PNG2020 Implementation Progress Report

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Personnel and funding

In 2022 all geodetic staff (and all of DLPP) became “unattached” and were required to reapply for their positions. This unfortunately resulted in the loss of some key geodetic and other HQ staff.

Extensive delays with PNG Indonesia border survey with funding reallocation

4 million kina funding pending through PIP has now been allocated to complete the geodetic surveys and PNG2020 implementation during 2023 - 2028.

This is a very significant achievement to finalise the new geodetic datum after many years of poor funding and 2.5 year delay from the global pandemic.

Implementation Progress 2022 to 2023
Geodetic observations - completed

NAC Geodetic survey, Kavieng (part of airport upgrade) – November 2022

WNB, Bialla – Ulamona (Asia Pacific Surveys) – November 2022

AROB geodetic surveys (Calvin Nalei – Buka airport, Buin) – February 2023

Morobe Province and Lae City geodetic survey (January – March 2023) as part of the Lae Seismic Zone GNSS survey (run by DSLS, Unitech in collaboration with OSG, Geoscience Australia with funding from DFAT, Australia)

PNG Indonesia border CBRF densification survey (NMB and OSG) – commenced in July 2023 – Vanimo and Wutung

Prioritisation of zero order and first order geodetic control – GNSS surveys

Resurvey existing PNG94 zero order network to provide rigorous geodetic ties and transformation between the PNG94 and PNG2020 datums.

Adopt or construct new 0/1st order geodetic stations, at least one in each province, located in the provincial capital or major airport (e.g. meteorological station and landside State land for easy access).

Ensure accessible 0/1st order geodetic control at each major resource project, agricultural region and significant town (government or education compound).

0/1st order control to monitor active tectonic faults and volcanic hazards

0/1st order control co-located with tide gauges to monitor land movement at NMSA tide gauges which monitor sea level change.

Implementation Progress 2023

Geodetic observations to finalise PNG2020 zero order network

Madang and Goroka updates from 2022 earthquake (Lae Seismic Zone GNSS survey) – November 2023 – January 2024

PIP funding and border survey for remaining sites (in red)

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GNSS CORS establishment

Theodist and Position Partners (PP)
AllDayRTK network

Plan to establish GNSS CORS (continuous reference stations) in Port Moresby and potentially Lae and Mt Hagen that can provide single-base RTCM data on a subscription basis to surveyors. Potential inclusion in APREF network. This will enable surveyors to get real-time 1-2 cm accurate PNG94/PNG2020 coordinates within 5-10 km range of the CORS with a single receiver or GNSS enabled drone (RTK or PPK).

RTCM data via NTRIP (using mobile data) or high rate Rinex 2, 3 or new 4 data (for PPK) – Part of AllDayRTK network

Theodist/PP CORS would be rigorously connected by multi-day static survey to existing PNG geodetic control to ensure delivery of PNG94/PNG2020 coordinates and also PNG08/PNG2020 elevations (MSL).

Implementation plan 2023/2024

By 30 June 2024

Complete geodetic observations of zero order network and selected 1st order network stations. Private sector contributions welcomed with quid-pro-quo support!

By 31 October 2024

Complete geodetic analysis of entire archive or historical and current GNSS data and ancillary geodetic observations. Compute PNG2020 3D coordinates of zero order (defining) network

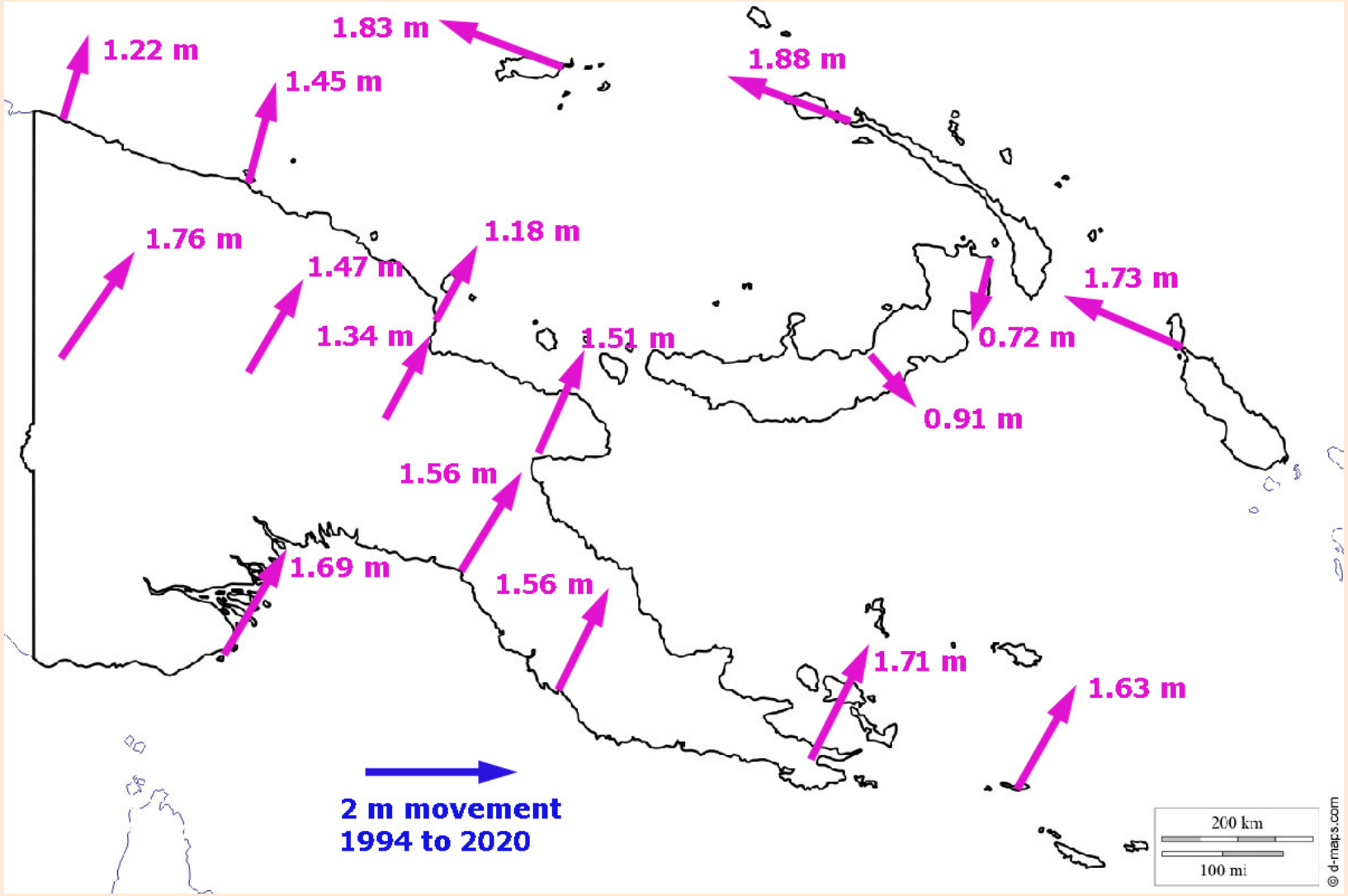
By 31 December 2024

Develop PNG2020 geoid model. Web access to PNG geodetic database. Gazettal of the PNG2020 datum in the PNG Government Gazette.

By 30 June 2025

Densification surveys in locations of high importance (urban areas, development, resource areas). Development of PNG2020 town grids, velocity models, transformation parameters, technical manuals, guidance notes, geodetic registry submissions. Workshops for surveyors and GIS professionals.

PNG94 to PNG2020 coordinate differences



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Further steps ...

Online GNSS post-processing service for PNG

Request Geoscience Australia to provide PNG2020 (and PNG94) coordinates in AusPOS (online GPS processing service) for data submitted within PNG's territorial limits and EEZ. Alternatively, a PNGpos can be developed.

Cadastral data (DCDB, Mining and Petroleum lease data)

Transition DCDB and other foundation spatial datasets from PNG94 to PNG2020

Transformation of legacy geodetic data (AGD66, WGS72, PNG94, other)

Many thousands of PSMs only have legacy geodetic coordinates and elevation data. These need to be transformed by collocation methods to PNG2020 if not physically resurveyed. Extensive program to augment PSM sketches (mostly scanned by NMB staff) with PNG2020 coordinates and PNG2020 elevations. Continual updates of the geodetic database.

PNG2020 – alignment with ITRF2020

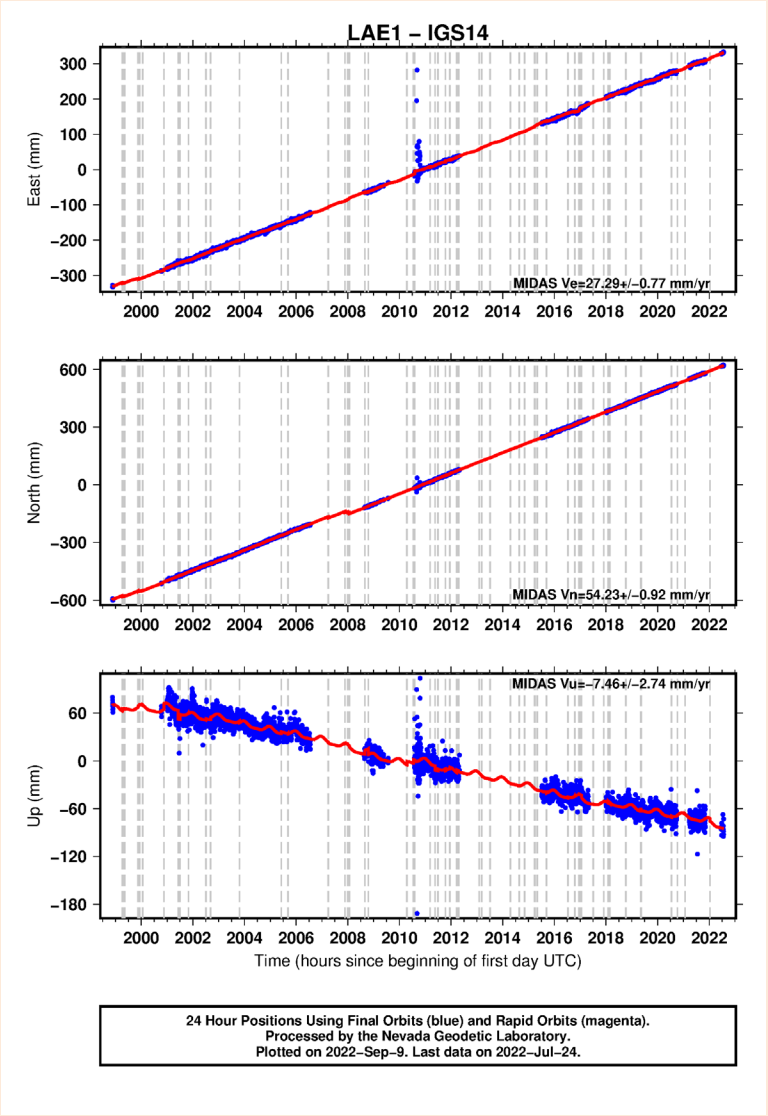
PNG2020 will be aligned with ITRF2020 at epoch 2020.0
(< 4 mm difference from ITRF2014 at epoch 2020.0)

Better than 0.25 m agreement with ITRF PPP positioning at end of 2023

PNG2020 Deformation model:

ITRF2020 based velocity grid for time-dependent secular transformations between ITRF2020 and PNG2020 (primarily to support PPP usage)

Coseismic and postseismic displacement grids developed after significant earthquakes to enable coordinate updates after earthquakes and spatial transformations across earthquake events



Site velocity estimation

All PNG GNSS static data (dual-frequency) processed in an ITRF2020 RF will be stacked to form a site time series. From this the site velocity and other offsets (e.g. coseismic, postseismic decay) can be estimated. Noise model (to model out seasonal signals) may be applied

The site velocity is used to estimate the coordinates at any defined epoch or reference epoch (2020.0 for PNG2020)

PNG ITRF2020 velocity grid (deformation model)

Velocities initially used to estimate microplate rotation models by inversion of velocities and plate boundary elastic strain correction to estimate pole of rotation (using approach used by Achraf Koulali, Paul Tregoning and Laura Wallace in earlier geodynamics studies)
2nd order residuals interpolated by a kriging process to estimate plate boundary strain correction grid.

The correction grid will be combined with the interseismic velocity grid generated from each microplate rotation model to form the final velocity grid.

Grid spacing 0.1 degree over PNG and will be provided in csv, NTv2, NetCDF(GGXF) and other well used formats for ingestion into positioning and GIS software.

PNG2020 transformation grids

In addition to the time-dependent ITRF2020 to PNG2020 transformation grid (using bilinear interpolation of the velocity grid) the following transformation grids will be developed:

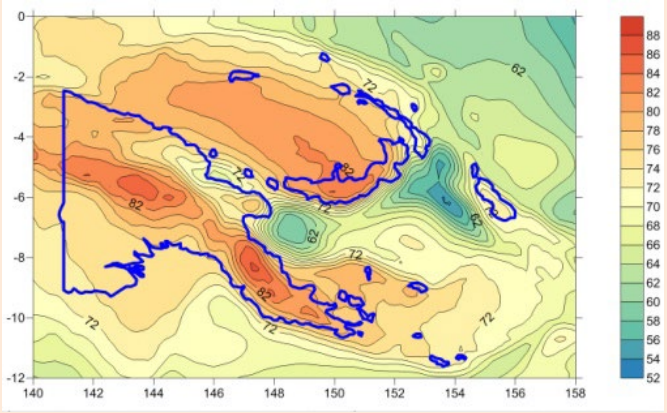
PNG94(2023) to PNG2020(2023) (in csv, NTv2, NetCDF and GeoTIFF)
This transformation grid will use the latest adjustment of PNG94 that includes known coseismic displacements between 1994 and 2023.

PNG94(1994) to PNG94(2023) (in csv, NTv2, NetCDF and GeoTIFF)
This transformation grid models known distortions of PNG94 and coseismic displacements between 1994 and 2023.

AGD66 to PNG94(1994) and **AGD66 to PNG2020(2023)** grids may also be developed to support transformation of legacy spatial data

PNG2020 geoid model

The imminent release of EGM2020 is proposed to be used as the basis of a new geoid model to replace PNG08 (a provisional geoid model from 2011) to enable MSL estimation from GNSS in PNG.



Offsets between the EGM2020 geoid surface and MSL observed at recently installed tide-gauges around PNG (NMSA) will be used to develop an MSL corrected model due to large Mean Dynamic Topography (MDT) offsets in warm tropical seas (up to 1.5 metres in PNG) – (Curtin University, Perth?)

Released in csv and binary formats (e.g. GeoTIFF) used with widely used positioning equipment and positioning software.

PNG2020 components

Physical infrastructure
(e.g. CORS, PSMs and their maintenance)

Access
(station information, coordinates, RT data stream, CORS Rinex data, online processing)

Tools
(models, transformations, guidance notes, geodetic registry and GIS configurations)

PNG2020 – access – geodetic control database

UN-GGIM and FAIR (findable, accessible, interoperable and reusable) principles recommend:

Open and free access to national geodetic control information.

PNG geodetic control information (e.g. coordinates) is currently only available on request and photocopies of PSM location sketches are available for a fee from the National Mapping Bureau.

There is an urgent need to have the geodetic control database and PSM data made publicly available from the web (e.g. searchable database and Google kml) at no cost

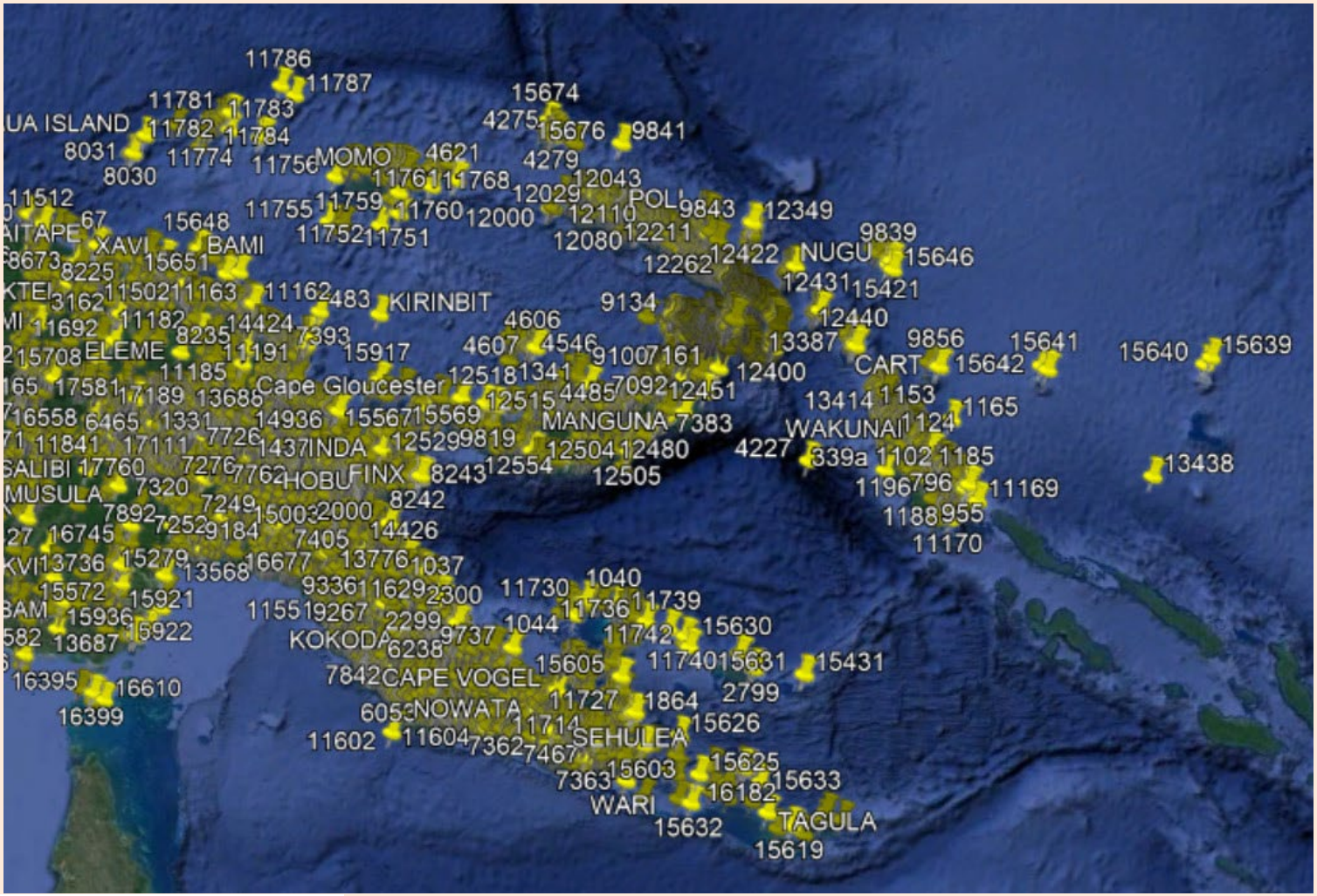
The ASPNG can also host this type of service if requested by OSG.

Land Information New Zealand (LINZ) has a good template for this service

Mobile web Apps (PSM finders) are also now widely used by surveyors

PNG2020 – physical infrastructure – passive network

~15,000 brass plaques, bolts, star pickets and pins in concrete, pillars etc.



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Emt’sol!