Why, what and how of GNSS CORS and Geospatial Infrastructure

Dr John Dawson

Director of Positioning
Geoscience Australia

Vice-Chair UN-GGIM-AP
Geodetic Reference Frame
Geodesy

noun

Science of measuring the **shape**, **orientation** and **gravity field** of the Earth and how it changes over **time**.

In the Pacific **GNSS** is the primary tool for Geodesy
GNSS Coordinates

- A simple shape that roughly matches the size of the Earth to which we can reference coordinates
- Ellipsoid (close to a sphere)
- GNSS coordinates are measured relative to this surface.
Complexities of GNSS positioning

It is actually the force of gravity that governs fluid flow, not height. Using a geometric height system, fluids can appear to flow uphill.
Good coordinates for good coordination

• Where am I?
• How far away are things I care about?
• How do I get there?

• How do I navigate ships safely through reefs?
• How can I compute and define maritime boundaries?
• How can I define the property boundaries within my country?
• How can I monitor and model groundwater in the lens?
• How can I be sure to build the hospital above the flood warning level?
• How can I define the flood warning level accurately across a whole country at locations / islands that don’t have a tide gauge?
Good coordinates for good coordination

- **Earthquakes**: detect strain build up in tectonically active regions

- **Tsunami**: observe environmental hazards to better understand them (e.g. Fukushima)

- **Volcano**: observations help detect the build up and release phase
GNSS Heighting

Figure: Ellipsoidal height of the tide gauge sensor benchmark (black squares) as determined from GNSS analysis (grey line) and the levelled height difference between the GNSS monument and the tide gauge.

Results from all countries are available from:
Dawson and Saunders, 2011
Dawson and Saunders, 2011
GPS versus InSAR Matupit Island

![Graph showing GPS versus InSAR data for Matupit Island]
Satellites observations are able to detect millimetre scale trends in ocean and land height:

- **Oceanography**: changes in sea level from satellite altimetry and tide gauges
- **Atmospheric**: GNSS can detect changes in the atmosphere for extreme events; GA data used for weather forecasting by BoM
- **Groundwater changes**: changes in gravity to map seasonal groundwater movement
Construction and Engineering

- Installing and managing water, sewerage and telecommunication assets
- Bridges that meet in the middle
- Construction of houses and buildings in safe regions
- Monitoring information can help inform building codes
- Precise, efficient and increasingly cheap positioning capability.
Good coordinates for good coordination

- Where should I build my house?
- Where should I go in case of a flood or tsunami?
- How can I mitigate the impacts of sea level rise?
- Pacific island nations have a need for improved height reference frame for planning, modelling, monitoring and mitigation.
Geodesy (GNSS) provides a foundation and framework for the collection, management and use of national geospatial information.
Australia’s Positioning Program

Vision: an integrated national positioning capability to accelerate the adoption and development of location-based technology and applications in Australia
Good coordinates for good coordination

National
National Landsat 8 dataset
Australia’s Positioning Program

Reference Frame
Contribution: ITRF

Products and Services
Ensure user access to the ITRF and national datum

An effective national positioning capability including SBAS

 +/- 1mm

 +/- 1cm
Australia’s Positioning Program

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![Map of Australia](image10.png)
Satellite-Based Augmentation System (SBAS)
Australia’s Positioning Program

SBAS services
Open access PPP (10cm)

NPI
High reliability core network
Open access CORS data
Open source software
Earth Observation Datacubes
UN-GGIM-AP

- Regional Committee of UN-GGIM.
- Established: 1 November 2012
- Member: National Geospatial Information Authorities of 56 countries and regions in Asia and the Pacific
- Chair: Dr. Andy Barnicoat (Australia)
- Vice Chair: China, Japan, Mongolia
- Secretariat: UN-ESCAP
UN-GGIM-AP

Vital Role in
(Relevant to geospatial information management)
- Resolves regional issues
- Facilitate regional capacity building
- Promote globally the unique needs and interests of the region
- Contribute to the discussions in UN-GGIM

WGs
- WG1: Geodetic Reference Frame
- WG2: Cadastre and Land Management
- TBD
1. Asia Pacific Reference Frame (APREF) and the Asia Pacific Regional Geodetic Project (APRGP)
2. Asia Pacific Regional Height System Unification
3. Support geodetic capacity building
4. General Assembly Resolution on A Global Geodetic Reference Frame (GGRF) for Sustainable Development
WG1 Activity - Regional Reference Frame

• APREF and APRGP

• Provide access to global latitude, longitude and height (i.e. access to ITRF)

• Encourage GNSS data sharing

• Make linkages between national datums

• Geodetic capacity building
WG1 Activity - Regional Reference Frame

**APREF**
- Continuous GNSS Data
- Asia Pacific Reference Frame (APREF)
- Station Coordinates + Velocities

**APRGP**
- Campaign (1 week per year) GNSS Data
- Asia Pacific Regional Geodetic Project (APRGP)
- Station Coordinates
WG1 Activity - Regional Reference Frame

**APREF**
- 3 x analysis centres (Australia x 2 + China)
- 620 GNSS stations
- 28 Member States

**APRGP**
- Annual campaign since 1997 (21)
- 2015, 2016, 2017, 2018 reports
WG1 Activity - Regional Reference Frame


- APREF network and time-series plots, see http://192.104.43.25/status/solutions/analysis.html
WG1 Activity - Regional Reference Frame
WG1 Activity - Regional Reference Frame

Report on the Analysis of the Asia Pacific Regional Geodetic Project (APRGP) GPS Campaign 2015

Report on the Analysis of the Asia Pacific Regional Geodetic Project (APRGP) GPS Campaign 2016

Report on the Analysis of the Asia Pacific Regional Geodetic Project (APRGP) GPS Campaign 2017
Key Messages

• Geodesy (largely through GNSS) provides a foundation and framework for the collection, management and use of national geospatial information

• See the bigger picture that is of interest to decision makers

• Regional important too