Australian Government

Geoscience Australia

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.

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 Antennna Reference Point (ARP).

User File	Antenna Type	Antenna Height (m)	Start Time	End Time
8006018A080.08O	SOKGSR2700IS NONE	1.6750	2008-01-17 21:11:59	2008-01-18 06:17:00

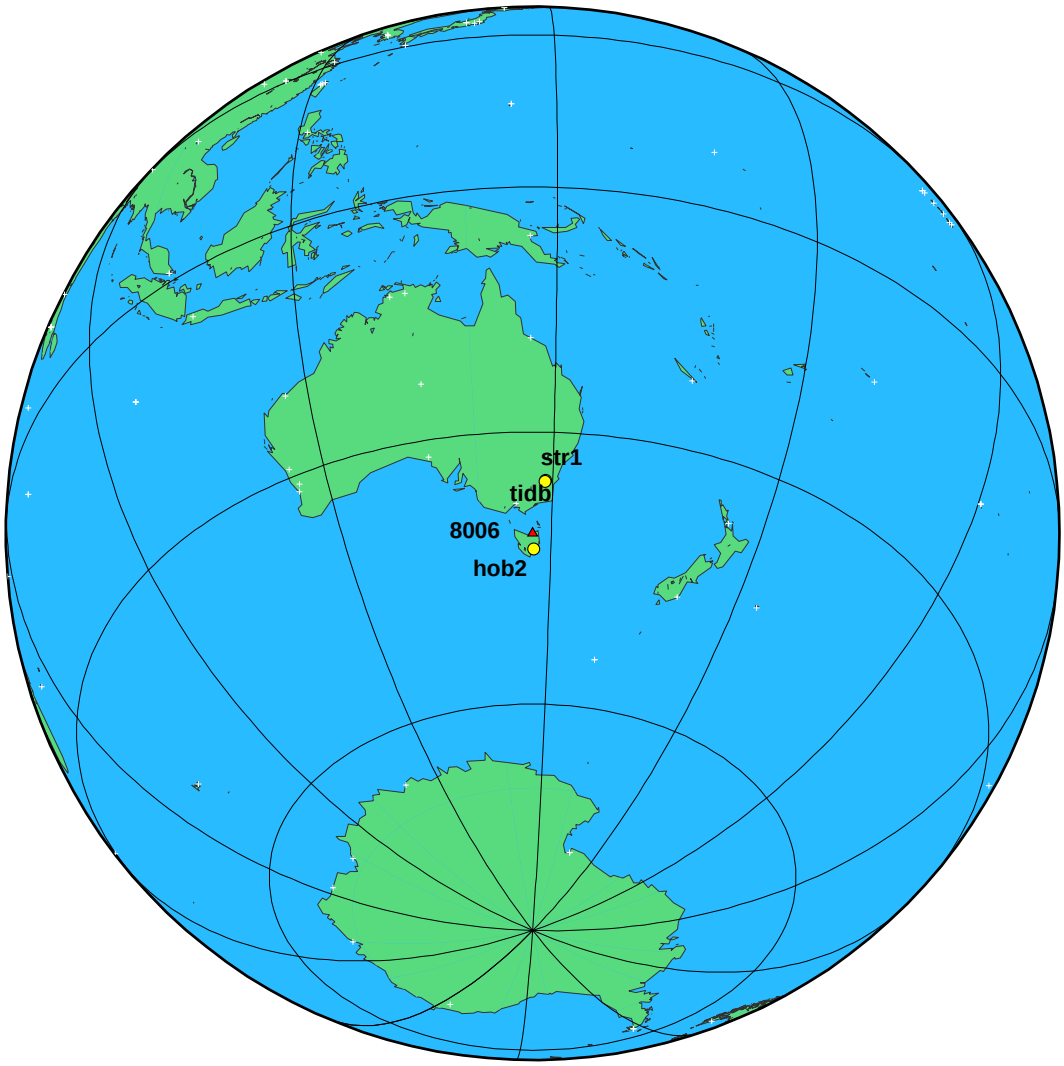

Figure 1: Global View – submitted GPS station(s) and nearby IGS GPS stations used in the processing; triangle(s) represent submitted user data; circle(s) represent the nearest available IGS stations.

2 Processing Summary

Date	IGS Data	User Data	Orbit Type
2008-01-17	hob2 tidb str1	8006	IGS Rapid
2008-01-18	hob2 tidb str1	8006	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 and 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
str1	-4467102.302	2683039.531	-3666949.979	GDA94
8006	-4051535.208	2601352.978	-4169318.052	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	665.426	646.141	GDA94
hob2	-42-48 -16.9852	147 26 19.4356	41.149	44.455	GDA94
str1	-35-18 -55.9395	149 0 36.1797	800.028	780.691	GDA94
8006	-41 -4 -52.5507	147 17 48.6945	133.887	134.190	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	41.149	44.455	GDA94
str1	682726.018	6090110.672	55	800.028	780.691	GDA94
8006	524935.672	5452179.341	55	133.887	134.190	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	2008/01/18
hob2	-3950071.812	2522415.294	-4311637.940	2008/01/18
str1	-4467102.783	2683039.492	-3666949.336	2008/01/18

```
8006     -4051535.727    2601353.026   -4169317.448 2008/01/18
8006            0.067 m        0.059 m        0.045 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

```
                                        Ellipsoidal  Above-Geoid
       Latitude(DMS)   Longitude(DMS)    Height(m)     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
str1  -35-18 -55.9151  149  0  36.1908      799.976      780.731
8006  -41 -4 -52.5261  147 17  48.7048      133.839      134.611
8006            0.020 m          0.044 m      0.088 m            RMS
```

5 Solution Information

To validate your solution you should check the :-

i. Antenna Reference Point (ARP) to Ground Mark records;

ii. Apriori Coordinate Updates (valid range is 0.000 - 15.000 m);

iii. Coordinate Precision (valid range is 0.001 - 0.025 m);

iv. Root Mean Square (RMS) (valid range is 0.0005 - 0.0250 m); and

v. % 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.

```
          Height(m)          Antenna Offsets(m)
Station   Up            East      North     Up     yyyy/mm/dd
8006      1.6750        0.0000   -0.0011    0.1257 2008/01/17
8006      1.6750       -0.0000   -0.0011    0.1257 2008/01/18
```

5.2 Apriori Coordinate Updates - Cartesian, per day

```
              dX(m)          dY(m)          dZ(m) yyyy/mm/dd
8006          0.010         -0.010          0.012 2008/01/17
8006          0.031         -0.179          0.161 2008/01/18
```

5.3 Coordinate Precision - Cartesian, per day

```
1 Sigma       sX(m)          sY(m)          sZ(m) yyyy/mm/dd
8006          0.015          0.006          0.012 2008/01/17
8006          0.007          0.010          0.007 2008/01/18
```

5.4 Coordinate Value - Cartesian, ITRF2000, per day

```
               X(m)           Y(m)           Z(m)   ITRF2000 @
8006     -4051535.633    2601352.999   -4169317.387 2008/01/17
8006     -4051535.746    2601353.104   -4169317.468 2008/01/18
```

5.5 Geodetic, GRS80 Ellipsoid, ITRF2000, per day

```
                                    Ellipsoidal
       Latitude(DMS)   Longitude(DMS)    Height(m)
8006  -41 -4 -52.5266  147 17  48.7036      133.729 2008/01/17
8006  -41 -4 -52.5253  147 17  48.7025      133.896 2008/01/18
```

5.6 RMS, Observations, Deletions per day

Data	RMS (m)	# Observations	% Obs. Deleted	Date
tidb	0.0062	1586	0 %	2008-01-17
hob2	0.0058	1598	0 %	2008-01-17
str1	0.0054	1596	0 %	2008-01-17
8006	0.0058	4780	0 %	2008-01-17
tidb	0.0060	4420	21 %	2008-01-18
hob2	0.0077	4988	18 %	2008-01-18
str1	0.0062	4528	21 %	2008-01-18
8006	0.0067	13936	20 %	2008-01-18

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^o, 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