Applicability of Recent Low-Cost GNSS Receivers to Deformation Monitoring

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SUMMARY

The continuous development of low-cost Global Navigation Satellite Systems (GNSS) chipsets and advances in processing algorithms that address the limitations of such hardware enable the exploitation of mass-market receivers in new fields of engineering and science. The ubiquitous presence of such devices is a factor that can particularly stimulate innovations and thus open the door to new applications for low-cost GNSS receivers. In this study, we focus on the actual positioning performance of recent mass-market GNSS receivers. In particular, this study aims to verify whether the low-cost receivers may be employed for precise deformation monitoring and reach an accuracy level close to that of high-grade receivers.

The experiment is based on GNSS observations collected using the most recent multi-frequency GNSS low-cost receivers provided by u-blox, Skytraq, and Septentrio. They are connected to two different types of GNSS antennas, a patch one dedicated to the low-cost receivers and a Leica AR10 surveying-grade one. In addition, Trimble Alloy that is a high-grade geodetic receiver, is also employed and treated as a benchmark in this study. GNSS data collected during the experiment are processed in Bernese GNSS Software v.5.2 in double-difference mode. To achieve the highest possible accuracy, it is necessary to develop an optimal processing strategy suitable for deformation monitoring with low-cost GNSS receivers. This is done by extensive testing and selection of the most appropriate type of observations and their linear combinations, elevation cut-off angle, ambiguity resolution strategy, network geometry, troposphere and ionospheric delays handling, etc.

The results show that with the optimal low-cost receiver data processing strategy, the latest low-cost receivers may be considered a mature complement to high-grade receivers in engineering applications, such as deformation monitoring.