The Potential of Starlette and Ajisai for Station Positioning

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Motivation

Problems of SLR in ITRF2005
- Scale difference between SLR and VLBI
- Z-shift of SLR network
- Good tracking records
  - Ajisai has the best tracking record of all geodetic satellites
  - Starlette has usually more passes than Lageos-1/2
- Stability of SLR solutions
  - More passes per station give better coordinate and EOP solution, if orbits are precise enough

Datum information of SLR observations

Method:

$$C_{datum} = (G^T C_{SLR}^{-1} G)^{-1}$$

C_{SLR}:   Covariance matrix of SLR solution (loose constrained)

G: Coefficients of 7 parameter similarity transformation matrix

C_{datum}:   Covariance matrix of datum parameters

Results:

➤ Standard deviations for datum parameters

➤ Correlations between datum parameters

Sensitivity of datum parameters for different satellites
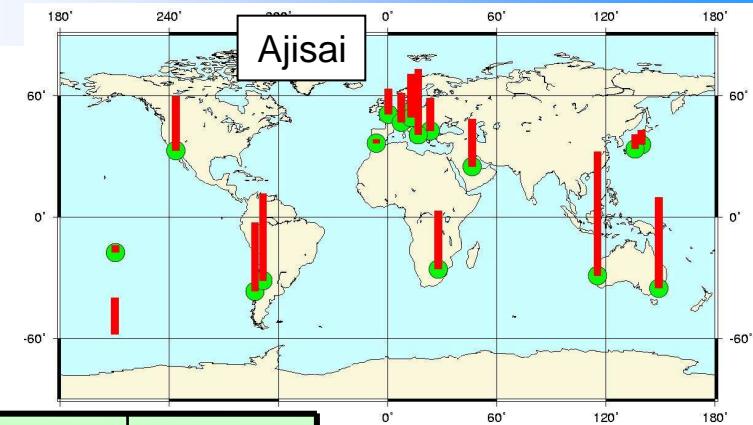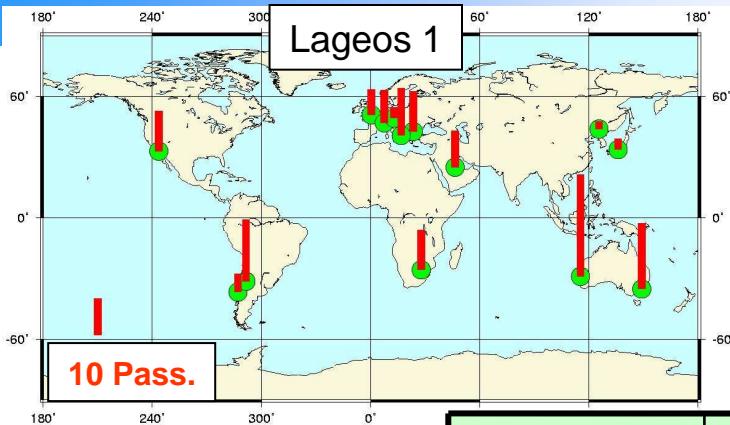
	Etalon 1	**Lageos 1**	**Ajisai**	**Starlette**
Altitude [km]	19105	5850	1485	815
σTx [mm]	12.1	1.1	0.7	0.9
σTy [mm]	15.8	1.0	0.7	0.8
σTz [mm]	61.0	2.9	1.1	1.2
σscale [mm]	11.2	3.1	0.7	0.8
Tx,y : Tz	**1 : 4.4**	**1 : 2.8**	**1 : 1,5**	**1 : 1.4**
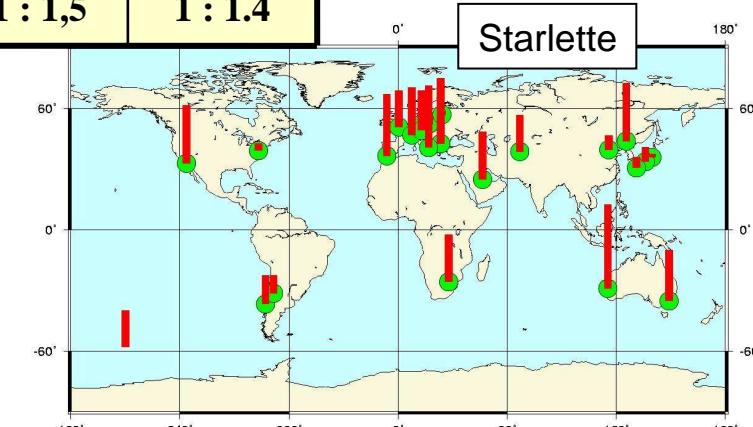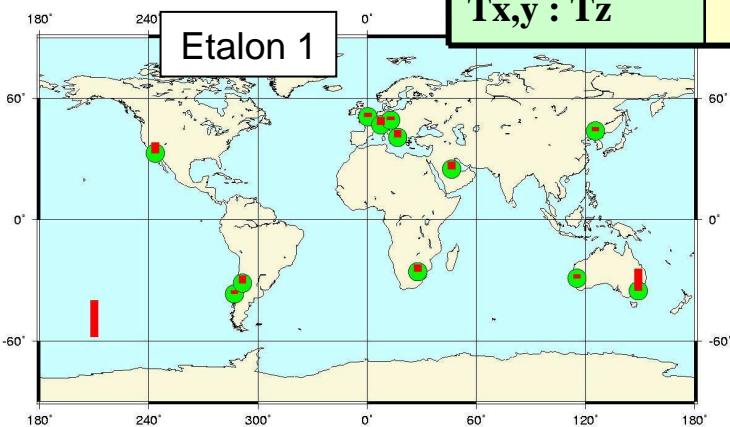
Number of observing stations per month
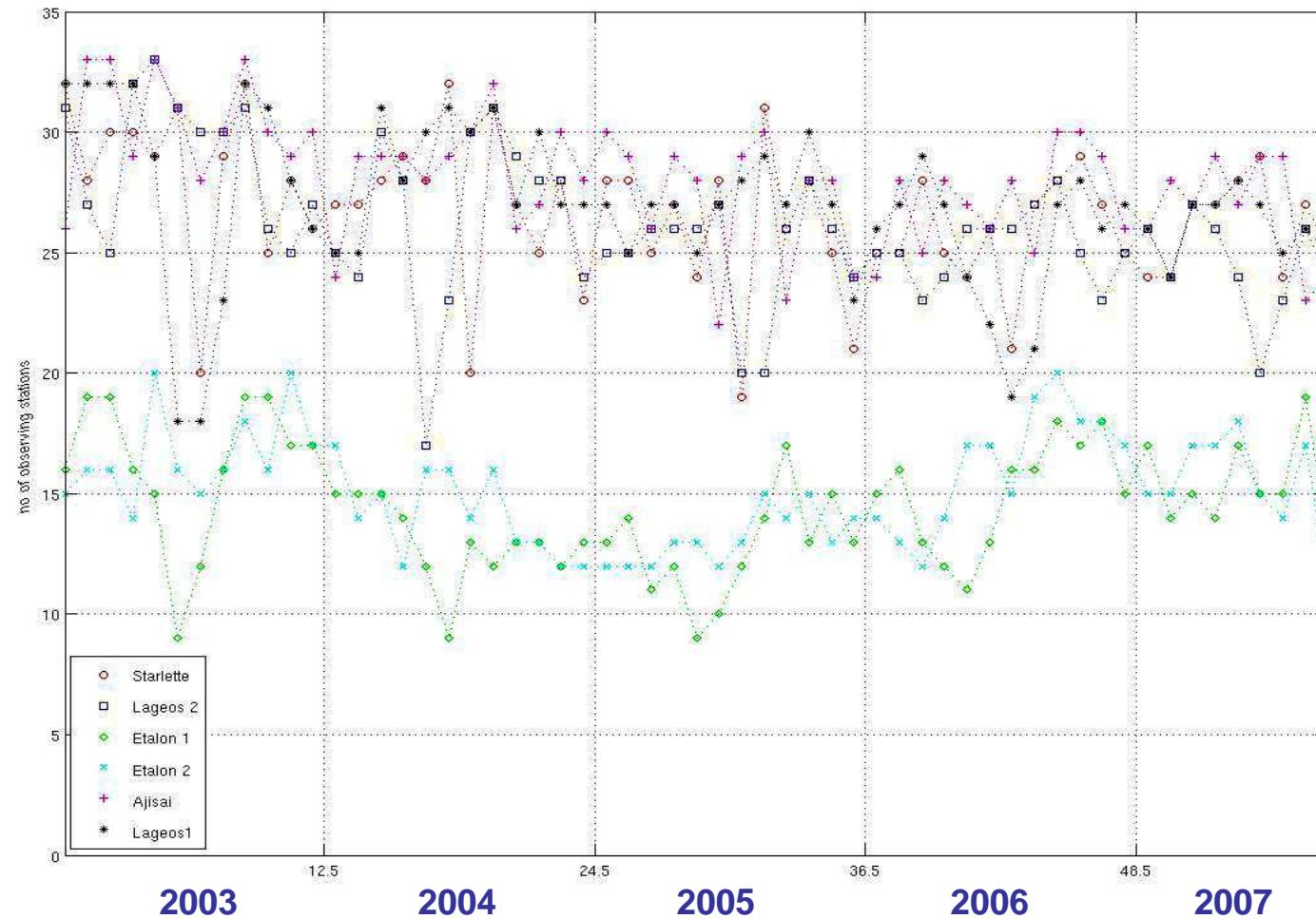
Number of passes per month
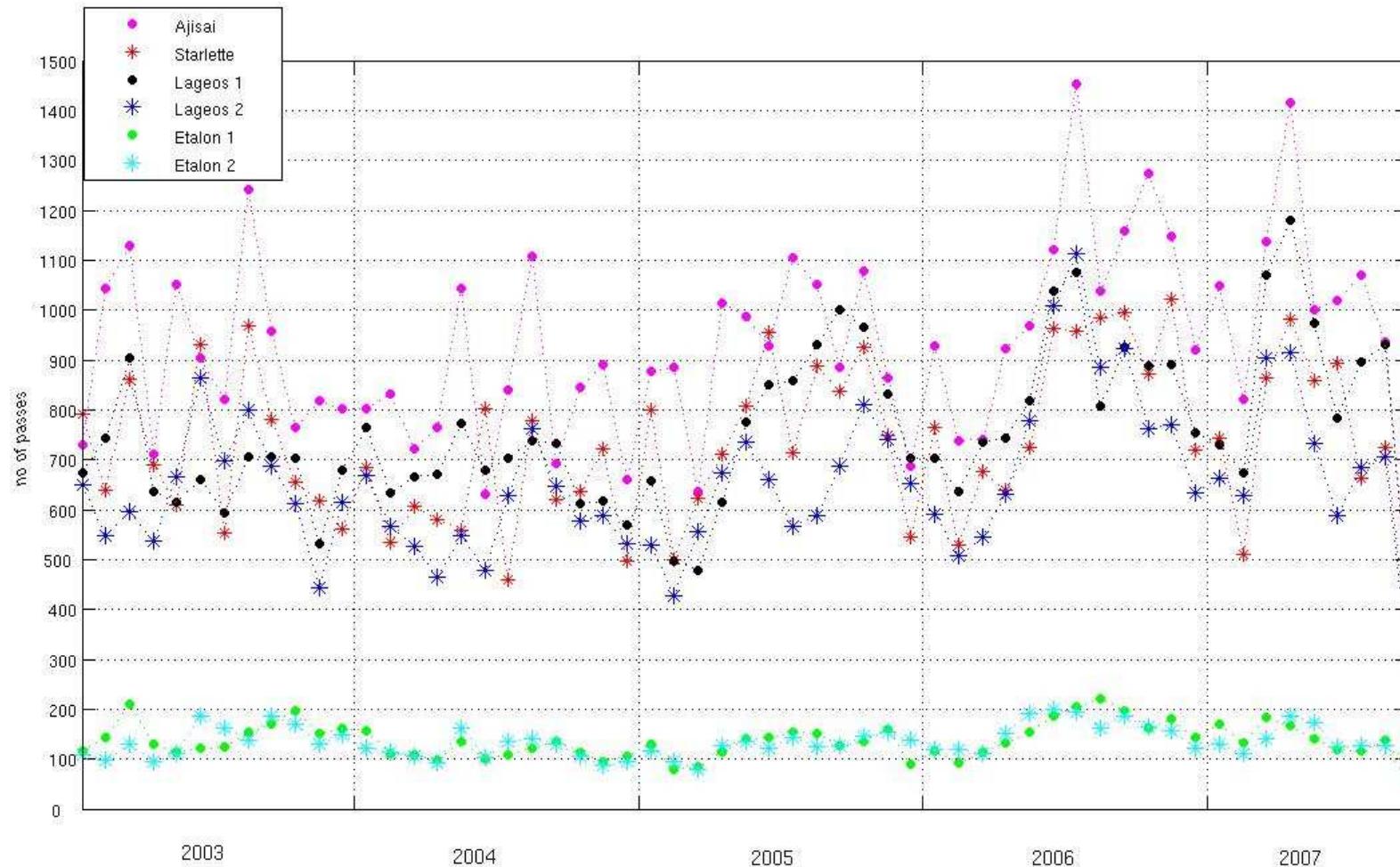
Models

- ILRS/AWG models
- Gravity Field
  - GFZ, Eigen04-S1
  - Up to degree and order 60
- Ocean tides
  - FES 2004
    - direct effect
    - ocean loading
- Atmosphere
  - Cira 86

Solved Parameters

- 6 orbital elements
- Daily EOP's
- Daily correction parameters for atmosphere
- 3.5 days corrections to solar radiation pressure
- 1 set of once/rev parameters along track and normal
- Station coordinates
- Biases for selected stations (AWG set)

Starlette and Ajisai solutions

	Starlette		Ajisai		Lageos1		Lageos2		Etalon1		Etalon2	
Beijing	2.07	4					1.74	2				
Borowiec	3.11	3										
Changchu	2.06	16			1.00	2	0.75	3	2.21	1	3.48	1
Concepci	0.16	1	1.39	4								
Conc_red			3.13	19								
CRL Lase	0.64	1	1.48	4	3.21	1	0.33	1				
Graz, Au	0.87	18	1.79	9	0.43	11	0.37	10			0.12	2
Greenbel	0.91	2										
Hartebee	1.34	13	2.08	16	0.96	12	0.82	12	0.77	2		
Herstmon	0.79	10	1.94	7	0.65	7	0.55	10	0.17	1		
Katzivel	1.78	8					1.09	1				
Maidanak	4.35	10					2.29	6				
Matera M	1.10	19	1.43	18	0.70	13	0.57	14	0.25	2	0.72	1
Monu. Pe	1.18	16	2.42	15	1.08	11	0.67	11	0.59	3	0.34	1
MStromlo	1.17	14	2.53	25	0.75	18	0.83	16	2.46	1	1.66	2
Papetee			0.82	2	0.26	1	0.16	1				
Potsdam,	0.88	6	1.50	1								
Riga	0.31	1										
Riyadh,S	1.28	13	2.17	13	0.67	10	0.82	11	0.67	2	0.38	2
San Fern	1.05	17	0.26	1	0.21	1	1.02	8				
San Juan	0.93	5	2.26	24	0.69	17	0.54	8	0.44	2		
Shanghai							1.21	1				
Simosato	0.59	4	1.90	6	0.39	3	0.46	5				
Tanegash	0.32	3										
Wettzell	0.58	11	1.92	12	0.39	3	0.58	7	0.28	1	0.45	3
Yarragad	0.93	23	1.86	34	0.67	28	0.62	20	0.51	6	0.44	4
Zimmerwa	0.70	13	1.53	8	0.36	9	0.46	8	0.72	2	0.89	2
Zimm_red			1.88	8								
arc	1.27	231	2.16	226	0.72	147	0.77	155	0.79	23	0.96	18

Solutions, coordinate precision:
relation between x,y and z

Lageos only:	Starlette+Ajisai:	All:
1:0.9	1:1.3	1:1

Coordinate precision:

4 mm	6 mm	3 mm

Transformations

to ITRF2005_rescaled

	Lageos only	Starlette	All 6 Sat.
Scale[ppb]	-0.32	-4.03	-1.47
TX [cm]	-0.27	1.33	0.21
Ty [cm]	-0.11	-0.54	0.31
Tz [cm]	-0.18	-1.37	-1.97

to original ITRF2005

	Lageos only	Starlette	All 6 Sat.
Scale[ppb]	-2.35	-6.2	-3.15
TX[cm]	-2.58	-0.40	0.21
TY[cm]	0.96	0.14	0.31
TZ[cm]	-0.90	-1.75	-1.97

Conclusion

• Starlette and Ajisai have a good tracking record
• Orbit computation is not easy and requires still some tuning of the models and parameters
• Test results show that the scale difference compared to ITRF2005 is even bigger than with Lageos-1/2 and Etalon-1/2 only
• We will continue to process (routine processing)
• The use of Starlette and Ajisai for low degree harmonics has also to be considered