



Collaboration, Innovation and Resilience: Championing a Digital Generation

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Online GPS processing with AUSPOS in ITRF2020

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PLATINUM SPONSORS



Outline

- Overview
- ITRF and APREF
- AUSPOS in ITRF2020
- Comparative Analysis
- Conclusions



Overview



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- AUSPOS is a free online **GPS** data processing platform provided by Geoscience Australia (GA) since 2001.
- Designed to service Australian government and survey industry originally.
 - Survey and cadastral applications
 - Geodetic infrastructure
 - Access to the reference frame
- Now, AUSPOS is used by a diverse group worldwide.
- Uses relative positioning methodology and supports RINEX formats (v2, v3, v4)
- AUSPOS processes around 300,000 jobs annually.
- Supports national and international geodetic frameworks (GDA2020 and ITRF2020/IGS20)



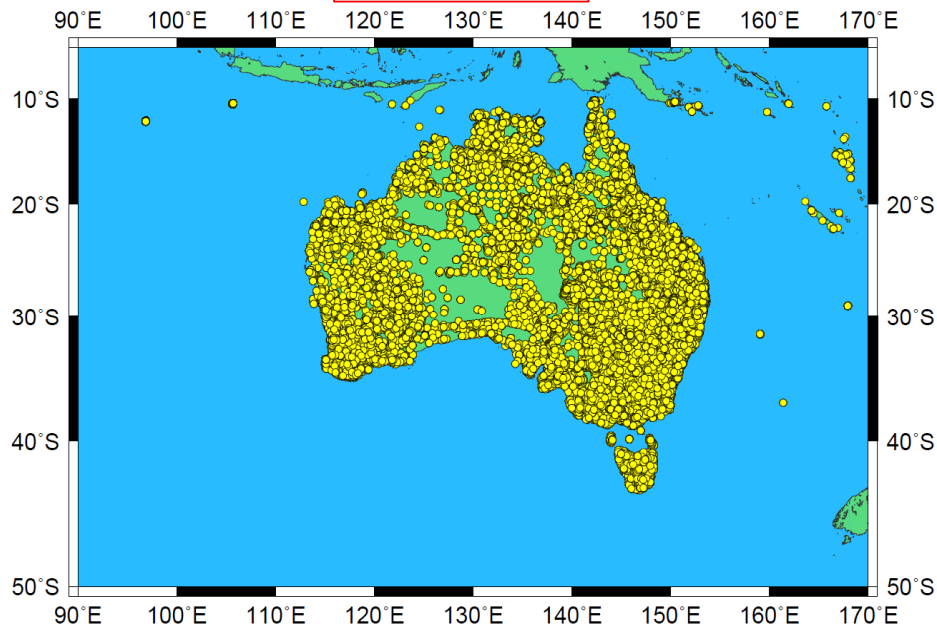
Overview



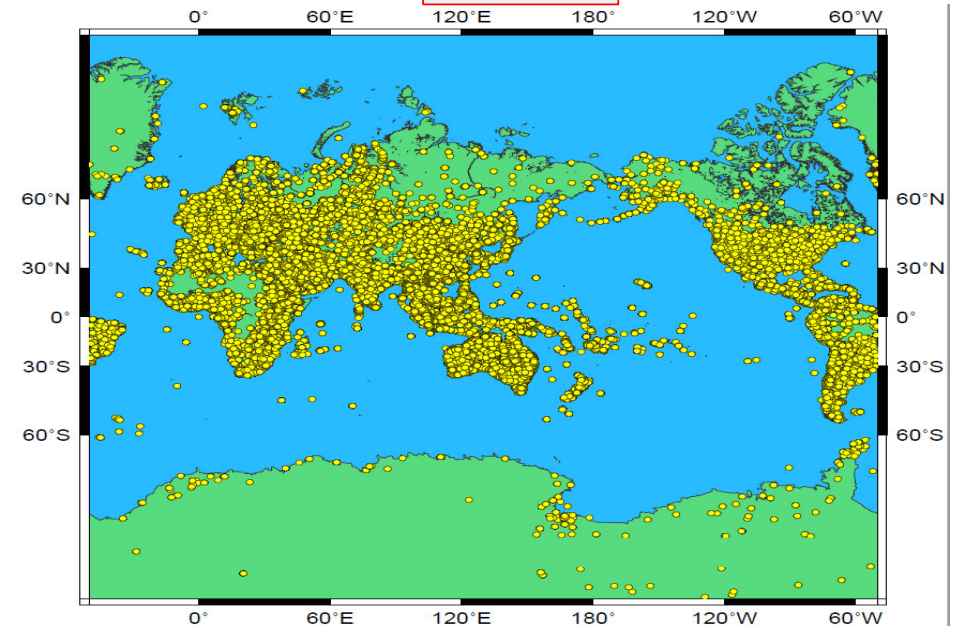
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Australian



Global



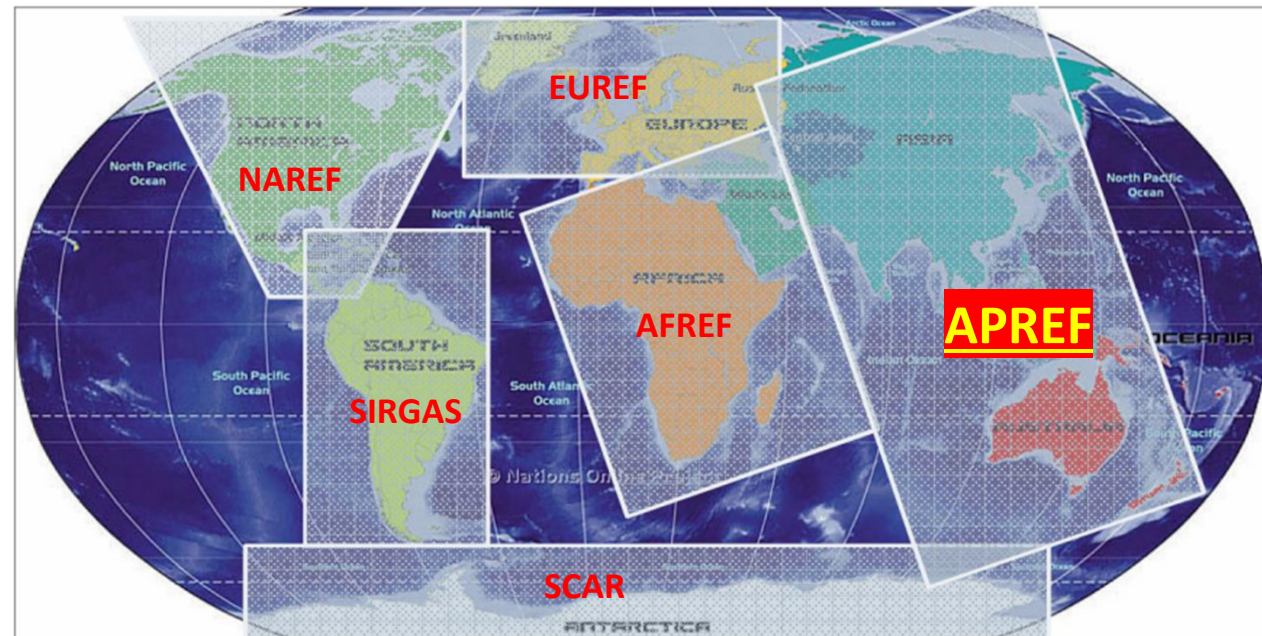
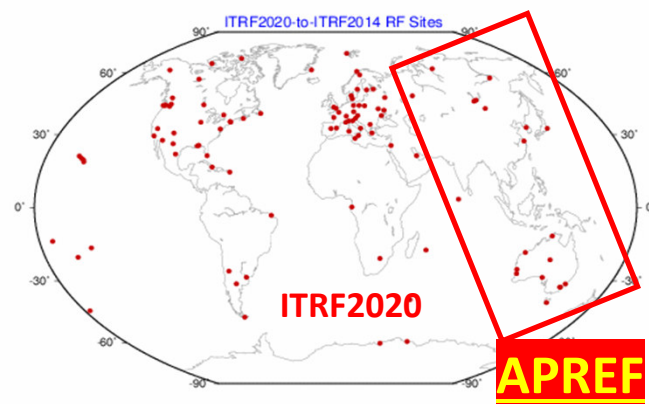
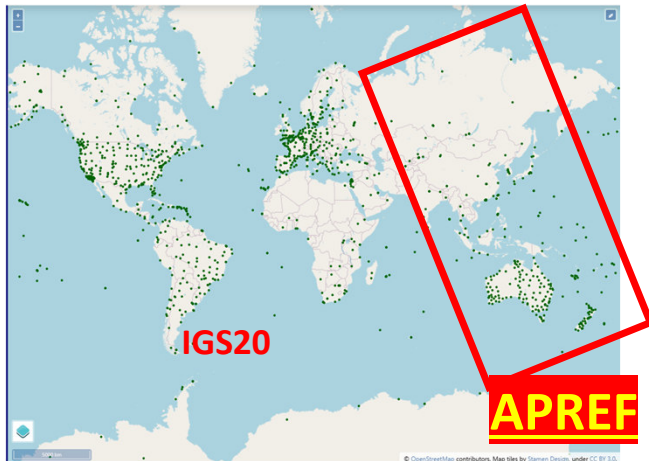
- From 2001 to Aug-2020, AUSPOS successfully processed more than 1 MILLION observations
- Since Sep-2020, AUSPOS was launched in AWS Cloud and has already processed around 1.3 MILLION jobs.

ITRF and APREF



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J. Dawson and G. Hu, 2013, FIG

ITRF and APREF



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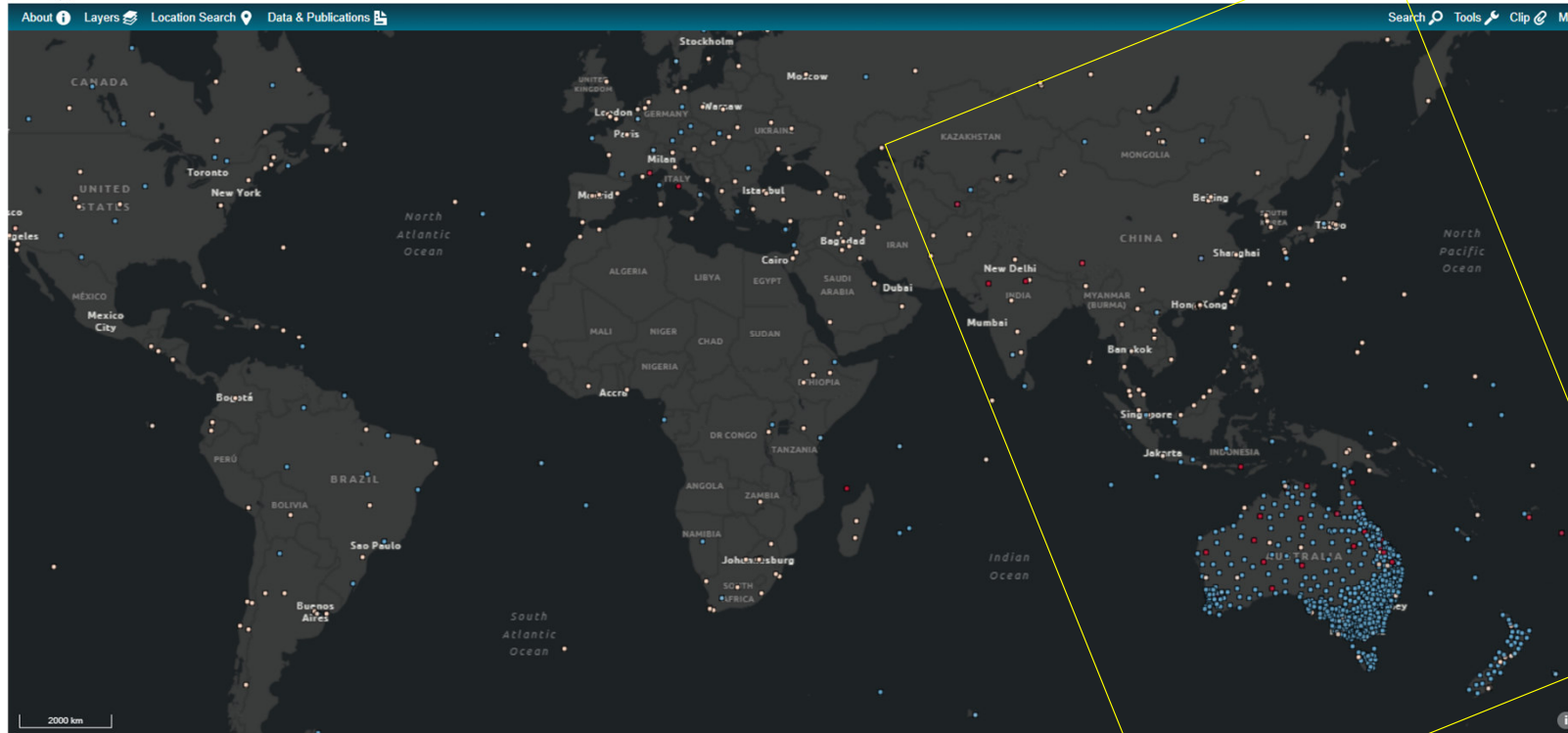
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National Positioning Infrastructure



- AUSPOS uses the ITRF2020 reference frame (around 7 IGS core sites for each job)
- An additional non-ITRF2020 core sites are also selected from other networks, such as APREF network (around 8 core sites for each job)
- Over 1000 CORS sites (IGS + APREF) used by AUSPOS

AUSPOS in ITRF2020



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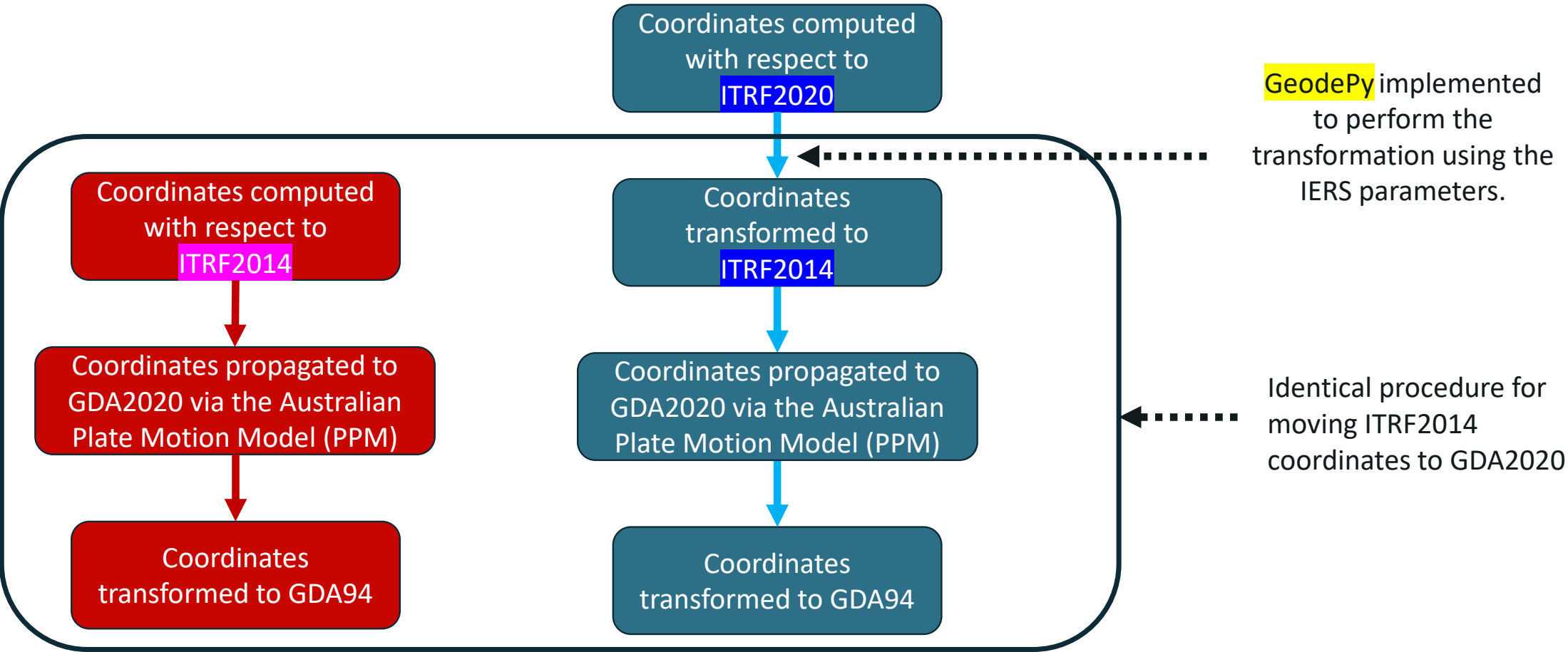
v2.4 (ITRF2014 / IGb14)	v3.0 (ITRF2020 / IGS20)
Computes coordinates with respect to ITRF2014	Computes coordinates with respect to ITRF2020
Computes GDA2020 coordinates and GDA94 coordinates	Computes GDA2020 coordinates and GDA94 coordinates.
Uses Bernese v5.2 (as at 2019)	Uses Bernese v5.2 (as at 2021)
➤ Cumulative solution SNX file ▪ refence site selection and ▪ priori Crd / Vel in AUSPOS network calculation ➤ aligned to ITRF2014/IGb14 and contains solutions until 2020	➤ Cumulative solution SNX file ▪ refence site selection and ▪ priori Crd / Vel in AUSPOS network calculation ➤ aligned to ITRF2020/IGS20 and contains solutions until 2022
Uses IGb14 products provided by the IGS (not available now)	Uses the most up to date IGS20 products provided by the IGS

AUSPOS in ITRF2020



v2.4 (ITRF2014 / IGB14)

v3.0 (ITRF2020 / IGS20)



AUSPOS in ITRF2020



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- A two-step approach (ITRF2020 → ITRF2014 → GDA2020).
- It is recommended by the Intergovernmental Committee on Surveying and Mapping (ICSM, 2024).
- It has been implemented in AUSPOS v3.0.
- This transformation is done using Geoscience Australia's GeodePy Python package.

AUSPOS in ITRF2020



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- Used reference:
 - ITRF2014/IGb14 → ITRF2020/IGS20
 - Coordinates
 - Velocities
- Ocean Tidal Model:
 - FES2004 → FES2014b
- Satellite Antenna Offset:
 - GPS IIIA antenna
 - published by Lockheed Martin in 2021 → estimated based on Galileo
- Ground receiver antenna:
 - Part of antenna re-calibrated

Comparative Analysis

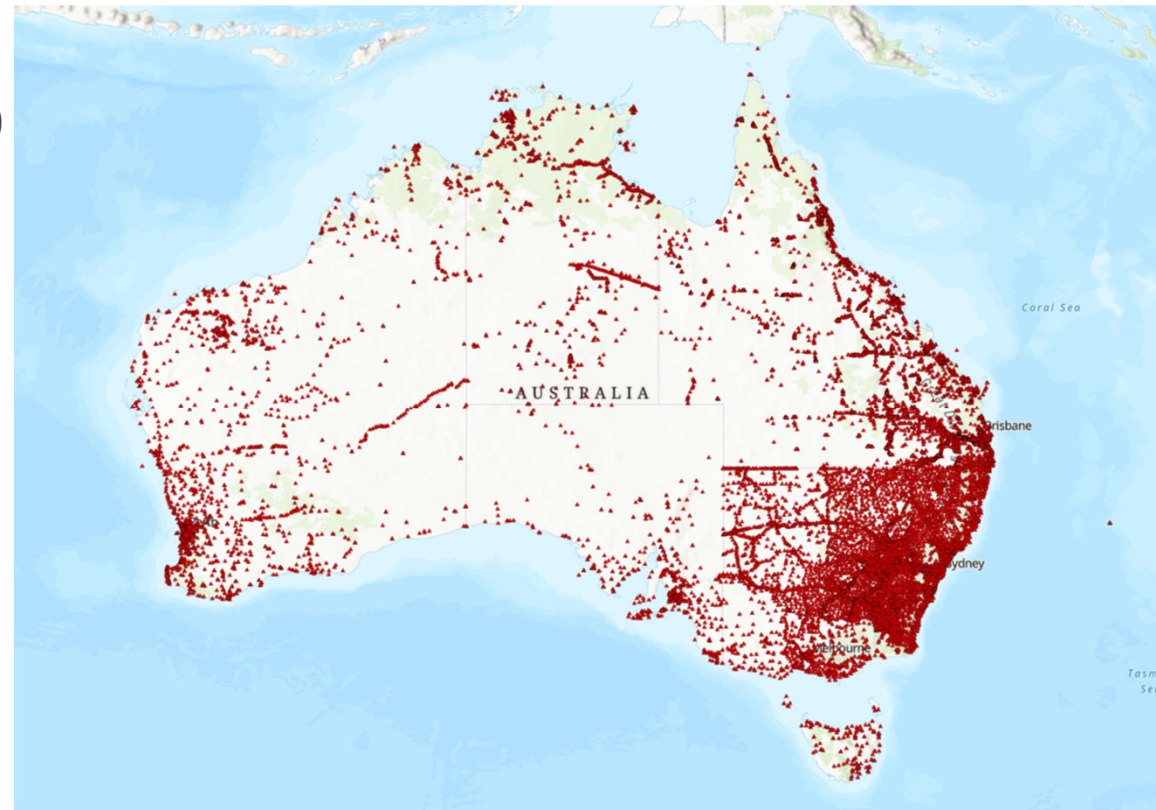


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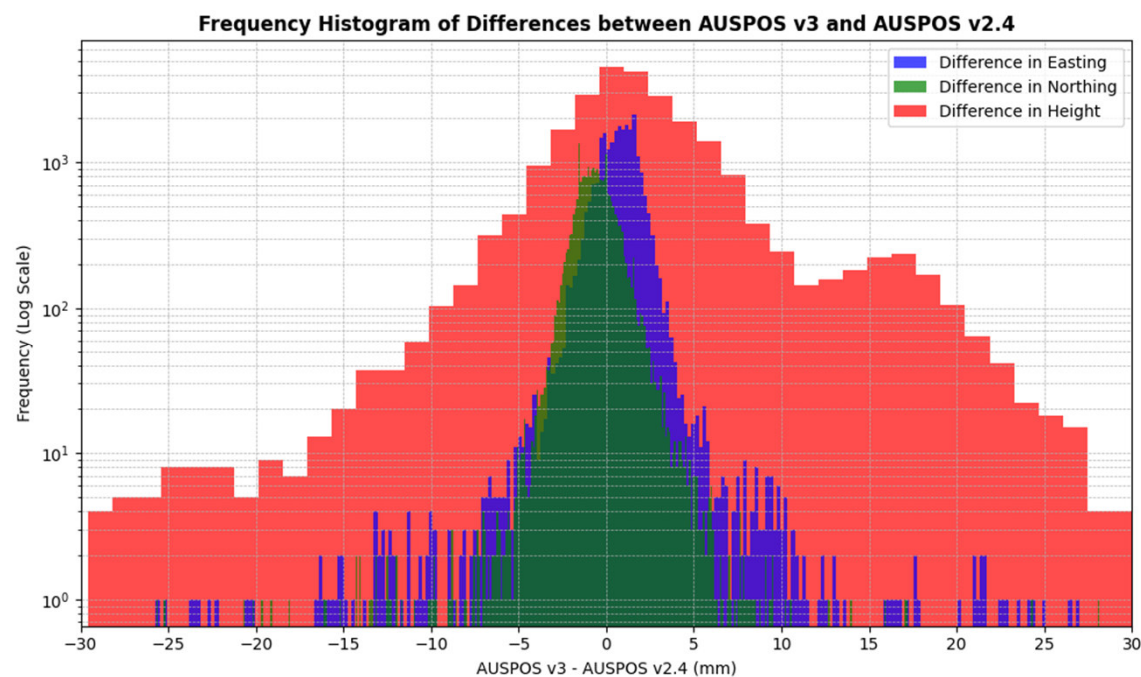
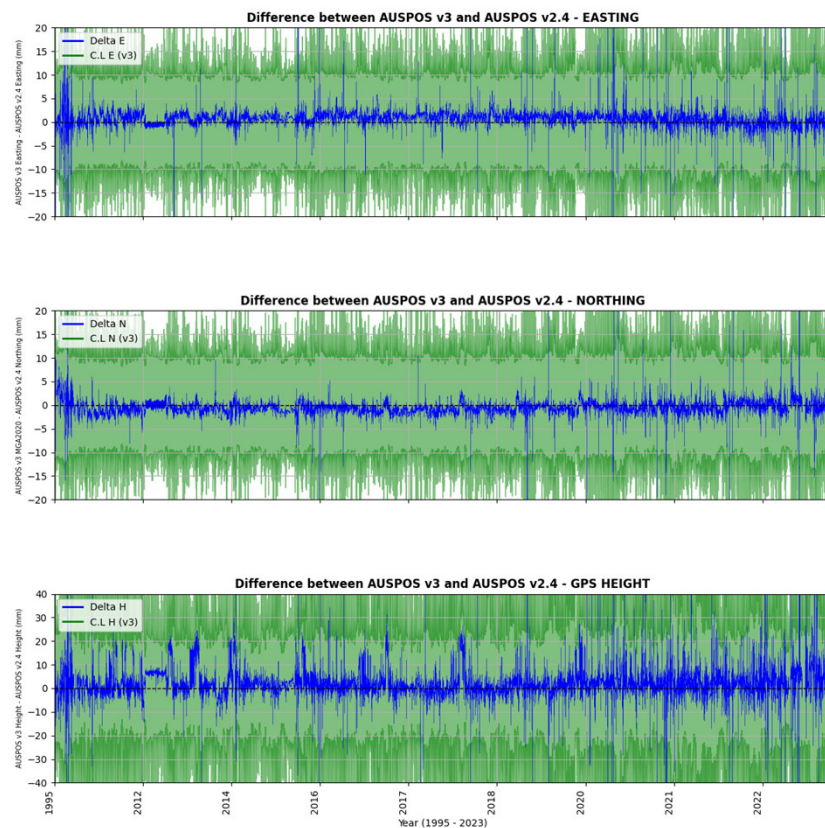
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NGCA Testing – Validating the performance of AUSPOS v3.0

- 7000+ AUSPOS jobs run using AUSPOS v3.0 and AUSPOS v2.4.
- 24,577 sites across Australia spanning 1995 to 2023.
- GDA2020 solutions from both AUSPOS systems compared



Difference between GDA2020 coordinates derived from v3.0 and v2.4 for each site



Comparative Analysis



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GDA2020 Coordinate Residuals	Easting	Northing	GPS Height
Mean (mm)	0.7	-0.6	2.1
RMS (mm)	3.1	1.9	14.4
95% Confidence Interval (mm)	[0.67, 0.75]	[-0.58, -0.54]	[1.95, 2.30]
# Sites with Difference > 30 mm	11	7	68
# Sites with Difference < - 30 mm	8	2	47
# Statistically Significant Differences (S.S)	17	1	25

- Mean and/or median differences in GDA2020 coordinates derived from AUSPOS v3.0 and v2.4 are less than ~1mm in E, N and ~2mm in U.
- A total of 40 sites (out of 24,557) have been identified as having at least one coordinate component whereby the difference between AUSPOS v3.0 and v2.4 solutions are statistically significant.

Conclusions

- Differences between AUSPOS v3.0 (ITRF2020/IGS20) and AUSPOS v2.4 (ITRF2014/IGb14),
 - It is very unlikely to be statistically significant.
 - users may expect differences of ~ 15-40 mm in the height because part of antenna types re-calibrated.
- Being confident of providing optimal strategies to user for positioning.
- High quality GPS measurements are important for accurate coordinates.

The most relevant SDGs related to the presentation and theme of this session

9 INDUSTRY, INNOVATION
AND INFRASTRUCTURE



1st relevant
SDG

13 CLIMATE
ACTION



2nd relevant
SDG

11 SUSTAINABLE CITIES
AND COMMUNITIES



3rd relevant
SDG

**SUSTAINABLE
DEVELOPMENT GOALS**

International Federation of Surveyors supports the
Sustainable Development Goals