CODE IGS reference products including Galileo

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The International GNSS service (IGS) has been providing precise reference products for the Global Navigation Satellite Systems (GNSS) GPS and (starting later) GLONASS since more than 25 years. These orbit, clock correction, coordinate reference frame, troposphere, ionosphere, and bias products are freely distributed and widely used by scientific, administrative, and commercial users from all over the world. The IGS facilities needed for data collection, product generation, product combination, as well as data and product dissemination, are well established. The Center for Orbit Determination in Europe (CODE) is one of the Analysis Centers (AC) contributing to the IGS from the beginning. It generates IGS products using the Bernese GNSS Software.

In the last decade new GNSS (European Galileo and Chinese BeiDou) and regional complementary systems to GPS (Japanese QZSS and Indian IRNSS/NAVIC) were deployed. The existing GNSS are constantly modernized, offering - among others - more stable satellite clocks and new signals. The exploitation of the new data and their integration into the existing IGS infrastructure was the goal of the Multi-GNSS EXTension (MGEX) when it was initiated in 2012. CODE has been participating in the MGEX with its own orbit and clock solution from the beginning. Since 2014 CODE's MGEX (COM) contribution considers five GNSS, namely GPS, GLONASS, Galileo, BeiDou2 (BDS2), and QZSS. We provide an overview of the latest developments of the COM solution with respect to processing strategy, orbit modelling, attitude modelling, antenna calibrations, handling of code and phase biases, and ambiguity resolution. The impact of these changes on the COM products will be discussed.

Recent assessment showed that especially the Galileo analysis within the MGEX has reached a state of maturity, which is almost comparable to GPS and GLONASS. Based on this finding the IGS decided to consider Galileo in its third reprocessing campaign, which will contribute to the next ITRF. Recognizing the demands expressed by the GNSS community, CODE decided in 2019 to go a step further and consider Galileo also in its IGS RAPID and ULTRA-RAPID reference products. We summarize our experiences from the first months of triple-system (ULTRA)-RAPID analysis including GPS, GLONASS, and Galileo. Finally we provide an outlook of CODE's IGS analysis with the
focus on the new GNSS.