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# A refined non-gravitational force modelling for GPS and Galileo satellites with a focus on orbit prediction

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As a result of advancing GNSS orbit modelling techniques and introducing new processing algorithms over the last few decades the centimeter-level accuracy of the computed orbits have become possible. As a direct consequence, this also led to improvements in the orbit prediction solutions. To a large degree, these achievements have been attained thanks to the refinements in the non-gravitational force modelling.

With the total number of satellites exceeding 20, the European Galileo system is currently the third largest GNSS after GPS and GLONASS. Due to the relatively large area-to-mass ratio and non-cubic shape of the Galileo satellites, the accurate assessment of the contribution of the associated non-gravitational forces is crucial. Underestimation of these forces results in large deviations of the computed orbits from the actual satellite trajectories. This is confirmed by significant discrepancies among Galileo precise orbit solutions of, e.g., various IGS analysis centers employing different approaches in their modelling strategies.

In this study we introduce a priori box-wing models for GPS and Galileo satellites that are based on the analysis of the evolution of extended empirical CODE model (ECOM2) parameters over a period of time. The introduced box-wing models are tuned to account for the major part of the non-gravitational forces, whereas the remaining unaccounted forces are absorbed by a refined set of empirical parameters. Performance of the models is assessed in both orbit determination and prediction.