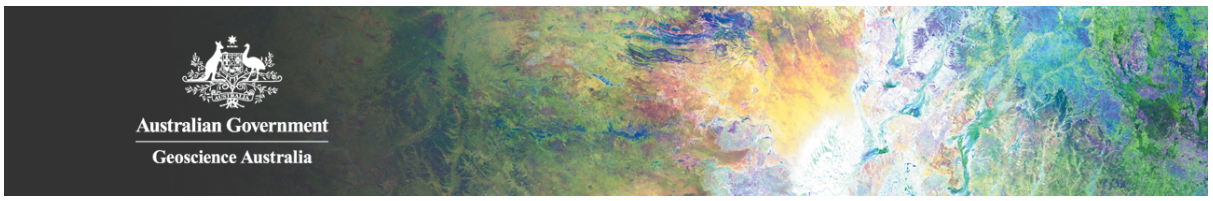

AUSPOS GPS Processing Report

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
SAMA	samaalts2040.19o	SEPALTUS_NR3 NONE	2.000	2019/07/23 18:52:30	2019/07/23 22:55:30

2 Processing Summary

Date	User Stations	Reference Stations	Orbit Type
2019/07/23 18:52:30	SAMA	AREG BOAV BRMU CRO1 GLPS GUAT KOUG KOUR LMMF MANA POVE RDSD SCUB SSIA	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 @
SAMA	1701317.764	-6020944.075	1234528.934	23/07/2019
AREG	1942816.521	-5804077.107	-1796884.341	23/07/2019
BOAV	3117452.175	-5555487.895	314480.986	23/07/2019
BRMU	2304703.273	-4874817.174	3395187.052	23/07/2019
CRO1	2607771.338	-5488076.601	1932767.971	23/07/2019
GLPS	-33800.919	-6377516.517	-82154.232	23/07/2019
GUAT	-56063.526	-6174978.632	1596665.290	23/07/2019
KOUG	3855263.302	-5049732.012	563040.523	23/07/2019
KOUR	3839591.315	-5059567.584	579957.230	23/07/2019
LMMF	2993387.399	-5399363.830	1596748.151	23/07/2019
MANA	407981.952	-6222925.651	1333529.098	23/07/2019
POVE	2774265.601	-5662060.197	-959415.751	23/07/2019
RDSD	2078678.916	-5683737.238	2006886.963	23/07/2019
SCUB	1474538.004	-5811243.265	2168958.888	23/07/2019
SSIA	95567.105	-6197785.585	1500590.614	23/07/2019

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)
SAMA	11 14 06.55415	-74 13 17.32667	-3.825	1.612
AREG	-16 27 55.52075	-71 29 34.44957	2489.327	2449.472
BOAV	2 50 42.66442	-60 42 04.01615	69.536	84.834
BRMU	32 22 13.43981	-64 41 46.59017	-11.642	20.807
CRO1	17 45 24.83953	-64 35 03.54608	-31.929	11.750
GLPS	-0 44 34.79278	-90 18 13.19588	1.775	5.354
GUAT	14 35 25.45587	-90 31 12.65663	1519.842	1517.282
KOUG	5 05 54.49834	-52 38 23.10180	107.244	141.827
KOUR	5 15 07.85875	-52 48 21.45708	-25.772	8.489
LMMF	14 35 41.34365	-60 59 46.23203	-27.117	10.987
MANA	12 08 56.18278	-86 14 56.37429	71.016	66.408
POVE	-8 42 33.60389	-63 53 46.75270	119.606	107.628
RDSD	18 27 41.03369	-69 54 40.76207	-9.194	26.182
SCUB	20 00 43.43033	-75 45 44.34159	20.911	44.493
SSIA	13 41 49.50805	-89 06 59.74019	626.653	625.225

3.3 UTM Grid, GRS80 Ellipsoid, ITRF2020

Station	East (m)	North (m)	Zone	Ellipsoidal Height (m)	Derived Above Geoid Height(m)
SAMA	584982.865	1242093.212	18	-3.825	1.612
AREG	233835.630	8177939.132	19	2489.327	2449.472
BOAV	755563.752	314735.570	20	69.536	84.834
BRMU	340415.187	3582757.915	20	-11.642	20.807
CRO1	332034.051	1963998.593	20	-31.929	11.750
GLPS	800120.968	9917784.726	15	1.775	5.354
GUAT	767172.939	1614480.840	15	1519.842	1517.282
KOUG	318229.359	563780.429	22	107.244	141.827
KOUR	299847.147	580829.154	22	-25.772	8.489
LMMF	715865.063	1614463.274	20	-27.117	10.987
MANA	581710.944	1343135.886	16	71.016	66.408
POVE	401400.629	9037165.961	20	119.606	107.628
RDSD	403775.730	2041476.419	19	-9.194	26.182
SCUB	420261.908	2212997.848	18	20.911	44.493
SSIA	271084.553	1515227.424	16	626.653	625.225

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

Station	Longitude(East) (m)	Latitude(North) (m)	Ellipsoidal Height(Up) (m)
SAMA	0.011	0.009	0.033
AREG	0.015	0.012	0.041
BOAV	0.010	0.007	0.018
BRMU	0.010	0.008	0.020
CRO1	0.012	0.008	0.021
GLPS	0.014	0.009	0.021
GUAT	0.011	0.007	0.018
KOUG	0.010	0.008	0.018
KOUR	0.010	0.008	0.019
LMMF	0.010	0.006	0.018
MANA	0.013	0.009	0.029
POVE	0.011	0.010	0.029
RDSD	0.009	0.007	0.018
SCUB	0.010	0.008	0.020
SSIA	0.014	0.009	0.030

4 Ambiguity Resolution - Per Baseline

Baseline	Ambiguities Resolved	Baseline Length (km)
BOAV - KOUG	91.7 %	928.405
CRO1 - LMMF	43.8 %	519.114
BRMU - LMMF	80.0 %	1995.950
RDSD - SCUB	90.9 %	638.366
BOAV - LMMF	91.7 %	1297.681
AREG - POVE	63.6 %	1188.625
GUAT - SSIA	84.6 %	180.948
MANA - SAMA	64.3 %	1312.751
GLPS - GUAT	64.7 %	1691.139
KOUG - KOUR	100.0 %	25.070
SAMA - RDSD	91.6 %	923.389
GUAT - MANA	62.5 %	535.610
LMMF - RDSD	80.0 %	1042.005
BOAV - POVE	84.6 %	1323.612
AVERAGE	78.1%	971.619

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.