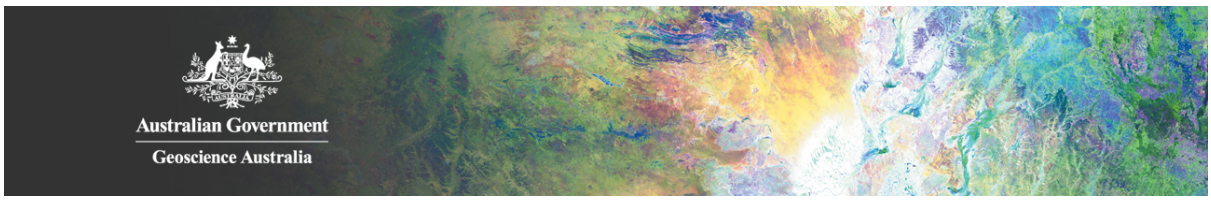

AUSPOS GPS Processing Report

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
POPL	poplbmgps1510.19o	SEPALTUS_NR3 NONE	2.000	2019/05/31 14:29:30	2019/05/31 18:59:00

2 Processing Summary

Date	User Stations	Reference Stations	Orbit Type
2019/05/31 14:29:30	POPL	BARH BOAV BRMU CRO1 GODE GUAT HLFX KOUG KOUR LMMF MANA RDSD WDC5	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 @
POPL	1984007.373	-5666066.846	2146738.152	31/05/2019
BARH	1693644.616	-4239067.587	4439567.309	31/05/2019
BOAV	3117452.163	-5555487.877	314480.975	31/05/2019
BRMU	2304703.281	-4874817.174	3395187.050	31/05/2019
CRO1	2607771.335	-5488076.593	1932767.972	31/05/2019
GODE	1130773.529	-4831253.578	3994200.465	31/05/2019
GUAT	-56063.524	-6174978.655	1596665.296	31/05/2019
HLFX	2018905.535	-4069070.521	4462415.501	31/05/2019
KOUG	3855263.309	-5049732.031	563040.523	31/05/2019
KOUR	3839591.318	-5059567.590	579957.225	31/05/2019
LMMF	2993387.394	-5399363.835	1596748.158	31/05/2019
MANA	407981.943	-6222925.652	1333529.095	31/05/2019
RDSD	2078678.899	-5683737.217	2006886.947	31/05/2019
WDC5	1112158.639	-4842855.619	3985496.981	31/05/2019

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)
POPL	19 47 55.60677	-70 42 07.16698	-38.340	3.055
BARH	44 23 42.17594	-68 13 18.09501	6.750	31.498
BOAV	2 50 42.66408	-60 42 04.01619	69.514	84.812
BRMU	32 22 13.43969	-64 41 46.58991	-11.640	20.809
CRO1	17 45 24.83964	-64 35 03.54606	-31.937	11.742
GODE	39 01 18.22127	-76 49 36.59741	14.496	47.761
GUAT	14 35 25.45585	-90 31 12.65656	1519.866	1517.306
HLFX	44 41 00.78219	-63 36 40.61684	3.099	24.463
KOUG	5 05 54.49827	-52 38 23.10198	107.263	141.846
KOUR	5 15 07.85856	-52 48 21.45710	-25.766	8.495
LMMF	14 35 41.34383	-60 59 46.23226	-27.114	10.990
MANA	12 08 56.18270	-86 14 56.37458	71.016	66.408
RDSD	18 27 41.03347	-69 54 40.76235	-9.223	26.153
WDC5	38 55 14.03292	-77 03 58.74617	58.983	91.848

3.3 UTM Grid, GRS80 Ellipsoid, ITRF2020

Station	East (m)	North (m)	Zone	Ellipsoidal Height (m)	Derived Above Geoid Height(m)
POPL	321717.386	2190111.616	19	-38.340	3.055
BARH	561984.585	4916046.114	19	6.750	31.498
BOAV	755563.750	314735.560	20	69.514	84.812
BRMU	340415.194	3582757.911	20	-11.640	20.809
CRO1	332034.051	1963998.597	20	-31.937	11.742
GODE	341854.140	4320775.454	18	14.496	47.761
GUAT	767172.941	1614480.839	15	1519.866	1517.306
HLFX	451557.122	4947979.581	20	3.099	24.463
KOUG	318229.353	563780.427	22	107.263	141.846
KOUR	299847.146	580829.148	22	-25.766	8.495
LMMF	715865.056	1614463.280	20	-27.114	10.990
MANA	581710.935	1343135.883	16	71.016	66.408
RDSD	403775.721	2041476.412	19	-9.223	26.153
WDC5	320865.709	4309991.433	18	58.983	91.848

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

Station	Longitude(East) (m)	Latitude(North) (m)	Ellipsoidal Height(Up) (m)
POPL	0.009	0.006	0.021
BARH	0.006	0.006	0.013
BOAV	0.007	0.005	0.015
BRMU	0.006	0.005	0.013
CRO1	0.008	0.005	0.015
GODE	0.007	0.005	0.013
GUAT	0.010	0.005	0.016
HLFX	0.006	0.006	0.015
KOUG	0.007	0.005	0.014
KOUR	0.007	0.005	0.015
LMMF	0.006	0.005	0.013
MANA	0.011	0.006	0.024
RDSD	0.007	0.005	0.013
WDC5	0.008	0.006	0.018

4 Ambiguity Resolution - Per Baseline

Baseline	Ambiguities Resolved	Baseline Length (km)
BOAV - KOUG	93.3 %	928.405
CRO1 - LMMF	78.3 %	519.114
BRMU - LMMF	87.5 %	1995.950
KOUG - LMMF	76.5 %	1390.548
BARH - HLFX	76.5 %	367.717
BRMU - WDC5	100.0 %	1331.033
BARH - WDC5	83.3 %	953.345
GODE - WDC5	88.9 %	23.598
KOUG - KOUR	88.3 %	25.070
MANA - RDSD	73.7 %	1880.256
POPL - RDSD	94.4 %	169.804
GUAT - MANA	64.7 %	535.610
LMMF - RDSD	88.2 %	1042.005
AVERAGE	84.1%	858.650

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.