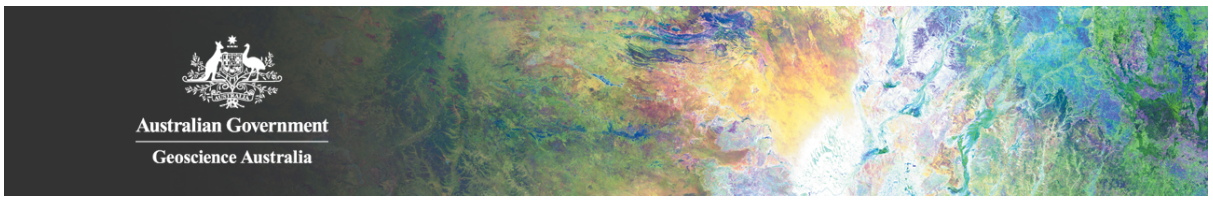


AUSPOS GPS Processing Report

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.

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

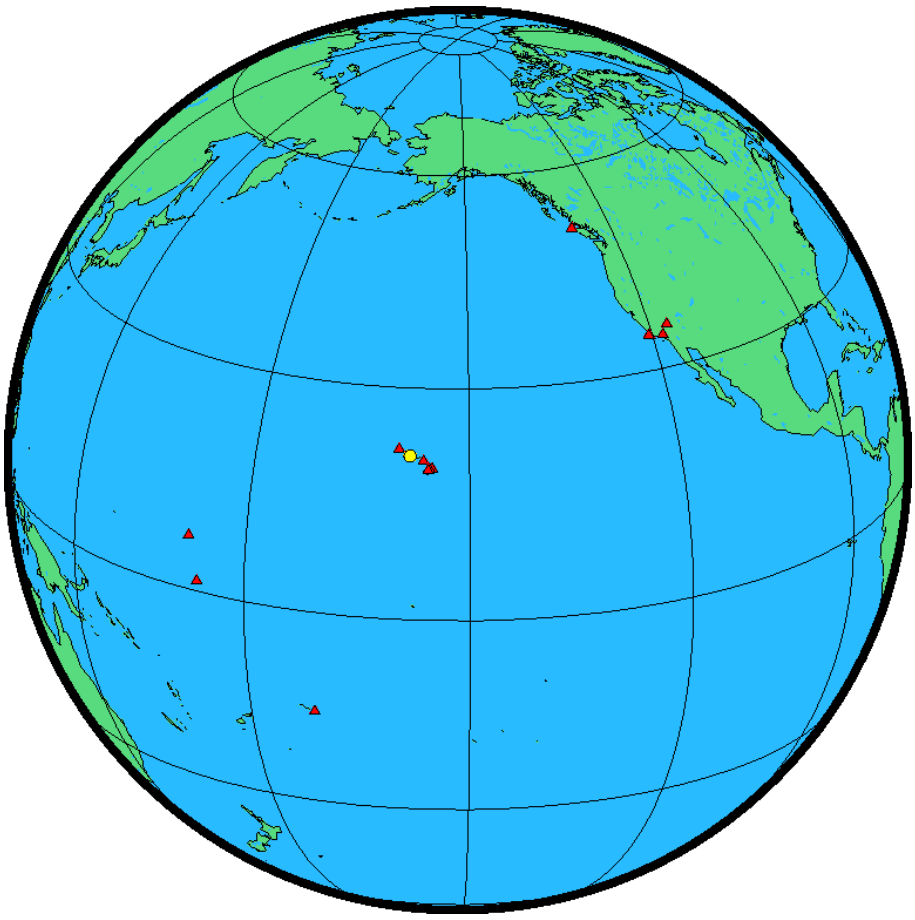
Geoscience Australia
Cnr Jerrabomberra and Hindmarsh Drive
GPO Box 378, Canberra, ACT 2601, Australia
Freecall (Within Australia): 1800 800 173
Tel: +61 2 6249 9111. Fax +61 2 6249 9929
Geoscience Australia
Home Page: http://www.ga.gov.au

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
BARB	barberspointuh4.o	SEPALTUS_NR3 NONE	2.000	2020/07/31 21:00:00	2020/07/31 23:32:30

2 Processing Summary



Date	User Stations	Reference Stations	Orbit Type
2020/07/31 21:00:00	BARB	ASPA GOLD HILR HOLB JPLM KIRI KOKB MAJU MAUI MKEA MLO1 VNDP	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 @
BARB	-5516010.900	-2215250.858	2304635.774	31/07/2020
ASPA	-6100260.189	-996502.579	-1567977.210	31/07/2020
GOLD	-2353614.524	-4641385.256	3676976.364	31/07/2020
HILR	-5445922.139	-2533750.265	2138282.296	31/07/2020
HOLB	-2503040.759	-3188233.326	4908701.407	31/07/2020
JPLM	-2493304.885	-4655214.879	3565497.646	31/07/2020
KIRI	-6327822.319	785605.223	149769.570	31/07/2020
KOKB	-5543838.340	-2054585.777	2387810.461	31/07/2020
MAJU	-6257572.115	950333.524	785215.616	31/07/2020
MAUI	-5466069.091	-2404327.112	2242127.940	31/07/2020
MKEA	-5464105.421	-2495165.413	2148291.687	31/07/2020
MLO1	-5478044.904	-2487693.446	2120497.355	31/07/2020
VNDP	-2678090.605	-4525436.840	3597432.007	31/07/2020

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)
BARB	21 19 18.74222	-158 07 09.90737	17.463	2.339
ASPA	-14 19 33.92470	-170 43 20.79214	53.461	20.837
GOLD	35 25 30.55948	-116 53 21.30892	986.644	1017.336
HILR	19 43 02.61387	-155 02 58.17651	30.766	13.398
HOLB	50 38 25.26673	-128 08 06.00068	559.613	575.277
JPLM	34 12 17.35846	-118 10 23.63596	423.985	457.473
KIRI	1 21 16.51030	172 55 22.39171	36.168	4.857
KOKB	22 07 34.56356	-159 39 53.77424	1167.362	1150.338
MAJU	7 07 08.94646	171 21 52.24747	33.698	4.954
MAUI	20 42 23.97361	-156 15 25.31996	3062.094	3044.156
MKEA	19 48 04.89116	-155 27 22.85808	3754.653	3728.362
MLO1	19 32 09.32678	-155 34 34.38866	3429.540	3401.851
VNDP	34 33 22.73104	-120 36 59.24400	-11.539	24.674

3.3 UTM Grid, GRS80 Ellipsoid, ITRF2020

Station	East (m)	North (m)	Zone	Ellipsoidal Height (m)	Derived Above Geoid Height(m)
BARB	591322.791	2358026.046	4	17.463	2.339
ASPA	529931.032	8416191.310	2	53.461	20.837
GOLD	510053.347	3920198.472	11	986.644	1017.336
HILR	285196.643	2181505.022	5	30.766	13.398
HOLB	561164.266	5610188.887	9	559.613	575.277
JPLM	391912.481	3785488.745	11	423.985	457.473
KIRI	713950.130	149807.650	59	36.168	4.857
KOKB	431424.428	2446953.006	4	1167.362	1150.338
MAJU	540250.822	786936.585	59	33.698	4.954
MAUI	785708.936	2292102.821	4	3062.094	3044.156
MKEA	242671.079	2191369.314	5	3754.653	3728.362
MLO1	229661.876	2162161.326	5	3429.540	3401.851
VNDP	718692.443	3826422.873	10	-11.539	24.674

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

Station	Longitude(East) (m)	Latitude(North) (m)	Ellipsoidal Height(Up) (m)
BARB	0.011	0.008	0.031
ASPA	0.010	0.006	0.015
GOLD	0.009	0.006	0.014
HILR	0.018	0.013	0.040
HOLB	0.011	0.010	0.029
JPLM	0.012	0.010	0.027
KIRI	0.009	0.006	0.013
KOKB	0.007	0.005	0.013
MAJU	0.009	0.005	0.013
MAUI	0.008	0.006	0.014
MKEA	0.008	0.006	0.014
MLO1	0.010	0.007	0.025
VNDP	0.011	0.010	0.026

4 Ambiguity Resolution - Per Baseline

Baseline	Ambiguities Resolved	Baseline Length (km)
KIRI - MAJU	100.0 %	660.199
GOLD - JPLM	85.7 %	179.254
MAUI - MLO1	62.5 %	147.944
MKEA - MLO1	68.8 %	31.979
KOKB - MAJU	75.0 %	3479.550
KOKB - BARB	69.2 %	183.046
GOLD - VNDP	92.3 %	353.633
ASPA - MAJU	72.7 %	3058.175
GOLD - HOLB	66.7 %	1910.792
GOLD - MKEA	18.2 %	4076.554
HILR - MKEA	60.0 %	43.813
KOKB - MLO1	100.0 %	513.193
AVERAGE	72.6%	1219.844

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.