

AUSLIG SLR Analysis

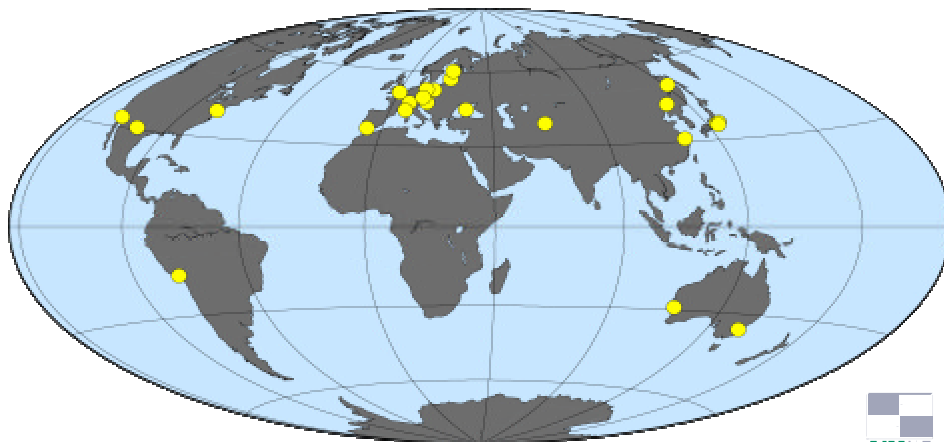
ILRS Analysis Working Group

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Australian Surveying and Land Information Group



AUSLIG SLR Analysis

- Stations - September 1999



AUSLIG SLR Analysis

- Data, Lageos1

Station	Normal Points
RIGA	365
HERS	394
BORO	395
MONU	754
MCDO	160
METS	148
POTS	224
GRAS	188
MAID	37
YARR	419
STRM	341
AREQ	86
SHAN	88
SANF	265
CHAN	448
GREE	388
WETT	289
GRAZ	572
GRAS	128
KOGA	74
KASH	33
KOMS	16
KATZ	25



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- Orbit Modeling

Earth's Gravitational (Static) Potential Model	JGM-3 – degree and order 70
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	Cannonball
Atmospheric Drag	Jachhia Model
Centre of Mass Correction / Attitude	Observation Correction applied



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- 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	Bulletin A – apriori
Earth Rotation (UT1)	Bulletin A – apriori
Daily and Sub-daily tidal corrections to X,Y and UT1	Applied



AUSLIG SLR Analysis

- Station Position Modelling and Reference Frame (cont...)

Plate Motion	ITRF97
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	Scherneck (1991)
Station Displacement – Pole Tide	Applied as a default
Station Displacement – Atmospheric Loading	NIL
Reference Frame –	ITRF97



AUSLIG SLR Analysis

- Estimated Parameters

Global	Station Coordinates
	3 - Daily UT and pole
Arc	State vector for all satellites
	One Solar Radiation Pressure scale factor
	General Acceleration estimated once per five day – constant, once per revolution sine and cosine of the period in the along track and cross track direction
	Measurement range bias – pass by pass
	Measurement time bias – pass by pass



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- Apriori Constraints

Global	Station Coordinates --- 1 m
	Data Processing
	3 - Daily UT and pole --- Pole XY 100 arc secs, A1-UT 1e-06 secs
	Normal Equations
	3 - Daily UT and pole ---
	<ul style="list-style-type: none"> • First Pole XY 0.0001 arc secs, A1-UT 1e-08 secs • Pole XY 1 arc secs, A1-UT 1e-04 secs
Arc	State vector --- Position and Velocities 1.0e14 m and m/sec
	One Solar Radiation Pressure scale factor --- 1.0 1/sec-2
	General Acceleration --- 1.0e-08 m/sec-2
	Measurement range bias --- 1.0 m
	Measurement time bias --- 0.001 sec



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- Post-Fit Residuals (mm)

Station	Residual
RIGA	7.3
HERS	3.7
BORO	6.8
MONU	4.4
MCDO	5.2
METS	7.3
POTS	5.9
GRAS	3.1
MAID	9.6
YARR	4.0
STRM	4.0
AREQ	4.8
SHAN	7.7
SANF	8.2
CHAN	7.6
GREE	3.6
WETT	7.6
GRAZ	3.9
GRAS	4.2
KOGA	5.2
KASH	4.4
KOMS	4.4
KATZ	10.5



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- SLR Lageos1 Sep. 1999 versus ITRF97

	ID	dE (mm)	dN (mm)	dU (mm)
1	RIGA 1884	1.9	3.1	22.3
2	KATS 1893	-13.8	-0.3	-43.3
3	MCDO 7080	-7.5	-11.1	3.2
4	YARA 7090	7.9	17.4	6.2
5	GREE 7105	1.0	10.2	7.3
6	MONU 7110	-1.7	11.6	8.9
7	CHAN 7237	0.9	-0.8	-29.5
8	AREQ 7403	0.8	-23.0	-1.9
9	ZIMM 7810	0.3	-8.9	-4.8
10	BORO 7811	-3.1	1.0	-2.5
11	GRAS 7835	3.5	-4.5	-8.2
12	POTS 7836	0.3	2.1	-0.1
13	SHAN 7837	-9.9	-10.9	-17.4
14	GRAZ 7839	13.4	10.9	2.9
15	HERS 7840	3.3	-10.1	8.6
16	WETT 8834	2.1	1.0	17.2
	RMS	6.3	10.1	16.2



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- SLR Lageos1 Sep. 1999 versus ITRF97

RMS : 11.63 (mm)
DOF : 41

Scale : -2.51 (+/- 0.24) ppb
Rotation X : -0.21 (+/- 0.06) mas
Rotation Y : -0.12 (+/- 0.07) mas
Rotation Z : -0.29 (+/- 0.06) mas
Translation X : 0.44 (+/- 0.18) cm
Translation Y : 0.29 (+/- 0.15) cm
Translation Z : 2.01 (+/- 0.16) cm



AUSLIG SLR Analysis

- Range Bias (mm)

STATION	#	MEAN	WMEAN	MIN	MAX	RMS
MAID 18645401	10	0.9	0.3	-11.4	11.8	8.4
KOMS 18685901	7	5.7	1.2	-36.9	29.4	20.9
RIGA 18844401	25	4.9	6.2	-129.9	63.6	56.0
KATZ 18931801	5	2.1	1.2	-21.4	15.2	14.4
MCDO 70802419	17	-3.1	-2.2	-17.7	12.2	8.2
YARR 70900513	36	-4.5	-2.8	-25.8	39.2	14.3
GREE 71050725	35	-2.3	0.1	-22.3	25.5	10.7
MONU 71100411	71	-2.3	-1.6	-24.4	18.3	9.0
CHAN 72371901	44	-3.5	-6.8	-38.4	29.4	14.6
KOGA 73287101	6	4.2	5.7	-7.1	18.9	9.1
KASH 73357201	3	4.3	5.4	-6.8	10.2	7.9
MIUR 73377301	1	16.7	16.7	16.7	16.7	0.0
AREQ 74031303	9	1.8	2.1	-7.5	19.7	8.6
CAGF 75486201	3	-5.1	-4.4	-18.4	8.8	11.1
METS 78067601	12	2.8	2.9	-56.2	22.4	20.6
ZIMM 78106801	2	-6.3	-6.8	-11.9	-0.7	5.6
BORO 78113802	30	-4.7	-5.6	-32.7	28.1	14.7
SANF 78244502	36	-0.4	0.0	-36.9	56.6	19.7
GRAS 78353102	18	0.9	1.8	-12.8	15.1	7.7
POTS 78365801	28	0.3	0.4	-21.5	22.8	10.6
SHAN 78372805	12	5.2	3.5	-13.6	30.3	12.9
GRAZ 78393402	40	0.6	0.5	-18.4	22.4	10.7
HERS 78403501	35	0.1	-0.9	-28.3	20.8	10.2
GRAS 78457801	10	-0.6	-0.4	-15.9	17.0	9.4
STRM 78498001	41	-0.1	1.3	-24.5	22.6	11.5
WETT 88341001	33	-1.2	-2.2	-18.6	29.6	10.1



AUSLIG SLR Analysis

- Time Bias (usec)

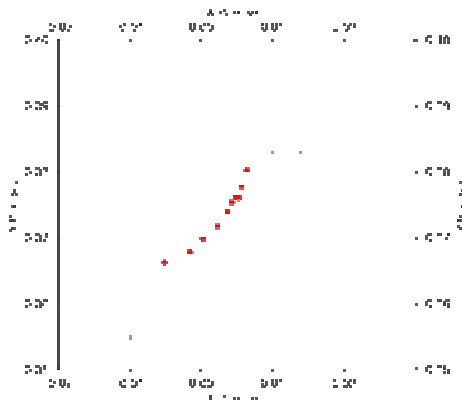
STATION	#	MEAN	WMEAN	MIN	MAX	RMS
MAID 18645401	10	-7.6	-12.0	-28.1	7.8	11.1
KOMS 18685901	7	1.0	3.4	-58.1	29.1	29.1
RIGA 18844401	25	-0.2	-0.6	-13.6	17.2	9.4
KATZ 18931801	5	-1.3	-1.0	-6.1	1.4	2.6
MCDO 70802419	17	-1.8	-1.6	-14.1	15.1	7.3
YARR 70900513	36	5.0	5.6	-12.6	27.5	8.1
GREE 71050725	35	-3.3	-3.8	-22.3	16.5	10.7
MONU 71100411	71	2.8	2.7	-19.9	31.5	9.4
CHAN 72371901	44	8.1	8.2	-15.4	36.2	11.7
KOGA 73287101	6	11.5	9.4	-8.1	22.1	10.2
KASH 73357201	3	-1.7	0.7	-11.3	6.6	7.4
MIUR 73377301	1	6.6	6.6	6.6	6.6	0.0
AREQ 74031303	9	-0.8	-1.0	-11.3	14.0	7.6
CAGF 75486201	3	-9.0	-11.4	-32.5	4.0	16.7
METS 78067601	12	-15.0	-16.4	-32.0	0.5	10.7
ZIMM 78106801	2	2.6	2.4	-4.8	10.1	7.4
BORO 78113802	30	-3.8	-3.1	-20.6	9.1	7.5
SANF 78244502	36	-1.7	-1.4	-39.2	44.2	12.8
GRAS 78353102	18	-1.2	-1.8	-19.4	22.7	9.0
POTS 78365801	28	-3.1	-3.4	-14.9	10.9	6.1
SHAN 78372805	12	-4.0	-5.1	-20.4	17.3	10.3
GRAZ 78393402	40	-2.0	-3.8	-18.9	36.8	12.1
HERS 78403501	35	-1.2	-0.9	-15.9	17.8	8.2
GRAS 78457801	10	-3.5	-3.5	-22.0	19.5	11.0
STRM 78498001	41	2.2	1.6	-18.5	26.0	9.5
WETT 88341001	33	1.0	-0.3	-17.8	34.1	10.4

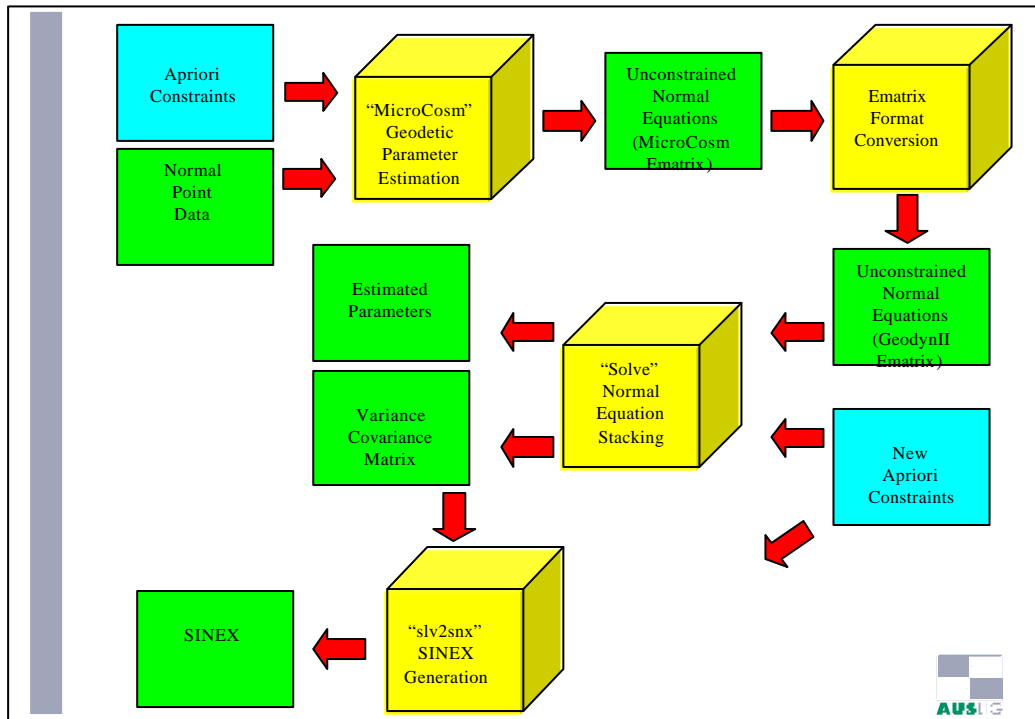


AUSLIG SLR Analysis

- AUSLIG versus Bulletin B EOP

AUSLIG SLR reception 1999 Lagrangian VERTS FINAL POLE POSITION





AUSLIG SLR Analysis

- Final comments
 - mechanics of submission to IERS
 - contribution to ITRF
 - analysis combinations centre
 - GPS week solutions for EOP and biases
 - full analysis centre
 - product distribution
 - combination with other techniques
 - comprehensive product?
 - SINEX standards