UNITED NATIONS GLOBAL GEODETIC CENTRE OF EXCELLENCE

MODERNISING GEOSPATIAL REFERENCE SYSTEM CAPACITY DEVELOPMENT WORKSHOP

National geodetic adjustments

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HOW

Day 2, Session 2 [2_2_1]

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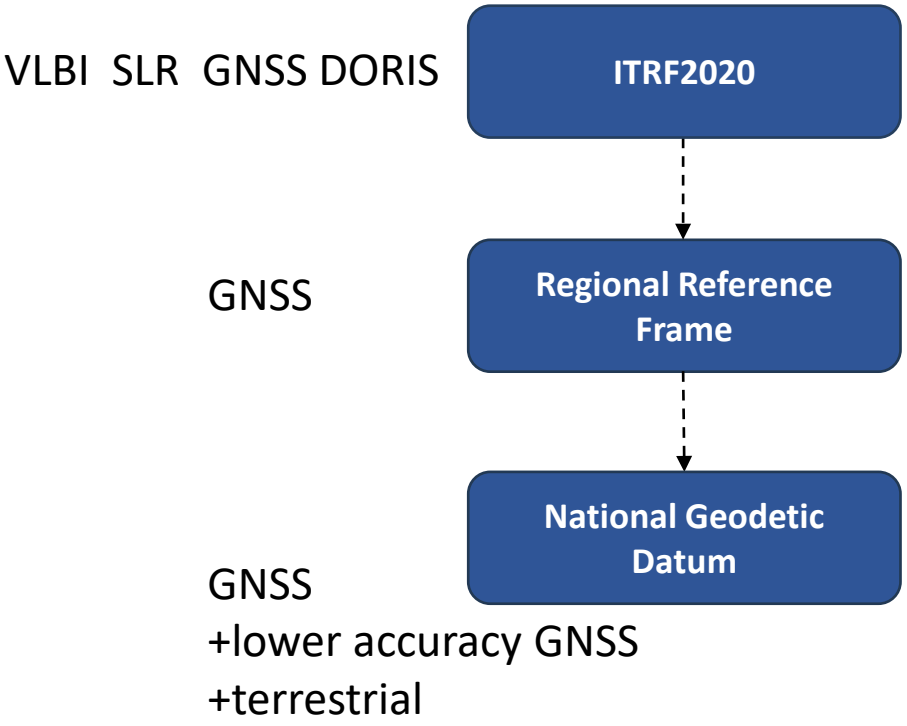
Summary

- A national geodetic adjustment is the process used to define or refine the coordinates of survey marks in a country.
- The adjustment procedure optimizes the accuracy of the coordinates and ensures consistency with regional and international reference frames.
- A new national geodetic adjustment can be done to align with new versions of ITRF or accommodate a new or denser national GNSS CORS network.

When to consider performing a national geodetic adjustment

- Datum not aligned with current version of ITRF
- Distortion in datum due to geophysical reasons
- Increase in accuracy of datum is needed for emerging technologies
- GNSS CORS network has been densified (improved resolution)

How to aligning NGD with ITRF



1. Created by IAG Services

   Choose an ITRF realisation and epoch to align to (e.g. ITRF2020@2024)

2. Created by Regional Bodies

   Densifed version of ITRF (e.g AFREF)

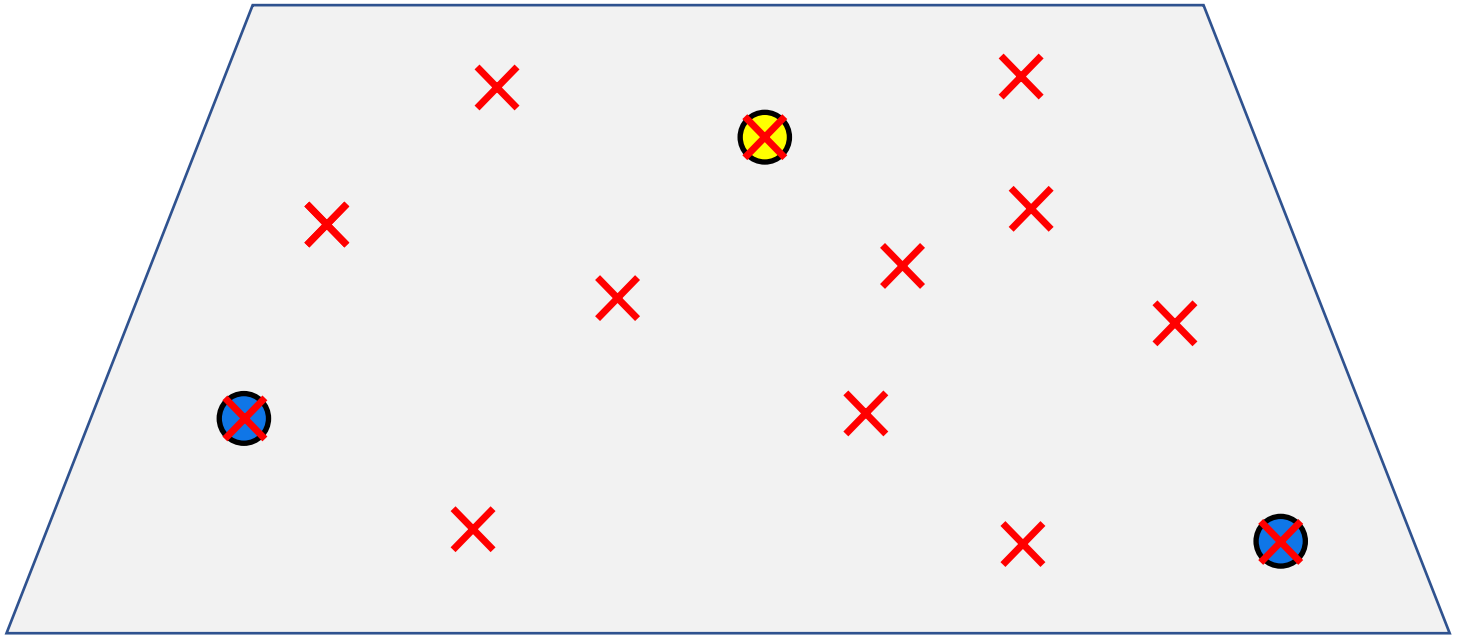
3. Created by National Bodies

   National adjustment

STRONGER.
TOGETHER.

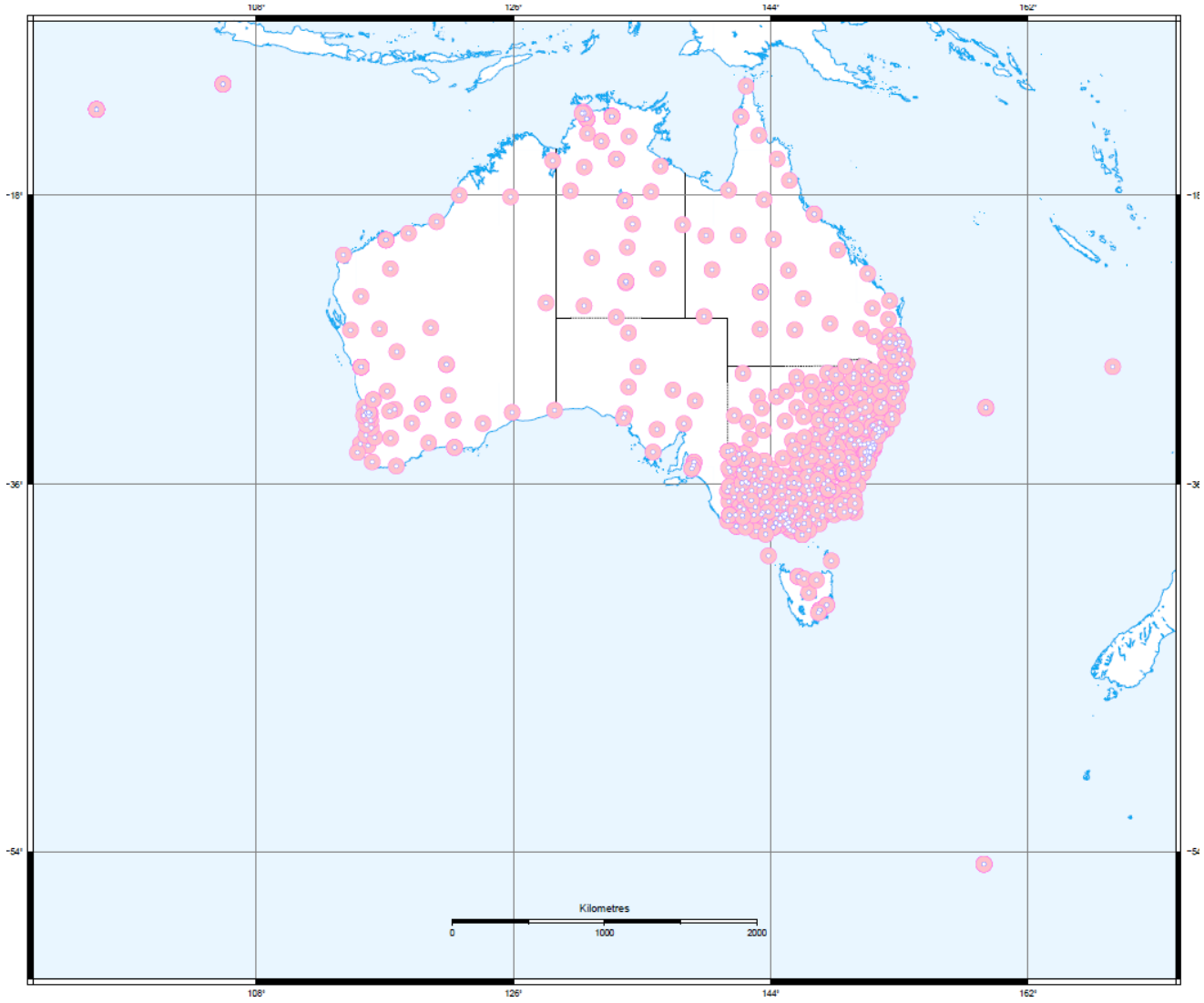
How to align NGD with ITRF

- GNSS CORS included in International or regional reference frame
- GNSS CORS included in regional reference frame
- National GNSS CORS



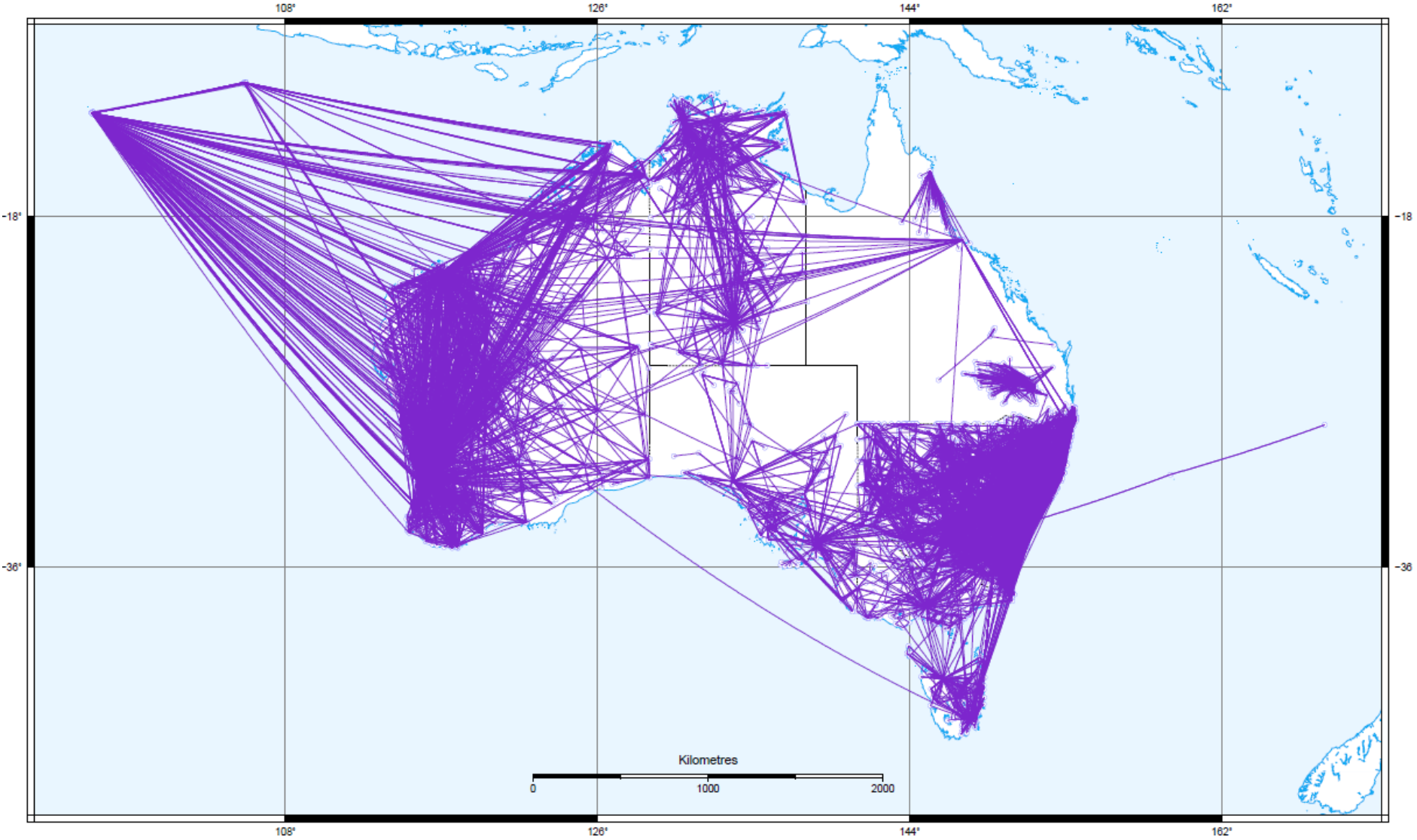
STRONGER.
TOGETHER.

Regional Reference Frame (e.g. APREF)



- Continuously estimated from:
  - Weekly solutions combined from daily GNSS analysis
  - Aligned to IGb14
  - Cumulative solution combines weekly solutions from 1994
  - Full variance matrix
  - Provides datum constraint for jurisdiction and national adjustments
- Densification of ITRF in the Asia Pacific region:
- 726 GNSS CORS total;
- 488 on AU plate.
- **Only 15 in ITRF2014**

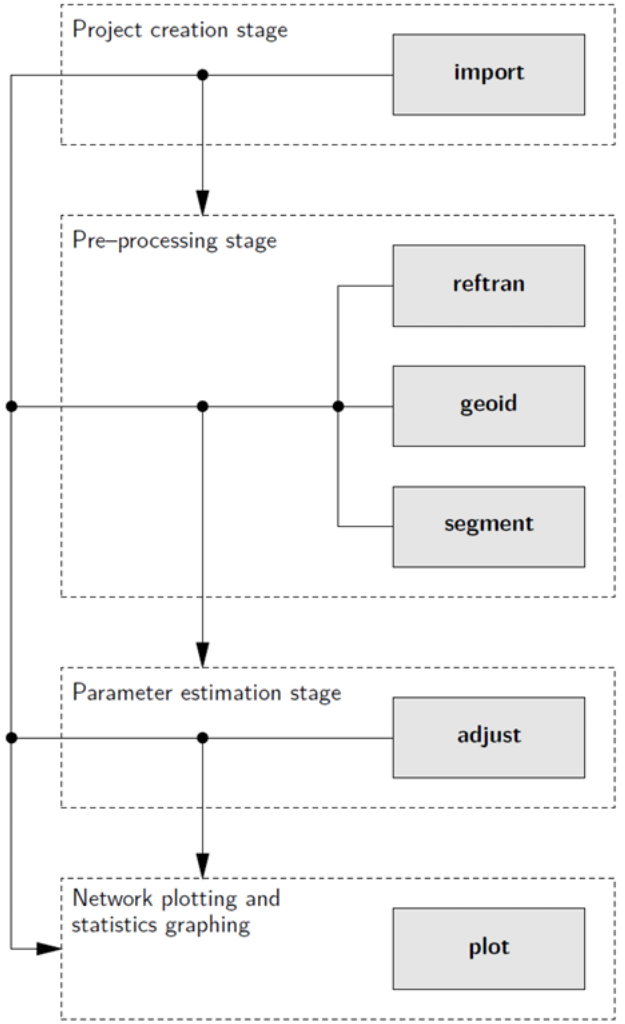
Campaign archive



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

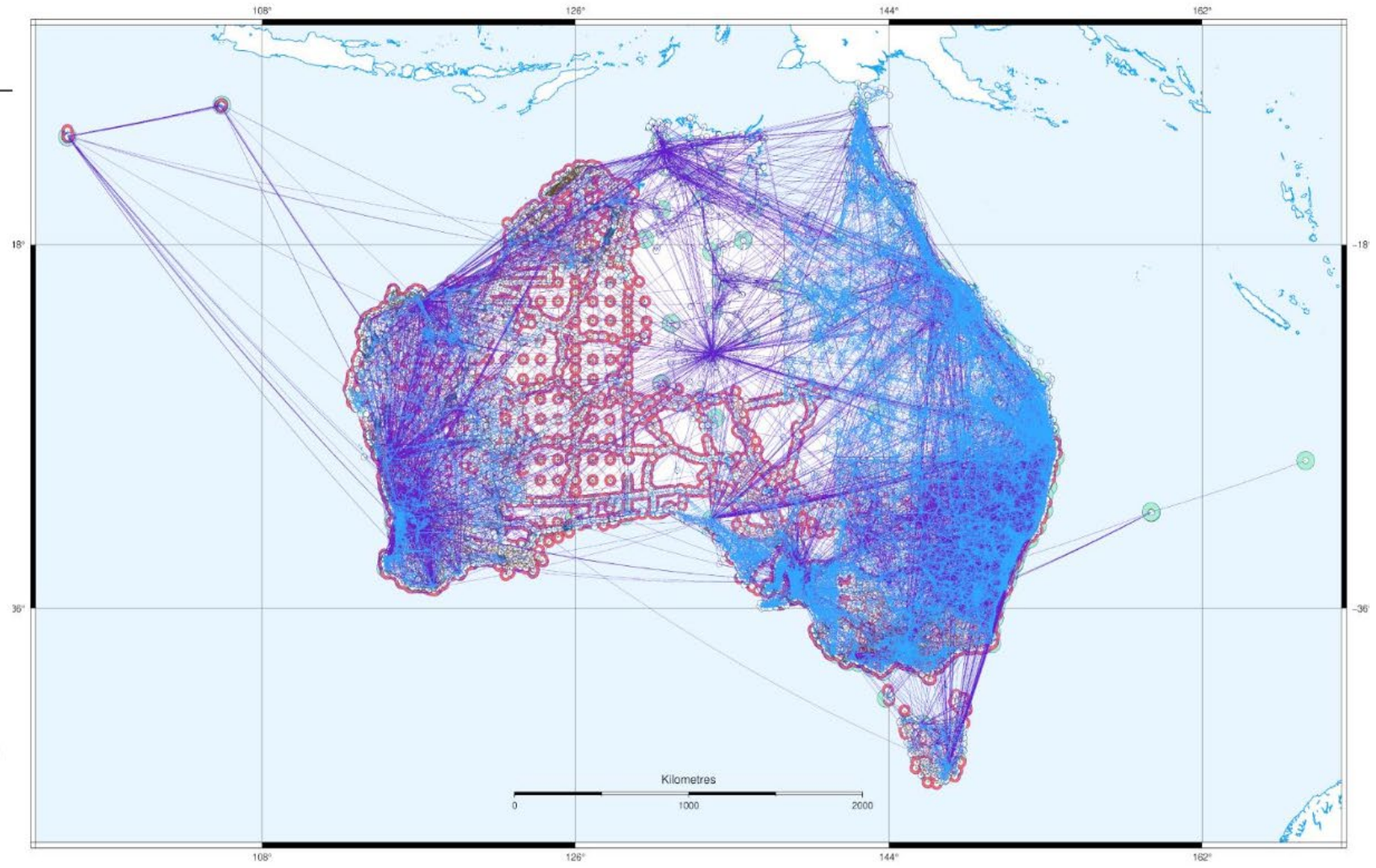
Fully automated adjustment approach

- Import all data
  - SINEX, GNSS baselines, terrestrial measurements, levelling
- Align stations and measurements to an epoch (e.g. 2020)
  - Datum/frame transformation (ITRF2000,2005,2008,2014)
  - Apply plate motion model if no direct parameters are available
- Apply geoid model to convert orthometric data to ellipsoidal
  - (Gravity) deflections of the vertical
  - Ellipsoid-geoid separations
- Automatic network segmentation
- Parallel or sequential phased adjustment
- Export uncertainties



National adjustment

333,164	Stations
2,400,419	Measurements
1,542	Geodetic azimuth
132	Astronomic azimuth
215	Zenith angle
484,696	Direction set
201,213	MLS arc
186,479	Ellipsoid arc
46,464	Slope distance
1,171,545	GNSS baseline
89,175	GNSS baseline cluster
2,178	GNSS point cluster
230	Ellipsoid height
204,178	Orthometric height
12,372	Level difference



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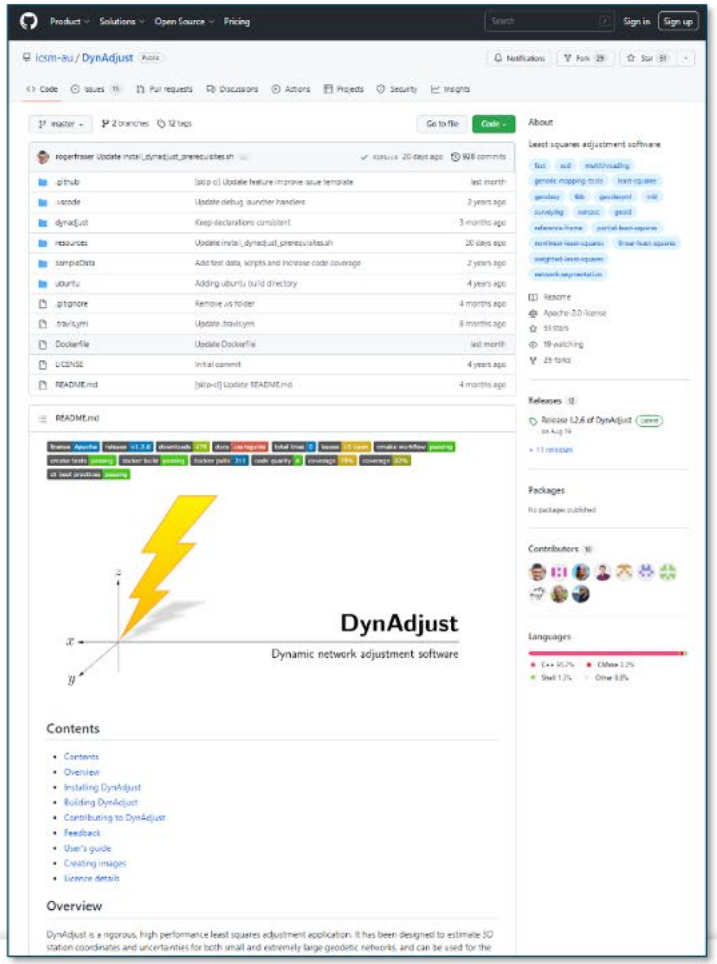
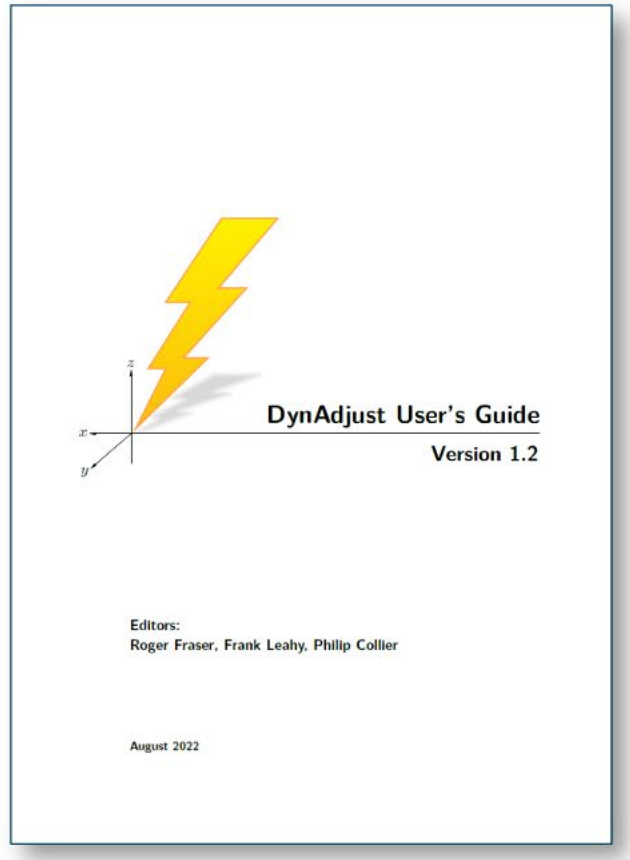
DynAdjust

DynAdjust: open source adjustment package

Generic Mapping Tools





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https://github.com/icsm-au/dynadjust

Resources

- GNSS analysis
  - BERNESE – network GNSS analysis
  - AUSPOS – GPS site analysis https://www.ga.gov.au/scientific-topics/positioning-navigation/geodesy/auspos
  - OPUS – GNSS site analysis https://geodesy.noaa.gov/OPUS/
- CATREF – combination software
- Geodetic Adjustment
  - DynAdjust (https://github.com/icsm-au/DynAdjust)
- Least Squares training presentation
  - Full presentation – https://www.youtube.com/watch?v=T5YB_1Jpjp0 (1hr 42 mins)
  - Chapter 1 – What is Least Squares and why are we using it in DCM? https://youtu.be/0YkjHsVgGMk (26 mins)
  - Chapter 2 – Why do we iterate? https://youtu.be/_iFg3Ho_cRI (18 mins)
  - Chapter 3 – Weighting Observations https://youtu.be/2yQCWblrQGs (10 mins)
  - Chapter 4 – Constraints https://youtu.be/WcwKv-vWUtk (7 mins)
  - DynAdjust Q&A https://youtu.be/WZN38NrPBeY