Australian Government
Geoscience Australia

POSITIONING AUSTRALIA

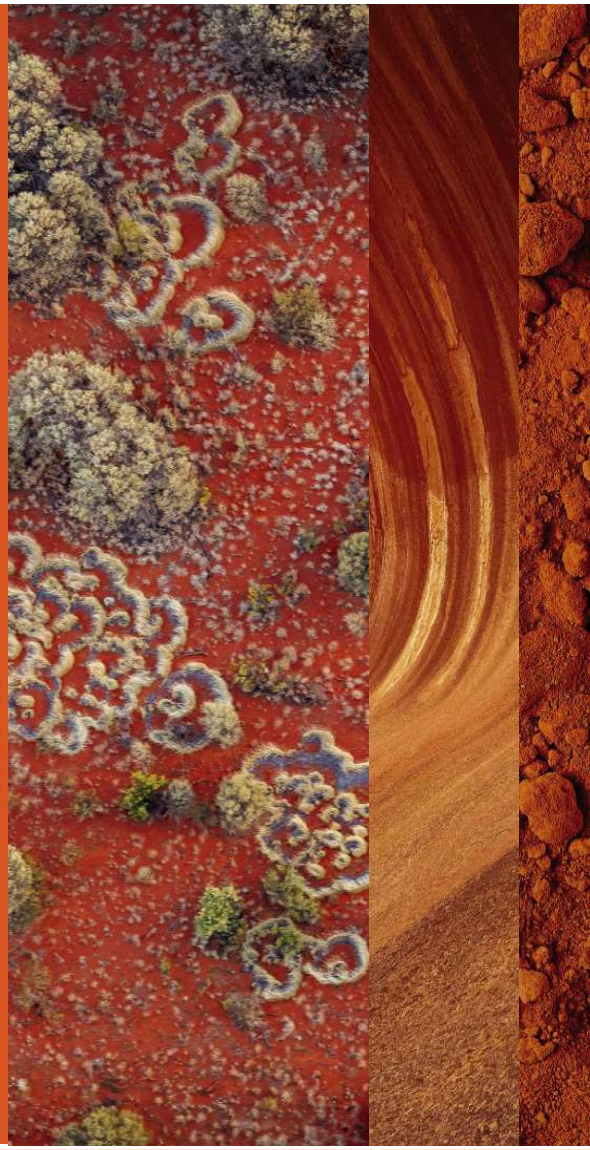
Global to the Regional

Dr John Dawson

Director of Positioning, Geoscience Australia

Vice-Chair UN-GGIM-AP WG1

UN-GGIM-AP Canberra 2019



Presentation Overview

ITRS and ITRF and their importance

Regional ITRF densifications and the Asia Pacific Reference Frame

Overview how member states can contribute to APREF

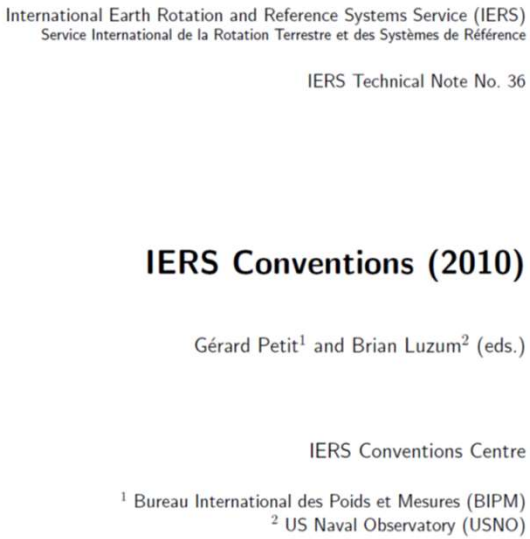
Australian example of how we use APREF products

ITRS and ITRF and their importance

International Terrestrial Reference System

International Terrestrial Reference System (ITRS)

- An internationally-agreed set of prescriptions and conventions to define a Conventional Terrestrial Reference System
- Realised through creating a reference frame – International Terrestrial Reference Frame (ITRF)
- Connected to International Celestial Reference System (ICRS) via Earth Orientation Parameters (EOP)
- More information: https://www.iers.org/IERS/EN/Science/ITRS/ITRS.html


International Earth Rotation and Reference Systems Service (IERS)
Service International de la Rotation Terrestre et des Systèmes de Référence

IERS Technical Note No. 36

IERS Conventions (2010)

Gérard Petit[1] and Brian Luzum[2] (eds.)

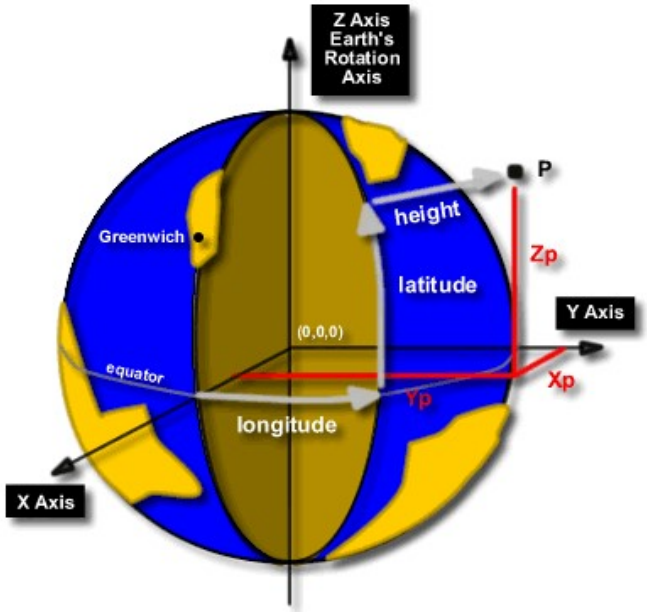
IERS Conventions Centre

[1] Bureau International des Poids et Mesures (BIPM)
[2] US Naval Observatory (USNO)

International Terrestrial Reference System

An ITRS meets the following conditions

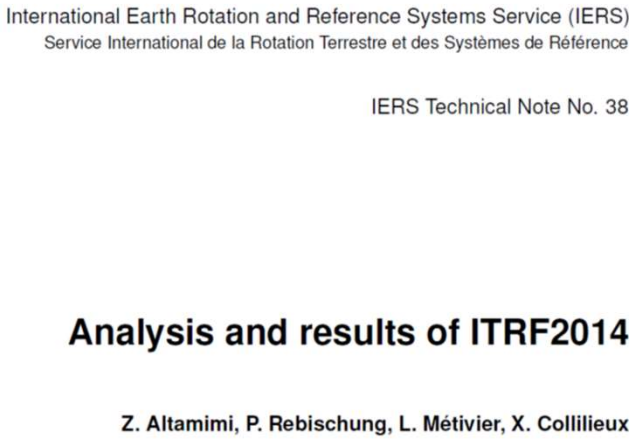
- Geocentric (origin is Earth centre of mass)
- Uses the metre as the unit of length
- Initial orientation given by BIH orientation at 1984
- The time evolution of the orientation is ensured by using a no-net rotation condition with regards to horizontal tectonic motions over the whole earth.
- The ITRS is of very little use to the practitioner – we need a realisation (some coordinates)



International Terrestrial Reference Frame

International Terrestrial Reference Frame (ITRF)

- Follows the conventions set out for the ITRS
- Re-realised routinely (ITRF89, ITRF90, ITRF91, ITRF92, ITRF93, ITRF94, ITRF95, ITRF96, ITRF97, ITRF2000, ITRF2005, ITRF2008, ITRF2014)
- Provides a set of coordinates and velocities for several hundred stations worldwide
- Uses a geocentric coordinate system (XYZ)
- Data from four space geodesy observing systems
- Most recent is ITRF2014
- ITRF2020 is in development



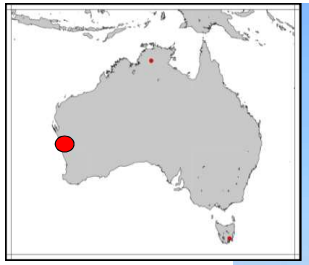
Data for ITRF

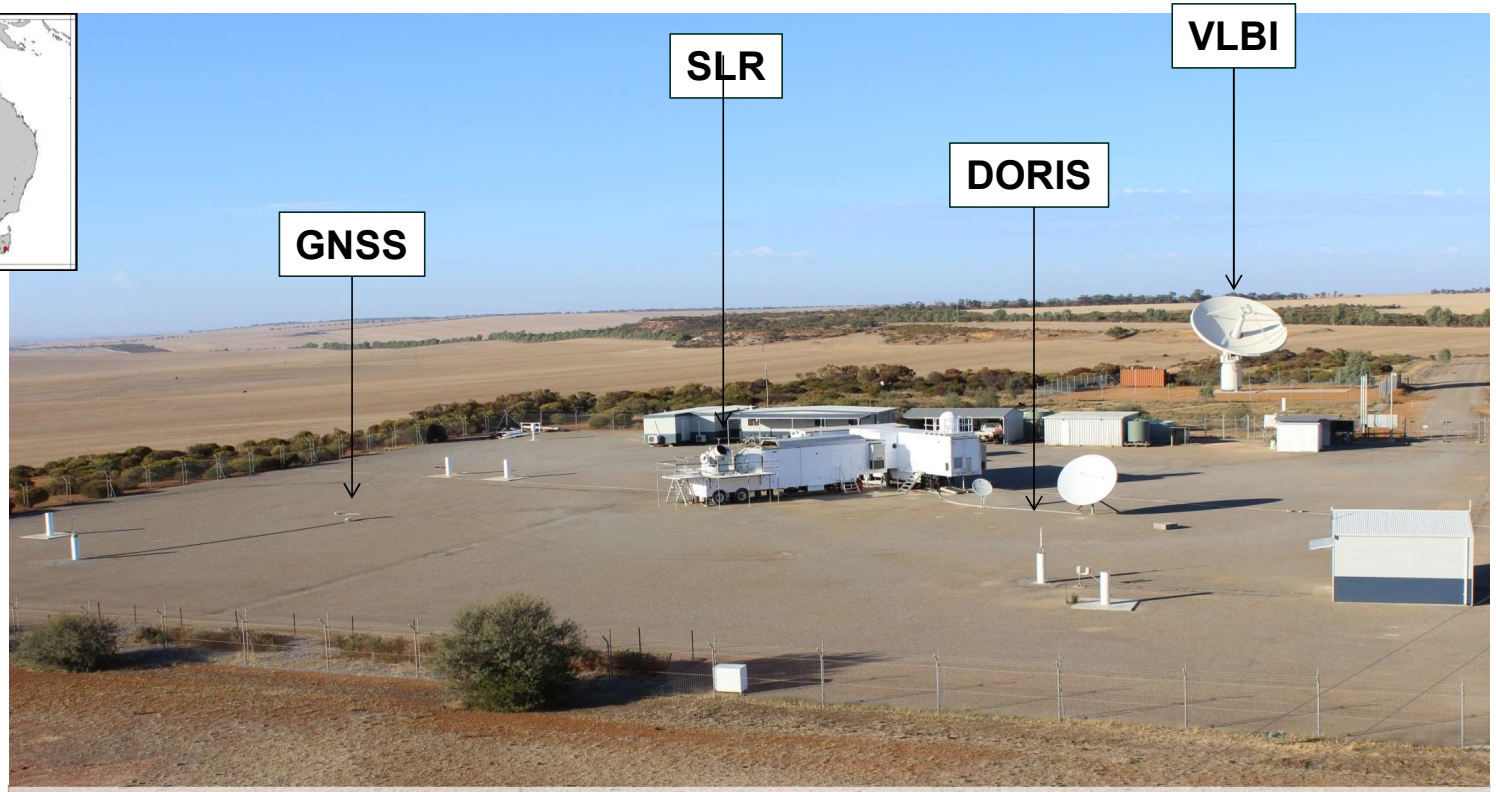
Four observational techniques

- GNSS (GPS and GLONASS)
- Satellite Laser Ranging (SLR)
- Very Long Baseline Interferometry (VLBI)
- Doppler Orbitography and Radiopositioning Integrated by Satellite (DORIS)

- Station position time series
- Earth Orientation Parameters (EOP)
- Local ties (high accuracy survey connection between the above techniques at observatories)

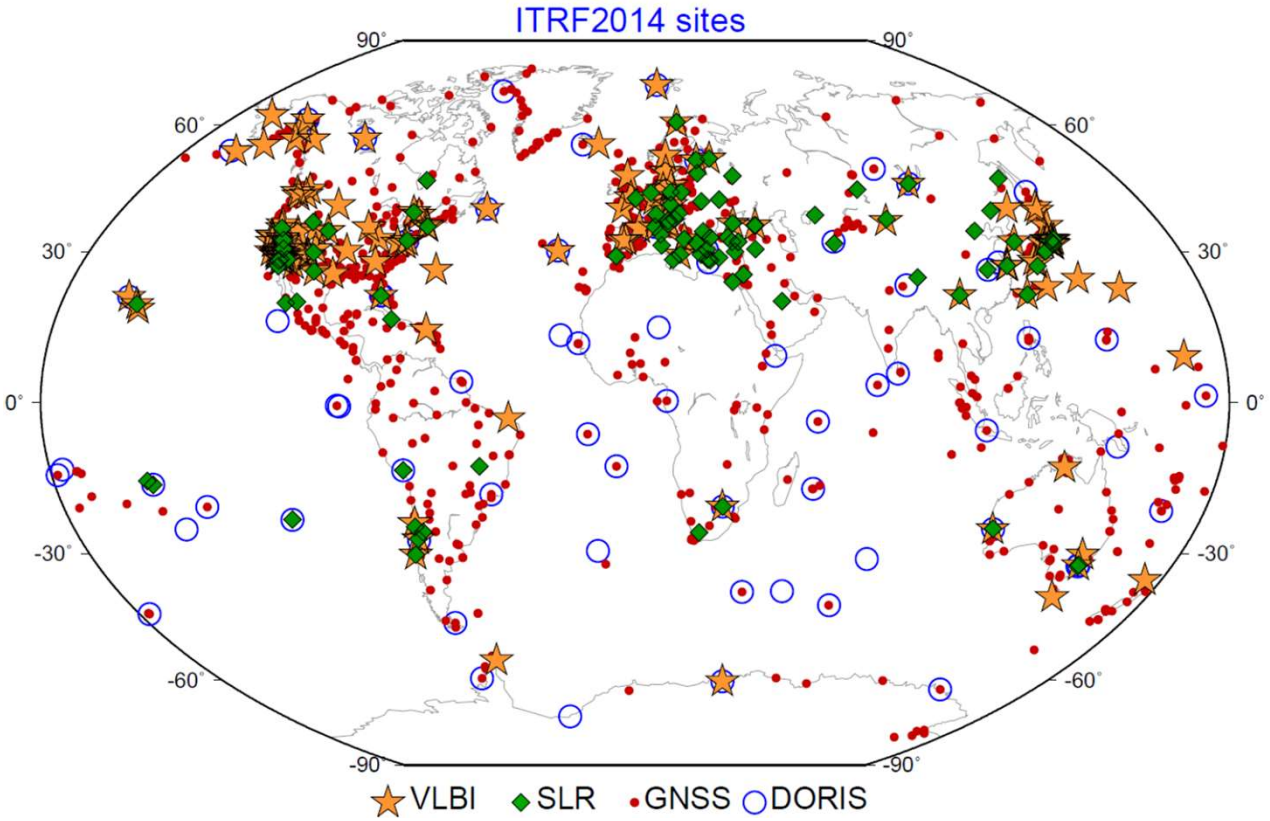
Yarragadee Observatory, Western Australia





The Australian government ensures a significant contribution to ITRF from the Australian Continent and Pacific region

International Terrestrial Reference Frame

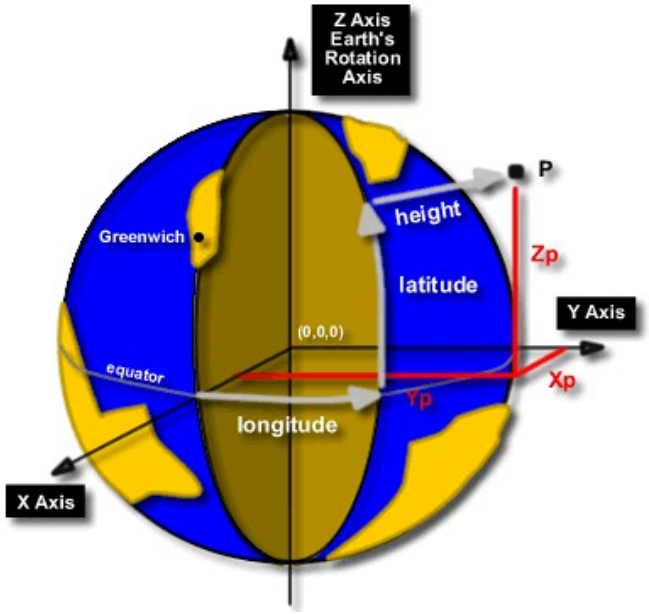


International Terrestrial Reference Frame

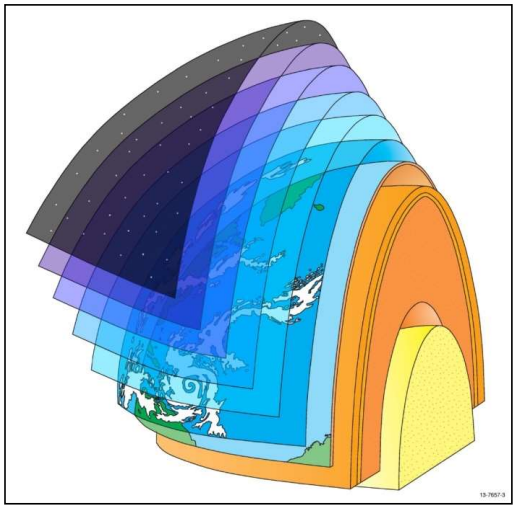
ITRF2014

- Observations from 1980.0 to 2015.1 (but only a few stations have observations over the entire period)
- Accounts for annual and semi-annual signals
- Includes post-seismic deformation models for sites affected by significant earthquakes
- Products include coordinates, velocities and transformation parameters
- More information: http://itrf.ensg.ign.fr/

Why the ITRF is so important



Earth System Science



Well defined and realised station coordinates (and velocities) underpin science of the Earth's interior, solid Earth, atmosphere, oceans, cryosphere, space environment

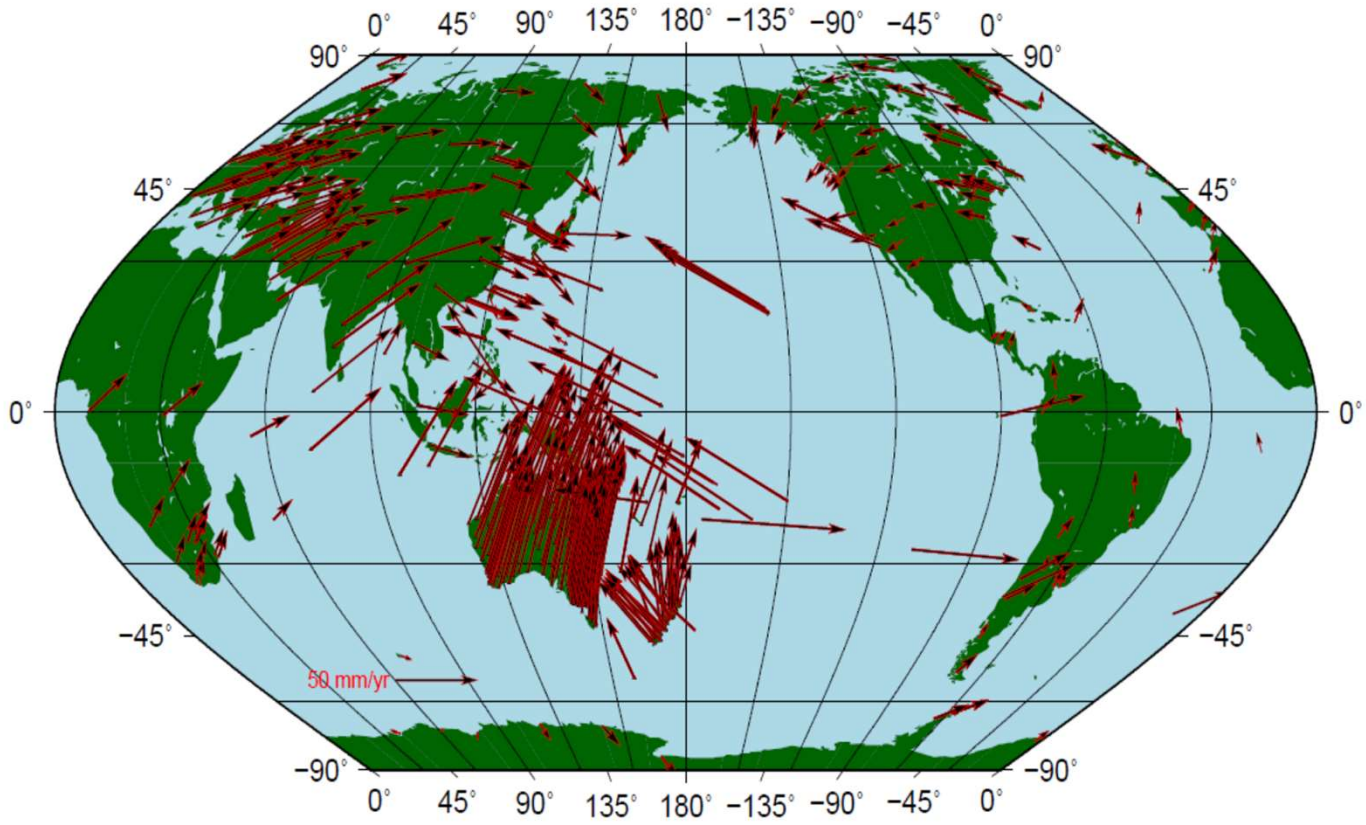
Regional ITRF densifications and APREF

Regional Reference Frames

Regional Reference Frames

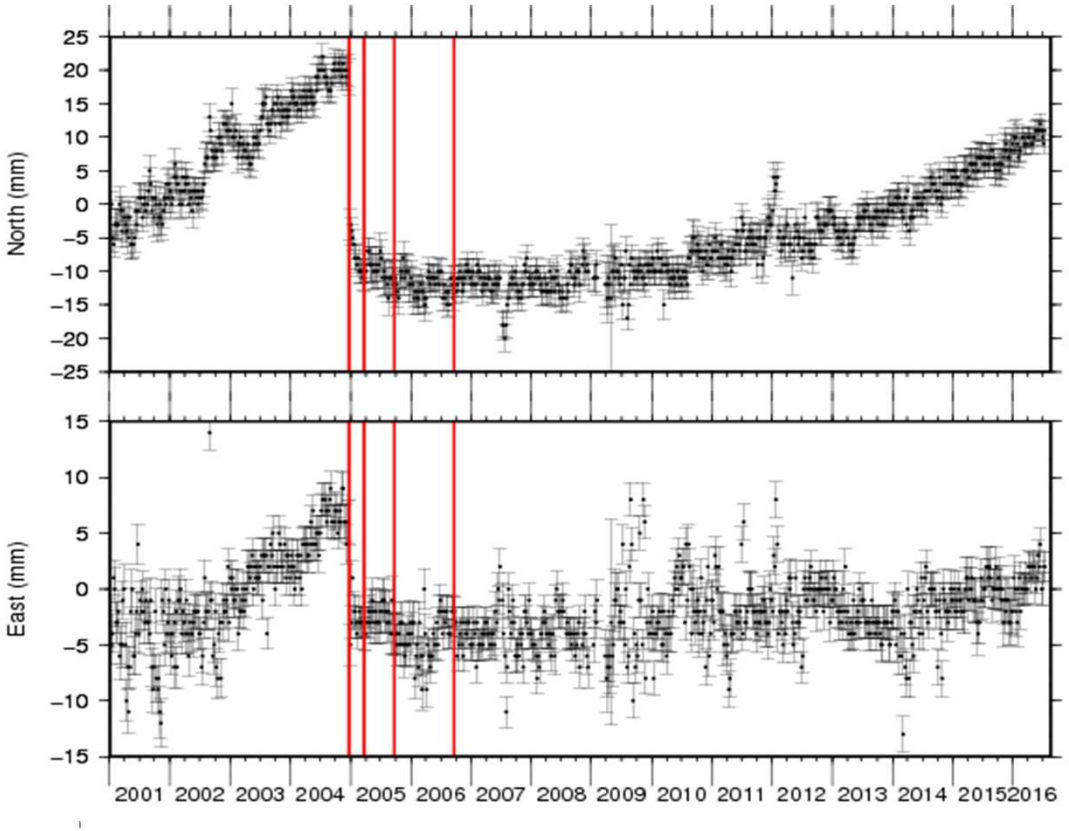
- Cover large regions of the globe
- Greater densification of stations
- Easier (but slightly indirect) link to the ITRF
- Consists solely of GNSS stations (including ITRF GNSS stations)
- Coordinates, velocities and time series plots produced
- Africa – AFREF
- Europe – EUREF
- North and South America – SIRGAS
- Asia-Pacific – APREF (also APRGP – campaign mode)

Asia Pacific Reference Frame



Asia Pacific Reference Frame

Macquarie Island coordinate time-series

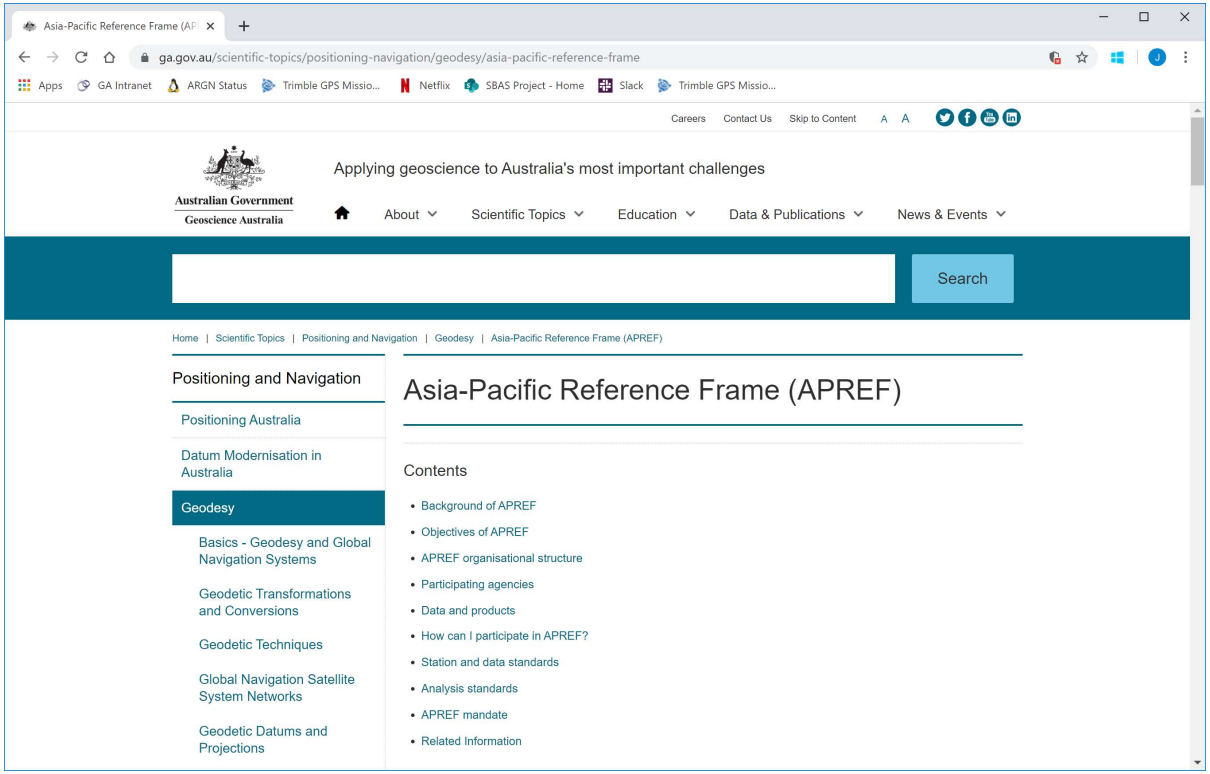


Report on the Asia Pacific Reference Frame (APREF) Project

GEOSCIENCE AUSTRALIA
RECORD 2019/17

G. Hu, M. Jia, J. Dawson

Asia Pacific Reference Frame



> www.ga.gov.au then search for APREF

Proposing a New APREF Station

4.2 Propose an APREF Station

(a) Station Operators, who have are participating in the APREF project, can propose new stations for inclusion into the network via email to:

gnss@ga.gov.au

Subject: Proposed APREF Station

The email should state:

- A long-term commitment (at least 2 years) to operate the station.
- The chosen four-character identification code.
- Digital photos of the station.
- The receiver and antenna type using standard names.
- The planned data products (RINEX daily files are the minimum requirement).
- Any restrictions to be placed on the data products.

Unless otherwise stated it is assumed that all data products will be open access.

- If the Station Operator is not the Station Owner, then a signed letter of consent should be issued by the Station Owner for a secondary party to submit on their behalf.

Send

From ▾ Ryan.Ruddick@ga.gov.au

To... GA GNSS Operations;

Cc...

Subject Proposed APREF Station

Dear APREF Data Centre,

I would like to propose the GNSS reference station "CBLA00AUS" into the Asia-Pacific Reference Frame (APREF) network.

The station is located near the town of Columboola in Queensland, Australia. The station has been in operation for 4 years and we have an agreement to operate this station for a further 10 years. The station is owned and operated by Geoscience Australia.

To help with your assessment I have attached photos of the station showing the monument, the antenna serial number and the antenna from all four cardinal directions.

The station is equipped with a "LEIAR10 NONE" geodetic antenna connected to a "LEICA GR25" geodetic multi-GNSS receiver. The equipment has been configured to track the GPS, GAL and GLO constellations.

The station will provide Daily RINEX Files. Geoscience Australian encourages open data, as such there is no restriction on the files.

Kind regards,

Ryan Ruddick
Section Leader | GNSS Infrastructure and Informatics
National Positioning Infrastructure | Positioning and Community Safety Division

t +61 2 6249 9426 **m** +61 (0) 429 771 069

GEOSCIENCE AUSTRALIA
APPLYING GEOSCIENCE TO AUSTRALIA'S MOST IMPORTANT CHALLENGES

Make flexibility work. If you receive an email from me at a time that is outside of normal business hours, I am sending it at a time that suits me. I am not expecting you to read or reply until normal business hours.

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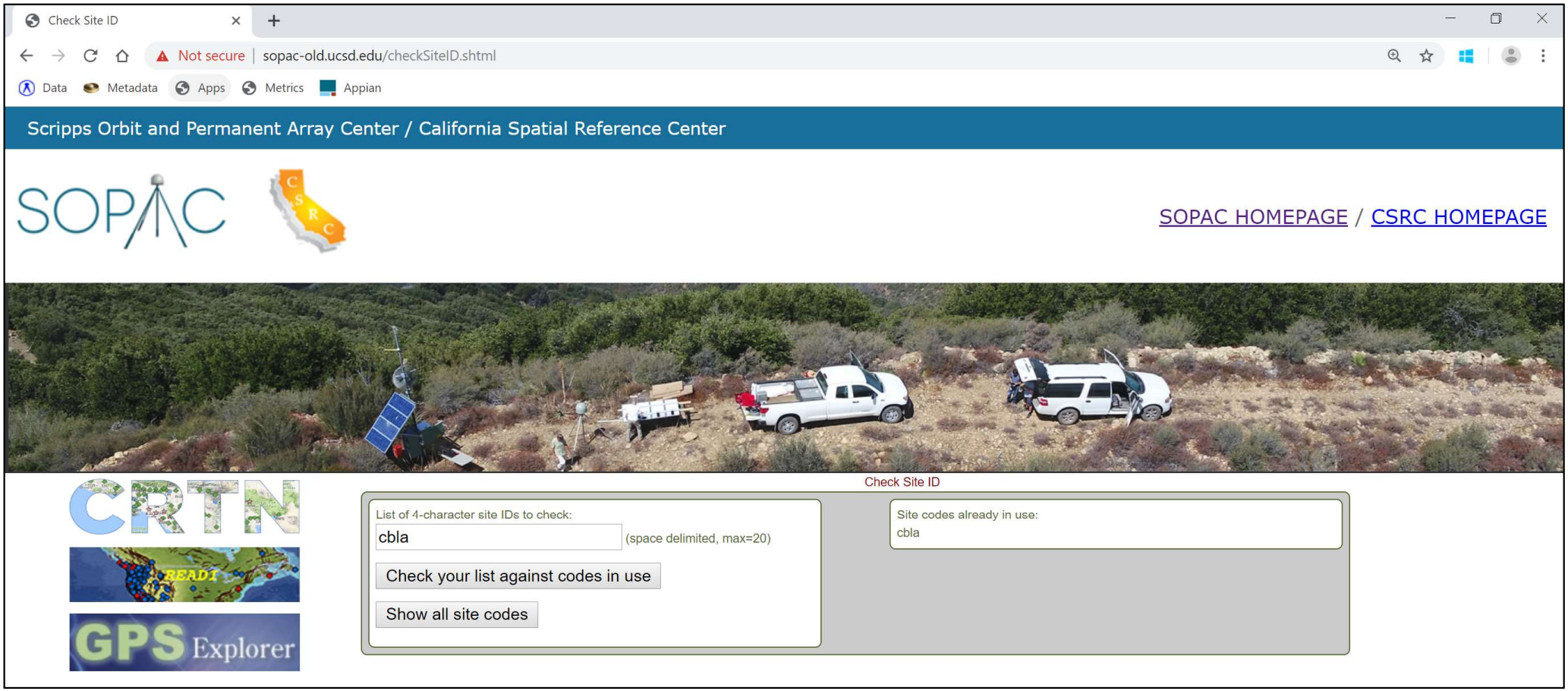

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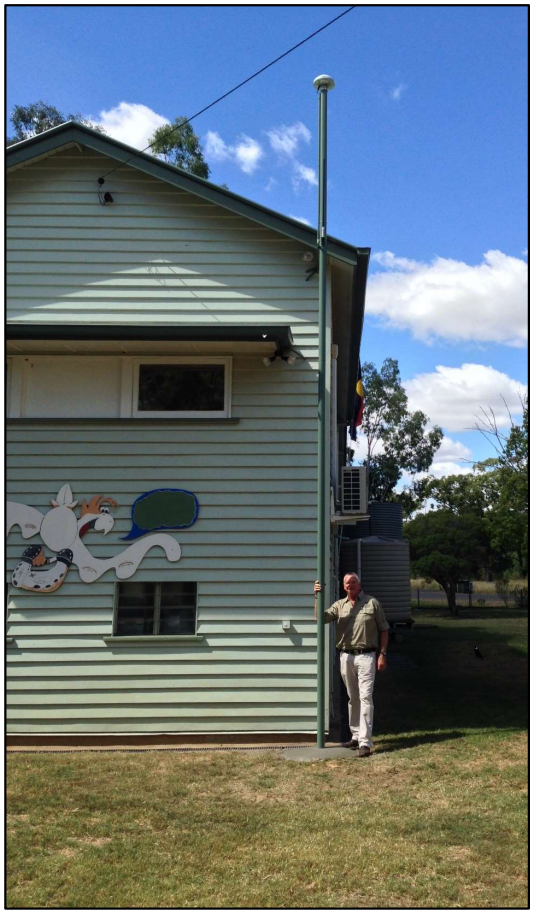
CBLA00AUS_ANT_SN.JPG

CBLA00AUS_MN_001.JPG



CBLA00AUS_MN_002.JPG

CBLA00AUS_ANT_000.JPG

CBLA00AUS_ANT_090.JPG

CBLA00AUS_ANT_180.JPG

CBLA00AUS_ANT_270.JPG

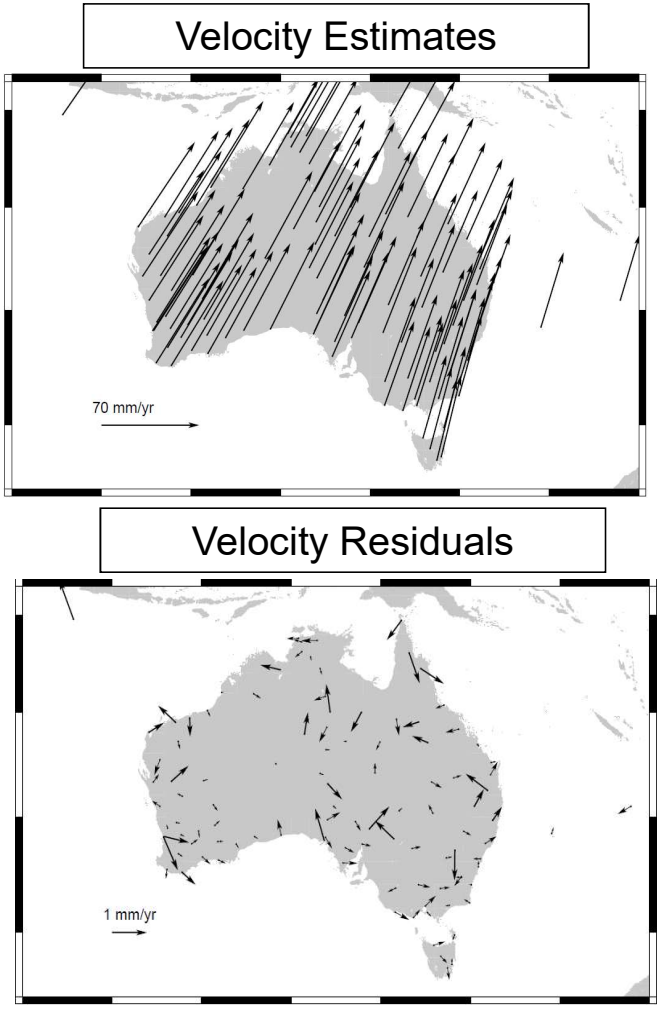
5	**Metadata Submission**
5.1	**Site Log Files**
(a)	Accepted stations are invited to submit their complete metadata records. Metadata will be accepted via: • The Geoscience Australia GNSS Site Manager. https://gnss-site-manager.geodesy.ga.gov.au • IGS style site log files. • GeodesyML site log files. To use the Geoscience Australia GNSS Site Manager, Station Operator are required to have an individual account. The APREF network operations team will provided account details and submission instructions.

6	**Data Submission**
6.1	**RINEX Daily Files**
(a)	Accepted stations are invited to submit RINEX daily files to one or more APREF data repositories Data submission will be accepted via: • Pushing to a secure API (https). • Pushing to a secure FTP server (sftp). Both methods require the Station Operator to have an individual account. The APREF network operations team will provided account details and submission instructions.

How we use APREF in Australia

Geocentric Datum of Australia

- The Geocentric Datum of Australia 2020 (GDA2020) was derived from the APREF solution
- ITRF2014@2020
- 109 high quality sites extracted and their coordinates are the basis for legally traceable positioning in Australia
- Velocity estimates used to determine plate model which is subsequently used to model between ITRF@epoch and GDA2020



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