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

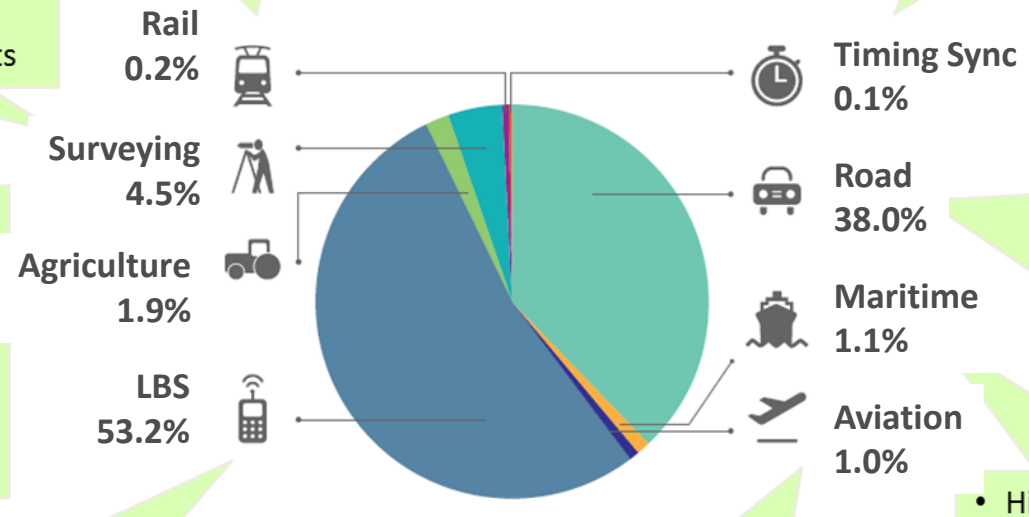
The Why - changing world …

- 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

Cumulative Core Revenue 2013-2023



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

- 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

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

- Higher Tonnage
- Public Safety
- Environmental Protection
- 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

http://minister.infrastructure.gov.au/chester/releases/ | Citrix XenApp - Applications | $12 million boost for positi...

FIONA NASH | DARREN CHESTER | PAUL FLETCHER | SEARCH

The Hon Darren Chester MP
Minister for Infrastructure and Transport

BIOGRAPHY | MEDIA RELEASES | SPEECHES | INTERVIEWS | OPINION PIECES | PHOTOS | TWEETS | MH370 | CONTACT

Home > Chester > Media Releases > 2017 > January > $12 million boost for positioning technology in Australia

Listen A- A+

$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**

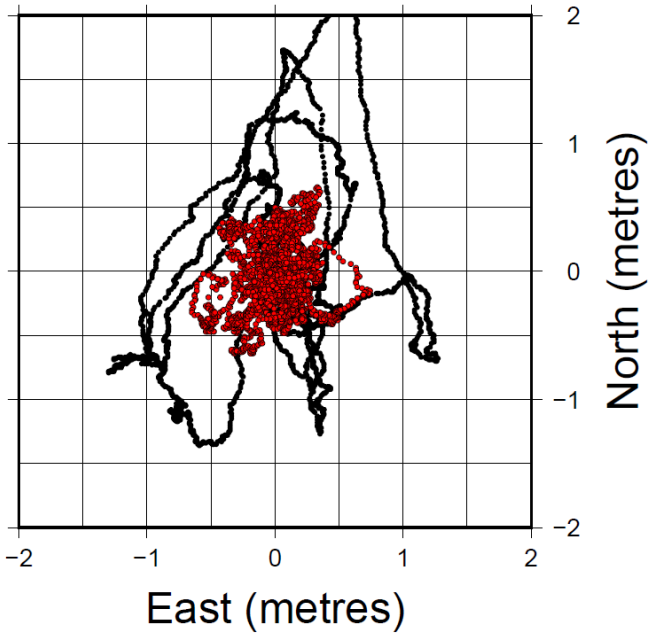
MEDIA RELEASE
DC010/2017
17 January 2017

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

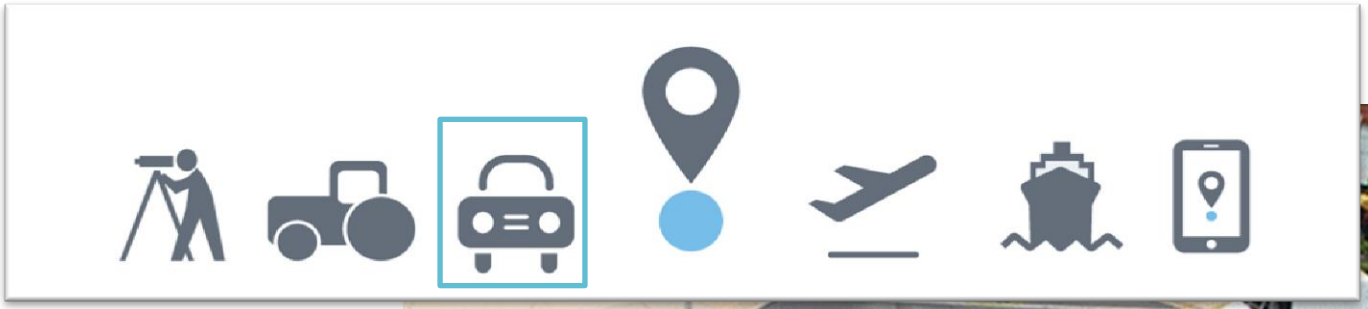
The Australian Government will invest $12 million in a two-year program looking into the future of positioning technology in Australia.

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.

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

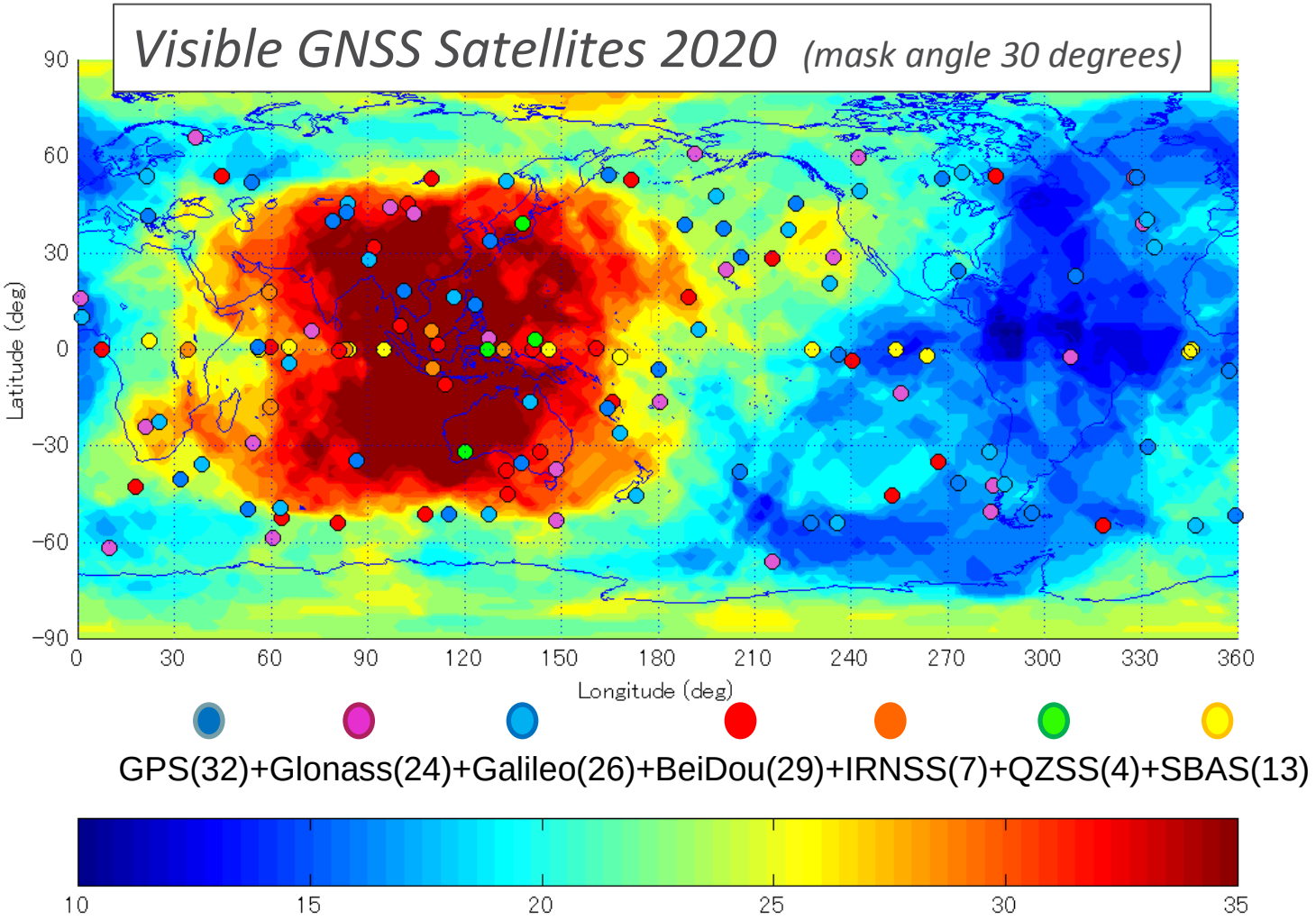
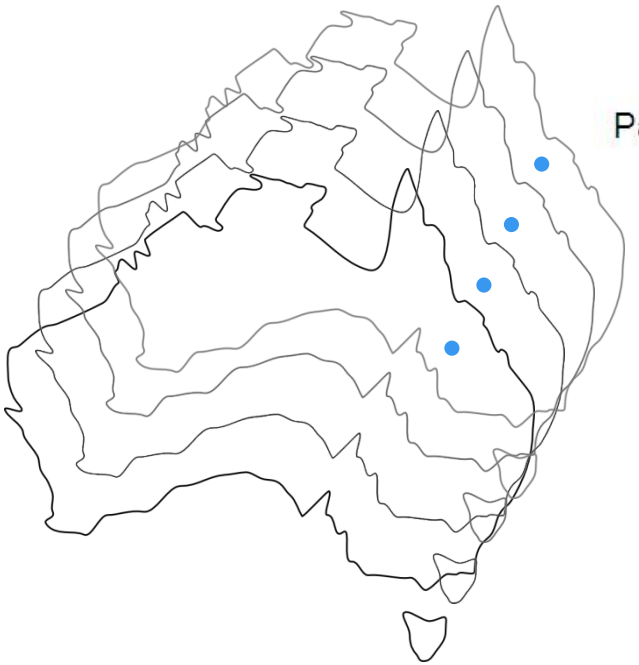
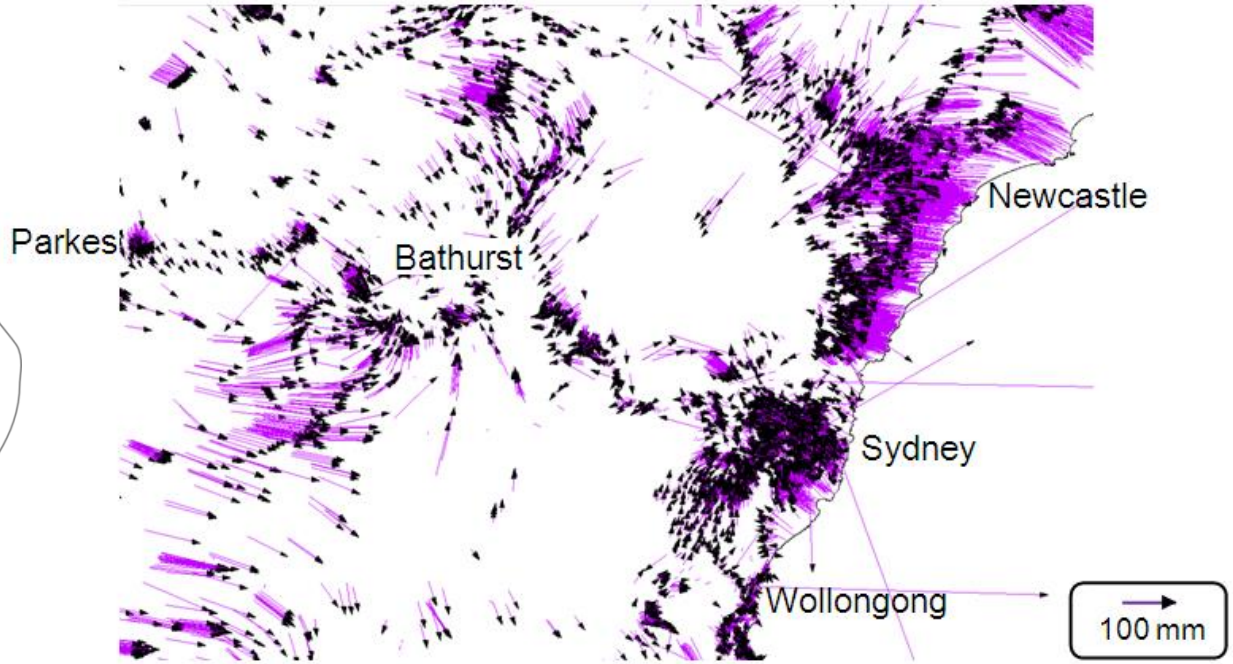


Figure courtesy Prof Chris Rizos, UNSW

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

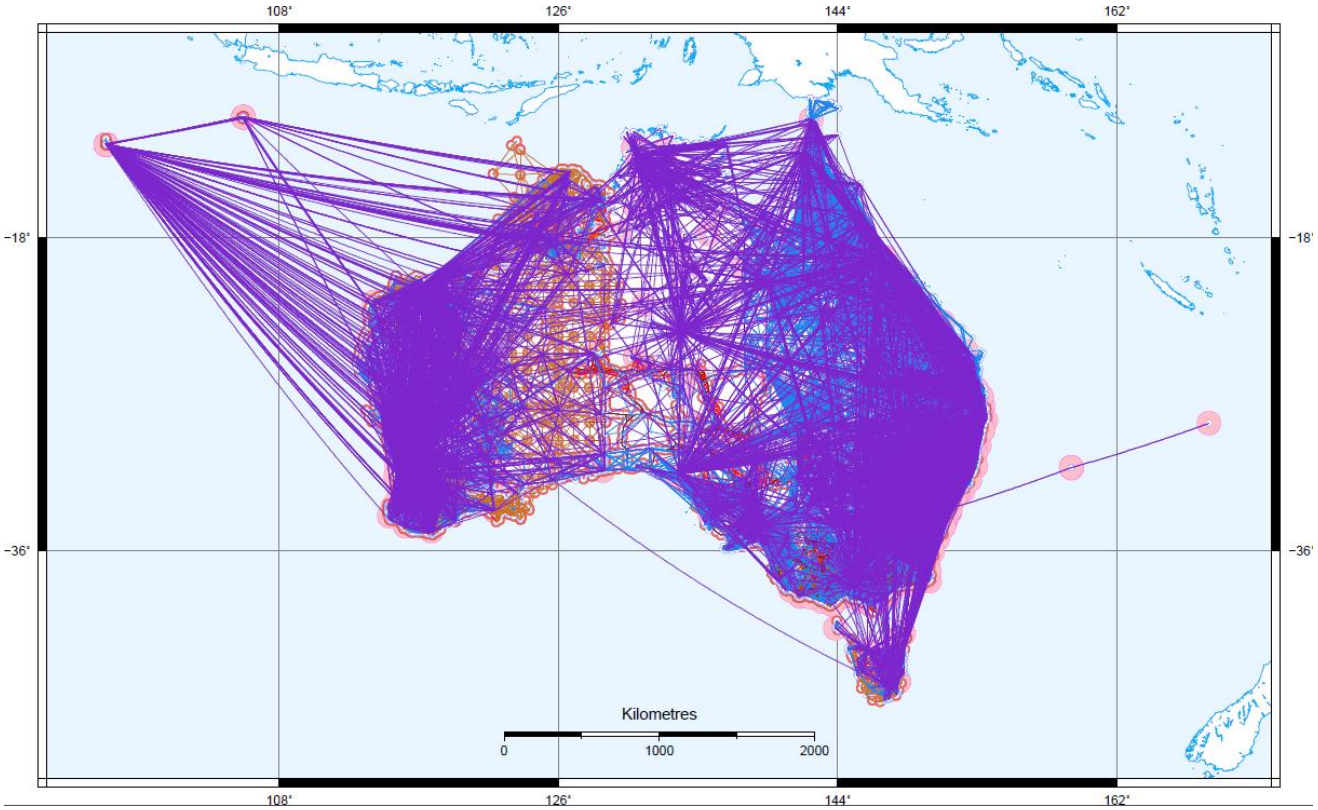
New national datum – GDA2020

- 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

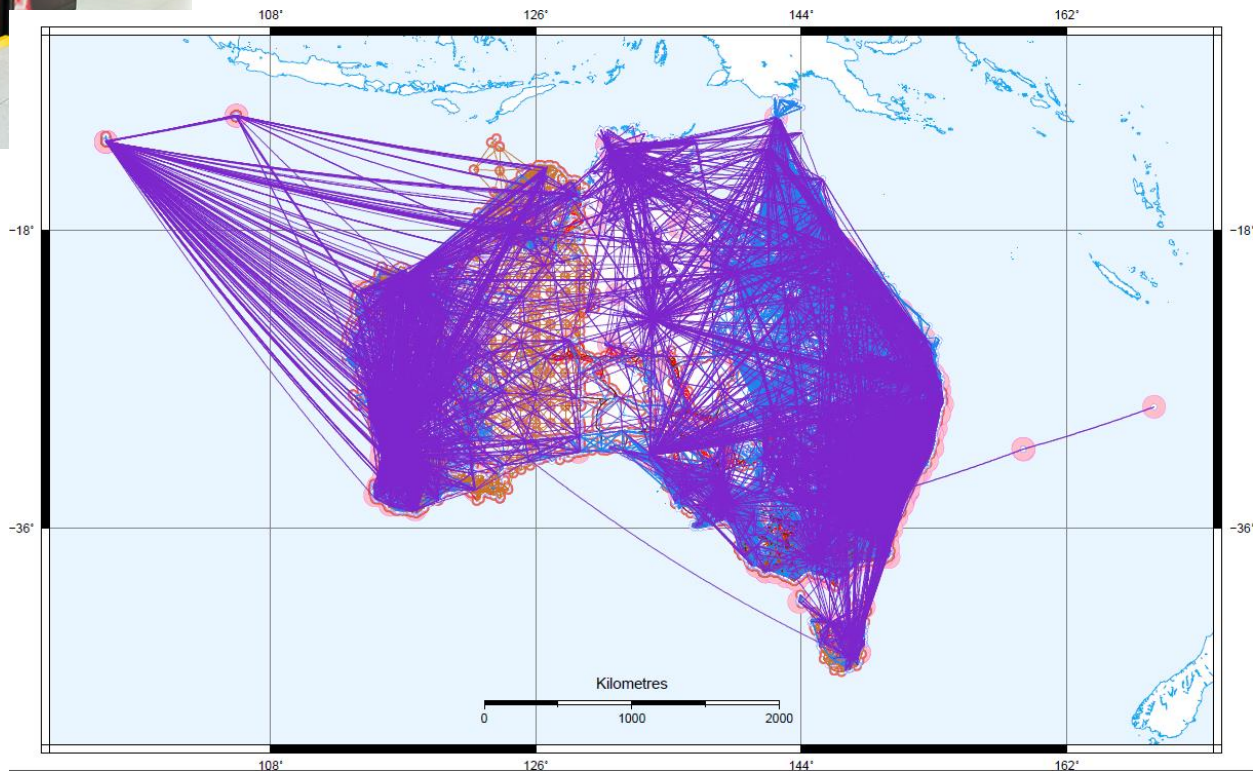


1

2

3

NCI Supercomputer



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

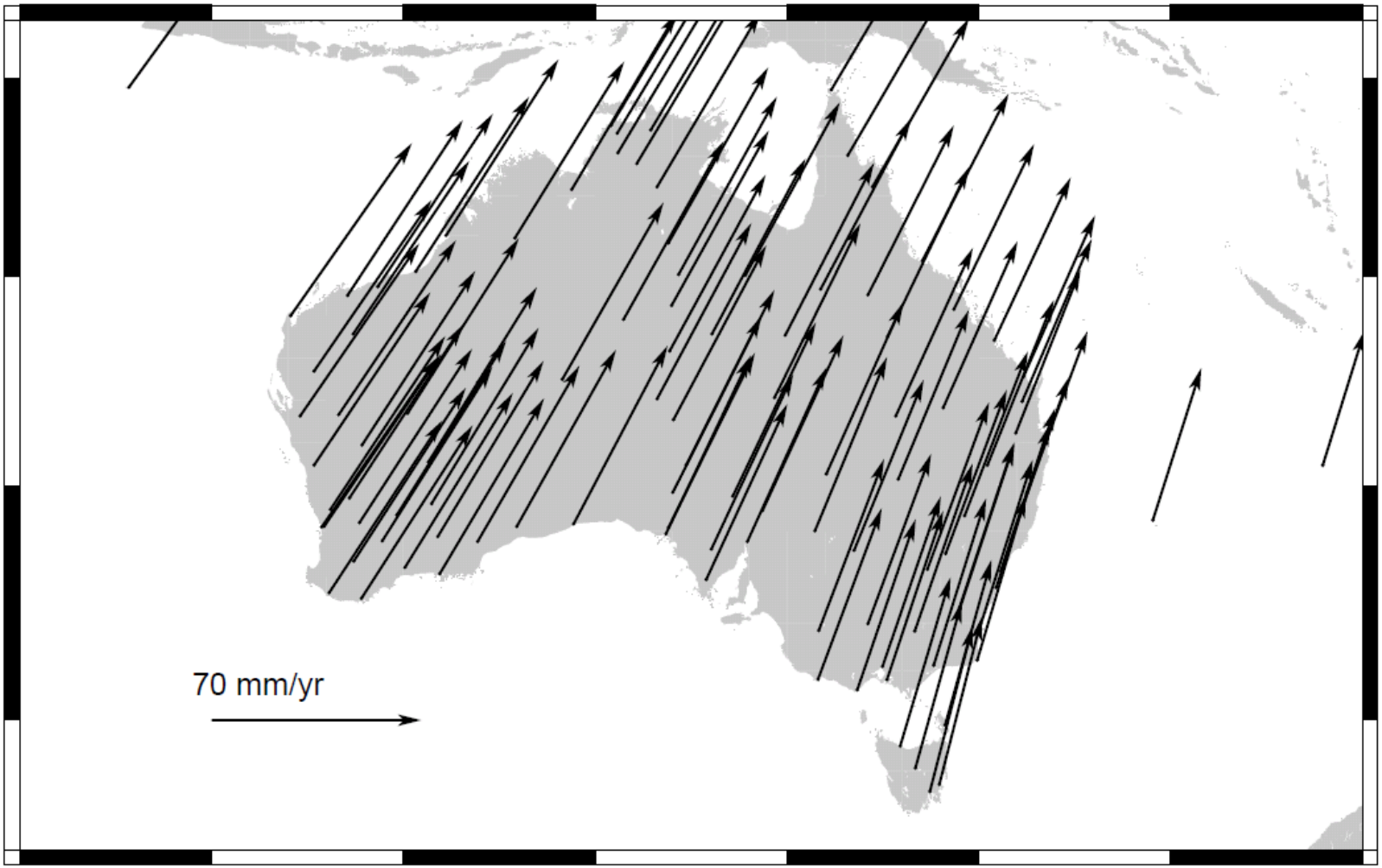
Plate Motion Model

- 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.

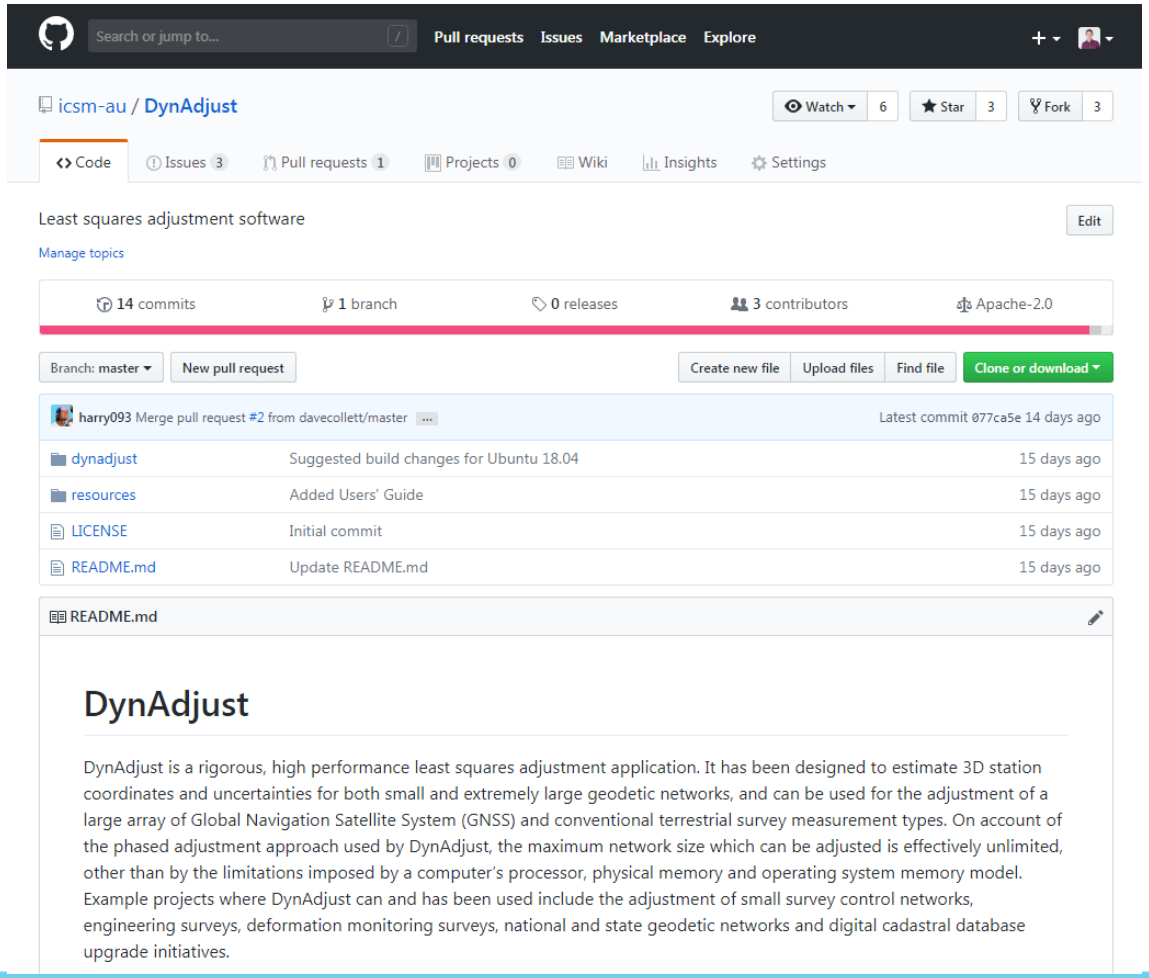
	$t_x, \dot{t}_x$	$t_y, \dot{t}_y$	$t_z, \dot{t}_z$	$s_c, \dot{s}_c$	$r_x, \dot{r}_x$	$r_y, \dot{r}_y$	$r_z, \dot{r}_z$
rates	0.00	0.00	0.00	0.00	0.00	0.00	0.00
uncertainty	0.00	0.00	0.00	0.00	0.00	0.00	0.00
rates	0.00	0.00	0.00	0.00	0.00150379	0.00118346	0.00120716
uncertainty	0.00	0.00	0.00	0.00	0.00000417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



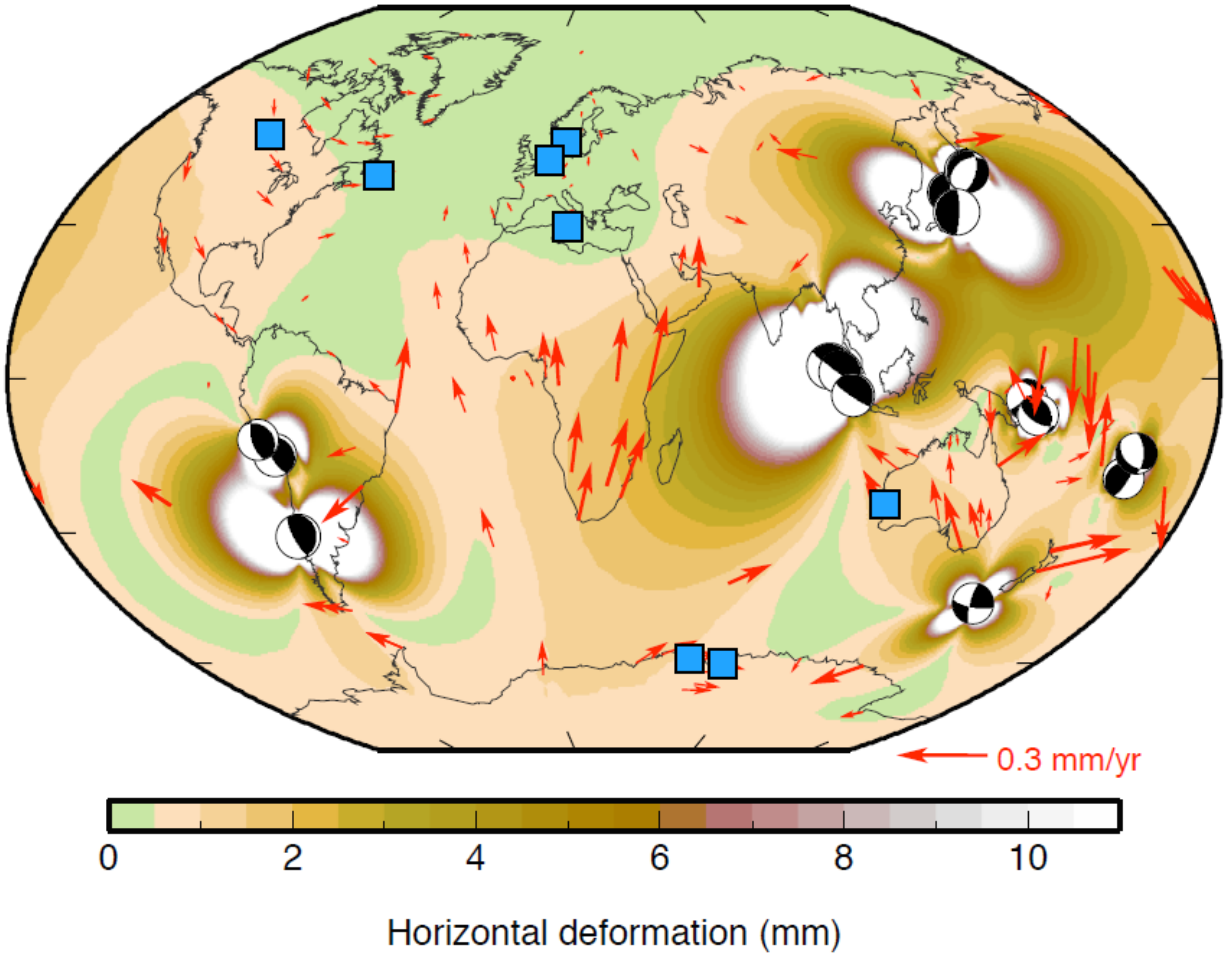
Australian Government
Geoscience Australia

Australia's new national datum (GDA2020)

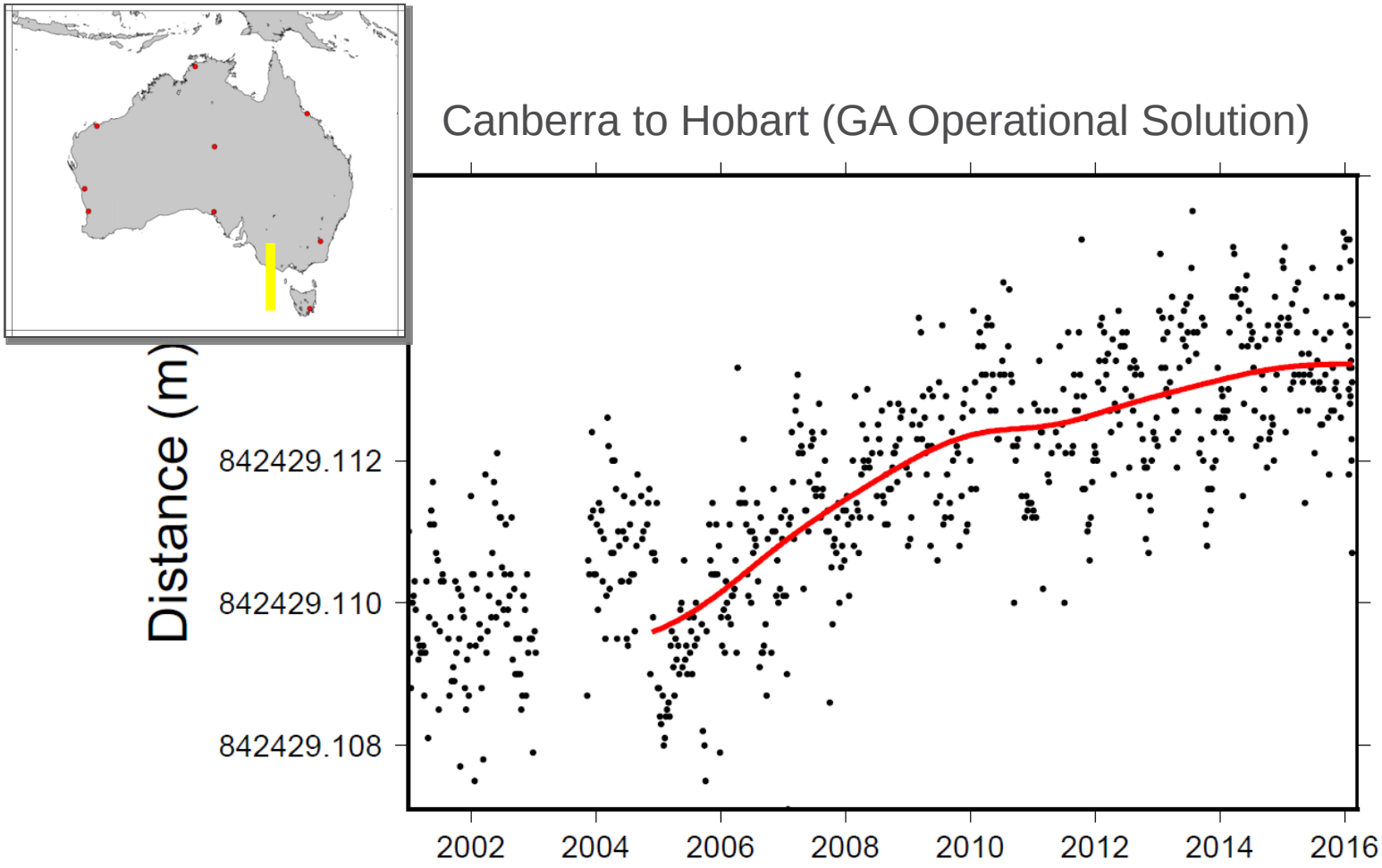
Nicholas Brown, Craig Harrison, Roger Fraser and John Dawson

National Geodesy Section Leader
Geoscience Australia
Chair of Permanent Committee on Geodesy

Tregoning et al, 2013



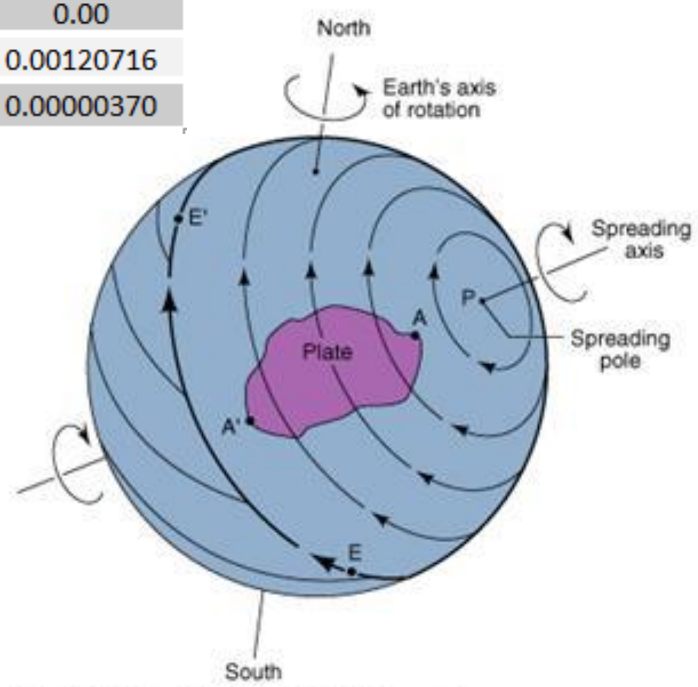
2004 Mw=8.1 Macquarie Ridge earthquake



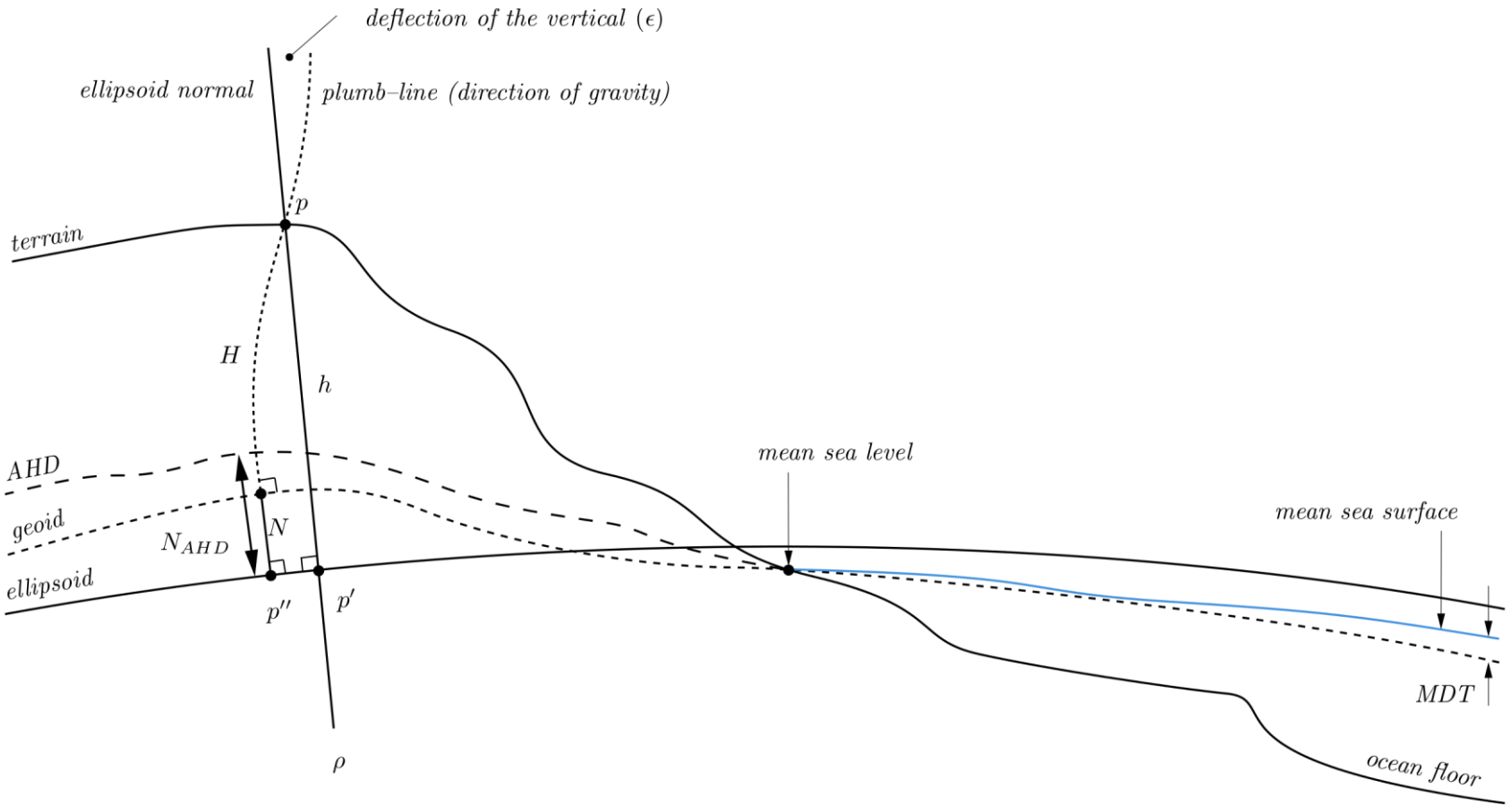
Australian Plate Model (GDA2020 – ITRF2014)

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, respecti 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

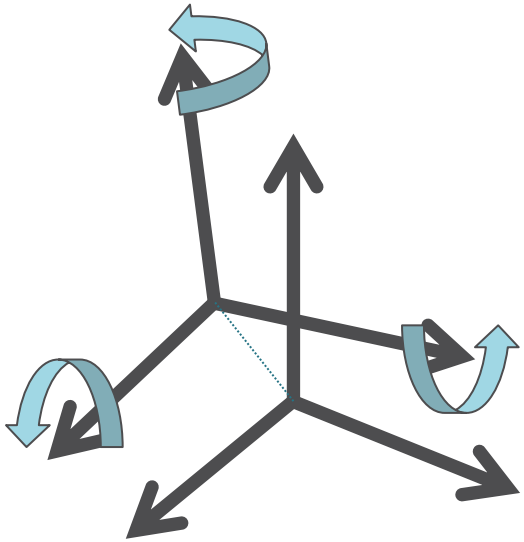


Geometric Component

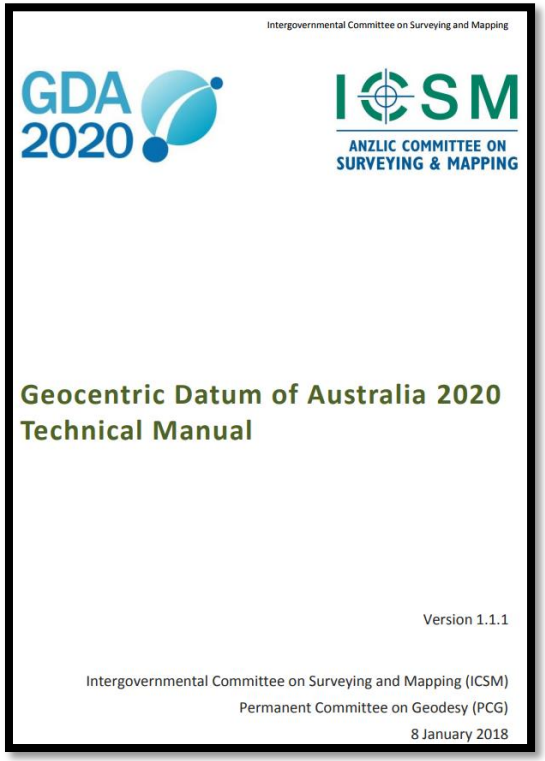


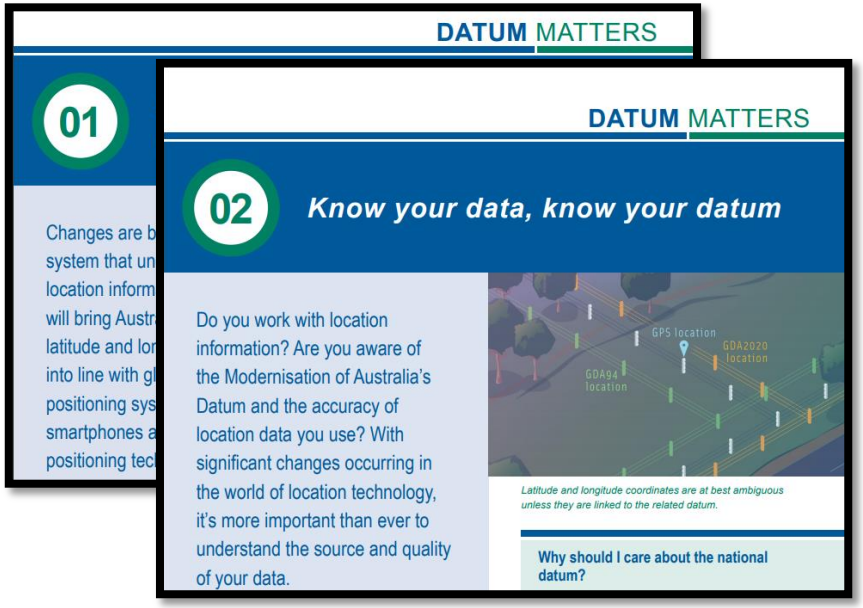
GDA94 – GDA2020 Transformation

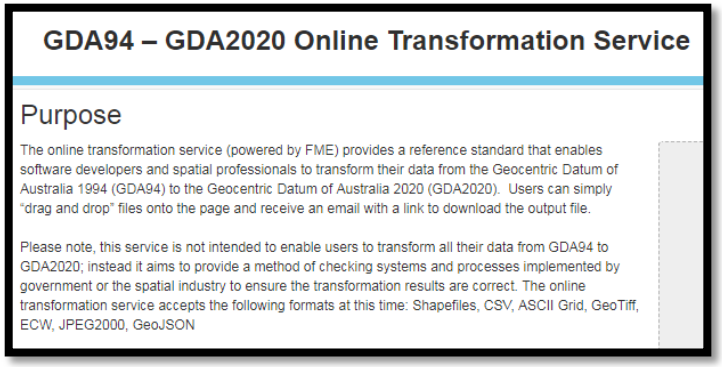
- Use common points from GDA94 Determination and GDA2020 Determination
- 21 reference points from GDA94 AFN minus MAC1, COCO and XMIS due to seismic displacement
- Solve for the 7-parameters (3 x rotation, 1 x scale and 3 x translation) using CATREF software

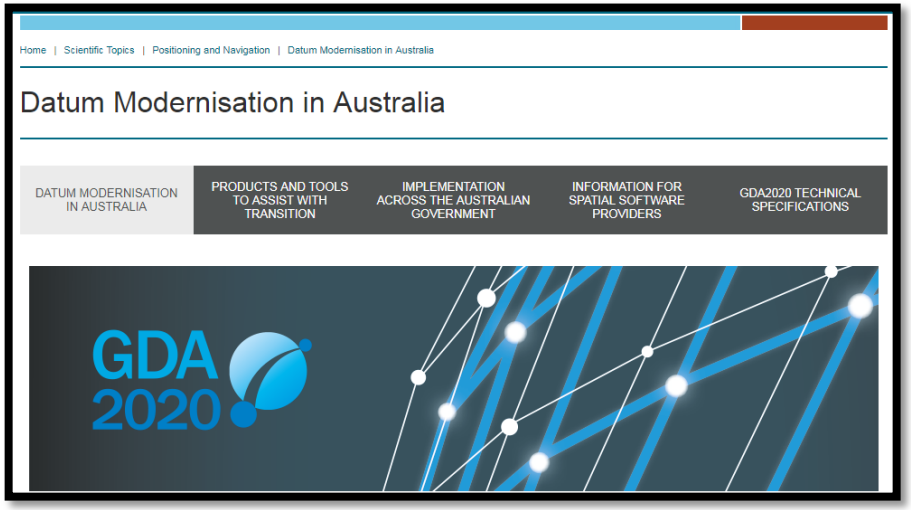


GDA2020 Products and Services

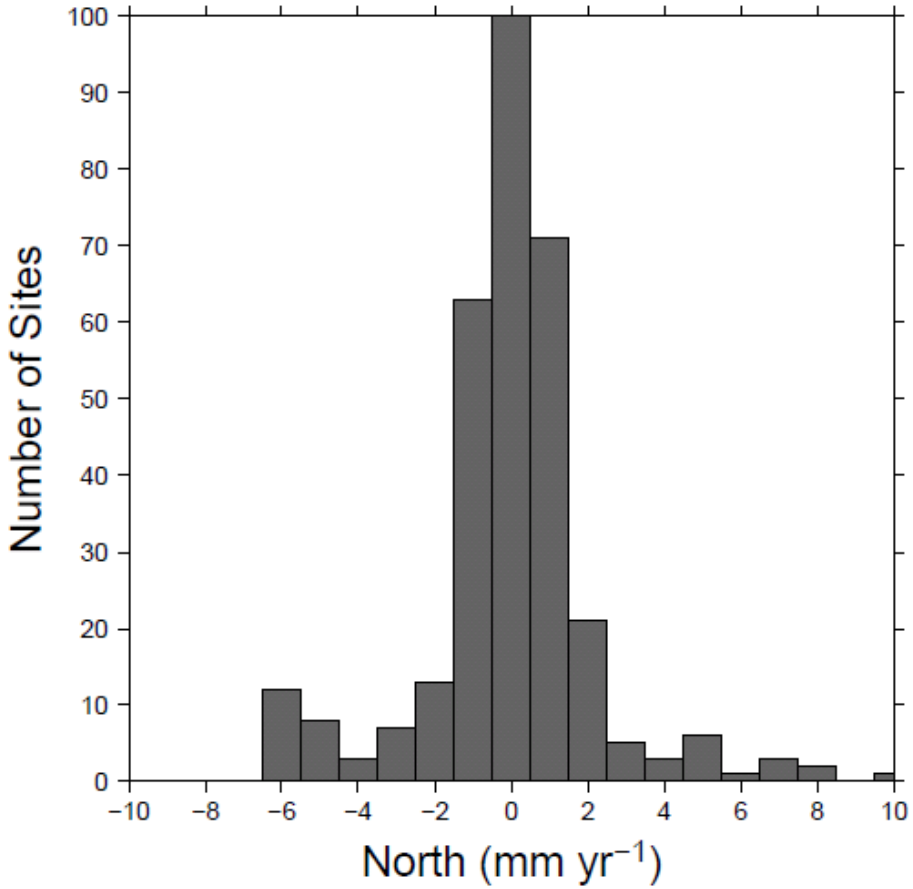


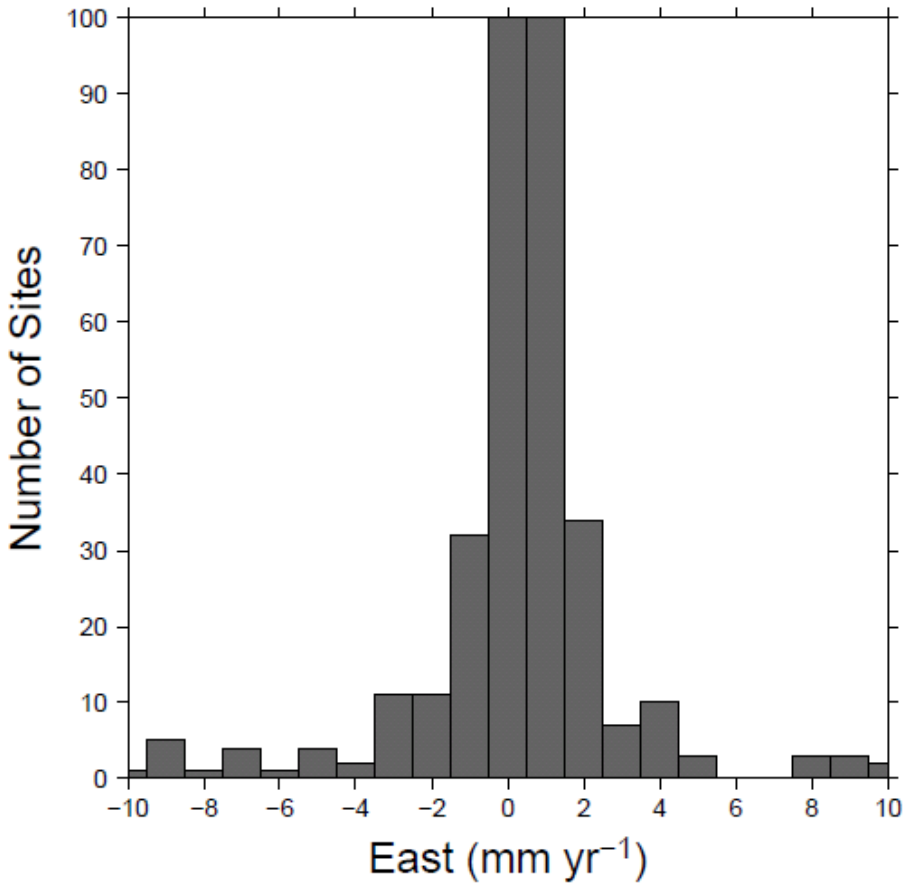


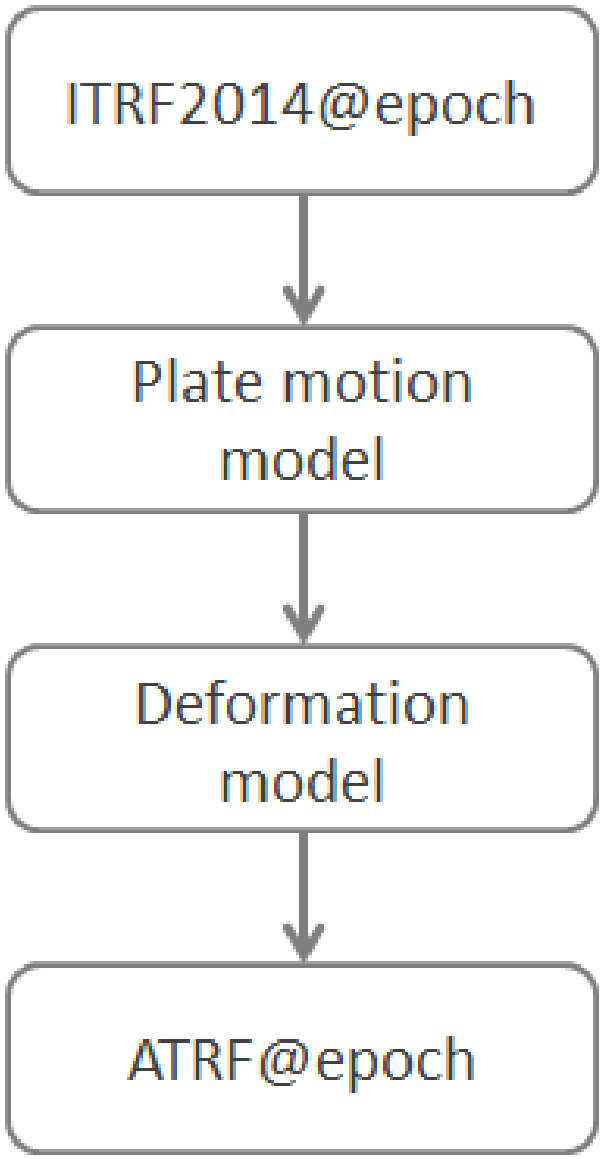




What About the Tier 3 Sites?

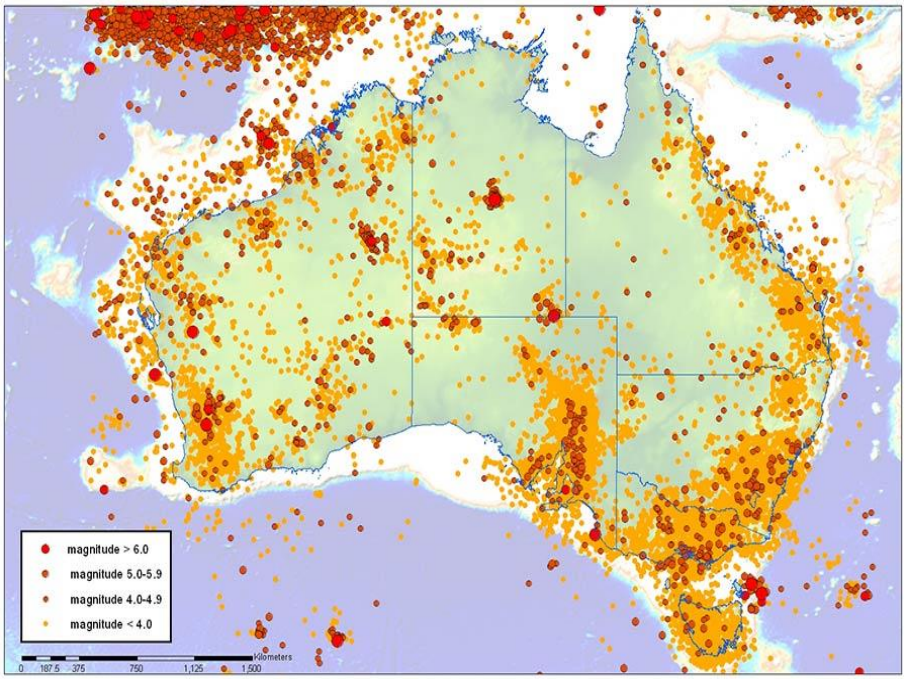


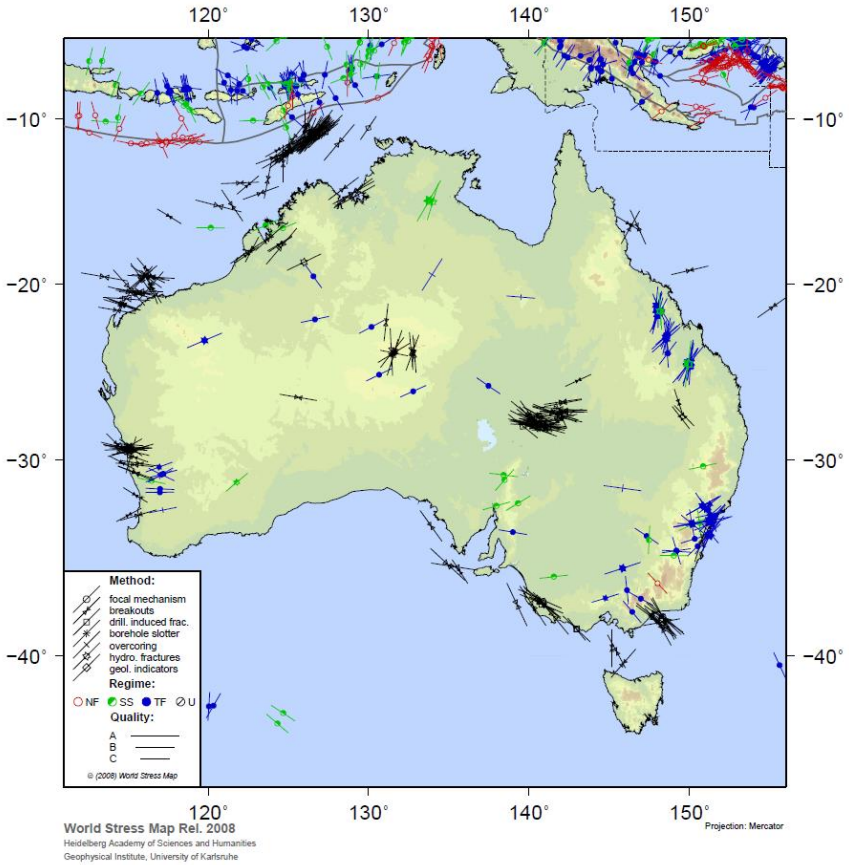




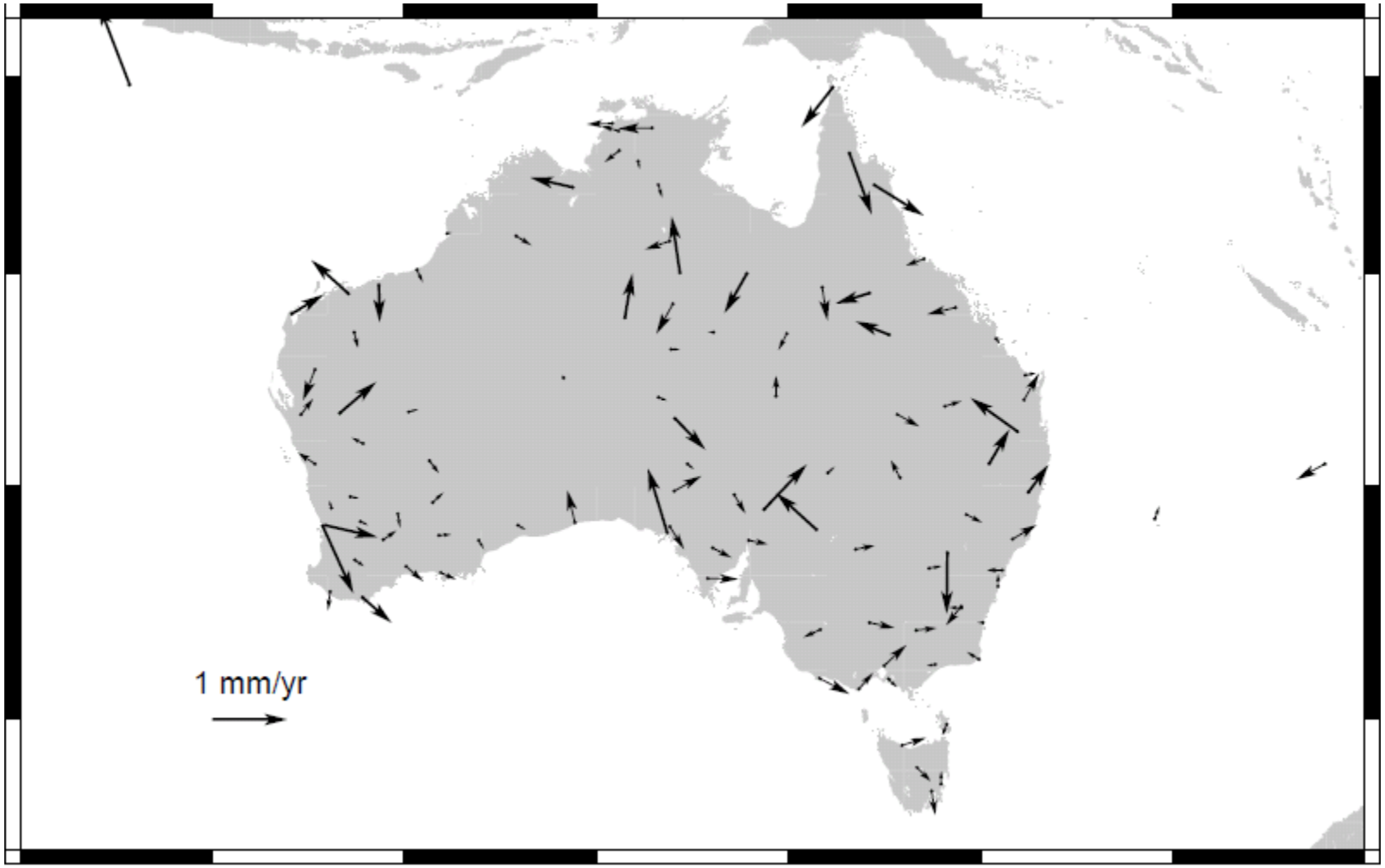
Is a plate motion model acceptable?

- 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)





Residual Crustal Deformation



Residual Crustal Deformation