1.7 Using SLR for GNSS orbit model validation

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ESOC's Navigation Support Office provides services and products related to GNSS systems in support to ESA missions and European customers. With our software NAPEOS we process the various GNSS systems (Galileo, GPS, GLONASS, BeiDou, QZSS) for highly accurate orbit and clock estimation and prediction. As official ILRS analysis center we also contribute routinely to the ILRS products and to ILRS reprocessing activities.

As part of our research activities we are steadily trying to improve existing GNSS orbit models and to develop new models as new GNSS systems arise. SLR data is an important tool to validate our models with an independent measurement. We use it, e.g., for the validation of our reprocessed orbit series when contributing to the IGS reprocessing activities applying the latest models.

One of the challenges for precise orbit modelling of new GNSS constellations is the modelling of the solar radiation pressure. A mis-modelling of this surface force acting on the satellites causes periodic orbit errors of several centimetres. As the epoch-wise estimated satellite clocks tend to absorb orbit model deficiencies the clock products are affected as well. To model the SRP forces sufficiently a very good knowledge of the satellites surface properties and geometry as well as the attitude behaviour (during transition modes and eclipses) is needed. If this information is not or only insufficient available, SLR observations are very valuable means to investigate the satellites' in-orbit behaviour.

We developed satellite-type specific box-wing models for the various GNSS constellations. We generated orbit time series for the GPS, GLONASS, BeiDou and QZSS satellites using GNSS data from the ESA and the MGEX tracking network and applying the different box-wing models. We will demonstrate the usage of SLR data for the validation of the different orbit series. Emphasis is given to box-wing model improvements verified by SLR data. We will also address the potential benefit of using dedicated SLR tracking scenarios for attitude model validation.