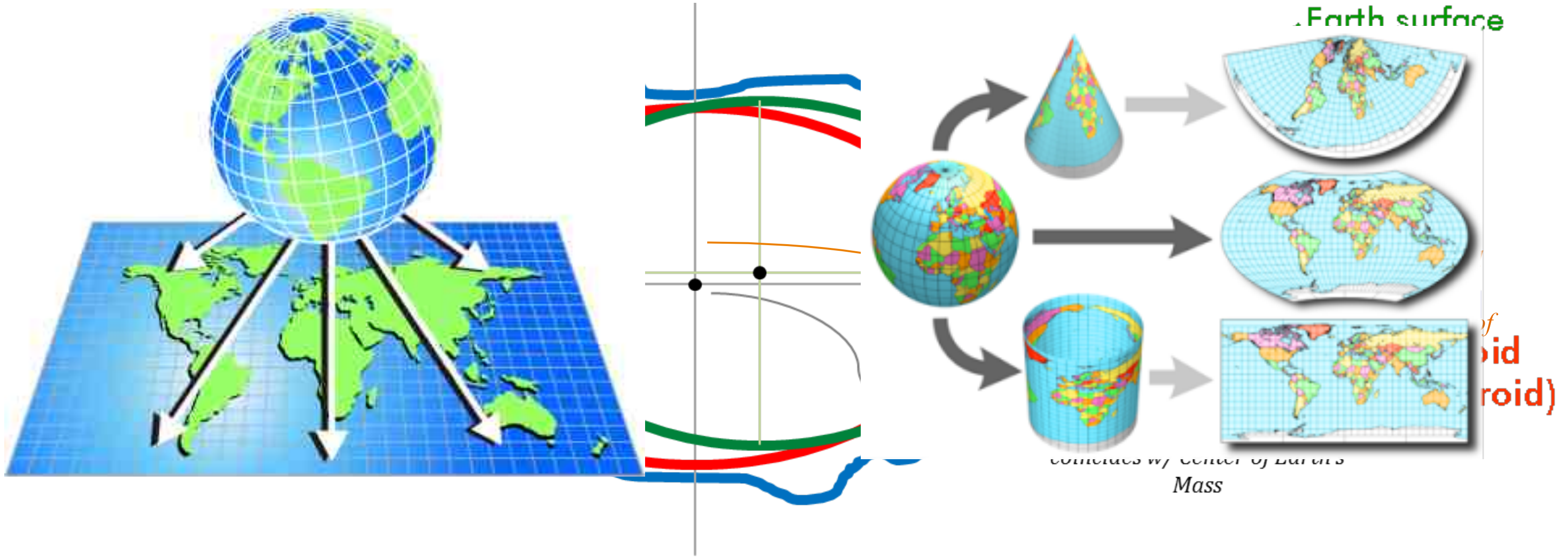
And position measurement depends on what reference system it is based on.





So what is a reference system? What differentiates it from a reference frame?

Before anything else...



Projection

A systematic representation of all or part of the surface of a round body, especially the Earth, on a flat surface (Snyder)

Ellipsoid

A mathematical figure that approximates the shape of the Earth (NOAA)

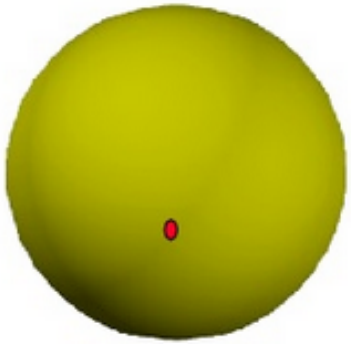
Datum

A set of fundamental reference points on which survey measurements are based

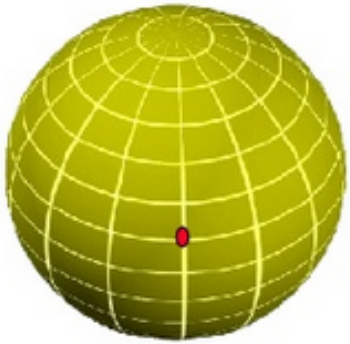
Can either be geocentric (origin at center of the Earth) or geodetic (origin at specific point on surface of the Earth)

Before anything else...

Datum vs. Coordinate System



A datum defines the initial point and reference surface



A coordinate system determines how locations are referenced from the datum

Before anything else...

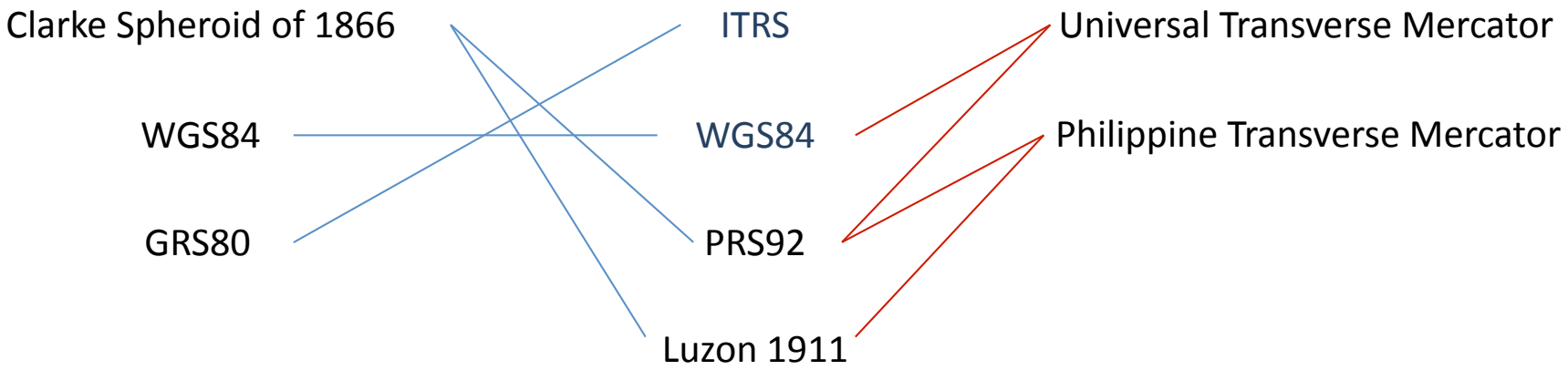
Ellipsoid	Datum	Projection/ Coordinate System
		ITRS
Universal Transverse Mercator		
		PRS92
	WGS84	
		Philippine Transverse Mercator
Clarke Spheroid of 1866		
		Luzon 1911

Before anything else...

Ellipsoid

Datum

Projection/ Coordinate System

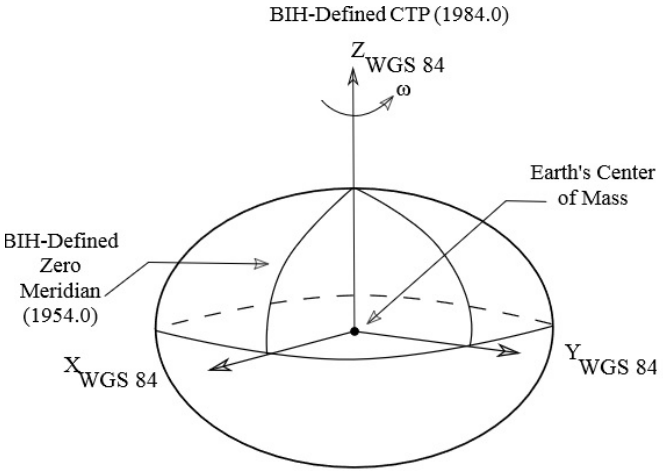


Reference Systems and Frames

*Reference System is the complete **conceptual** definition of how a coordinate system is formed*

- *defines the origin and the orientation of fundamental planes or axes of the system*
- *also includes the underlying fundamental mathematical and physical models*
- *For example:*

	PRS92	WGS84	ITRS
Reference Ellipsoid	Clarke Spheroid of 1866	WGS84 Ellipsoid	GRS80 Ellipsoid
a	6,378,206.4	6,378,137.0	6,378,137.0
b	6,356,583.8	6,356,752.3141	6,356,752.3142
f	1 : 294.9786982	1 : 298.257223563	1 : 298.257222101
Origin	Station Balanacan	Center of the earth	Center of the earth



Source: Satellite Geodesy by Günter Seeber; Physical Geodesy by Dr. Bernhard Hofmann-Wellenhof

Reference Systems and Frames

*Reference Frame is the **practical** realization of a reference system through observations*

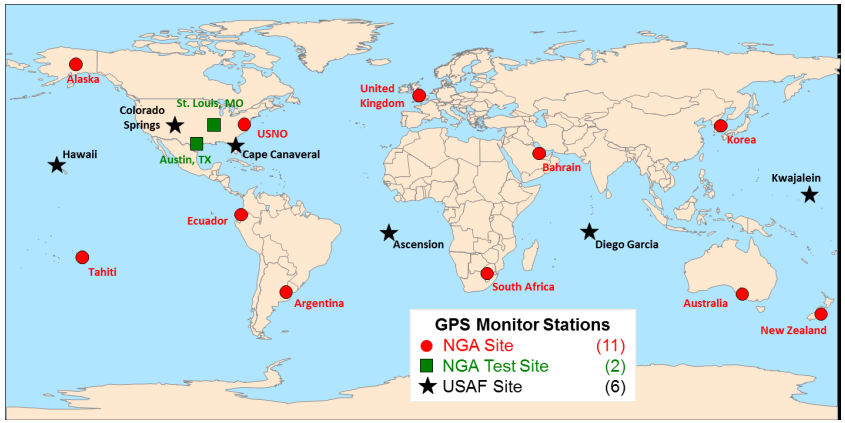
- *consists of a set of identifiable fiducial points on the sky (e.g. stars, quasars) or on the Earth's surface (e.g. fundamental stations)*
- *For example:*

	Reference Frame
Luzon Datum of 1911	Triangulation Network of the Philippines
PRS92	PRS92 GCP network
WGS84	WGS84 Frame
ITRS	ITRF

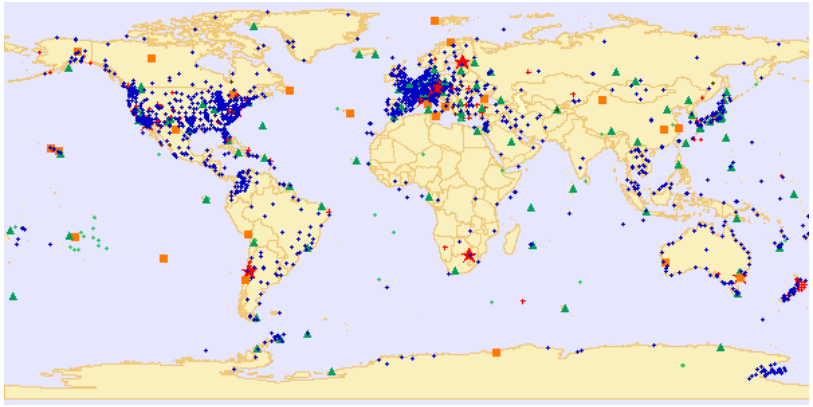
Source: Satellite Geodesy by Günter Seeber; Physical Geodesy by Dr. Bernhard Hofmann-Wellenhof

Reference Systems and Frames

	Reference Frame
Luzon Datum of 1911	Triangulation Network of the Philippines
PRS92	PRS92 GCP network
WGS84	WGS84 Frame
ITRS	ITRF

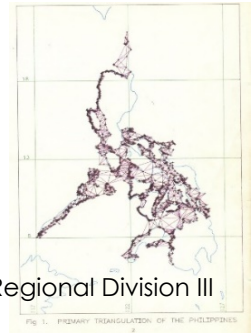


WGS84 Frame



ITRF

LUZON 1911



PRS92

Datums in Use

Geodetic Control Networks

Horizontal

- Luzon Datum
- Philippine Reference System of 1992
- World Geodetic System 1984 (or ITRF)

- *Propagated by GNSS observation*
- *Physical realization: geodetic control points (passive and active)*

Vertical

- Mean Sea Level

- *Propagated by geodetic leveling*
- *Physical realization: benchmarks*

Gravity

- NAMRIA absolute gravity station

- *Densified using gravity observations*
- *Physical realization: gravity stations*

Luzon Datum of 1911

The Geodetic Datum for all surveying and mapping activities in the Philippines until 1988

- *Reference Ellipsoid*
  Clarke Spheroid of 1866
- *Origin*
  Sta. Balanacan, Marinduque
- *Reference Frame*
  Triangulation Network

  A "local" network of triangulation points established using optical instruments and astronomical observations.

  Used as reference in establishing project controls for cadastral, topographic and hydrographic surveys

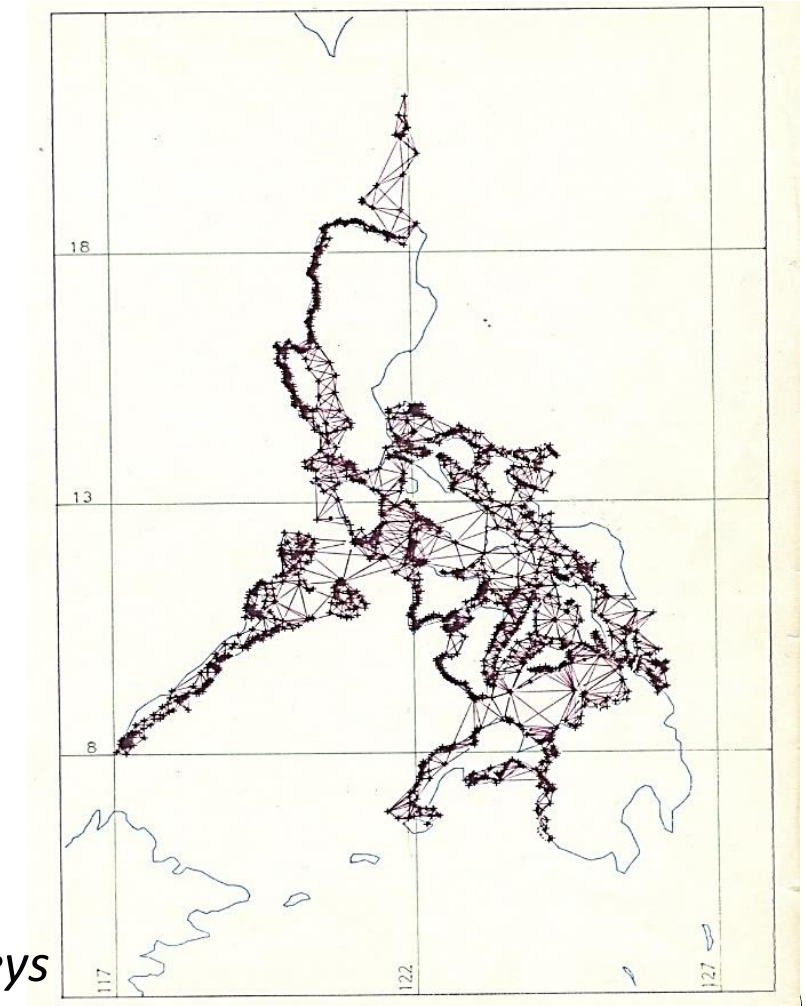


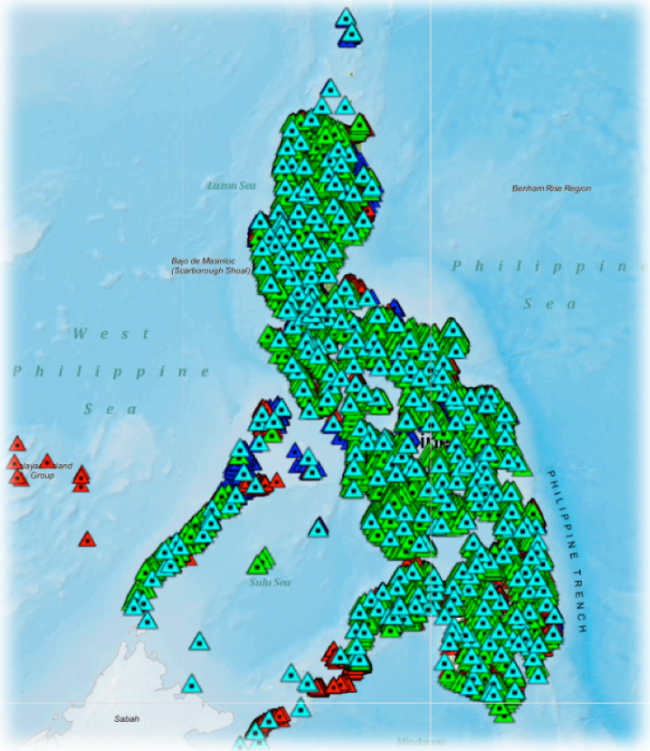
Fig 1. PRIMARY TRIANGULATION OF THE PHILIPPINES

Philippine Reference System of 1992

The reference system for all surveying and mapping activities in the Philippines from 1992 to present

- *Reference Ellipsoid*
  Clarke Spheroid of 1866
- *Origin*
  Sta. Balanacan, Marinduque
- *Geoid-spheroid separation*: 0.34 meters
- *Reference Frame*
  PRS92 geodetic control network

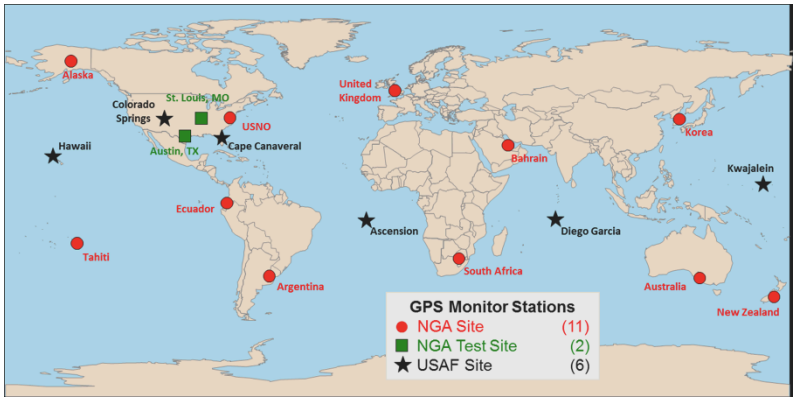
  A "local" network of geodetic control points established using global navigation satellite system (GNSS) technology
- With 7 transformation parameters relating PRS92 and WGS84 (Orig)



WGS84 and ITRF

WGS84

WGS84 reference frame established in 1987 was realized through a set of 11 TRANSIT (Doppler) station (later became ~15 GPS Tracking stations) coordinates in XYZ world



WGS 84 Station Coordinate Updates

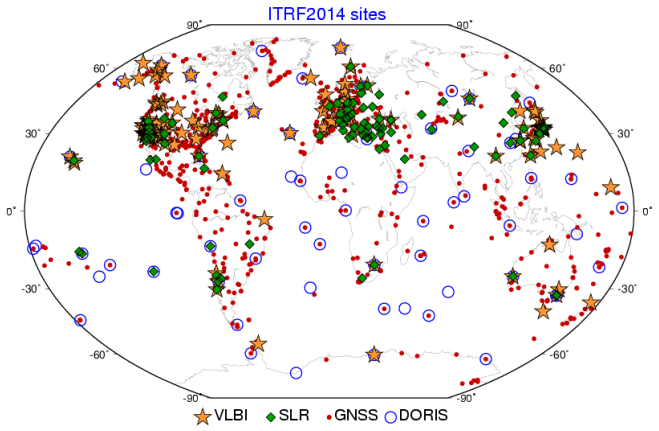
Name	Implementation date		ITRF Epoch	Accuracy
	GPS Broadcast Orbits	NGA Precise Ephemeris		
WGS 84	1987	1 Jan 1987		1-2 meters
WGS 84 (G730)	29 Jun 1994	2 Jan 1994	1994.0	10 cm/component rms
WGS 84 (G873)	29 Jan 1997	29 Sep 1996	1997.0	5 cm/component rms
WGS 84 (G1150)	20 Jan 2002	20 Jan 2002	2001.0	1cm/component rms
WGS 84 (G1674)	8 Feb 2012	7 May 2012	2005.0	<1cm/component rms
WGS 84 (G1762)	16 Oct 2013	16 Oct 2013	2005.0	<1cm/component rms

PRS92

ITRF

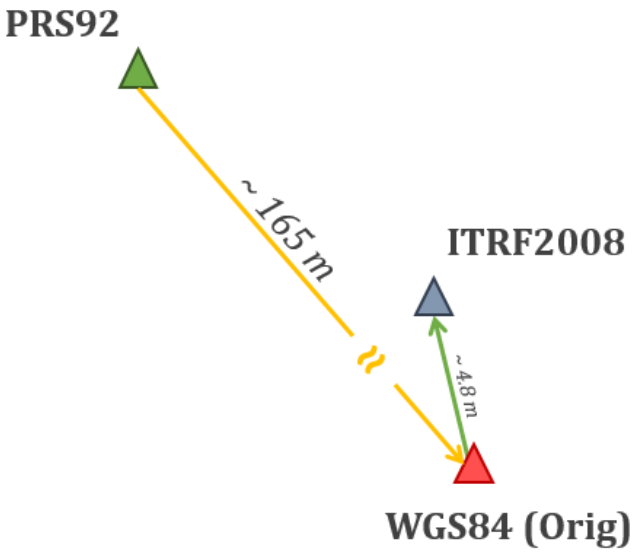
International Terrestrial Reference Frame (ITRF) established in 1988 was realized through a combination of GNSS, VLBI, SLR and DORIS station coordinates in XYZ (with 1-mm sigma) worldwide

Constantly updated due to evolving instruments and data increase, the latest being ITRF2014



PRS92 vs. WGS84 vs. ITRF

Site ID	PRS92			Original WGS84			ITRF2008		
	Latitude	Longitude	Height	Latitude	Longitude	Height	Latitude	Longitude	Height
PBAY	16.48313	121.14163	286.287	16.48151	121.14294	324.584	16.48155	121.14293	322.8978
PCB2	15.45173	120.93742	37.585	15.45017	120.93876	78.501	15.44606	120.93881	76.7968
PCAN	13.93374	121.39541	65.951	13.93229	121.39678	112.329	13.93233	121.39678	110.4624
PCEB	10.31921	123.88844	67.631	10.31806	123.88989	129.334	10.31811	123.88989	124.8694
PDAV	7.12732	125.64188	28.984	7.12645	125.64341	101.715	7.12649	125.64341	98.8607
PDUM	9.32289	123.29860	28.498	9.32180	123.30009	90.978	9.32184	123.30008	88.3908
PFLO	14.98443	120.49801	51.300	14.98289	120.49936	92.514	14.98293	120.49936	90.7626
PGEN	6.06568	125.13011	50.667	6.06487	125.13167	124.036	6.06491	125.13166	121.1308
PILC	10.76405	122.55296	20.404	10.76284	122.55441	77.770	10.76288	122.55441	75.3693
PLEG	13.16252	123.72834	157.954	13.16117	123.72973	212.100	13.16122	123.72973	210.0499
PMRV	14.43746	120.48886	20.347	14.43595	120.49023	63.102	14.43600	120.49022	61.3026
PPPC	9.77412	118.73876	18.841	9.77289	118.74024	69.018	9.77293	118.74023	65.1462
PSRF	14.98340	120.92629	29.984	14.98187	120.92764	72.243	14.98192	120.92763	70.5244
PSTC	14.28308	121.41315	18.869	14.28161	121.41451	64.315	14.28165	121.41451	62.4868
PSUR	9.79284	125.49224	15.894	9.79177	125.49370	82.751	9.79181	125.49370	80.2945
PTAC	11.25103	125.00281	21.860	11.24985	125.00424	84.085	11.24989	125.00423	79.7290
PTAG	14.53690	121.03941	44.613	14.53540	121.04077	88.429	14.53544	121.04077	86.6434
PTGY	14.10171	120.93692	674.062	14.10024	120.93829	718.852	14.10028	120.93829	715.3871
PURD	16.00576	120.57429	45.773	16.00415	120.57562	84.154	16.00420	120.57561	80.4316



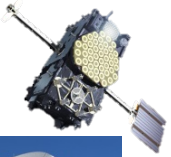
** Based on PageNET AGS coordinates*

ITRF2008 from APRGP processing

What is so important about Global Geodetic Reference Frames?

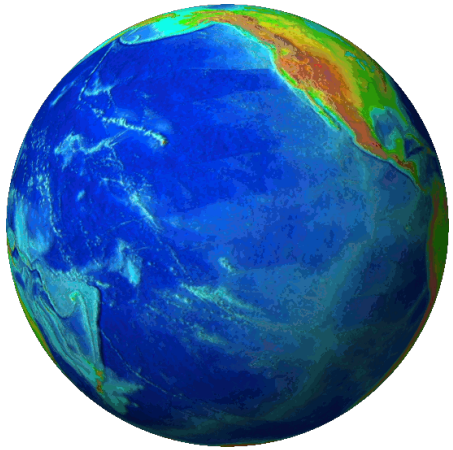
Evolution of Datums

Geocentric (Global) and dynamic datums
(e.g. WGS84, ITRF)



Local (National) and static datums
(e.g. NAD83, Luzon Datum, Tokyo Datum)

A Dynamic World



Global Geodetic Reference Frames

February 26, 2015

UN General Assembly Resolution No. 69/366

'A call for the adoption of a global geodetic reference frame for sustainable development'

United Nations

United Nations A/RES/69/266

General Assembly

Distr.: General
11 March 2015

Sixty-ninth session
Agenda item 9

Resolution adopted by the General Assembly on 26 February 2015

[*without reference to a Main Committee (A/69/L.53 and Add.1)*]

69/266. A global geodetic reference frame for sustainable development

The General Assembly,

Reaffirming the purposes and principles of the Charter of the United Nations,

Reaffirming also its resolution 54/68 of 6 December 1999, in which it endorsed the resolution entitled "The Space Millennium: Vienna Declaration on Space and Human Development",[1] which included, inter alia, key actions to improve the efficiency and security of transport, search and rescue, geodesy and other activities by promoting the enhancement of, universal access to and compatibility of space-based navigation and positioning systems, including Global Navigation Satellite systems,

Reaffirming further its resolution 57/253 of 20 December 2002, in which it endorsed the Plan of Implementation of the World Summit on Sustainable Development (Johannesburg Plan of Implementation),[2] and means of implementation, which included, inter alia, strengthening cooperation and coordination among global observing systems and research programmes for integrated global observations, taking into account the need for building capacity and sharing of data from ground-based observations, satellite remote sensing and other sources among all countries,

Reaffirming its resolution 66/288 of 27 July 2012, in which it endorsed the outcome document of the United Nations Conference on Sustainable Development, entitled "The future we want", in which Heads of State and Government recognized the importance of space-technology-based data, in situ monitoring and reliable geospatial information for sustainable development policymaking, programming and project operations,

Noting Economic and Social Council resolution 2011/24 of 27 July 2011, by which the Council established the Committee of Experts on Global Geospatial Information Management, encouraged Member States to hold regular high-level,

[1] Adopted by the Third United Nations Conference on the Exploration and Peaceful Uses of Outer Space (UNISPACE III), held in Vienna from 19 to 30 July 1999 (A/CONF.184/6, chap. I, resolution 1).
[2] *Report of the World Summit on Sustainable Development, Johannesburg, South Africa, 26 August–4 September 2002* (United Nations publication, Sales No. E.03.II.A.1 and corrigendum, chap. I, resolution 2, annex).

15-02936 (E)

Please recycle

Global Geodetic Reference Frames

"generic term for a framework which allows users to precisely determine and express locations on the Earth, as well as to quantify changes of the Earth in space and time" – UN GGIM

***GGRF** is fundamental for monitoring changes to the Earth including the continents, ice caps, oceans and the atmosphere. It is also fundamental for mapping, navigation and universal timing.*

**WGS84 and ITRF are 'synonymous' (aligned to cm-level)*

UN-GGIM
UNITED NATIONS INITIATIVE ON GLOBAL GEOSPATIAL INFORMATION MANAGEMENT

Global Geodetic Reference Frames

ITRF IN THE ASIA-PACIFIC		
Country	**Geodetic Datum**	**ITRF**
Australia	**GDA94**	**ITRF92@1994.0**
	GDA2020	**ITRF20yy (?)**
Papua New Guinea	**PNG94**	**ITRF92@1994.0**
Indonesia	**DGN95**	**ITRF2005@1995.0**
	Ina-GRS2013/SRGI2013	**ITRF2008@2010.0**
Japan	**JGD2000**	**ITRF94@1997.0**
Taiwan	**TWD97**	**ITRF94@1997.0**
Singapore	**SVY21**	**ITRF95@1995.0**
New Zealand	**NZGD2000**	**ITRF96@2000.0**
China	**CTRF2000**	**ITRF97@2000.0**
Hong Kong	**HongKong2000**	**ITRF96@1996.0**
Malaysia	**GDM2000**	**ITRF2000@2000.0**
South Korea	**KGD2002**	**ITRF2000@2002.0**
Viet Nam	**VN2000**	**ITRF2005@20xx**
Brunei Darussalam	**GDBD2009**	**ITRF2005@2009.0**
Thailand	**(Zero-Order Network)**	**ITRF2005@1996.3**
PHILIPPINES	**PRS92**	
Myanmar	**Myanmar2000 (?)**	**?**
Cambodia	**(Koica Proj in progress)**	**ITRF2000@1998.9**
Laos	**LAO97 (local)**	**n/a**

What is a modern PGRS? How do we go about it?

Limitations of PRS92

Global Geodetic Reference Frame

"generic term for a framework which allows users to precisely determine and express locations on the Earth, as well as to quantify changes of the Earth in space and time"
– UN GGIM

UN-GGIM
UNITED NATIONS INITIATIVE ON GLOBAL GEOSPATIAL INFORMATION MANAGEMENT

Examples: WGS84 and ITRF

WGS 84
World Geodetic System 1984

International Terrestrial Reference Frame
I T R F

**WGS84 and ITRF are almost 'synonymous' (aligned to cm-level)*

Philippine Reference System of 1992

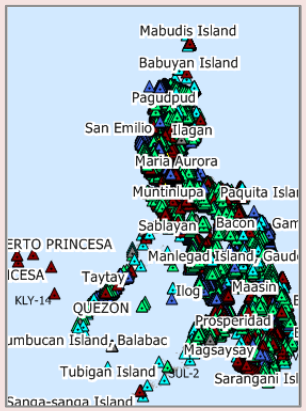
Standard reference system for all surveying and mapping activities in the Philippines, by virtue of E.O. 45

A homogeneous national network of geodetic control points (GCPs), marked by survey monuments or mojons, that has been established using Global Positioning System (GPS) technology.

At the time of establishment, PRS92 is the best fit reference system for the country. However, PRS92 is a static and local system.

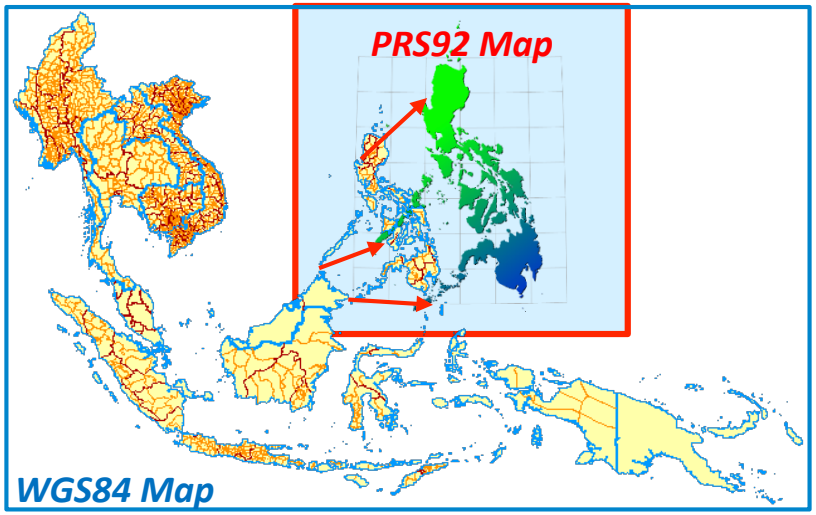
PHILIPPINE REFERENCE SYSTEM OF 1992

PRS 92



Limitations of PRS92

Global Geodetic Reference Frame	Philippine Reference System of 1992
▪ *Dynamic* ▪ *Global fit*	▪ *Static* ▪ *Local fit*



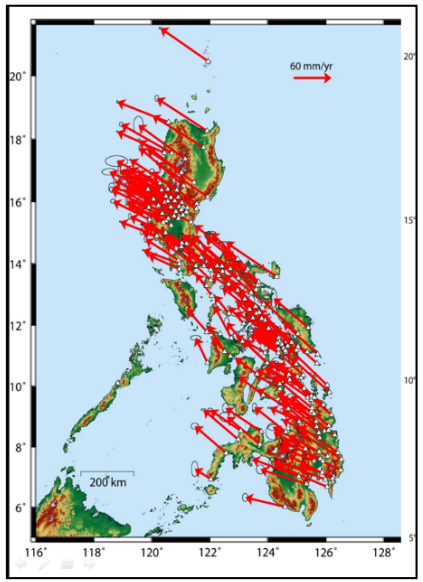
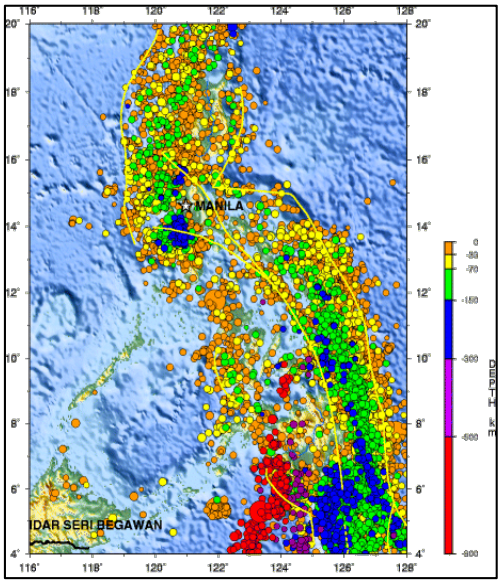


Plate tectonics



Earthquakes (1990-2006)

Modernization of the PGRS

Major Objective:

*To develop and provide access to an **authoritative** geodetic reference system **aligned** with a **global** geodetic reference frame, that will serve as the **common** reference for all surveying and mapping activities in the country*

Modernization of the PGRS

Technical Working Group on the PGRS Modernization

Government

Academe

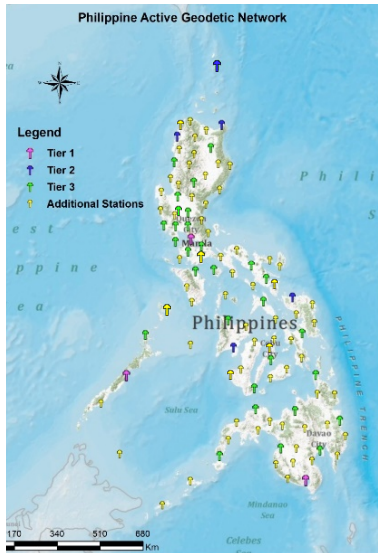
Private Sector

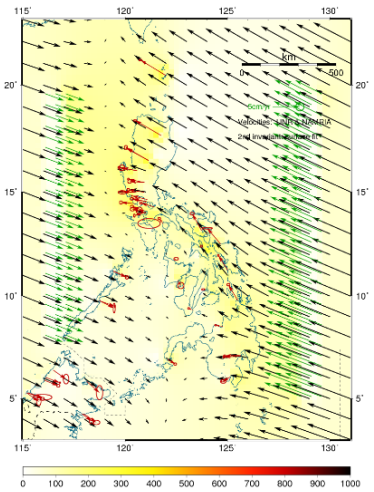
Modernization of the Philippine Geodetic Reference System
44th Annual Regional Convention – Geodetic Engineers of the Philippines, Inc. Regional Division III
Otel Pampanga, San Fernando City
16 – 17 March 2018

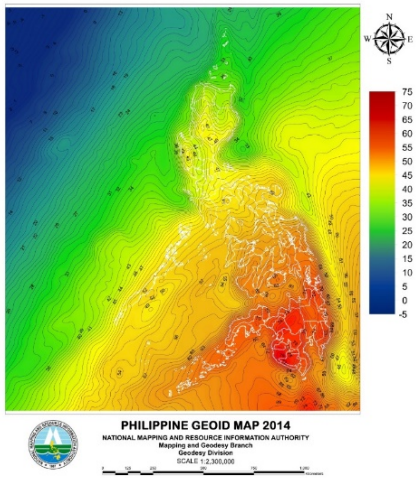
Modernization of the PGRS

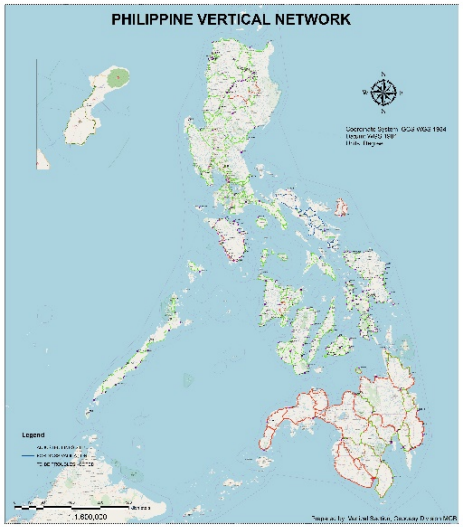
Modern PGRS

- Philippine Geocentric Datum of 2020 (PGD2020)
- Philippine Geoid Model (PGM20xx)
- Philippine Geodetic Vertical Datum of 2020 (PGVD2020)









Modernization of the Philippine Geodetic Reference System

44th Annual Regional Convention – Geodetic Engineers of the Philippines, Inc. Regional Division III
Otel Pampanga, San Fernando City
16 – 17 March 2018

Modernization of the PGRS

Components :

- Migration to a geocentric and dynamic datum (Philippine Geocentric Datum 20??)
- Development and Maintenance of the Philippine Geodetic Vertical Datum 2020
- Strengthening of core competencies, R&D and IEC

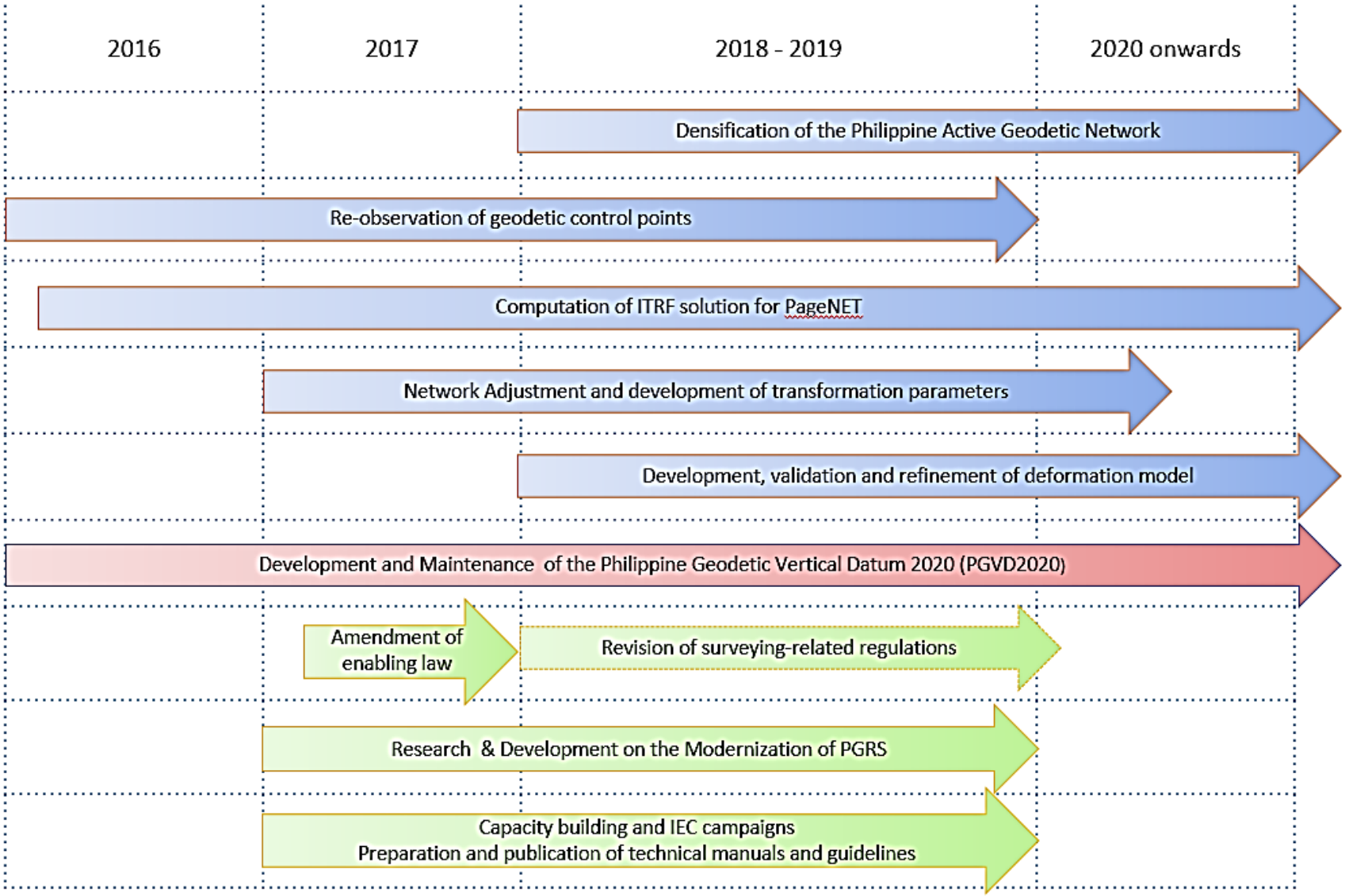
-- Establish 200 AGS

-- Develop deformation model
-- Compute ITRF coordinates of PageNet
-- Re-observe 3000 GCPs (Zero, 1st & 2nd)

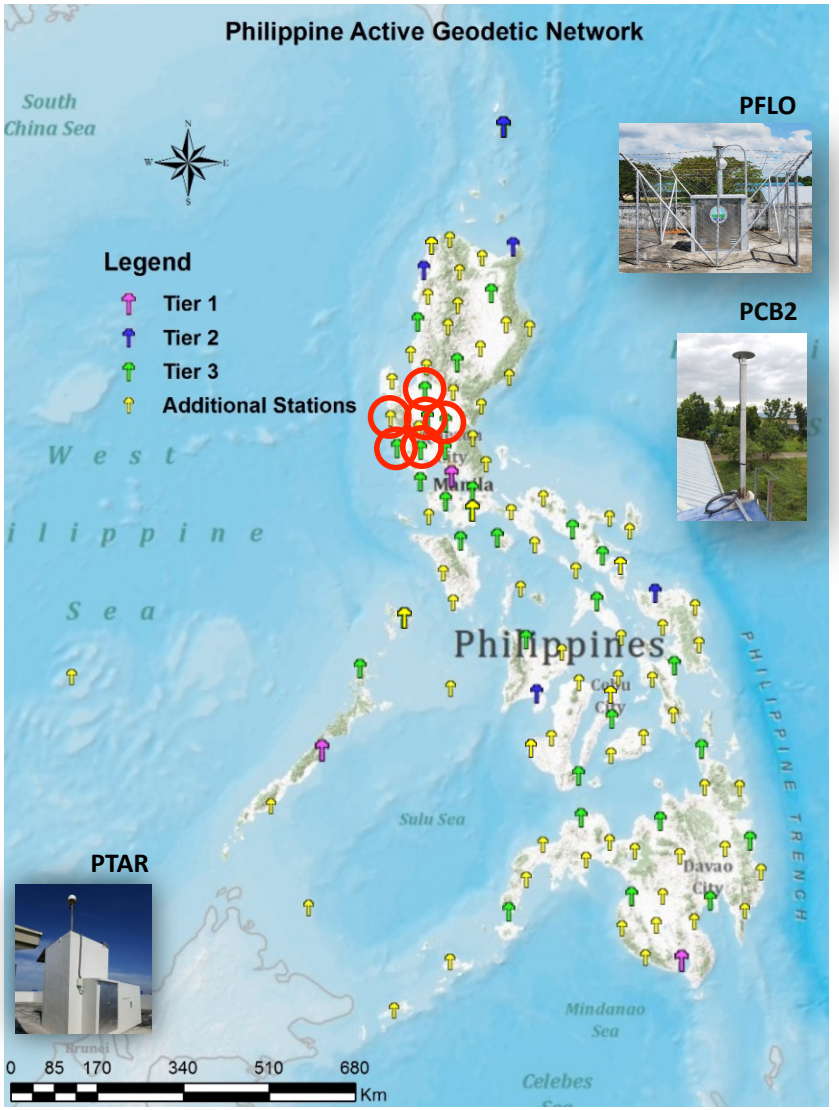
-- Densify gravity stations
-- Re-compute PGM2014

-- Train NAMRIA staff
-- Massive IEC campaigns
-- Amendment of existing laws (PRS92 to PGD2016)
-- R&D on PGRS Modernization

Modernization of the PGRS



PGD2020: Densification of PAGeNet

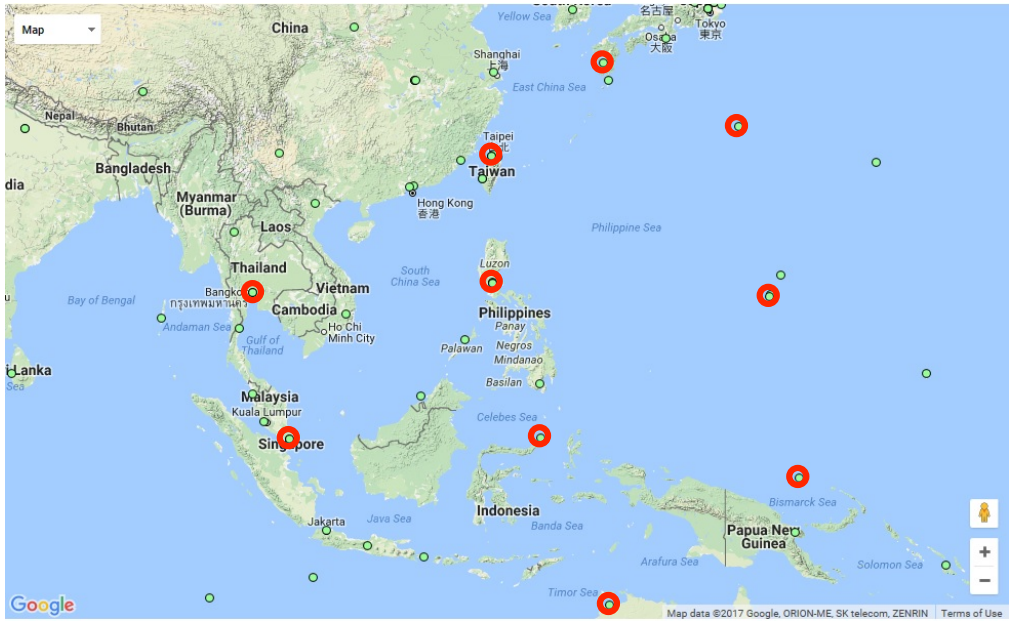


The country's network of permanently-installed, continuously operating geodetic reference stations

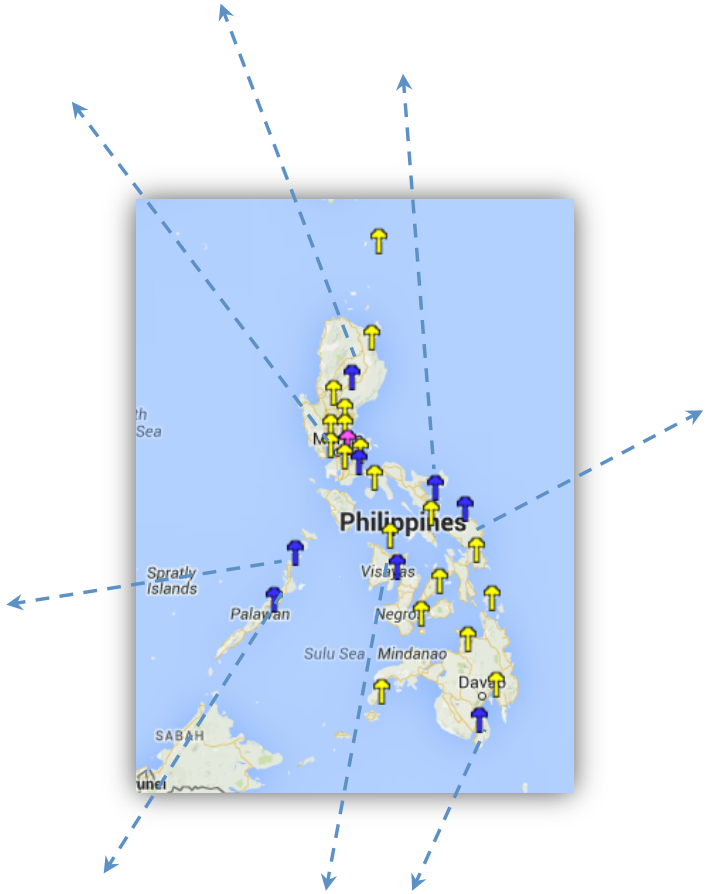
- *41 stations operational*
  - ***6 in Region III (PCB2, PFLO, PMRV, PSNR, PSRF, PTAR)***
  - *3 IGS sites (PTAG, PPPC, PGEN)*
  - *2 MGM-Net sites (PLUZ, PMIN)*
  - *1 REGINA site (PTGG)*
- *6 AGS for installation this year*
  - *Tandag City, Surigao del Sur*
  - *Pagadian City, Zamboanga del Norte*
  - *Maramag, Bukidnon*
- *6 sites for reconnaissance in 2018*

PGD2020: Alignment to ITRF

Connect PAGeNet to ITRF and compute coordinate solutions using Bernese Software

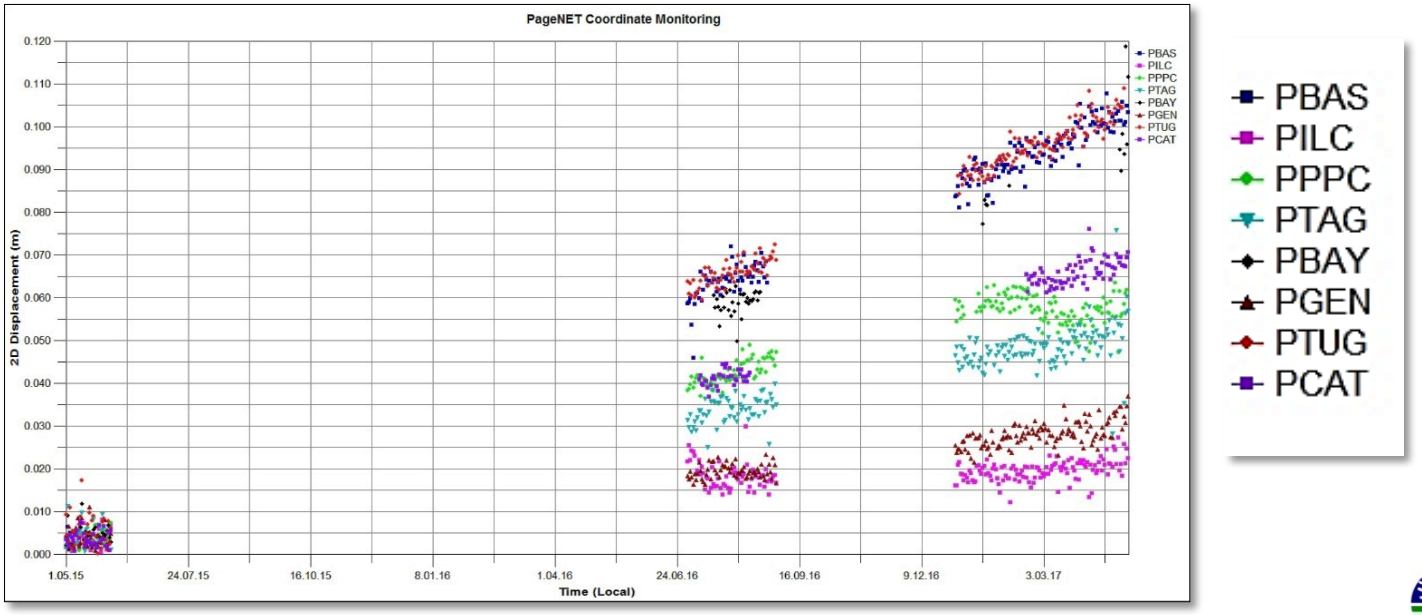


http://www.igs.org/



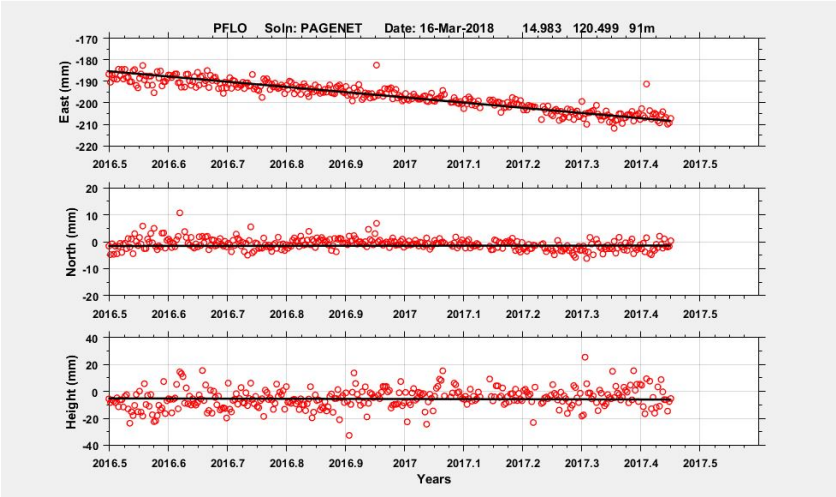
PGD2020: Alignment to ITRF

Site	May 2015 – August 2016				May 2015 – March 2017			
	dN	*dE*	*2D*	*dU*	*dN*	*dE*	*2D*	*dU*
PTAG	0.006	(0.035)	0.035	(0.005)	0.012	(0.048)	0.049	(0.013)
PPPC	(0.026)	0.035	0.044	(0.005)	(0.024)	0.049	0.055	(0.003)
PGEN	(0.009)	(0.017)	0.020	(0.012)	(0.014)	(0.025)	0.029	(0.004)
PBAS	0.035	(0.056)	0.067	0.001	0.053	(0.081)	0.097	(0.002)
PTUG	0.035	(0.059)	0.069	(0.004)	0.050	(0.084)	0.098	(0.007)
PBAY	0.031	(0.052)	0.060	(0.005)	0.052	(0.083)	0.098	(0.024)
PCAT	**0.035**	**(0.024)**	**0.042**	**0.001**	**0.052**	**(0.040)**	**0.065**	**0.006**
PILC	(0.017)	0.001	0.017	(0.001)	(0.019)	0.004	0.020	(0.000)

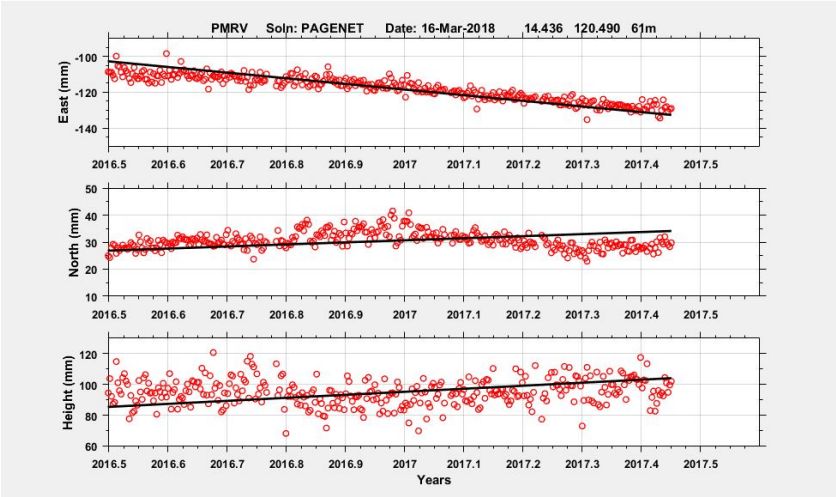


PGD2020: Alignment to ITRF

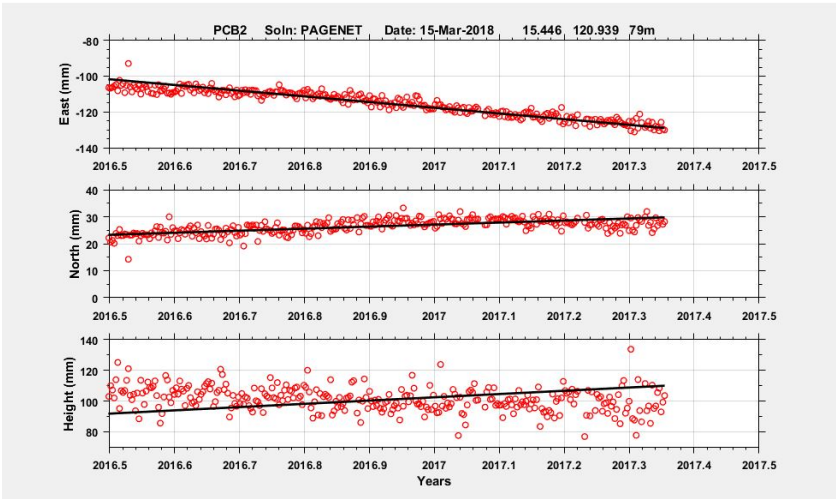
in ITRF2014



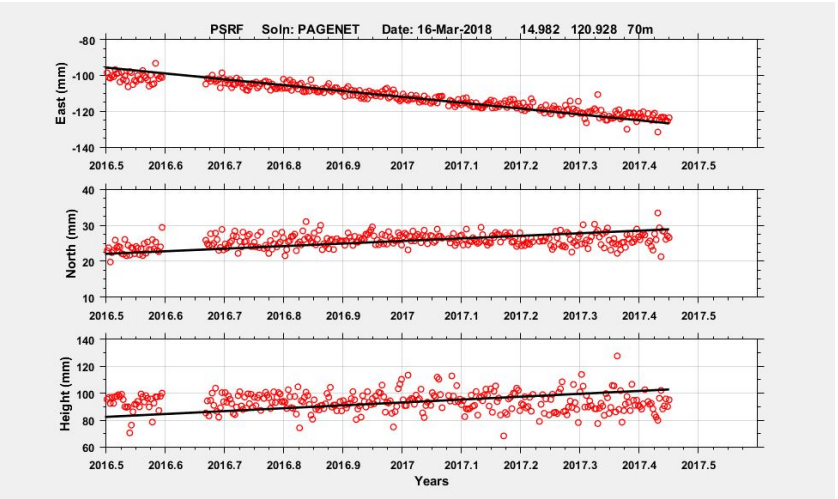
PFLO: 24.21 +/- 0.17 mm (NW)



PMRV: 32.30 +/- 0.24 mm (NW)



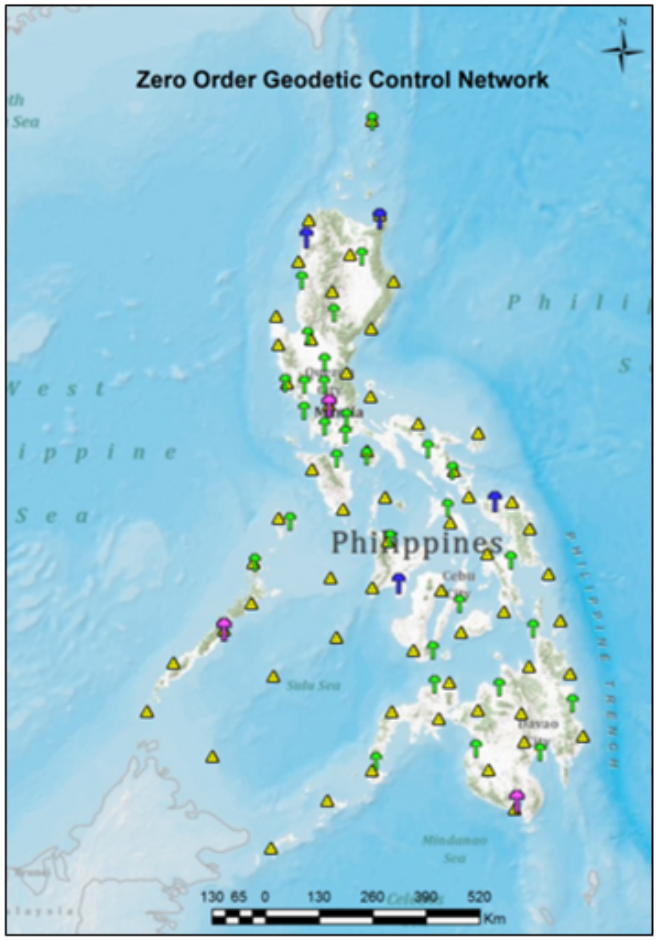
PCB2: 32.34 +/- 0.24 mm (NW)



PSRF: 33.39 +/- 0.24 mm (NW)

PGD2020: GCP Re-observation

Completed re-observation of the zero-order geodetic control points



2008-2010 Campaign

- *59 stations occupied*
  Luzon – 33 Mindanao – 16
  Visayas – 10
- *11 interconnected loops*
- *9 hours per session*
  (2 sessions per loop)
- *Observed using dual frequency receivers*

ZBS-67 (2008)

2015 Re-observation

- *66 stations occupied*
  Luzon – 35 Mindanao – 17
  Visayas – 14
- *9 interconnected loops*
- *12 hours per session*
  (2 sessions per loop)
- *18 of the 66 stations are new points*

ZBS-67 (2015)

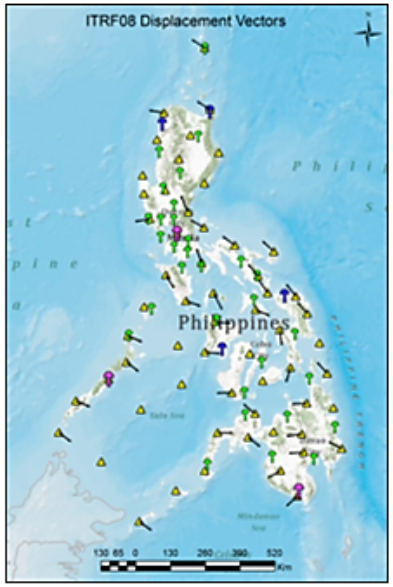
PGD2020: GCP Re-observation

Completed re-observation of the zero-order geodetic control points

2010 - 2015

Cluster	ITRF08		Local WGS84	
	Annual Rate (cm)	*Direction*	*Annual Rate (cm)*	*Direction*
Eastern Luzon	3.89	NW	2.11	NW
North-western 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

Maximum: BHL – 94 = 0.424m NW, (2D, local WGS84)

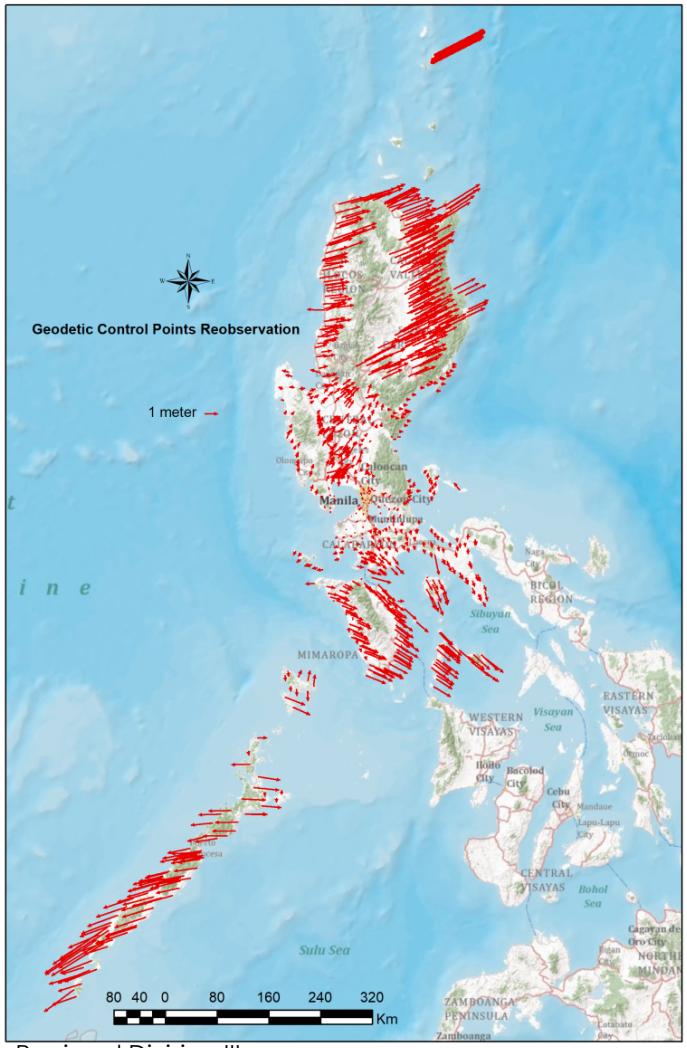


Preliminary results

PGD2020: GCP Re-observation

Ongoing re-observation of the 1st- and 2nd-order GCPs

PROVINCE	1ST	2ND	Alternate	Total
Siquijor			33	33
Batanes			41	41
Ilocos Norte	3	12	2	17
Ilocos Sur	1	21	8	30
La Union	2	13	9	24
Pangasinan	4	32	7	43
Nueva Vizcaya	2	6	12	20
Quirino		6	4	10
Isabela	4	53	27	84
Cagayan	4	57	15	76
Abra		27	10	37
Kalinga		13	9	22
Ifugao	1	15	7	23
Apayao		20	6	26
Benguet	2	23	11	36
Mountain Province	1	21	4	26
Bulacan		6	18	24
Aurora		21	13	34
Nueva Ecija	1	18	26	45
Pampanga		14	35	49
Zambales	1	12	11	24
Tarlac	2	26	23	51
Bataan		4	14	18
NCR	2	13	31	46
Cavite		4	12	16
Laguna	2	8	15	25

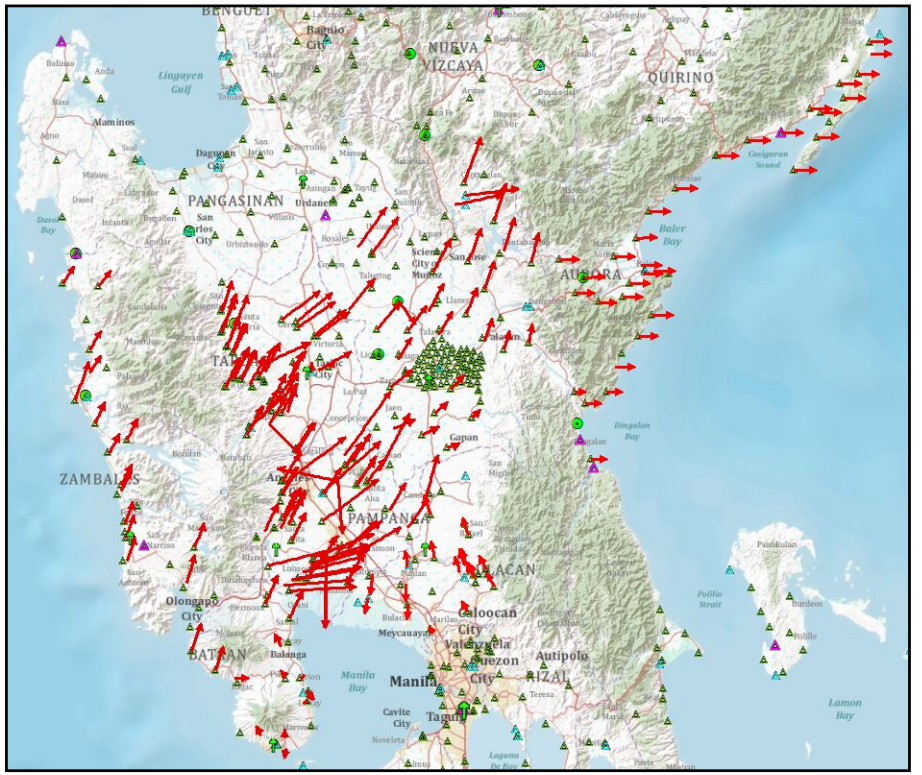


Preliminary results
In WGS84 (Orig)

PGD2020: GCP Re-observation

Ongoing re-observation of the 1st- and 2nd-order GCPs

Province	Average 2D Displacement (m)	Direction
Aurora	0.32	NE
Bulacan	0.25	NW
Bataan	0.23	NE/NW
Nueva Ecija	0.48	NE
Pampanga	0.74	NE
Tarlac	0.51	NE
Zambales	0.38	NE

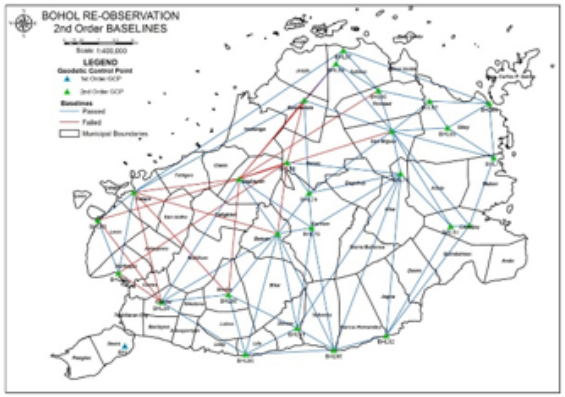


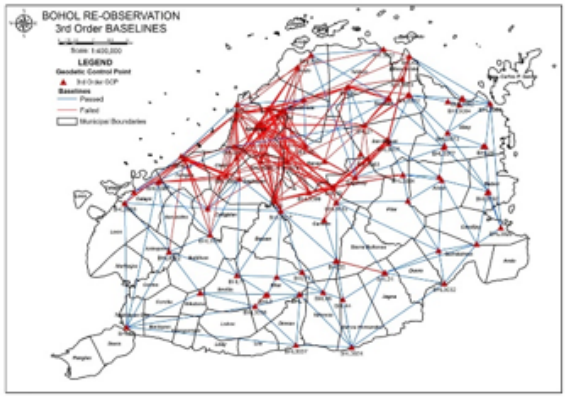
Preliminary results in WGS84 (Orig)

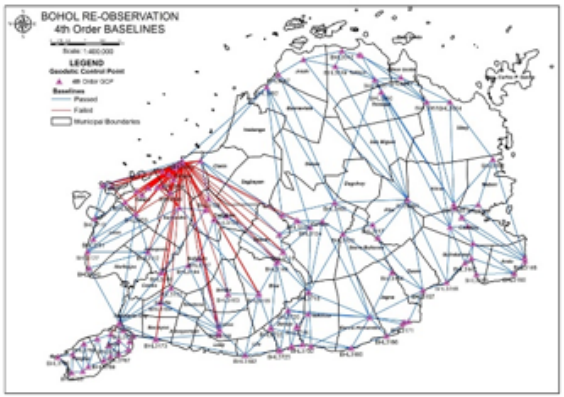
PGD2020: GCP Re-observation

Bohol GCP re-observation after the M7.2 October 2013 earthquake

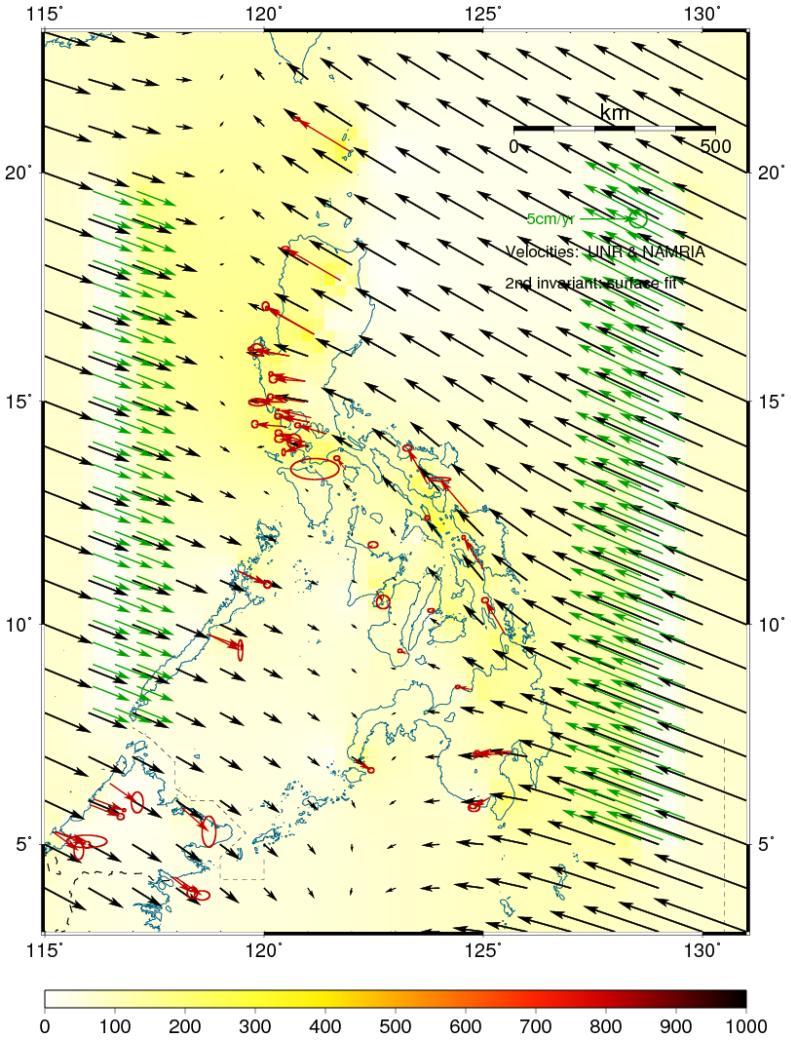
Order	Accuracy Standard	No. of GCPs Re-observed	Affected GCPs	No. of Failed Baselines / Total No. Baselines
2nd	20 ppm	26	BHL-73, BHL-68, BHL-76, BHL-94	16 / 325
3rd	50 ppm	99	BHL-7, BHL-27, BHL-29, BHL-30, BHL-31, BHL-33, BHL-34, BHL-37, BHL-39, BHL-40, BHL-47, BHL-48, BHL-3005, BHL-3016, BHL-3059, 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





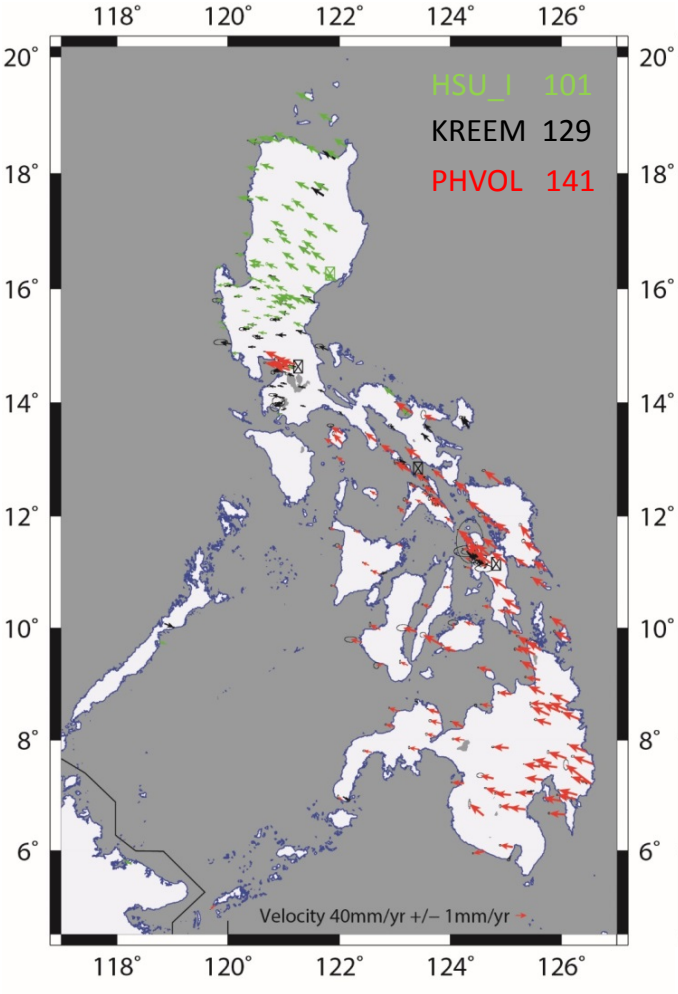


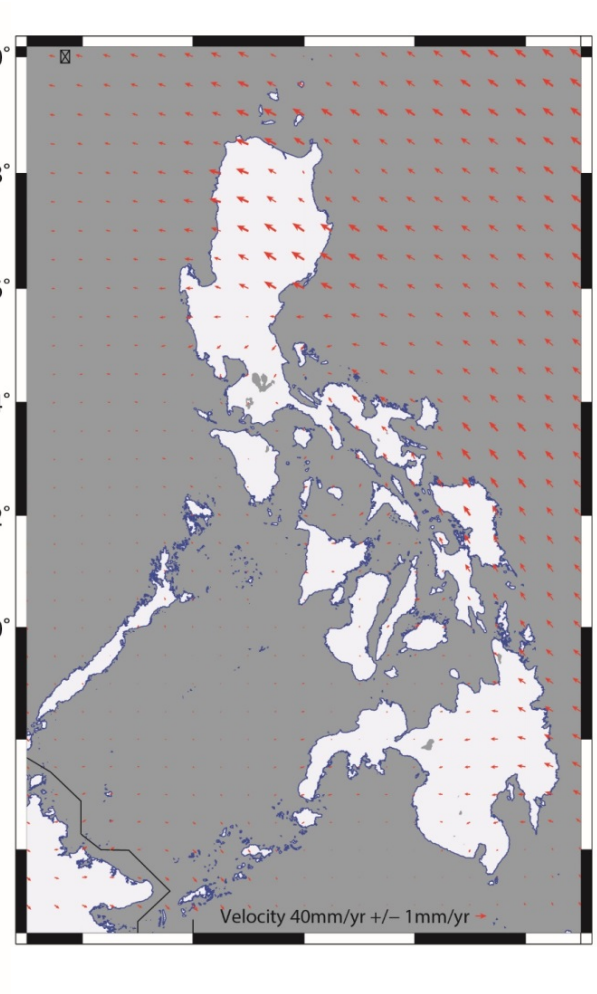
PGD2020: Deformation Modelling



- *Sub-TWG on Deformation Modelling*
  - *NAMRIA, Phivolcs, UP and Feati*
- *3-day Dynamic Datum Course with Newcastle University (UK)*
  - *Prototype deformation model created based on 3 years PageNET data*
- *Model to be supplemented with campaign data from NAMRIA GCP re-observations and Phivolcs campaign sites (1996 to present)*

PGD2020: Deformation Modelling

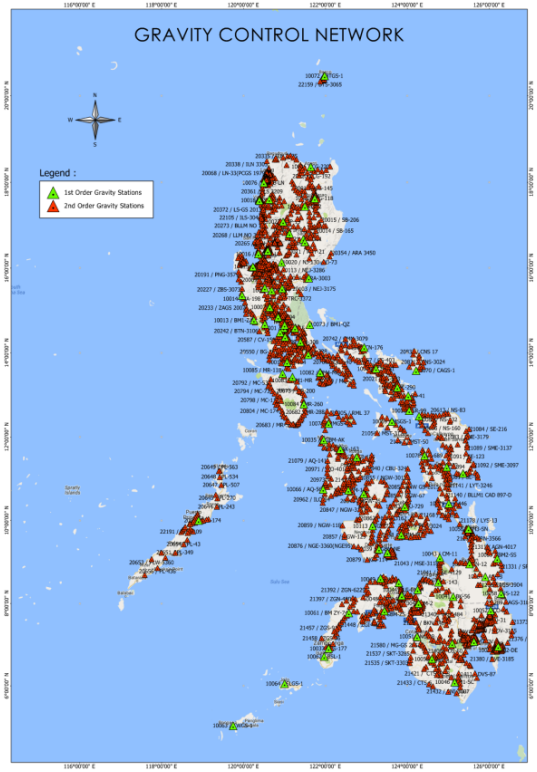




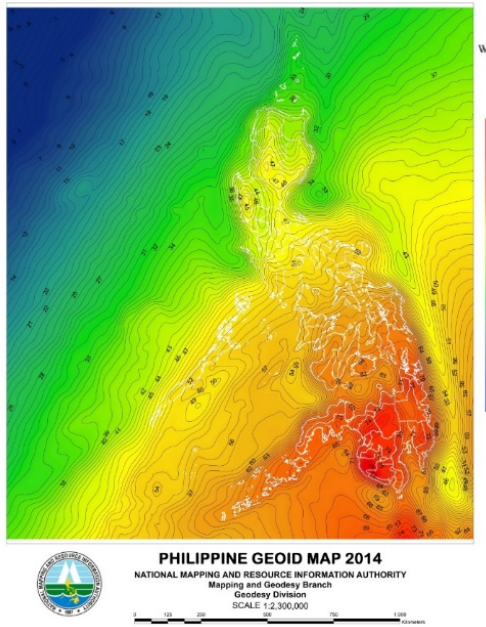
Deformation Modeling Training for Geodesy Division Personnel

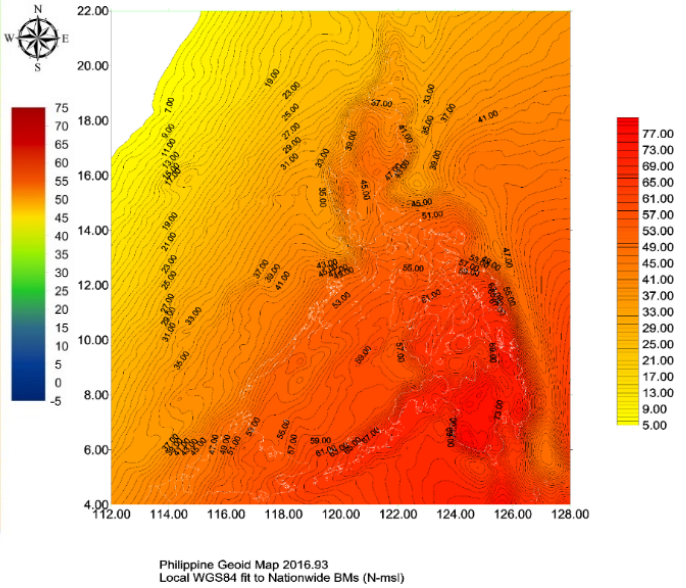
Modernization of the Philippine Geodetic Reference System
44th Annual Regional Convention – Geodetic Engineers of the Philippines, Inc. Regional Division III
Otel Pampanga, San Fernando City
16 – 17 March 2018

PGVD2020: Recomputation of PGM



- *Densification of gravity stations*
  - *To date: 3,383 stations Universe: 41,000*
- *Re-computation of the Philippine Geoid Model 2014*
  - *PGM2016 already available*
- *Ongoing re-levelling campaign to troubleshoot level network*
  - *200 of 1,000 target benchmarks surveyed in Luzon (FY2017)*

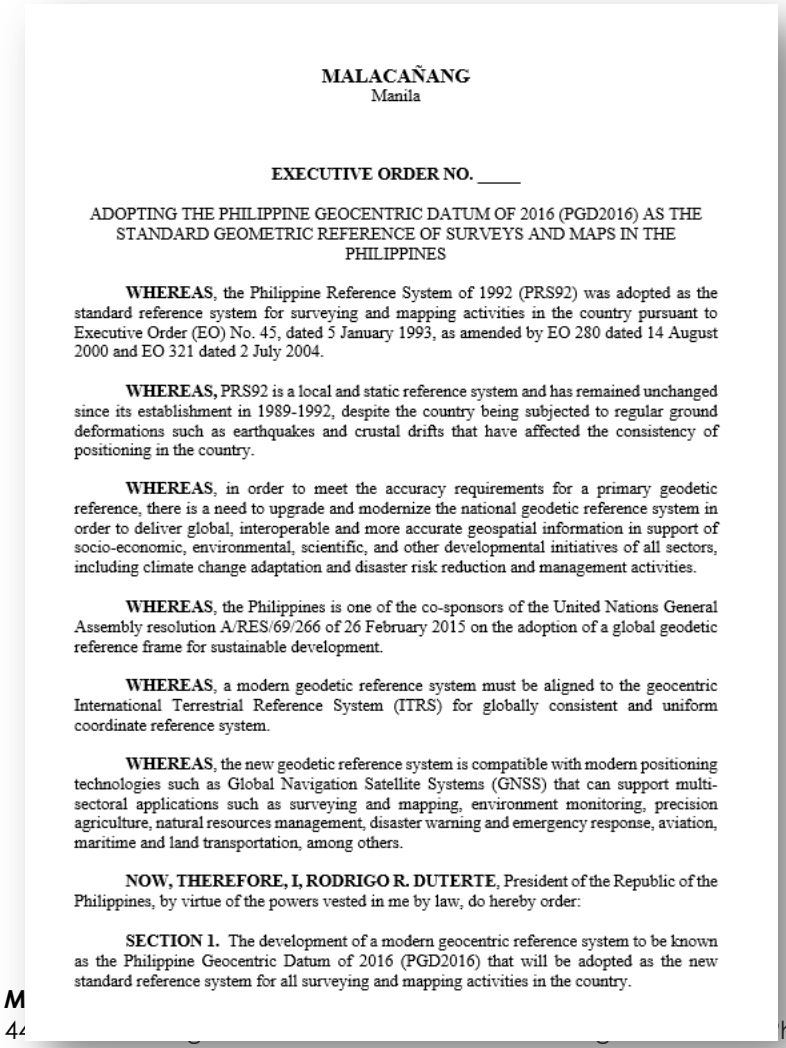




Note : PGM2016 is available for download at namria.gov.ph;
Featured Site- Philippine Geoid Model

Strengthening of Competencies

Amendment of laws, policies and guidelines



MALACAÑANG
Manila

EXECUTIVE ORDER NO. ____

ADOPTING THE PHILIPPINE GEOCENTRIC DATUM OF 2016 (PGD2016) AS THE STANDARD GEOMETRIC REFERENCE OF SURVEYS AND MAPS IN THE PHILIPPINES

WHEREAS, the Philippine Reference System of 1992 (PRS92) was adopted as the standard reference system for surveying and mapping activities in the country pursuant to Executive Order (EO) No. 45, dated 5 January 1993, as amended by EO 280 dated 14 August 2000 and EO 321 dated 2 July 2004.

WHEREAS, PRS92 is a local and static reference system and has remained unchanged since its establishment in 1989-1992, despite the country being subjected to regular ground deformations such as earthquakes and crustal drifts that have affected the consistency of positioning in the country.

WHEREAS, in order to meet the accuracy requirements for a primary geodetic reference, there is a need to upgrade and modernize the national geodetic reference system in order to deliver global, interoperable and more accurate geospatial information in support of socio-economic, environmental, scientific, and other developmental initiatives of all sectors, including climate change adaptation and disaster risk reduction and management activities.

WHEREAS, the Philippines is one of the co-sponsors of the United Nations General Assembly resolution A/RES/69/266 of 26 February 2015 on the adoption of a global geodetic reference frame for sustainable development.

WHEREAS, a modern geodetic reference system must be aligned to the geocentric International Terrestrial Reference System (ITRS) for globally consistent and uniform coordinate reference system.

WHEREAS, the new geodetic reference system is compatible with modern positioning technologies such as Global Navigation Satellite Systems (GNSS) that can support multi-sectoral applications such as surveying and mapping, environment monitoring, precision agriculture, natural resources management, disaster warning and emergency response, aviation, maritime and land transportation, among others.

NOW, THEREFORE, I, RODRIGO R. DUTERTE, President of the Republic of the Philippines, by virtue of the powers vested in me by law, do hereby order:

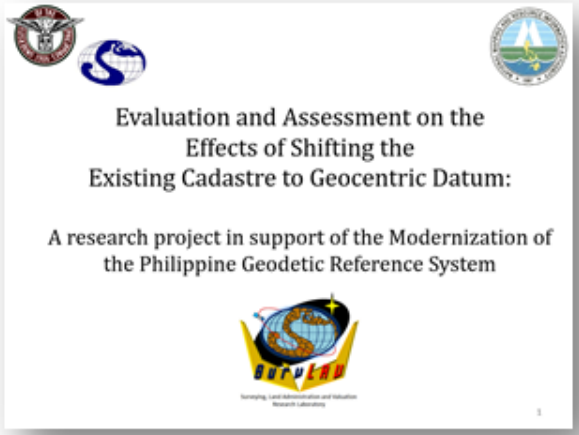
SECTION 1. The development of a modern geocentric reference system to be known as the Philippine Geocentric Datum of 2016 (PGD2016) that will be adopted as the new standard reference system for all surveying and mapping activities in the country.

Re-submitted proposed Executive Order on the Philippine Geocentric Datum of 2020 (PGD2020) to the DENR

Strengthening of Competencies

Research and Development in support to the PGRS Modernization

- Partnership with the UP-TCAGP to undertake research studies on topics relevant to the PGRS modernization, i.e.
  - *Implications of migrating to semi-dynamic geocentric datum*
  - *Effects of datum change to titling*
  - *Recommended transformation strategy in relating existing systems to the new datum*



Strengthening of Competencies

Research and Development in support to the PGRS Modernization

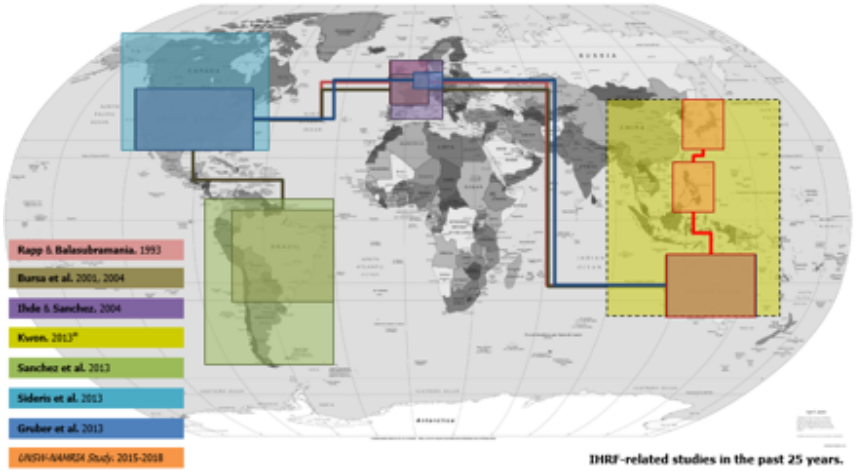
Towards the Development of the IHRF in the Asia-Pacific Region

Jak Sarmiento

August 2016 NAMRIA Report

Surveying and Geospatial Engineering
School of Civil and Environmental Engineering
Supervisors: ***Dr. Chris Rizos & Dr. Craig Roberts***

Globalisation of Heights



IHRF-related studies in the past 25 years.

Modernization of the Philippine Geodetic Reference System
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Otel Pampanga, San Fernando City
16 – 17 March 2018

Strengthening of Competencies

Research and Development in support to the PGRS Modernization

Remote sensing and field investigations of the earthquake cycle

John Dale B. Dianala, *PhD student, Department of Earth Sciences, University of Oxford, United Kingdom; with a CHED-Newton PhD Scholarship*

Instructor (on study leave), National Institute of Geological Sciences, University of the Philippines, Diliman

Supervisor: ***Richard T. Walker***, *Professor of Tectonics, Department of Earth Sciences, University of Oxford, United Kingdom*

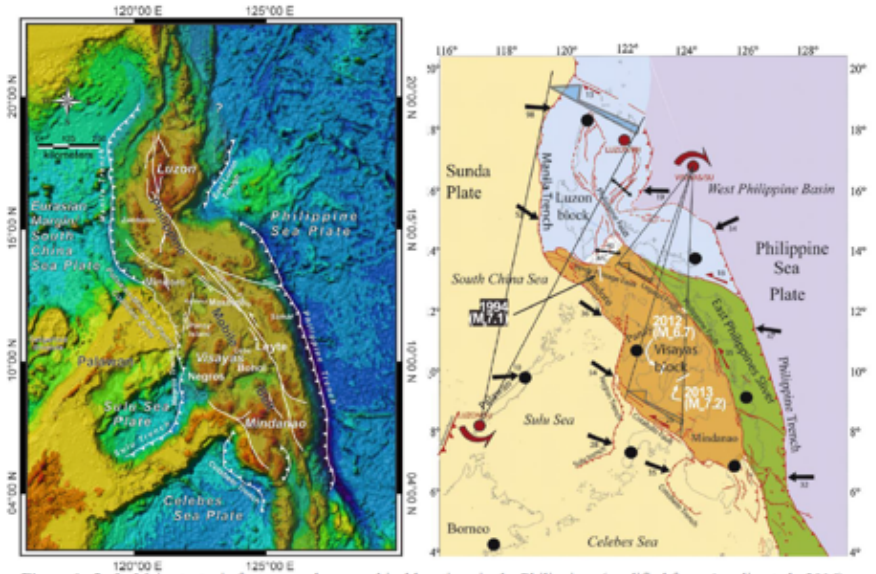
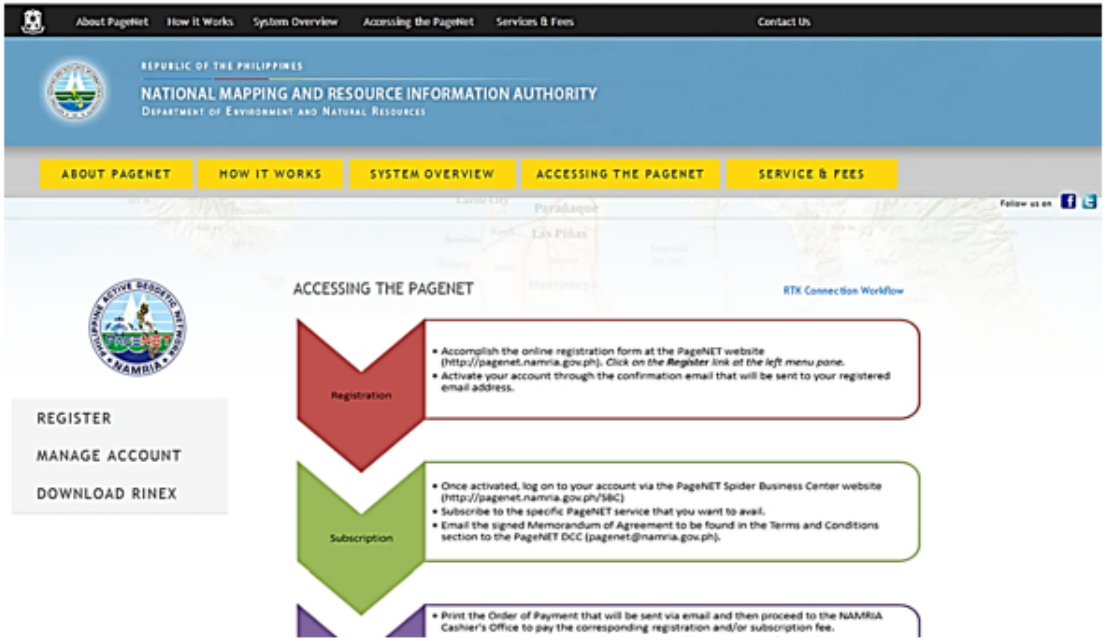


Figure 1. Left: Major tectonic features and geographical locations in the Philippines (modified from Aurelio et al., 2016). **Right**: Map of rigid block model showing faults (white lines) on the Visayas Block (orange area) that ruptured in significant earthquakes in 1994, 2012, and 2013 (see text for description of these earthquakes).

Strengthening of Competencies

Complimentary subscription to PAGeNet services for DENR regional offices and GNSS suppliers




MOU

NAMRIA-QCP-03-Form6 Rev 2

MEMORANDUM OF UNDERSTANDING

KNOW ALL MEN BY THESE PRESENTS:

This Memorandum of Understanding is made and entered into by and between:

The **NATIONAL MAPPING AND RESOURCE INFORMATION AUTHORITY (NAMRIA)**, a government entity with office address at Lawton Avenue, Fort Bonifacio, Taguig City, Metro Manila, Philippines as herein represented by **Dr. Peter N. Tiangco, CESO I,** Administrator, hereinafter referred to as the **FIRST PARTY**.

-and-

DEPARTMENT OF ENVIRONMENT AND NATURAL RESOURCES (DENR) REGION _____ with principal office at _____ as herein represented by _____ hereinafter referred to as the **SECOND PARTY**.

Strengthening of Competencies

Free 15s (2018 only) and 30s (2008-2018) RINEX data for download

NEWS AND EVENTS

You are here > Home > News and Events

NAMRIA to offer PAGeNet RINEX data for free starting 2018

Charisma Victoria Cayapan | 13 December 2017

Good news to the geomatics and scientific community!

Starting 01 January 2018, RINEX* data from the Philippine Active Geodetic Network (PAGeNet) will be offered to the public for free. This move is aimed at mainstreaming the use of PAGeNet products and services in various surveying and mapping activities of its stakeholders

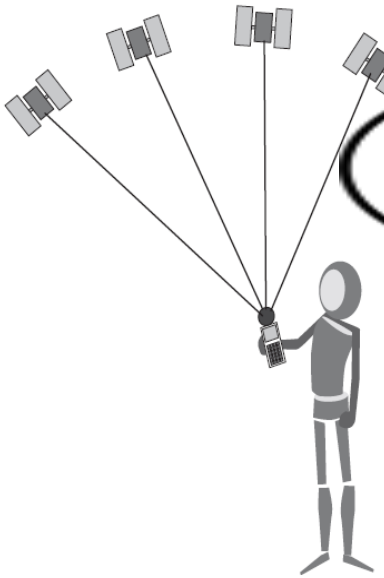
How will a modern PGRS *impact* geodetic engineers?

Modern PGRS and the GE

✓ A ‘world-class’ PGRS = A ‘world-class’ GE

Consistent, Accurate, Up-to-date and Interoperable

Modern PGRS and the GE



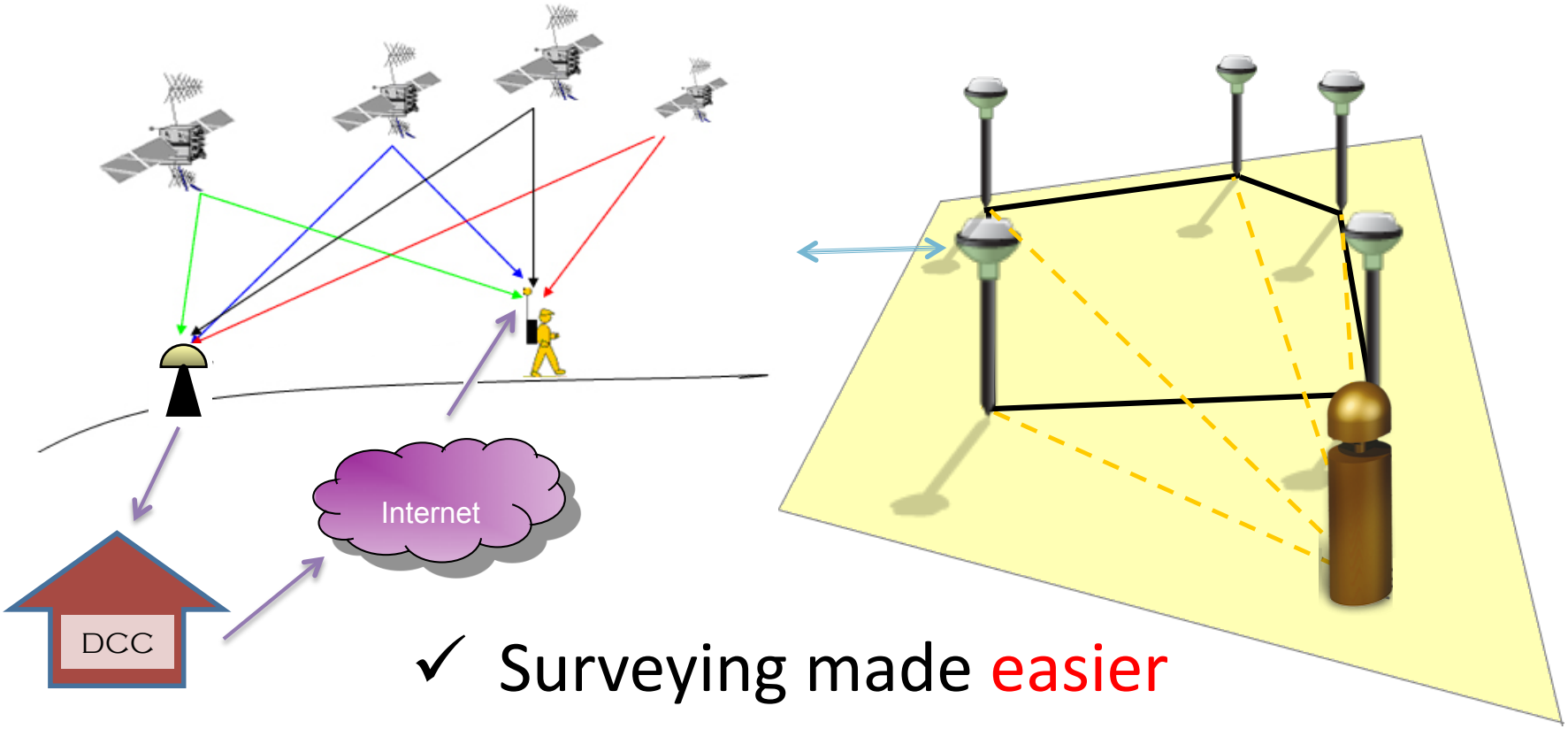
PGD2020
ϕ = 14°32'7.43"N
λ = 121° 2'26.78"E

PGD2020
ϕ = 14°32'7.54"N
λ = 121° 2'25.95"E

✓ More equipped to deal with the changing Earth

GEs have access to position data that reflects real world conditions

Modern PGRS and the GE



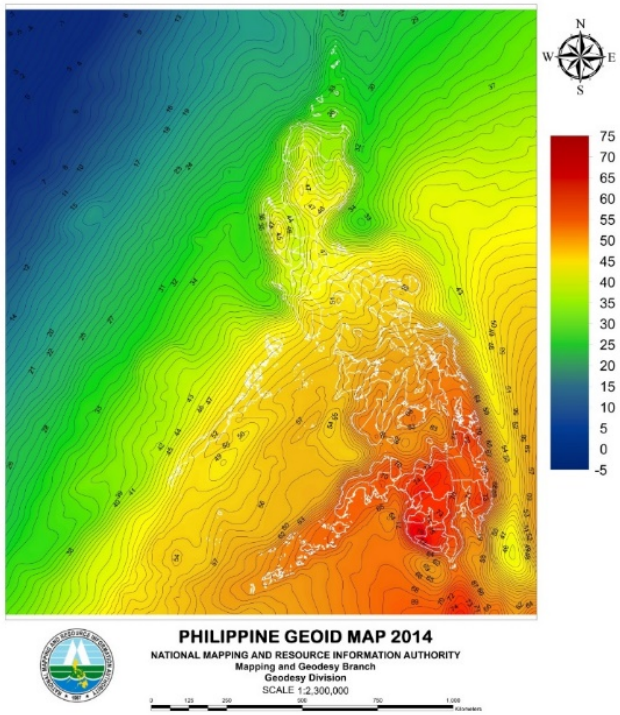
✓ Surveying made easier

Availability of reference station data 24/7/365 through the PAGeNet

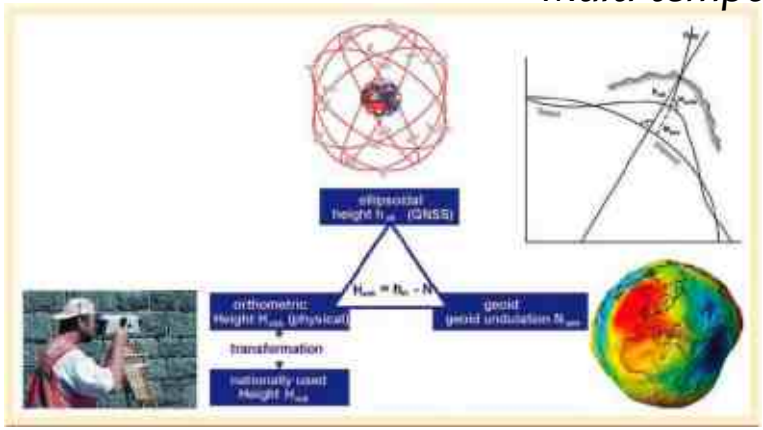
No need to put up a base station

Ongoing densification of PAGeNet to bring corrections closer to stakeholders

Modern PGRS and the GE



- ✓ Latitude
- ✓ Longitude
- ✓ Ellipsoidal height
- ✓ Elevation (AMSL)
- ✓ Gravity
- ✓ *Multi-temporal*

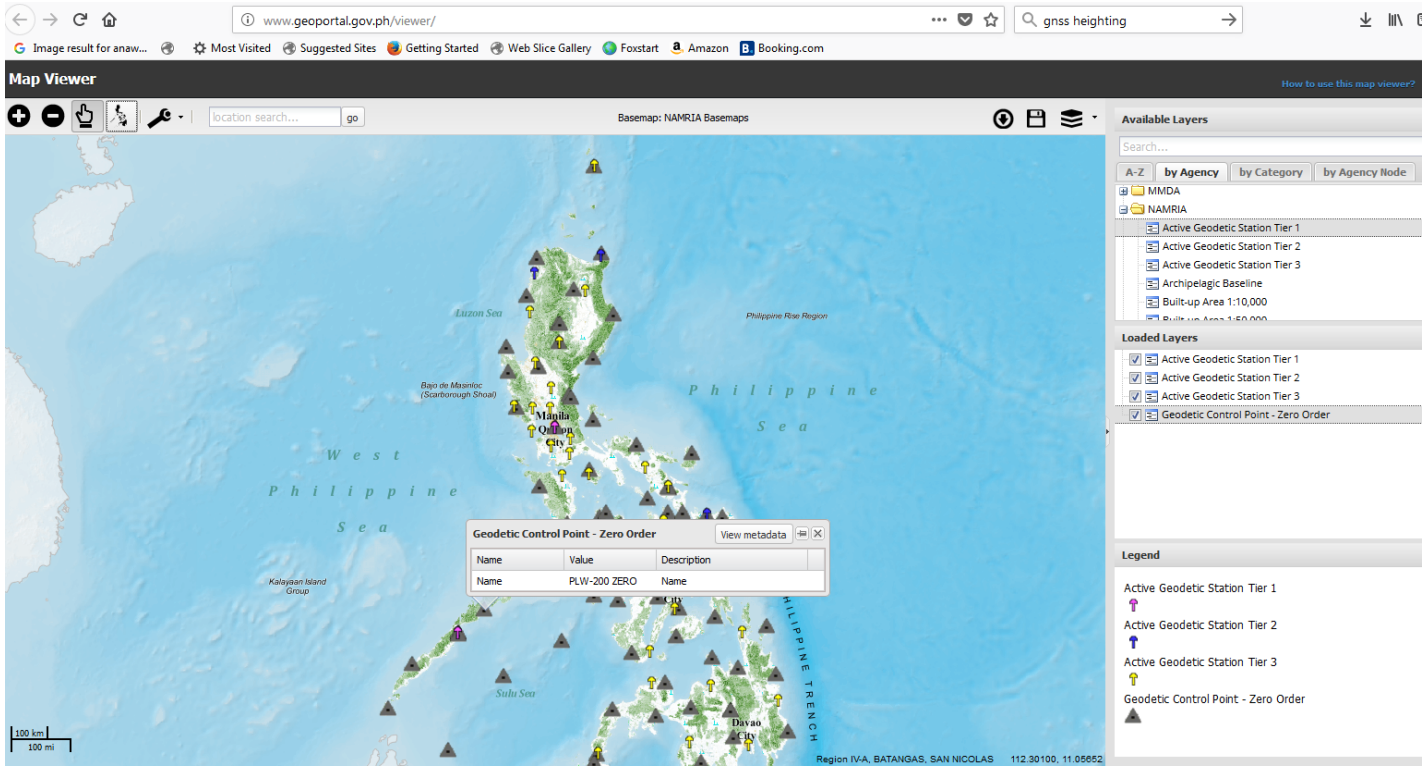


✓ Surveying made easier

A 4-D geodetic reference with unified control points

Elevation measurements using GNSS and the Philippine Geoid Model

Modern PGRS and the GE

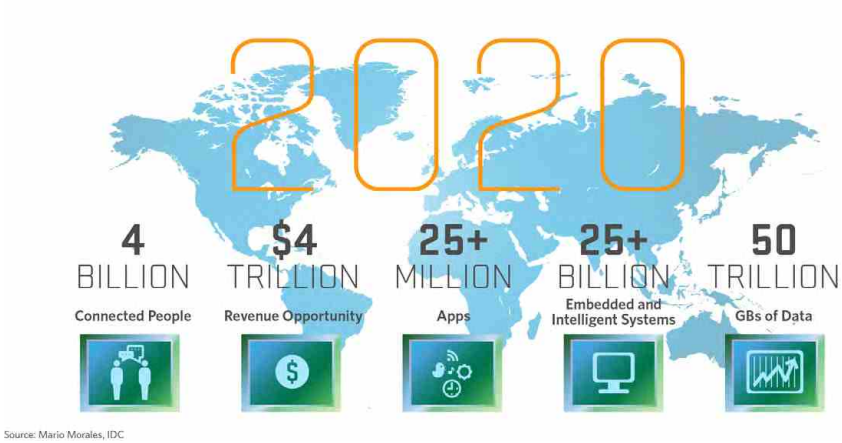


✓ Surveying made easier

Online portal for viewing geodetic reference station data

Web-based transformation utility (PRS92 ↔ ITRF ↔ WGS84)

Modern PGRS and the GE



✓ Opens the door to a world of applications

Accurate and up-to-date positions at the palm of your hand

In closing…

References

- *Map Projection and Coordinate Systems.*
  Emmanuel P. Sambale. November 2006
  https://www.slideshare.net/esambale/projections-eps

Maraming salamat po!

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