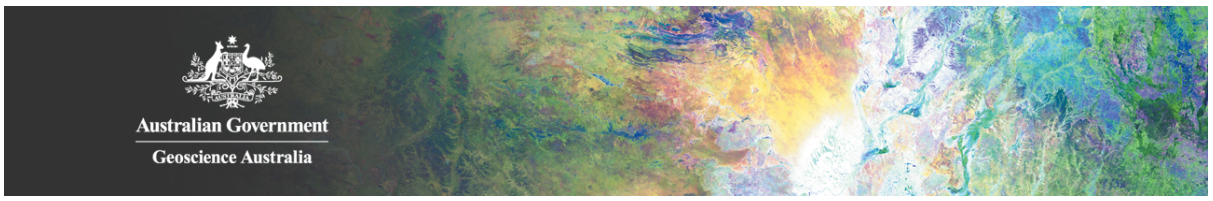

AUSPOS GPS Processing Report

July 31, 2022

This document is a report of the GPS data processing undertaken by the AUSPOS Online GPS Processing Service (version: AUSPOS 2.4) . 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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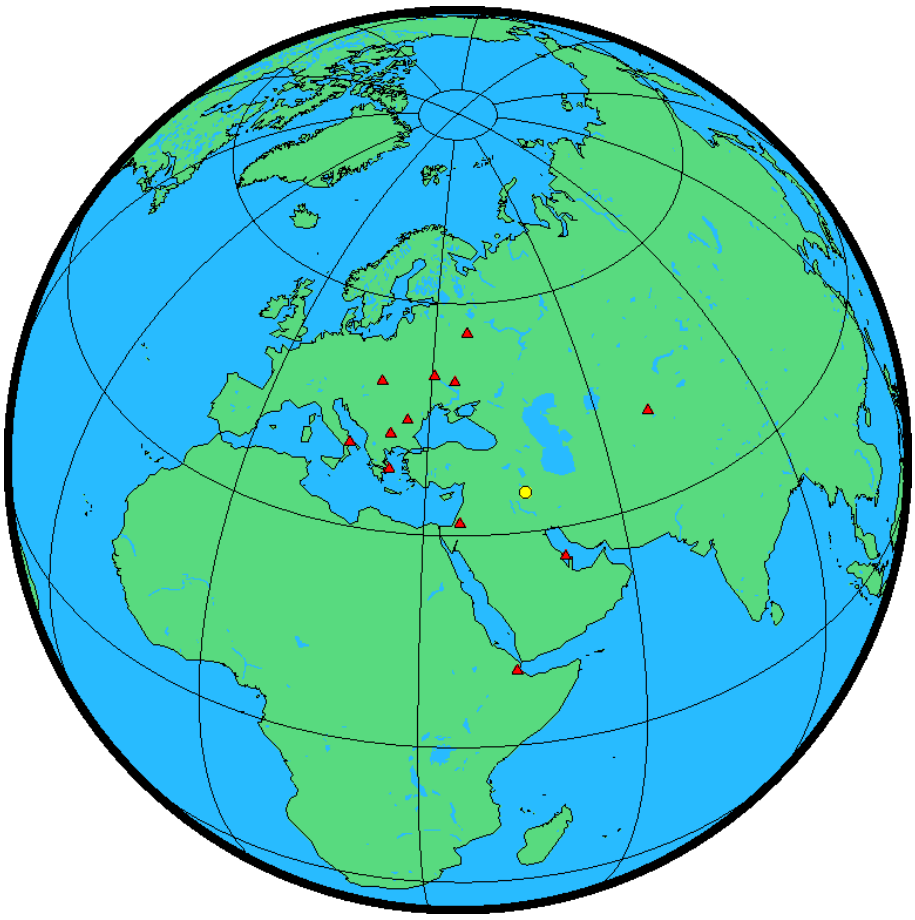
1 User Data

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
DARR	DarR.220	UNIUA35 NONE	0.000	2022/07/20 00:00:00	2022/07/20 23:59:30

2 Processing Summary



Date	User Stations	Reference Stations	Orbit Type
2022/07/20 00:00:00	DARR	BHR4 BUCU DJIG DRAG DYNG GANP GLSV MAT1 MDVJ POLV SOFI TASH	IGS rapid

3 Computed Coordinates, ITRF2014

All coordinates are based on the IGS realisation of the ITRF2014 reference frame. All the given ITRF2014 coordinates refer to a mean epoch of the site observation data. All coordinates refer to the Ground Mark.

3.1 Cartesian, ITRF2014

Station	X (m)	Y (m)	Z (m)	ITRF2014 @
DARR	3649732.959	3737635.544	3647904.090	20/07/2022
BHR4	3633910.068	4425277.917	2799863.371	20/07/2022
BUCU	4093760.560	2007794.112	4445130.149	20/07/2022
DJIG	4583085.871	4250982.704	1266243.238	20/07/2022
DRAG	4432980.304	3149432.336	3322110.787	20/07/2022
DYNG	4595220.055	2039434.215	3912625.891	20/07/2022
GANP	3929181.236	1455237.003	4793654.069	20/07/2022
GLSV	3512888.607	2068980.129	4888903.351	20/07/2022
MAT1	4641951.126	1393053.994	4133281.120	20/07/2022
MDVJ	2845455.698	2160954.455	5265993.331	20/07/2022
POLV	3411556.984	2348464.208	4834397.020	20/07/2022
SOFI	4319371.782	1868688.101	4292064.080	20/07/2022
TASH	1695944.735	4487138.695	4190140.766	20/07/2022

3.2 Geodetic, GRS80 Ellipsoid, ITRF2014

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)
DARR	35 06 25.86160	45 40 54.23711	526.715	520.096
BHR4	26 12 32.92569	50 36 29.34373	-13.880	13.690
BUCU	44 27 50.20870	26 07 32.68474	143.230	107.682
DJIG	11 31 34.64121	42 50 49.44294	711.383	724.109
DRAG	31 35 35.53382	35 23 31.46845	31.863	13.609
DYNG	38 04 42.78739	23 55 56.76685	510.574	471.288
GANP	49 02 04.97651	20 19 22.58597	746.032	703.992
GLSV	50 21 51.06538	30 29 48.25616	226.317	200.775
MAT1	40 38 56.63426	16 42 16.38393	534.526	489.023
MDVJ	56 01 17.37913	37 12 52.23747	257.103	241.408
POLV	49 36 09.41717	34 32 34.56907	178.353	159.772
SOFI	42 33 21.94740	23 23 41.05577	1119.517	1074.440
TASH	41 19 40.97922	69 17 44.05891	439.713	483.283

3.3 UTM Grid, GRS80 Ellipsoid, ITRF2014

Station	East (m)	North (m)	Zone	Ellipsoidal Height (m)	Derived Above Geoid Height(m)
DARR	562128.493	3885142.019	38	526.715	520.096
BHR4	460854.182	2898904.894	39	-13.880	13.690
BUCU	430455.884	4923776.158	35	143.230	107.682
DJIG	265181.271	1275054.352	38	711.383	724.109
DRAG	726966.061	3497829.843	36	31.863	13.609
DYNG	757212.233	4218592.073	34	510.574	471.288
GANP	450512.749	5431535.766	34	746.032	703.992
GLSV	321967.869	5582119.656	36	226.317	200.775
MAT1	644116.267	4501197.847	33	534.526	489.023
MDVJ	388711.479	6209909.963	37	257.103	241.408
POLV	611484.321	5495592.558	36	178.353	159.772
SOFI	696595.332	4714301.431	34	1119.517	1074.440
TASH	524734.407	4575216.871	42	439.713	483.283

3.4 Positional Uncertainty (95% C.L.) - Geodetic, ITRF2014

Station	Longitude(East) (m)	Latitude(North) (m)	Ellipsoidal Height(Up) (m)
DARR	0.005	0.004	0.012
BHR4	0.005	0.003	0.008
BUCU	0.004	0.003	0.007
DJIG	0.006	0.005	0.012
DRAG	0.004	0.003	0.008
DYNG	0.005	0.003	0.008
GANP	0.005	0.003	0.008
GLSV	0.004	0.003	0.007
MAT1	0.005	0.003	0.008
MDVJ	0.004	0.003	0.008
POLV	0.004	0.003	0.008
SOFI	0.005	0.003	0.008
TASH	0.006	0.003	0.010

4 Ambiguity Resolution - Per Baseline

Baseline	Ambiguities Resolved	Baseline Length (km)
GLSV - POLV	84.3 %	302.242
DRAG - DARR	70.6 %	1032.279
BHR4 - DJIG	77.2 %	1811.989
DJIG - DRAG	21.8 %	2337.207
BUCU - GLSV	91.2 %	733.547
GLSV - MDVJ	86.6 %	772.090
BUCU - DYNG	94.4 %	732.136
BUCU - SOFI	57.6 %	306.072
DRAG - DYNG	87.1 %	1267.725
GANP - GLSV	95.0 %	747.698
BUCU - MAT1	72.7 %	880.720
BHR4 - TASH	32.2 %	2385.877
AVERAGE	72.6%	1109.132

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	IGS14 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	IGS14 phase-centre variation model applied
Satellite phase centre calibration	IGS14 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	IGS14 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 ITRF2014. Uncertainties are scaled using an empirically derived model which is a function of data span, quality and geographical location.