
Analysis of Multi-Wavelength SLR Tracking Data Using Precise Orbits

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Abstract

Using precise Lageos-1/2 orbit generated by the DOGS (DGFI Orbit and Geodetic Parameter estimation Software) Package (<http://ilrsac.dgfi.badw.de/dogs>), multi-wavelength tracking data from Zimmerwald and Concepcion were analysed. We solved for station coordinates and color dependent biases. Some statistics and the history of bias differences for various tropospheric refraction models are shown. Additionally the available full-rate tracking data were analysed to see if there are differences to the biases obtained from the onsite normal points. The results show that the switch from internal to external calibration at Zimmerwald give a significant improvement of the relative biases, mainly from the infrared part. Finally we tried to rate the refraction models from the resulting bias differences.

Introduction

After an email request from Werner Gurtner to investigate if the new calibration scheme for Zimmerwald, Switzerland, since June 21 2006, has improved the quality of the two frequency data, we decided to reprocess all Zimmerwald data for 2005 and 2006 with the new DOGS programme, version 4.07, (Angermann et al. 2004) and strategy.

For the period 2005/06 we solved weekly Lageos-1/2 arcs using the same models as in the weekly position and EOP series. The parameters solved in this weekly arcs are:

- internal arc parameters
- earth orientation parameters
- station coordinates
- weekly biases for selected stations
- for Zimmerwald additionally a colour dependent bias per pass

Analysis

In a first step we looked into the range residual for the two colours, not solving for biases to see if the discrepancy between red and blue range residuals decrease after the calibration change. It is evident, that the range residuals reduced after the change in the Zimmerwald calibration from internal to external. In figure 1 the residuals prior and after the event are plotted. As next test we compared the relative biases between red and blue to see whether we could see an improvement of the data quality, too. In figure 2 the relative biases red-blue are summarized.

Using these results we tried to look for systematic characteristics in the relative biases. Unfortunately we did not see any correlation between bias and elevation resp. atmospheric data. The relative bias between is small after the change in calibration, see figure 3, but the precision is still not good enough to make full use of information contained in the two colors.

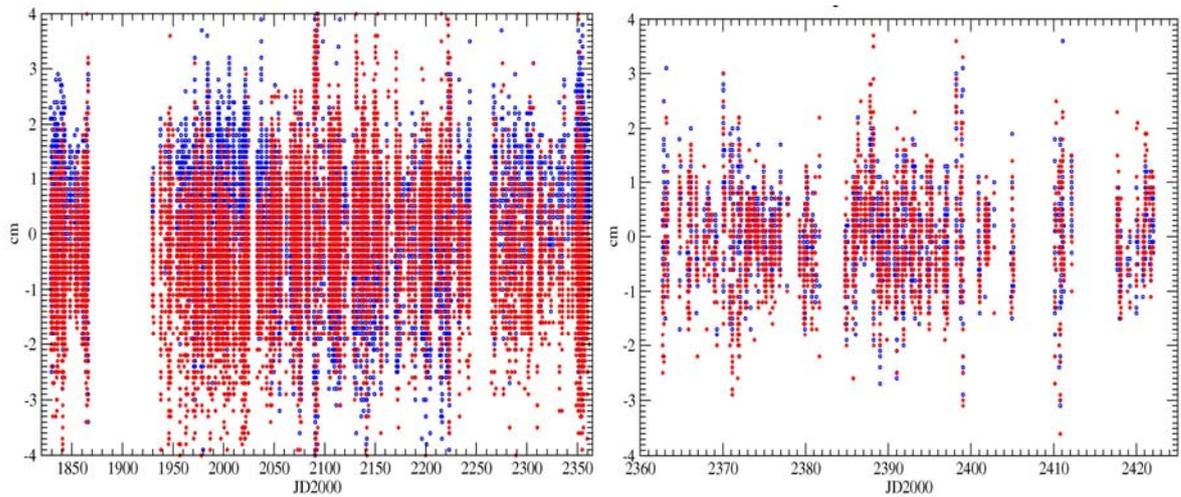


Figure 1. Lageos-1 range residuals (red and blue Laser) for Zimmerwald

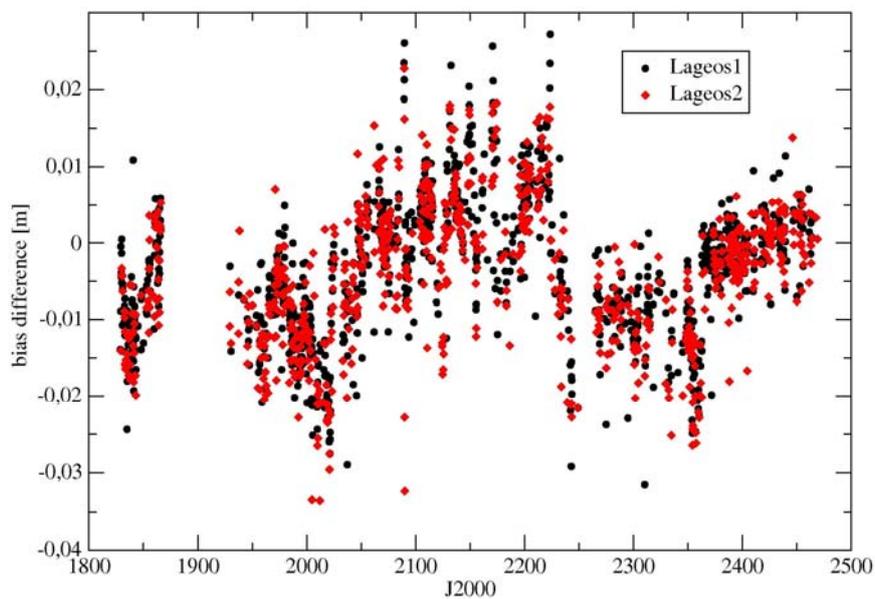


Figure 2. Relative bias between red and blue Laser (cal. change at 2362.5 JD2000)

A test to use the full rate tracking data provided for some of the Zimmerwald passes, did also fail because the epochs of the returned pulses are not identical and an interpolation to simultaneous results did not reach the required accuracy.

There is another station, Concepcion in Chile, operated by the TIGO system, which has the capability of two frequency ranging. We also tried to analyse these tracking data, but there is also no evidence of any systematic in the relative residuals. Mainly due to the fact the most of the time TIGO only delivers red wavelength tracking data, see figure 4, for all two-frequency passes available in 2005/06. The only result is that the biases are bigger than the Zimmerwald biases which could indicate that the calibration of the TIGO system is not stable enough because the tropospheric conditions in Chile are not so different to Europe. But there could also be other reasons for that higher noise in the relative biases.

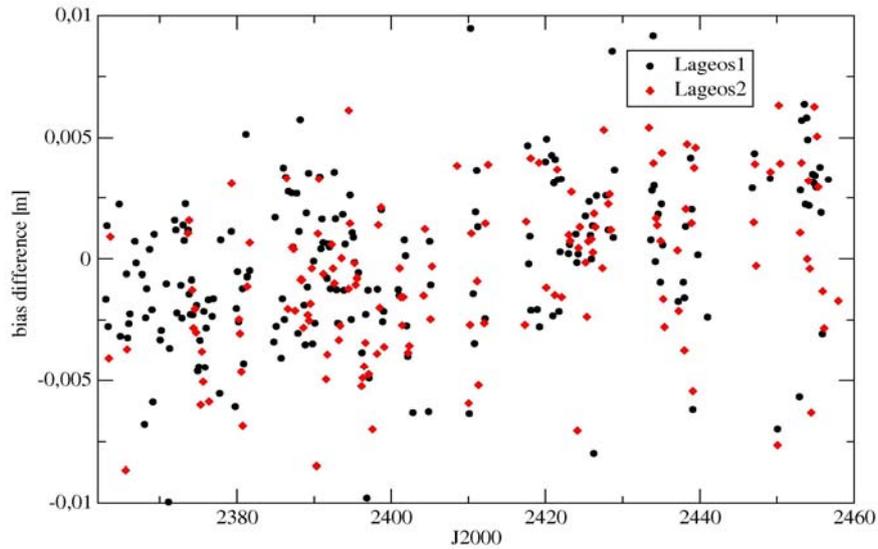


Figure 3. Relative bias after calibration change for Lageos-1/2

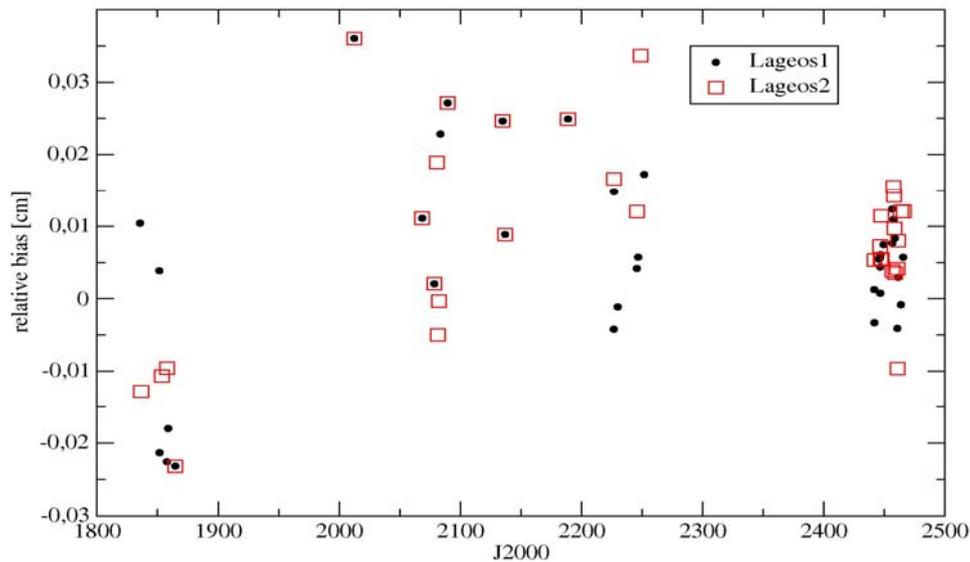


Figure 4. Relative biases for Concepcion in Chile (TIGO system)

Analysis of Troposphere Models.

To get at least some results from our computations we tried to see if there is a difference in the relative biases for the presently used Model Marini-Murray and the new Mendes-Pavlis model. There is no direct improvement if we look into the relative biases only, see figure 5. But if we look into the orbital fit, a clear indication that the new Mendes-Pavlis model gives an improvement is the mean weekly r.m.s. fit for the Zimmerwald SLR station which decrease significantly. In figure 6 we see the weekly r.m.s for Lageos-2 for Zimmerwald with solved station coordinates and relative range biases.

Conclusion

The new calibration at Zimmerwald, Switzerland, improved the quality of the two frequency SLR tracking data but there is still not enough precision in the relative biases to make full use of the data. The other two wavelength tracking system TIGO

at Concepcion in Chile has higher relative biases which could be the cause of calibration problems, like the Zimmerwald system.

The new Mendes-Pavlis tropospheric delay model gives, at least for the two frequency systems, an improvement compared to the old Marini-Murray model.

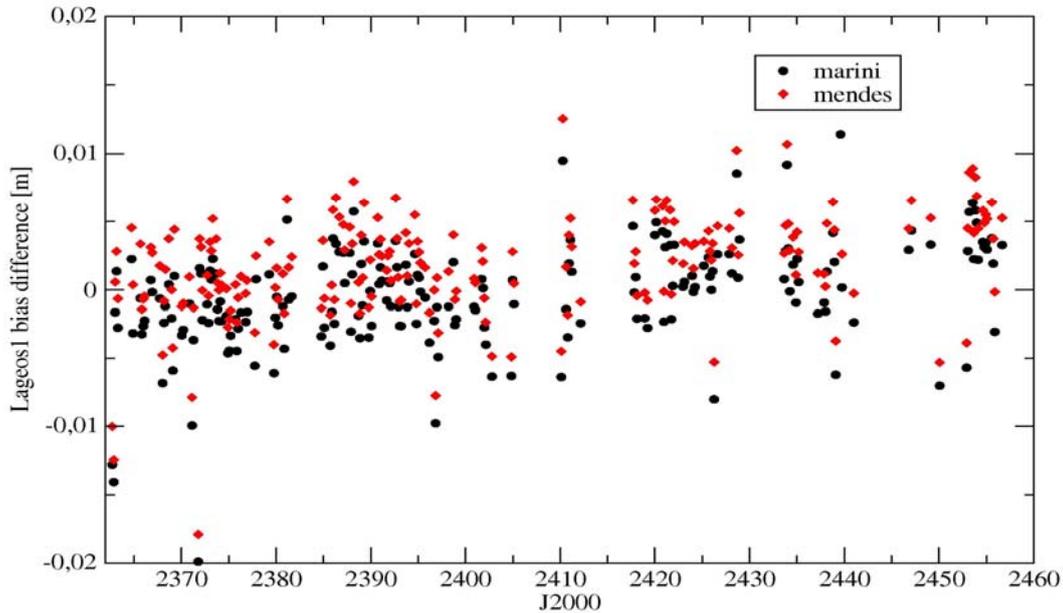


Figure 5. Relative biases for Lageos-1 using Marini and Mendes refraction model

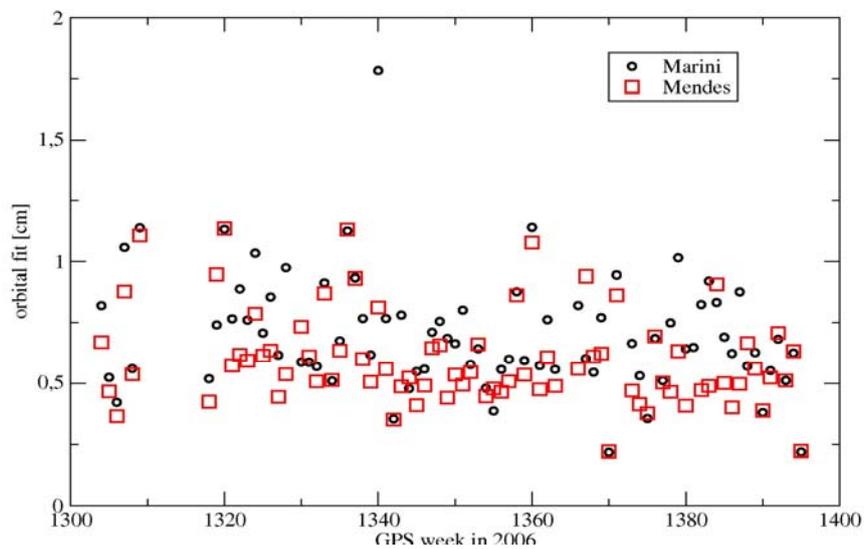


Figure 6. Mean weekly residuals of Lageos-2 arcs for Zimmerwald

References

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