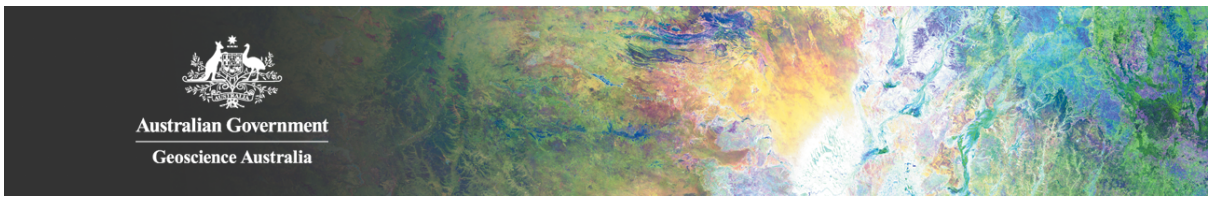


AUSPOS GPS Processing Report

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.

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

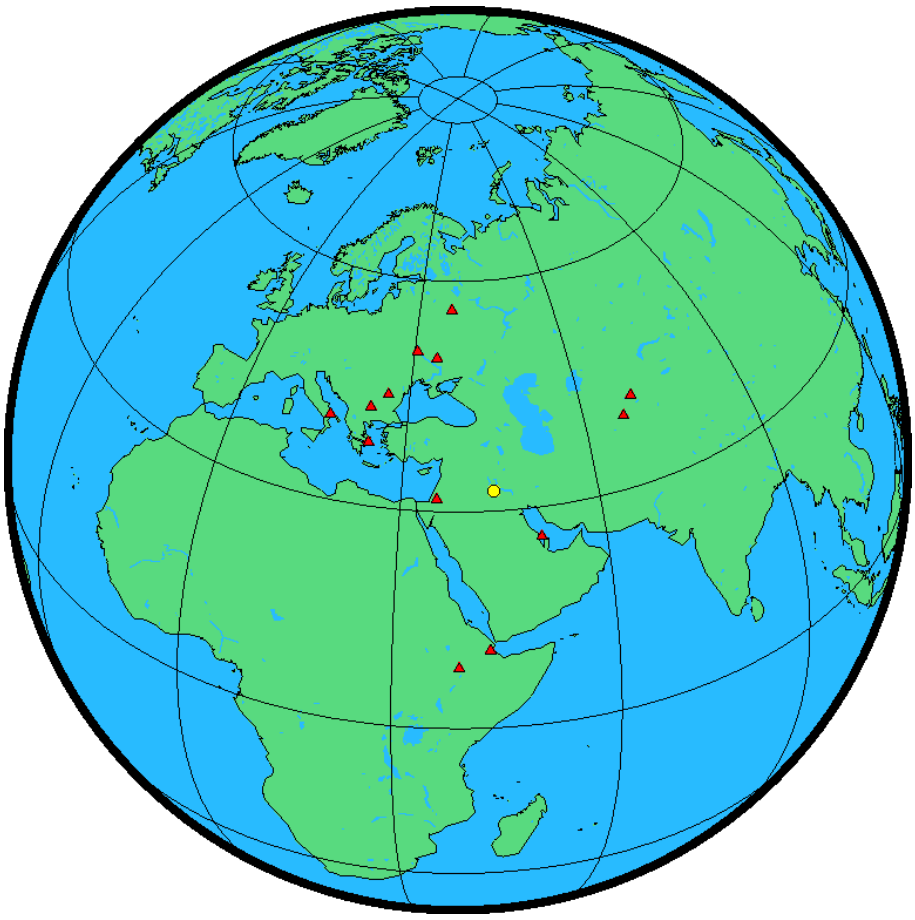
Geoscience Australia
Cnr Jerrabomberra and Hindmarsh Drive
GPO Box 378, Canberra, ACT 2601, Australia
Freecall (Within Australia): 1800 800 173
Tel: +61 2 6249 9111. Fax +61 2 6249 9929
Geoscience Australia
Home Page: http://www.ga.gov.au

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
KBLR	KblR.220	UNIUA35 NONE	0.000	2022/07/21 00:00:00	2022/07/21 23:59:30

2 Processing Summary



Date	User Stations	Reference Stations	Orbit Type
2022/07/21 00:00:00	KBLR	ADIS BHR4 BUCU DJIG DRAG DYNG GLSV KITG 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 @
KBLR	3868476.106	3736971.702	3416495.855	21/07/2022
ADIS	4913652.515	3945922.871	995383.555	21/07/2022
BHR4	3633910.066	4425277.912	2799863.371	21/07/2022
BUCU	4093760.561	2007794.112	4445130.151	21/07/2022
DJIG	4583085.873	4250982.706	1266243.240	21/07/2022
DRAG	4432980.304	3149432.335	3322110.790	21/07/2022
DYNG	4595220.054	2039434.211	3912625.887	21/07/2022
GLSV	3512888.607	2068980.128	4888903.349	21/07/2022
KITG	1944879.570	4556783.834	4004205.961	21/07/2022
MAT1	4641951.128	1393053.993	4133281.123	21/07/2022
MDVJ	2845455.698	2160954.456	5265993.338	21/07/2022
POLV	3411556.984	2348464.207	4834397.020	21/07/2022
SOFI	4319371.787	1868688.102	4292064.083	21/07/2022
TASH	1695944.736	4487138.694	4190140.766	21/07/2022

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)
KBLR	32 35 52.37206	44 00 33.86840	42.574	43.615
ADIS	9 02 06.49608	38 45 58.70450	2439.119	2446.178
BHR4	26 12 32.92575	50 36 29.34367	-13.884	13.686
BUCU	44 27 50.20872	26 07 32.68472	143.232	107.684
DJIG	11 31 34.64126	42 50 49.44293	711.386	724.112
DRAG	31 35 35.53391	35 23 31.46845	31.863	13.609
DYNG	38 04 42.78736	23 55 56.76673	510.569	471.283
GLSV	50 21 51.06537	30 29 48.25611	226.316	200.774
KITG	39 08 00.19169	66 53 12.26440	620.644	657.738
MAT1	40 38 56.63429	16 42 16.38388	534.530	489.027
MDVJ	56 01 17.37922	37 12 52.23748	257.110	241.415
POLV	49 36 09.41721	34 32 34.56904	178.353	159.772
SOFI	42 33 21.94738	23 23 41.05573	1119.523	1074.446
TASH	41 19 40.97923	69 17 44.05887	439.712	483.282

3.3 UTM Grid, GRS80 Ellipsoid, ITRF2014

Station	East (m)	North (m)	Zone	Ellipsoidal Height (m)	Derived Above Geoid Height(m)
KBLR	407043.570	3607142.381	38	42.574	43.615
ADIS	474316.264	998745.144	37	2439.119	2446.178
BHR4	460854.181	2898904.896	39	-13.884	13.686
BUCU	430455.883	4923776.159	35	143.232	107.684
DJIG	265181.271	1275054.353	38	711.386	724.112
DRAG	726966.061	3497829.846	36	31.863	13.609
DYNG	757212.230	4218592.072	34	510.569	471.283
GLSV	321967.868	5582119.656	36	226.316	200.774
KITG	317344.680	4333705.275	42	620.644	657.738
MAT1	644116.266	4501197.848	33	534.530	489.027
MDVJ	388711.480	6209909.966	37	257.110	241.415
POLV	611484.320	5495592.559	36	178.353	159.772
SOFI	696595.332	4714301.430	34	1119.523	1074.446
TASH	524734.406	4575216.871	42	439.712	483.282

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

Station	Longitude(East) (m)	Latitude(North) (m)	Ellipsoidal Height(Up) (m)
KBLR	0.005	0.003	0.012
ADIS	0.005	0.004	0.010
BHR4	0.005	0.003	0.008
BUCU	0.004	0.003	0.007
DJIG	0.005	0.004	0.010
DRAG	0.004	0.003	0.007
DYNG	0.005	0.003	0.008
GLSV	0.004	0.003	0.007
KITG	0.006	0.003	0.010
MAT1	0.005	0.003	0.008
MDVJ	0.004	0.003	0.009
POLV	0.004	0.003	0.008
SOFI	0.005	0.003	0.008
TASH	0.006	0.003	0.009

4 Ambiguity Resolution - Per Baseline

Baseline	Ambiguities Resolved	Baseline Length (km)
KITG - TASH	89.5 %	318.419
GLSV - POLV	77.8 %	302.242
DRAG - KBLR	62.0 %	820.229
BHR4 - DJIG	85.7 %	1811.989
DJIG - DRAG	31.2 %	2337.207
BUCU - GLSV	86.5 %	733.547
GLSV - MDVJ	77.1 %	772.090
DRAG - DYNG	89.3 %	1267.725
BUCU - DYNG	90.8 %	732.136
BUCU - SOFI	66.3 %	306.072
BUCU - MAT1	73.7 %	880.720
ADIS - DJIG	68.9 %	525.072
BHR4 - TASH	32.8 %	2385.877
AVERAGE	71.7%	1014.871

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.