Orbit determination and prediction accuracy of TOPEX with a priori solar radiation force derived from photometrics and laser ranging data

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The decommissioning of the (TOPography EXperiment) TOPEX/Poseidon (T/P) altimetry satellite took place in 2006 after a 13 year mission, leaving behind a large space debris object in a populated circular orbit approximately 1340 km in altitude. Even after its mission ended, T/P has been tracked with satellite laser ranging (SLR) and photometrics in order to better understating its current orbital and spin dynamics. Using such measurements, in a previous paper (D. Kucharski, et al., 2017) it was demonstrated that T/P is gaining rotational energy at an average rate of 2.87 J/day, based on 11 years of combined photometric and SLR measurements. It was also demonstrated that the mechanism behind this increase in spin energy is due to solar radiation pressure (SRP) ranging from 65 μN to 228 μN.

While it may be standard practice for satellite operators to use highly accurate macro-models to predict the orbits of their assets, the application of such models to space debris is relatively overlooked due to the unknown attitude and spin dynamics. In this paper, we implement the models discussed in (D. Kucharski, et al., 2017) to calculate the forces due to SRP and analyse the perturbations on the orbit of T/P. Using the same SLR measurements in the period used to derive the models of (D. Kucharski, et al., 2017), the orbit accuracy will be investigated in comparison to the so-called cannon-ball assumption. This aims to demonstrate an approach to better improve orbit predictions and provide more accurate conjunction warnings.