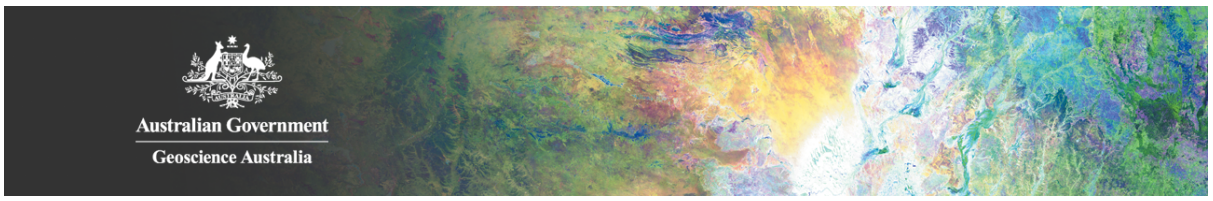

AUSPOS GPS Processing Report

August 15, 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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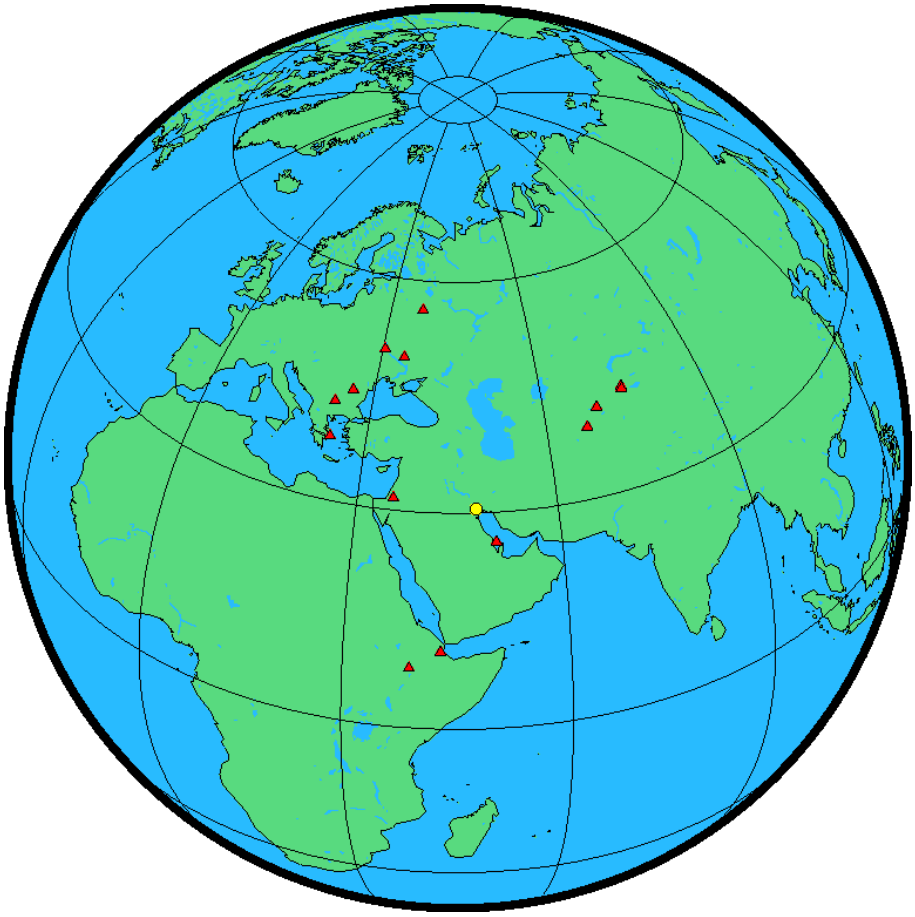
1 User Data

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
BASR	0_01D_01S_R_20 222150000_01D_01S_MO.rnx	UNIUA35 NONE	0.000	2022/08/03 00:00:00	2022/08/03 23:59:30

2 Processing Summary



Date	User Stations	Reference Stations	Orbit Type
2022/08/03 00:00:00	BASR	ADIS BHR4 BUCU CHUM DJIG DRAG DYNG GLSV KIT3 MDVJ POL2 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 @
BASR	3695207.772	4073761.527	3218801.032	03/08/2022
ADIS	4913652.512	3945922.868	995383.555	03/08/2022
BHR4	3633910.065	4425277.911	2799863.371	03/08/2022
BUCU	4093760.560	2007794.113	4445130.151	03/08/2022
CHUM	1228950.316	4508080.011	4327868.542	03/08/2022
DJIG	4583085.873	4250982.705	1266243.240	03/08/2022
DRAG	4432980.306	3149432.339	3322110.793	03/08/2022
DYNG	4595220.055	2039434.215	3912625.886	03/08/2022
GLSV	3512888.600	2068980.127	4888903.345	03/08/2022
KIT3	1944944.657	4556652.362	4004326.061	03/08/2022
MDVJ	2845455.694	2160954.453	5265993.330	03/08/2022
POL2	1239970.887	4530790.169	4302578.880	03/08/2022
POLV	3411556.987	2348464.209	4834397.022	03/08/2022
SOFI	4319371.787	1868688.105	4292064.087	03/08/2022
TASH	1695944.734	4487138.686	4190140.762	03/08/2022

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)
BASR	30 30 20.64498	47 47 22.59456	-2.528	12.908
ADIS	9 02 06.49612	38 45 58.70447	2439.115	2446.174
BHR4	26 12 32.92580	50 36 29.34368	-13.886	13.684
BUCU	44 27 50.20873	26 07 32.68478	143.232	107.684
CHUM	42 59 54.60571	74 45 03.97617	716.337	759.327
DJIG	11 31 34.64126	42 50 49.44293	711.386	724.112
DRAG	31 35 35.53394	35 23 31.46852	31.869	13.615
DYNG	38 04 42.78727	23 55 56.76684	510.570	471.284
GLSV	50 21 51.06545	30 29 48.25622	226.309	200.767
KIT3	39 08 05.16384	66 53 07.62354	622.470	659.567
MDVJ	56 01 17.37921	37 12 52.23751	257.100	241.405
POL2	42 40 47.17485	74 41 39.37542	1714.210	1754.276
POLV	49 36 09.41714	34 32 34.56905	178.357	159.776
SOFI	42 33 21.94744	23 23 41.05585	1119.527	1074.450
TASH	41 19 40.97931	69 17 44.05880	439.703	483.273

3.3 UTM Grid, GRS80 Ellipsoid, ITRF2014

Station	East (m)	North (m)	Zone	Ellipsoidal Height (m)	Derived Above Geoid Height(m)
BASR	767728.341	3378137.135	38	-2.528	12.908
ADIS	474316.264	998745.145	37	2439.115	2446.174
BHR4	460854.181	2898904.897	39	-13.886	13.684
BUCU	430455.885	4923776.159	35	143.232	107.684
CHUM	479712.440	4760678.451	43	716.337	759.327
DJIG	265181.271	1275054.353	38	711.386	724.112
DRAG	726966.062	3497829.846	36	31.869	13.615
DYNG	757212.233	4218592.070	34	510.570	471.284
GLSV	321967.870	5582119.658	36	226.309	200.767
KIT3	317236.818	4333861.164	42	622.470	659.567
MDVJ	388711.480	6209909.965	37	257.100	241.405
POL2	474951.501	4725300.189	43	1714.210	1754.276
POLV	611484.321	5495592.557	36	178.357	159.776
SOFI	696595.334	4714301.432	34	1119.527	1074.450
TASH	524734.405	4575216.874	42	439.703	483.273

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

Station	Longitude(East) (m)	Latitude(North) (m)	Ellipsoidal Height(Up) (m)
BASR	0.006	0.005	0.016
ADIS	0.006	0.005	0.011
BHR4	0.005	0.003	0.008
BUCU	0.005	0.003	0.008
CHUM	0.005	0.003	0.009
DJIG	0.005	0.005	0.011
DRAG	0.005	0.003	0.008
DYNG	0.005	0.003	0.009
GLSV	0.005	0.003	0.008
KIT3	0.005	0.003	0.009
MDVJ	0.005	0.004	0.010
POL2	0.005	0.003	0.010
POLV	0.005	0.003	0.008
SOFI	0.005	0.003	0.009
TASH	0.005	0.003	0.008

4 Ambiguity Resolution - Per Baseline

Baseline	Ambiguities Resolved	Baseline Length (km)
KIT3 - TASH	76.4 %	318.371
CHUM - POL2	80.3 %	35.732
BHR4 - DJIG	75.7 %	1811.989
GLSV - POLV	80.5 %	302.242
DJIG - DRAG	34.5 %	2337.207
BUCU - GLSV	96.3 %	733.547
GLSV - MDVJ	85.1 %	772.090
DRAG - DYNG	83.0 %	1267.725
BUCU - DYNG	98.1 %	732.136
BUCU - SOFI	58.6 %	306.072
BHR4 - BASR	63.9 %	550.300
CHUM - TASH	85.4 %	487.331
ADIS - DJIG	75.0 %	525.072
BHR4 - TASH	14.3 %	2385.877
AVERAGE	72.0%	897.549

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.