Australian Government
Geoscience Australia

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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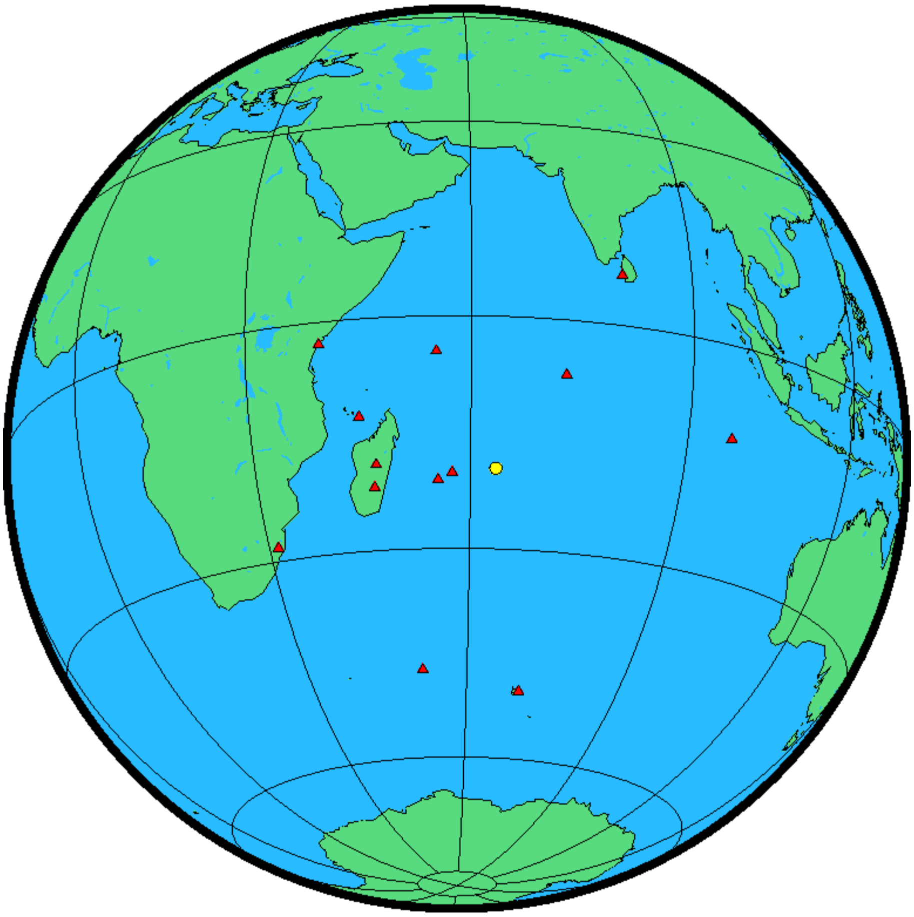
1 User Data

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
RODR	rodriguesgps.o	SEPALTUS_NR3 NONE	2.000	2019/12/18 11:05:00	2019/12/18 15:21:30

2 Processing Summary



Date	User Stations	Reference Stations	Orbit Type
2019/12/18 11:05:00	RODR	ABPO COCO CZTG DGAR KERG MAL2 MAYG REUN SEYG SGOC ULDI VACS VOIM	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 @
RODR	2688077.781	5372933.081	-2134399.553	18/12/2019
ABPO	4097216.516	4429119.222	-2065771.178	18/12/2019
COCO	-741951.091	6190961.732	-1337767.387	18/12/2019
CZTG	2719994.842	3463392.630	-4598612.940	18/12/2019
DGAR	1916268.749	6029977.738	-801719.421	18/12/2019
KERG	1406337.225	3918161.070	-4816167.384	18/12/2019
MAL2	4865385.417	4110717.502	-331137.379	18/12/2019
MAYG	4379104.208	4418744.615	-1401897.793	18/12/2019
REUN	3364098.975	4907944.639	-2293466.688	18/12/2019
SEYG	3597835.884	5240884.104	-516780.959	18/12/2019
SGOC	1113279.655	6233644.352	760277.215	18/12/2019
ULDI	4796680.983	2930311.705	-3005435.644	18/12/2019
VACS	3215946.885	5047449.775	-2198718.167	18/12/2019
VOIM	4054014.067	4316070.356	-2365223.935	18/12/2019

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)
RODR	-19 40 48.94294	63 25 16.33778	-7.462	3.047
ABPO	-19 01 05.89555	47 13 45.17072	1552.959	1553.749
COCO	-12 11 18.02435	96 50 02.31154	-35.293	3.266
CZTG	-46 25 54.82701	51 51 19.73479	202.801	151.006
DGAR	-7 16 10.85119	72 22 12.88361	-64.928	8.953
KERG	-49 21 05.28222	70 15 19.88191	73.001	32.735
MAL2	-2 59 45.79110	40 11 38.92752	-20.930	9.485
MAYG	-12 46 55.38798	45 15 29.35964	-16.560	4.031
REUN	-21 12 29.60661	55 34 18.19909	1558.361	1552.128
SEYG	-4 40 43.43160	55 31 50.27643	-37.622	3.380
SGOC	6 53 31.47963	79 52 27.04940	-78.474	18.703
ULDI	-28 17 35.21558	31 25 15.33285	608.032	583.537
VACS	-20 17 49.46812	57 29 49.34002	421.158	424.070
VOIM	-21 54 22.68141	46 47 35.76983	1163.383	1159.551

3.3 UTM Grid, GRS80 Ellipsoid, ITRF2020

Station	East (m)	North (m)	Zone	Ellipsoidal Height (m)	Derived Above Geoid Height(m)
RODR	544148.827	7823845.623	41	-7.462	3.047
ABPO	734645.822	7895659.185	38	1552.959	1553.749
COCO	264322.014	8651679.087	47	-35.293	3.266
CZTG	565724.535	4857608.508	39	202.801	151.006
DGAR	209611.489	9195594.954	43	-64.928	8.953
KERG	591183.116	4532714.019	42	73.001	32.735
MAL2	632707.818	9668770.795	37	-20.930	9.485
MAYG	528019.043	8586952.136	38	-16.560	4.031
REUN	351756.192	7654138.827	40	1558.361	1552.128
SEYG	337019.630	9482677.626	40	-37.622	3.380
SGOC	375615.891	761965.111	44	-78.474	18.703
ULDI	345152.711	6869315.488	36	608.032	583.537
VACS	551895.130	7755565.792	40	421.158	424.070
VOIM	685246.109	7576462.401	38	1163.383	1159.551

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

Station	Longitude(East) (m)	Latitude(North) (m)	Ellipsoidal Height(Up) (m)
RODR	0.014	0.011	0.046
ABPO	0.011	0.008	0.020
COCO	0.011	0.008	0.021
CZTG	0.011	0.009	0.023
DGAR	0.011	0.008	0.021
KERG	0.011	0.010	0.022
MAL2	0.014	0.009	0.022
MAYG	0.015	0.009	0.031
REUN	0.011	0.008	0.021
SEYG	0.013	0.008	0.022
SGOC	0.017	0.012	0.044
ULDI	0.021	0.012	0.046
VACS	0.011	0.008	0.022
VOIM	0.012	0.008	0.022

4 Ambiguity Resolution - Per Baseline

Baseline	Ambiguities Resolved	Baseline Length (km)
RODR - VACS	78.6 %	623.476
MAL2 - MAYG	78.9 %	1215.680
KERG - REUN	54.2 %	3343.130
CZTG - KERG	85.7 %	1407.068
COCO - DGAR	80.0 %	2716.504
ABPO - VOIM	64.7 %	322.984
ABPO - MAYG	84.2 %	721.316
REUN - ULDI	68.4 %	2543.663
ABPO - DGAR	73.3 %	2986.153
DGAR - SGOC	85.0 %	1768.079
MAYG - SEYG	95.0 %	1438.654
ABPO - REUN	61.6 %	904.754
ABPO - VACS	68.4 %	1084.732
AVERAGE	75.2%	1621.246

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.