



## Why, what and how of GNSS CORS and Geospatial Infrastructure

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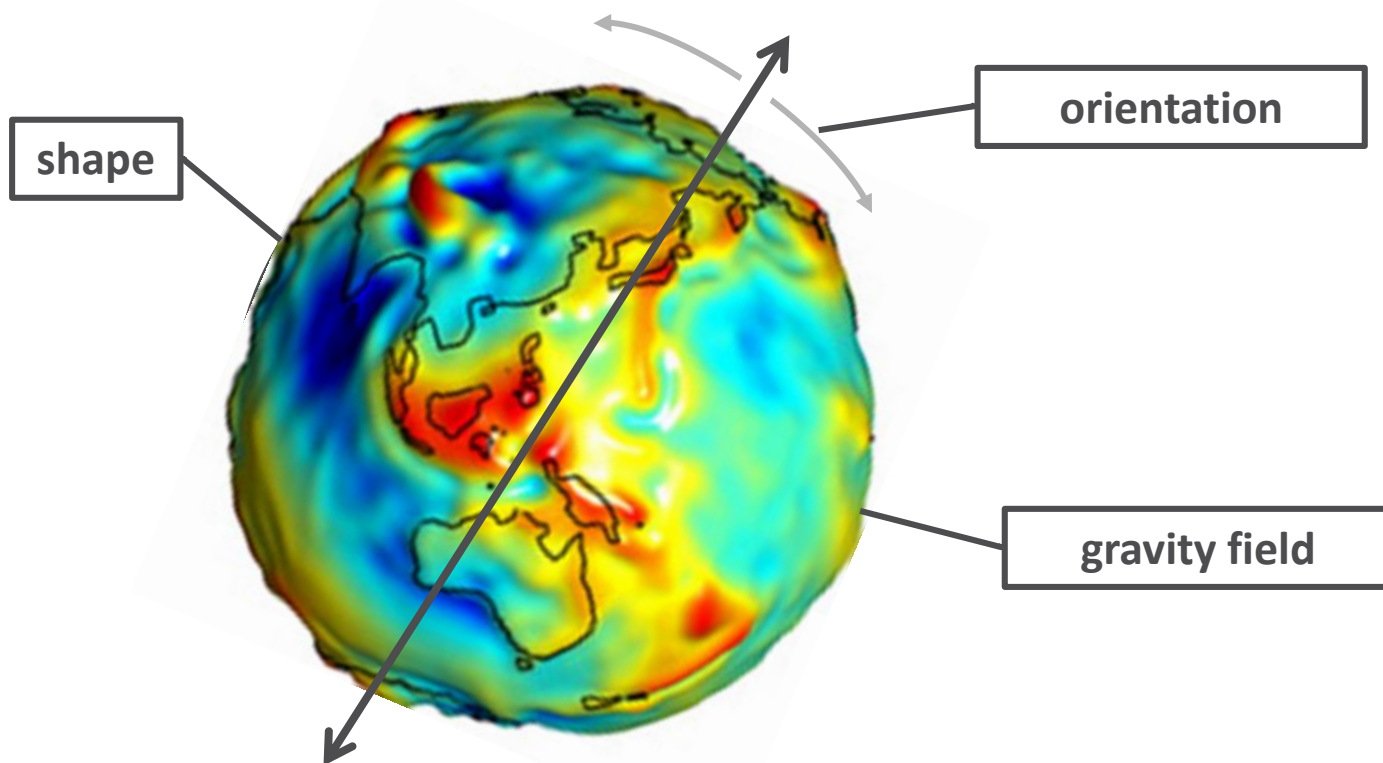
Vice-Chair UN-GGIM-AP  
Geodetic Reference Frame



# Geodesy

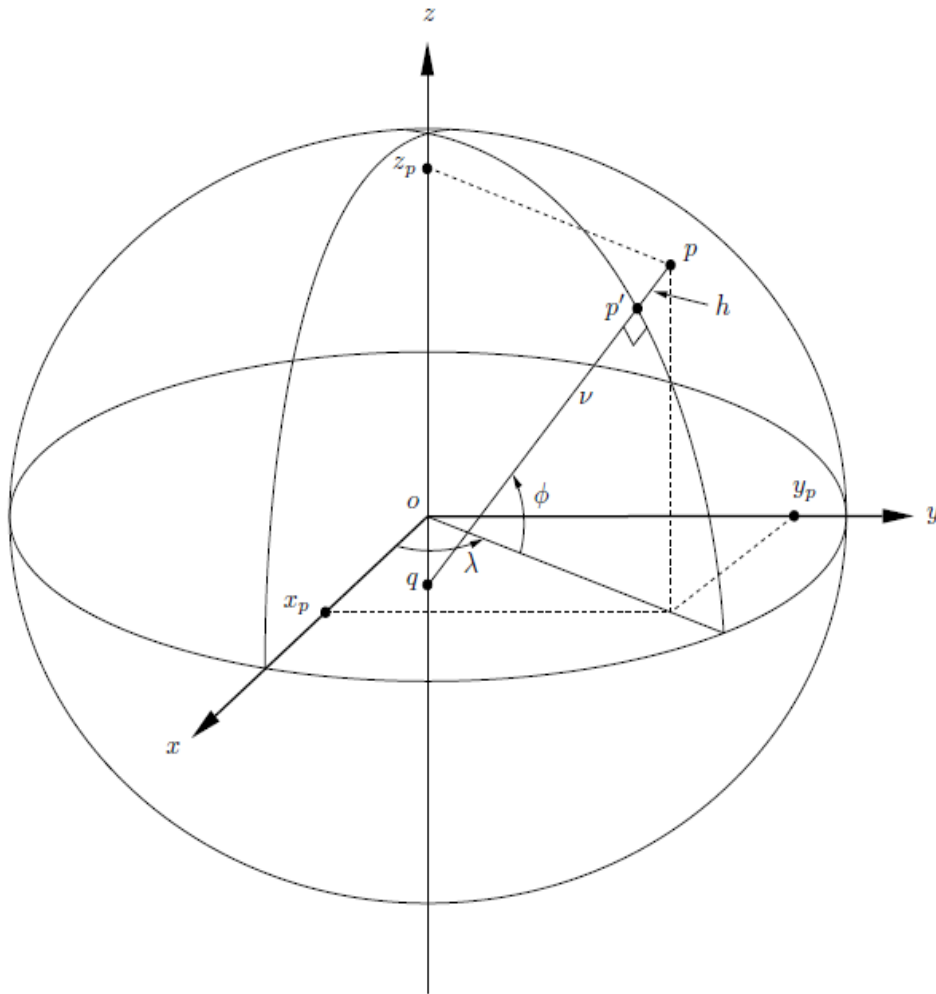
*noun*

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



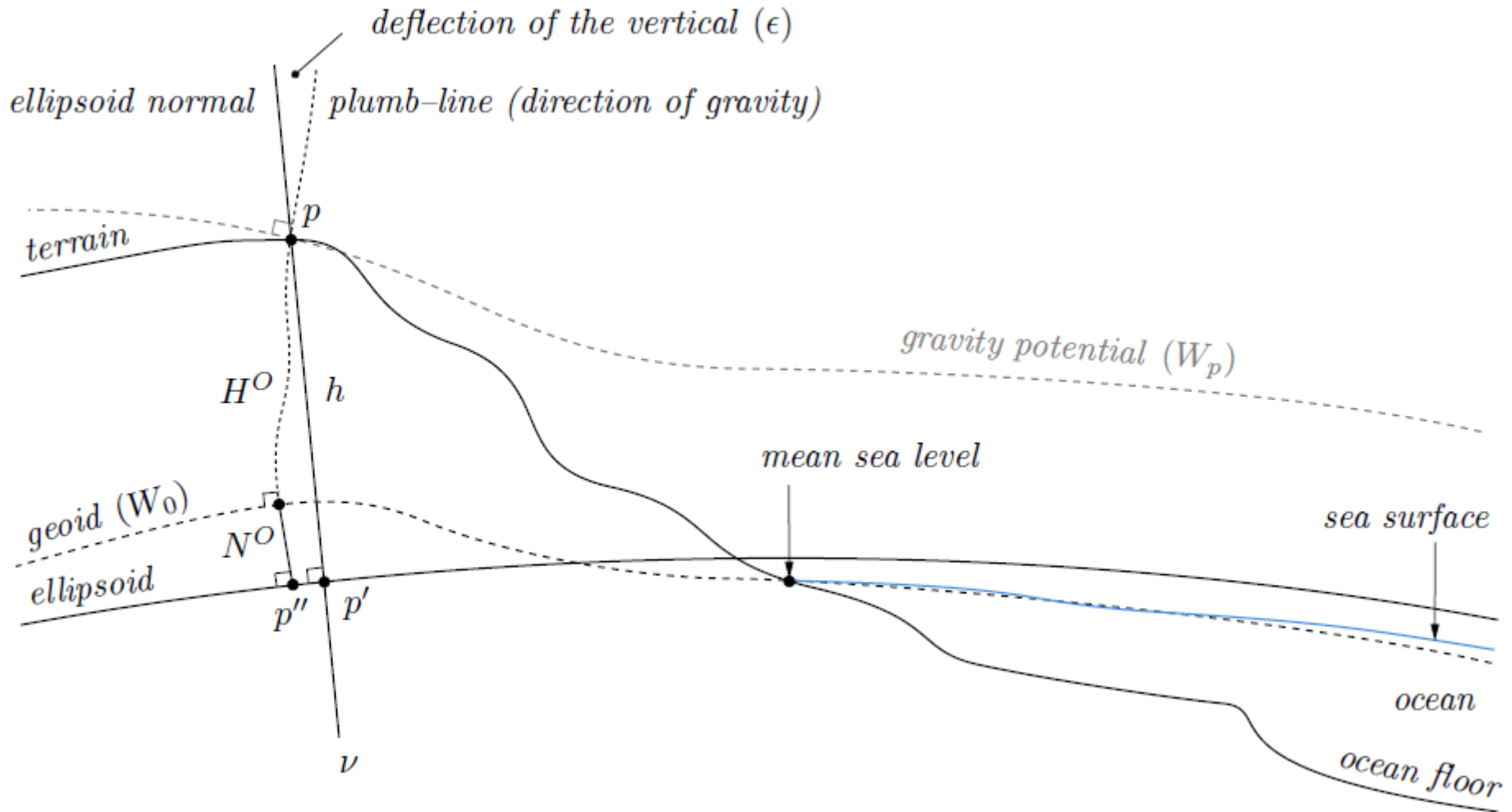
In the Pacific **GNSS** is the primary tool for Geodesy

# GNSS Coordinates



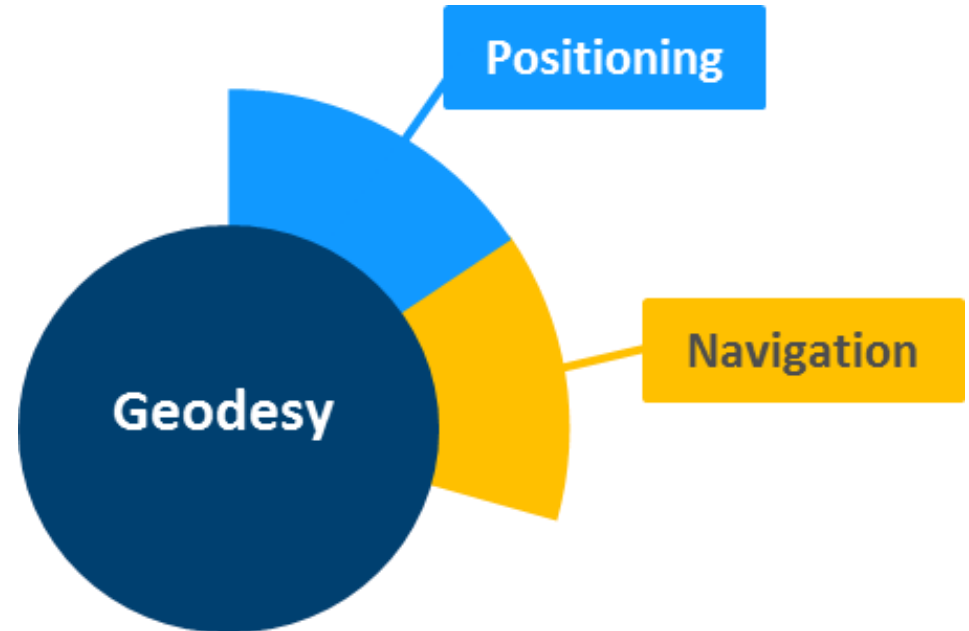
- A simple shape that roughly matches the size of the Earth to which we can reference coordinates
- Ellipsoid (close to a sphere)
- GNSS coordinates are measured relative to this surface.

# Complexities of GNSS positioning



# 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

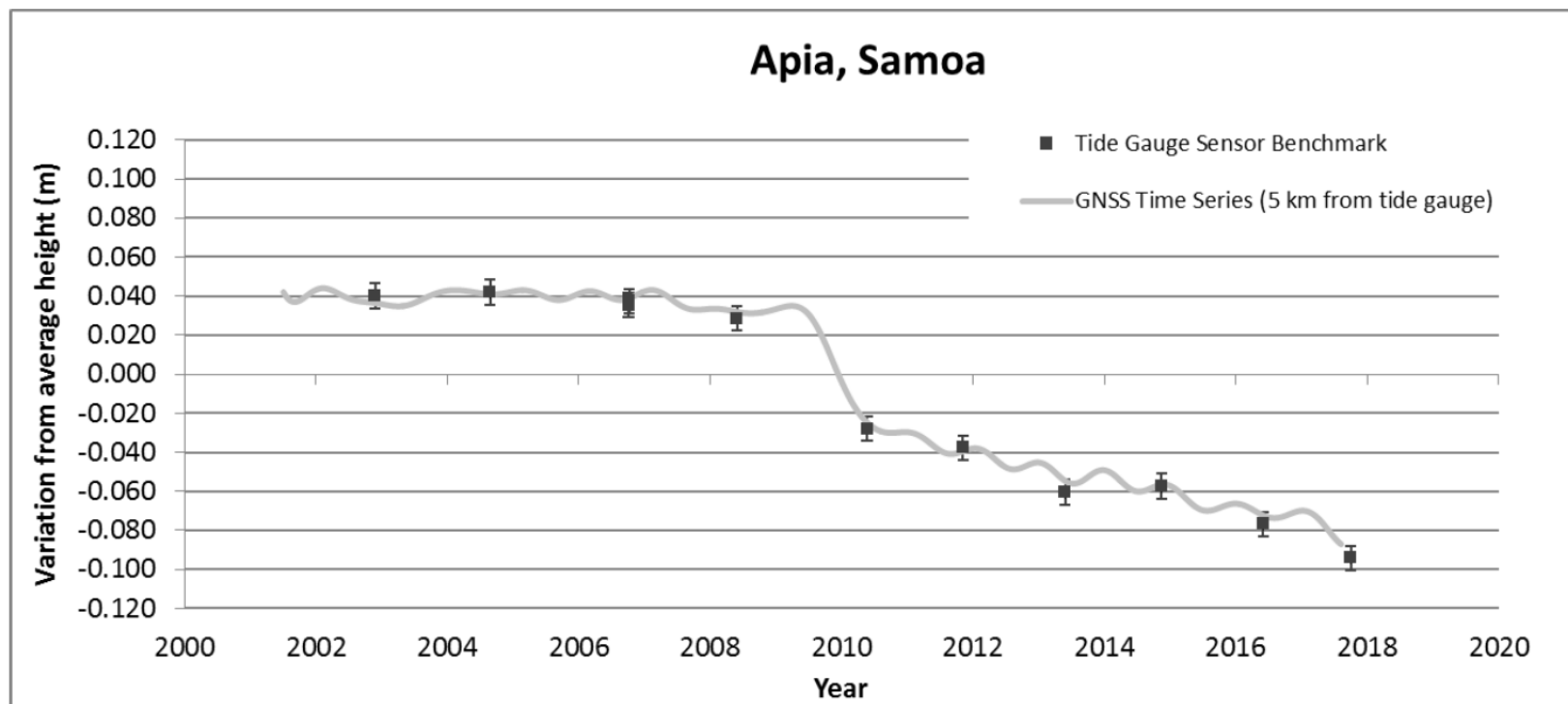
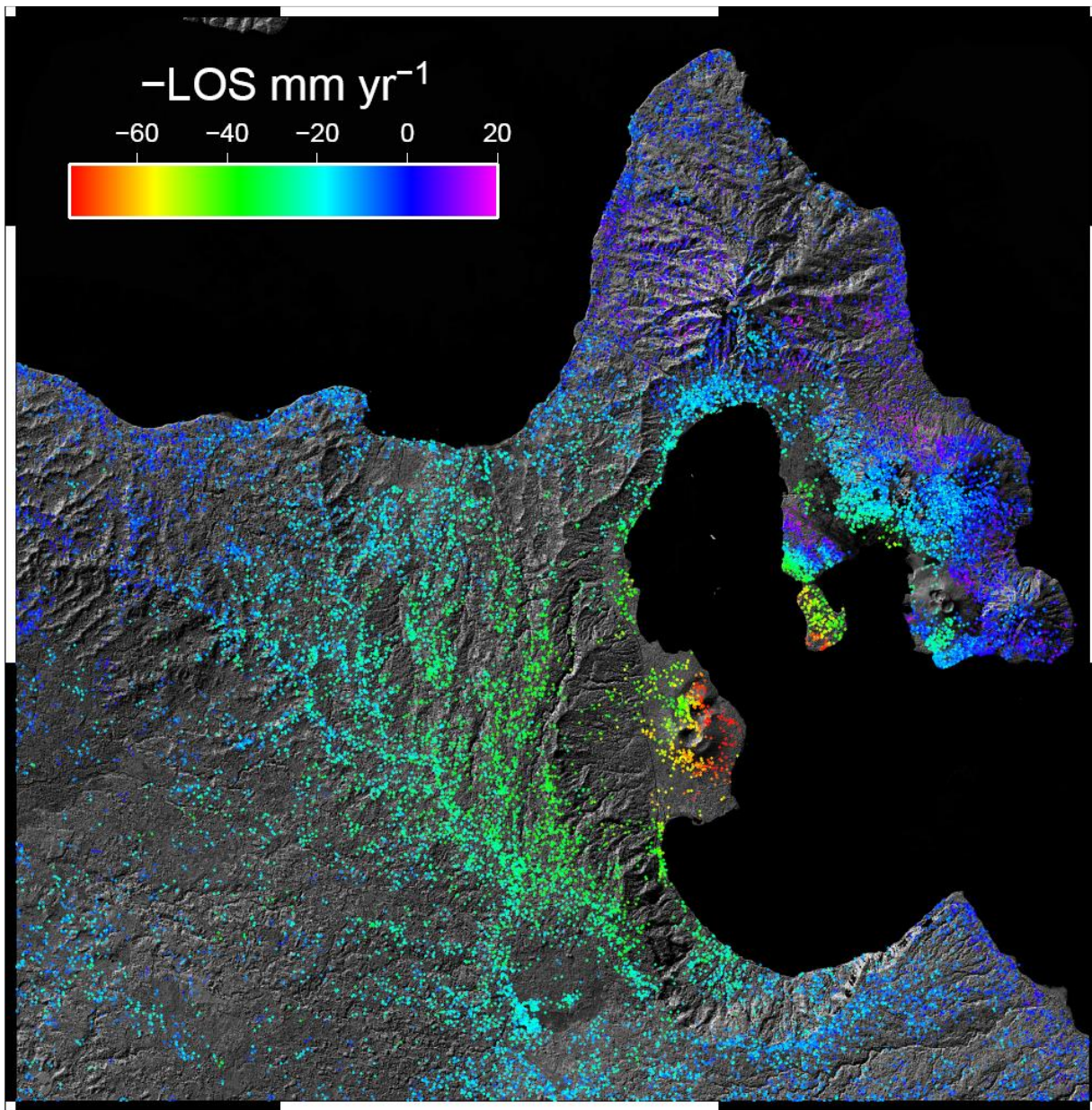


Figure: Ellipsoidal height of the tide gauge sensor benchmark (black squares) as determined from GNSS analysis (grey line) and the levelled height difference between the GNSS monument and the tide gauge.

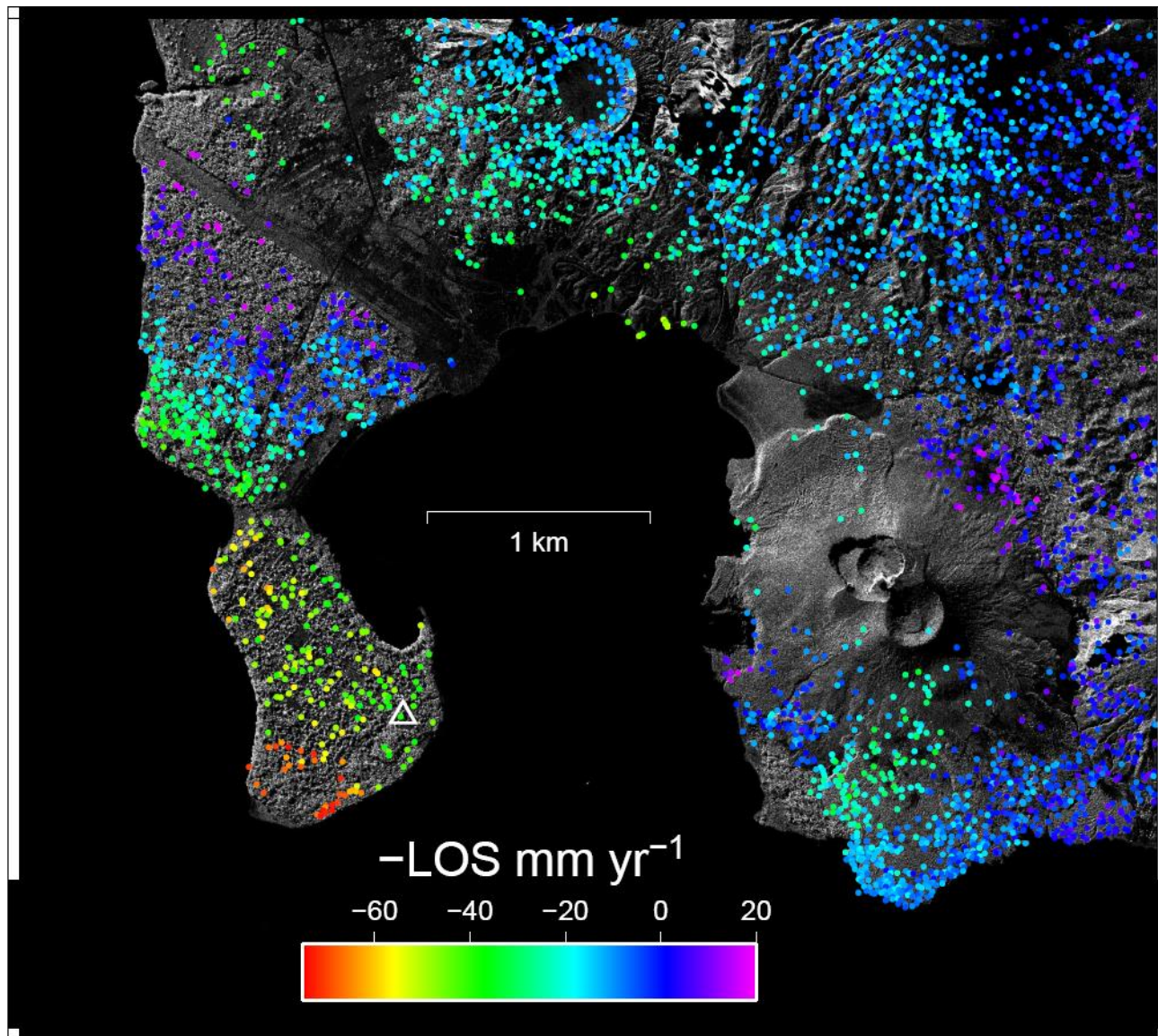
**Results from all countries are available from:**

<http://www.ga.gov.au/scientific-topics/positioning-navigation/geodesy/pacificsealevel>



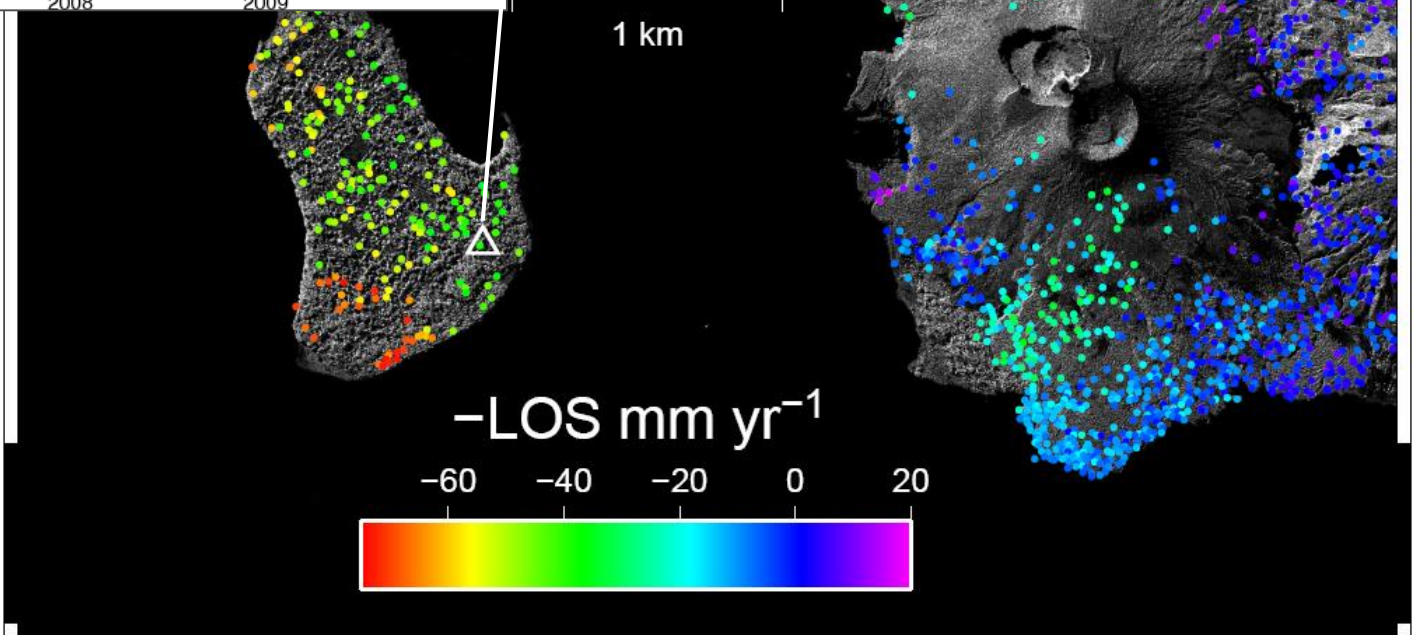
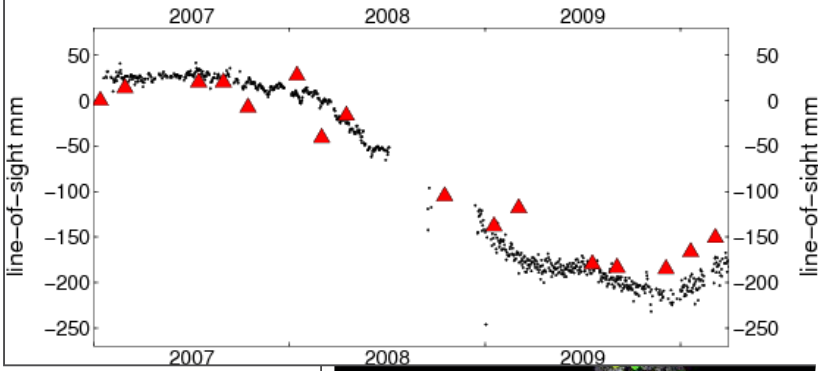
*Dawson and Saunders, 2011*



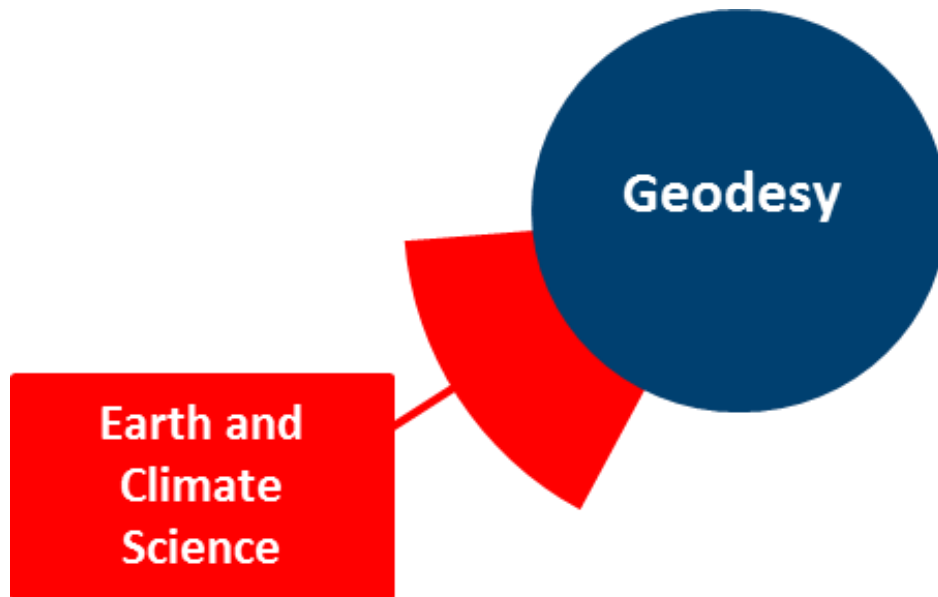


*Dawson and Saunders, 2011*

# GPS versus InSAR Matupit Island



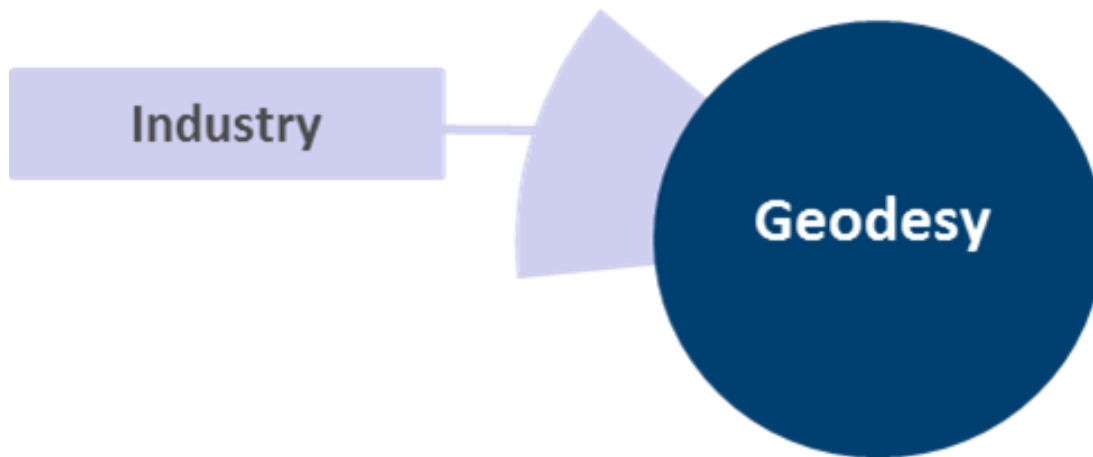
# Good coordinates for good coordination



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

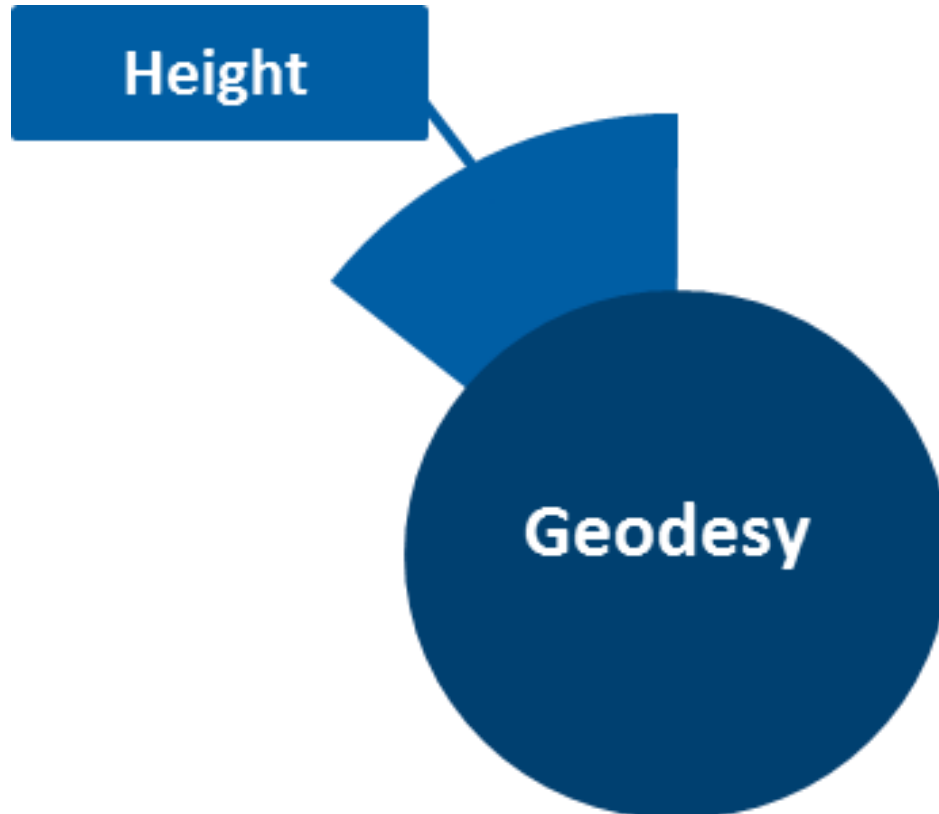
# Good coordinates for good coordination



## Construction and Engineering

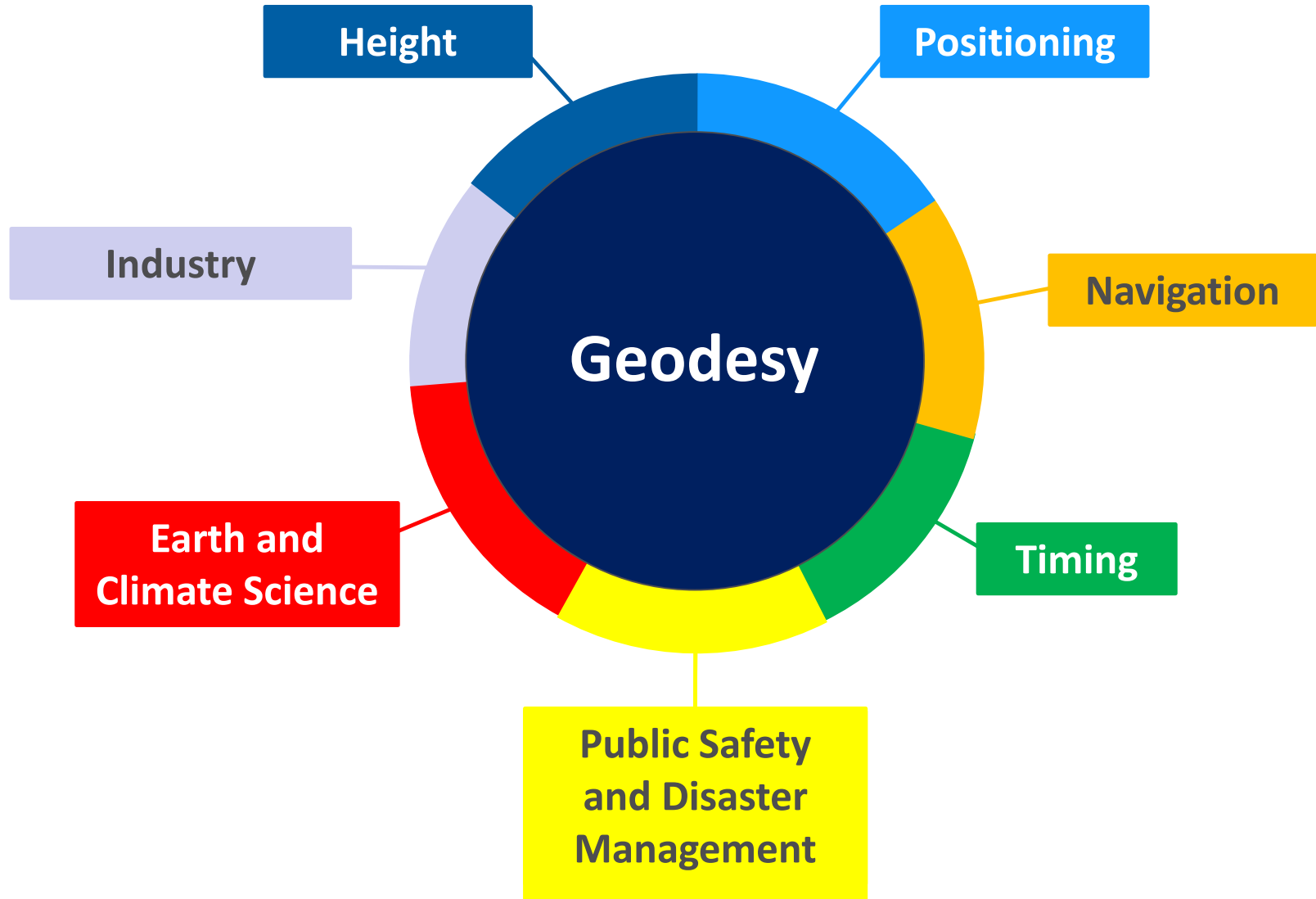
- Installing and managing water, sewerage and telecommunication assets
- Bridges that meet in the middle
- Construction of houses and buildings in safe regions
- Monitoring information can help inform building codes
- Precise, efficient and increasingly cheap positioning capability.

# 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



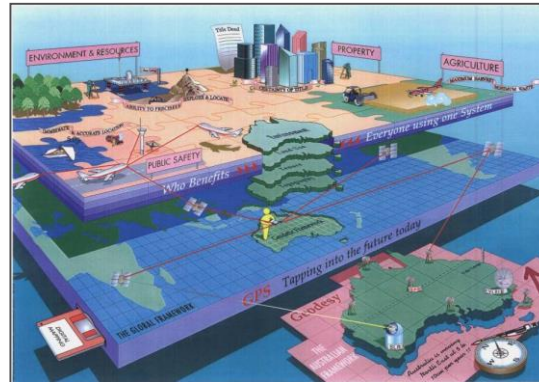
# Australia's Positioning Program

Reference Frame  
Contribution: ITRF



+/- 1mm

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





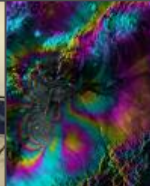






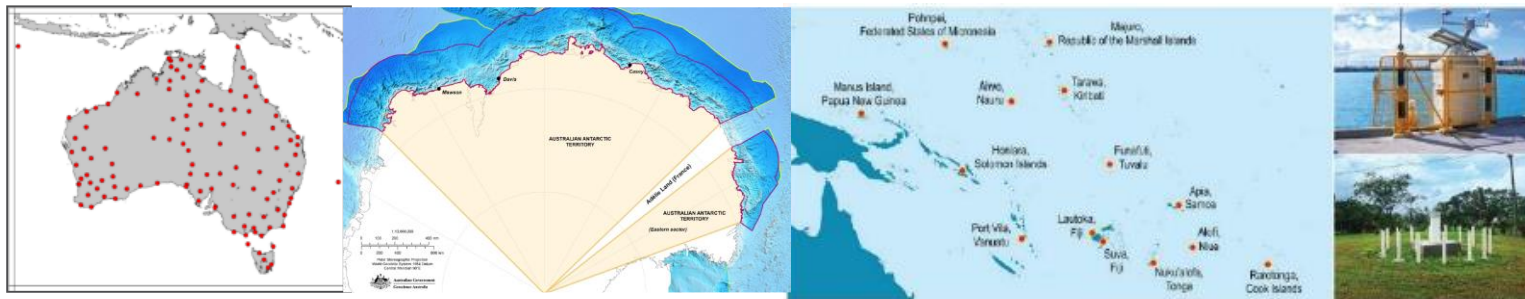
+/- 1cm

An effective national  
positioning capability  
including SBAS

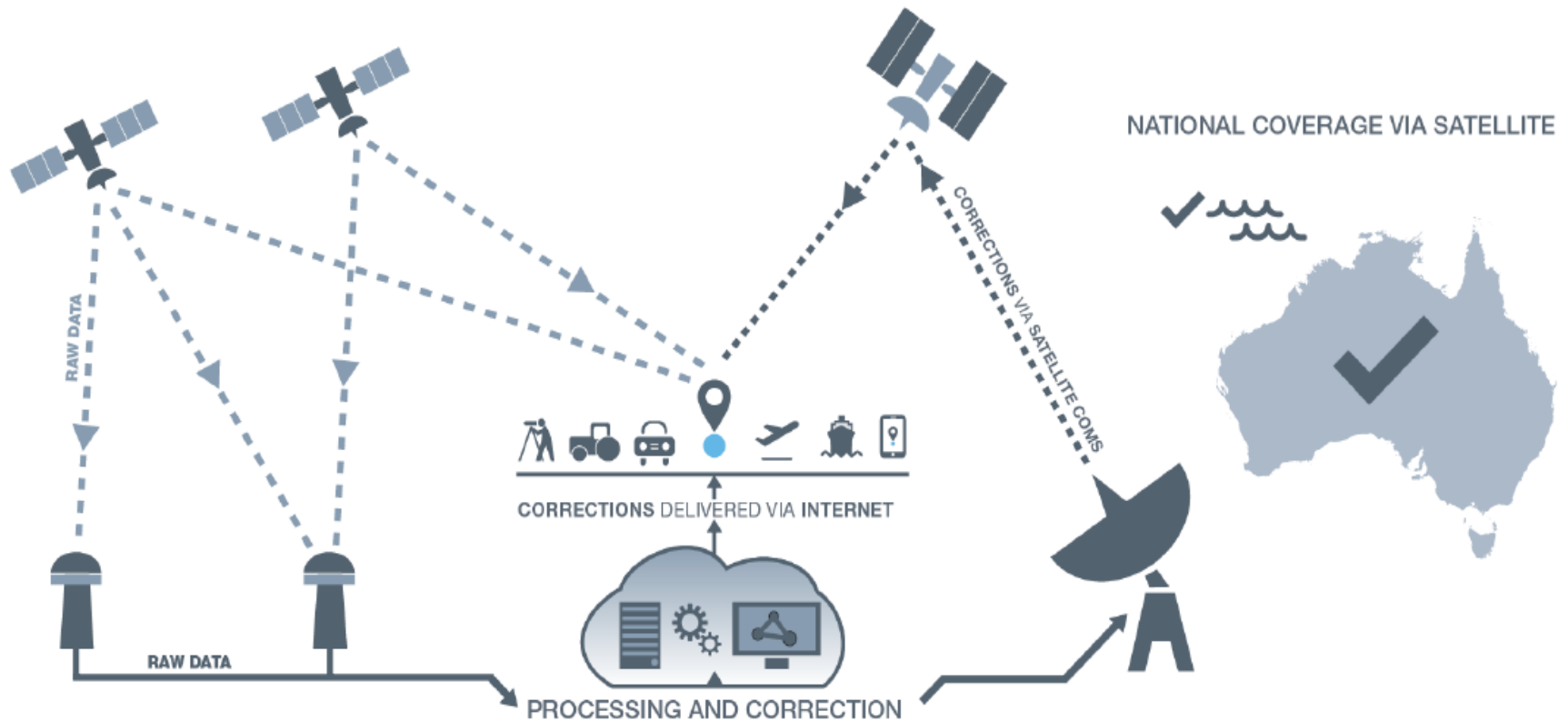


# Australia's Positioning Program

VLBI	SLR	GNSS	Gravity	Radar	Calibrate	Survey	SBAS	Coordination
								



# Satellite-Based Augmentation System (SBAS)



# Australia's Positioning Program



SBAS services  
Open access PPP (10cm)



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

	Afghanistan		American Samoa		Armenia		Australia
	Azerbaijan		Bangladesh		Bhutan		Brunei Darussalam
	Cambodia		China		Cook Islands		Democratic People's Republic of Korea
	Fiji		French Polynesia		Guam		Hong Kong, China
	India		Indonesia		Islamic Republic of Iran		Japan
	Kazakhstan		Kiribati		Kyrgyzstan		Lao People's Democratic Republic
	Macao, China		Malaysia		Maldives		Marshall Islands
	Micronesia		Mongolia		Myanmar		Nauru
	Nepal		New Caledonia		New Zealand		Niue
	Northern Marianas		Pakistan		Palau		Papua New Guinea
	Philippines		Republic of Korea		Russian Federation		Samoa
	Singapore		Solomon Islands		Sri Lanka		Tajikistan
	Thailand		Timor-Leste		Tonga		Turkmenistan
	Tuvalu		Uzbekistan		Vanuatu		Viet Nam

# 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

## WG1 - Activity

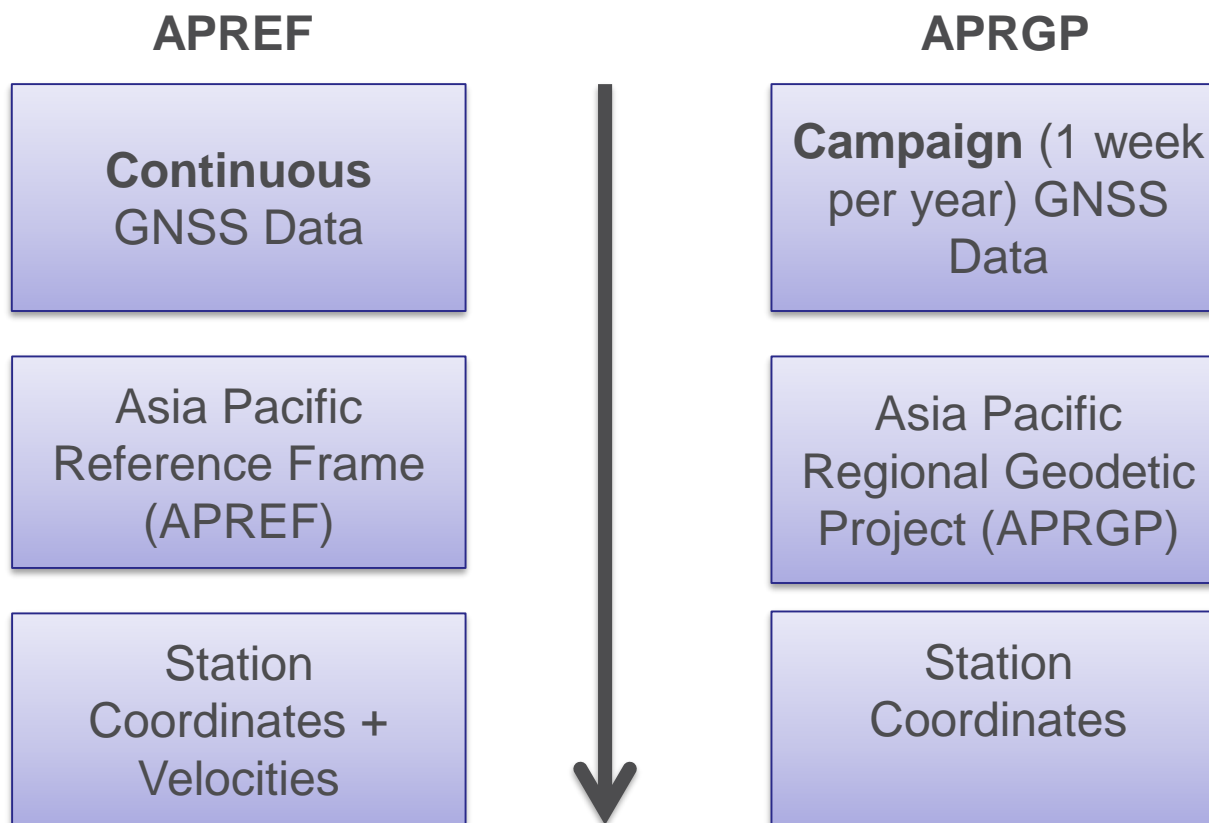
1. Asia Pacific Reference Frame (APREF) and the Asia Pacific Regional Geodetic Project (APRGP)
2. Asia Pacific Regional Height System Unification
3. Support geodetic capacity building
4. General Assembly Resolution on *A Global Geodetic Reference Frame (GGRF) for Sustainable Development*



# 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



# WG1 Activity - Regional Reference Frame

## APREF

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

## APRGP

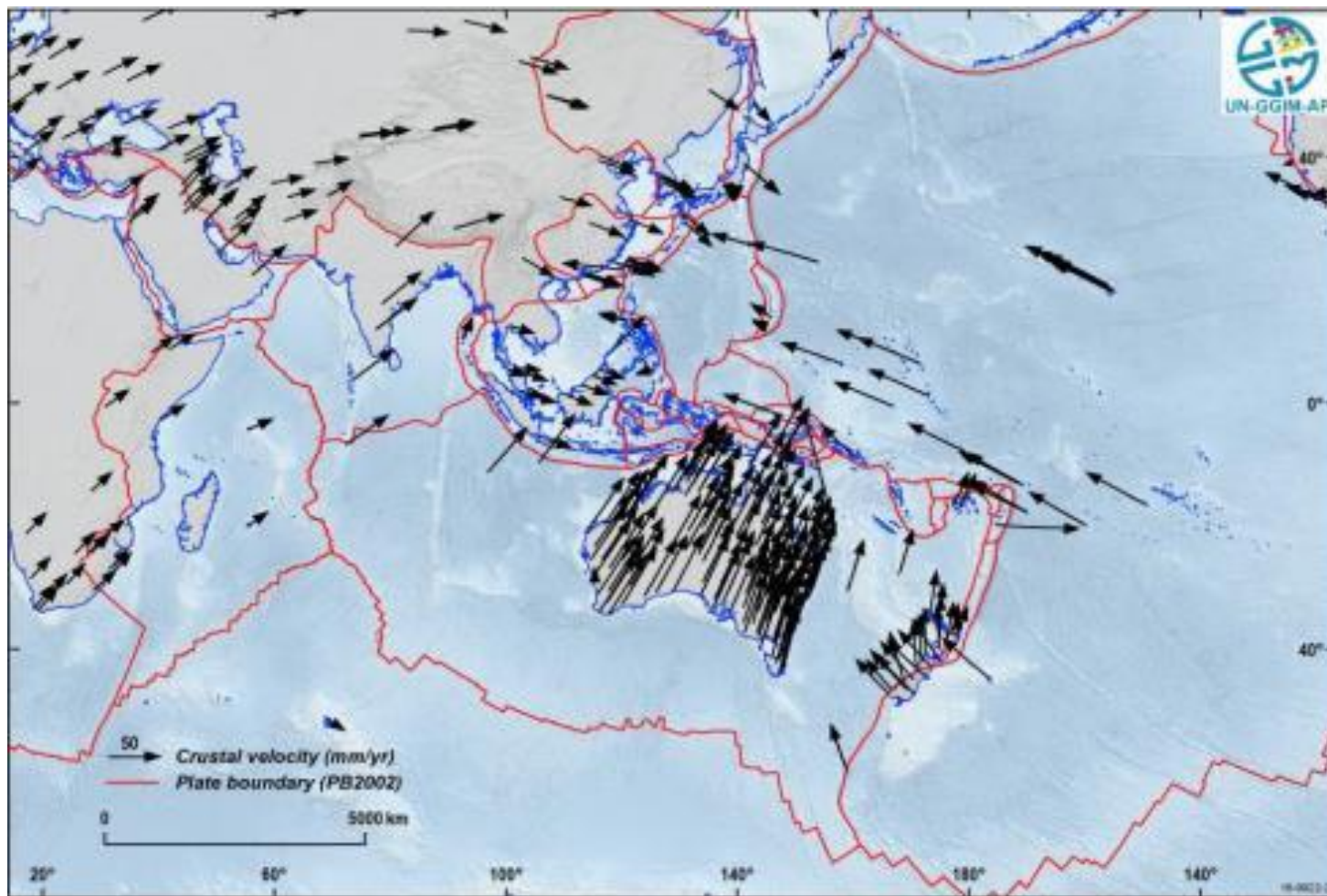
- Annual campaign since 1997 (21)
- 2015, 2016, 2017, 2018 reports



## WG1 Activity - Regional Reference Frame

- [Website: http://www.ga.gov.au/scientific-topics/positioning-navigation/geodesy/asia-pacific-reference-frame](http://www.ga.gov.au/scientific-topics/positioning-navigation/geodesy/asia-pacific-reference-frame)
- Daily GNSS RINEX data, see <ftp://ftp.ga.gov.au/geodesy-outgoing/gnss/data/daily/>
- Weekly coordinate estimates in SINEX format, see <ftp://ftp.ga.gov.au/geodesy-outgoing/gnss/solutions/apref/>
- 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

Record 2016/20 | eCat 101401

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

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Record 2017/17 | eCat 101401

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

Record 2018/23 | eCat 121942

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

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## 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

