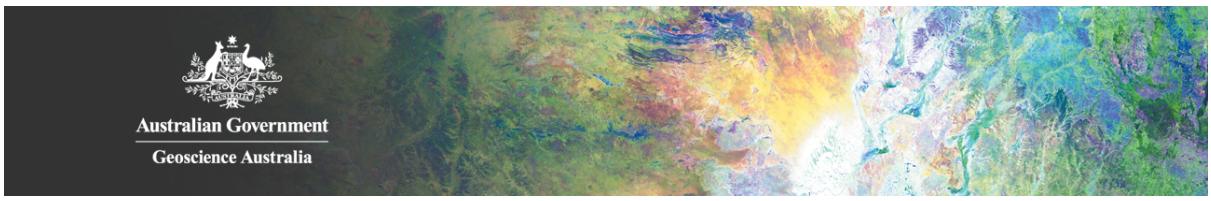

AUSPOS GPS Processing Report

March 13, 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.

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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
MATA	matageon1790.19o	SEPALTUS_NR3 NONE	2.000	2019/06/28 14:45:30	2019/06/28 18:48:00

2 Processing Summary

Date	User Stations	Reference Stations	Orbit Type
2019/06/28 14:45:30	MATA	ANTC AREQ BOAV BRAZ CORD GLPS LPGS MTV1 POAL POVE SANT SCRZ TOPL UFPR UNSA	IGS final

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 @
MATA	1874350.731	-5806145.141	-1852941.031	28/06/2019
ANTC	1608538.528	-4816370.497	-3847798.269	28/06/2019
AREQ	1942826.284	-5804070.350	-1796894.121	28/06/2019
BOAV	3117452.169	-5555487.878	314480.976	28/06/2019
BRAZ	4115014.074	-4550641.644	-1741443.786	28/06/2019
CORD	2345503.865	-4910842.923	-3316365.238	28/06/2019
GLPS	-33800.927	-6377516.517	-82154.235	28/06/2019
LPGS	2780103.001	-4437419.028	-3629404.375	28/06/2019
MTV1	2914537.028	-4349790.388	-3630033.335	28/06/2019
POAL	3467519.431	-4300378.658	-3177517.522	28/06/2019
POVE	2774265.578	-5662060.170	-959415.749	28/06/2019
SANT	1769693.440	-5044574.289	-3468320.896	28/06/2019
SCRZ	2743005.923	-5420745.285	-1937116.998	28/06/2019
TOPL	4174345.580	-4690236.778	-1118921.186	28/06/2019
UFPR	3763751.684	-4365113.940	-2724404.494	28/06/2019
UNSA	2412830.505	-5271936.765	-2652208.877	28/06/2019

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)
MATA	-17 00 03.34109	-72 06 31.62560	32.152	3.147
ANTC	-37 20 19.31486	-71 31 55.42864	745.560	721.961
AREQ	-16 27 55.85622	-71 29 34.06526	2488.927	2449.072
BOAV	2 50 42.66412	-60 42 04.01604	69.519	84.817
BRAZ	-15 56 50.90338	-47 52 40.33076	1106.017	1118.607
CORD	-31 31 42.36075	-64 28 12.17584	746.845	720.457
GLPS	-0 44 34.79288	-90 18 13.19612	1.775	5.354
LPGS	-34 54 24.27761	-57 55 56.28037	29.865	13.928
MTV1	-34 54 48.91986	-56 10 34.68518	40.738	26.371
POAL	-30 04 26.54507	-51 07 11.15530	76.740	71.704
POVE	-8 42 33.60400	-63 53 46.75298	119.571	107.593
SANT	-33 09 01.03492	-70 40 06.79921	723.111	695.208
SCRZ	-17 47 48.44480	-63 09 34.82643	442.064	419.601
TOPL	-10 10 15.78477	-48 19 50.44741	256.534	274.486
UFPR	-25 26 54.11924	-49 13 51.43964	925.791	921.925
UNSA	-24 43 38.83776	-65 24 27.51429	1257.789	1224.377

3.3 UTM Grid, GRS80 Ellipsoid, ITRF2020

Station	East (m)	North (m)	Zone	Ellipsoidal Height (m)	Derived Above Geoid Height(m)
MATA	807857.836	8118069.812	18	32.152	3.147
ANTC	275690.703	5864546.299	19	745.560	721.961
AREQ	233847.161	8177928.956	19	2488.927	2449.072
BOAV	755563.755	314735.561	20	69.519	84.817
BRAZ	191901.143	8234747.580	23	1106.017	1118.607
CORD	360433.082	6510895.560	20	746.845	720.457
GLPS	800120.960	9917784.723	15	1.775	5.354
LPGS	414828.358	6136902.064	21	29.865	13.928
MTV1	575243.690	6136229.966	21	40.738	26.371
POAL	488457.488	6673004.291	22	76.740	71.704
POVE	401400.621	9037165.958	20	119.571	107.593
SANT	344386.393	6330812.695	19	723.111	695.208
SCRZ	483077.218	8032289.357	20	442.064	419.601
TOPL	792491.099	8874471.573	22	256.534	274.486
UFPR	677878.450	7184223.547	22	925.791	921.925
UNSA	256465.348	7263089.005	20	1257.789	1224.377

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

Station	Longitude(East) (m)	Latitude(North) (m)	Ellipsoidal Height(Up) (m)
MATA	0.016	0.010	0.051
ANTC	0.011	0.009	0.029
AREQ	0.009	0.006	0.015
BOAV	0.009	0.007	0.017
BRAZ	0.008	0.006	0.016
CORD	0.011	0.009	0.031
GLPS	0.014	0.008	0.018
LPGS	0.010	0.008	0.018
MTV1	0.010	0.010	0.035
POAL	0.008	0.006	0.017
POVE	0.010	0.006	0.022
SANT	0.011	0.008	0.026
SCRZ	0.010	0.006	0.017
TOPL	0.008	0.006	0.016
UFPR	0.008	0.006	0.017
UNSA	0.011	0.008	0.018

4 Ambiguity Resolution - Per Baseline

Baseline	Ambiguities Resolved	Baseline Length (km)
CORD - SANT	81.8 %	610.354
CORD - LPGS	77.0 %	714.843
BRAZ - UFPR	92.9 %	1060.197
BRAZ - TOPL	80.0 %	640.735
AREQ - SANT	80.0 %	1844.038
POVE - SCRZ	68.7 %	1007.527
BOAV - TOPL	84.6 %	1979.981
ANTC - SANT	75.0 %	471.223
AREQ - UNSA	59.9 %	1111.591
AREQ - MATA	38.5 %	88.512
POAL - UFPR	85.7 %	545.212
AREQ - POVE	69.2 %	1188.624
MTV1 - POAL	75.0 %	716.241
AREQ - GLPS	45.0 %	2678.848
BOAV - POVE	81.2 %	1323.612
AVERAGE	73.0%	1065.436

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.