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# Advancing the orbit model for Galileo satellites during eclipse seasons

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In 2012 the Center for Orbit Determination in Europe (CODE) joined the Multi-GNSS-EXtension project (MGEX) of the International GNSS Service (IGS). Since the end of 2013 the CODE MGEX contributions were based on combined solutions of five already established and emerging GNSS: GPS, GLONASS, Galileo, Beidou and QZSS. This undertaking was made possible thanks to continuous development of new models and approaches and their introduction in our processing schemes in order to ensure delivery of products of the highest quality.

The European Galileo system is currently the third largest GNSS after GPS and GLONASS with a total number of active satellites approaching 20. The introduction of extended empirical CODE model (ECOM2) to the CODE MGEX solutions brought significant improvements to the Galileo products. The use of the Galileo satellites metadata that were recently made public has further enhanced the quality of the produced solutions. However, these still show significant degradations during eclipse seasons, which are similarly observed in solutions of other IGS MGEX analysis centers to different extends. In particular, this is reflected in elevated orbit misclosures at day boundaries, deterioration of satellite clocks and excessive Satellite Laser Ranging (SLR) residuals during these periods. Since the ECOM2 parameters are designed to absorb the solar radiation pressure effect they are switched off during eclipses. Hence, there is no empirical force parameter left that can absorb any unmodelled perturbations (e.g., due to thermal re-radiation (TRR)) during an eclipse period. Because of their low weight the Galileo satellites are more sensitive to non-gravitational forces than other GNSS satellites.

In this study we advance our orbit model further by introducing empirical parameters to account for unmodelled perturbations acting on Galileo satellites, e.g., TRR effects, while the satellites pass the Earth's shadow. The presented results include the assessment of the benefits of significantly improved modelling on both IOV and FOC satellites with a focus on eclipse seasons.