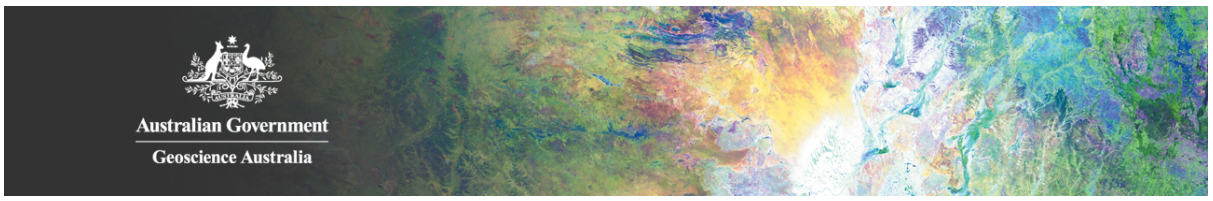

AUSPOS GPS Processing Report

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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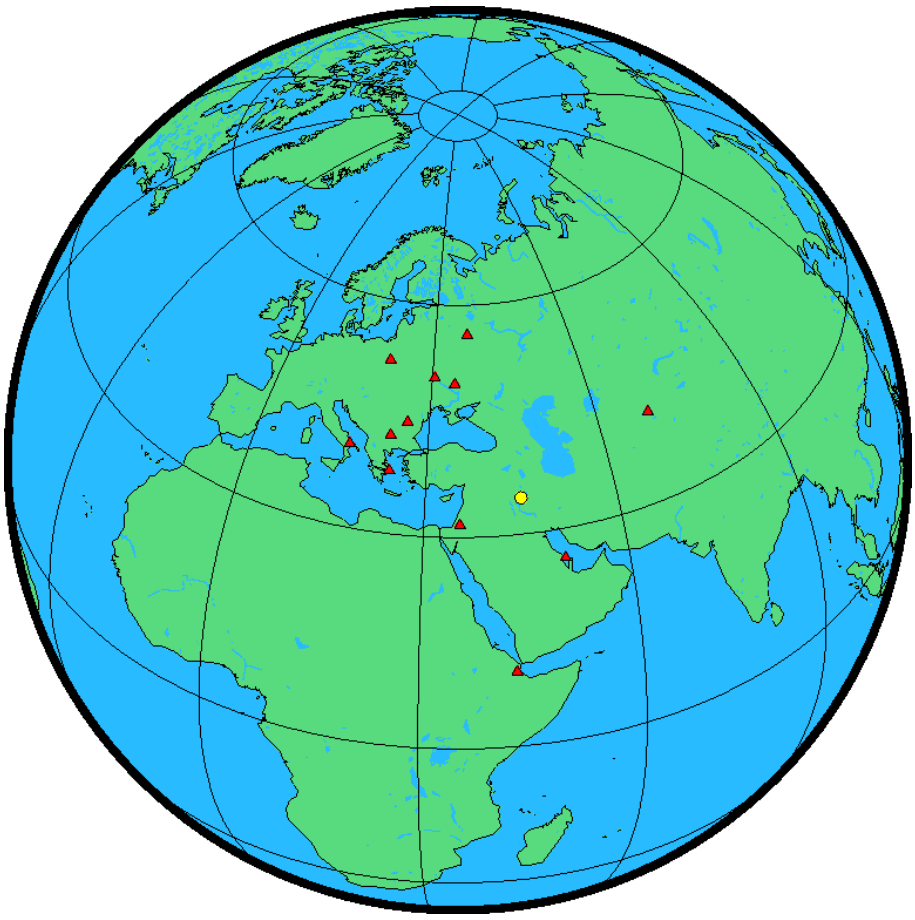
1 User Data

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
KUKR	KukR.220	UNIUA35 NONE	0.000	2022/07/20 00:00:00	2022/07/20 00:43:30

2 Processing Summary



Date	User Stations	Reference Stations	Orbit Type
2022/07/20 00:00:00	KUKR	BHR4 BUCU DJIG DRAG DYNG GLSV JOZ2 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 @
KUKR	3716167.982	3709671.820	3608904.242	20/07/2022
BHR4	3633910.056	4425277.901	2799863.368	20/07/2022
BUCU	4093760.569	2007794.114	4445130.148	20/07/2022
DJIG	4583085.868	4250982.702	1266243.244	20/07/2022
DRAG	4432980.299	3149432.334	3322110.790	20/07/2022
DYNG	4595220.045	2039434.203	3912625.878	20/07/2022
GLSV	3512888.609	2068980.130	4888903.344	20/07/2022
JOZ2	3664880.252	1409190.864	5009618.619	20/07/2022
MAT1	4641951.123	1393053.993	4133281.119	20/07/2022
MDVJ	2845455.699	2160954.457	5265993.335	20/07/2022
POLV	3411556.975	2348464.203	4834397.010	20/07/2022
SOFI	4319371.781	1868688.103	4292064.083	20/07/2022
TASH	1695944.738	4487138.685	4190140.761	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)
KUKR	34 40 49.75917	44 56 59.55855	227.417	225.362
BHR4	26 12 32.92588	50 36 29.34370	-13.899	13.671
BUCU	44 27 50.20847	26 07 32.68465	143.235	107.687
DJIG	11 31 34.64142	42 50 49.44294	711.381	724.107
DRAG	31 35 35.53398	35 23 31.46852	31.860	13.606
DYNG	38 04 42.78736	23 55 56.76659	510.555	471.269
GLSV	50 21 51.06521	30 29 48.25614	226.314	200.772
JOZ2	52 05 52.21713	21 01 56.48349	152.511	120.968
MAT1	40 38 56.63430	16 42 16.38394	534.523	489.020
MDVJ	56 01 17.37913	37 12 52.23751	257.108	241.413
POLV	49 36 09.41721	34 32 34.56912	178.339	159.758
SOFI	42 33 21.94747	23 23 41.05587	1119.520	1074.443
TASH	41 19 40.97925	69 17 44.05862	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)
KUKR	495408.520	3837612.547	38	227.417	225.362
BHR4	460854.182	2898904.900	39	-13.899	13.671
BUCU	430455.882	4923776.151	35	143.235	107.687
DJIG	265181.271	1275054.358	38	711.381	724.107
DRAG	726966.062	3497829.848	36	31.860	13.606
DYNG	757212.226	4218592.072	34	510.555	471.269
GLSV	321967.868	5582119.650	36	226.314	200.772
JOZ2	502216.447	5771920.629	34	152.511	120.968
MAT1	644116.267	4501197.848	33	534.523	489.020
MDVJ	388711.480	6209909.963	37	257.108	241.413
POLV	611484.322	5495592.559	36	178.339	159.758
SOFI	696595.335	4714301.433	34	1119.520	1074.443
TASH	524734.401	4575216.872	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)
KUKR	0.596	0.089	0.204 *
BHR4	0.009	0.006	0.013
BUCU	0.009	0.006	0.013
DJIG	0.027	0.019	0.038
DRAG	0.009	0.006	0.013
DYNG	0.025	0.016	0.038
GLSV	0.008	0.006	0.013
JOZ2	0.015	0.014	0.035
MAT1	0.009	0.006	0.013
MDVJ	0.008	0.006	0.013
POLV	0.009	0.006	0.013
SOFI	0.009	0.006	0.013
TASH	0.009	0.006	0.013

***WARNING:**
The estimated coordinates have precision outside of the boundary of 0.095 m
Please use this solution with caution

4 Ambiguity Resolution - Per Baseline

Baseline	Ambiguities Resolved	Baseline Length (km)
GLSV - POLV	0.0 %	302.242
GLSV - JOZ2	88.9 %	687.747
BHR4 - DJIG	15.4 %	1811.989
DYNG - POLV	0.0 %	1531.738
POLV - TASH	0.0 %	2816.437
DJIG - DRAG	0.0 %	2337.207
BUCU - GLSV	0.0 %	733.547
GLSV - MDVJ	62.5 %	772.090
DRAG - DYNG	50.0 %	1267.725
GLSV - SOFI	0.0 %	1023.108
BHR4 - KUKR	0.0 %	1083.238
BUCU - MAT1	0.0 %	880.720
AVERAGE	18.1%	1270.649

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.

***WARNING:**

This solution has not resolved any ambiguities for your submitted data. Please use this solution with caution.

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.