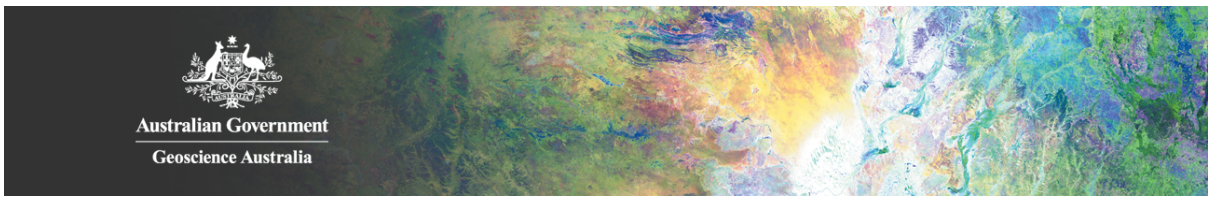

AUSPOS GPS Processing Report

February 23, 2023

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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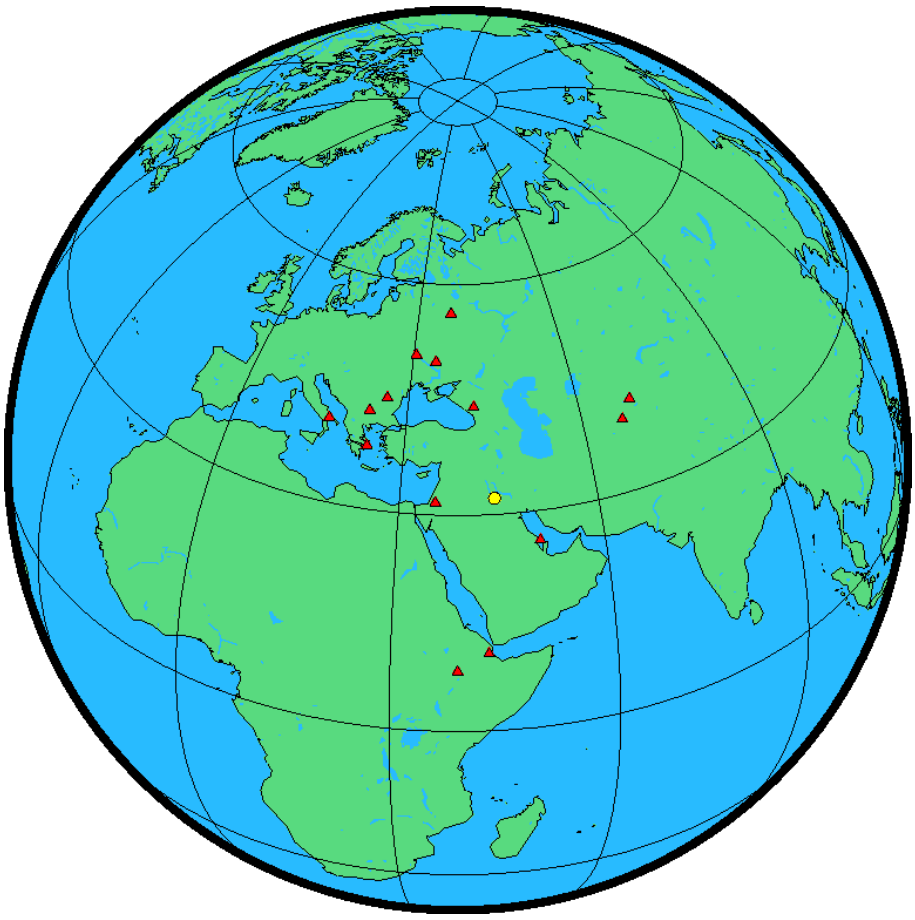
1 User Data

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
NAJR	NajR99IRQ_R_2023 0380000_01D_01S.23O	UNIUA35 NONE	0.000	2023/02/07 00:00:00	2023/02/07 23:59:30

2 Processing Summary



Date	User Stations	Reference Stations	Orbit Type
2023/02/07 00:00:00	NAJR	ADIS BHR4 BUCU DJIG DRAG DYNG GLSV KIT3 MAT1 MDVJ POLV SOFI TASH ZECK	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 @
NAJR	3872137.815	3777605.232	3367662.262	07/02/2023
ADIS	4913652.500	3945922.876	995383.569	07/02/2023
BHR4	3633910.040	4425277.907	2799863.385	07/02/2023
BUCU	4093760.544	2007794.118	4445130.146	07/02/2023
DJIG	4583085.857	4250982.713	1266243.255	07/02/2023
DRAG	4432980.277	3149432.345	3322110.802	07/02/2023
DYNG	4595220.046	2039434.212	3912625.880	07/02/2023
GLSV	3512888.596	2068980.137	4888903.344	07/02/2023
KIT3	1944944.654	4556652.374	4004326.073	07/02/2023
MAT1	4641951.113	1393054.008	4133281.131	07/02/2023
MDVJ	2845455.686	2160954.456	5265993.319	07/02/2023
POLV	3411556.970	2348464.213	4834397.017	07/02/2023
SOFI	4319371.771	1868688.112	4292064.084	07/02/2023
TASH	1695944.719	4487138.682	4190140.765	07/02/2023
ZECK	3451174.309	3060335.694	4391955.812	07/02/2023

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)
NAJR	32 04 35.80852	44 17 31.18858	55.113	57.645
ADIS	9 02 06.49658	38 45 58.70493	2439.113	2446.172
BHR4	26 12 32.92648	50 36 29.34427	-13.896	13.674
BUCU	44 27 50.20890	26 07 32.68534	143.220	107.672
DJIG	11 31 34.64179	42 50 49.44347	711.382	724.108
DRAG	31 35 35.53450	35 23 31.46934	31.856	13.602
DYNG	38 04 42.78731	23 55 56.76691	510.560	471.274
GLSV	50 21 51.06539	30 29 48.25678	226.309	200.767
KIT3	39 08 05.16397	66 53 07.62385	622.485	659.582
MAT1	40 38 56.63471	16 42 16.38467	534.527	489.024
MDVJ	56 01 17.37912	37 12 52.23795	257.089	241.394
POLV	49 36 09.41733	34 32 34.56968	178.345	159.764
SOFI	42 33 21.94762	23 23 41.05639	1119.516	1074.439
TASH	41 19 40.97956	69 17 44.05933	439.698	483.268
ZECK	43 47 18.22100	41 33 54.25886	1166.302	1143.402

3.3 UTM Grid, GRS80 Ellipsoid, ITRF2014

Station	East (m)	North (m)	Zone	Ellipsoidal Height (m)	Derived Above Geoid Height(m)
NAJR	433180.236	3549147.020	38	55.113	57.645
ADIS	474316.278	998745.159	37	2439.113	2446.172
BHR4	460854.197	2898904.918	39	-13.896	13.674
BUCU	430455.897	4923776.164	35	143.220	107.672
DJIG	265181.287	1275054.369	38	711.382	724.108
DRAG	726966.084	3497829.864	36	31.856	13.602
DYNG	757212.234	4218592.071	34	510.560	471.274
GLSV	321967.881	5582119.656	36	226.309	200.767
KIT3	317236.826	4333861.168	42	622.485	659.582
MAT1	644116.284	4501197.861	33	534.527	489.024
MDVJ	388711.488	6209909.962	37	257.089	241.394
POLV	611484.333	5495592.563	36	178.345	159.764
SOFI	696595.346	4714301.438	34	1119.516	1074.439
TASH	524734.417	4575216.881	42	439.698	483.268
ZECK	706384.875	4851568.743	37	1166.302	1143.402

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

Station	Longitude(East) (m)	Latitude(North) (m)	Ellipsoidal Height(Up) (m)
NAJR	0.004	0.003	0.010
ADIS	0.004	0.003	0.009
BHR4	0.004	0.003	0.008
BUCU	0.003	0.003	0.006
DJIG	0.004	0.003	0.009
DRAG	0.003	0.003	0.007
DYNG	0.004	0.003	0.007
GLSV	0.003	0.003	0.007
KIT3	0.004	0.003	0.008
MAT1	0.004	0.003	0.007
MDVJ	0.003	0.003	0.007
POLV	0.003	0.003	0.006
SOFI	0.004	0.003	0.007
TASH	0.004	0.003	0.008
ZECK	0.003	0.003	0.006

4 Ambiguity Resolution - Per Baseline

Baseline	Ambiguities Resolved	Baseline Length (km)
KIT3 - TASH	89.6 %	318.371
GLSV - POLV	86.6 %	302.242
DRAG - NAJR	90.9 %	843.339
TASH - ZECK	43.5 %	2270.975
BHR4 - DJIG	84.6 %	1811.989
DJIG - DRAG	23.2 %	2337.207
POLV - ZECK	85.7 %	839.098
DYNG - SOFI	90.6 %	499.219
BUCU - SOFI	78.3 %	306.072
DRAG - DYNG	75.9 %	1267.725
MDVJ - POLV	85.5 %	736.143
BUCU - MAT1	77.6 %	880.720
BUCU - POLV	88.9 %	856.146
ADIS - DJIG	72.5 %	525.072
AVERAGE	76.7%	985.308

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.