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# AUSPOS Online GPS Processing Report

National Geospatial Reference Systems
Geospatial and Earth Monitoring 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

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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 |
|---|---|---|---|---|
| Rover_reprocessed.09o | DEFAULT(NONE) | 0.0000 | 2009-04-02 09:33:00 | 2009-04-02 17:54:00 |


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 |
|---|---|---|---|
| 2009-04-02 | mas1 gmas lpal | Rove | IGS Final |

# 3 Computed Coordinates, ITRF2005

All computed coordinates are based on the IGS realisation of the ITRF2005 reference frame, provided by the IGS cumulative solution. All the given ITRF2005 coordinates refer to a mean epoch of the site observation data. All coordinates refer to the Ground Mark.

## 3.1 Cartesian, ITRF2005

| | X(m) | Y(m) | Z(m) | ITRF2005 @ |
|---|---|---|---|---|
| gmas | 5439112.550 | -1522134.896 | 2953556.230 | 2009/04/02 |
| lpal | 5326646.266 | -1719826.181 | 3052043.757 | 2009/04/02 |
| mas1 | 5439192.201 | -1522055.406 | 2953454.915 | 2009/04/02 |
| Rove | 6167515.154 | -861530.212 | 1375702.060 | 2009/04/02 |

## 3.2 Geodetic, GRS80 Ellipsoid, ITRF2005

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

| | Latitude(DMS) | Longitude(DMS) | Ellipsoidal Height(m) | Above-Geoid Height(m) |
|---|---|---|---|---|
| gmas | 27 45 53.2201 | -15-38 -3.3693 | 195.425 | 153.609 |
| lpal | 28 45 49.9400 | -17-53 -37.7790 | 2199.203 | 2158.799 |
| mas1 | 27 45 49.4712 | -15-37 -59.7899 | 197.147 | 155.341 |
| Rove | 12 32 18.6452 | -7-57 -7.5545 | 404.189 | 373.533 |

# 4 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) %;

## 4.1 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 |
| Rove | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 2009/04/02 |

## 4.2 Apriori Coordinate Updates - Cartesian, per day

| | dX(m) | dY(m) | dZ(m) | yyyy/mm/dd |
|---|---|---|---|---|
| Rove | -0.073 | 0.046 | 0.001 | 2009/04/02 |

## 4.3 Coordinate Precision - Cartesian, per day

| 1 Sigma | sX(m) | sY(m) | sZ(m) | yyyy/mm/dd |
|---|---|---|---|---|
| Rove | 0.014 | 0.009 | 0.005 | 2009/04/02 |

### 4.4 RMS, Observations, Deletions per day

| Data | RMS (m) | # Observations | % Obs. Deleted | Date |
|---|---|---|---|---|
| gmas | 0.0095 | 5867 | 0 % | 2009-04-02 |
| lpal | 0.0096 | 5764 | 0 % | 2009-04-02 |
| mas1 | 0.0091 | 5867 | 0 % | 2009-04-02 |
| Rove | 0.0094 | 17498 | 0 % | 2009-04-02 |

# 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>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 and Nutation | IERS 2003 |
| Polar Motion | IGS Earth Orientation Parameters (Ultra-rapid, Rapid, Final) - apriori |
| Earth Rotation (UT1) | IGS Earth Orientation Parameters (Ultra-rapid, Rapid, Final) - apriori |
| Plate Motion | IGS Cumulative SSC (ITRF2005) |
| 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 (ITRF2005) |