Appendix 1

Comparison information sheets

These have been provided by the host laboratories, to indicate the setup of local and portable equipment.

BIPM GPS calibration information sheet

Laboratory:	NMI Sydney, Australia
Date and hour of the beginning of measurements:	27/11/2003, MJD 52970
Date and hour of the end of measurements:	25/01/2004, MJD 53029

Receiver setup information

	Local:	**Portable: NML**
• Maker:	NMI/Topcon	NMI/Topcon
• Type:	Topcon Euro-80	Euro-80 Dual Frequency
• Serial number:	8RQRKXT534	8R633IOLON4
• Receiver internal delay (GPS) :	46.5 ns (uncalibrated)	44.79 ns (uncalibrated)
• Receiver internal delay (GLO) :		
• Antenna cable identification:	TCDF-1	NML IF
Corresponding cable delay :	(75.9 ± 1.0) ns	(159.8 ± 1.0) ns
• UTC cable identification:	UTC(AUS) 9.1.02	APMP Portable
Corresponding cable delay :	(76.0 ± 1.0) ns	(85.9 ± 1.0) ns
Delay to local UTC :	(76.0 ± 1.0) ns	(85.9 ± 1.0) ns
• Receiver trigger level:	0.5V	0.5 V
• Coordinates reference frame:	ITRF93	ITRF2000 @ 18/12/2003
~~Latitude~~ or X m	-4648200.298	-4648204.271
~~Longitude~~ or Y m	2560484.03	2560477.026
~~Height~~ or Z m	-3526505.358	-3526504.952

Antenna information

	Local:	**Portable:**
• Maker:	Topcon	Topcon/Javad
• Type:	Regant-1	MarAnt
• Serial number:	RA0122	MAGGD #0191
If the antenna is temperature stabilised		
• Set temperature value :		—

Antenna cable information

• Maker:	Rojone
• Type:	LMR400
• Is it a phase stabilised cable:	No
• Length of cable outside the building :	10m

General information

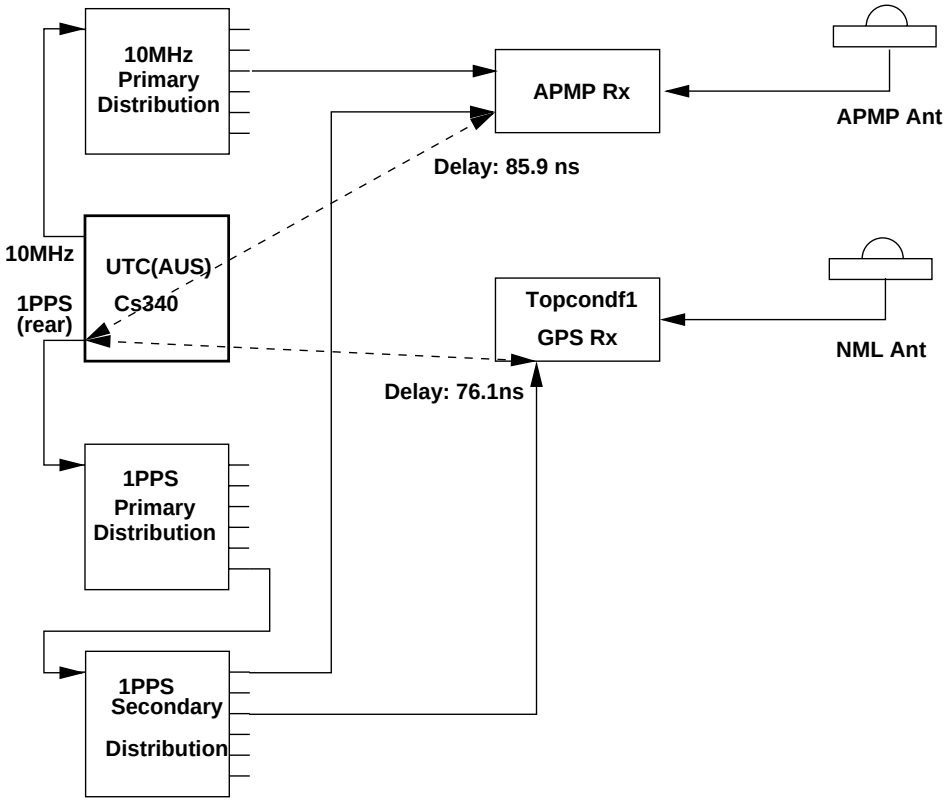
• Rise time of the local UTC pulse:	≤ 4ns
• Is the laboratory air conditioned:	Yes
• Set temperature value and uncertainty :	(20 ± 2) °C
• Set humidity value and uncertainty :	(50 ± 10) %

Cable delay control

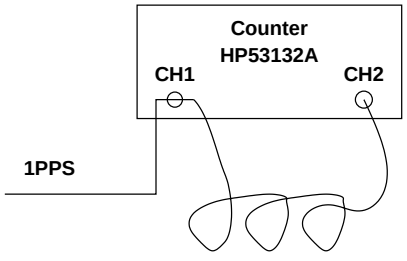
Cable identification	delay measured by NML	delay measured by local method
NML-IF Antenna cable	(159.8 ± 1.0) ns	

Plot of the experiment set-up:

Link to the local UTC of both receivers and Antenna positions



Description of the local method of cable delay measurement:



Cable to be measured

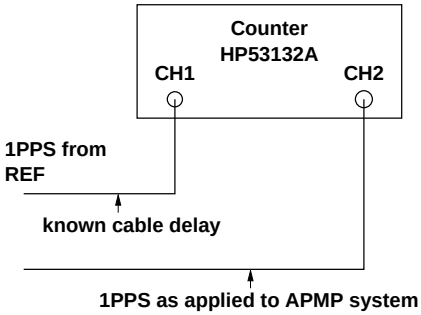
	CH1	CH2
Trigger	1.0V	1.0V
Termination	1M	50 ohm

Mode: Time interval Ch1 to Ch2

Notes:

1. **For antenna measurements, a TNC to BNC adapter was used on each end of the cable.**
2. **Delay Values are Mean and Standard Deviation of 100 measurements.**

We observe a typical day-to-day variation of ±0.5 ns in the delay measured for a given cable, and we therefore estimate the uncertainty of this method at ±1 ns.



	CH1	CH2
Trigger	1.0V	1.0V
Termination	50 ohm	50 ohm

Mode: Time interval Ch1 to Ch2

1PPS delay to APMP system is "known cable delay" plus measurement.

BIPM GPS calibration information sheet

Laboratory:	BNM – SYRTE , Observatoire de Paris
Date and hour of the beginning of measurements:	2004/February/27 (MJD:53062) at 10h10 (UTC)
Date and hour of the end of measurements:	2004/March/10 (MJD:53074) at 23h59 (UTC)

Receiver setup information

	Local:	**Portable: NML**
• Maker:	Allen Osborne Associates	Allen-Osborne
• Type:	TTR – 5	TTR6
• Serial number:	051	467
• Receiver internal delay (GPS) :	54 ns	
• Receiver internal delay (GLO) :		
• Antenna cable identification:	505 IF	NML IF
Corresponding cable delay :	168 ns ± 0.3 ns	
• UTC cable identification:	503	
Corresponding cable delay :	/	
Delay to local UTC :	304 ns	306 ns (D. Valat, email)
• Receiver trigger level:	0.5 V	
• Coordinates reference frame:	ITRF 88	
Latitude:	4 202 780 .30 m	
Longitude:	171 370 .03 m	
Height:	4 778 660 .12 m	

Antenna information

	Local:	**Portable:**
• Maker:	Allen Osborne Associates	Allen Osborne
• Type:		TTR6
• Serial number:		572
If the antenna is temperature stabilised		
• Set temperature value :	/	

Antenna cable information

• Maker:	
• Type:	RG – 58
• Is it a phase stabilised cable:	No
• Length of cable outside the building :	Approximately 6 meters

General information

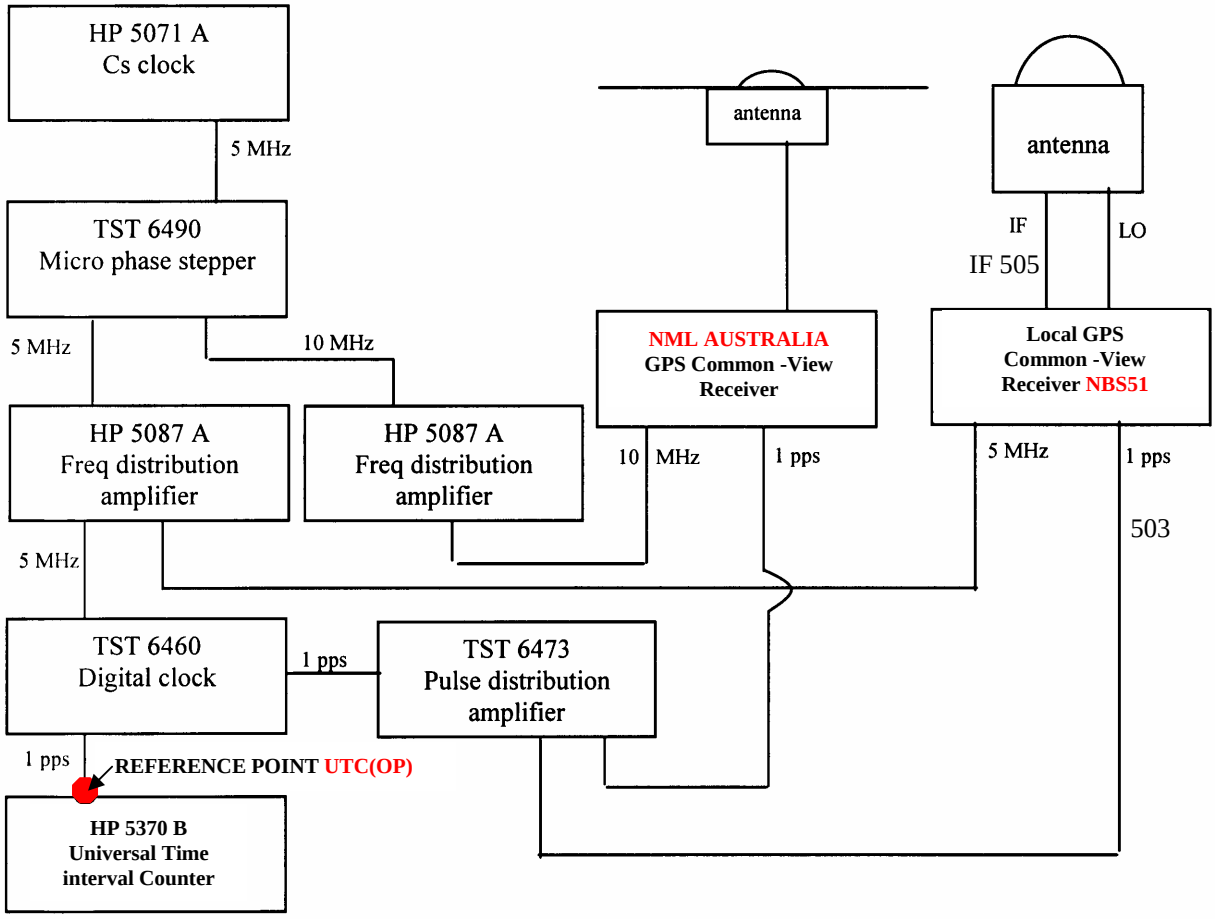
• Rise time of the local UTC pulse:	4 ns
• Is the laboratory air conditioned:	Yes
• Set temperature value and uncertainty :	(21.5 ± 2) °C
• Set humidity value and uncertainty :	/

Cable delay control

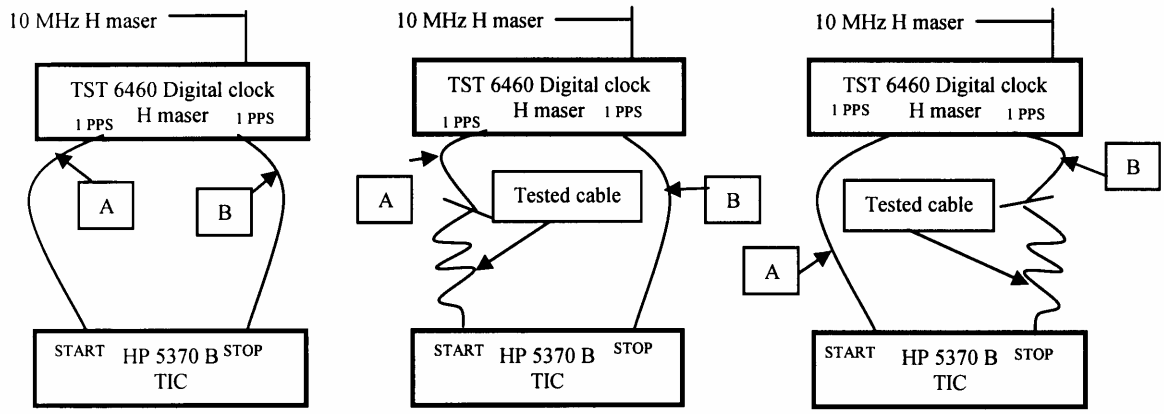
Cable identification	delay measured by NML	delay measured by local method
NML-IF Antenna cable	234.5 ns ± 0.5 ns	NOT MEASURED

Plot of the experiment set-up:

Link to the local UTC of both receivers and Antenna positions



Description of the local method of cable delay measurement:



The method used to calibrate the cables is a double wheight method in five steps as shown above.
At each step (i) the TIC gives the result (R_i)of 100 measurments.
The test cable delay is then obtained by the following formula:

$$\text{Delay} = \frac{R_2 - \left(\frac{R_1 + R_3}{2}\right) + \left(\frac{R_3 + R_5}{2}\right) - R_4}{2} + \text{corrections}$$

The corrections are the estimated delay introduced by adaptators : - 0,1 ns / adaptator

BIPM GPS calibration information sheet

Laboratory:	NMI Sydney, Australia
Date and hour of the beginning of measurements:	18/03/2004, MJD 53082
Date and hour of the end of measurements:	06/04/2004, MJD 53101

Receiver setup information

	Local:	**Portable: NML**
• Maker:	NMI/Topcon	NMI/Topcon
• Type:	Topcon Euro-80	Euro-80 Dual Frequency
• Serial number:	8RQRKXT534	8R633IOLON4
• Receiver internal delay (GPS) :	46.5 ns (uncalibrated)	44.79 ns (uncalibrated)
• Receiver internal delay (GLO) :		
• Antenna cable identification:	TCDF-1	NML IF
Corresponding cable delay :	(75.9 ± 1.0) ns	(159.8 ± 1.0) ns
• UTC cable identification:	UTC(AUS) 9.1.02	APMP Portable
Corresponding cable delay :	(76.0 ± 1.0) ns	(85.9 ± 1.0) ns
Delay to local UTC :	(76.0 ± 1.0) ns	(85.9 ± 1.0) ns
• Receiver trigger level:	0.5V	0.5 V
• Coordinates reference frame:	ITRF93	ITRF2000 @ 21/03/2004
~~Latitude~~ or X m	-4648200.298	-4648204.276
~~Longitude~~ or Y m	2560484.03	2560477.037
~~Height~~ or Z m	-3526505.358	-3526504.944

Antenna information

	Local:	**Portable:**
• Maker:	Topcon	Topcon/Javad
• Type:	Regant-1	MarAnt
• Serial number:	RA0122	MAGGD #0191
If the antenna is temperature stabilised		
• Set temperature value :		—

Antenna cable information

• Maker:	Rojone
• Type:	LMR400
• Is it a phase stabilised cable:	No
• Length of cable outside the building :	10m

General information

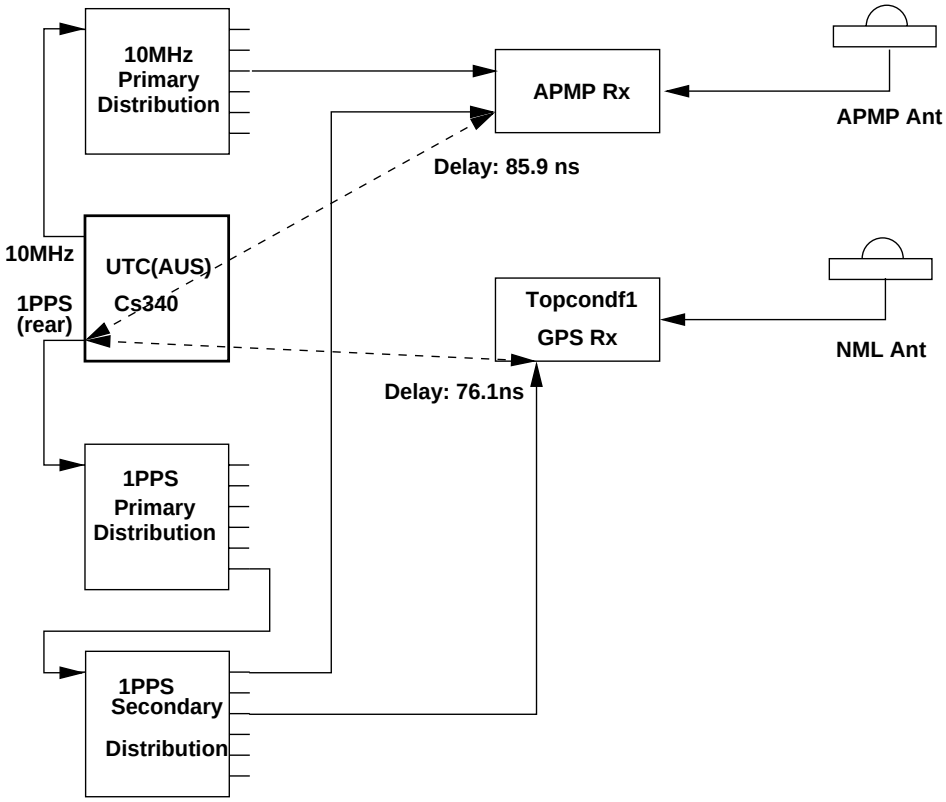
• Rise time of the local UTC pulse:	≤ 4ns
• Is the laboratory air conditioned:	Yes
• Set temperature value and uncertainty :	(20 ± 2) °C
• Set humidity value and uncertainty :	(50 ± 10) %

Cable delay control

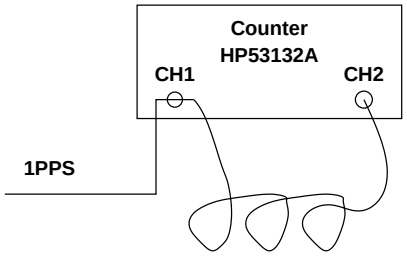
Cable identification	delay measured by NML	delay measured by local method
NML-IF Antenna cable	(159.8 ± 1.0) ns	

Plot of the experiment set-up:

Link to the local UTC of both receivers and Antenna positions



Description of the local method of cable delay measurement:



Cable to be measured

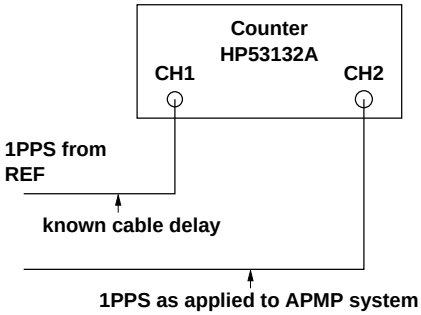
	CH1	CH2
Trigger	1.0V	1.0V
Termination	1M	50 ohm

Mode: Time interval Ch1 to Ch2

Notes:

1. **For antenna measurements, a TNC to BNC adapter was used on each end of the cable.**
2. **Delay Values are Mean and Standard Deviation of 100 measurements.**

We observe a typical day-to-day variation of ±0.5 ns in the delay measured for a given cable, and we therefore estimate the uncertainty of this method at ±1 ns.



	CH1	CH2
Trigger	1.0V	1.0V
Termination	50 ohm	50 ohm

Mode: Time interval Ch1 to Ch2

1PPS delay to APMP system is "known cable delay" plus measurement.

BIPM GPS calibration information sheet

Laboratory:	TL
Date and hour of the beginning of measurements:	2004/04/21 UTC 00:00
Date and hour of the end of measurements:	2004/05/02 UTC 23:59

Receiver setup information		
	Local:	**Portable: NML**
• Maker:	NML/Topcon	NML/Topcon
• Type:	Euro-80 Dual Frequency	Euro-80 Dual Frequency
• Serial number:		8R633IOLON4
• Receiver internal delay (GPS):	45.1 ns	
• Receiver internal delay (GLO):		
• Antenna cable identification:		NML IF
Corresponding cable delay:	119.1 ns	(159.8 ± 1.0) ns
• UTC cable identification:	RG-58	RG-58
Corresponding cable delay:	30.7 ns	37.6 ns
Delay to local UTC:	0 ns	0 ns
• Receiver trigger level:	0.5 V	0.5 V
• Coordinates reference frame:		
Latitude:	24.9535365344	
Longitude:	121.1646005980	
Height:	201.445	

Antenna information		
	Local:	**Portable:**
• Maker:	Ashtech	Topcon/Javad
• Type:	Choke ring	MarAnt
• Serial number:	Ash701945C_M	MAGGD #0191
If the antenna is temperature stabilized		
• Set temperature value:	—	—

Antenna cable information	
• Maker	Beldon
• Type	RG-8
• Is it a phase stabilised cable:	No
• Length of cable outside the building:	15 m

General information	
• Rise time of the local UTC pulse:	
• Is the laboratory air conditioned:	Yes
• Set temperature value and uncertainty:	23 ± 1 °C
• Set humidity value and uncertainty:	50 ± 5 %

Cable delay control		
Cable identification	delay measured by NML	delay measured by local method
NML-IF Antenna cable	(159.8 ± 1.0) ns	(159.0 ± 1.5) ns

BIPM GPS calibration information sheet

Laboratory:	TL
Date and hour of the beginning of measurements:	2004/04/21 UTC 00:00
Date and hour of the end of measurements:	2004/05/02 UTC 23:59

Receiver setup information		
	Local:	**Portable: NML**
• Maker:	AOA	NML/Topcon
• Type:	TTR6	Euro-80 Dual Frequency
• Serial number:		8R633IOLON4
• Receiver internal delay (GPS):	50 ns	
• Receiver internal delay (GLO):		
• Antenna cable identification:	RG-58	NML IF
Corresponding cable delay:	308 ns	(159.8 ± 1.0) ns
• UTC cable identification:	RG-58	RG-58
Corresponding cable delay:	5 ns	37.6 ns
Delay to local UTC:	-46.2 ns	0 ns
• Receiver trigger level:	0.5 V	0.5 V
• Coordinates reference frame:		
Latitude:	24.9535356144	
Longitude:	121.1645396555	
Height:	201.631	

Antenna information		
	Local:	**Portable:**
• Maker:	AOA	Topcon/Javad
• Type:		MarAnt
• Serial number:		MAGGD #0191
If the antenna is temperature stabilized		
• Set temperature value:	—	—

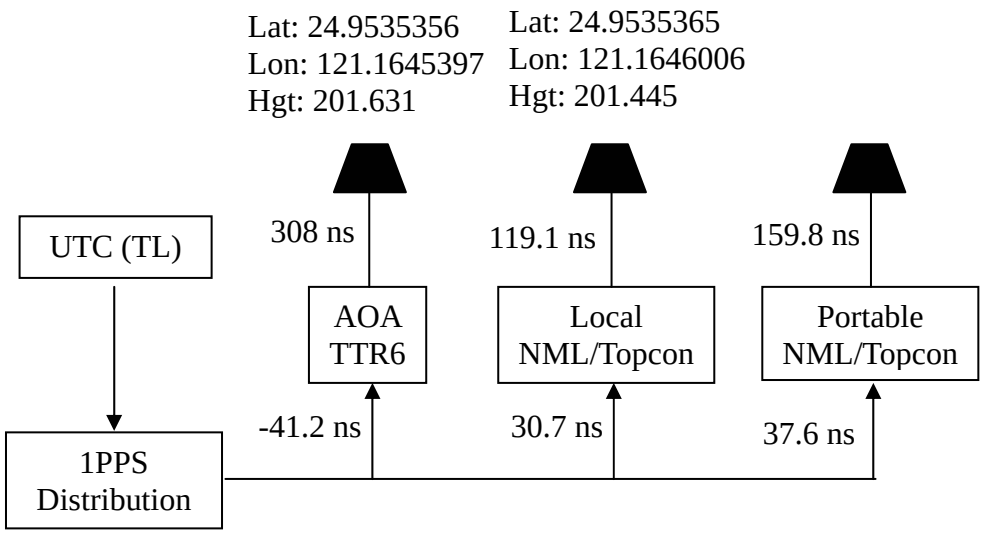
Antenna cable information	
• Maker	
• Type	RG-58
• Is it a phase stabilised cable:	No
• Length of cable outside the building:	15 m

General information	
• Rise time of the local UTC pulse:	
• Is the laboratory air conditioned:	Yes
• Set temperature value and uncertainty:	23 ± 1 °C
• Set humidity value and uncertainty:	50 ± 5 %

Cable delay control		
Cable identification	delay measured by NML	delay measured by local method
NML-IF Antenna cable	(159.8 ± 1.0) ns	(159.0 ± 1.5) ns

Plot of the experiment set-up:

Link to the local UTC of both receivers and Antenna positions



Description of the local method of cable delay measurement:

Using HP network analyzer for measuring cable delay.

ANNEX 2

BIPM GPS calibration information sheet

Laboratory:	NICT TOKYO JAPAN
Date and hour of the beginning of measurements:	**17 May 2004 (MJD 53142) UTC:01hxxmxxs**
Date and hour of the end of measurements:	**24 May 2004 (MJD 53149) UTC:01h30mxxs**

Receiver setup information

		Local: TTR6		**Local:E-80**	**Portable: NML**
• Maker:		AOA		Javad	NML/Topcon
• Type:		TTR-6		Euro-80	Euro-80 Dual Frequency
• Serial number:		451		8PN45EETDKW	8R633IOLON4
• Receiver internal delay (GPS) :		44.8ns		47.2ns	44.79ns
• Receiver internal delay (GLO) :		-		-	-
• Antenna cable identification:		TTR6(219.6ns)		E80	NML IF
Corresponding cable delay :		250.0ns		152.15ns	(159.8 ± 1.0) ns
• UTC cable identification:		GPS G		UTC(NICT)1pps C3	UTC(NICT)1pps JRC#2
Corresponding cable delay :					
Delay to local UTC :	Header Value	316.1ns		344.123ns	85.64ns
	Meas. Value	306.43ns		344.123ns	319.97ns
• Receiver trigger level:		0.5V		0.4V	0.5 V
• Coordinates reference frame:		WGS-84		WGS-84	WGS-84
Latitude or X m		-3942161.90m		-3942164.215m	-4648204.271m
Longitude or Y m		3368284.20m		3368281.976m	+2560477.026m
Height or Z m		3701886.69m		3701887.149m	-3526504.952m

Antenna information

	Local: TTR6		**Local:E80**	**Portable:**
• Maker:	AOA		Javad	Topcon/Japad
• Type:			RegAnt 1,	MarAnt
• Serial number:	Down Converter S/N449		S/N RA0238	MAGGD #0191
If the antenna is temperature stabilised				
• Set temperature value :				-

Local antenna cable information

• Maker:			Times Microwave-systems	NML IF
• Type:	RG58AU		LMR-400 DB	
• Is it a phase stabilised cable:	No	No	No	
• Length of cable outside the building :	Approx. 18 m		Approx. 18 m	Approx. 18 m

General information

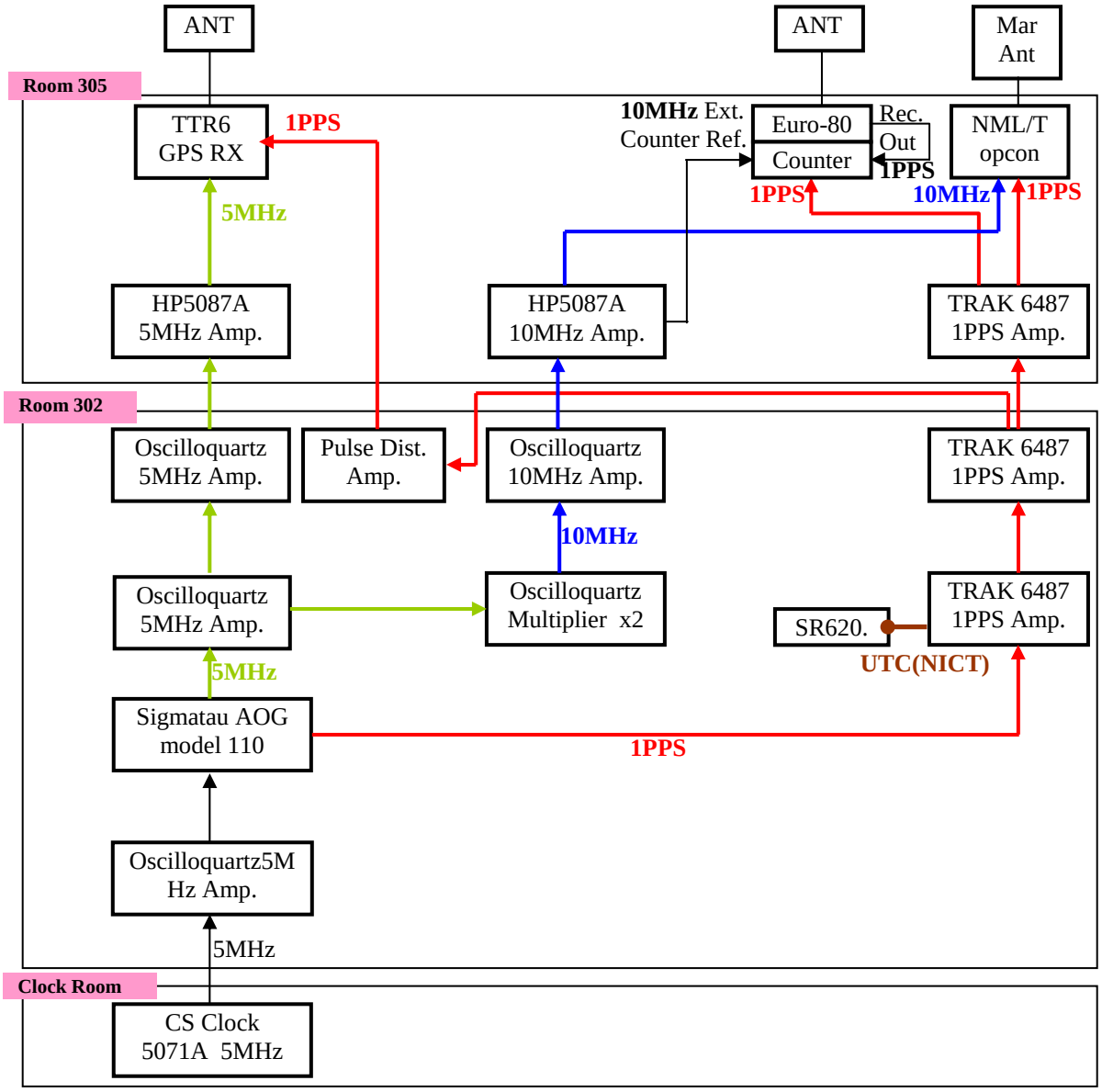
• Rise time of the local UTC pulse:	4.7ns(10%-90%)pulse height 4.59v DC
• **Is the laboratory air conditioned:**	YES
• Set temperature value and uncertainty :	GPS RX Room 23℃±2℃
• Set humidity value and uncertainty :	N/A

Cable delay control

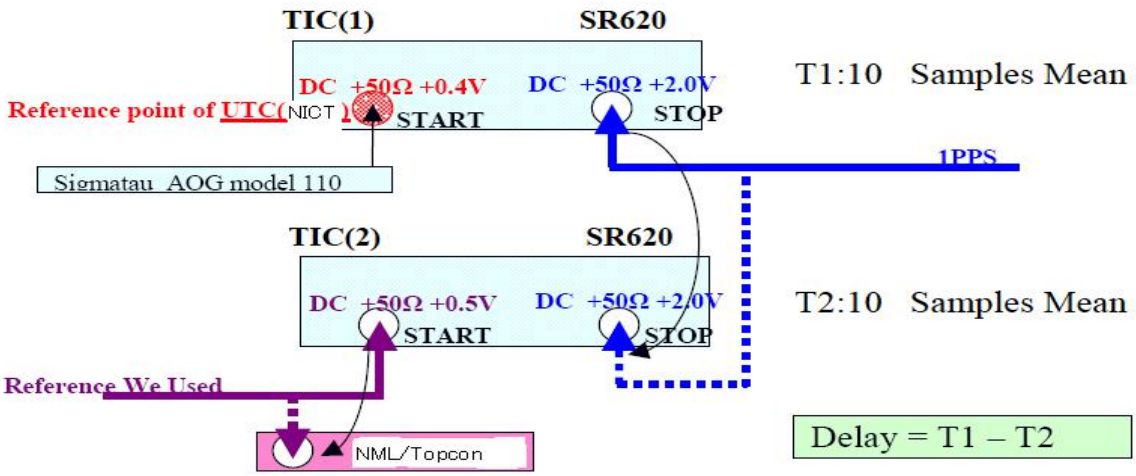
Cable identification	delay measured by NML	Delay measured by local method
NML-IF Antenna cable	(159.8 ± 1.0) ns	

Plot of the experiment set-up:

Link to the local UTC of both receivers and Antenna positions



Description of the local method of cable delay measurement:



BIPM GPS calibration information sheet

Laboratory:	NMIJ
Date and hour of the beginning of measurements:	2004-05-26 03:00 UTC
Date and hour of the end of measurements:	2004-05-31 04:00 UTC

Receiver setup information

	Local:	**Portable: NML**
• Maker:	AOA	NML/Topcon
• Type:	TTR6	Euro-80 Dual Frequency
• Serial number:	484	8R633IOLON4
• Receiver internal delay (GPS) :	50.0ns	
• Receiver internal delay (GLO) :		
• Antenna cable identification:		NML IF
Corresponding cable delay :	259.0ns	(159.8 ± 1.0) ns
• UTC cable identification:		
Corresponding cable delay :		
Delay to local UTC :	27.0ns	**510.6 ns**
• Receiver trigger level:		0.5 V
• Coordinates reference frame:	ITRF94	
Latitude:	36 03 32.3826 (deg, min, sec)	
Longitude:	140 08 06.2173 (deg, min, sec)	
Height:	83.98 (m)	

Antenna information

	Local:	**Portable:**
• Maker:	AOA	Topcon/Javad
• Type:	GPS	MarAnt
• Serial number:	682	MAGGD #0191
If the antenna is temperature stabilised		
• Set temperature value :	—	—

Antenna cable information

• Maker:	Fujikura
• Type:	RG-55/U
• Is it a phase stabilised cable:	
• Length of cable outside the building :	15m

General information

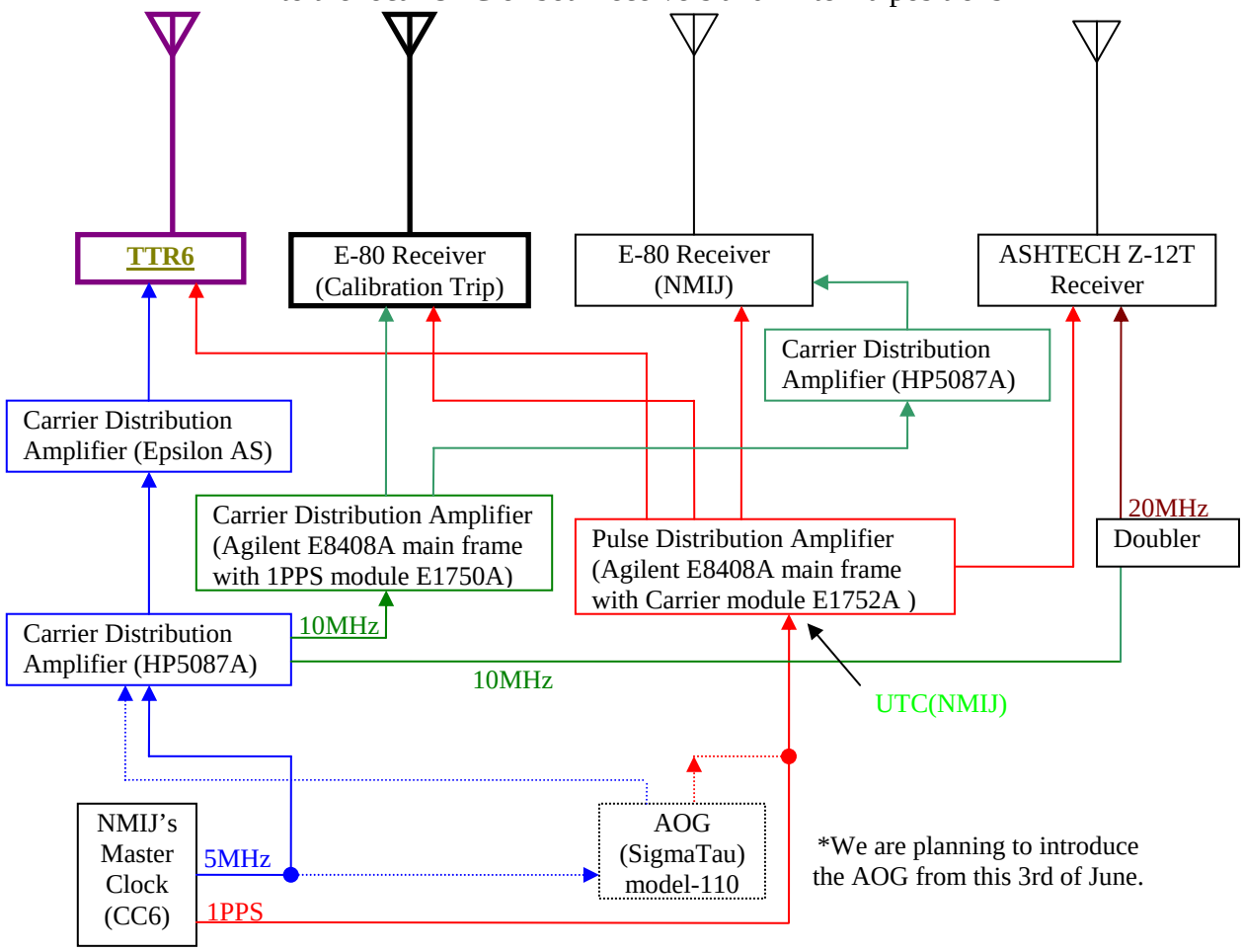
• Rise time of the local UTC pulse:	3.7ns
• Is the laboratory air conditioned:	Yes
• Set temperature value and uncertainty :	23℃±1℃
• Set humidity value and uncertainty :	50%

Cable delay control

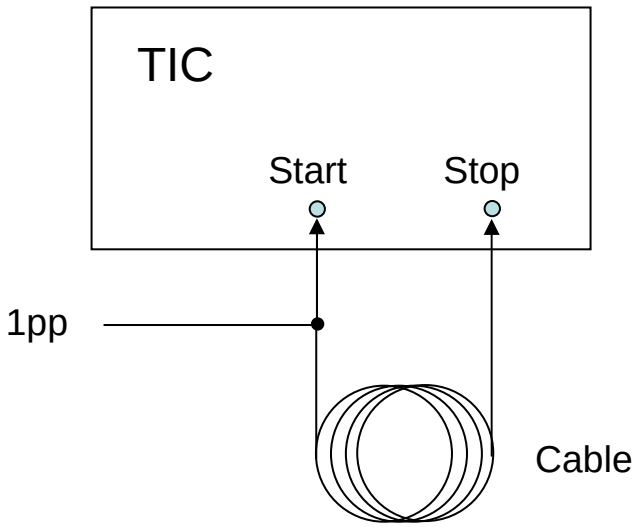
Cable identification	delay measured by NML	delay measured by local method
NML-IF Antenna cable	(159.8 ± 1.0) ns	

Plot of the experiment set-up:

Link to the local UTC of both receivers and Antenna positions



Description of the local method of cable delay measurement:



BIPM GPS calibration information sheet

Laboratory:	SPRING Singapore
Date and hour of the beginning of measurements:	8 June 2004 (MJD53164) UTC 4:15:00
Date and hour of the end of measurements:	16 June 2004 (MJD53172) UTC 0:45:00

Receiver setup information

	Local:	**Portable: NML**
• Maker:	NML/OnCore	NML/Topcon
• Type:	OnCore VP card	Euro-80 Dual Frequency
• Serial number:		8R633IOLON4
• Receiver internal delay (GPS) :	-30ns	
• Receiver internal delay (GLO) :		
• Antenna cable identification:	SPRING cable 4	SPRING cable 2
Corresponding cable delay :	(344±2) ns	(270 ± 2) ns
• UTC cable identification:		
Corresponding cable delay :	(14.8 ± 2.0) ns	(72.0 ± 2.0) ns
Delay to local UTC :		
• Receiver trigger level:		0.5 V
• Coordinates reference frame:	WGS 84	WGS 84
Latitude:	1 17 31.0164	1 17 31.1951
Longitude:	103 47 7.8152	103 47 7.6288
Height:	67 m	67 m

Antenna information

	Local:	**Portable:**
• Maker:	Motorola	Topcon/Javad
• Type:	OnCore	MarAnt
• Serial number:		MAGGD #0191
If the antenna is temperature stabilised		
• Set temperature value :	—	—

Antenna cable information

	Local:	**Portable:**
• Maker:	Huber+ Suhner	Huber+ Suhner
• Type:	Sucofeed 7/8 inch HF	Sucofeed ½ inch HF
• Is it a phase stabilised cable:	No	No
• Length of cable outside the building :	84 m	70 m

General information

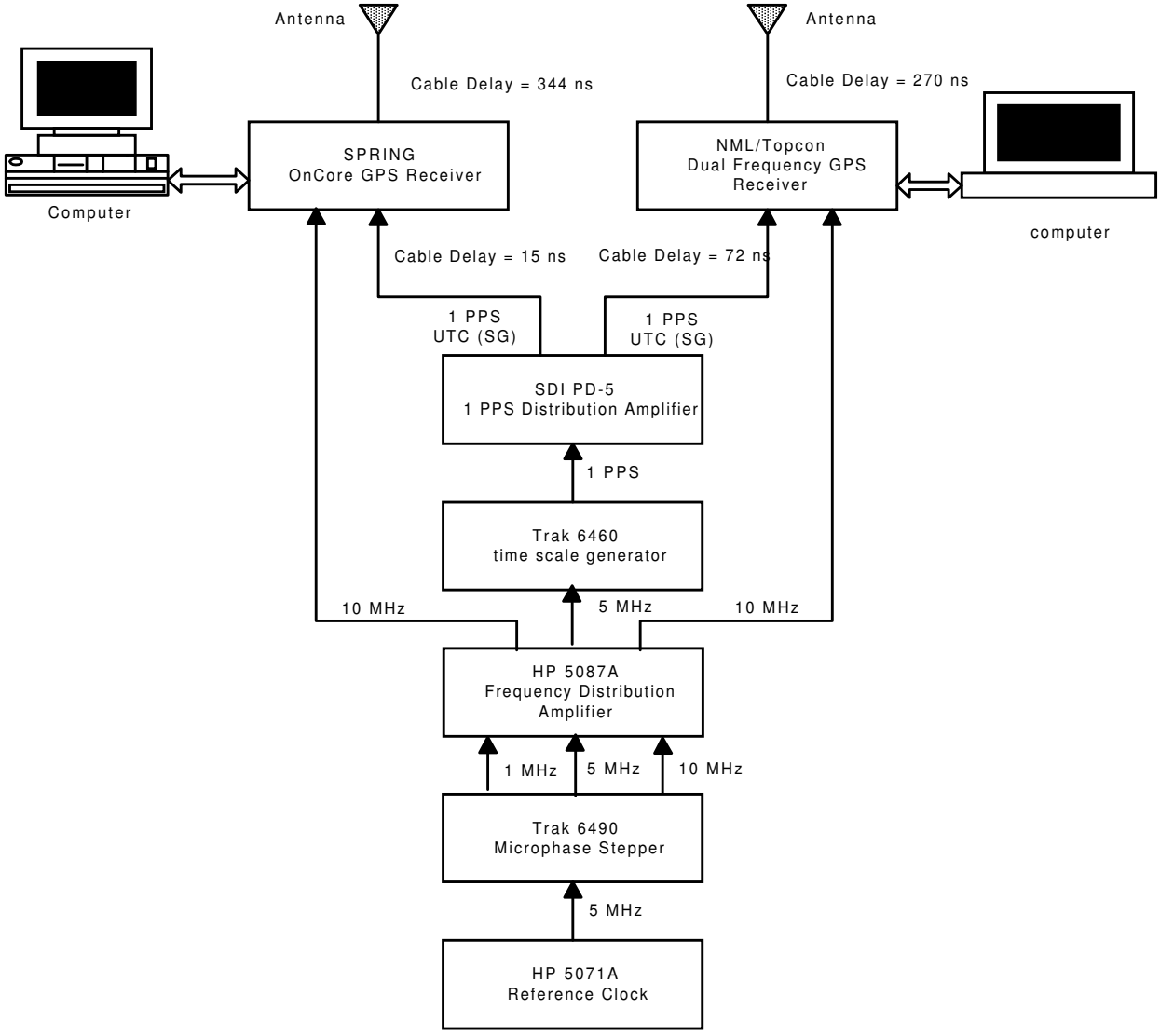
• Rise time of the local UTC pulse:	(4.31 ± 0.12) ns
• Is the laboratory air conditioned:	Yes
• Set temperature value and uncertainty :	23 ± 1 ° C
• Set humidity value and uncertainty :	55 ± 5 % rh

Cable delay control

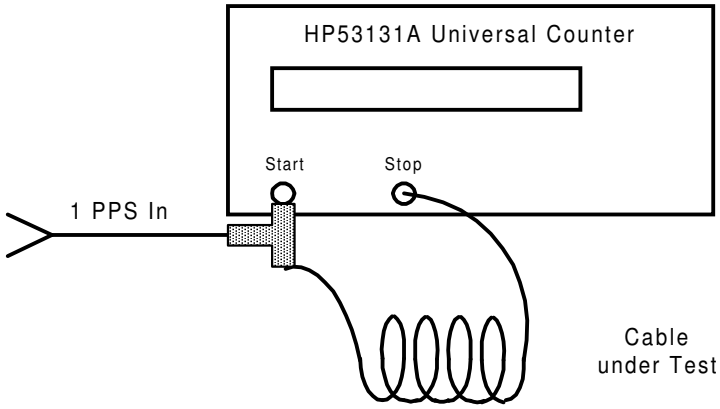
Cable identification	delay measured by NML	delay measured by local method
NML-IF Antenna cable	(159.8 ± 1.0) ns	(158.5 ± 2.0) ns

Plot of the experiment set-up:

Link to the local UTC of both receivers and Antenna positions



Description of the local method of cable delay measurement:



BIPM GPS calibration information sheet

Laboratory:	NMI Sydney, Australia
Date and hour of the beginning of measurements:	24/06/2004, MJD 53180
Date and hour of the end of measurements:	22/07/2004, MJD 53208

Receiver setup information

	Local:	**Portable: NML**
• Maker:	NMI/Topcon	NMI/Topcon
• Type:	Topcon Euro-80	Euro-80 Dual Frequency
• Serial number:	8RQRKXT534	8R633IOLON4
• Receiver internal delay (GPS) :	46.5 ns (uncalibrated)	44.79 ns (uncalibrated)
• Receiver internal delay (GLO) :		
• Antenna cable identification:	TCDF-1	NML IF
Corresponding cable delay :	(75.9 ± 1.0) ns	(159.8 ± 1.0) ns
• UTC cable identification:	UTC(AUS) 9.1.02	APMP Portable
Corresponding cable delay :	(76.0 ± 1.0) ns	(85.9 ± 1.0) ns
Delay to local UTC :	(76.0 ± 1.0) ns	(85.9 ± 1.0) ns
• Receiver trigger level:	0.5V	0.5 V
• Coordinates reference frame:	ITRF93	ITRF2000 @ 27/06/04
~~Latitude~~ or X m	-4648200.298	-4648199.675
~~Longitude~~ or Y m	2560484.03	2560483.895
~~Height~~ or Z m	-3526505.358	-3526506.097

Antenna information

	Local:	**Portable:**
• Maker:	Topcon	Topcon/Javad
• Type:	Regant-1	MarAnt
• Serial number:	RA0122	MAGGD #0191
If the antenna is temperature stabilised		
• Set temperature value :		—

Antenna cable information

• Maker:	Rojone
• Type:	LMR400
• Is it a phase stabilised cable:	No
• Length of cable outside the building :	10m

General information

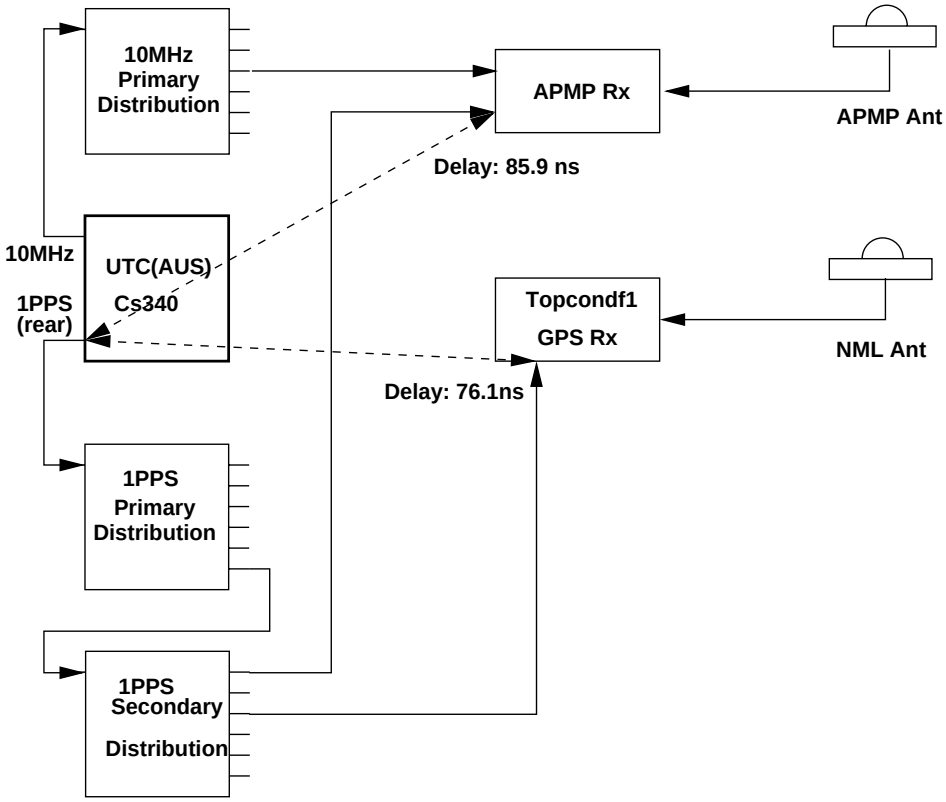
• Rise time of the local UTC pulse:	≤ 4ns
• Is the laboratory air conditioned:	Yes
• Set temperature value and uncertainty :	(20 ± 2) °C
• Set humidity value and uncertainty :	(50 ± 10) %

Cable delay control

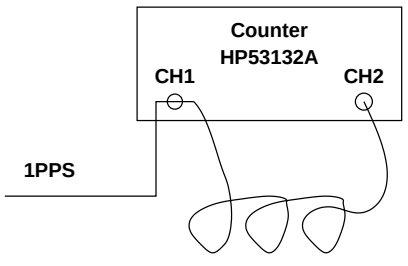
Cable identification	delay measured by NML	delay measured by local method
NML-IF Antenna cable	(159.8 ± 1.0) ns	(159.3 ± 1.0) ns

Plot of the experiment set-up:

Link to the local UTC of both receivers and Antenna positions



Description of the local method of cable delay measurement:



Cable to be measured

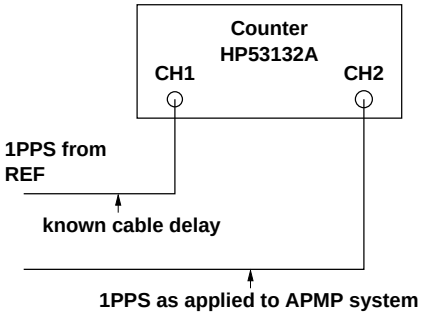
	CH1	CH2
Trigger	1.0V	1.0V
Termination	1M	50 ohm

Mode: Time interval Ch1 to Ch2

Notes:

1. **For antenna measurements, a TNC to BNC adapter was used on each end of the cable.**
2. **Delay Values are Mean and Standard Deviation of 100 measurements.**

We observe a typical day-to-day variation of ±0.5 ns in the delay measured for a given cable, and we therefore estimate the uncertainty of this method at ±1 ns.



	CH1	CH2
Trigger	1.0V	1.0V
Termination	50 ohm	50 ohm

Mode: Time interval Ch1 to Ch2

1PPS delay to APMP system is "known cable delay" plus measurement.

Appendix 2

Antenna coordinate processing reports

These are provided from the AusPOS Online GPS Processing service, and include full details of the calculation of precise antenna coordinates for the portable system antenna.

Australian Government
Geoscience Australia

AUSPOS Online GPS Processing Report

Space Geodesy Analysis Centre
Minerals and Geohazards Division, Geoscience Australia

September 10, 2004

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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Job number: #104049; User: `bruce.warrington@measurement.gov.au` AUSPOS version 1.01.24

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
APMP0580.04O	DEFAULT(NONE)	0.0000	2004-02-27 10:11:00	2004-02-27 23:59:59
APMP0590.04O	DEFAULT(NONE)	0.0000	2004-02-28 00:00:00	2004-02-28 23:59:59
APMP0600.04O	DEFAULT(NONE)	0.0000	2004-02-29 00:00:00	2004-02-29 23:59:59
APMP0610.04O	DEFAULT(NONE)	0.0000	2004-03-01 00:00:00	2004-03-01 23:59:59
APMP0620.04O	DEFAULT(NONE)	0.0000	2004-03-02 00:00:00	2004-03-02 23:59:59
APMP0630.04O	DEFAULT(NONE)	0.0000	2004-03-03 00:00:00	2004-03-03 23:59:59

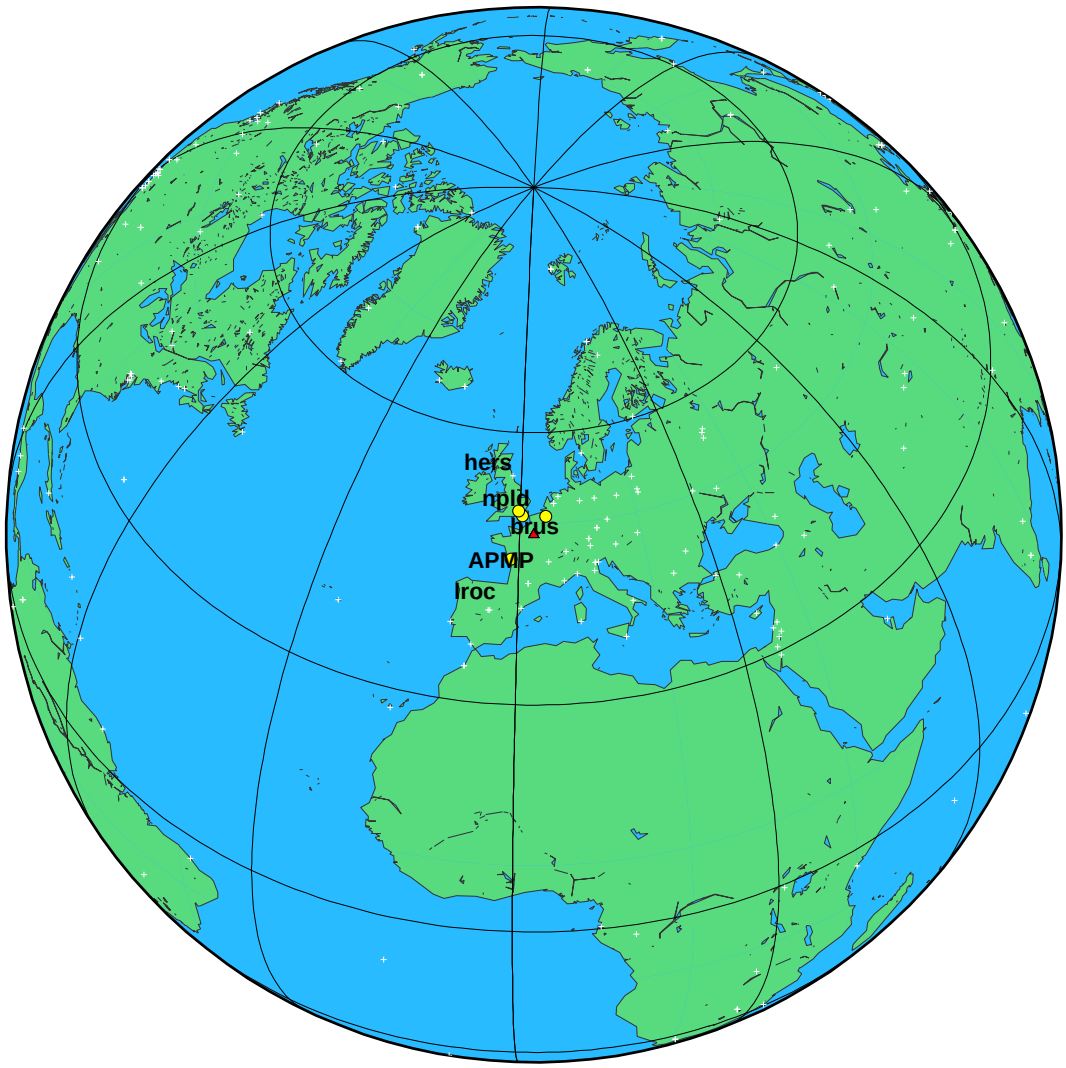

Figure 1: Global View – submitted GPS station(s) and nearby IGS GPS stations used in the processing; triangle(s) represent submitted user data; circle(s) represent the nearest available IGS stations.

2 Processing Summary

Date	IGS Data	User Data	Orbit Type
2004-02-27	brus hers npld	APMP	IGS Final
2004-02-28	brus hers npld	APMP	IGS Final
2004-02-29	brus hers npld	APMP	IGS Final
2004-03-01	brus hers npld	APMP	IGS Final
2004-03-02	brus npld lroc	APMP	IGS Final
2004-03-03	brus hers lroc	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 @	
hers	4033470.129	23672.880	4924301.301	2004/02/29	
brus	4027893.769	307045.812	4919475.107	2004/03/01	
npld	3985500.312	-23625.461	4962941.685	2004/02/29	
APMP	4202783.525	171367.812	4778657.541	2004/03/01	
APMP	0.002 m	0.004 m	0.004 m		RMS
lroc	4424632.586	-94175.244	4577544.067	2004/03/03	

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)	
hers	50 52 2.3289	0 20 10.5769	76.492	31.471	
brus	50 47 52.1441	4 21 33.1883	149.680	104.159	
npld	51 25 15.5300	0-20 -22.6932	72.646	26.553	
APMP	48 50 9.1056	2 20 5.7574	124.628	80.086	
APMP	0.002 m	0.005 m	0.004 m		RMS
lroc	46 9 32.1913	-1-13 -9.5410	57.862	9.814	

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
APMP	0.0000	0.0000	0.0000	0.0000	2004/02/27
APMP	0.0000	0.0000	0.0000	0.0000	2004/02/28

APMP	0.0000	0.0000	0.0000	0.0000	2004/02/29
APMP	0.0000	0.0000	0.0000	0.0000	2004/03/01
APMP	0.0000	0.0000	0.0000	0.0000	2004/03/02
APMP	0.0000	0.0000	0.0000	0.0000	2004/03/03

4.2 Apriori Coordinate Updates - Cartesian, per day

	dX(m)	dY(m)	dZ(m)	yyyy/mm/dd
APMP	0.008	0.009	0.009	2004/02/27
APMP	0.030	0.006	0.033	2004/02/28
APMP	0.030	0.012	0.029	2004/02/29
APMP	0.015	0.004	0.012	2004/03/01
APMP	0.020	0.002	0.023	2004/03/02
APMP	0.023	0.004	0.022	2004/03/03

4.3 Coordinate Precision - Cartesian, per day

1 Sigma	sX(m)	sY(m)	sZ(m)	yyyy/mm/dd
APMP	0.004	0.004	0.004	2004/02/27
APMP	0.003	0.003	0.003	2004/02/28
APMP	0.003	0.003	0.003	2004/02/29
APMP	0.003	0.003	0.003	2004/03/01
APMP	0.003	0.003	0.003	2004/03/02
APMP	0.003	0.003	0.003	2004/03/03

4.4 Coordinate Value - Cartesian, ITRF2000, per day

	X(m)	Y(m)	Z(m)	ITRF2000 @
APMP	4202783.521	171367.821	4778657.537	2004/02/27
APMP	4202783.523	171367.809	4778657.545	2004/02/28
APMP	4202783.528	171367.813	4778657.545	2004/02/29
APMP	4202783.525	171367.812	4778657.543	2004/03/01
APMP	4202783.527	171367.807	4778657.541	2004/03/02
APMP	4202783.524	171367.810	4778657.536	2004/03/03

4.5 Geodetic, GRS80 Ellipsoid, ITRF2000, per day

	Latitude(DMS)		Longitude(DMS)		Ellipsoidal Height(m)	
APMP	48 50	9.1056	2 20	5.7579	124.622	2004/02/27
APMP	48 50	9.1057	2 20	5.7573	124.629	2004/02/28
APMP	48 50	9.1056	2 20	5.7575	124.633	2004/02/29
APMP	48 50	9.1056	2 20	5.7574	124.629	2004/03/01
APMP	48 50	9.1056	2 20	5.7572	124.629	2004/03/02
APMP	48 50	9.1055	2 20	5.7573	124.623	2004/03/03

4.6 RMS, Observations, Deletions per day

Data	RMS (m)	# Observations	% Obs. Deleted	Date
hers	0.0073	8108	7 %	2004-02-27
brus	0.0076	8106	9 %	2004-02-27
npld	0.0071	8290	6 %	2004-02-27
APMP	0.0073	24504	7 %	2004-02-27
hers	0.0066	14430	4 %	2004-02-28
brus	0.0066	14162	8 %	2004-02-28
npld	0.0069	14850	3 %	2004-02-28
APMP	0.0067	43442	5 %	2004-02-28
hers	0.0062	13873	5 %	2004-02-29
brus	0.0065	14428	6 %	2004-02-29
npld	0.0063	15102	2 %	2004-02-29
APMP	0.0063	43403	4 %	2004-02-29
hers	0.0062	14406	4 %	2004-03-01
brus	0.0064	15065	3 %	2004-03-01
npld	0.0062	14465	6 %	2004-03-01
APMP	0.0063	43936	4 %	2004-03-01
brus	0.0066	16245	5 %	2004-03-02
npld	0.0061	16592	2 %	2004-03-02
APMP	0.0064	49192	3 %	2004-03-02
hers	0.0062	16100	3 %	2004-03-03
brus	0.0065	16431	3 %	2004-03-03
APMP	0.0063	48931	3 %	2004-03-03

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

Australian Government

Geoscience Australia

AUSPOS Online GPS Processing Report

Space Geodesy Analysis Centre
Minerals and Geohazards Division, Geoscience Australia

September 10, 2004

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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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Job number: #104048; User: `bruce.warrington@measurement.gov.au` AUSPOS version 1.01.24

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
APMP0780.04O	DEFAULT(NONE)	0.0000	2004-03-18 01:25:59	2004-03-18 23:59:59
APMP0790.04O	DEFAULT(NONE)	0.0000	2004-03-19 00:00:00	2004-03-19 23:59:59
APMP0800.04O	DEFAULT(NONE)	0.0000	2004-03-20 00:00:00	2004-03-20 23:59:59
APMP0810.04O	DEFAULT(NONE)	0.0000	2004-03-21 00:00:00	2004-03-21 23:59:59
APMP0820.04O	DEFAULT(NONE)	0.0000	2004-03-22 00:00:00	2004-03-22 23:59:59
APMP0830.04O	DEFAULT(NONE)	0.0000	2004-03-23 00:00:00	2004-03-23 23:59:59

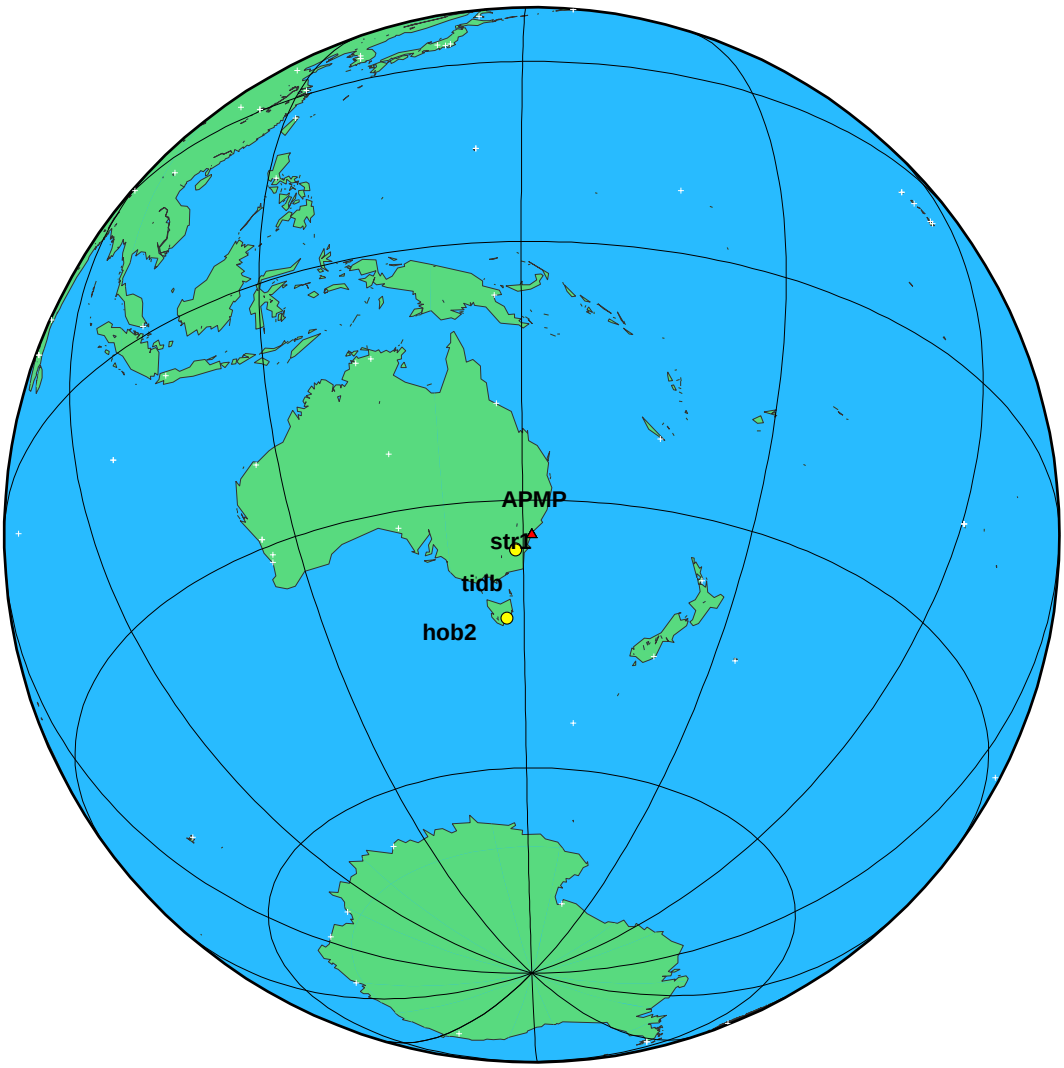

Figure 1: Global View – submitted GPS station(s) and nearby IGS GPS stations used in the processing; triangle(s) represent submitted user data; circle(s) represent the nearest available IGS stations.

2 Processing Summary

Date	IGS Data	User Data	Orbit Type
2004-03-18	str1 tidb hob2	APMP	IGS Final
2004-03-19	str1 tidb hob2	APMP	IGS Final
2004-03-20	str1 tidb hob2	APMP	IGS Final
2004-03-21	str1 tidb hob2	APMP	IGS Final
2004-03-22	str1 tidb hob2	APMP	IGS Final
2004-03-23	str1 tidb hob2	APMP	IGS Final

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	-4460996.065	2682557.135	-3674443.860	GDA94
hob2	-3950071.284	2522415.222	-4311638.526	GDA94
str1	-4467102.303	2683039.532	-3666949.981	GDA94
APMP	-4648203.955	2560477.101	-3526505.422	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	665.425	646.139	GDA94
hob2	-42-48 -16.9852	147 26 19.4356	41.144	44.450	GDA94
str1	-35-18 -55.9395	149 0 36.1797	800.030	780.693	GDA94
APMP	-33-46 -58.1709	151 9 6.1092	99.134	75.995	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	665.425	646.139	GDA94
hob2	535873.397	5260777.226	55	41.144	44.450	GDA94
str1	682726.017	6090110.670	55	800.030	780.693	GDA94
APMP	328868.658	6260388.351	56	99.134	75.995	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	-4460996.405	2682557.092	-3674443.384	2004/03/21
hob2	-3950071.658	2522415.260	-4311638.088	2004/03/21
str1	-4467102.642	2683039.488	-3666949.504	2004/03/21

APMP	-4648204.276	2560477.037	-3526504.944	2004/03/21
APMP	0.009 m	0.008 m	0.008 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

	Latitude(DMS)	Longitude(DMS)	Ellipsoidal Height(m)	Above-Geoid Height(m)
tidb	-35-23 -57.1384	148 58 47.9929	665.368	646.205
hob2	-42-48 -16.9674	147 26 19.4430	41.093	44.603
str1	-35-18 -55.9219	149 0 36.1881	799.974	780.729
APMP	-33-46 -58.1534	151 9 6.1174	99.076	76.222
APMP	0.003 m	0.004 m	0.014 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
APMP	0.0000	0.0000	0.0000	0.0000	2004/03/18
APMP	0.0000	0.0000	0.0000	0.0000	2004/03/19
APMP	0.0000	0.0000	0.0000	0.0000	2004/03/20
APMP	0.0000	0.0000	0.0000	0.0000	2004/03/21
APMP	0.0000	0.0000	0.0000	0.0000	2004/03/22
APMP	0.0000	0.0000	0.0000	0.0000	2004/03/23

5.2 Apriori Coordinate Updates - Cartesian, per day

	dX(m)	dY(m)	dZ(m)	yyyy/mm/dd
APMP	0.010	-0.012	0.012	2004/03/18
APMP	0.018	-0.004	0.019	2004/03/19
APMP	0.013	-0.008	0.011	2004/03/20
APMP	0.001	-0.009	0.012	2004/03/21
APMP	0.002	0.007	0.009	2004/03/22
APMP	-0.005	0.002	0.009	2004/03/23

5.3 Coordinate Precision - Cartesian, per day

1 Sigma	sX(m)	sY(m)	sZ(m)	yyyy/mm/dd
APMP	0.005	0.005	0.005	2004/03/18
APMP	0.004	0.004	0.004	2004/03/19
APMP	0.005	0.005	0.005	2004/03/20
APMP	0.005	0.005	0.005	2004/03/21
APMP	0.004	0.004	0.004	2004/03/22
APMP	0.004	0.004	0.004	2004/03/23

5.4 Coordinate Value - Cartesian, ITRF2000, per day

	X(m)	Y(m)	Z(m)	ITRF2000 @
APMP	-4648204.276	2560477.038	-3526504.947	2004/03/18
APMP	-4648204.263	2560477.029	-3526504.929	2004/03/19
APMP	-4648204.271	2560477.026	-3526504.941	2004/03/20
APMP	-4648204.291	2560477.048	-3526504.957	2004/03/21
APMP	-4648204.279	2560477.037	-3526504.945	2004/03/22
APMP	-4648204.282	2560477.046	-3526504.947	2004/03/23

5.5 Geodetic, GRS80 Ellipsoid, ITRF2000, per day

	Latitude(DMS)	Longitude(DMS)	Ellipsoidal Height(m)	
APMP	-33-46 -58.1535	151 9 6.1174	99.078	2004/03/18
APMP	-33-46 -58.1533	151 9 6.1175	99.055	2004/03/19
APMP	-33-46 -58.1535	151 9 6.1177	99.066	2004/03/20
APMP	-33-46 -58.1535	151 9 6.1173	99.098	2004/03/21
APMP	-33-46 -58.1534	151 9 6.1175	99.079	2004/03/22
APMP	-33-46 -58.1534	151 9 6.1172	99.085	2004/03/23

5.6 RMS, Observations, Deletions per day

Data	RMS (m)	# Observations	% Obs. Deleted	Date
tidb	0.0089	14117	6 %	2004-03-18
hob2	0.0097	13575	4 %	2004-03-18
str1	0.0085	14629	6 %	2004-03-18
APMP	0.0090	42321	5 %	2004-03-18
tidb	0.0082	15089	7 %	2004-03-19
hob2	0.0092	13354	8 %	2004-03-19
str1	0.0083	14709	9 %	2004-03-19
APMP	0.0086	43152	8 %	2004-03-19
tidb	0.0095	17809	4 %	2004-03-20
hob2	0.0096	16512	2 %	2004-03-20
str1	0.0095	17690	5 %	2004-03-20
APMP	0.0095	52011	4 %	2004-03-20
tidb	0.0100	18206	2 %	2004-03-21
hob2	0.0110	15934	5 %	2004-03-21
str1	0.0096	18088	3 %	2004-03-21
APMP	0.0102	52228	3 %	2004-03-21
tidb	0.0084	18787	4 %	2004-03-22
hob2	0.0084	16845	5 %	2004-03-22
str1	0.0080	18922	4 %	2004-03-22
APMP	0.0083	54554	4 %	2004-03-22
tidb	0.0087	18722	3 %	2004-03-23
hob2	0.0092	16435	4 %	2004-03-23
str1	0.0082	18783	2 %	2004-03-23
APMP	0.0087	53940	3 %	2004-03-23

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

Australian Government

Geoscience Australia

AUSPOS Online GPS Processing Report

Space Geodesy Analysis Centre
Minerals and Geohazards Division, Geoscience Australia

June 28, 2004

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.

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An overview of the GPS processing strategy is attached to this report. Please direct email correspondence to geodesy@ga.gov.au

AUSPOS Project Manager

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Job number: #102625; User: `peter.fisk@csiro.au` AUSPOS version 1.01.24

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
TLTW1140.04O	DEFAULT(NONE)	0.0000	2004-04-23 00:00:00	2004-04-23 23:59:59
TLTW1150.04O	DEFAULT(NONE)	0.0000	2004-04-24 00:00:00	2004-04-24 23:59:59

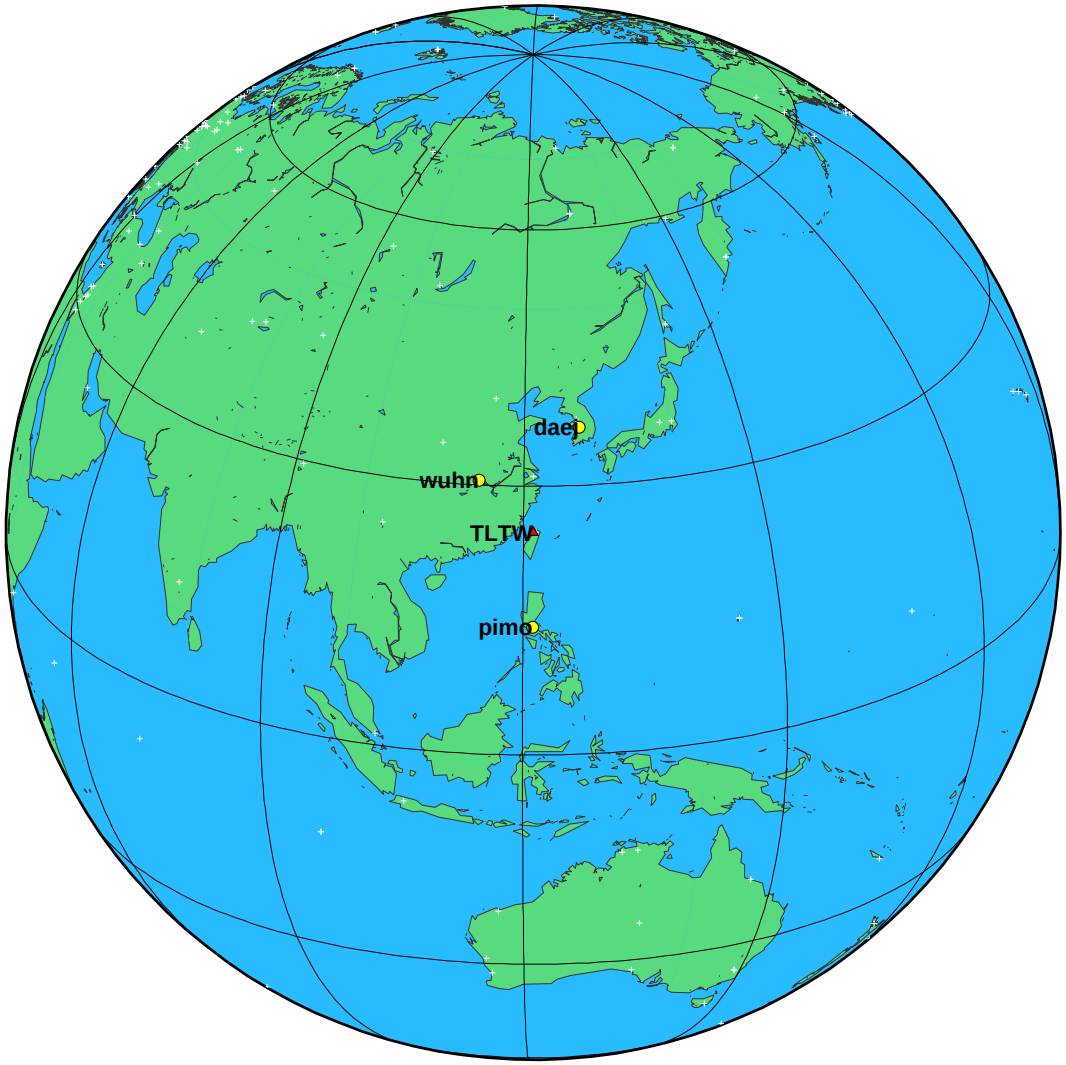

Figure 1: Global View – submitted GPS station(s) and nearby IGS GPS stations used in the processing; triangle(s) represent submitted user data; circle(s) represent the nearest available IGS stations.

2 Processing Summary

Date	IGS Data	User Data	Orbit Type
2004-04-23	wuhn pimo daej	TLTW	IGS Final
2004-04-24	wuhn pimo daej	TLTW	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 @	
wuhn	-2267749.410	5009154.323	3221290.696	2004/04/24	
daej	-3120041.959	4084614.889	3764026.906	2004/04/24	
pimo	-3186293.921	5286624.204	1601158.260	2004/04/24	
TLTW	-2994425.895	4951311.783	2674496.617	2004/04/24	
TLTW	0.010 m	0.017 m	0.018 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)	
wuhn	30 31 53.9494	114 21 26.1426	25.879	40.305	
daej	36 23 57.9433	127 22 28.1244	116.829	91.811	
pimo	14 38 8.5901	121 4 39.8347	95.517	51.989	
TLTW	24 57 12.8151	121 9 52.0875	202.329	183.269	
TLTW	0.009 m	0.004 m	0.025 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.

	Height(m)	Antenna Offsets(m)			
Station	Up	East	North	Up	yyyy/mm/dd
TLTW	0.0000	0.0000	0.0000	0.0000	2004/04/23
TLTW	0.0000	0.0000	0.0000	0.0000	2004/04/24

4.2 Apriori Coordinate Updates - Cartesian, per day

	dX(m)	dY(m)	dZ(m)	yyyy/mm/dd
TLTW	-0.032	-0.009	0.011	2004/04/23
TLTW	0.022	-0.001	0.000	2004/04/24

4.3 Coordinate Precision - Cartesian, per day

1 Sigma	sX(m)	sY(m)	sZ(m)	yyyy/mm/dd
TLTW	0.007	0.015	0.007	2004/04/23
TLTW	0.007	0.007	0.007	2004/04/24

4.4 Coordinate Value - Cartesian, ITRF2000, per day

	X(m)	Y(m)	Z(m)	ITRF2000 @
TLTW	-2994425.885	4951311.759	2674496.599	2004/04/23
TLTW	-2994425.905	4951311.788	2674496.634	2004/04/24

4.5 Geodetic, GRS80 Ellipsoid, ITRF2000, per day

	Latitude(DMS)	Longitude(DMS)	Ellipsoidal Height(m)	
TLTW	24 57 12.8149	121 9 52.0876	202.298	2004/04/23
TLTW	24 57 12.8154	121 9 52.0877	202.344	2004/04/24

4.6 RMS, Observations, Deletions per day

Data	RMS (m)	# Observations	% Obs. Deleted	Date
wuhn	0.0151	11828	16 %	2004-04-23
daej	0.0136	11007	12 %	2004-04-23
pimo	0.0151	9337	17 %	2004-04-23
TLTW	0.0146	32172	15 %	2004-04-23
wuhn	0.0149	19575	13 %	2004-04-24
daej	0.0132	17709	12 %	2004-04-24
pimo	0.0140	14687	27 %	2004-04-24
TLTW	0.0141	51971	17 %	2004-04-24

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

Australian Government
Geoscience Australia

AUSPOS Online GPS Processing Report

Space Geodesy Analysis Centre
Minerals and Geohazards Division, Geoscience Australia

June 29, 2004

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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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Job number: #17641; User: `peter.fisk@csiro.au` AUSPOS version 1.01.24

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
NICT1420.04O	DEFAULT(NONE)	0.0000	2004-05-21 00:00:00	2004-05-21 23:59:59
NICT1430.04O	DEFAULT(NONE)	0.0000	2004-05-22 00:00:00	2004-05-22 23:59:59

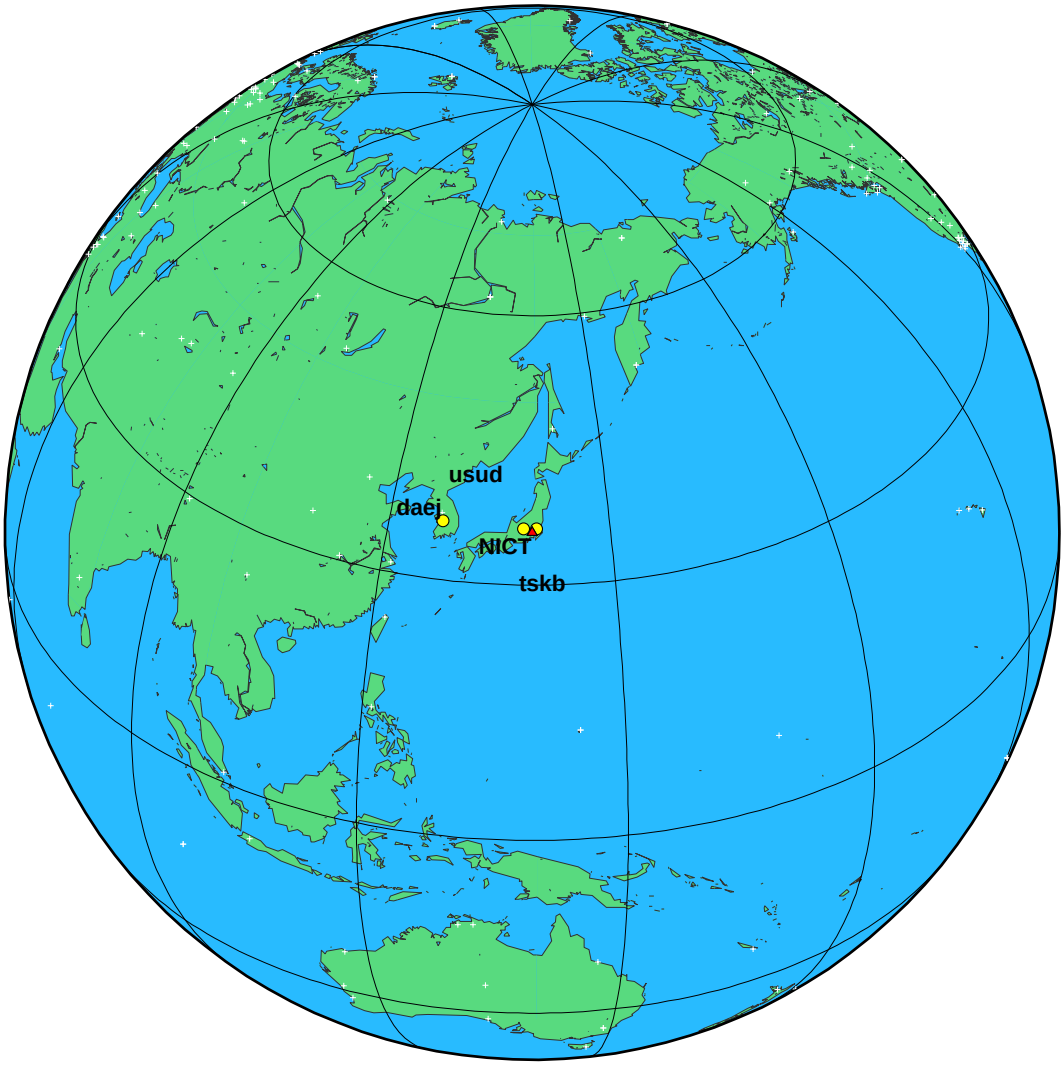

Figure 1: Global View – submitted GPS station(s) and nearby IGS GPS stations used in the processing; triangle(s) represent submitted user data; circle(s) represent the nearest available IGS stations.

2 Processing Summary

Date	IGS Data	User Data	Orbit Type
2004-05-21	tskb usud daej	NICT	IGS Final
2004-05-22	tskb usud daej	NICT	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 @	
usud	-3855263.022	3427432.544	3741020.314	2004/05/22	
tskb	-3957199.245	3310199.711	3737711.650	2004/05/22	
daej	-3120041.961	4084614.888	3764026.906	2004/05/22	
NICT	-3942161.308	3368285.880	3701886.725	2004/05/22	
NICT	0.001 m	0.001 m	0.002 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)	
usud	36 7 59.1978	138 21 43.3570	1508.616	1465.997	
tskb	36 6 20.4469	140 5 14.9875	67.248	28.298	
daej	36 23 57.9433	127 22 28.1245	116.830	91.812	
NICT	35 42 23.9392	139 29 18.7997	131.323	93.579	
NICT	0.001 m	0.000 m	0.002 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.

	Height(m)	Antenna Offsets(m)			
Station	Up	East	North	Up	yyyy/mm/dd
NICT	0.0000	0.0000	0.0000	0.0000	2004/05/21
NICT	0.0000	0.0000	0.0000	0.0000	2004/05/22

4.2 Apriori Coordinate Updates - Cartesian, per day

	dX(m)	dY(m)	dZ(m)	yyyy/mm/dd
NICT	-0.005	-0.001	0.004	2004/05/21
NICT	-0.014	0.011	0.012	2004/05/22

4.3 Coordinate Precision - Cartesian, per day

1 Sigma	sX(m)	sY(m)	sZ(m)	yyyy/mm/dd
NICT	0.004	0.004	0.004	2004/05/21
NICT	0.005	0.005	0.005	2004/05/22

4.4 Coordinate Value - Cartesian, ITRF2000, per day

	X(m)	Y(m)	Z(m)	ITRF2000 @
NICT	-3942161.308	3368285.880	3701886.723	2004/05/21
NICT	-3942161.309	3368285.881	3701886.727	2004/05/22

4.5 Geodetic, GRS80 Ellipsoid, ITRF2000, per day

	Latitude(DMS)	Longitude(DMS)	Ellipsoidal Height(m)	
NICT	35 42 23.9392	139 29 18.7997	131.321	2004/05/21
NICT	35 42 23.9393	139 29 18.7997	131.324	2004/05/22

4.6 RMS, Observations, Deletions per day

Data	RMS (m)	# Observations	% Obs. Deleted	Date
usud	0.0085	21105	1 %	2004-05-21
tskb	0.0082	22466	1 %	2004-05-21
daej	0.0087	17443	3 %	2004-05-21
NICT	0.0085	61014	1 %	2004-05-21
usud	0.0101	20746	4 %	2004-05-22
tskb	0.0081	22409	3 %	2004-05-22
daej	0.0090	18517	8 %	2004-05-22
NICT	0.0091	61672	5 %	2004-05-22

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
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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
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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.
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Nutation	IAU80/IERS96 (including epsilon and psi corrections)
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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

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June 28, 2004

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Job number: #17621; User: `peter.fisk@csiro.au` AUSPOS version 1.01.24

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
NMIJ1480.04O	DEFAULT(NONE)	0.0000	2004-05-27 00:00:00	2004-05-27 23:59:59
NMIJ1490.04O	DEFAULT(NONE)	0.0000	2004-05-28 00:00:00	2004-05-28 23:59:59

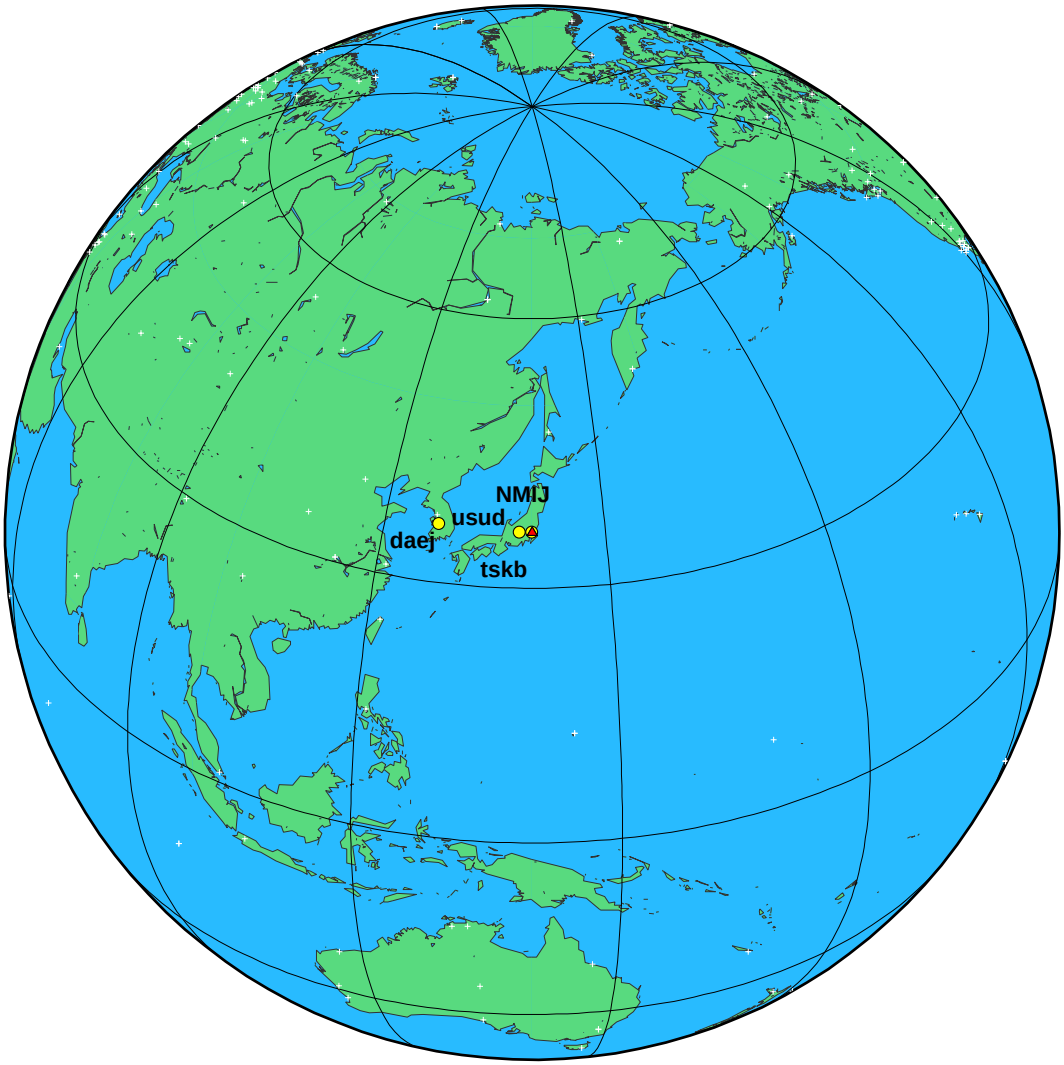

Figure 1: Global View – submitted GPS station(s) and nearby IGS GPS stations used in the processing; triangle(s) represent submitted user data; circle(s) represent the nearest available IGS stations.

2 Processing Summary

Date	IGS Data	User Data	Orbit Type
2004-05-27	tskb usud daej	NMIJ	IGS Final
2004-05-28	tskb usud daej	NMIJ	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 @	
usud	-3855263.022	3427432.544	3741020.314	2004/05/28	
tskb	-3957199.245	3310199.711	3737711.650	2004/05/28	
daej	-3120041.961	4084614.888	3764026.905	2004/05/28	
NMIJ	-3962302.243	3308875.364	3733523.235	2004/05/28	
NMIJ	0.002 m	0.001 m	0.003 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)	
usud	36 7 59.1978	138 21 43.3570	1508.616	1465.997	
tskb	36 6 20.4469	140 5 14.9875	67.248	28.298	
daej	36 23 57.9433	127 22 28.1245	116.829	91.811	
NMIJ	36 3 32.0393	140 8 6.4005	78.502	40.011	
NMIJ	0.003 m	0.001 m	0.001 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.

	Height(m)	Antenna Offsets(m)			
Station	Up	East	North	Up	yyyy/mm/dd
NMIJ	0.0000	0.0000	0.0000	0.0000	2004/05/27
NMIJ	0.0000	0.0000	0.0000	0.0000	2004/05/28

4.2 Apriori Coordinate Updates - Cartesian, per day

	dX(m)	dY(m)	dZ(m)	yyyy/mm/dd
NMIJ	-0.018	-0.003	0.013	2004/05/27
NMIJ	-0.006	0.004	0.007	2004/05/28

4.3 Coordinate Precision - Cartesian, per day

1 Sigma	sX(m)	sY(m)	sZ(m)	yyyy/mm/dd
NMIJ	0.005	0.005	0.005	2004/05/27
NMIJ	0.004	0.004	0.004	2004/05/28

4.4 Coordinate Value - Cartesian, ITRF2000, per day

	X(m)	Y(m)	Z(m)	ITRF2000 @
NMIJ	-3962302.241	3308875.365	3733523.238	2004/05/27
NMIJ	-3962302.244	3308875.364	3733523.232	2004/05/28

4.5 Geodetic, GRS80 Ellipsoid, ITRF2000, per day

	Latitude(DMS)			Longitude(DMS)			Ellipsoidal Height(m)	
NMIJ	36	3	32.0394	140	8	6.4004	78.503	2004/05/27
NMIJ	36	3	32.0392	140	8	6.4005	78.501	2004/05/28

4.6 RMS, Observations, Deletions per day

Data	RMS (m)	# Observations	% Obs. Deleted	Date
usud	0.0099	15054	16 %	2004-05-27
tskb	0.0080	18968	3 %	2004-05-27
daej	0.0092	14905	13 %	2004-05-27
NMIJ	0.0090	48927	10 %	2004-05-27
usud	0.0097	20511	7 %	2004-05-28
tskb	0.0077	22351	5 %	2004-05-28
daej	0.0095	18919	8 %	2004-05-28
NMIJ	0.0089	61781	7 %	2004-05-28

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

Australian Government

Geoscience Australia

AUSPOS Online GPS Processing Report

Space Geodesy Analysis Centre
Minerals and Geohazards Division, Geoscience Australia

September 11, 2004

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

AUSPOS Project Manager

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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
APMP1610.04O	DEFAULT(NONE)	0.0000	2004-06-09 00:00:00	2004-06-09 23:59:59
APMP1620.04O	DEFAULT(NONE)	0.0000	2004-06-10 00:00:00	2004-06-10 23:59:59
APMP1630.04O	DEFAULT(NONE)	0.0000	2004-06-11 00:00:00	2004-06-11 23:59:59
APMP1640.04O	DEFAULT(NONE)	0.0000	2004-06-12 00:00:00	2004-06-12 23:59:59
APMP1650.04O	DEFAULT(NONE)	0.0000	2004-06-13 00:00:00	2004-06-13 23:59:59

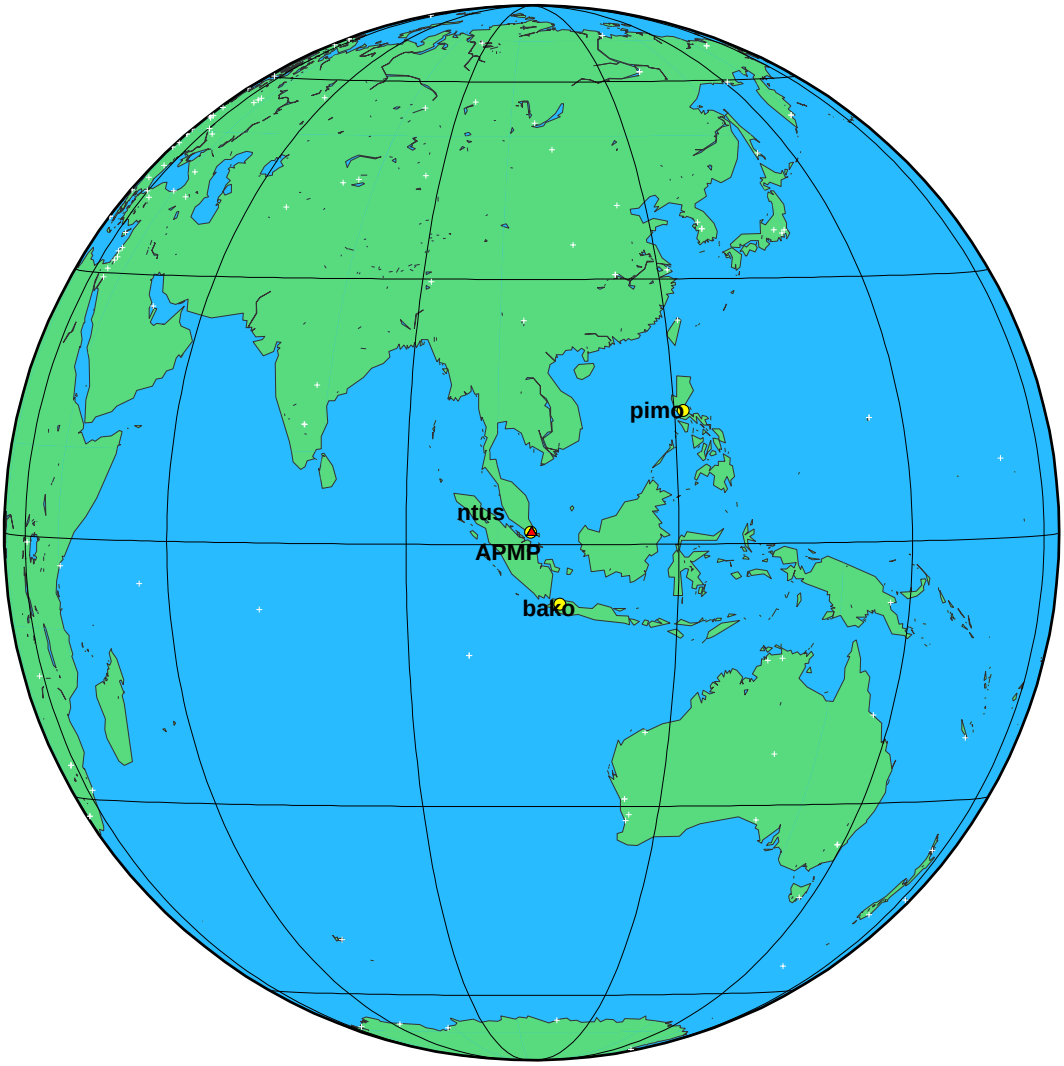


Figure 1: Global View – submitted GPS station(s) and nearby IGS GPS stations used in the processing; triangle(s) represent submitted user data; circle(s) represent the nearest available IGS stations.

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.

	Height(m)	Antenna Offsets(m)			
Station	Up	East	North	Up	yyyy/mm/dd
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^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

Appendix 3

Summary plots of comparison data

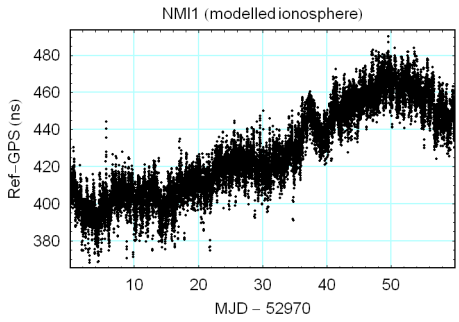
The data shown includes REF–GPS; DSG and ISG (see §5.3); and the comparison data set $(REF–SV)_k$ – $(REF–SV)_{APMP}$, together with results for the mean offset.

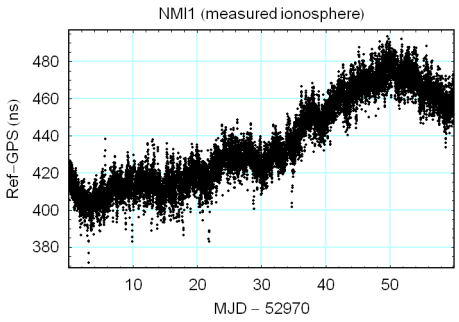
Please note that values for DSG and ISG are in units of 0.1 ns.

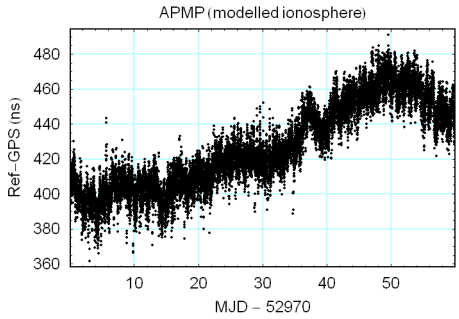
For an explanation of the plots provided for TL, please refer to §5.3.

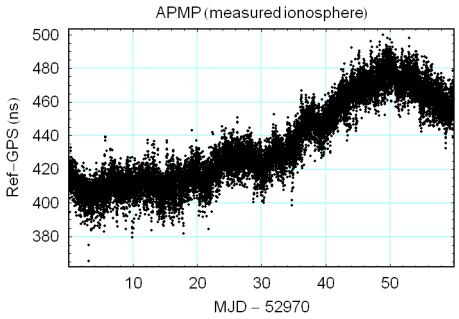
NMI (1)

- REF–GPS data:

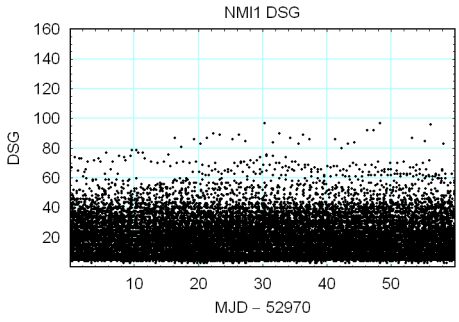


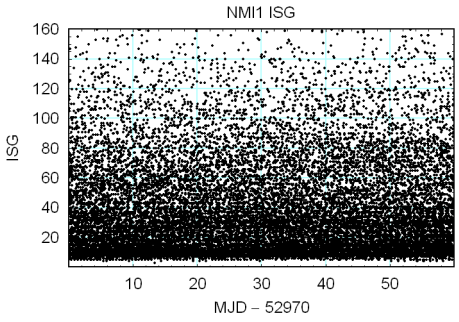


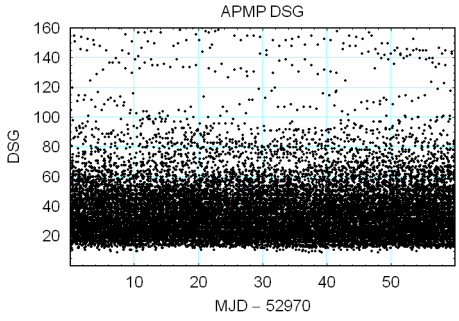


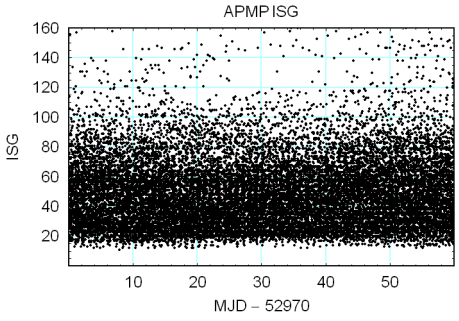


- DSG and ISG:

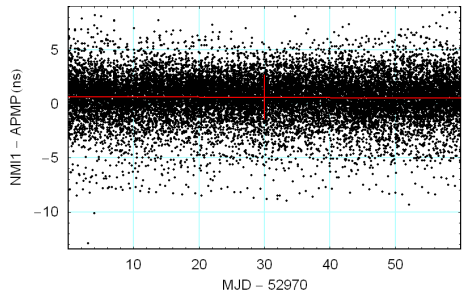








- $(REF–SV)_{NMI} – (REF–SV)_{APMP}$, common-view tracks, no delay corrections applied:

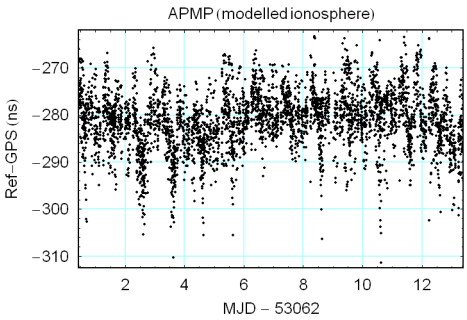


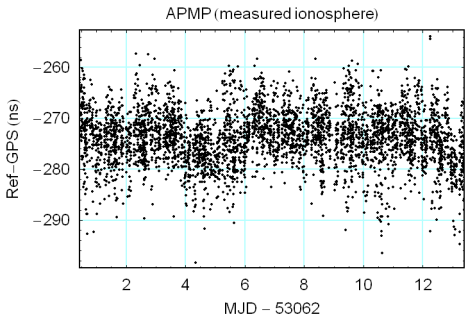
Summary
19526 common–view tracks, MJD 52970 – 53029
Mean offset at MJD 53000.

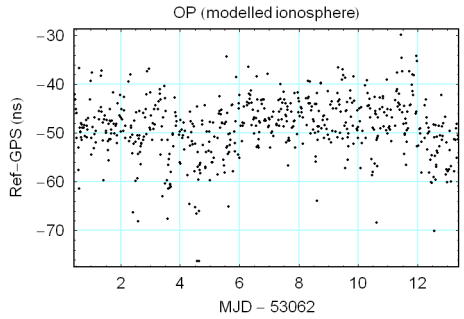
	(unweighted	/	weighted)	
Mean offset	0.6	/	0.9	ns
RMS	2.0	/		ns
Slope	–3±1	/	–7±1	ps/day

OP (BNM-SYRTE)

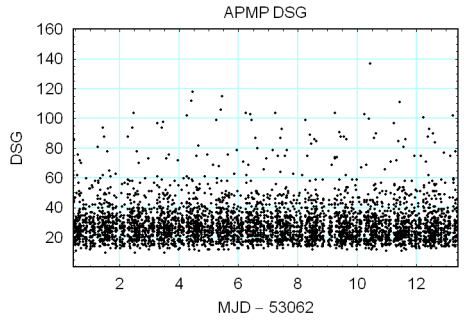
- REF–GPS data:

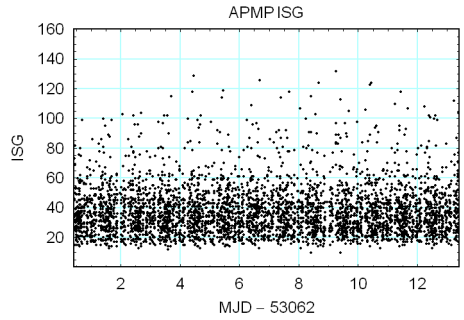


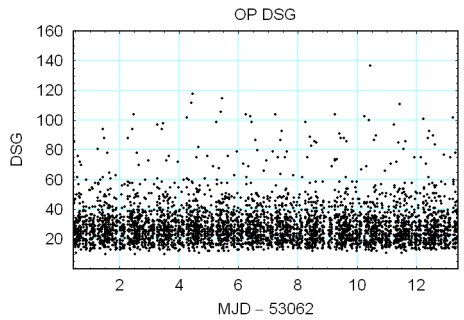




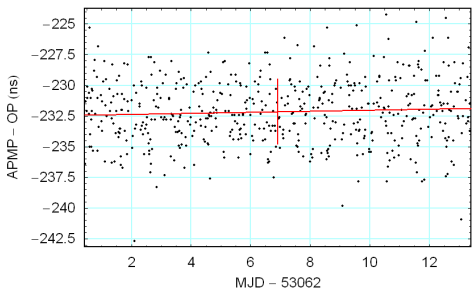
- DSG and ISG:







- $(REF–SV)_{APMP} – (REF–SV)_{OP}$, common-view tracks, no delay corrections applied:

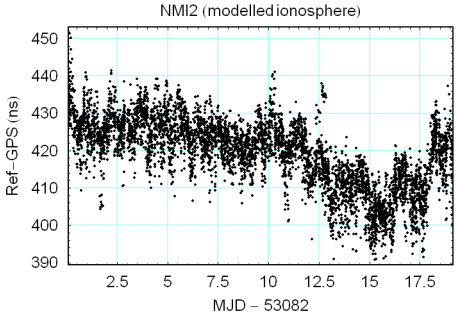


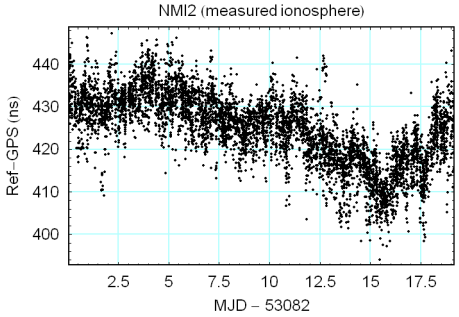
Summary
539 common–view tracks, MJD 53062 – 53075
Mean offset at MJD 53068.9

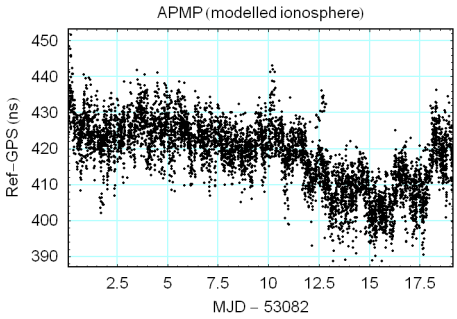
	(unweighted	/	weighted)	
Mean offset	−232.1	/	−232.4	ns
RMS	2.6	/		ns
Slope	40±30	/	36±30	ps/day

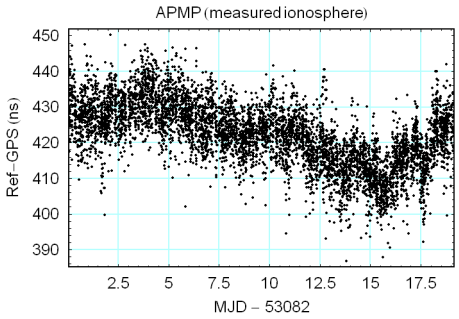
NMI (2)

- REF–GPS data:

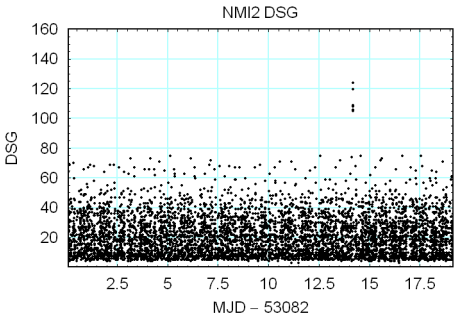


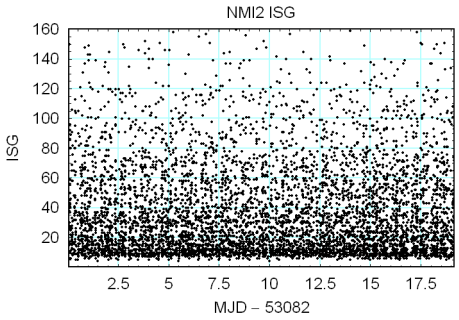


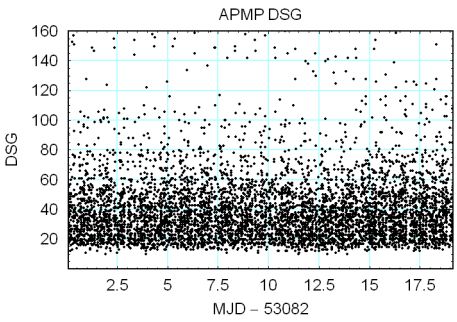


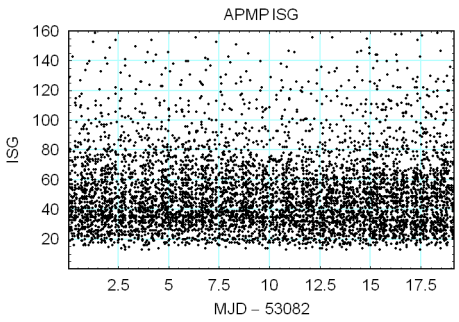


- DSG and ISG:

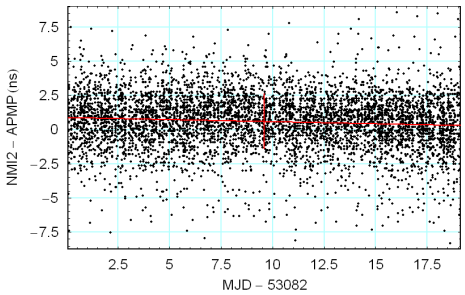








- $(REF–SV)_{NMI} – (REF–SV)_{APMP}$, common-view tracks, no delay corrections applied:

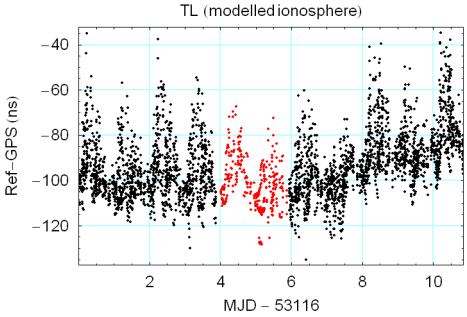


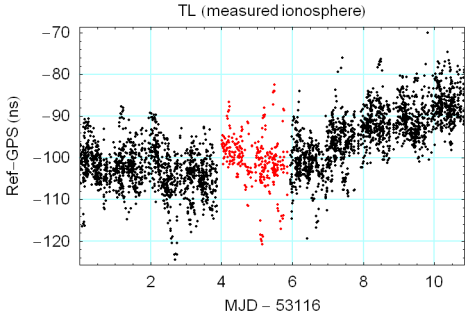
Summary
5809 common–view tracks, MJD 53082 – 53101
Mean offset at MJD 53091.6

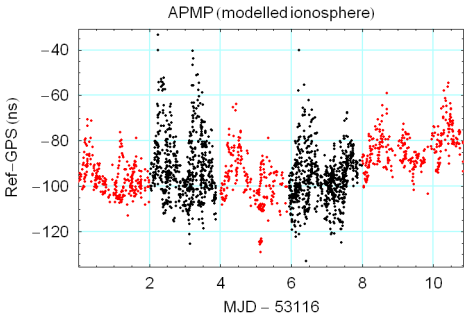
	(unweighted	/	weighted)	
Mean offset	0.6	/	1.0	ns
RMS	2.0	/		ns
Slope	–30±5	/	–35±3	ps/day

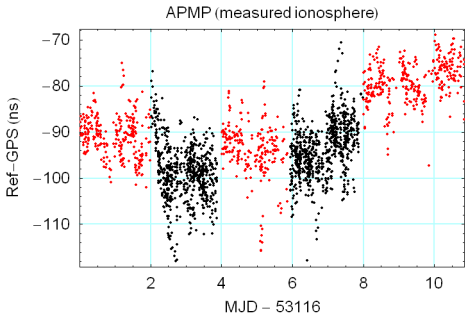
TL

- REF–GPS data:

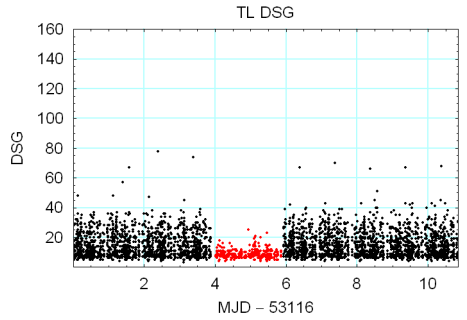


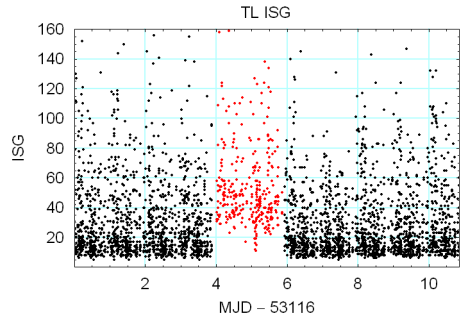


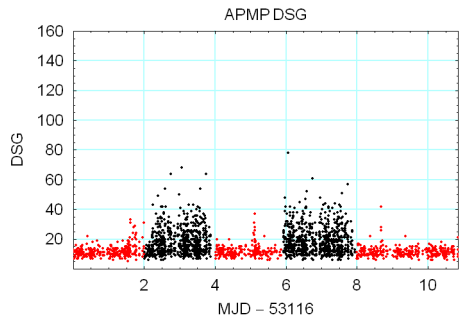


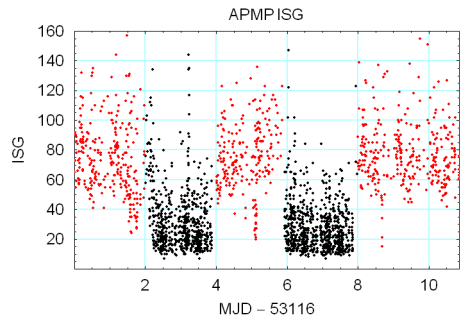


- DSG and ISG:

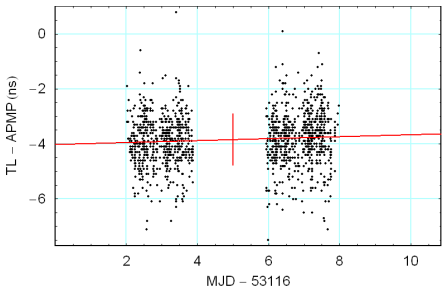








- $(REF–SV)_{TL} – (REF–SV)_{APMP}$, common-view tracks, no delay corrections applied:

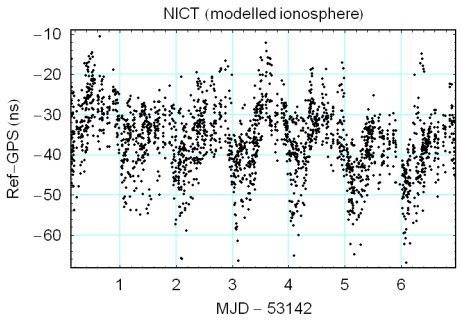


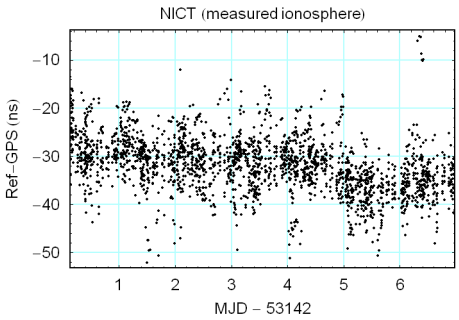
Summary
1342 common–view tracks, MJD 53118 – 53123
Mean offset at MJD 53121.

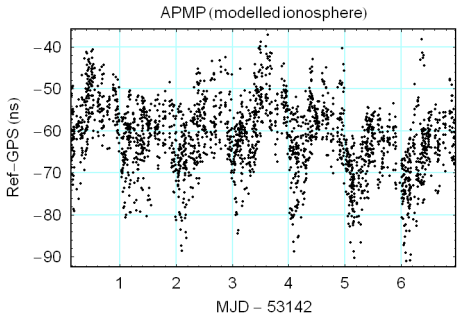
	(unweighted	/	weighted)	
Mean offset	–3.8	/	–3.8	ns
RMS	0.9	/		ns
Slope	36±13	/	33±10	ps/day

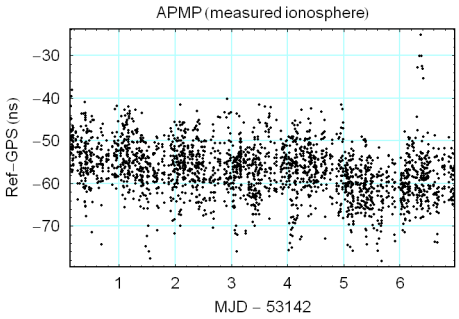
NICT

- REF–GPS data:

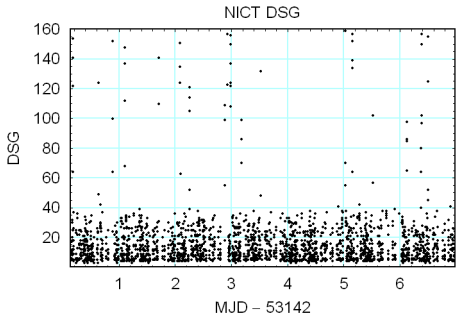


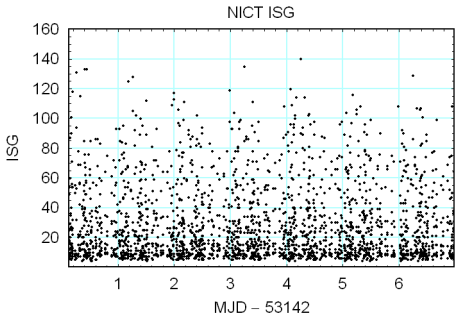


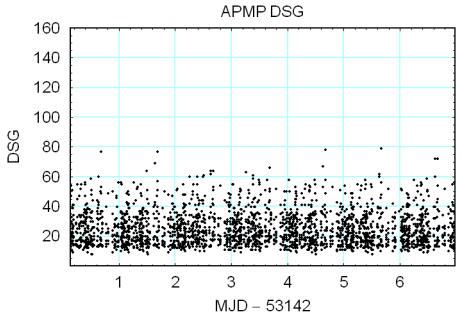


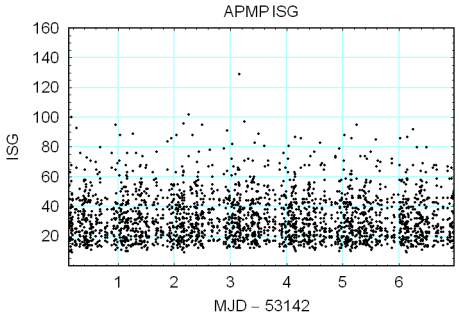


- DSG and ISG:

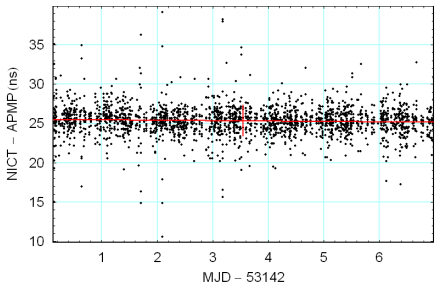








- $(\text{REF–SV})_{\text{NICT}} - (\text{REF–SV})_{\text{APMP}}$, common-view tracks, no delay corrections applied:

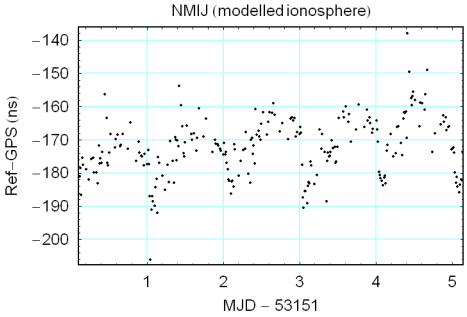


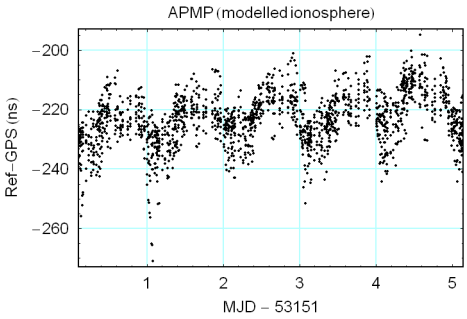
Summary
2252 common–view tracks, MJD 53142 – 53148
Mean offset at MJD 53145.6

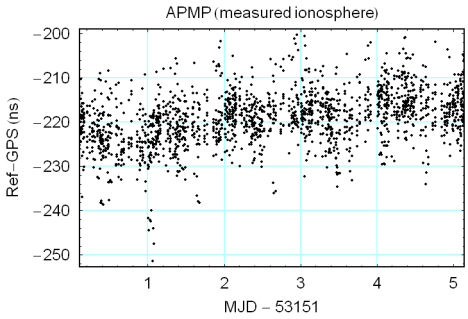
	(unweighted	/	weighted)	
Mean offset	25.4	/	25.5	ns
RMS	1.9	/		ns
Slope	–59±21	/	–66±12	ps/day

NMIJ

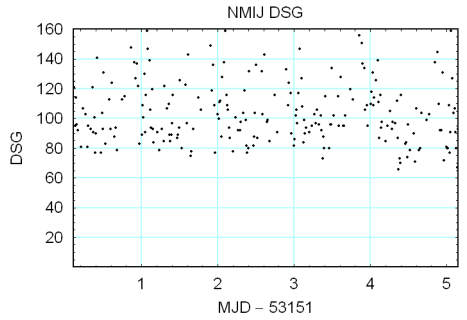
- REF–GPS data:

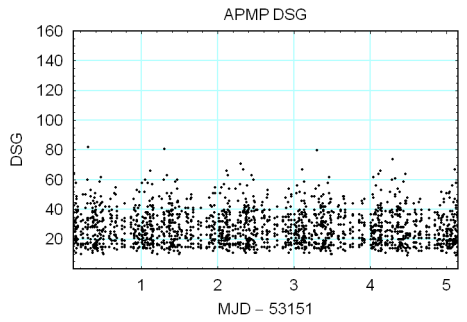


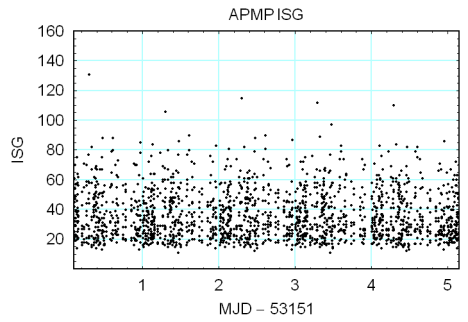




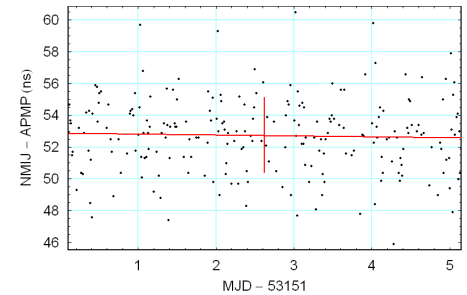
- DSG and ISG:







- $(\text{REF–SV})_{\text{NMIJ}} - (\text{REF–SV})_{\text{APMP}}$, common-view tracks, no delay corrections applied:

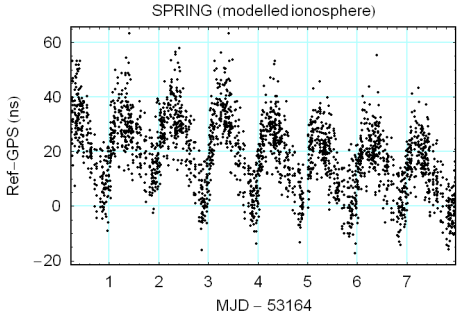


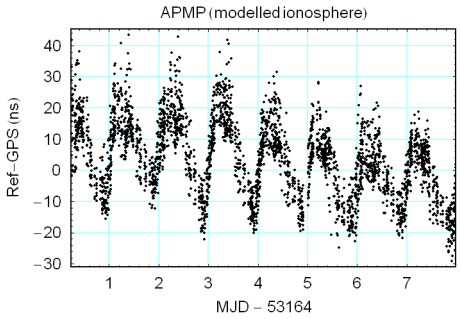
Summary
230 common–view tracks, MJD 53151 – 53156
Mean offset at MJD 53153.6

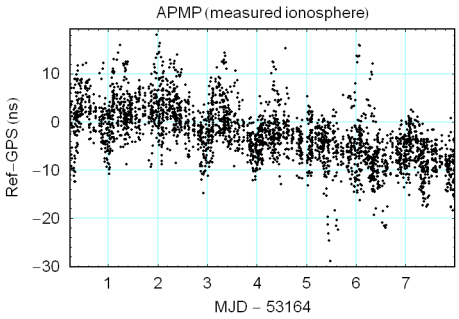
	(unweighted	/	weighted)	
Mean offset	52.7	/	52.5	ns
RMS	2.4	/		ns
Slope	−56±104	/	−52±102	ps/day

SPRING

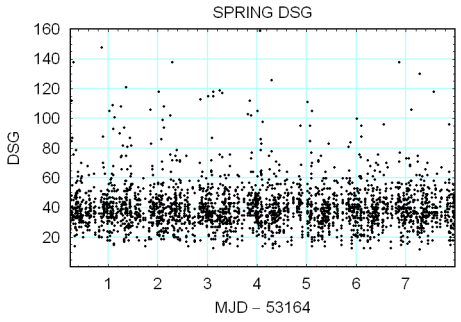
- REF–GPS data:

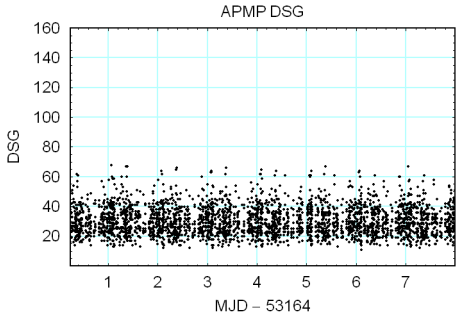


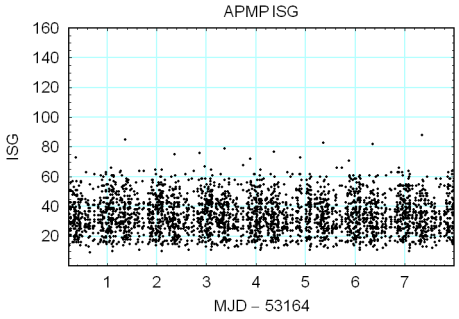




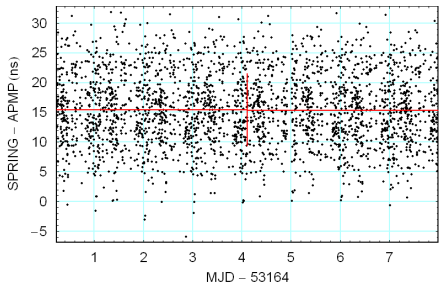
- DSG and ISG:







- $(\text{REF–SV})_{\text{SPRING}} - (\text{REF–SV})_{\text{APMP}}$, common-view tracks, no delay corrections applied:

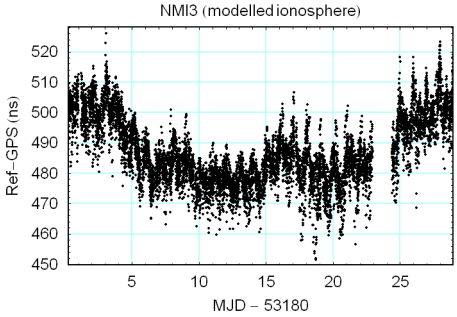


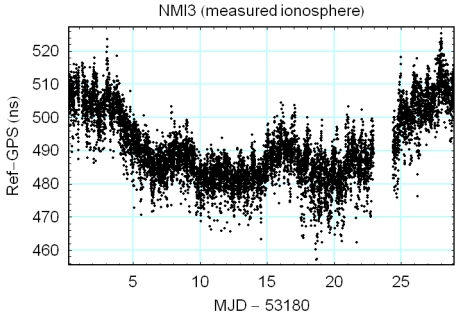
Summary
2691 common–view tracks, MJD 53164 – 53171
Mean offset at MJD 53168.1

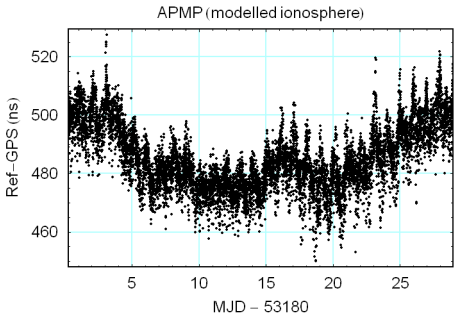
	(unweighted	/	weighted)	
Mean offset	15.4	/	15.7	ns
RMS	6.1	/		ns
Slope	–23±52	/	–34±49	ps/day

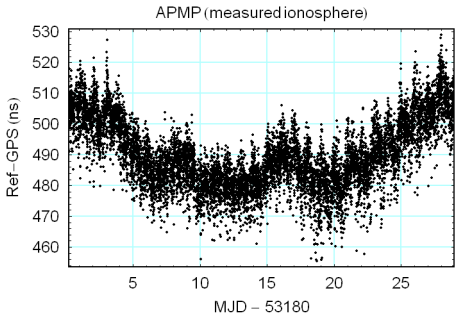
NMI (3)

- REF–GPS data:

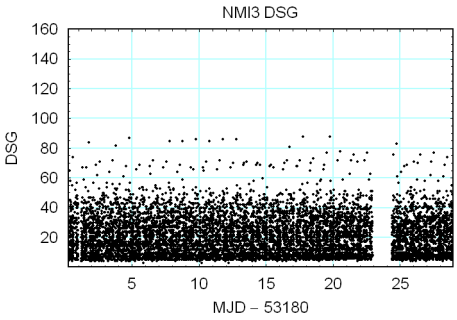


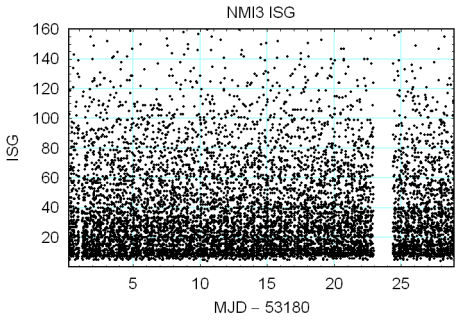


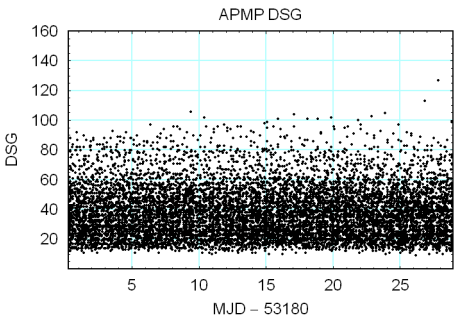


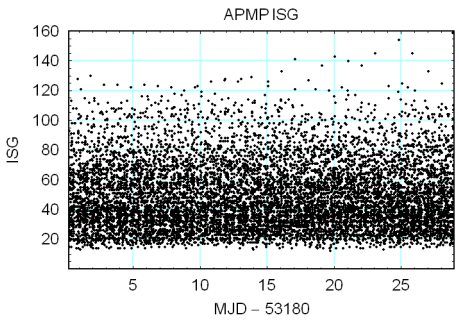


- DSG and ISG:

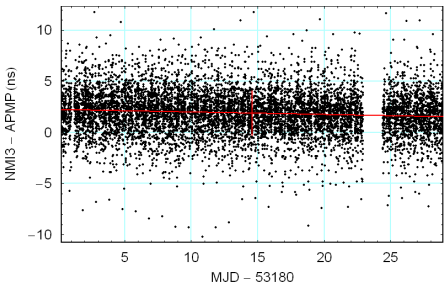








- $(REF–SV)_{NMI} – (REF–SV)_{APMP}$, common-view tracks, no delay corrections applied:



Summary
9058 common–view tracks, MJD 53180 – 53208
Mean offset at MJD 53194.6

	(unweighted	/	weighted)	
Mean offset	1.9	/	2.3	ns
RMS	2.2	/		ns
Slope	–24±3	/	–29±2	ps/day