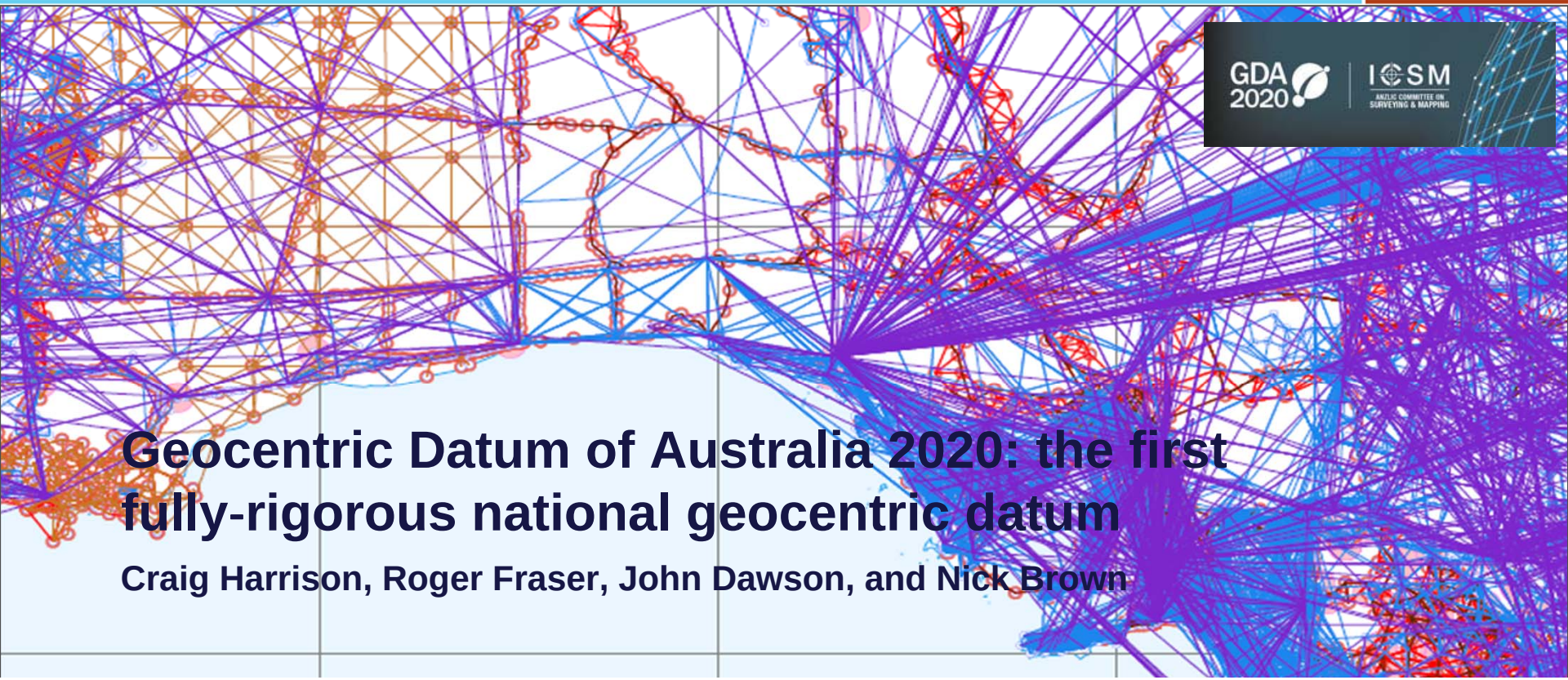
Australian Government
Geoscience Australia



Geocentric Datum of Australia 2020: the first fully-rigorous national geocentric datum

Craig Harrison, Roger Fraser, John Dawson, and Nick Brown

Collaborators

- **GA**: John Dawson*, Nick Brown*, GNSS Analysis Team, GNSS Operations Team
- **Defence**: Zarina Jayaswal*
- **ACT**: Gavin Evans^
- **NSW**: Simon McElroy*, Joel Haasdyk^, Nic Gowans^
- **Victoria**: Roger Fraser^ & Alex Woods
- **Tasmania**: Scott Strong^
- **SA**: Steve Turner*, Andrew Falkenberg*, Stephen Latham, Malcolm Driver
- **WA**: Linda Morgan^, Kent Wheeler^, Irek Baran, Rod Stone
- **NT**: Rob Sarib*, Amy Peterson^, Mathew Fraser
- **Queensland**: Matt Higgins*, Darren Burns*, Steve Tarbit, Peter Todd
- **UNSW**: Chris Rizos*
- **RMIT**: Don Grant*

(AWG members, * PCG members, ^ both)

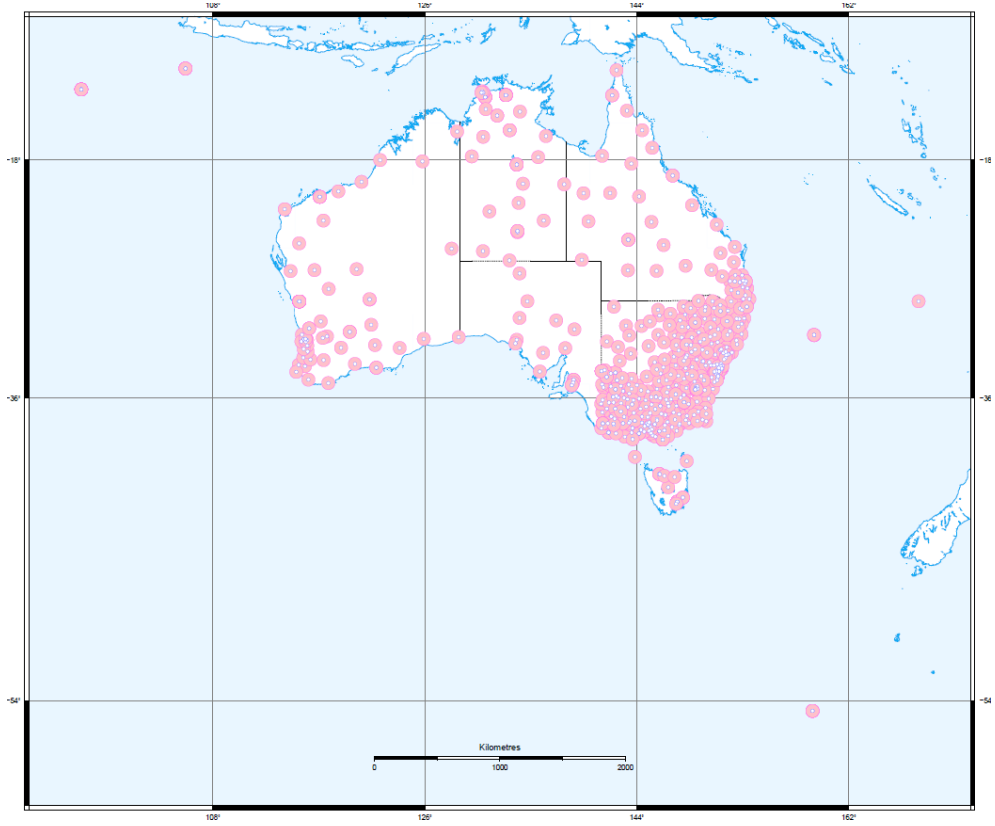
Improvements over GDA94

- Truly national adjustment
- The ability to automatically segment the network is a world first
- 3D adjustment (Earth-centred Cartesian reference frame)
- Rigorous uncertainties in accordance with SP1
  - Positional uncertainties
  - Relative uncertainties
- 1 January 2020 reference epoch
- Distortion free

Input data sets

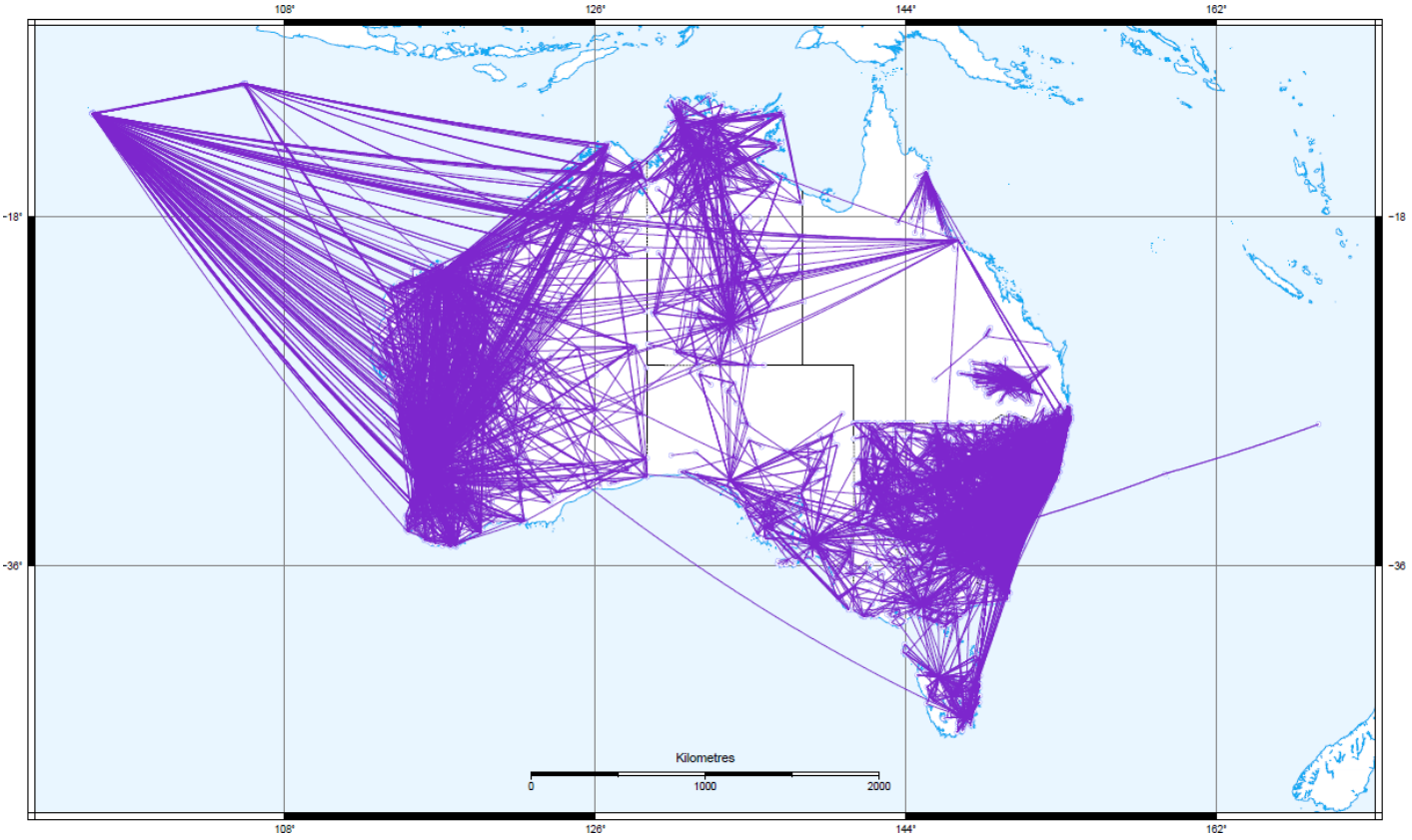
- Asia-Pacific Reference Frame (APREF)
  - 454-station GNSS point cluster
  - Constrains the adjustment
- National GNSS Campaign Archive (NGCA)
  - High quality GNSS campaign observations
  - Submitted by jurisdictions, processed by GA
- Jurisdictional Data Archives (JDA)
  - Everything else, including GNSS not suitable for inclusion in NGCA
- Specialised scientific GNSS data sets, e.g., Seismic Zone Survey and Surat Basin geodetic network

APREF

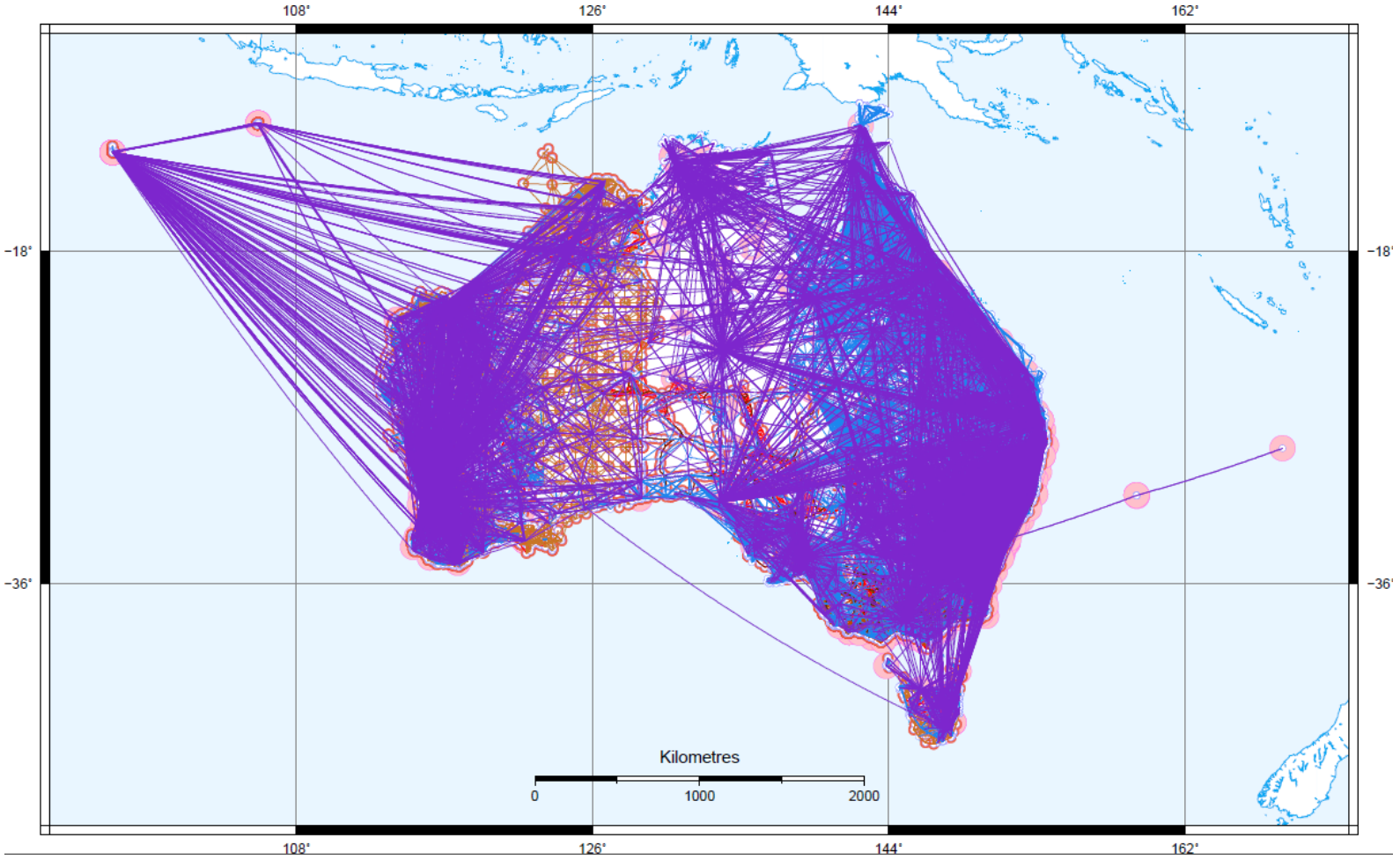


- Weekly solution time series combination
- 454 stations (53 with disconts)
- Data span:
  - 14-1-1996 to 8-10-2016
  - GPS week 836 to 1917
- Coordinates were transformed from ITRF2014 to GDA2020

NGCA



- Network backbone
- 6+ hour GNSS observations
- Processed by GA
- 6,092 stations with 11,578 baselines in 3,206 clusters



Network details

(A) Horizontal angle:	0
(B) Geodetic azimuth:	1711
(C) Chord dist:	0
(D) Directions:	324020
(E) Ellipsoid arc:	7652
(G) GPS baseline:	1212357
(H) Orthometric height:	131336
(I) Astronomic latitude:	0
(J) Astronomic longitude:	0
(K) Astronomic azimuth:	87
(L) Level difference:	3376
(M) Mean sea level arc:	195930
(P) Geodetic latitude:	0
(Q) Geodetic longitude:	0
(R) Ellipsoidal height:	0
(S) Slope distance:	46064
(V) Zenith angle:	3
(X) GPS baseline cluster:	45483
(Y) GPS point cluster:	1686
(Z) Vertical angle:	0

- 1,969,705 measurements to 245,774 stations
- $\sigma_0 = 1.012$
- 4 iterations at 22 hrs/iteration and requires ~20GB of RAM

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- $\sigma_0 = 1.012$
- ~~4 iterations at 22 hrs/iteration and requires ~20GB of RAM~~
- ~~4 iterations at 6 hrs/iteration and requires ~20GB of RAM~~
- 4 iterations at 2.5 hrs/iteration and requires 2.8**TB** of RAM

Products and services

- Coordinates – Recognised Value Standard of Measurement of Position signed off 11 October
- Rigorous uncertainties and covariance information
- AUSGeoid2020
- Transformation grids have been developed: Conformal and Conformal + Distortion
- GDA2020 Technical Manual (includes the transformation parameters and the gazettal)
- Coordinate transformation web service (based on FME)

Preparing for ATRF

- Time-tagged reference frame, aligned to the ITRF
- To be enabled in 2020
- Complement GDA2020
- Focus of development is on automation
- Working with NCI to reduce iteration time
  - Hardware
  - Software

More information

- ICSM Statement on Datum Modernisation: www.icsm.gov.au/geodesy/modern.html
- Datum Modernisation in Australia: http://www.ga.gov.au/scientific-topics/positioning-navigation/datum-modernisation
- GDA2020 Technical Manual: http://www.icsm.gov.au/gda/tech.html
- GDA Modernisation Implementation Working Group: http://www.icsm.gov.au/gda2020/gmiwg.html
- GDA2020 Forum: http://gda2020.invisionzone.com/