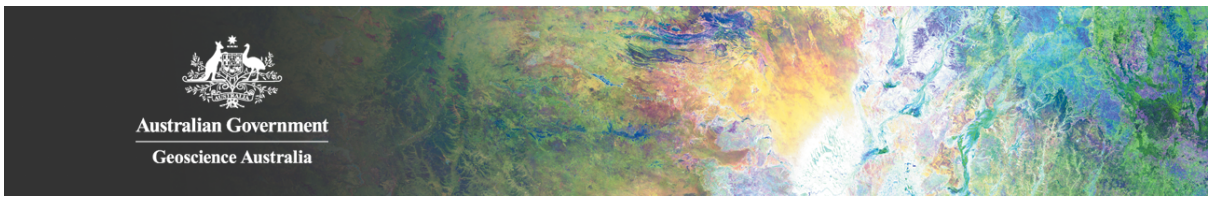


AUSPOS GPS Processing Report

October 7, 2025

This document is a report of the GPS data processing undertaken by the AUSPOS Online GPS Processing Service (version: AUSPOS 3.0). The AUSPOS Online GPS Processing Service uses International GNSS Service (IGS) products (final, rapid, ultra-rapid depending on availability) to compute precise coordinates in International Terrestrial Reference Frame (ITRF) anywhere on Earth and Geocentric Datum of Australia (GDA) within Australia. The Service is designed to process only dual frequency GPS phase data.

An overview of the GPS processing strategy is included in this report.

Please direct any correspondence to GNSSAnalysis@ga.gov.au

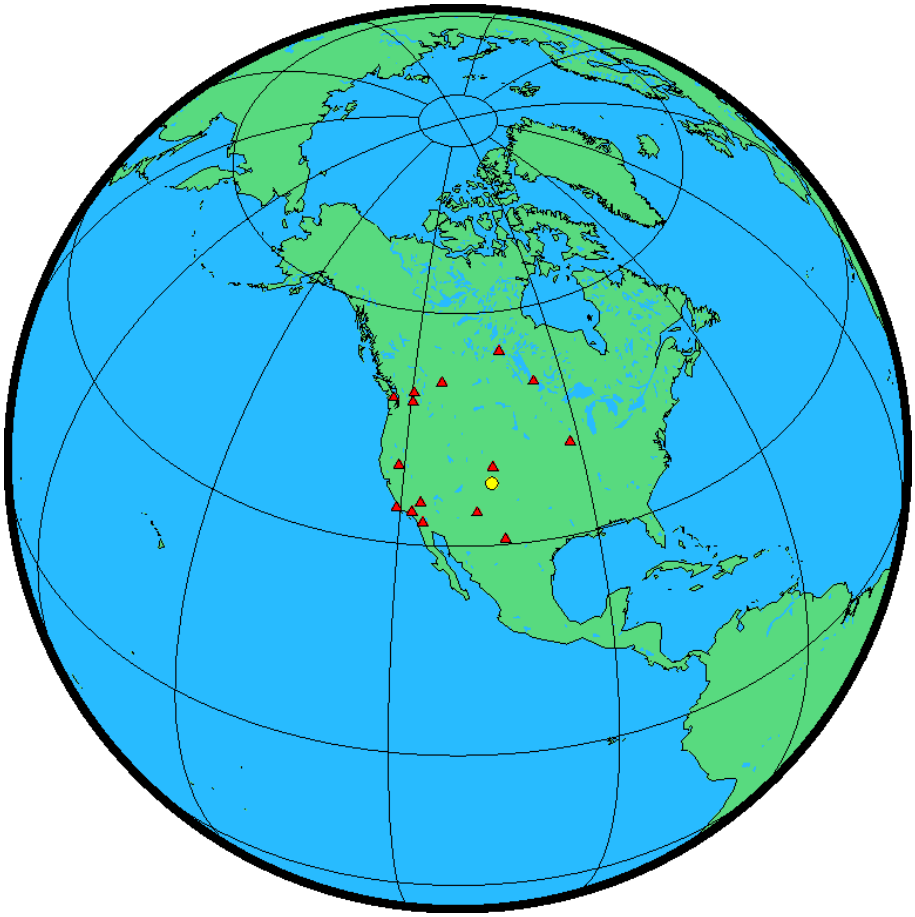
Geoscience Australia
Cnr Jerrabomberra and Hindmarsh Drive
GPO Box 378, Canberra, ACT 2601, Australia
Freecall (Within Australia): 1800 800 173
Tel: +61 2 6249 9111. Fax +61 2 6249 9929
Geoscience Australia
Home Page: http://www.ga.gov.au

1 User Data

All antenna heights refer to the vertical distance from the Ground Mark to the Antenna Reference Point (ARP).

Station (s)	Submitted File	Antenna Type	Antenna Height (m)	Start Time	End Time
DEFA	Crestone.rnx	TRMDA2 NONE	0.000	2025/10/05 13:21:30	2025/10/05 15:36:00
R001	EastCrestone.rnx	TRMDA2 NONE	0.000	2025/10/05 12:45:30	2025/10/05 15:00:00

2 Processing Summary



Date	User Stations	Reference Stations	Orbit Type
2025/10/05 12:45:30	DEFA R001	ALBH BREW DRAO DUBO FLIN GOLD JPLM MDO1 MONP NIST NLIB PIE1 PRDS QUIN VNDP	IGS rapid

3 Computed Coordinates, ITRF2020

All coordinates are based on the IGS realisation of the ITRF2020 reference frame. All the given ITRF2020 coordinates refer to a mean epoch of the site observation data. All coordinates refer to the Ground Mark.

3.1 Cartesian, ITRF2020

Station	X (m)	Y (m)	Z (m)	ITRF2020 @
DEFA	-1353612.459	-4852869.361	3905218.516	05/10/2025
R001	-1353489.149	-4852878.096	3905250.351	05/10/2025
ALBH	-2341333.164	-3539049.537	4745791.228	05/10/2025
BREW	-2112007.450	-3705351.824	4726826.992	05/10/2025
DRAO	-2059165.118	-3621108.404	4814432.193	05/10/2025
DUBO	-417604.058	-4064529.841	4881432.108	05/10/2025
FLIN	-766174.952	-3611375.393	5184056.200	05/10/2025
GOLD	-2353614.599	-4641385.221	3676976.346	05/10/2025
JPLM	-2493305.027	-4655214.757	3565497.695	05/10/2025
MDO1	-1329999.039	-5328393.361	3236504.049	05/10/2025
MONP	-2386247.738	-4802358.830	3444902.515	05/10/2025
NIST	-1288398.614	-4721696.929	4078625.320	05/10/2025
NLIB	-130934.932	-4762291.685	4226854.594	05/10/2025
PIE1	-1640917.187	-5014781.184	3575446.981	05/10/2025
PRDS	-1659603.318	-3676725.789	4925493.412	05/10/2025
QUIN	-2517231.560	-4198594.910	4076531.140	05/10/2025
VNDP	-2678090.756	-4525436.679	3597432.109	05/10/2025

3.2 Geodetic, GRS80 Ellipsoid, ITRF2020

Geoid-ellipsoidal separations, in this section, are computed using a spherical harmonic synthesis of the global EGM2008 geoid. More information on the EGM2008 geoid can be found at http://earth-info.nga.mil/GandG/wgs84/gravitymod/egm2008/.

Station	Latitude (DMS)	Longitude (DMS)	Ellipsoidal Height(m)	Derived Above Geoid Height(m)
DEFA	37 58 00.77732	-105 35 07.43571	4343.026	4358.302
R001	37 58 02.08358	-105 35 02.47680	4343.126	4358.399
ALBH	48 23 23.20702	-123 29 14.90138	31.764	50.216
BREW	48 07 53.47959	-119 40 57.49417	238.594	257.048
DRAO	49 19 21.42142	-119 37 29.94951	541.877	558.425
DUBO	50 15 31.70944	-95 51 58.26825	245.277	274.970
FLIN	54 43 32.09834	-101 58 40.94299	311.579	342.387
GOLD	35 25 30.55895	-116 53 21.31217	986.635	1017.327
JPLM	34 12 17.36052	-118 10 23.64310	423.980	457.468
MDO1	30 40 49.83635	-104 00 53.98467	2004.483	2026.562
MONP	32 53 30.99377	-116 25 20.48531	1842.521	1874.680
NIST	39 59 42.23808	-105 15 45.38764	1648.343	1664.276
NLIB	41 46 17.72680	-91 34 29.63725	206.965	239.828
PIE1	34 18 05.41691	-108 07 08.14821	2347.721	2369.474
PRDS	50 52 16.85942	-114 17 36.60418	1247.950	1263.858
QUIN	39 58 28.39206	-120 56 39.95899	1105.762	1129.390
VNDP	34 33 22.73491	-120 36 59.25231	-11.532	24.681

3.3 UTM Grid, GRS80 Ellipsoid, ITRF2020

Station	East (m)	North (m)	Zone	Ellipsoidal Height (m)	Derived Above Geoid Height(m)
DEFA	448580.224	4202302.191	13	4343.026	4358.302
R001	448701.471	4202341.691	13	4343.126	4358.399
ALBH	463911.546	5359738.884	10	31.764	50.216
BREW	300404.371	5334399.338	11	238.594	257.048
DRAO	309254.988	5466635.434	11	541.877	558.425
DUBO	295709.164	5571337.421	15	245.277	274.970
FLIN	308229.955	6068325.517	14	311.579	342.387
GOLD	510053.265	3920198.456	11	986.635	1017.327
JPLM	391912.299	3785488.810	11	423.980	457.468
MDO1	594348.766	3394609.143	13	2004.483	2026.562
MONP	554027.059	3639455.708	11	1842.521	1874.680
NIST	477582.260	4427242.628	13	1648.343	1664.276
NLIB	618445.978	4625398.106	15	206.965	239.828
PIE1	765157.958	3799345.893	12	2347.721	2369.474
PRDS	690424.282	5639008.735	11	1247.950	1263.858
QUIN	675534.344	4426956.291	10	1105.762	1129.390
VNDP	718692.229	3826422.987	10	-11.532	24.681

3.4 Positional Uncertainty (95% C.L.) - Geodetic, ITRF2020

Station	Longitude(East) (m)	Latitude(North) (m)	Ellipsoidal Height(Up) (m)
DEFA	0.009	0.008	0.031
R001	0.007	0.006	0.023
ALBH	0.006	0.006	0.015
BREW	0.005	0.004	0.009
DRAO	0.005	0.004	0.009
DUBO	0.005	0.005	0.010
FLIN	0.005	0.005	0.009
GOLD	0.005	0.004	0.009
JPLM	0.006	0.005	0.017
MDO1	0.005	0.004	0.010
MONP	0.005	0.004	0.010
NIST	0.005	0.004	0.009
NLIB	0.006	0.005	0.011
PIE1	0.005	0.004	0.010
PRDS	0.006	0.006	0.015
QUIN	0.005	0.004	0.010
VNDP	0.006	0.005	0.016

4 Ambiguity Resolution - Per Baseline

Baseline	Ambiguities Resolved	Baseline Length (km)
GOLD - JPLM	85.7 %	179.254
NIST - NLIB	42.9 %	1167.622
GOLD - VNDP	78.5 %	353.633
BREW - PRDS	90.0 %	494.932
BREW - DRAO	83.3 %	132.529
BREW - NIST	90.9 %	1459.950
GOLD - MONP	71.4 %	284.316
MDO1 - VNDP	100.0 %	1610.081
NIST - PIE1	91.7 %	680.703
DUBO - FLIN	90.0 %	646.863
MDO1 - NIST	100.0 %	1038.739
NIST - R001	80.0 %	226.945
GOLD - QUIN	80.0 %	618.448
FLIN - NIST	90.9 %	1651.517
ALBH - BREW	91.7 %	283.913
DEFA - R001	100.0 %	0.128
AVERAGE	85.4%	676.848

Please note for a regional solution, such as used by AUSPOS, ambiguity resolution success rate of 50% or better for a baseline formed by a user site indicates a reliable solution.

5 Computation Standards

5.1 Computation System

Software	Bernese GNSS Software Version 5.2.
GNSS system(s)	GPS only.

5.2 Data Preprocessing and Measurement Modelling

Data preprocessing	Phase preprocessing is undertaken in a baseline by baseline mode using triple-difference. In most cases, cycle slips are fixed by the simultaneous analysis of different linear combinations of L1 and L2. If a cycle slip cannot be fixed reliably, bad data points are removed or new ambiguities are set up A data screening step on the basis of weighted postfit residuals is also performed, and outliers are removed.
Basic observable	Carrier phase with an elevation angle cutoff of 7° and a sampling rate of 3 minutes. However, data cleaning is performed a sampling rate of 30 seconds. Elevation dependent weighting is applied according to $1/\sin(e)^2$ where e is the satellite elevation.
Modelled observable	Double differences of the ionosphere-free linear combination.
Ground antenna phase centre calibrations	IGS20 absolute phase-centre variation model is applied.
Tropospheric Model	A priori model is the GMF mapped with the DRY-GMF.
Tropospheric Estimation	Zenith delay corrections are estimated relying on the WET-GMF mapping function in intervals of 2 hour. N-S and E-W horizontal delay parameters are solved for every 24 hours.
Tropospheric Mapping Function	GMF
Ionosphere	First-order effect eliminated by forming the ionosphere-free linear combination of L1 and L2. Second and third effect applied.
Tidal displacements	Solid earth tidal displacements are derived from the complete model from the IERS Conventions 2010, but ocean tide loading is not applied.
Atmospheric loading	Applied
Satellite centre of mass correction	IGS20 phase-centre variation model applied
Satellite phase centre calibration	IGS20 phase-centre variation model applied
Satellite trajectories	Best available IGS products.
Earth Orientation	Best available IGS products.

5.3 Estimation Process

Adjustment	Weighted least-squares algorithm.
Station coordinates	Coordinate constraints are applied at the Reference sites with standard deviation of 1mm and 2mm for horizontal and vertical components respectively.
Troposphere	Zenith delay parameters and pairs of horizontal delay gradient parameters are estimated for each station in intervals of 2 hours and 24 hours.
Ionospheric correction	An ionospheric map derived from the contributing reference stations is used to aid ambiguity resolution.
Ambiguity	Ambiguities are resolved in a baseline-by-baseline mode using the Code-Based strategy for 200-6000km baselines, the Phase-Based L5/L3 strategy for 20-200km baselines, the Quasi-Ionosphere-Free (QIF) strategy for 20-2000km baselines and the Direct L1/L2 strategy for 0-20km baselines.

5.4 Reference Frame and Coordinate Uncertainty

Terrestrial reference frame	IGS20 station coordinates and velocities mapped to the mean epoch of observation.
Australian datums	GDA2020 and GDA94.
Derived AHD	For stations within Australia, AUSGeoid2020 (V20180201) is used to compute AHD. AUSGeoid2020 is the Australia-wide gravimetric quasigeoid model that has been a posteriori fitted to the AHD. For reference, derived AHD is always determined from the GDA2020 coordinates. In the GDA94 section of the report, AHD values are assumed to be identical to those derived from GDA2020.
Above-geoid heights	Earth Gravitational Model EGM2008 released by the National Geospatial-Intelligence Agency (NGA) EGM Development Team is used to compute above-geoid heights. This gravitational model is complete to spherical harmonic degree and order 2159, and contains additional coefficients extending to degree 2190 and order 2159.
Coordinate uncertainty	Coordinate uncertainty is expressed in terms of the 95% confidence level for GDA94, GDA2020 and ITRF2020. Uncertainties are scaled using an empirically derived model which is a function of data span, quality and geographical location.