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## AUSPOS Online GPS Processing Report

Space Geodesy Analysis Centre  
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](mailto: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 Antennna Reference Point (ARP).

User File	Antenna Type	Antenna Height (m)	Start Time	End Time
8100046A.070	SOKGSR2700IS NONE	1.7340	2008-02-14 21:10:00	2008-02-15 06:08:00

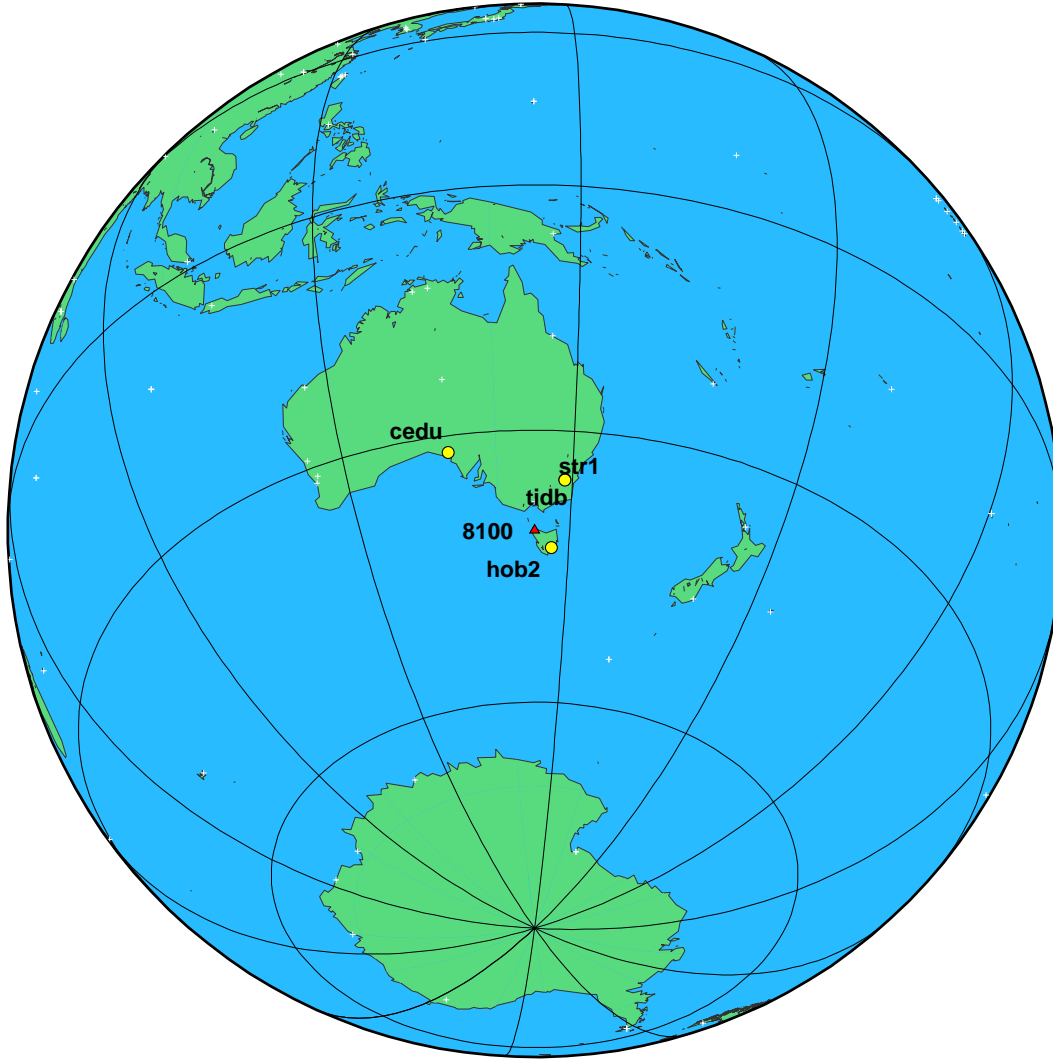


Figure 1: Global View – submitted GPS station(s) and nearby IGS GPS stations used in the processing; triangle(s) represent submitted user data; circle(s) represent the nearest available IGS stations.

## 2 Processing Summary

Date	IGS Data	User Data	Orbit Type
2008-02-14	hob2 tidb str1	8100	IGS Rapid
2008-02-15	hob2 tidb cedu	8100	IGS Rapid

Warning: An IGS Rapid orbit product has been used in this computation. For the highest quality coordinates please resubmit approximately 2 weeks after the observation session end to ensure the use of the IGS Final orbit product.

## 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](http://www.ga.gov.au/nmd/geodesy/datums/gda.jsp) and [www.icsm.gov.au/icsm/gda/gdatm/](http://www.icsm.gov.au/icsm/gda/gdatm/)

### 3.1 Cartesian, GDA94

	X(m)	Y(m)	Z(m)	
tidb	-4460996.066	2682557.135	-3674443.861	GDA94
hob2	-3950071.287	2522415.222	-4311638.529	GDA94
str1	-4467102.302	2683039.531	-3666949.979	GDA94
8100	-3949645.101	2770125.014	-4158355.419	GDA94
cedu	-3753472.147	3912741.048	-3347961.036	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/](http://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		665.427	646.141	GDA94
hob2	-42-48	-16.9852	147 26	19.4356		41.148	44.454	GDA94
str1	-35-18	-55.9395	149 0	36.1797		800.028	780.691	GDA94
8100	-40-57	-2.8844	144 57	20.5116		87.364	89.590	GDA94
cedu	-31-52	-0.0164	133 48	35.3757		144.822	153.381	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	665.427	646.141	GDA94
hob2	535873.399	5260777.226	55	41.148	44.454	GDA94
str1	682726.018	6090110.671	55	800.028	780.691	GDA94
8100	327938.047	5464692.159	55	87.364	89.590	GDA94
cedu	387415.775	6473725.246	53	144.822	153.381	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	-4460996.550	2682557.098	-3674443.216	2008/02/15	
hob2	-3950071.815	2522415.294	-4311637.937	2008/02/15	
str1	-4467102.785	2683039.492	-3666949.333	2008/02/14	
8100	-3949645.638	2770125.068	-4158354.804	2008/02/15	
8100	0.010 m	0.030 m	0.016 m		RMS
cedu	-3753472.715	3912741.028	-3347960.330	2008/02/15	

## 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](http://earth-info.nga.mil/GandG/wgsegm/egm96.html)

	Latitude(DMS)		Longitude(DMS)			Ellipsoidal Height(m)	Above-Geoid Height(m)	
tidb	-35-23	-57.1316	148 58	47.9956		665.375	646.212	
hob2	-42-48	-16.9605	147 26	19.4455		41.101	44.611	
str1	-35-18	-55.9150	149 0	36.1909		799.976	780.731	
8100	-40-57	-2.8593	144 57	20.5229		87.316	89.760	
8100		0.007 m		0.021 m		0.027 m		RMS
cedu	-31-51	-59.9905	133 48	35.3918		144.771	154.035	

## 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)			
	Up	East	North	Up	yyyy/mm/dd
8100	1.7340	0.0000	-0.0011	0.1257	2008/02/14
8100	1.7340	0.0000	-0.0011	0.1257	2008/02/15

### 5.2 Apriori Coordinate Updates - Cartesian, per day

	dX(m)	dY(m)	dZ(m)	yyyy/mm/dd
8100	0.006	0.012	-0.003	2008/02/14
8100	-0.034	0.017	-0.011	2008/02/15

### 5.3 Coordinate Precision - Cartesian, per day

1 Sigma	sX(m)	sY(m)	sZ(m)	yyyy/mm/dd
8100	0.006	0.007	0.006	2008/02/14
8100	0.018	0.006	0.012	2008/02/15

### 5.4 Coordinate Value - Cartesian, ITRF2000, per day

	X(m)	Y(m)	Z(m)	ITRF2000 @
8100	-3949645.637	2770125.033	-4158354.799	2008/02/14
8100	-3949645.653	2770125.091	-4158354.825	2008/02/15

5.5 Geodetic, GRS80 Ellipsoid, ITRF2000, per day

Latitude(DMS)			Longitude(DMS)			Ellipsoidal Height(m)	
8100	-40-57	-2.8596	144	57	20.5241	87.297	2008/02/14
8100	-40-57	-2.8593	144	57	20.5224	87.350	2008/02/15

5.6 RMS, Observations, Deletions per day

Data	RMS (m)	# Observations	% Obs. Deleted	Date
tidb	0.0036	1622	0 %	2008-02-14
hob2	0.0039	1752	0 %	2008-02-14
str1	0.0033	1621	0 %	2008-02-14
8100	0.0036	4995	0 %	2008-02-14
tidb	0.0141	4649	9 %	2008-02-15
hob2	0.0069	5976	3 %	2008-02-15
cedu	0.0147	4386	7 %	2008-02-15
8100	0.0120	15011	6 %	2008-02-15

# 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