Testing a low-cost methodology for 3D documentation of long-term GNSS sites

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Continuously operating Global navigation satellite systems (GNSS) sites are used for many purposes including monitoring vertical land motion. To reliably reach desired sub-mm velocity accuracies, performance needs to improve further. Improvements in accuracy over the next decade are likely to come from a variety of sources. One of them is likely to be from developing an understanding of how the varying surroundings at a site affect the position estimate. 3-D documentation of GNSS sites could help in documenting changes around the antenna to provide an archive of data for potential future developments in processing. Regular basic documentation would also help for current precise processing efforts. We test a low-cost Structure-from-Motion (SfM) photogrammetry technique for 3-D modelling of long-term GNSS sites. SfM photogrammetry creates 3-D models from a set of overlapping still photographs. Images were acquired following a systematic pattern around a simulated long term GNSS station using a consumer-grade compact camera (Canon G9) and two smartphones (Huawei P20 and Tecno C8). The 3-D modelling was performed using freely accessible software (VisualSfM v.0.5.23, MeshLab v.2016.12 and CloudCompare v.2.10-alpha). As an appraisal of this method, the SfM models generated are compared with a similar model derived using a high precision terrestrial laser scanner. In addition, the modelling capabilities of VisualSfM were validated by comparing it with a mature commercial SfM software (Pix4D v.3.2.23). The results obtained suggest that the proposed method offers analytical potential in understanding the dynamics of long-term GNSS sites. While further tests are required, the initial findings are promising.