



UNITED NATIONS GLOBAL GEODETIC CENTRE OF EXCELLENCE

MODERNISING GEOSPATIAL REFERENCE SYSTEM CAPACITY DEVELOPMENT WORKSHOP

National geodetic adjustments

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HOW

Day 1, Session 4 [1_4_2]

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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)

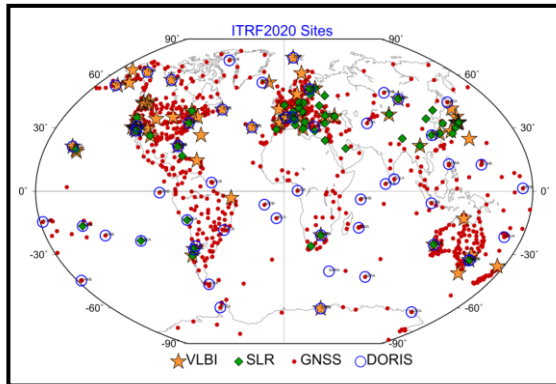


**STRONGER.
TOGETHER.**

How to align NGD with ITRF

ITRF2020

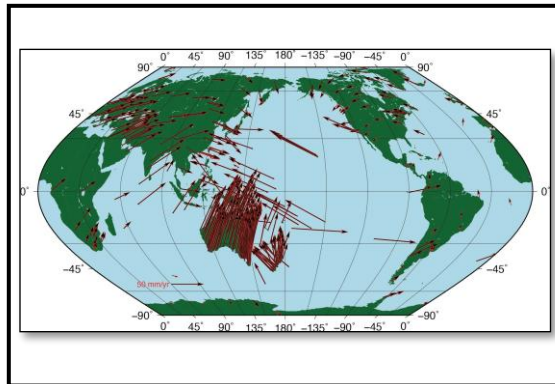
VLBI + SLR + GNSS + DORIS



- International Terrestrial Reference Frame
- Time dependent
- Developed by IAG Services

Regional Reference Frame

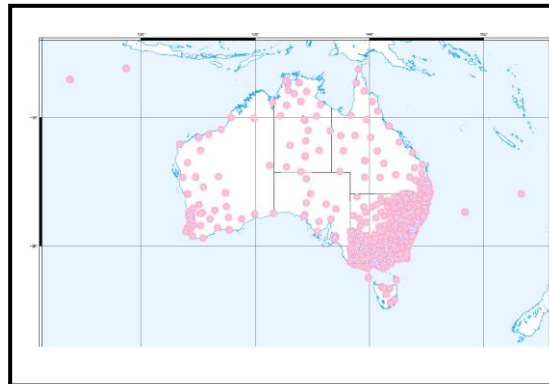
GNSS



- Asia-Pacific Reference Frame
- Time dependent
- Developed by regional scientific organisations (Geoscience Australia)

National GNSS Network

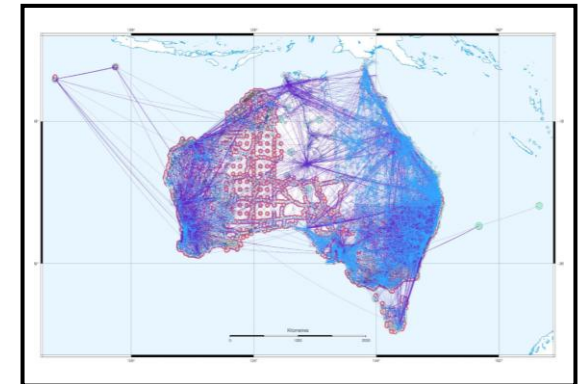
GNSS



- Australian GNSS CORS network on the Australian continental plate
- Time dependent
- Developed by regional scientific organisations (Geoscience Australia)

National Geodetic Datum

GNSS + Terrestrial



- Australian geodetic adjustment
- Constrained to the GNSS CORS network on the Australian continental plate
- Time dependent datum (ATRF) and Static datum (GDA2020)
- Developed by regional scientific organisations (Geoscience Australia)

How to align NGD with ITRF

Perform a National Geodetic Adjustment:

- Use the National GNSS Network station coordinates as control / datum points in a comprehensive national geodetic adjustment.
- Integrate all available national geodetic data in a national geodetic adjustment (GNSS, terrestrial, levelling, etc.) to establish a consistent and modern national geodetic datum aligned with ITRF2020.
- This can be done using software like DynAdjust
- This propagates the GNSS station coordinates down to the local survey marks.



National GNSS Network

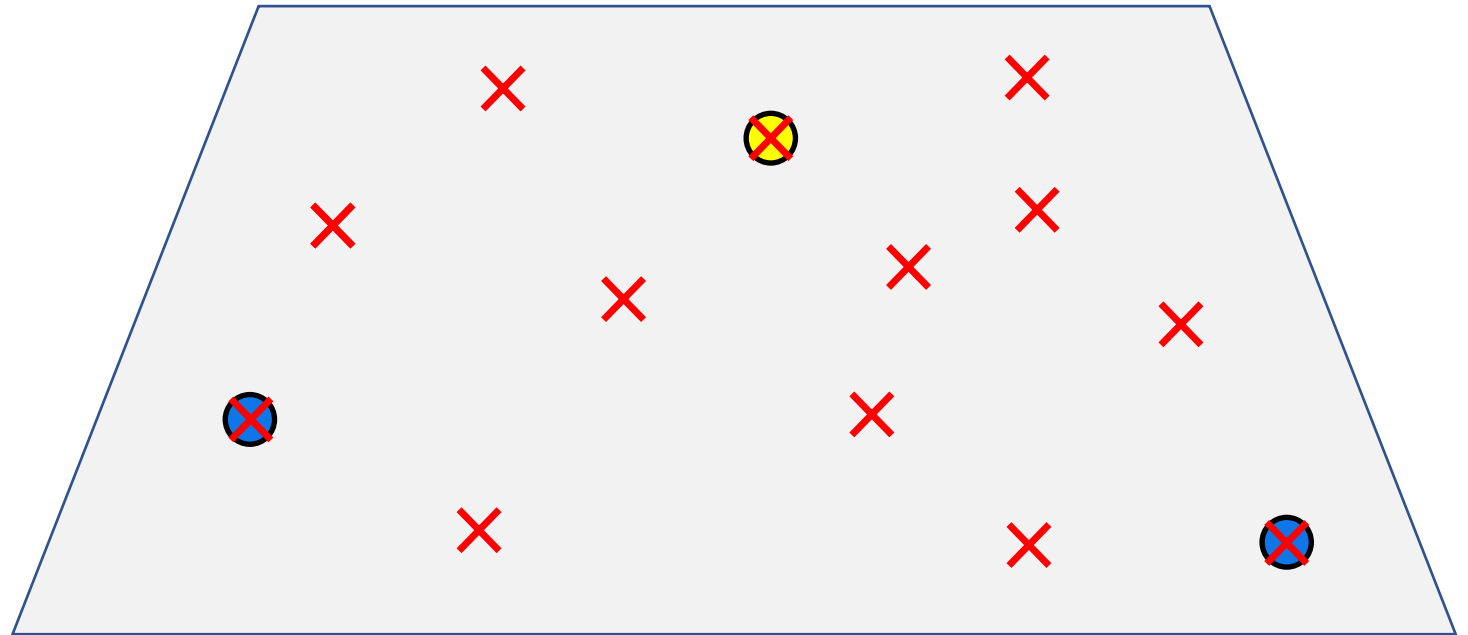
GNSS

National Geodetic
Datum

GNSS + Terrestrial

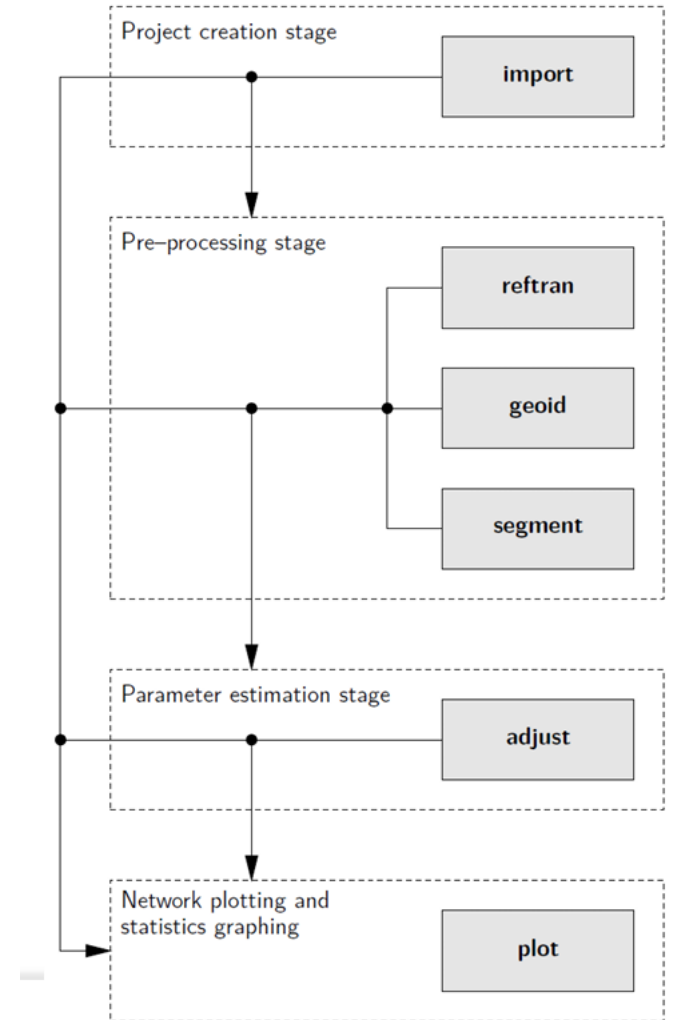
How to align NGD with ITRF

-  - GNSS CORS included in International or regional reference frame
-  - GNSS CORS included in National GNSS Network
-  - National survey marks



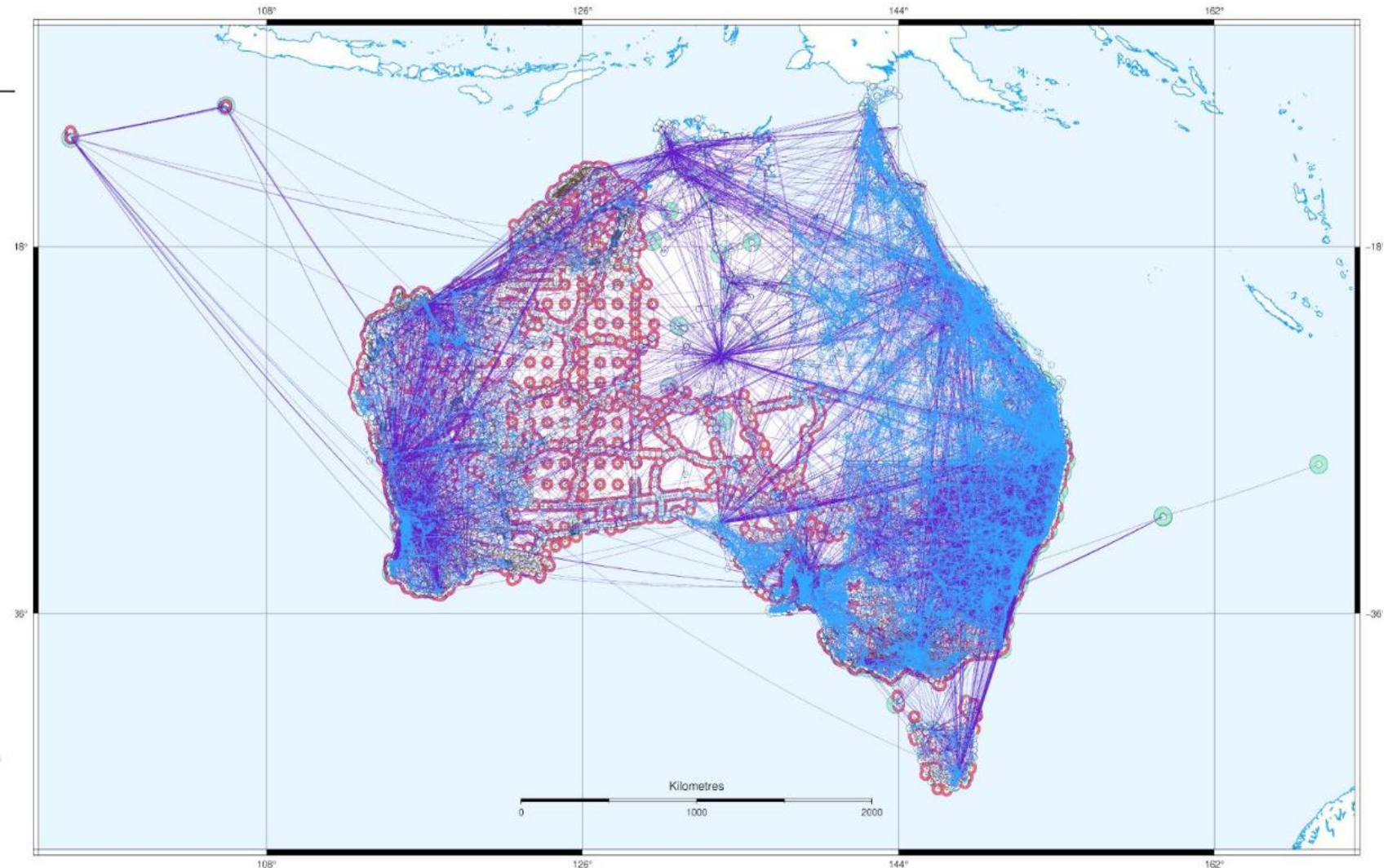
Fully automated adjustment approach

- 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



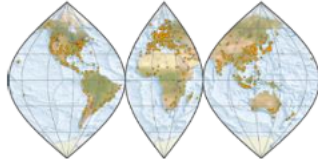
National adjustment

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



DynAdjust

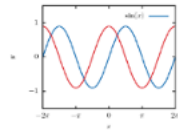
DynAdjust: open source adjustment package



Generic Mapping Tools

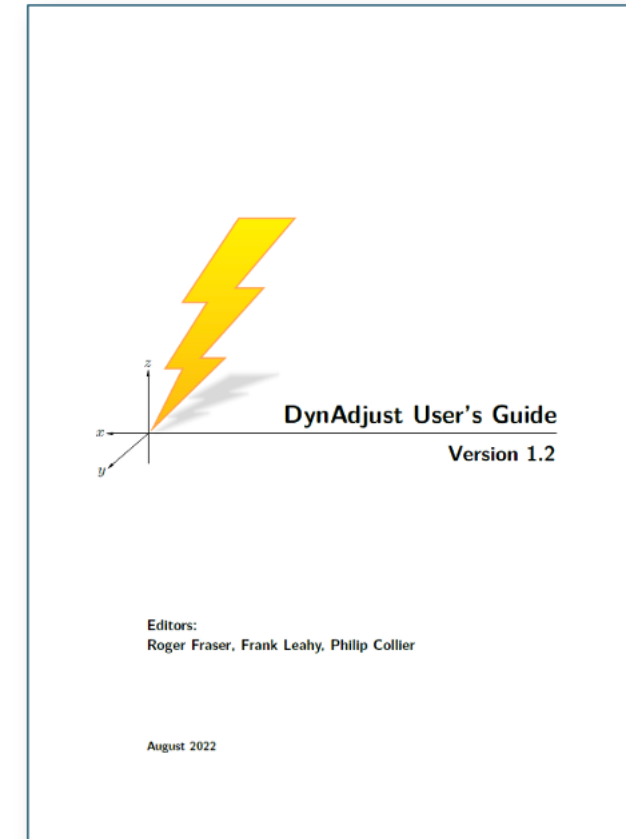
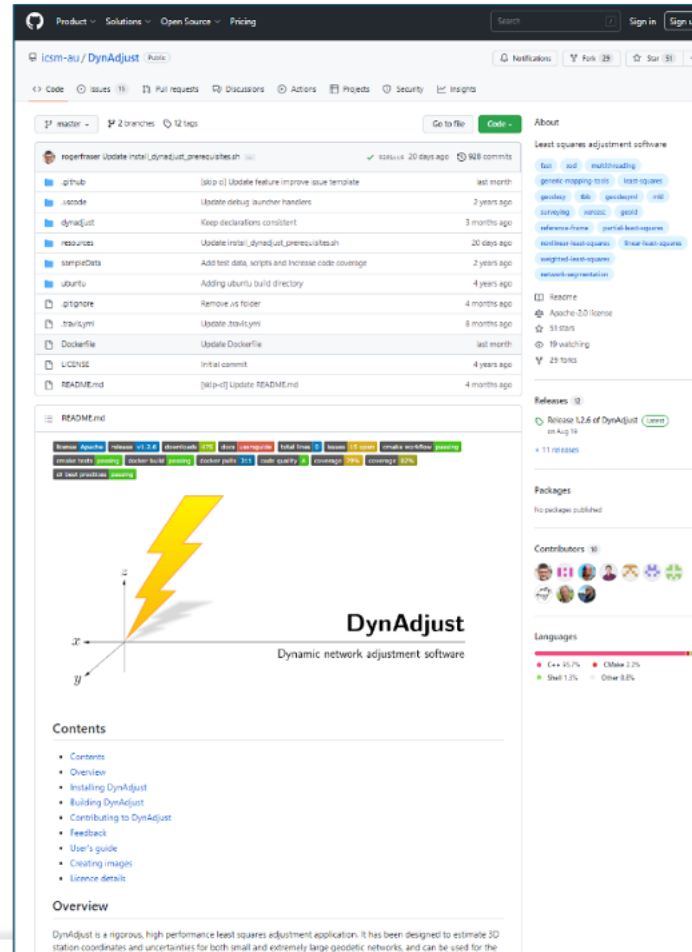


DIA



gnuplot

L^AT_EX



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/>
- GNSS quality checking (Anubis) <https://gnutsoftware.com/software/anubis/>
- GNSS checking, repairing and manipulating <https://kg4-dmz.gfz-potsdam.de/services/gfzrnrx>
- 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>

