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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
8005016A.080	SOKGSR2700IS NONE	1.6160	2008-01-15 20:36:59	2008-01-16 06:15:00

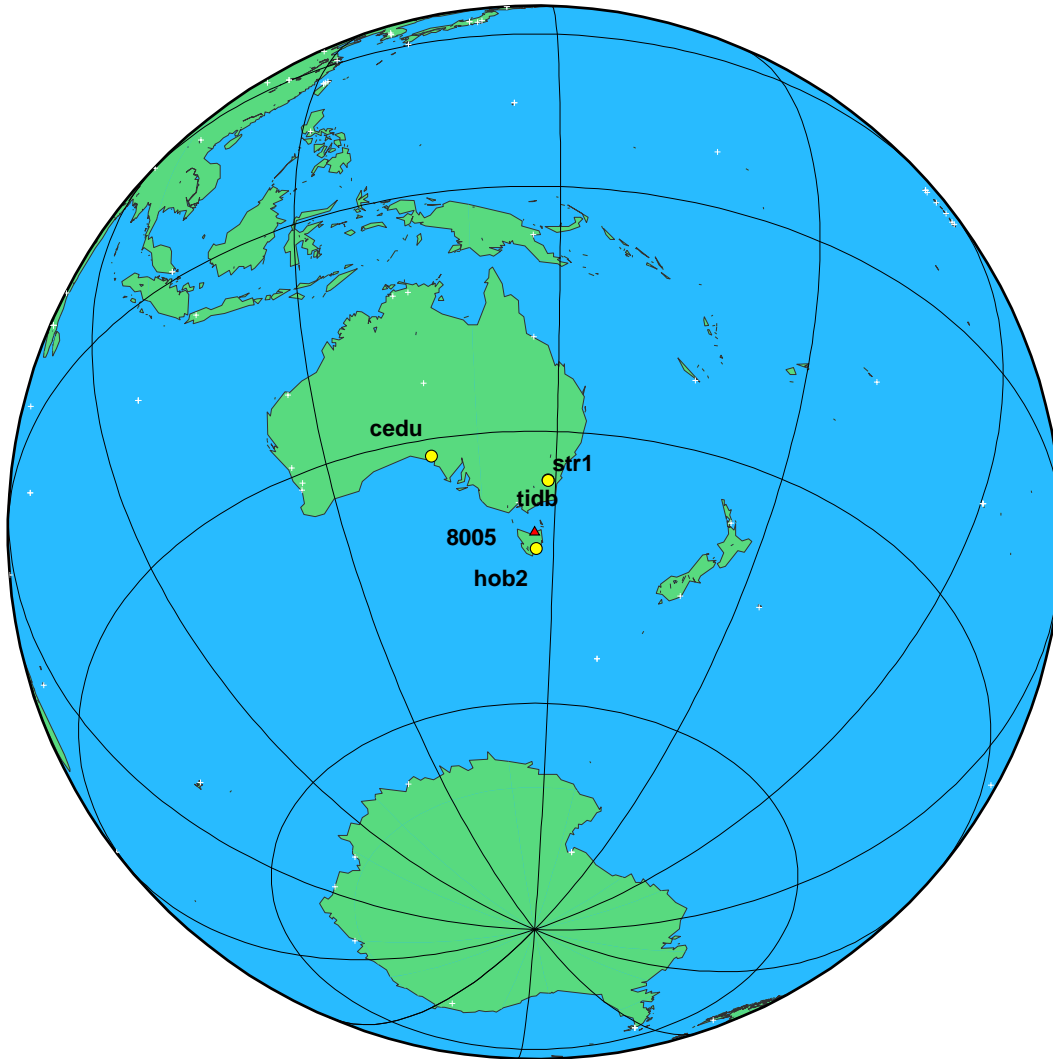


Figure 1: Global View – submitted GPS station(s) and nearby IGS GPS stations used in the processing; triangle(s) represent submitted user data; circle(s) represent the nearest available IGS stations.

## 2 Processing Summary

Date	IGS Data	User Data	Orbit Type
2008-01-15	hob2 tidb cedu	8005	IGS Rapid
2008-01-16	hob2 tidb str1	8005	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	2682557.136	-3674443.861	GDA94
hob2	-3950071.287	2522415.223	-4311638.529	GDA94
cedu	-3753472.147	3912741.047	-3347961.037	GDA94
8005	-4047615.782	2610545.469	-4167351.313	GDA94
str1	-4467102.302	2683039.531	-3666949.979	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	-57.1560	148 58	47.9845		665.426	646.141	GDA94
hob2	-42-48	-16.9852	147 26	19.4356		41.148	44.454	GDA94
cedu	-31-52	-0.0165	133 48	35.3757		144.822	153.381	GDA94
8005	-41 -3	-28.7398	147 10	46.7418		107.254	107.632	GDA94
str1	-35-18	-55.9395	149 0	36.1797		800.028	780.691	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	665.426	646.141	GDA94
hob2	535873.398		5260777.226		55	41.148	44.454	GDA94
cedu	387415.775		6473725.244		53	144.822	153.381	GDA94
8005	515095.636		5454790.666		55	107.254	107.632	GDA94
str1	682726.018		6090110.672		55	800.028	780.691	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	-4460996.547	2682557.098	-3674443.219	2008/01/16	
hob2	-3950071.811	2522415.294	-4311637.940	2008/01/16	
cedu	-3753472.711	3912741.027	-3347960.335	2008/01/15	
8005	-4047616.302	2610545.516	-4167350.708	2008/01/16	
8005	0.598 m	4.159 m	1.488 m		RMS
str1	-4467102.782	2683039.492	-3666949.336	2008/01/16	

## 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	-57.1317	148 58	47.9956		665.375	646.212	
hob2	-42-48	-16.9606	147 26	19.4454		41.101	44.611	
cedu	-31-51	-59.9907	133 48	35.3917		144.770	154.034	
8005	-41 -3	-28.7152	147 10	46.7521		107.205	108.089	
8005		0.029 m		3.820 m		2.298 m		RMS
str1	-35-18	-55.9151	149 0	36.1908		799.976	780.731	

## 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
8005	1.6160	0.0000	-0.0011	0.1257	2008/01/15
8005	1.6160	-0.0000	-0.0011	0.1257	2008/01/16

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

	dX(m)	dY(m)	dZ(m)	yyyy/mm/dd
8005	0.896	5.832	-2.047	2008/01/15
8005	-0.008	0.011	-0.013	2008/01/16

### 5.3 Coordinate Precision - Cartesian, per day

1 Sigma	sX(m)	sY(m)	sZ(m)	yyyy/mm/dd
8005	1.272	0.509	0.763	2008/01/15
8005	0.011	0.011	0.006	2008/01/16

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

	X(m)	Y(m)	Z(m)	ITRF2000 @
8005	-4047615.456	2610551.399	-4167352.812	2008/01/15
8005	-4047616.302	2610545.514	-4167350.708	2008/01/16

## 5.5 Geodetic, GRS80 Ellipsoid, ITRF2000, per day

	Latitude(DMS)	Longitude(DMS)	Ellipsoidal Height(m)	
8005	-41 -3 -28.7139	147 10 46.5208	110.455	2008/01/15
8005	-41 -3 -28.7153	147 10 46.7522	107.204	2008/01/16

## 5.6 RMS, Observations, Deletions per day

Data	RMS (m)	# Observations	% Obs. Deleted	Date
tidb	0.5164	1720	0 %	2008-01-15
hob2	0.5146	1879	1 %	2008-01-15
cedu	0.4591	1733	0 %	2008-01-15
8005	0.4979	5332	0 %	2008-01-15
tidb	0.0119	4193	4 %	2008-01-16
hob2	0.0092	5967	0 %	2008-01-16
str1	0.0121	5681	1 %	2008-01-16
8005	0.0110	15841	1 %	2008-01-16

WARNING: This solution has MAJOR modelling problems associated with the submitted GPS data. Please consider this solution as INVALID. If you would like more information on this solution you can contact the Geoscience Australia at [geodesy@ga.gov.au](mailto:geodesy@ga.gov.au) but to help us please quote your processing job number.

# 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