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On the potential of future observation types for the next generation GNSS

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Over the last decades, Global Navigation Satellite Systems (GNSS) have become one of the standards for positioning applications with highest precision. However, uncertainties in the modeling of f.i. solar radiation pressure (SRP) are still an important limiting effect in orbit modeling and hinder for example the accurate and reliable estimation of the origin of GNSS-based terrestrial reference frames (TRF). Therefore, current developments strive for observation types that can improve the absolute accuracy of the orbit as well as of the derived products. For example, the next generation GNSS, proposed by the German Aerospace Center (DLR) under the name "Kepler" as a concept for a future satellite constellation, involves the use of optical inter-satellite links (OISL), which have demonstrated to hold great potential for improving accuracies and decorrelating solved-for parameters. Building on this concept, we investigate the potential of other possible observation types for a future GNSS constellation using highly realistic simulations. To this end, we use not only OISL, but also accelerometer and attitude data, as well as the synchronization of the satellite clocks via the OISLs between the satellites. We evaluate the potential of these techniques each by itself and in combination in terms of orbital accuracy and formal errors as well as correlations of the solved-for parameters.