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The impact of the drag due to the neutral atmosphere on the orbit of LARES

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The acceleration due to the direct solar radiation pressure on LARES (LAser RElativity Satellite) represents the larger non-gravitational acceleration that acts on its orbit (about 1.2x10-9 m/s2). It is a factor of 3 smaller than that on LAGEOS satellites (LAser GEOdynamic Satellite) thanks to its smaller area-to-mass (A/M) ratio. However, despite the smaller A/M the acceleration due to the neutral atmosphere is a factor of 50 larger than that on the two LAGEOS satellites. This aspect radically changes the perspective with which the effects of the neutral drag should be considered for LARES, compared to what was done in the past for the LAGEOS satellites. Of course, this arises because of the much lower height of LARES (about 1450 km) with respect to that of the two LAGEOS satellites (about 5900 km), with several important consequences. Indeed, in a previous work (2016EGUGA..1814231P) we have been able to show that decay of the semi-major axis of LARES orbit (close to 1 m/yr over the analyzed timespan) was almost all explainable in term of the drag effects due to the neutral atmosphere. Conversely, for the two LAGEOS, the role of the neutral drag was a minority in explaining the observed decay (about 10%), resulting largely exceeded by thermal drag effects and charged particles effects. However, in the previous work, we also showed that after modelling the neutral atmosphere a residual along-track acceleration was still there, a factor of 70 smaller than that estimated to account for the effect of the neutral drag (about -1.4x10-11 m/s2) and that this was the evidence that other (possible) unmodeled non-gravitational perturbations were at work on LARES orbit. Recently, we extended this study to all orbital elements of LARES, and we considered also a larger timespan that covers almost all the time elapsed since the launch of this passive laser-ranged satellite. Our study is based on a careful analysis of the orbit of LARES with two different software, GEODYN II and SATRAP. The comparison between the residuals of the orbital elements of LARES obtained with GEODYN, with the effects on the same elements due to the neutral drag, that we derived by a parallel analysis with SATRAP, clearly show other underlying effects, possibly to be explainable by thermal drag like effects. This work is part of those of the LAser RAnged Satellites Experiment (LARASE). The main goal of LARASE is to improve the modelling of both the gravitational and non-gravitational perturbations on the LAGEOS, LAGEOS II and LARES satellites in such a way to further improve their precise orbit determination to better determine tiny relativistic effects in the weak-field and slow-motion limit of Einstein's theory of general relativity.