



Australian Government
Geoscience Australia



Australia's new national datum (GDA2020)

Nicholas Brown, Craig Harrison, Roger Fraser and John Dawson

National Geodesy Section Leader

Geoscience Australia

Chair of Permanent Committee on Geodesy

The Why - changing world ...

- Automated Train Management Systems
- Accurate Rail Centreline & Curvature Data
- Autonomous Trains (e.g. Mines and Ports)
- Reduced Maintenance Costs

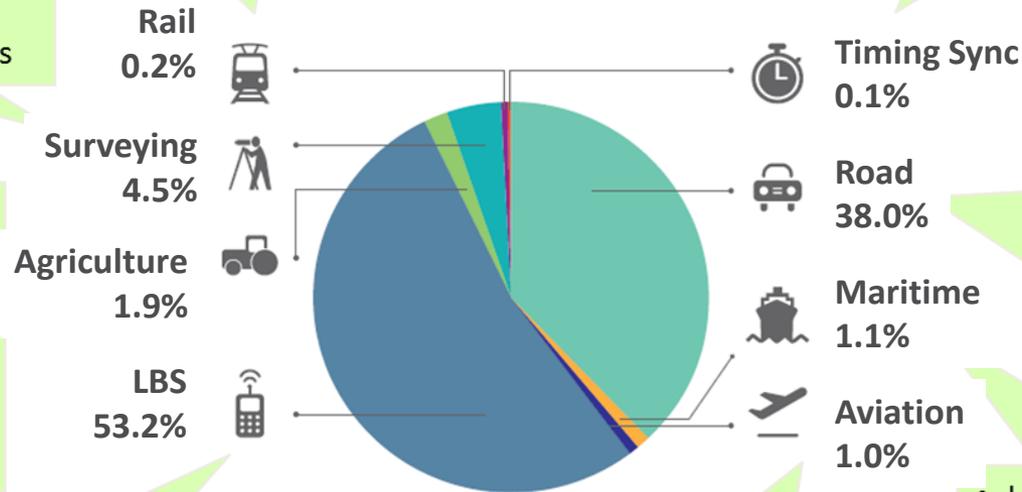
- Time Synchronisation (e.g. Energy, Finance, Telecommunications, Transport Networks)
- Time-Stamping (e.g. Financial Transactions and Network Issues)

- Consistent Spatial Data
- Higher Productivity
- Lower Equipment Costs

- Increased Yield
- Improved Safety
- Reduced Water Run-off, Soil Compaction, Soil Erosion & Fuel Usage
- Lower Emissions
- Preserved Water Quality

- Accurate Location Awareness
- Emergency Services
- Augmented Reality
- Value-Added Applications

Cumulative Core Revenue 2013-2023



- Autonomous Vehicles
- Reduced Fatalities
- Congestion Avoidance
- Reduced Emissions
- Reduced Road damage
- Incident Detection
- Dynamic Navigation
- Situational Awareness

- Higher Tonnage
- Public Safety
- Environmental Protection
- Fuel Efficiency
- Internationally Standardised

- Safety-of-Life Services
- Integrity Monitoring
- Fuel Efficiency
- Internationally Standardised

European GNSS Agency (GSA, 2015)



NPI NATIONAL POSITIONING INFRASTRUCTURE CAPABILITY



- Precise Positioning anywhere, anytime at centimetre level
- Improved access to GNSS data and products for existing and new industries

Precise Positioning

The screenshot shows a web browser window with the URL <http://minister.infrastructure.gov.au/chester/releases/>. The page header includes the name of the Minister, Darren Chester, and a search bar. The main content area features a navigation menu with categories like Biography, Media Releases, Speeches, Interviews, Opinion Pieces, Photos, Tweets, MH370, and Contact. The article title is '\$12 million boost for positioning technology in Australia'. A list of bullet points highlights the key points of the media release. A sidebar on the right contains information about the media release, including the date and the name of the joint release partner, Matthew Canavan.

Navigation: [Home](#) > [Chester](#) > [Media Releases](#) > [2017](#) > [January](#) > \$12 million boost for positioning technology in Australia

\$12 million boost for positioning technology in Australia

- **Testing of Satellite Based Augmentation Systems (SBAS) to be undertaken**
- **Future applications for all four major modes of transport in Australia**
- **Potential safety, productivity, efficiency and environmental benefits**

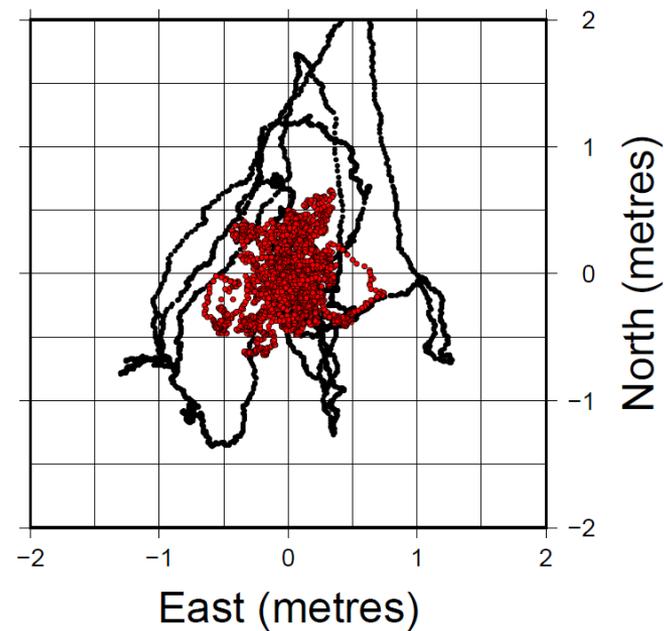
The Australian Government will invest \$12 million in a two-year program looking into the future of positioning technology in Australia.

From using Google Maps on your smartphone to emergency management and farming, most Australians use and benefit from positioning technology every day without realising it.

MEDIA RELEASE
DC010/2017
17 January 2017

JOINT RELEASE WITH:
Matthew Canavan
Minister for Resources and Northern Australia

Mass Market





- Parts of port operations becoming automated
- Safer navigation
- Improved tracking of container movements
- Under keel clearance monitoring for improved productivity
 - Port Hedland; 10 cm = extra \$200M/yr of iron ore exports







Aviation

- Improved positioning (2/4 m)
- Improved approach procedures with vertical guidance
- Higher integrity positioning

Image source: Royal Flying Doctor Service of Australia

Drones

- High-precision drone applications for post disaster management surveys, industrial, engineering applications



Users accessing ITRF data

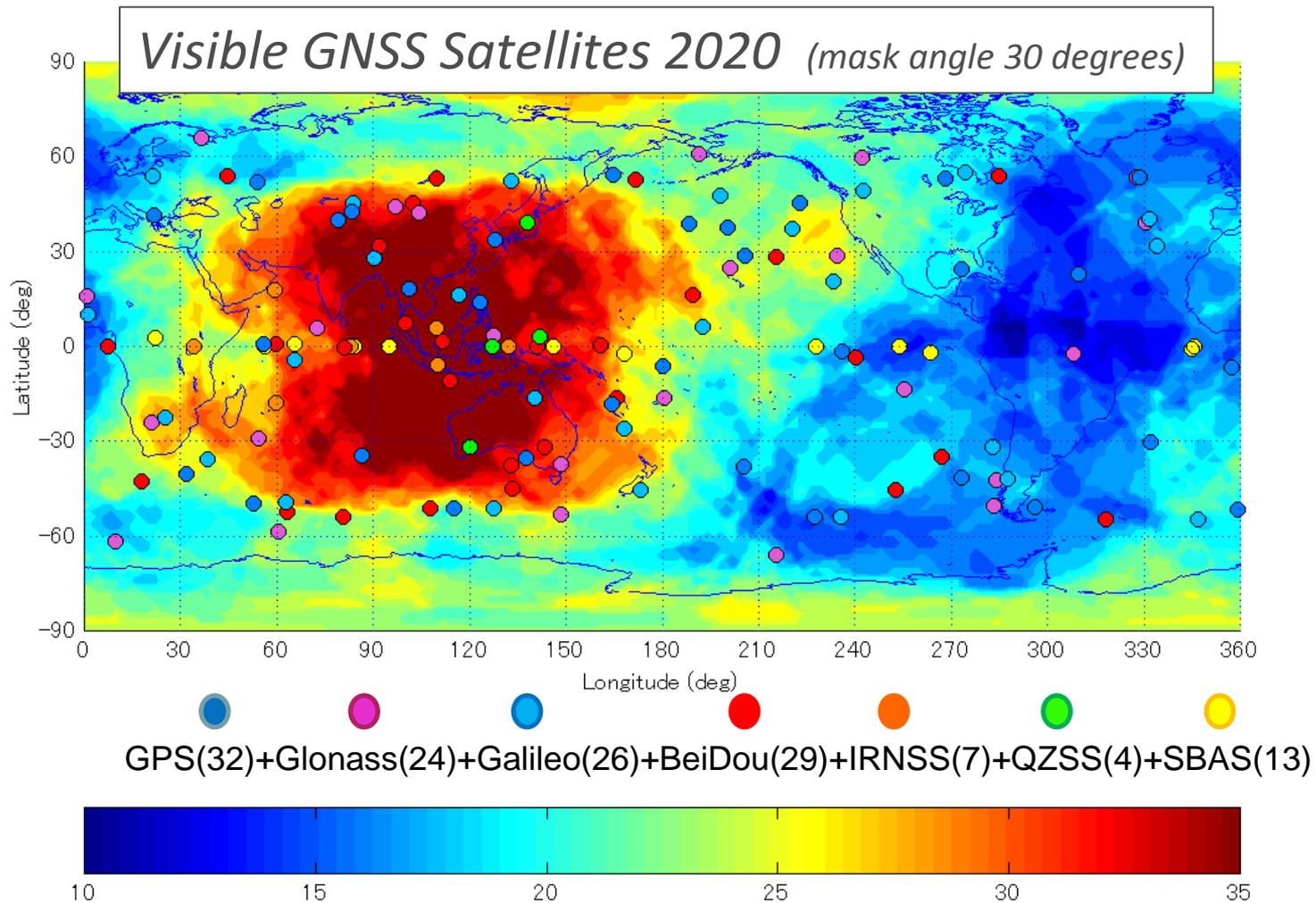
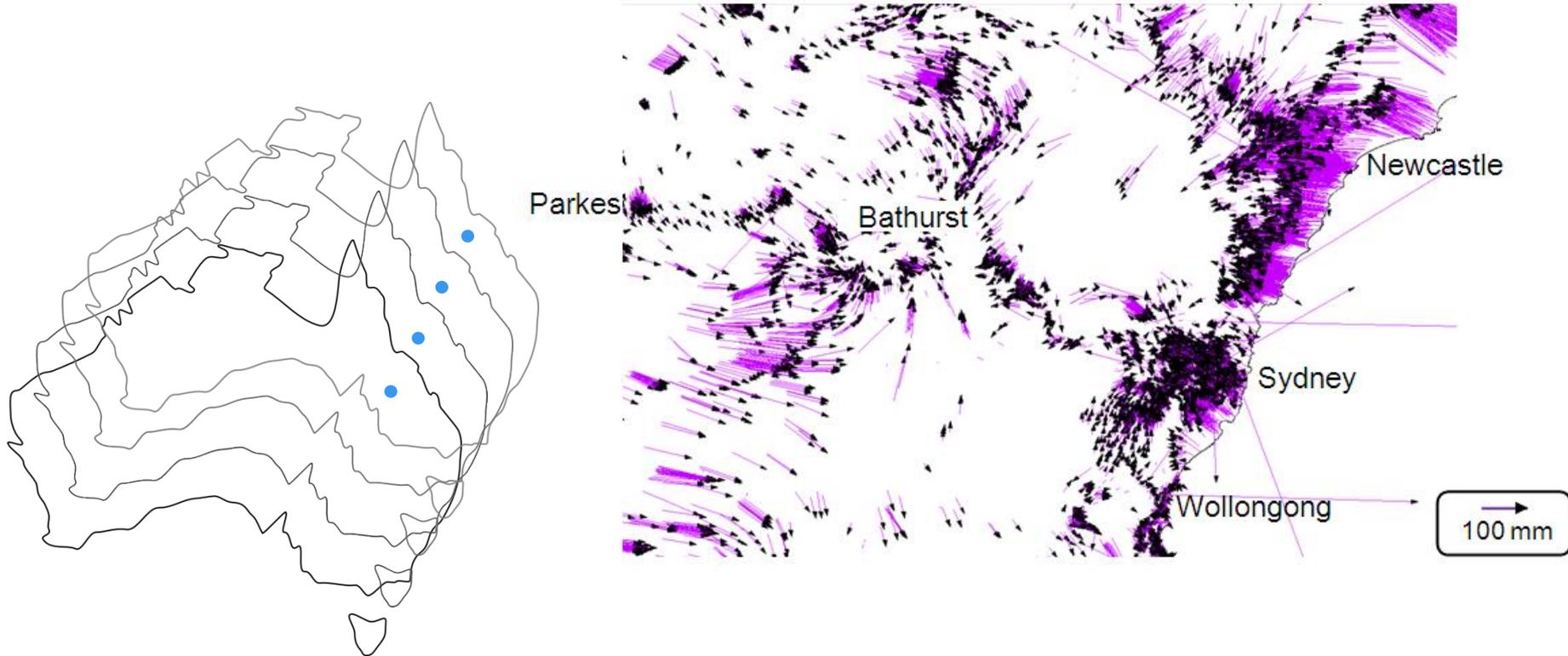


Figure courtesy Prof Chris Rizos, UNSW

Data can only be as accurate as your datum

- Need to remove biases and distortions and biases in GDA94



Source: Joel Haasdyk and Tony Watson, LPI NSW, APAS Conference 2013

New national datum – GDA2020

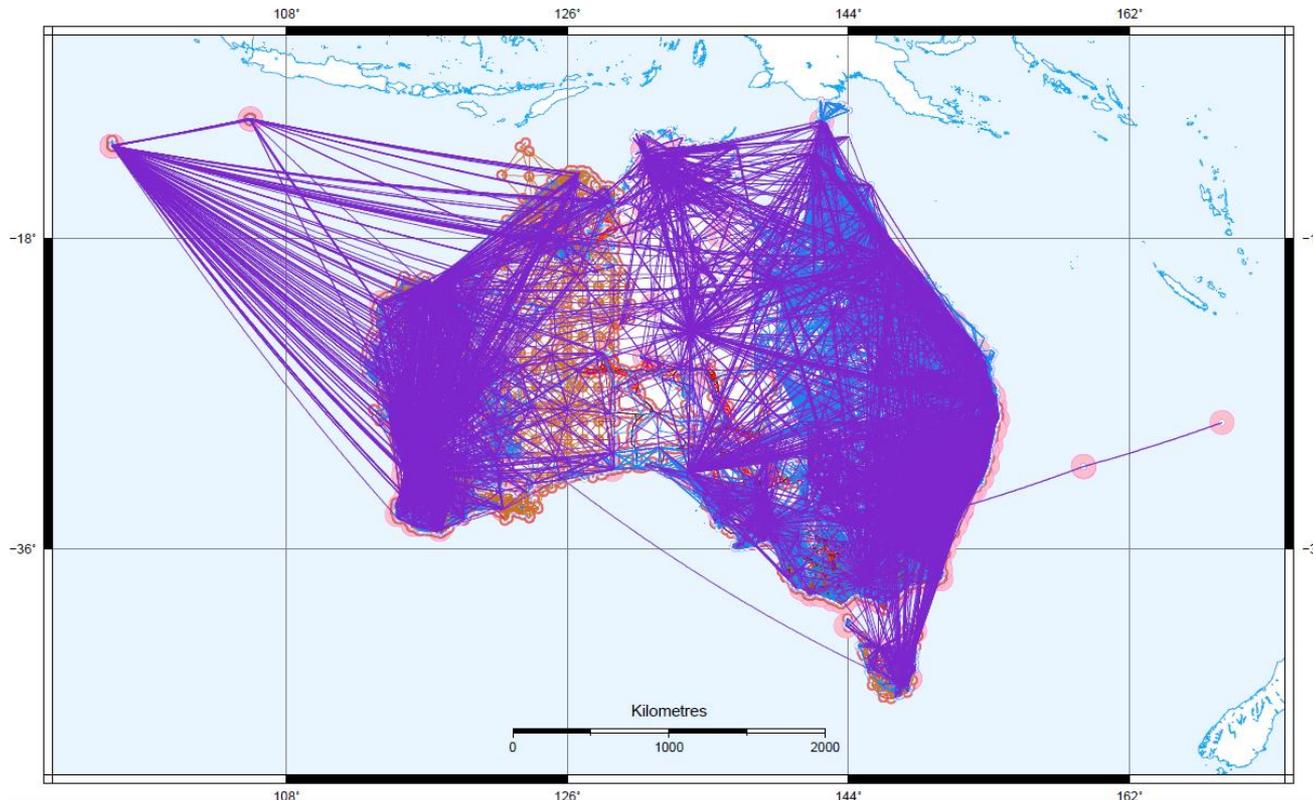


- Determination made in October 2017
- Update from 21 to 109 reference sites
- ~2 million measurements (GNSS + terrestrial)
- ~250,000 stations
- Rigorous national adjustment using DynaNet

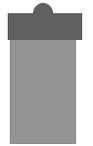
National Measurement (Recognized-Value Standard of Measurement of Position) Determination 2017

I, Dr R. Bruce Warrington, Chief Metrologist, National Measurement Institute, make the following determination.

Dated 11 October 2017



1



2



3



NCI Supercomputer



- 250,000 stations
- 2M measurements
- 2.8TB RAM
- ~5 hours

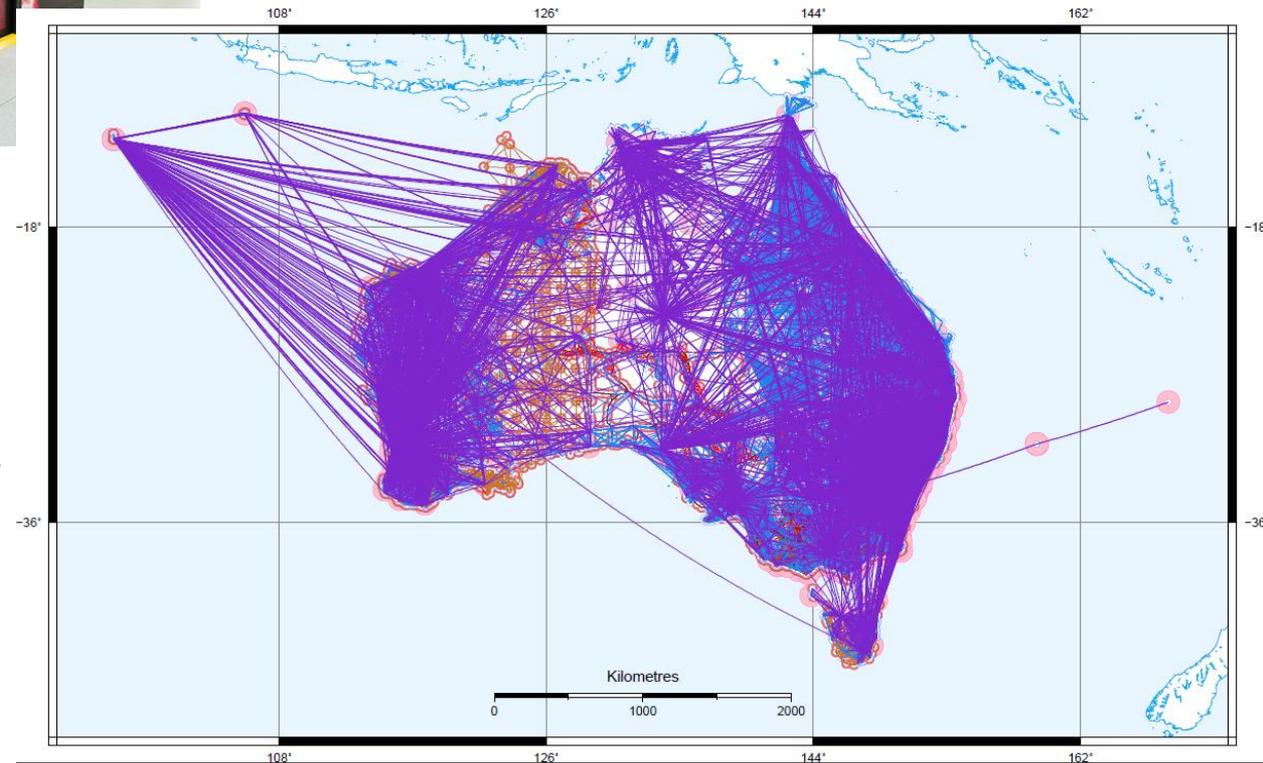


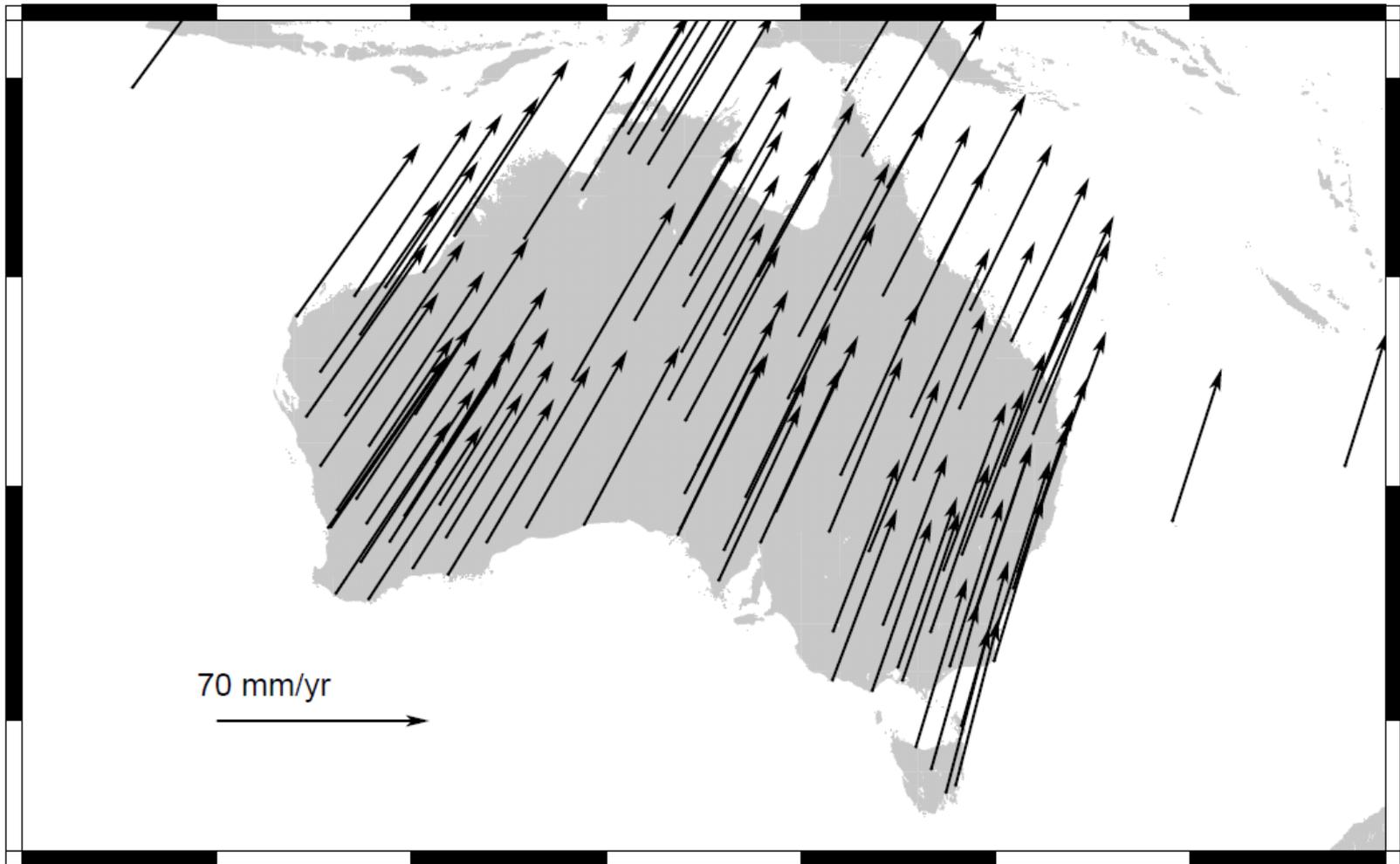
Plate Motion Model

- GDA2020 / ITRF2014 can be converted to ATRF using the Australian plate motion model
- The model describes motion of the Australian tectonic plate based on continental plate motion
- Computed from 109 reference sites which define GDA2020
- Only **rotation velocities** of the 14-parameter transformation

Table 1: Transformation parameters for ITRF2014 to GDA2020 along with their one-sigma uncertainties (1σ). Units are in metres (m) and m/yr for the translation and their rates, respectively, parts-per-million (ppm) and ppm/yr for scale and its rate, respectively, and arcseconds and arcseconds/yr for rotations and their rates, respectively. The reference epoch t_0 is 2020.0.

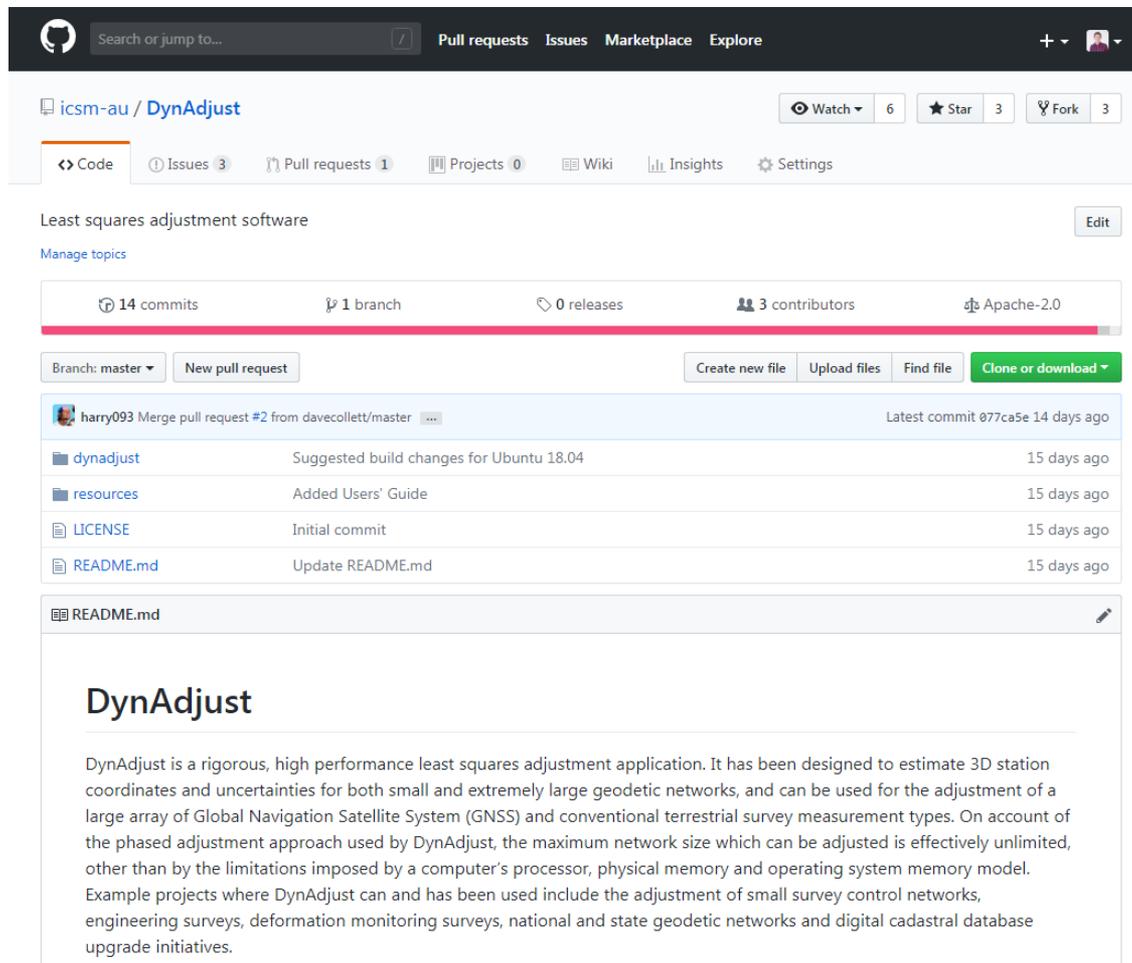
	t_x, \dot{t}_x	t_y, \dot{t}_y	t_z, \dot{t}_z	s_c, \dot{s}_c	r_x, \dot{r}_x	r_y, \dot{r}_y	r_z, \dot{r}_z
rates	0.00	0.00	0.00	0.00	0.00	0.00	0.00
uncertainty	0.00	0.00	0.00	0.00	0.00	0.00	0.00
rates	0.00	0.00	0.00	0.00	0.00150379	0.00118346	0.00120716
uncertainty	0.00	0.00	0.00	0.00	0.00000417	0.00000401	0.00000370

Crustal Motion



Open Source software

The software used to develop the new national datum, GDA2020, is available as Open Source software ...



The screenshot shows the GitHub repository page for 'icsm-au / DynAdjust'. The repository is described as 'Least squares adjustment software' and is licensed under Apache-2.0. It has 14 commits, 1 branch, 0 releases, 3 contributors, and 6 stars. The repository is on the 'master' branch. A recent pull request by 'harry093' is highlighted, which merges pull request #2 from 'davecollett/master'. The commit history shows several recent changes, including suggested build changes for Ubuntu 18.04, added users' guide, initial commit, and update to the README.md. The README.md file is currently selected, showing the title 'DynAdjust' and a detailed description of the software's capabilities and use cases.

Least squares adjustment software Edit

Manage topics

14 commits 1 branch 0 releases 3 contributors Apache-2.0

Branch: master New pull request Create new file Upload files Find file Clone or download

harry093 Merge pull request #2 from davecollett/master ... Latest commit 077ca5e 14 days ago

- dynadjust Suggested build changes for Ubuntu 18.04 15 days ago
- resources Added Users' Guide 15 days ago
- LICENSE Initial commit 15 days ago
- README.md Update README.md 15 days ago

README.md

DynAdjust

DynAdjust is a rigorous, high performance least squares adjustment application. It has been designed to estimate 3D station coordinates and uncertainties for both small and extremely large geodetic networks, and can be used for the adjustment of a large array of Global Navigation Satellite System (GNSS) and conventional terrestrial survey measurement types. On account of the phased adjustment approach used by DynAdjust, the maximum network size which can be adjusted is effectively unlimited, other than by the limitations imposed by a computer's processor, physical memory and operating system memory model. Example projects where DynAdjust can and has been used include the adjustment of small survey control networks, engineering surveys, deformation monitoring surveys, national and state geodetic networks and digital cadastral database upgrade initiatives.



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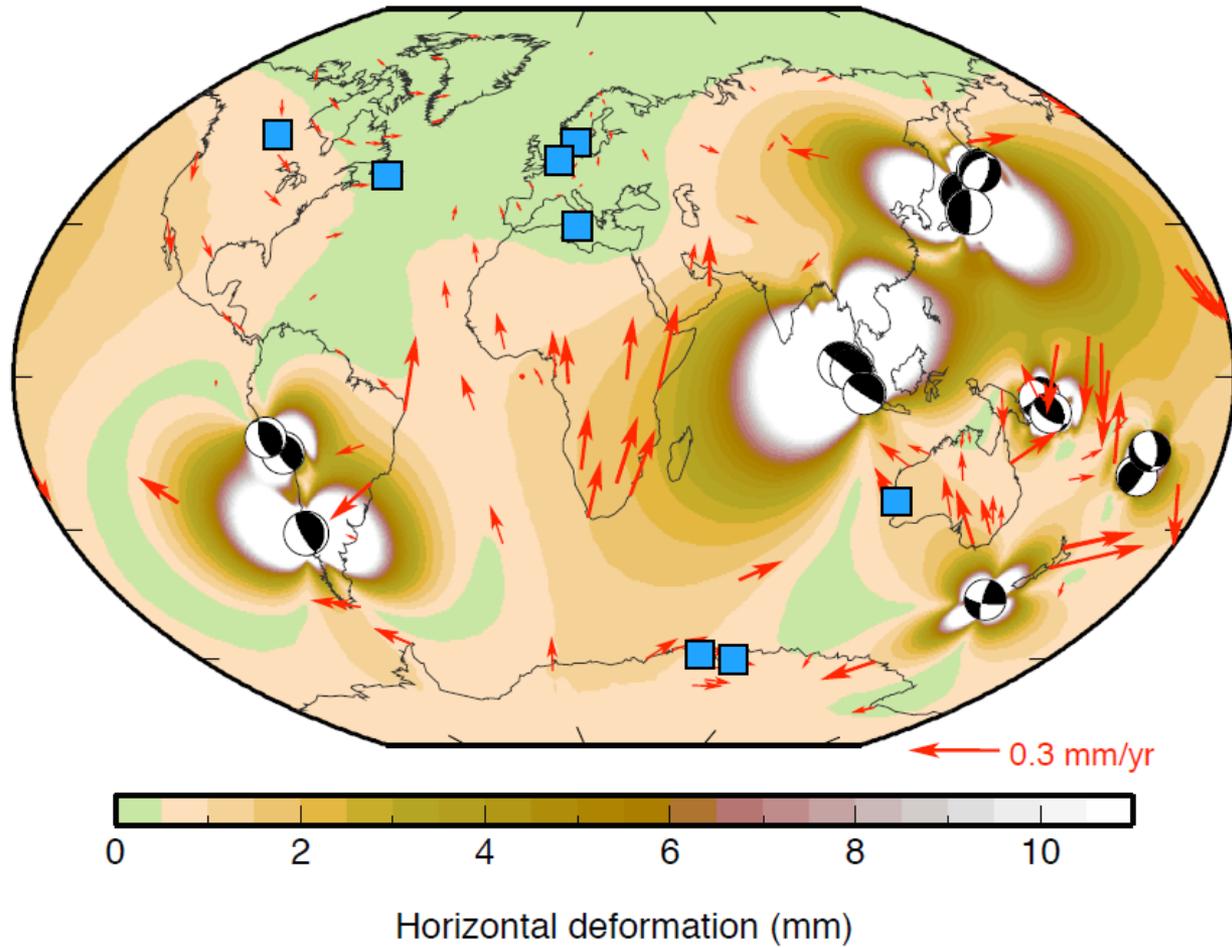
Nicholas Brown, Craig Harrison, Roger Fraser and John Dawson

National Geodesy Section Leader

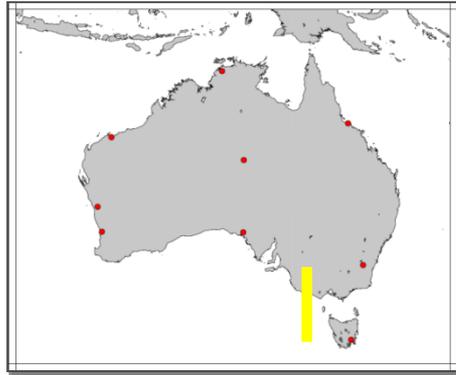
Geoscience Australia

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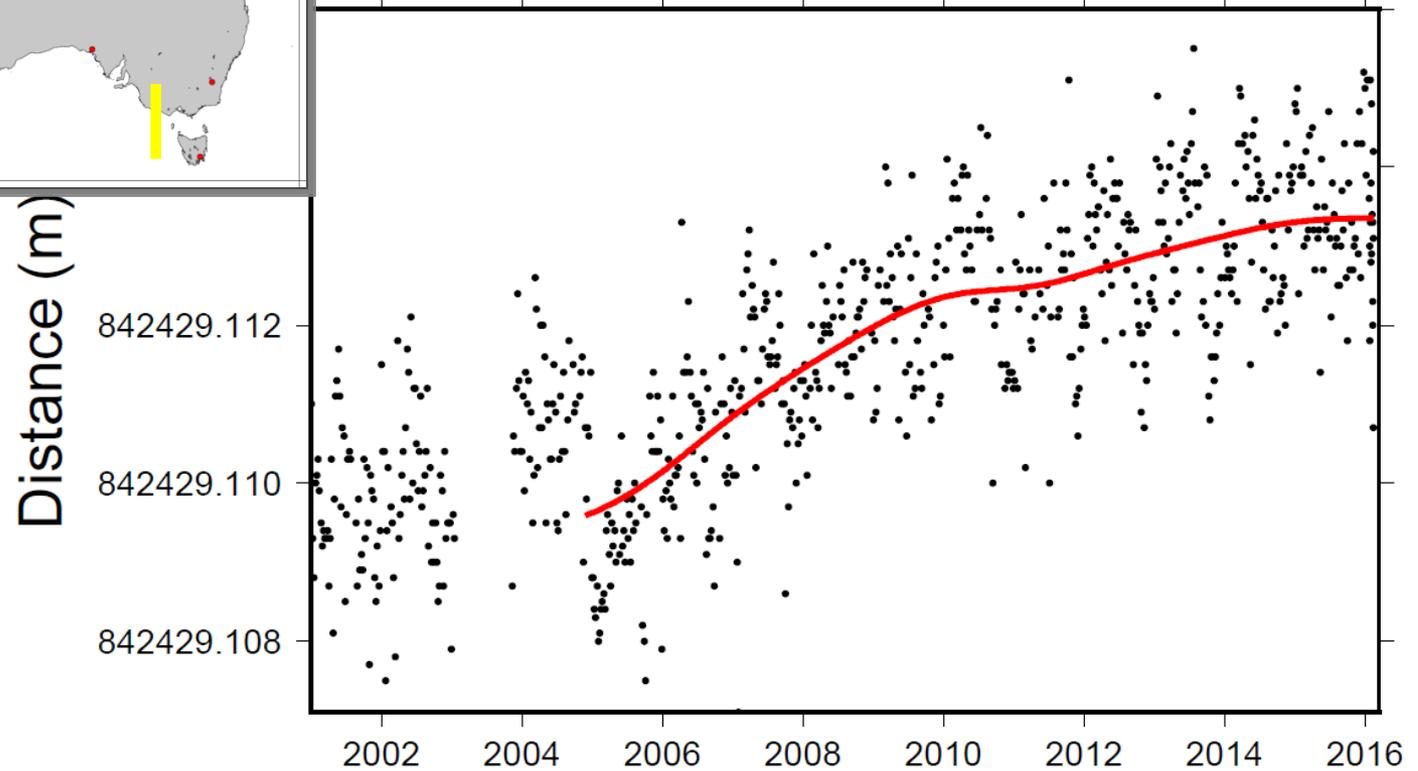
Tregoning et al, 2013



2004 Mw=8.1 Macquarie Ridge earthquake



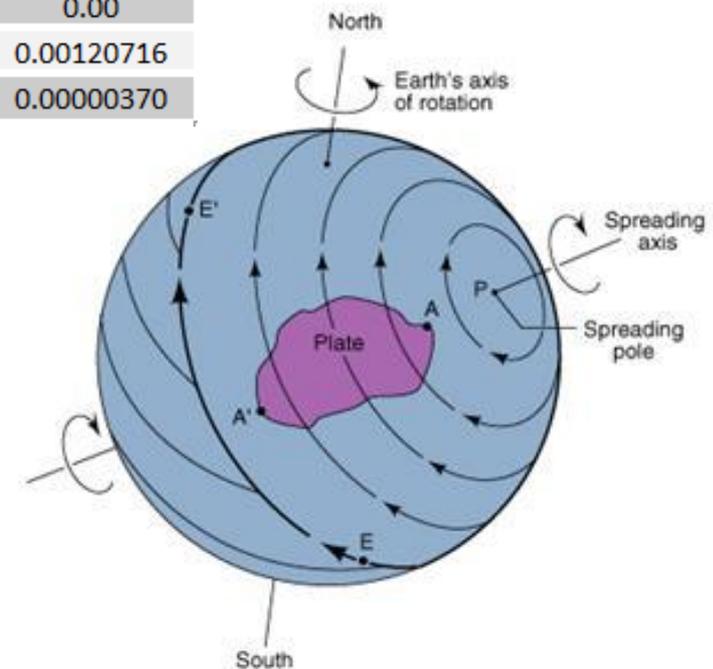
Canberra to Hobart (GA Operational Solution)



Australian Plate Model (GDA2020 – ITRF2014)

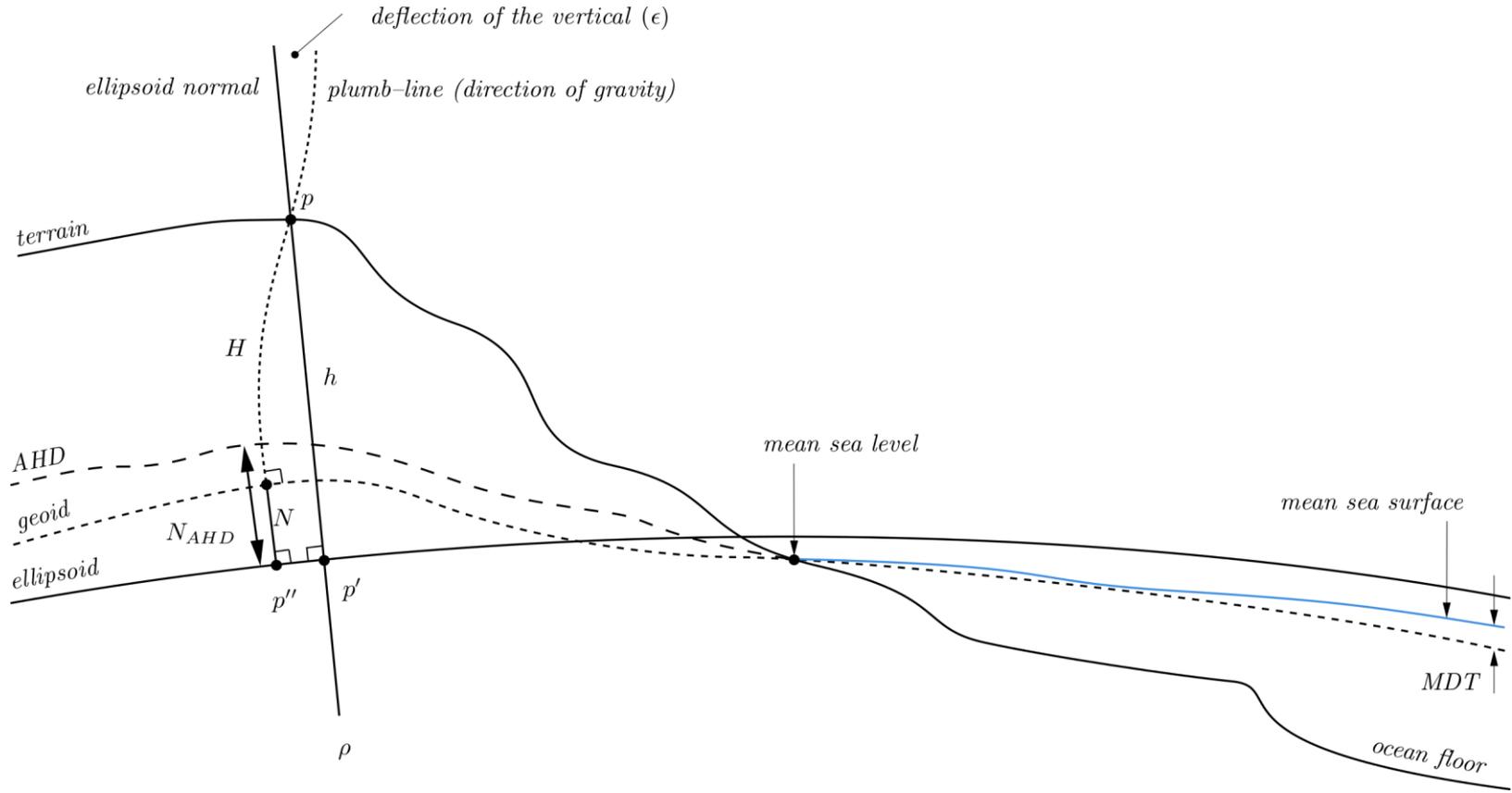
Table 3.3: Transformation parameters for ITRF2014 to GDA2020 along with their one sigma uncertainties (1σ). Units are in meters (m) and m/yr for the translation and their rates, respectively parts-per-million (ppm) and ppm/yr for scale and its rate, respectively, and arcseconds and arcseconds/yr for rotations and their rates, respectively. The reference epoch t_0 is 2020.0.

	t_x, \dot{t}_x	t_y, \dot{t}_y	t_z, \dot{t}_z	s_c, \dot{s}_c	r_x, \dot{r}_x	r_y, \dot{r}_y	r_z, \dot{r}_z
	0.00	0.00	0.00	0.00	0.00	0.00	0.00
uncertainty	0.00	0.00	0.00	0.00	0.00	0.00	0.00
rates	0.00	0.00	0.00	0.00	0.00150379	0.00118346	0.00120716
uncertainty	0.00	0.00	0.00	0.00	0.00000417	0.00000401	0.00000370



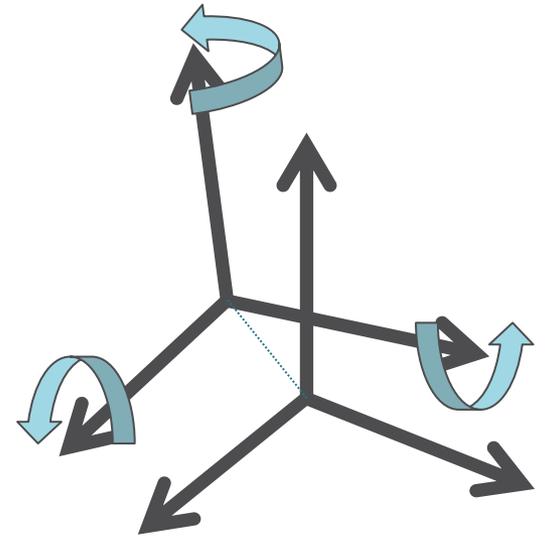
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Geometric Component



GDA94 – GDA2020 Transformation

- Use common points from GDA94 Determination and GDA2020 Determination
- 21 reference points from GDA94 AFN minus MAC1, COCO and XMIS due to seismic displacement
- Solve for the 7-parameters (3 x rotation, 1 x scale and 3 x translation) using CATREF software



GDA2020 Products and Services

Intergovernmental Committee on Surveying and Mapping




**Geocentric Datum of Australia 2020
Technical Manual**

Version 1.1.1

Intergovernmental Committee on Surveying and Mapping (ICSM)
Permanent Committee on Geodesy (PCG)
8 January 2018

DATUM MATTERS

01

Changes are being made to the national datum system that underpins location information in Australia. These changes will bring Australia's datum into line with global positioning systems and smartphones and other location technology.

02 *Know your data, know your datum*

Do you work with location information? Are you aware of the Modernisation of Australia's Datum and the accuracy of location data you use? With significant changes occurring in the world of location technology, it's more important than ever to understand the source and quality of your data.



Latitude and longitude coordinates are at best ambiguous unless they are linked to the related datum.

Why should I care about the national datum?

GDA94 – GDA2020 Online Transformation Service

Purpose

The online transformation service (powered by FME) provides a reference standard that enables software developers and spatial professionals to transform their data from the Geocentric Datum of Australia 1994 (GDA94) to the Geocentric Datum of Australia 2020 (GDA2020). Users can simply "drag and drop" files onto the page and receive an email with a link to download the output file.

Please note, this service is not intended to enable users to transform all their data from GDA94 to GDA2020; instead it aims to provide a method of checking systems and processes implemented by government or the spatial industry to ensure the transformation results are correct. The online transformation service accepts the following formats at this time: Shapefiles, CSV, ASCII Grid, GeoTiff, ECW, JPEG2000, GeoJSON

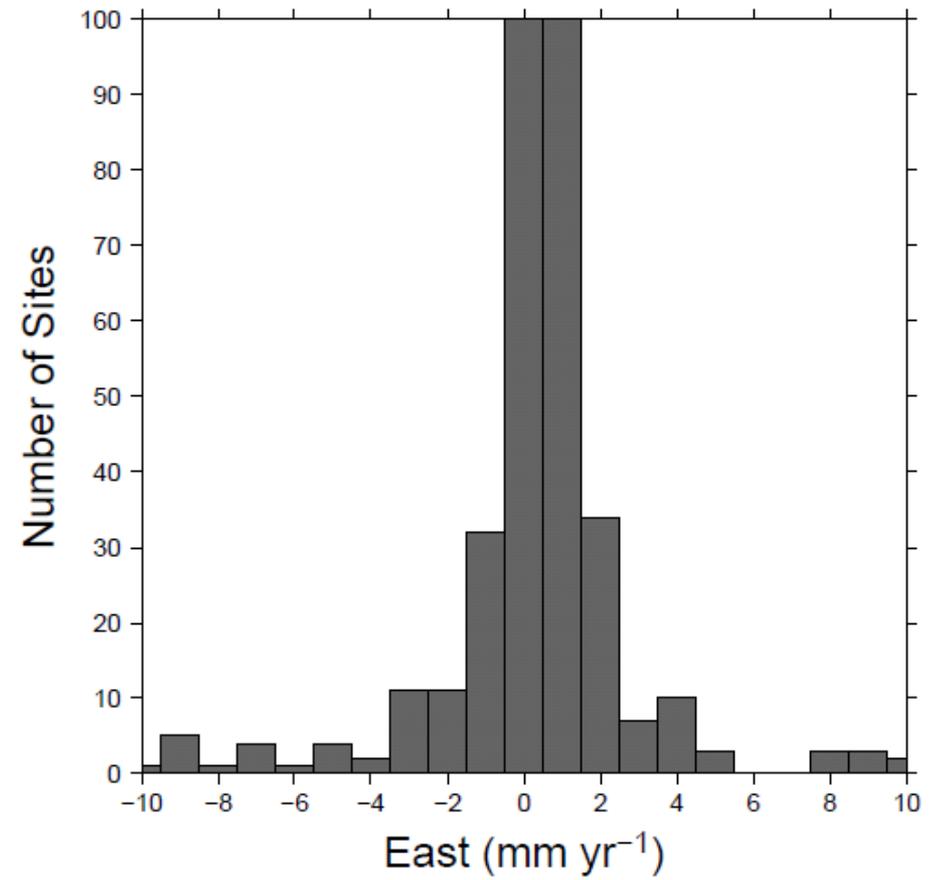
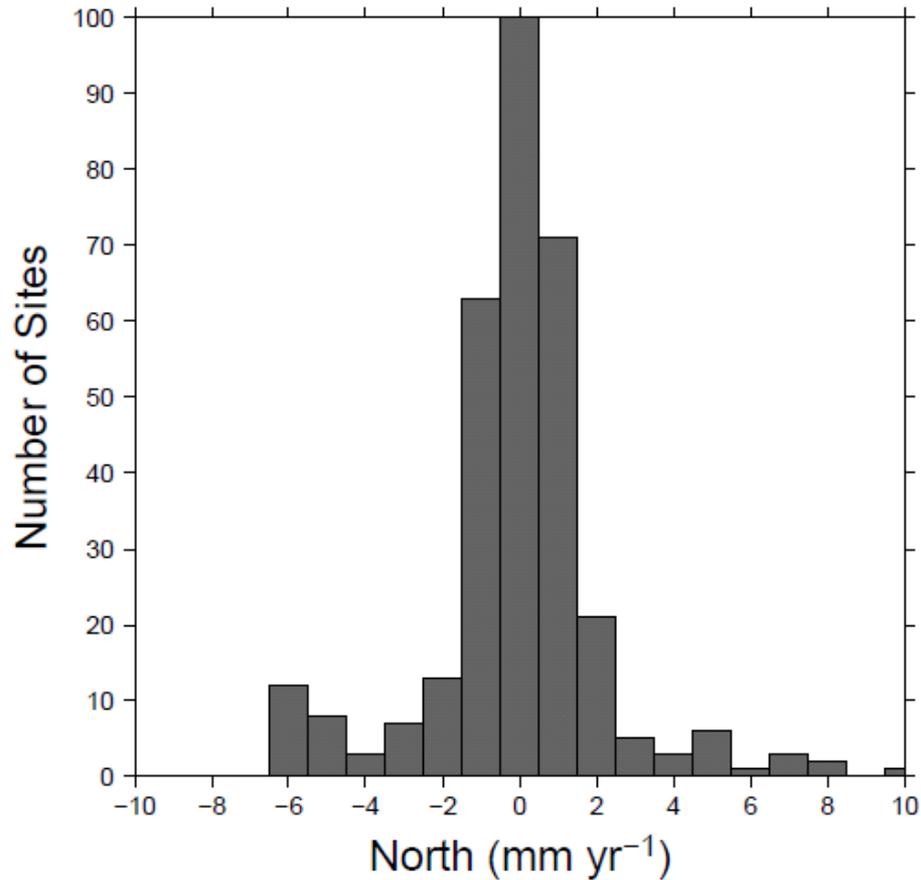
Home | Scientific Topics | Positioning and Navigation | Datum Modernisation in Australia

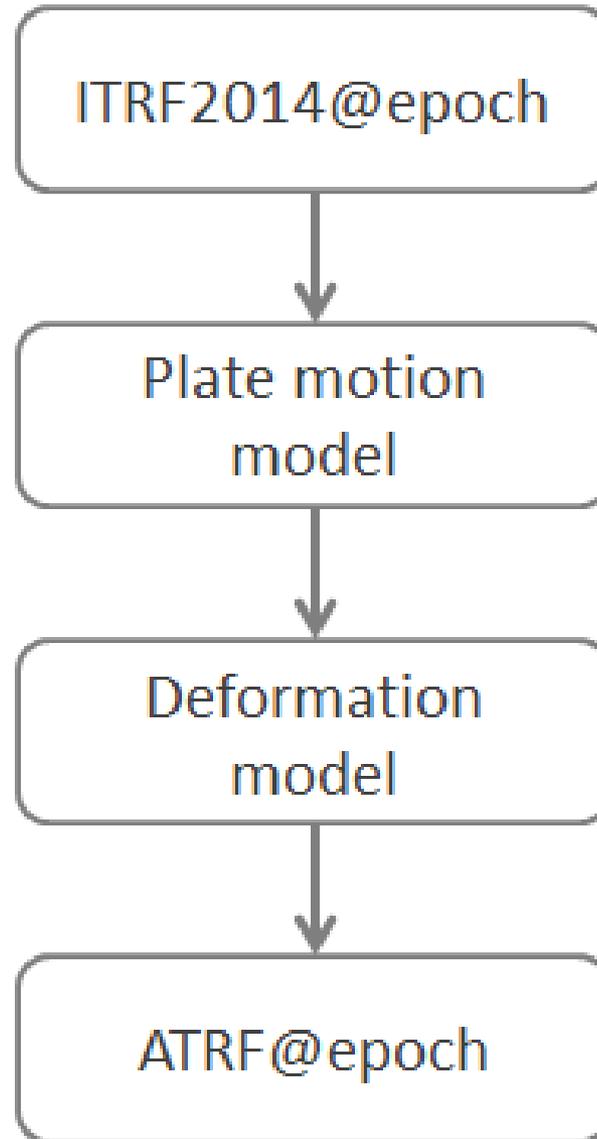
Datum Modernisation in Australia

DATUM MODERNISATION IN AUSTRALIA PRODUCTS AND TOOLS TO ASSIST WITH TRANSITION IMPLEMENTATION ACROSS THE AUSTRALIAN GOVERNMENT INFORMATION FOR SPATIAL SOFTWARE PROVIDERS GDA2020 TECHNICAL SPECIFICATIONS



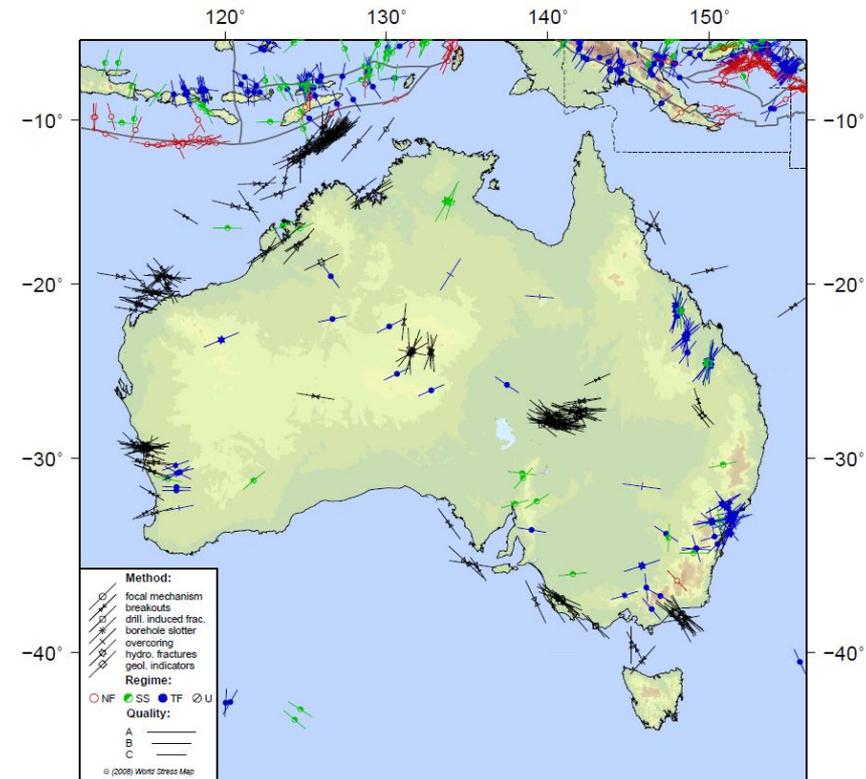
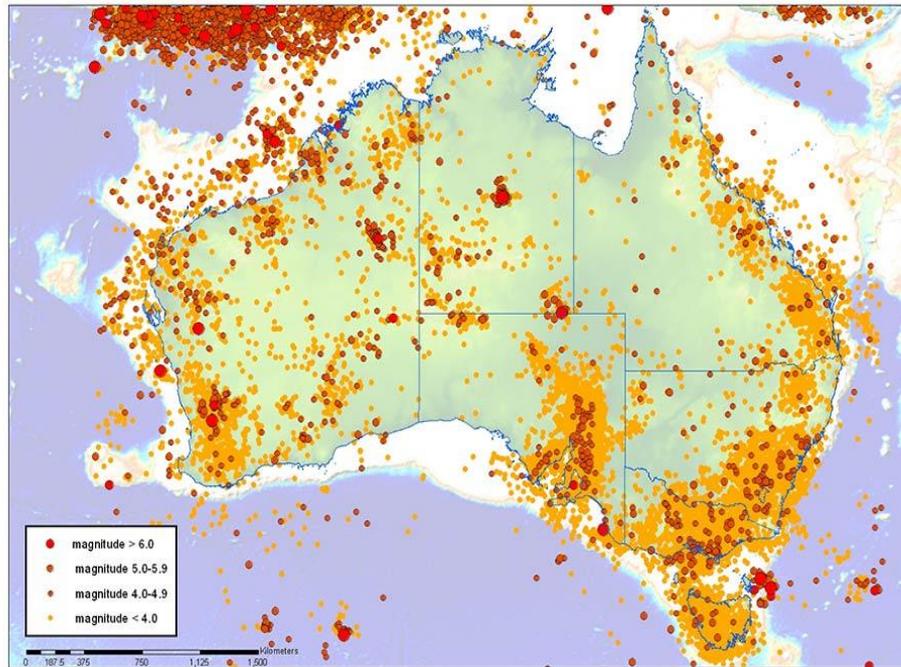
What About the Tier 3 Sites?





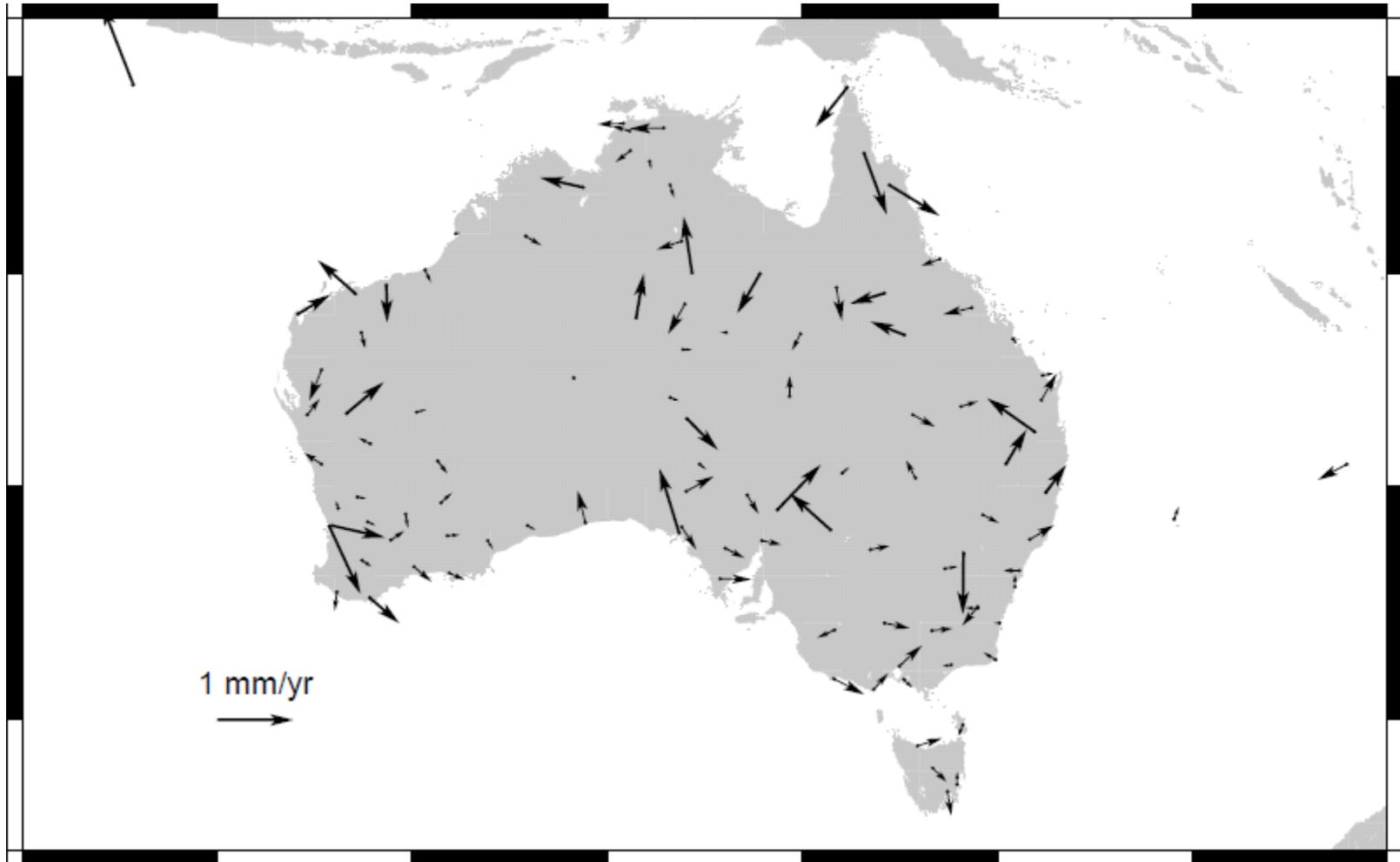
Is a plate motion model acceptable?

- Estimates of the regional seismic moments (e.g., Kostrov, 1974) lead to predictions of the deformation of the Australian plate of 0.65 ± 2 mm/yr (95% confidence level) (Leonard, 2008; Tregoning 2013)



World Stress Map Rel. 2008
Heidelberg Academy of Sciences and Humanities
Geophysical Institute, University of Karlsruhe
Projection: Mercator

Residual Crustal Deformation



Residual Crustal Deformation

