

Assessment of the Effects of Combining Multi-GNSS Constellations on the Solution Accuracy and Availability

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SUMMARY

GPS has been proven to achieve high accuracy positioning for many monitoring applications. However, potential weak geometry of the GPS constellation and/or the blockage of the satellite signals by surrounding obstacles may reduce the accuracy, availability and the reliability of GPS monitoring. The development of additional GNSS systems (i.e. GLONASS, BeiDou) broadens the perspective of combining one or more constellations with the GPS constellation in order to resolve cases of weak GPS satellite geometry that may lead to lower accuracy positions and therefore errors in monitoring information. The aim of this study is to compare the accuracy and the availability of the GPS solution with that of the GNSS solution, by evaluating their correlation with the corresponding satellite constellation. For this purpose, GNSS zero-baseline static measurements were carried out for 12 days simultaneously at two sites in the UK and China. The GPS/GNSS records were processed in kinematic Double-Difference (DD) mode to assess the accuracy and the availability of the positioning for the two sites, by using various combinations of GPS, GLONASS and BeiDou. The GPS and GNSS time series, expressing mainly noise caused by the satellite constellation and the receiver, were analysed using a moving standard deviation to define the variation of the noise level along the 24-hours of each day and finally were correlated with the corresponding DOP values. It was observed that the periods of high correlation for the GPS solution, corresponded to periods of high noise level and high DOP value, with the latter being above the mean DOP value of the day, while for the corresponding period of the GNSS solution, there was no correlation between noise and GNSS DOP value, indicating that the noise of the GNSS solution was not constellation-dependent. Thus, it was observed that for periods of weak GPS constellation, which can be defined from the corresponding DOP, the contribution of the GLONASS and/or BeiDou will lead to solution of higher accuracy, availability and limit the impact of potential weak satellites.

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