SOME REMARKS ON ACCURACY OF ATMOSPHERIC MODEL USED IN LASER RANGING OBSERVATIONS

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ABSTRACT. The presently used Marini-Murry model of atmospheric corrections in laser ranging observations takes into account an influence of atmosphere only up to 25 km. Our studies indicate that atmosphere is dense enough up to 100 km to slow down significantly electromagnetic waves. Systematic differences between delay values in the zenith direction calculated according to the Marini-Murry formula and those of our model equal even 10 cm. It is striking that various parameters determined from laser observations do not show such errors. Some suggestions of elucidation of this fact are proposed.

With the use of laser ranging observations, a station position is determined at present with accuracy of several millimeters. This accuracy is supposed to be limited by method of taking into account the influence of atmosphere. To check a possibility of improving corrections for the zenith delay in laser observations, we have considered a two-layer model of atmosphere which describes a density discontinuity on tropopause (*Sugawa and Kikuchi*, 1974). We have also looked for the limit height of atmosphere above which contributions to the delay are negligible. We found that the influence of atmosphere can be neglected only above 100 km over the Earth surface. Basing on the actual aerological soundings, we have found by numerical integration values of the zenith delay and compared them with those obtained with the help of the commonly used Marini-Murray formula (*Marini and Murray*, 1973). Figure 1 shows the result obtained on the base of ten years aerological data.

Surprising are the systematic differences between the both values varying from 6 cm in summer up to 11 cm in winter. In our opinion these differences are a consequence of cutting atmosphere up in the Marini-Murray model on 25 km which is the maximum height of aerological soundings. Indeed, results obtained with the help of our model practically coincide with those of the Marini-Murray model if we finish the numerical integration on the height of 25 km (Fig. 2). In Figure 2, the solid line describes values of the zenith delay calculated with the help of the Marini-Murray model, the dashed line corresponds to values calculated by numerical integration up to 22 km and the dashed-dotted line to values calculated up to 25 km.

A question arises why the station coordinates are determined with the millimeter accuracy though the atmospheric delay is taken into account only with several centimeters accuracy? At present, we cannot strictly answer this question. We plan to check a supposition that the millimeter accuracy is only a selfconsistent property of the GEODYN program and an actual accuracy can be worse.

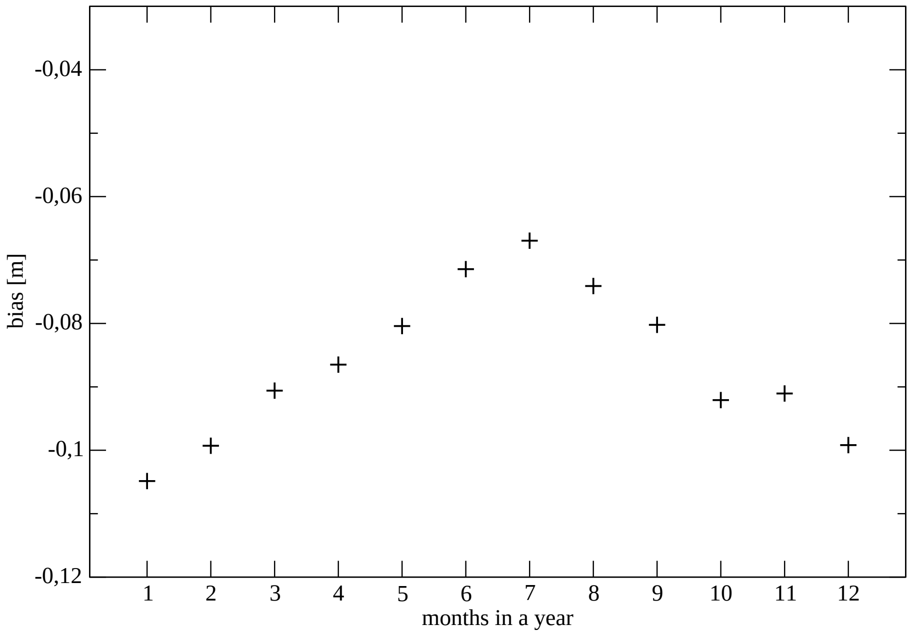

Figure 1: Differences between delay values in the zenith direction calculated according to the Marini-Murry formula (*Marini and Murray*, 1973) and those of our model.

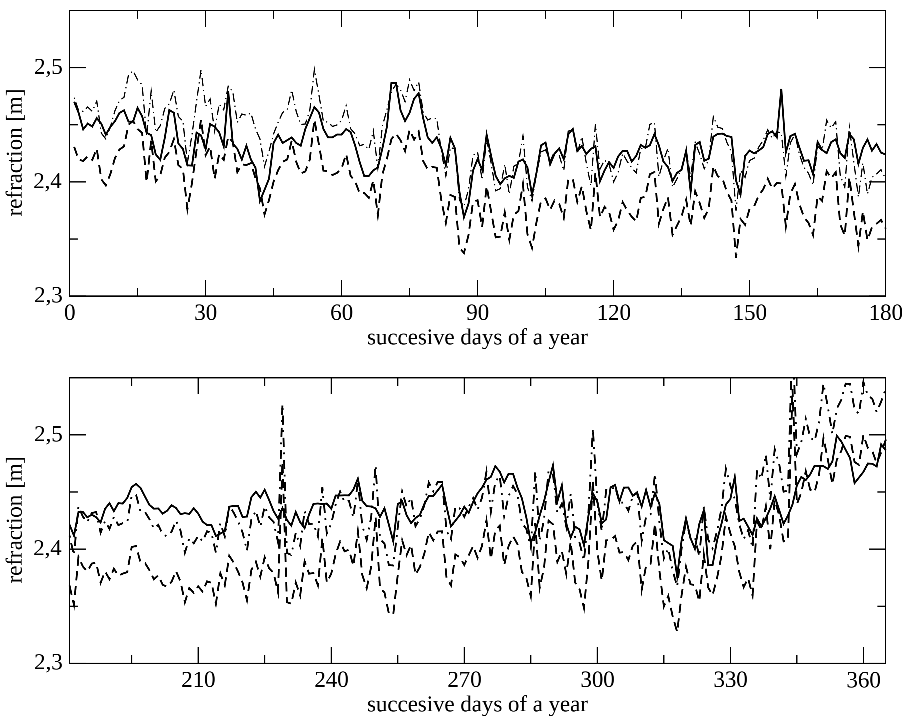

Figure 2: Delay values in the zenith direction calculated according to various methods using the aerological sounding data. See text for details.

REFERENCES

Sugawa C., N. Kikuchi, Pub. Astr. Observ., Beograd (1974).
Marini J. W., C. W. Murray, NASA Tech. Rep. X-591-73-351 (1973).