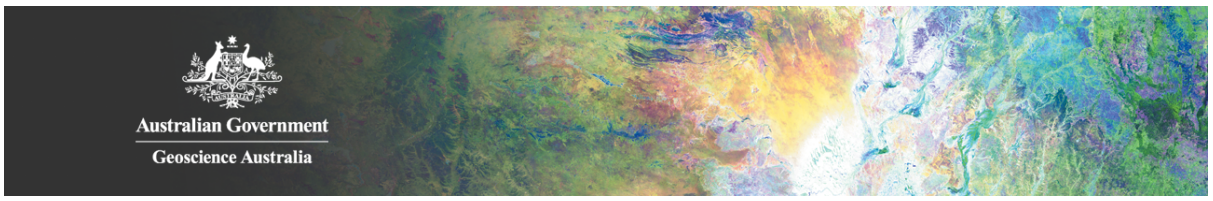

AUSPOS GPS Processing Report

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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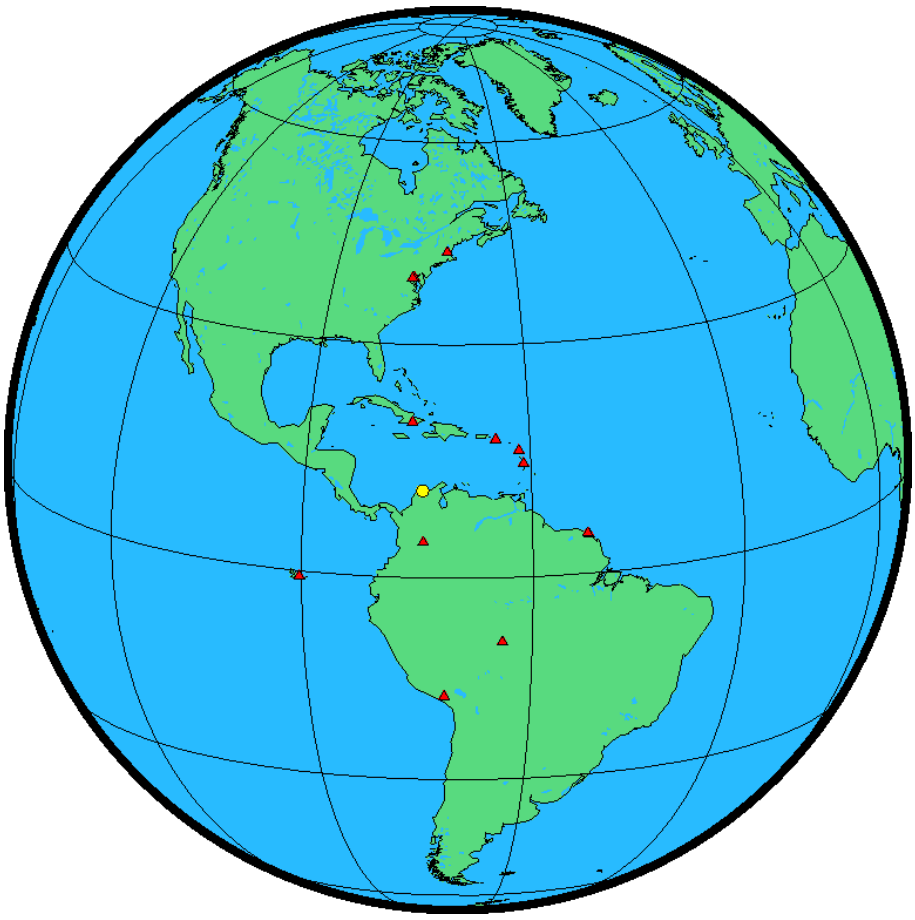
1 User Data

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
SNTM	santamartauh5.o	SEPALTUS_NR3 NONE	2.000	2023/09/27 17:15:00	2023/09/28 02:17:00

2 Processing Summary



Date	User Stations	Reference Stations	Orbit Type
2023/09/27 17:15:00	SNTM	ABMF AREG BOGT CRO1 GLPS GODE GODN KOUG KOUR LMMF POVE SCUB WDC5 WES2	IGS final

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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 @
SNTM	1701617.274	-6020893.250	1234373.119	27/09/2023
ABMF	2919785.816	-5383744.917	1774604.913	27/09/2023
AREG	1942816.468	-5804077.186	-1796884.318	27/09/2023
BOGT	1744398.885	-6116036.990	512731.964	27/09/2023
CRO1	2607771.365	-5488076.549	1932768.019	27/09/2023
GLPS	-33800.708	-6377516.508	-82154.189	27/09/2023
GODE	1130773.468	-4831253.578	3994200.474	27/09/2023
GODN	1130760.695	-4831298.679	3994155.206	27/09/2023
KOUG	3855263.287	-5049732.025	563040.574	27/09/2023
KOUR	3839591.309	-5059567.588	579957.273	27/09/2023
LMMF	2993387.438	-5399363.809	1596748.223	27/09/2023
POVE	2774265.587	-5662060.240	-959415.712	27/09/2023
SCUB	1474537.987	-5811243.255	2168958.903	27/09/2023
WDC5	1112158.573	-4842855.617	3985496.993	27/09/2023
WES2	1492232.951	-4458089.517	4296046.118	27/09/2023

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)
SNTM	11 14 01.37399	-74 13 07.36921	-2.266	3.095
ABMF	16 15 44.30626	-61 31 39.12620	-25.571	15.304
AREG	-16 27 55.51950	-71 29 34.45208	2489.377	2449.522
BOGT	4 38 24.27155	-74 04 51.38216	2576.209	2553.348
CRO1	17 45 24.84136	-64 35 03.54452	-31.948	11.731
GLPS	-0 44 34.79140	-90 18 13.18904	1.764	5.343
GODE	39 01 18.22179	-76 49 36.59985	14.491	47.756
GODN	39 01 16.24417	-76 49 37.54412	17.846	51.110
KOUG	5 05 54.49999	-52 38 23.10244	107.250	141.833
KOUR	5 15 07.86015	-52 48 21.45732	-25.768	8.493
LMMF	14 35 41.34589	-60 59 46.23057	-27.099	11.005
POVE	-8 42 33.60248	-63 53 46.75372	119.632	107.654
SCUB	20 00 43.43093	-75 45 44.34207	20.903	44.485
WDC5	38 55 14.03354	-77 03 58.74880	58.978	91.843
WES2	42 36 48.01175	-71 29 35.98973	85.020	113.647

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3.3 UTM Grid, GRS80 Ellipsoid, ITRF2020

Station	East (m)	North (m)	Zone	Ellipsoidal Height (m)	Derived Above Geoid Height(m)
SNTM	585285.236	1241934.893	18	-2.266	3.095
ABMF	657348.866	1798516.990	20	-25.571	15.304
AREG	233835.554	8177939.169	19	2489.377	2449.522
BOGT	601939.820	512945.140	18	2576.209	2553.348
CRO1	332034.097	1963998.649	20	-31.948	11.731
GLPS	800121.179	9917784.768	15	1.764	5.343
GODE	341854.082	4320775.471	18	14.491	47.756
GODN	341830.149	4320714.960	18	17.846	51.110
KOUG	318229.339	563780.480	22	107.250	141.833
KOUR	299847.140	580829.197	22	-25.768	8.493
LMMF	715865.106	1614463.344	20	-27.099	11.005
POVE	401400.598	9037166.004	20	119.632	107.654
SCUB	420261.894	2212997.866	18	20.903	44.485
WDC5	320865.646	4309991.454	18	58.978	91.843
WES2	295497.585	4720891.558	19	85.020	113.647

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

Station	Longitude(East) (m)	Latitude(North) (m)	Ellipsoidal Height(Up) (m)
SNTM	0.011	0.006	0.031
ABMF	0.009	0.006	0.018
AREG	0.009	0.008	0.018
BOGT	0.021	0.008	0.028
CRO1	0.008	0.005	0.015
GLPS	0.010	0.006	0.016
GODE	0.009	0.006	0.015
GODN	0.009	0.006	0.015
KOUG	0.008	0.005	0.014
KOUR	0.009	0.006	0.015
LMMF	0.008	0.005	0.014
POVE	0.009	0.007	0.018
SCUB	0.009	0.006	0.017
WDC5	0.010	0.007	0.018
WES2	0.010	0.008	0.022

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4 Ambiguity Resolution - Per Baseline

Baseline	Ambiguities Resolved	Baseline Length (km)
BOGT - KOUG	17.5 %	2365.436
ABMF - WDC5	9.5 %	2906.565
GODE - GODN	100.0 %	0.065
CRO1 - LMMF	72.0 %	519.114
AREG - POVE	76.0 %	1188.625
ABMF - SNTM	61.9 %	1477.072
KOUG - LMMF	56.4 %	1390.548
ABMF - LMMF	56.1 %	193.117
GODE - WDC5	88.5 %	23.598
KOUG - KOUR	62.3 %	25.070
GODE - WES2	80.8 %	600.845
SNTM - SCUB	52.4 %	984.362
KOUG - POVE	70.0 %	1965.038
AREG - GLPS	90.5 %	2678.833
AVERAGE	63.8%	1165.592

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.

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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.

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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.

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