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AUSPOS Online GPS Processing Report

Space Geodesy Analysis Centre
Minerals and 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

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1 User and IGS GPS Data

All antenna heights refer to the vertical distance from the Ground Mark to the Antenna Reference Point (ARP).

User File	Antenna Type	Antenna Height (m)	Start Time	End Time
APMP1610.040	DEFAULT (NONE)	0.0000	2004-06-09 00:00:00	2004-06-09 23:59:59
APMP1620.040	DEFAULT (NONE)	0.0000	2004-06-10 00:00:00	2004-06-10 23:59:59
APMP1630.040	DEFAULT (NONE)	0.0000	2004-06-11 00:00:00	2004-06-11 23:59:59
APMP1640.040	DEFAULT (NONE)	0.0000	2004-06-12 00:00:00	2004-06-12 23:59:59
APMP1650.040	DEFAULT (NONE)	0.0000	2004-06-13 00:00:00	2004-06-13 23:59:59



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
2004-06-09	ntus bako pimo	APMP	IGS Final
2004-06-10	ntus bako pimo	APMP	IGS Final
2004-06-11	ntus bako pimo	APMP	IGS Final
2004-06-12	ntus bako pimo	APMP	IGS Final
2004-06-13	ntus bako pimo	APMP	IGS Final

3 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.

3.1 Cartesian, ITRF2000

	X(m)	Y(m)	Z(m)	ITRF2000 @	
ntus	-1508022.908	6195576.657	148799.433	2004/06/11	
pimo	-3186293.922	5286624.211	1601158.263	2004/06/11	
bako	-1836969.124	6065617.140	-716257.832	2004/06/11	
APMP	-1519458.890	6192913.814	142851.472	2004/06/11	
APMP	0.013 m	0.009 m	0.004 m		RMS

3.2 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

	Latitude(DMS)		Longitude(DMS)		Ellipsoidal Height(m)	Above-Geoid Height(m)
ntus	1 20	44.8868	103 40	47.8462	75.421	68.331
pimo	14 38	8.5902	121 4	39.8346	95.524	51.996
bako	-6-29	-27.7965	106 50	56.0773	158.194	139.750
APMP	1 17	31.1958	103 47	7.6451	66.579	59.030
APMP		0.004 m		0.013 m	0.009 m	RMS

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.

Station	Height(m)	Antenna Offsets(m)			yyyy/mm/dd
	Up	East	North	Up	
APMP	0.0000	0.0000	0.0000	0.0000	2004/06/09
APMP	0.0000	0.0000	0.0000	0.0000	2004/06/10
APMP	0.0000	0.0000	0.0000	0.0000	2004/06/11
APMP	0.0000	0.0000	0.0000	0.0000	2004/06/12
APMP	0.0000	0.0000	0.0000	0.0000	2004/06/13

4.2 Apriori Coordinate Updates - Cartesian, per day

	dX(m)	dY(m)	dZ(m)	yyyy/mm/dd
APMP	0.028	-0.055	0.011	2004/06/09
APMP	-0.014	0.008	0.005	2004/06/10
APMP	0.011	-0.012	-0.001	2004/06/11
APMP	0.012	-0.010	0.000	2004/06/12
APMP	0.003	-0.013	-0.008	2004/06/13

4.3 Coordinate Precision - Cartesian, per day

1 Sigma	sX(m)	sY(m)	sZ(m)	yyyy/mm/dd
APMP	0.007	0.007	0.005	2004/06/09
APMP	0.005	0.005	0.005	2004/06/10
APMP	0.006	0.006	0.005	2004/06/11
APMP	0.005	0.005	0.005	2004/06/12
APMP	0.005	0.005	0.005	2004/06/13

4.4 Coordinate Value - Cartesian, ITRF2000, per day

	X(m)	Y(m)	Z(m)	ITRF2000 @
APMP	-1519458.894	6192913.799	142851.477	2004/06/09
APMP	-1519458.902	6192913.821	142851.473	2004/06/10
APMP	-1519458.891	6192913.804	142851.465	2004/06/11
APMP	-1519458.866	6192913.818	142851.472	2004/06/12
APMP	-1519458.899	6192913.818	142851.471	2004/06/13

4.5 Geodetic, GRS80 Ellipsoid, ITRF2000, per day

	Latitude(DMS)			Longitude(DMS)			Ellipsoidal Height(m)	
APMP	1	17	31.1959	103	47	7.6454	66.566	2004/06/09
APMP	1	17	31.1958	103	47	7.6455	66.589	2004/06/10
APMP	1	17	31.1956	103	47	7.6452	66.570	2004/06/11
APMP	1	17	31.1958	103	47	7.6443	66.577	2004/06/12
APMP	1	17	31.1957	103	47	7.6454	66.585	2004/06/13

4.6 RMS, Observations, Deletions per day

Data	RMS (m)	# Observations	% Obs. Deleted	Date
ntus	0.0129	30641	9 %	2004-06-09
pimo	0.0128	11925	32 %	2004-06-09
bako	0.0141	18993	29 %	2004-06-09
APMP	0.0133	61559	21 %	2004-06-09
ntus	0.0093	32067	5 %	2004-06-10
pimo	0.0097	12793	19 %	2004-06-10
bako	0.0112	21333	23 %	2004-06-10
APMP	0.0103	60767	15 %	2004-06-10
ntus	0.0110	33057	8 %	2004-06-11
pimo	0.0118	14925	20 %	2004-06-11
bako	0.0141	23479	20 %	2004-06-11
APMP	0.0122	71461	15 %	2004-06-11
ntus	0.0087	31319	4 %	2004-06-12
pimo	0.0098	14552	20 %	2004-06-12
bako	0.0103	21483	18 %	2004-06-12
APMP	0.0095	67354	12 %	2004-06-12
ntus	0.0092	28861	5 %	2004-06-13
pimo	0.0084	14699	17 %	2004-06-13
bako	0.0096	19284	21 %	2004-06-13
APMP	0.0091	62844	13 %	2004-06-13

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