Australian Government
Geoscience Australia

Upgraded AUSPOS and Refined Solution Uncertainty

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Introduction

- History and status of AUSPOS
- Some examples of AUSPOS solutions
- Upgraded AUSPOS
- An assessment method for determining coordinate uncertainty of AUSPOS solutions
- Coordinate uncertainties of different session length data for different states/territories
- Conclusions

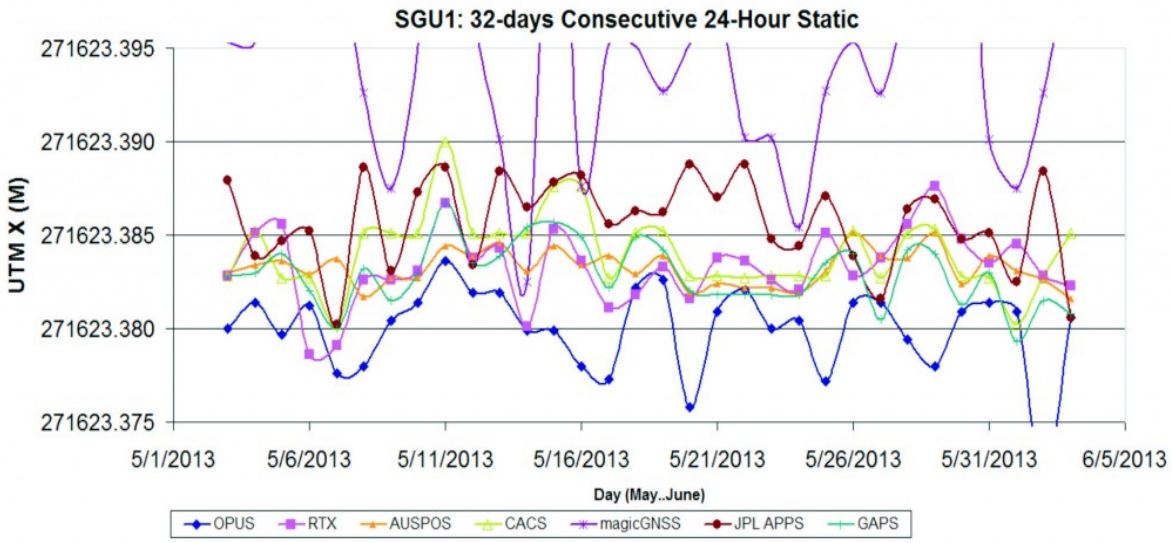
History and status of AUSPOS (1/4)

- AUSPOS was developed to provide an independent and competitive on-line GPS positioning service mainly for Australia users
- In 2010, AUSPOS was upgraded to Bernese GNSS Software processing engine
- In 2013, AUSPOS was ranked as the top one over 7 on-line GPS positioning services
- In 2014, a more realistic assessment method of coordinate uncertainty of AUSPOS solutions was developed and was applied to AUSPOS
- In 2015, AUSPOS was updated based on the latest Bernese GNSS software version 5.2

History and status of AUSPOS (2/4)

Score ranking

1. AUSPOS
2. CenterPointRTX
3. GAPS
4. APPS
5. OPUS
6. CSRS-PPP
7. magicGNSS

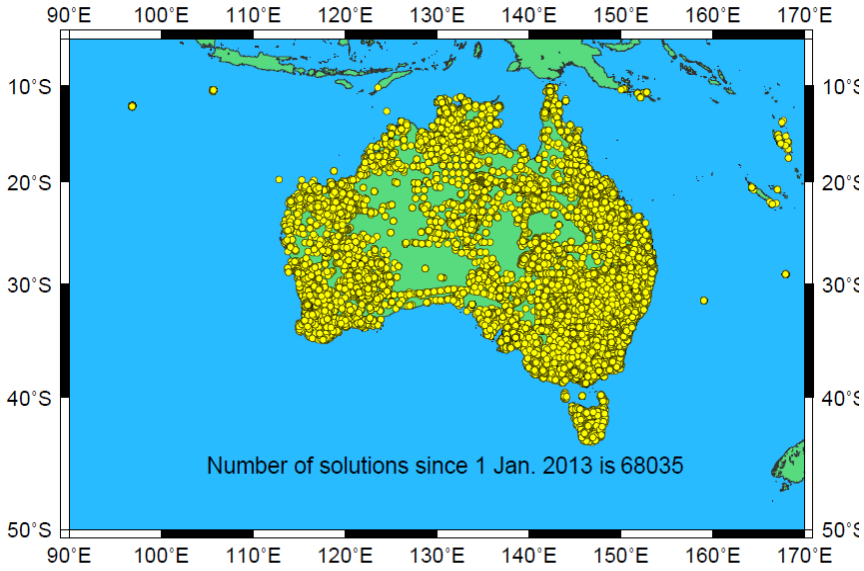


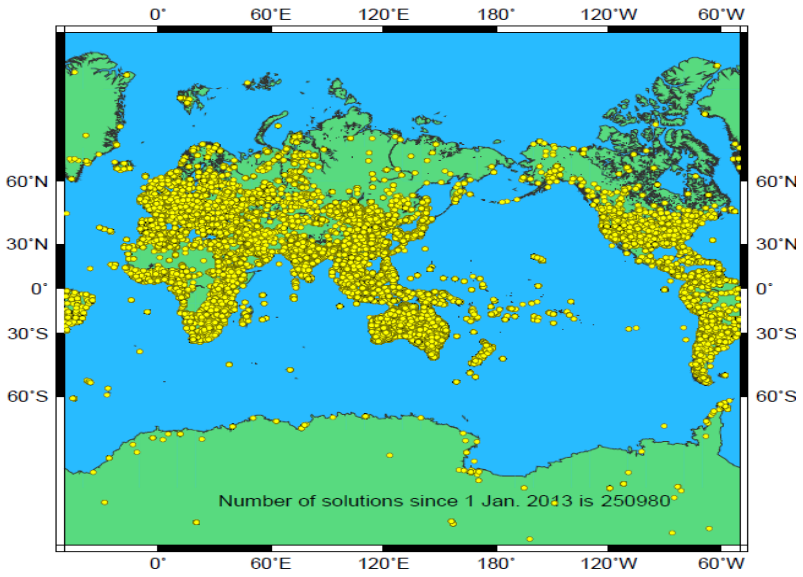
RANGE	OPUS	RTX	AUSPOS	CACS	magicGNSS	JPL APPS	GAPS
X	0.012	0.009	0.003	0.010	0.030	0.009	0.007
Y	0.006	0.004	0.005	0.009	0.018	0.004	0.004
Z	0.017	0.017	0.014	0.020	0.033	0.020	0.021
SCORE	**0.035**	**0.030**	**0.023**	**0.039**	**0.081**	**0.033**	**0.032**

(From Eric Gakstatter and Mark Silver GPS World October 2013)

History and status of AUSPOS (3/4)

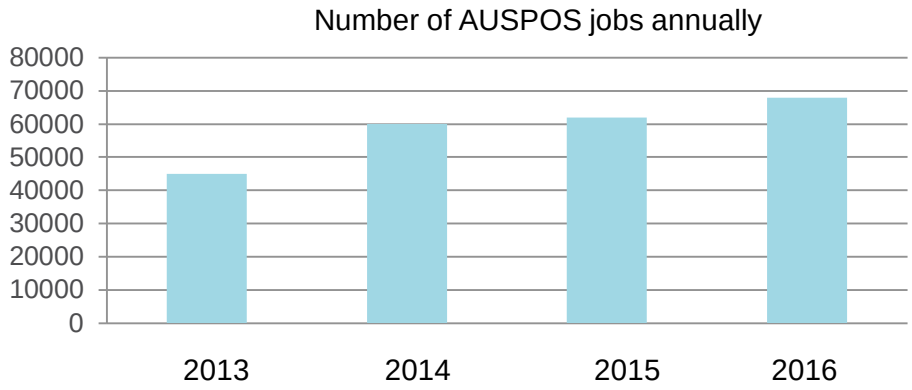
- Since AUSPOS was released in 2000, hundreds of thousands of jobs have been processed

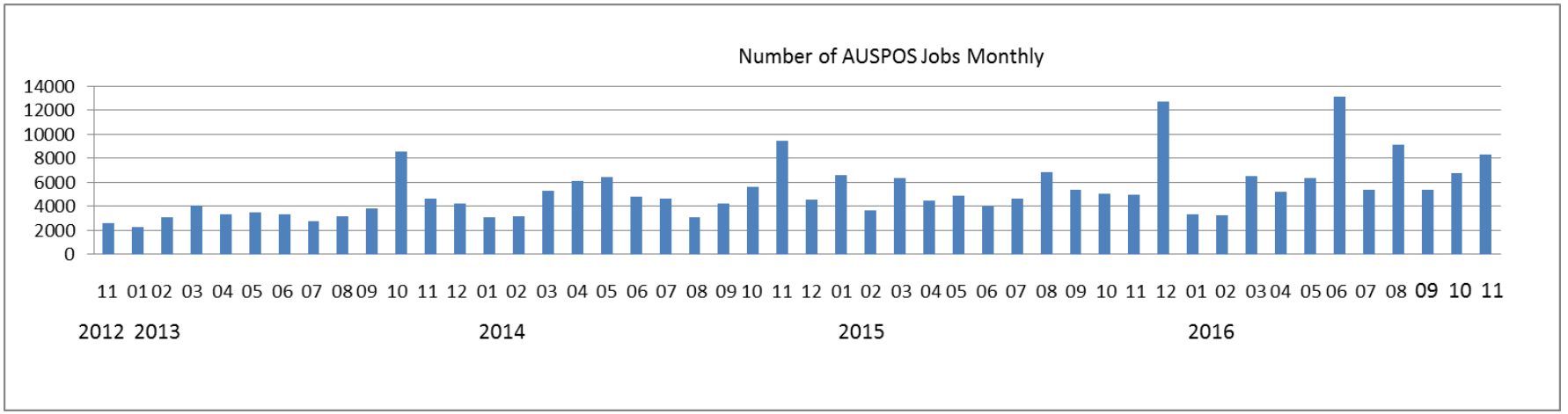




History and status of AUSPOS (4/4)

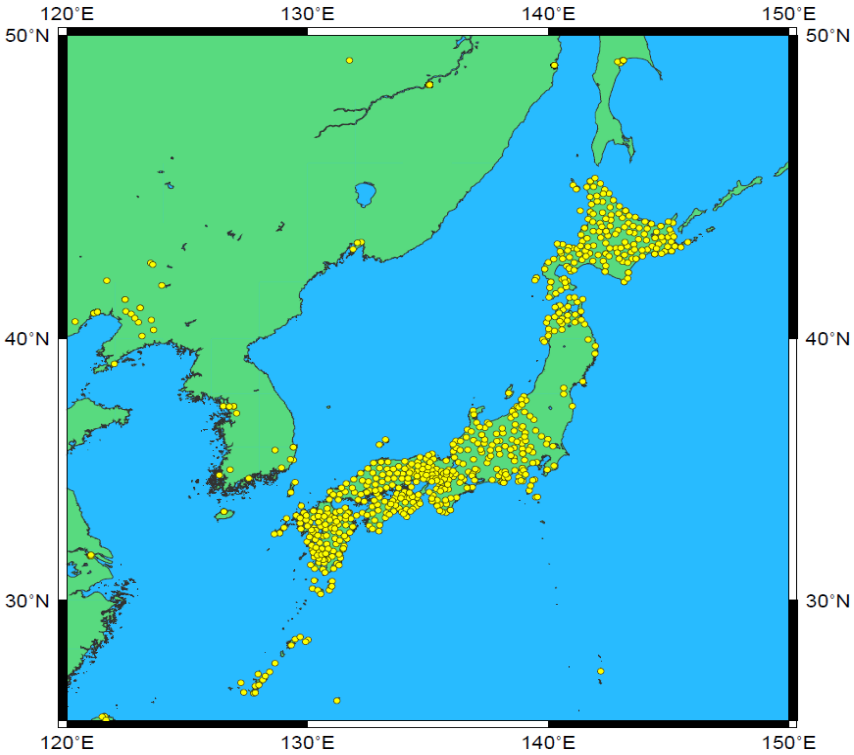
- Increase from 45000 in 2013 to 68000 in 2016
- Oct. 2013 US shutdown
- Nov. 2014 Philippine and Turkey users
- Dec. 2015 Colombia users
- Jun. 2016 Spain and Portugal users
- More users in Mar., Apr., May, Sep., Oct. and Nov.
- Less users in Jan., Feb. and Jul.



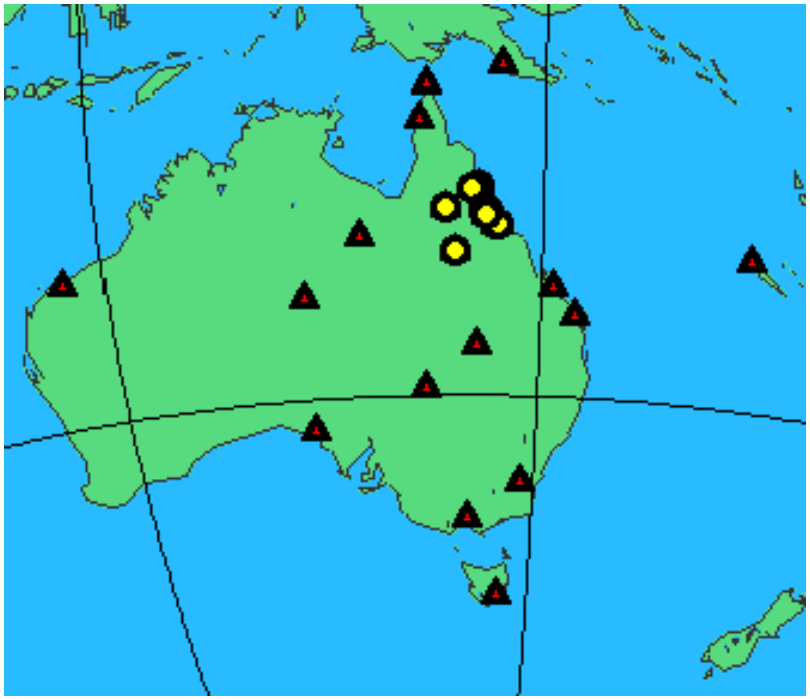


Examples of AUSPOS solutions (1/2)

Thousands of jobs from Japan within 2 days after 2011 Japan magnitude 9.0 earthquake

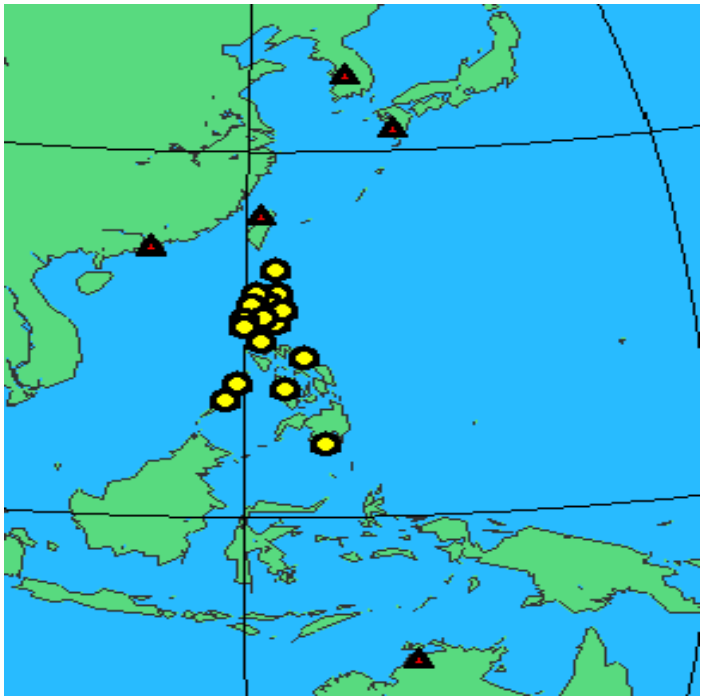


Multiple files in one AUSPOS job for an Australia user

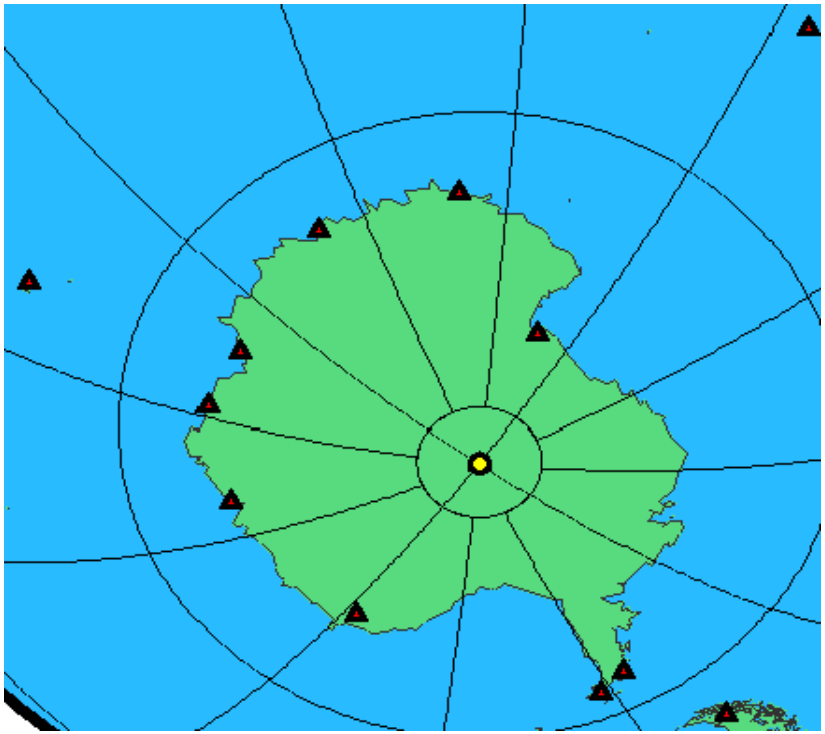


Examples of AUSPOS solutions (2/2)

AUSPOS solutions for Philippine national network



A user tried to determine the South Pole by AUSPOS



Upgraded AUSPOS (1/2)

AUSPOS was upgraded to the current version 2.2 in July 2015

The main upgrade included:

1. Tropospheric mapping function GMF and ocean loading model FES2004 were applied
2. Atmospheric pressure loading corrections applied
3. Higher order ionospheric corrections were applied
4. Ambiguity resolution strategies of the code-based for 180-6000km baselines, the phase-based L5/L3 for 18-200km baselines, the quasi-ionosphere-free (QIF) for 18-2000km baselines and the direct L1/L2 for 0-20km baselines were implemented rather than QIF only in the previous versions
5. Elevation cut-off angle changed from 10 to 7 degrees

Upgraded AUSPOS (2/2)

- Solution improvement from the upgrade
- Ambiguity resolution success rate is improved 1 - 4%
- Horizontal coordinate uncertainty (2D) is improved by 1 - 3%
- 3D coordinate uncertainty is improved by 1 – 20%

Assessment of coordinate uncertainty of AUSPOS solutions (1/4)

- Like other GNSS software, coordinate STD of AUSPOS solutions are optimistic
- In 2014, we developed an experimental method to build the relationships (ratios) between the coordinate STD the coordinate uncertainties (RMS)
- We applied the ratios to AUSPOS users coordinate STD to obtain their coordinate uncertainties (RMS)

Assessment of coordinate uncertainty of AUSPOS solutions (2/4)

A more detailed guide is developed to answer:

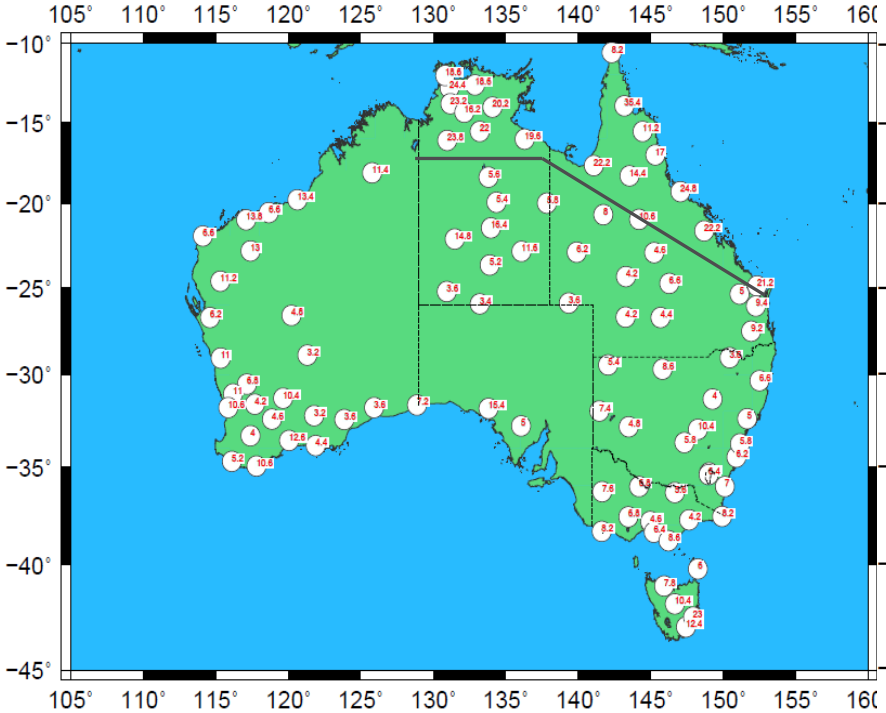
- How many hours data is need to collect from Darwin or from Hobart for specific coordinate uncertainties.

To find the answer

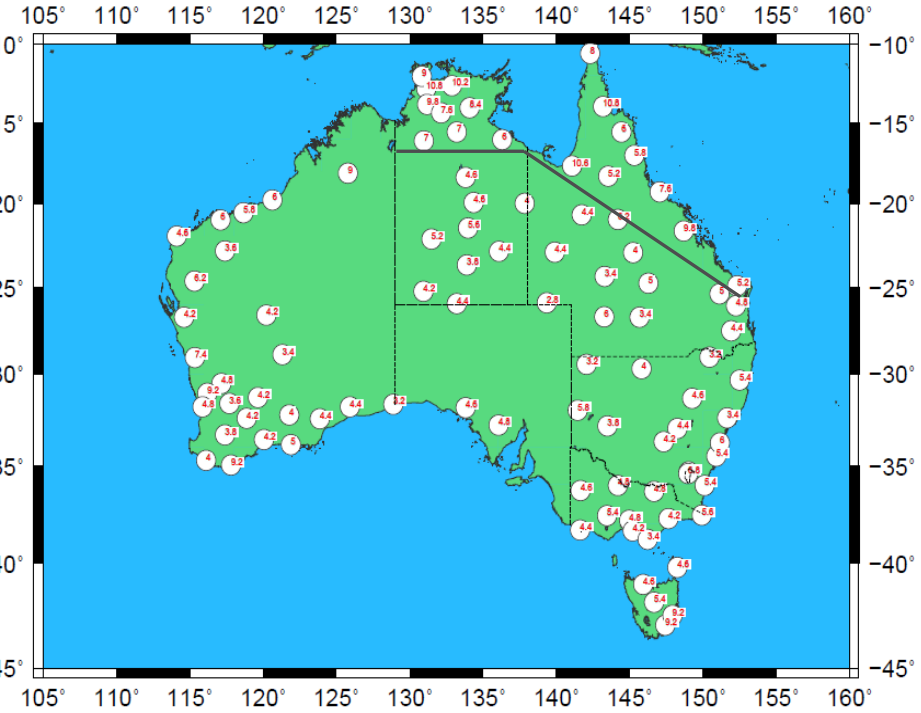
- One month data collected from 110 AuScope sites was processed by AUSPOS using different session lengths.

Assessment of coordinate uncertainty of AUSPOS solutions (3/4)

Coordinate RMS of the east from 2 hour data

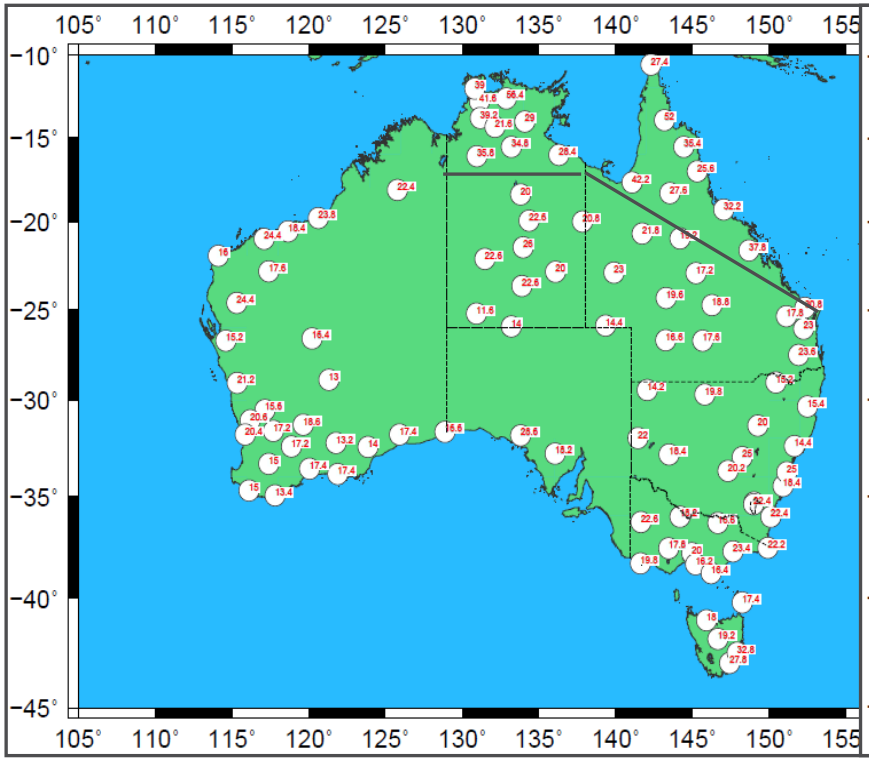


Coordinate RMS of the north from 2 hour data

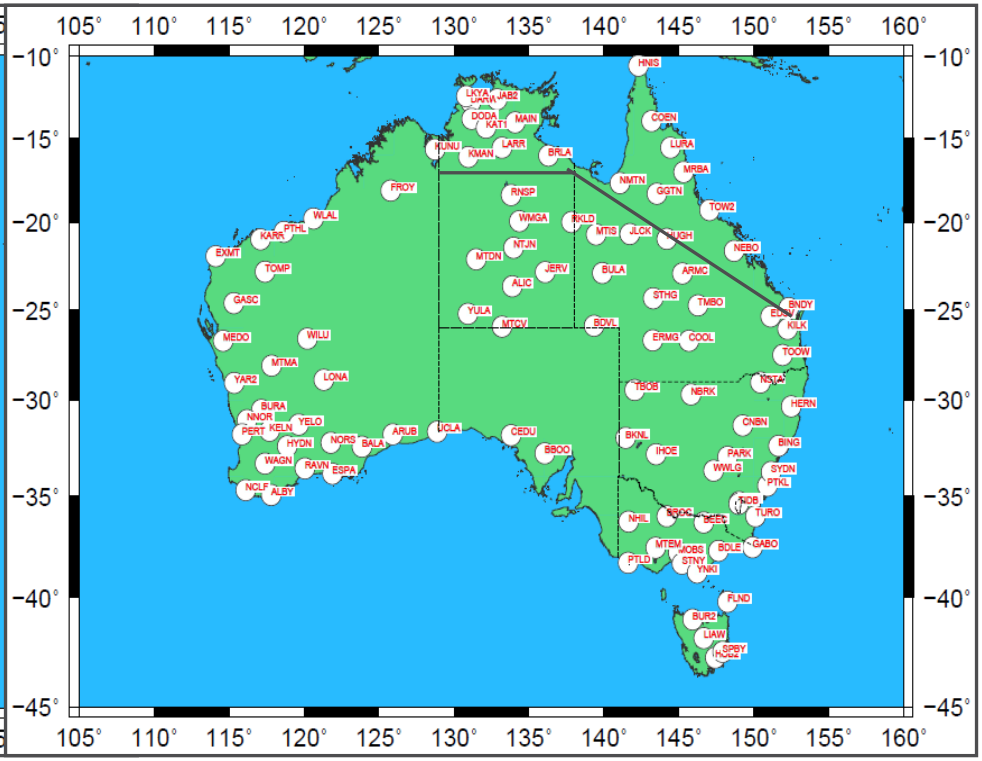


Assessment of coordinate uncertainty of AUSPOS solutions (4/4)

Coordinate RMS of the up from 2 hour data

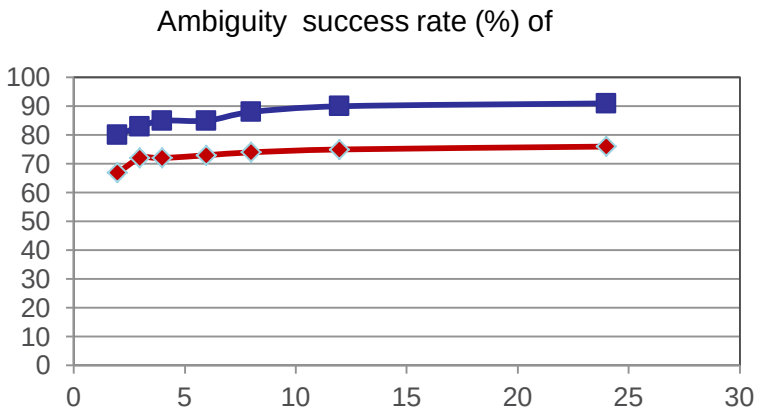


Parts of Australia Based on Coordinate RMS and AMB. fixed rate



Ambiguity fixed rate state (territory) by state

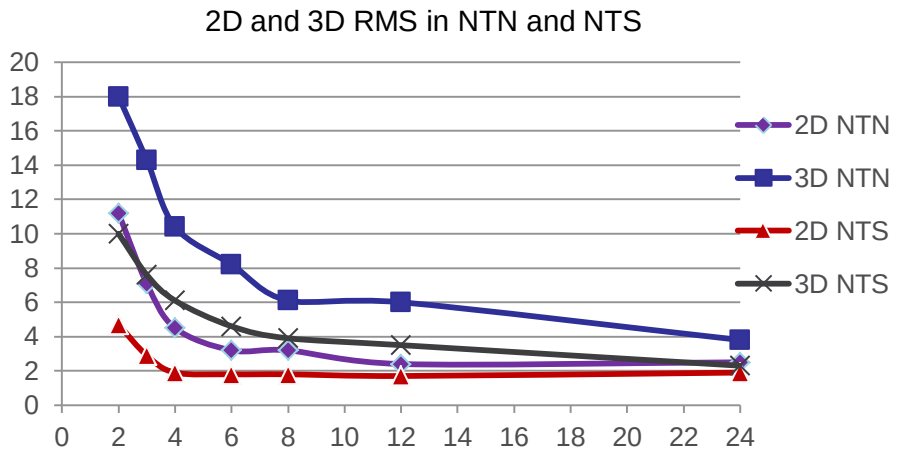
- Amb. fixed rate is much better in other parts than in NTN and QLDNE
- Number of Amb. fixed rate less than 50% is 8% and 9% in QLDNE and NTN, is 2% in other parts



Session (hour)	Ambiguity success rate (%)								
	NSW	NTN	NTS	QLDNE	QLDSW	SA	TAS	VIC	WA
2	80	67	80	71	77	81	77	77	80
3	82	72	83	74	80	84	82	80	82
4	84	72	85	76	82	86	83	82	84
6	86	73	85	76	82	87	86	85	85
8	88	74	88	78	84	89	86	87	87
12	89	75	90	78	85	90	88	88	88
24	91	76	91	80	86	89	92	90	89

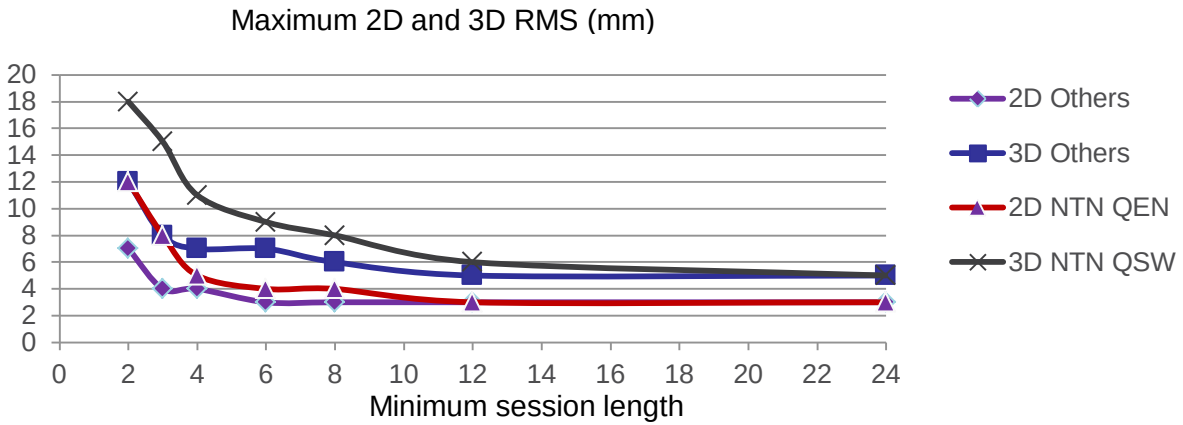
Coordinate RMS state (territory) by state

- 2D and 3D RMS are much worse for same session length in NTN and QLDNE than other parts
- 2D and 3D RMS are similar in other parts



Session (hour)	Coordinate RMS (mm)																	
	NSW		NTN		NTS		QLDNE		QLDSW		SA		TAS		VIC		WA	
	2D	3D	2D	3D	2D	3D	2D	3D	2D	3D	2D	3D	2D	3D	2D	3D	2D	3D
2	4	9.6	11.2	18.0	4.7	10	10.2	16.5	4	10.4	4.3	9.8	6.9	11.5	4.1	9.7	5	9.3
3	2.9	7.3	7.1	14.3	2.9	7.6	5.6	11.8	3.5	7.2	2.4	7.5	3.6	7.6	2.6	6.5	3.1	7.2
4	2.5	6.8	4.5	10.4	1.9	6.1	4.8	9.5	2.7	6.9	2.3	6.9	3.3	6.2	2.5	6.5	2.3	6.3
6	2.2	5.5	3.2	8.2	1.8	4.6	3.1	7.6	2.7	5.8	2.1	5.6	2.7	5.9	2.1	6.2	2.5	5.6
8	2.2	4.9	3.2	6.1	1.8	3.9	3.1	7.4	2.7	5	2.1	4.7	2.7	5.4	2.1	5.3	2.5	4.9
12	2	4.5	2.4	6	1.7	3.5	2.5	5.8	1.9	4.8	2	4.6	2.1	4.6	1.8	5	1.8	4
24	1.7	3	2.5	3.8	1.9	2.3	2.3	4.4	1.9	3.4	2.1	4.2	1.8	3.6	1.9	4	1.8	3.1

Concise guide of minimum observation span for specific coordinate RMS



Session (hour)	Maximum coordinate RMS for all other parts (mm)		Maximum coordinate RMS for NTN and QLDNE (mm)	
	2D	3D	2D	3D
2	7	12	12	18
3	4	8	8	15
4	4	7	5	11
6	3	7	4	9
8	3	6	4	8
12	3	5	3	6
24	3	5	3	5

Conclusions

- AUSPOS is upgraded from version 2.1 to 2.2
- One month data collected from 110 AusCope sites has been processed by the upgraded version of AUSPOS using 2 – 24 hours sessions
- Ambiguity success rates have been improved 1 – 4%
- 2D coordinate RMS has been improved by 1-3%
- 3D coordinate RMS has been improved by 1-20%
- Maximum 2D and 3D coordinate RMS are given for a specific session length for different locations
- Minimum session lengths are given for a specific coordinate RMS for different locations
- This research supports Australia AUSPOS users for their survey planning

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Questions?

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