**Australian Government**

**Geoscience Australia**

# AUSPOS Online GPS Processing Report

Space Geodesy Analysis Centre
Geohazards Division, Geoscience Australia

December 7, 2007

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

AUSPOS Project Manager

Geohazards Division
Geoscience Australia
Cnr Jerrabomberra and Hindmarsh Drive
GPO Box 378, Canberra, ACT 2601, Australia
Freecall (Within Australia): 1800 800 173
Tel: +61 2 6249 9111. Fax: +61 2 6249 9929
Geoscience Australia Home Page: www.ga.gov.au

Job number: #325212; User: `imtfield1@bigpond.com.au` AUSPOS version 1.01.25

# 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 |
|---|---|---|---|---|
| 9012.07O | SOKGSR2700IS NONE | 1.7140 | 2007-12-01 21:52:00 | 2007-12-02 05:50:00 |

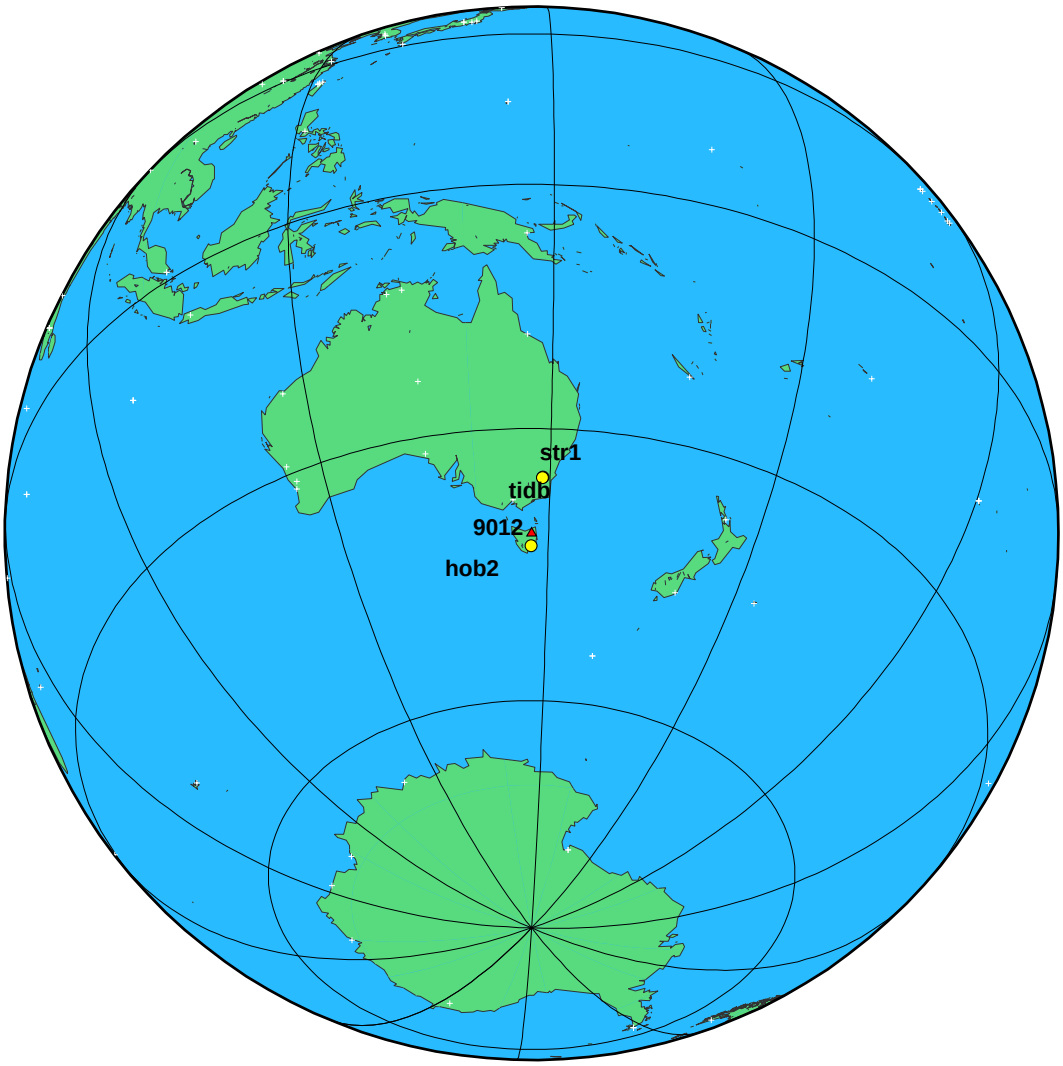


Figure 1: Global View – submitted GPS station(s) and nearby IGS GPS stations used in the processing; triangle(s) represent submitted user data; circle(s) represent the nearest available IGS stations.

# 2 Processing Summary

| Date | IGS Data | User Data | Orbit Type |
|---|---|---|---|
| 2007-12-01 | hob2 tidb str1 | 9012 | IGS Rapid |
| 2007-12-02 | hob2 tidb str1 | 9012 | 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 | 2522415.222 | -4311638.529 | GDA94 |
| str1 | -4467102.303 | 2683039.530 | -3666949.979 | GDA94 |
| 9012 | -4037797.661 | 2569287.969 | -4202557.748 | 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 | 41.148 | 44.454 | GDA94 |
| str1 | -35-18 -55.9395 | 149 0 36.1798 | 800.028 | 780.691 | GDA94 |
| 9012 | -41-28 -39.0554 | 147 31 51.6937 | 386.696 | 386.476 | 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 | 535873.399 | 5260777.226 | 55 | 41.148 | 44.454 | GDA94 |
| str1 | 682726.019 | 6090110.671 | 55 | 800.028 | 780.691 | GDA94 |
| 9012 | 544336.309 | 5408095.914 | 55 | 386.696 | 386.476 | 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 | 2007/12/02 |
| hob2 | -3950071.806 | 2522415.292 | -4311637.945 | 2007/12/02 |
| str1 | -4467102.778 | 2683039.491 | -3666949.342 | 2007/12/02 |

```
9012     -4037798.175    2569288.020   -4202557.153 2007/12/02
9012            0.015 m         0.001 m         0.006 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 -57.1319  148 58  47.9955      665.374      646.211
hob2  -42-48 -16.9609  147 26  19.4454       41.100       44.610
str1  -35-18 -55.9154  149  0  36.1908      799.976      780.731
9012  -41-28 -39.0310  147 31  51.7037      386.648      387.302
9012            0.004 m          0.008 m      0.013 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
9012      1.7140        0.0000   -0.0011    0.1257 2007/12/01
9012      1.7140        0.0000   -0.0011    0.1257 2007/12/02
```

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

```
               dX(m)          dY(m)          dZ(m) yyyy/mm/dd
9012          -0.048          0.018         -0.010 2007/12/01
9012          -0.007          0.008         -0.007 2007/12/02
```

### 5.3 Coordinate Precision - Cartesian, per day

```
1 Sigma        sX(m)          sY(m)          sZ(m) yyyy/mm/dd
9012           0.025          0.006          0.014 2007/12/01
9012           0.005          0.005          0.005 2007/12/02
```

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

```
                X(m)           Y(m)           Z(m)   ITRF2000 @
9012     -4037798.196    2569288.019   -4202557.161 2007/12/01
9012     -4037798.174    2569288.020   -4202557.152 2007/12/02
```

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

```
                                       Ellipsoidal
       Latitude(DMS)   Longitude(DMS)     Height(m)
9012  -41-28 -39.0309  147 31  51.7042      386.666 2007/12/01
9012  -41-28 -39.0310  147 31  51.7037      386.647 2007/12/02
```

## 5.6 RMS, Observations, Deletions per day

| Data | RMS (m) | # Observations | % Obs. Deleted | Date |
|---|---|---|---|---|
| tidb | 0.0054 | 1333 | 0 % | 2007-12-01 |
| hob2 | 0.0062 | 1588 | 0 % | 2007-12-01 |
| str1 | 0.0047 | 1523 | 0 % | 2007-12-01 |
| 9012 | 0.0055 | 4444 | 0 % | 2007-12-01 |
| tidb | 0.0052 | 3389 | 4 % | 2007-12-02 |
| hob2 | 0.0059 | 4836 | 0 % | 2007-12-02 |
| str1 | 0.0046 | 4642 | 0 % | 2007-12-02 |
| 9012 | 0.0053 | 12867 | 1 % | 2007-12-02 |

# A GPS Computation Standards

## A.1 Measurement Modelling

| | |
|---|---|
| Observable | Ionosphere corrected L1 double difference carrier phase,<br>Psuedo-range only used for receiver clock estimation,<br>Elevation cut-off $15^o$,<br>Sampling rate 30 seconds,<br>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<br>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<br><br>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 |