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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
9002.070	SOKGSR2700IS NONE	1.5920	2007-12-04 21:20:00	2007-12-05 08:00:00

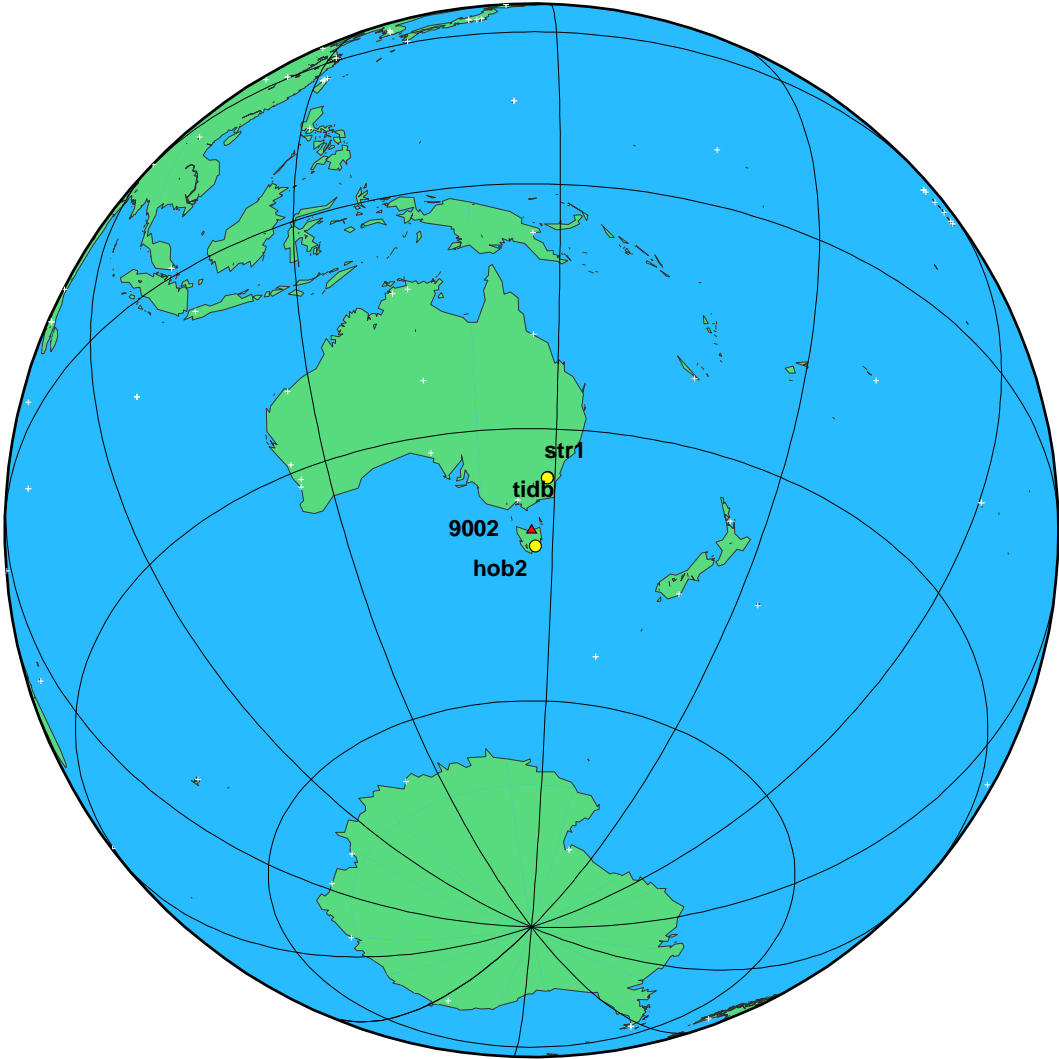


Figure 1: Global View – submitted GPS station(s) and nearby IGS GPS stations used in the processing; triangle(s) represent submitted user data; circle(s) represent the nearest available IGS stations.

## 2 Processing Summary

Date	IGS Data	User Data	Orbit Type
2007-12-04	hob2 tidb str1	9002	IGS Rapid
2007-12-05	hob2 tidb str1	9002	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	2522415.222	-4311638.528	GDA94
str1	-4467102.302	2683039.530	-3666949.979	GDA94
9002	-4030011.088	2629279.219	-4172503.969	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			665.426	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
9002	-41 -7	-12.0801	146 52	42.8649			46.152	46.828	GDA94

### 3.3 MGA Grid, GRS80 Ellipsoid, GDA94

	East(M)		North(M)		Zone	Ellipsoidal Height(m)	Above-Geoid Height(m)	
tidb	679807.858	6080884.476	55			665.426	646.141	GDA94
hob2	535873.399	5260777.226	55			41.148	44.454	GDA94
str1	682726.018	6090110.672	55			800.028	780.691	GDA94
9002	489806.398	5447912.087	55			46.152	46.828	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	-4460996.542	2682557.098	-3674443.224	2007/12/05
hob2	-3950071.807	2522415.292	-4311637.944	2007/12/05
str1	-4467102.778	2683039.491	-3666949.341	2007/12/05

9002	-4030011.606	2629279.268	-4172503.369	2007/12/05	
9002	0.018 m	0.012 m	0.003 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](http://earth-info.nga.mil/GandG/wgsegm/egm96.html)

	Latitude(DMS)		Longitude(DMS)		Ellipsoidal Height(m)	Above-Geoid Height(m)
tidb	-35-23	-57.1319	148 58	47.9955	665.374	646.211
hob2	-42-48	-16.9608	147 26	19.4454	41.100	44.610
str1	-35-18	-55.9154	149 0	36.1908	799.976	780.731
9002	-41 -7	-12.0556	146 52	42.8753	46.104	47.278
9002		0.008 m		0.020 m	0.005 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	
9002	1.5920	0.0000	-0.0011	0.1257	2007/12/04
9002	1.5920	0.0000	-0.0011	0.1257	2007/12/05

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

	dX(m)	dY(m)	dZ(m)	yyyy/mm/dd
9002	0.013	0.017	0.001	2007/12/04
9002	0.029	-0.010	0.028	2007/12/05

### 5.3 Coordinate Precision - Cartesian, per day

1 Sigma	sX(m)	sY(m)	sZ(m)	yyyy/mm/dd
9002	0.044	0.011	0.022	2007/12/04
9002	0.007	0.007	0.007	2007/12/05

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

	X(m)	Y(m)	Z(m)	ITRF2000 @
9002	-4030011.631	2629279.251	-4172503.366	2007/12/04
9002	-4030011.605	2629279.274	-4172503.370	2007/12/05

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

	Latitude(DMS)		Longitude(DMS)		Ellipsoidal Height(m)	
9002	-41 -7	-12.0553	146 52	42.8764	46.111	2007/12/04
9002	-41 -7	-12.0556	146 52	42.8750	46.106	2007/12/05

## 5.6 RMS, Observations, Deletions per day

Data	RMS (m)	# Observations	% Obs. Deleted	Date
tidb	0.0098	1650	0 %	2007-12-04
hob2	0.0124	1665	0 %	2007-12-04
str1	0.0096	1615	2 %	2007-12-04
9002	0.0107	4930	1 %	2007-12-04
tidb	0.0148	6694	2 %	2007-12-05
hob2	0.0133	7212	4 %	2007-12-05
str1	0.0140	7050	1 %	2007-12-05
9002	0.0140	20956	2 %	2007-12-05

# 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	Jachhria 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