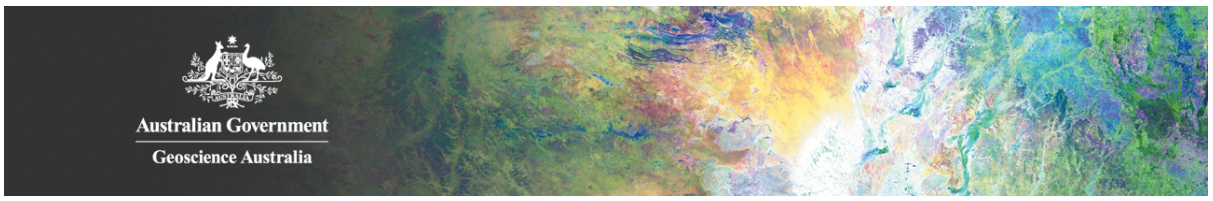

AUSPOS GPS Processing Report

September 14, 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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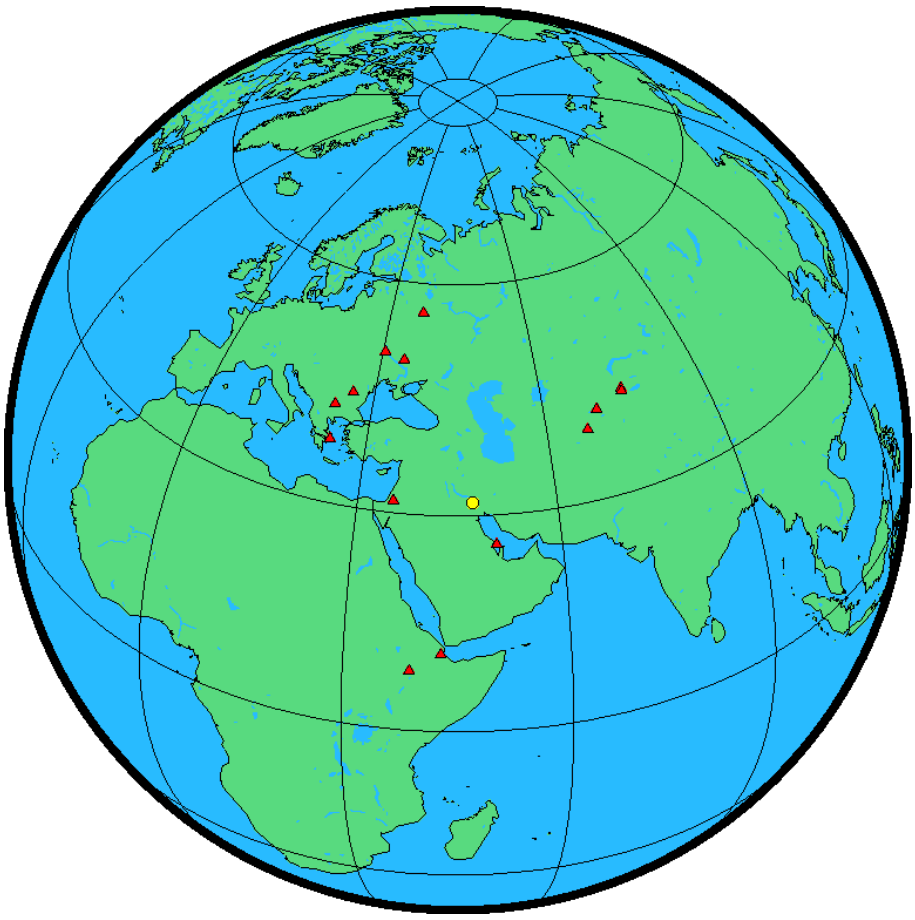
1 User Data

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
AMAR	AmaR99IRQ_R_2022 2300000_01D_01S.22O	UNIUA35 NONE	0.000	2022/08/18 00:00:00	2022/08/18 23:59:30

2 Processing Summary



Date	User Stations	Reference Stations	Orbit Type
2022/08/18 00:00:00	AMAR	ADIS BHR4 BUCU CHUM DJIG DRAG DYNG GLSV KIT3 MDVJ POL2 POLV SOFI TASH	IGS final

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 @
AMAR	3685767.139	3992557.175	3328750.336	18/08/2022
ADIS	4913652.507	3945922.865	995383.555	18/08/2022
BHR4	3633910.062	4425277.913	2799863.371	18/08/2022
BUCU	4093760.560	2007794.114	4445130.152	18/08/2022
CHUM	1228950.316	4508080.013	4327868.544	18/08/2022
DJIG	4583085.875	4250982.707	1266243.242	18/08/2022
DRAG	4432980.308	3149432.342	3322110.793	18/08/2022
DYNG	4595220.059	2039434.214	3912625.889	18/08/2022
GLSV	3512888.607	2068980.130	4888903.354	18/08/2022
KIT3	1944944.657	4556652.368	4004326.065	18/08/2022
MDVJ	2845455.696	2160954.455	5265993.337	18/08/2022
POL2	1239970.886	4530790.171	4302578.882	18/08/2022
POLV	3411556.981	2348464.207	4834397.018	18/08/2022
SOFI	4319371.788	1868688.102	4292064.083	18/08/2022
TASH	1695944.732	4487138.687	4190140.765	18/08/2022

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)
AMAR	31 39 49.31768	47 17 16.99847	1.325	14.720
ADIS	9 02 06.49614	38 45 58.70449	2439.109	2446.168
BHR4	26 12 32.92580	50 36 29.34381	-13.886	13.684
BUCU	44 27 50.20873	26 07 32.68483	143.233	107.685
CHUM	42 59 54.60571	74 45 03.97621	716.340	759.330
DJIG	11 31 34.64129	42 50 49.44294	711.389	724.115
DRAG	31 35 35.53387	35 23 31.46856	31.871	13.617
DYNG	38 04 42.78727	23 55 56.76677	510.575	471.289
GLSV	50 21 51.06545	30 29 48.25619	226.320	200.778
KIT3	39 08 05.16384	66 53 07.62362	622.477	659.574
MDVJ	56 01 17.37926	37 12 52.23755	257.107	241.412
POL2	42 40 47.17486	74 41 39.37550	1714.213	1754.279
POLV	49 36 09.41720	34 32 34.56911	178.350	159.769
SOFI	42 33 21.94735	23 23 41.05572	1119.524	1074.447
TASH	41 19 40.97938	69 17 44.05889	439.705	483.275

3.3 UTM Grid, GRS80 Ellipsoid, ITRF2014

Station	East (m)	North (m)	Zone	Ellipsoidal Height (m)	Derived Above Geoid Height(m)
AMAR	716930.221	3505434.762	38	1.325	14.720
ADIS	474316.264	998745.145	37	2439.109	2446.168
BHR4	460854.185	2898904.897	39	-13.886	13.684
BUCU	430455.886	4923776.159	35	143.233	107.685
CHUM	479712.441	4760678.451	43	716.340	759.330
DJIG	265181.271	1275054.354	38	711.389	724.115
DRAG	726966.064	3497829.845	36	31.871	13.617
DYNG	757212.231	4218592.070	34	510.575	471.289
GLSV	321967.870	5582119.658	36	226.320	200.778
KIT3	317236.820	4333861.164	42	622.477	659.574
MDVJ	388711.481	6209909.967	37	257.107	241.412
POL2	474951.503	4725300.190	43	1714.213	1754.279
POLV	611484.322	5495592.559	36	178.350	159.769
SOFI	696595.331	4714301.430	34	1119.524	1074.447
TASH	524734.407	4575216.876	42	439.705	483.275

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

Station	Longitude(East) (m)	Latitude(North) (m)	Ellipsoidal Height(Up) (m)
AMAR	0.006	0.005	0.019
ADIS	0.005	0.004	0.010
BHR4	0.005	0.003	0.008
BUCU	0.005	0.003	0.007
CHUM	0.005	0.003	0.008
DJIG	0.005	0.004	0.010
DRAG	0.004	0.003	0.008
DYNG	0.005	0.003	0.008
GLSV	0.004	0.003	0.008
KIT3	0.005	0.003	0.008
MDVJ	0.004	0.003	0.009
POL2	0.005	0.003	0.008
POLV	0.004	0.003	0.008
SOFI	0.005	0.003	0.008
TASH	0.005	0.003	0.008

4 Ambiguity Resolution - Per Baseline

Baseline	Ambiguities Resolved	Baseline Length (km)
MDVJ - POLV	77.9 %	736.143
KIT3 - TASH	83.4 %	318.371
CHUM - POL2	81.5 %	35.732
BHR4 - DJIG	76.2 %	1811.989
GLSV - POLV	80.3 %	302.242
DJIG - DRAG	30.0 %	2337.207
BUCU - GLSV	94.9 %	733.547
DRAG - DYNG	87.5 %	1267.725
BUCU - DYNG	96.2 %	732.136
BUCU - SOFI	69.9 %	306.072
BHR4 - AMAR	73.1 %	685.316
CHUM - TASH	81.6 %	487.331
ADIS - DJIG	65.8 %	525.072
BHR4 - TASH	35.6 %	2385.877
AVERAGE	73.9%	904.626

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.