Geodetic time series at Grasse – France from a collocation experiment

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Introduction

- Objective of the study: improvement and monitoring of the accuracy (biases and positioning).
- Grasse instruments, recent improvements in technique and analysis.
- 3 years collocation experiment from 1997 to 1999.

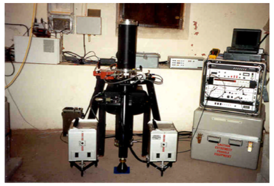
Grasse instruments

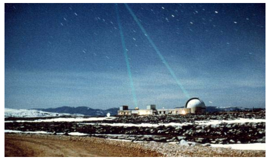
Permanent instruments

- 3 independent laser ranging stations: SLR fixed, LLR, and FTLRS.
- GPS receiver.

Instruments for geodetic campaigns

- Absolute gravimeter





Grasse LLR and SLR collocation objectives

- Search for systematic errors coming from different sources: instrumental bias, orbit and geographically correlated errors, coordinates.
- Improvement of the global accuracy.
- Possible detection of seasonal signals with their geophysical interpretation.

Method

- Determination of global dynamical LAGEOS arcs (10 days) with the best SLR stations (orbit average rms of 2 cm), but without the Grasse LLR data.
- Models used: GRIM5-S1, ITRF97.
- From the laser residuals, computation of correction to the 3 station coordinates (3 months) and estimation of a mean bias (1 year).
- Positioning fluctuations and biases analysis with collocation experiment.

Orbitography

- Stability of about 5 mm in the European stations positionning following the use or not of the Grasse LLR data.

Origin of error	**Mean rms (mm)**
Gravity field (GRIM5-S1)	2-3
Non gravitationnal forces	5-8
Others (tides, gravity field temporal varaitions)	1-2
Station coordinates (ITRF97)	3-5
Tectonic motion	1-3
Global residual network motion	2-4
Laser ranges	10-20
Global precision	**12-23**

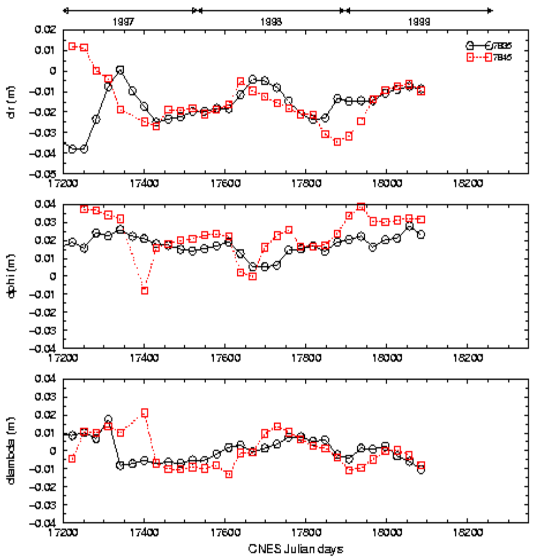
Mean annual range biases

	Mean biais (mm)	Mean biais (mm)	Mean biais (mm)
Station	1997	1998	1999
Grasse SLR	-7,6 ± 2,2	-2,9 ± 0,7	-7,3 ± 1,4
Grasse LLR	*	1,1 ± 1,3	-3,2 ± 1,6
Graz	1,7 ± 0,7	4,1 ± 0,7	0,1 ± 0,8
Herstmonceux	2,5 ± 0,9	1,7 ± 1,0	2,3 ± 1,0

* not mentioned because of a readjustment during 1997

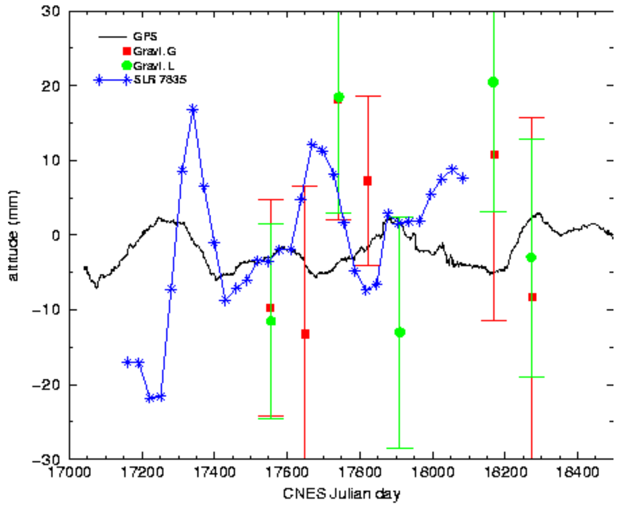
- Sub-centimetric values and good global stability.

OCA laser time series

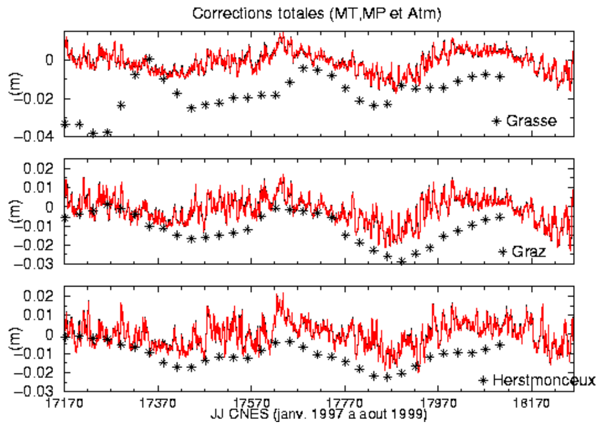


- Good agreement of the positionning (independent computations and instruments)

Altitude variations comparison of different techniques



Modelisation



Total vertical deformation (modelled) obtained from the addition of Earth tides (MT), polar tides (MP) and atmospheric loading effect (Atm), compared to laser positioning

Conclusion

- Standard deviation relative to the LAGEOS orbits of about 2 cm for SLR and LLR Grasse stations.
- Mean biases stability at a level better than 4 mm.
- Precision and agreement in positioning (over 3 months) better than 5 mm (SLR, LLR, and gravimetry).

Proposition to the ILRS:

➩ Publish biases to be taken into account in coordinates computations which is a kind of active quality control.

➩ Respect of the ILRS recommendation: minimum of 400 LAGEOS passes per year.

Seasonal positioning results

- Quite satisfactory agreement between the gravimetric signal and the altitude variations deduced from the laser positioning (phase and amplitude).
- Disagreement with some GPS results.
- Importance to pursue such experiments.

Discussion

- Annual bias stability at the level of few mm.
- Similarity of the seasonal signal observed with the different stations.
- Origin of this signal: tides, ocean and atmosphere loading effects, tropospheric corrections.
- This kind of study is only possible with at least 400 LAGEOS passes per year.