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AUSPOS Online GPS Processing Report

Space Geodesy Analysis Centre
Minerals and Geohazards Division, Geoscience Australia

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This document is a report of the GPS data processing undertaken by the AUSPOS Online GPS Processing Service. The AUSPOS Online GPS Processing Service uses International GPS Service (IGS) products (final, rapid, ultra-rapid depending on availability) including Precise Orbits, Earth Orientation, Coordinate Solutions (IGS-SSC) to compute precise coordinates in ITRF anywhere on Earth. The Service is designed to process only dual frequency GPS phase data.

The AUSPOS Online GPS Processing Service is a free service and you are encouraged to use it for your projects. However, you may not charge others for this service. Geoscience Australia does not warrant that this service a) is error free; b) meets the customer's requirements. Geoscience Australia shall not be liable to the customer in respect of any loss, damage or injury (including consequential loss, damage or injury) however caused, which may arise directly or indirectly in respect of this service.

An overview of the GPS processing strategy is attached to this report. Please direct email correspondence to geodesy@ga.gov.au

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1 User and IGS GPS Data

All antenna heights refer to the vertical distance from the Ground Mark to the Antenna Reference Point (ARP).

User File	Antenna Type	Antenna Height (m)	Start Time	End Time
APMP0780.040	DEFAULT (NONE)	0.0000	2004-03-18 01:25:59	2004-03-18 23:59:59
APMP0790.040	DEFAULT (NONE)	0.0000	2004-03-19 00:00:00	2004-03-19 23:59:59
APMP0800.040	DEFAULT (NONE)	0.0000	2004-03-20 00:00:00	2004-03-20 23:59:59
APMP0810.040	DEFAULT (NONE)	0.0000	2004-03-21 00:00:00	2004-03-21 23:59:59
APMP0820.040	DEFAULT (NONE)	0.0000	2004-03-22 00:00:00	2004-03-22 23:59:59
APMP0830.040	DEFAULT (NONE)	0.0000	2004-03-23 00:00:00	2004-03-23 23:59:59

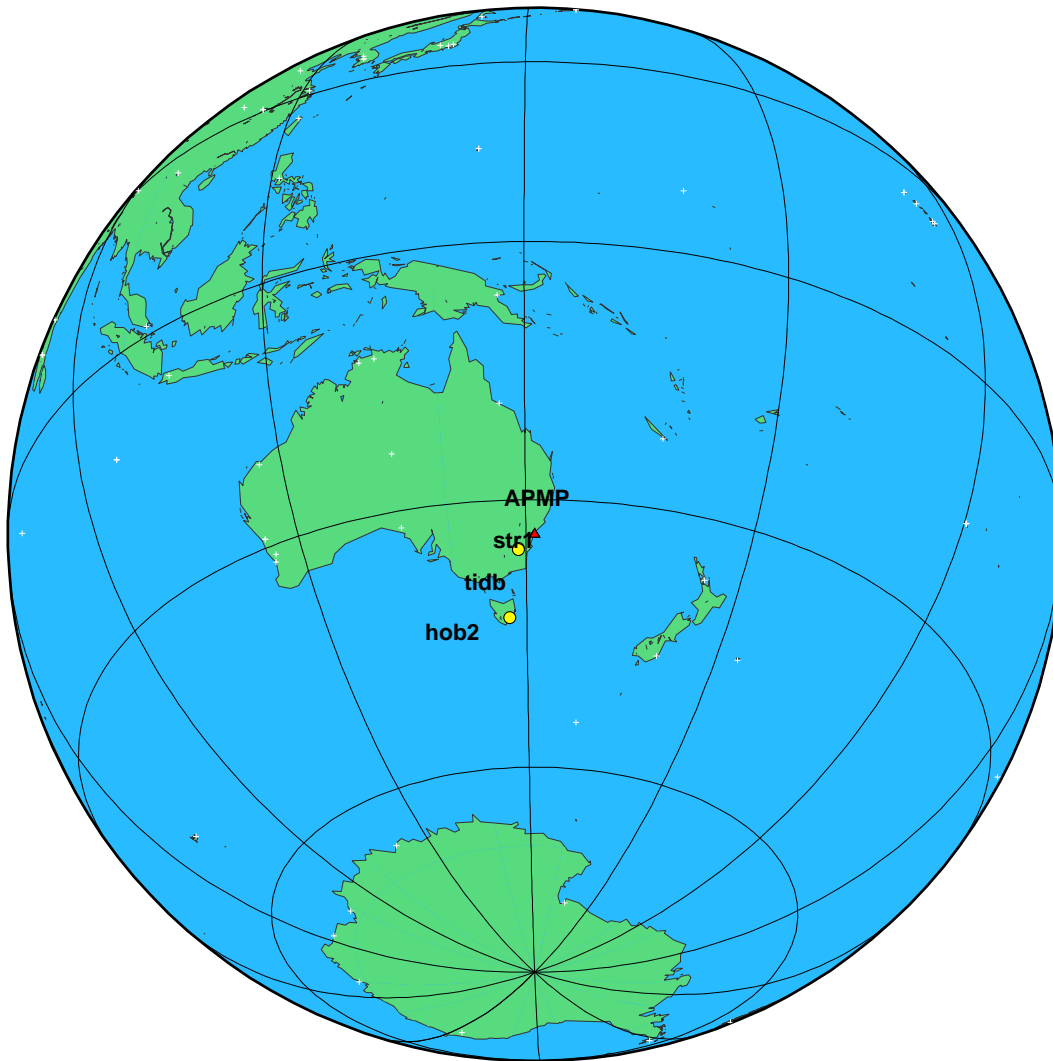


Figure 1: Global View – submitted GPS station(s) and nearby IGS GPS stations used in the processing; triangle(s) represent submitted user data; circle(s) represent the nearest available IGS stations.

2 Processing Summary

Date	IGS Data	User Data	Orbit Type
2004-03-18	str1 tidb hob2	APMP	IGS Final
2004-03-19	str1 tidb hob2	APMP	IGS Final
2004-03-20	str1 tidb hob2	APMP	IGS Final
2004-03-21	str1 tidb hob2	APMP	IGS Final
2004-03-22	str1 tidb hob2	APMP	IGS Final
2004-03-23	str1 tidb hob2	APMP	IGS Final

3 Computed Coordinates, GDA94

For Australian users Geocentric Datum of Australia (GDA94, ITRF92@1994.0) coordinates are provided. GDA94 coordinates are determined from ITRF coordinates by an Geoscience Australia (GA) derived coordinate transformation process. GA transformation parameters between ITRF and GDA94 are re-computed weekly, incorporating the latest available tectonic motions (determined from the GA GPS network). GA recommends that users within Australia use GDA94 coordinates. All coordinates refer to the Ground Mark. For general/technical information on GDA94 see www.ga.gov.au/nmd/geodesy/datums/gda.jsp and www.icsm.gov.au/icsm/gda/gdatm/

3.1 Cartesian, GDA94

	X(m)	Y(m)	Z(m)	
tidb	-4460996.065	2682557.135	-3674443.860	GDA94
hob2	-3950071.284	2522415.222	-4311638.526	GDA94
str1	-4467102.303	2683039.532	-3666949.981	GDA94
APMP	-4648203.955	2560477.101	-3526505.422	GDA94

3.2 Geodetic, GRS80 Ellipsoid, GDA94

The height above the Geoid is computed using the GPS Ellipsoidal height and subtracting a Geoid-Ellipsoid separation. Geoid-Ellipsoidal separations are computed using a bilinear interpolation of the AUSGeoid98 grid. The height above the Geoid is only provided for sites within the AUSGeoid98 extents. For information on AUSGeoid98 see www.ga.gov.au/nmd/geodesy/ausgeoid/

	Latitude(DMS)		Longitude(DMS)		Ellipsoidal Height(m)	Above-Geoid Height(m)	
tidb	-35-23	-57.1561	148 58	47.9845	665.425	646.139	GDA94
hob2	-42-48	-16.9852	147 26	19.4356	41.144	44.450	GDA94
str1	-35-18	-55.9395	149 0	36.1797	800.030	780.693	GDA94
APMP	-33-46	-58.1709	151 9	6.1092	99.134	75.995	GDA94

3.3 MGA Grid, GRS80 Ellipsoid, GDA94

	East(M)	North(M)	Zone	Ellipsoidal Height(m)	Above-Geoid Height(m)	
tidb	679807.859	6080884.476	55	665.425	646.139	GDA94
hob2	535873.397	5260777.226	55	41.144	44.450	GDA94
str1	682726.017	6090110.670	55	800.030	780.693	GDA94
APMP	328868.658	6260388.351	56	99.134	75.995	GDA94

4 Computed Coordinates, ITRF2000

All computed coordinates are based on the IGS realisation of the ITRF2000 reference frame, provided by the IGS cumulative solution. All the given ITRF2000 coordinates refer to a mean epoch of the site observation data. All coordinates refer to the Ground Mark.

4.1 Cartesian, ITRF2000

	X(m)	Y(m)	Z(m)	ITRF2000 @
tidb	-4460996.405	2682557.092	-3674443.384	2004/03/21
hob2	-3950071.658	2522415.260	-4311638.088	2004/03/21
str1	-4467102.642	2683039.488	-3666949.504	2004/03/21

APMP	-4648204.276	2560477.037	-3526504.944	2004/03/21	
APMP	0.009 m	0.008 m	0.008 m		RMS

4.2 Geodetic, GRS80 Ellipsoid, ITRF2000

The height above the Geoid is computed using the GPS Ellipsoidal height and subtracting a Geoid-Ellipsoid separation. Geoid-Ellipsoidal separations, in this section, are computed using a spherical harmonic synthesis of the global EGM96 geoid. More information on the EGM96 geoid can be found at earth-info.nga.mil/GandG/wgsegm/egm96.html

	Latitude(DMS)	Longitude(DMS)	Ellipsoidal Height(m)	Above-Geoid Height(m)
tidb	-35-23 -57.1384	148 58 47.9929	665.368	646.205
hob2	-42-48 -16.9674	147 26 19.4430	41.093	44.603
str1	-35-18 -55.9219	149 0 36.1881	799.974	780.729
APMP	-33-46 -58.1534	151 9 6.1174	99.076	76.222
APMP	0.003 m	0.004 m	0.014 m	RMS

5 Solution Information

To validate your solution you should check the :-

- Antenna Reference Point (ARP) to Ground Mark records;
- Apriori Coordinate Updates (valid range is 0.000 - 15.000 m);
- Coordinate Precision (valid range is 0.001 - 0.025 m);
- Root Mean Square (RMS) (valid range is 0.0005 - 0.0250 m); and
- % Observations Deleted (valid range is 0 - 25) %;

5.1 ARP to Ground Mark, per day

All heights refer to the vertical distance from the Ground Mark to the Antenna Reference Point (ARP). The Antenna Offsets refer to the vertical distance from the ARP to the L1 phase centre.

Station	Height(m)	Antenna Offsets(m)			yyyy/mm/dd
	Up	East	North	Up	
APMP	0.0000	0.0000	0.0000	0.0000	2004/03/18
APMP	0.0000	0.0000	0.0000	0.0000	2004/03/19
APMP	0.0000	0.0000	0.0000	0.0000	2004/03/20
APMP	0.0000	0.0000	0.0000	0.0000	2004/03/21
APMP	0.0000	0.0000	0.0000	0.0000	2004/03/22
APMP	0.0000	0.0000	0.0000	0.0000	2004/03/23

5.2 Apriori Coordinate Updates - Cartesian, per day

	dX(m)	dY(m)	dZ(m)	yyyy/mm/dd
APMP	0.010	-0.012	0.012	2004/03/18
APMP	0.018	-0.004	0.019	2004/03/19
APMP	0.013	-0.008	0.011	2004/03/20
APMP	0.001	-0.009	0.012	2004/03/21
APMP	0.002	0.007	0.009	2004/03/22
APMP	-0.005	0.002	0.009	2004/03/23

5.3 Coordinate Precision - Cartesian, per day

1 Sigma	sX(m)	sY(m)	sZ(m)	yyyy/mm/dd
APMP	0.005	0.005	0.005	2004/03/18
APMP	0.004	0.004	0.004	2004/03/19
APMP	0.005	0.005	0.005	2004/03/20
APMP	0.005	0.005	0.005	2004/03/21
APMP	0.004	0.004	0.004	2004/03/22
APMP	0.004	0.004	0.004	2004/03/23

5.4 Coordinate Value - Cartesian, ITRF2000, per day

	X(m)	Y(m)	Z(m)	ITRF2000 @
APMP	-4648204.276	2560477.038	-3526504.947	2004/03/18
APMP	-4648204.263	2560477.029	-3526504.929	2004/03/19
APMP	-4648204.271	2560477.026	-3526504.941	2004/03/20
APMP	-4648204.291	2560477.048	-3526504.957	2004/03/21
APMP	-4648204.279	2560477.037	-3526504.945	2004/03/22
APMP	-4648204.282	2560477.046	-3526504.947	2004/03/23

5.5 Geodetic, GRS80 Ellipsoid, ITRF2000, per day

	Latitude(DMS)		Longitude(DMS)		Ellipsoidal Height(m)		ITRF2000 @
APMP	-33-46	-58.1535	151	9	6.1174	99.078	2004/03/18
APMP	-33-46	-58.1533	151	9	6.1175	99.055	2004/03/19
APMP	-33-46	-58.1535	151	9	6.1177	99.066	2004/03/20
APMP	-33-46	-58.1535	151	9	6.1173	99.098	2004/03/21
APMP	-33-46	-58.1534	151	9	6.1175	99.079	2004/03/22
APMP	-33-46	-58.1534	151	9	6.1172	99.085	2004/03/23

5.6 RMS, Observations, Deletions per day

Data	RMS (m)	# Observations	% Obs. Deleted	Date
tidb	0.0089	14117	6 %	2004-03-18
hob2	0.0097	13575	4 %	2004-03-18
str1	0.0085	14629	6 %	2004-03-18
APMP	0.0090	42321	5 %	2004-03-18
tidb	0.0082	15089	7 %	2004-03-19
hob2	0.0092	13354	8 %	2004-03-19
str1	0.0083	14709	9 %	2004-03-19
APMP	0.0086	43152	8 %	2004-03-19
tidb	0.0095	17809	4 %	2004-03-20
hob2	0.0096	16512	2 %	2004-03-20
str1	0.0095	17690	5 %	2004-03-20
APMP	0.0095	52011	4 %	2004-03-20
tidb	0.0100	18206	2 %	2004-03-21
hob2	0.0110	15934	5 %	2004-03-21
str1	0.0096	18088	3 %	2004-03-21
APMP	0.0102	52228	3 %	2004-03-21
tidb	0.0084	18787	4 %	2004-03-22
hob2	0.0084	16845	5 %	2004-03-22
str1	0.0080	18922	4 %	2004-03-22
APMP	0.0083	54554	4 %	2004-03-22
tidb	0.0087	18722	3 %	2004-03-23
hob2	0.0092	16435	4 %	2004-03-23
str1	0.0082	18783	2 %	2004-03-23
APMP	0.0087	53940	3 %	2004-03-23

A GPS Computation Standards

A.1 Measurement Modelling

Observable	Ionosphere corrected L1 double difference carrier phase, Psuedo-range only used for receiver clock estimation, Elevation cut-off 15°, Sampling rate 30 seconds, Weighting 1.0cm for double difference, elevation dependent $1/\sin(E)$.
Troposphere	Hopfield, Niell mapping function
Preprocessing	Receiver clocks estimated using pseudo-range information
Satellite center of mass correction	Block II x,y,z: 0.2794, 0.0000, 1.0259 m Block IIA x,y,z: 0.2794, 0.0000, 1.2053 m
Satellite Antenna Phase centre calibration	Not applied
Ground Antenna phase centre calibrations	Elevation-dependent phase centre corrections are applied according to the model IGS01, the NGS antenna calibrations are used when the antenna used is not a recognised IGS type. The corrections are given relative to the Dorne Margolin T antenna.
Atmospheric Drag	Jachhia Model
Centre of Mass Correction / Attitude	Nil

A.2 Orbit Modelling

Earth's Gravitational (Static) Potential Model	EGM96 - degree and order 12
Solid Earth Tides (Dynamic) Potential	Love Model
Ocean Tide (Dynamic) Potential	Christodoulidis
Third Body Perturbations	Sun, Moon and Planets Values for physical constants - AU, Moon/Earth mass ratio, GM(moon, sun and planets) from JPL DE403 Planetary Ephemeris.
Direct Solar Radiation Pressure	Rock

A.3 Station Position Modelling and Reference Frame

Precession	IAU76/IERS96
Nutation	IAU80/IERS96 (including epsilon and psi corrections)
Sine terms added to accumulated precession and nutation in Right Ascension	As in IERS TN 21, p. 21
Geodesic Nutation	As in IERS TN 21, P. 37
Polar Motion	IGS Earth Orientation Parameters (Ultra-rapid, Rapid, Final) - apriori
Earth Rotation (UT1)	IGS Earth Orientation Parameters (Ultra-rapid, Rapid, Final) - apriori
Daily and Sub-daily tidal corrections to X, Y and UT1	Applied (IERS2000)
Plate Motion	IGS Cumulative SSC
Planetary and Lunar Ephemeris	JPL DE403
Station Displacement - Solid Earth Tide Loading	Williamson and Diamante (1972) + Wahr (1980) for the frequency dependent elastic response of the Earth's fluid interior.
Station Displacement - Ocean Tide Loading	not applied
Station Displacement - Pole Tide	applied
Station Displacement - Atmosphere Loading	not applied
Reference Frame	IGS Cumulative SSC