EGU22-9881
https://doi.org/10.5194/egusphere-egu22-9881
EGU General Assembly 2022

Performance of different UAS platforms, techniques (LIDAR and photogrammetry) and referencing approaches (RTK, PPK or GCP-based) to acquire 3D data in coastal cliffs

Álvaro Gómez-Gutiérrez, Manuel Sánchez-Fernández, and José Juan de Sanjosé-Blasco
Research Institute for Sustainable Territorial Development, University of Extremadura, Cáceres, Spain (alvgo@unex.es)

Understanding the dynamics of coastal areas is crucial to mitigate the effects of global change though monitoring these places could be challenging, difficult and dangerous, especially in the presence of (unstable) cliffs. The recent development of Unmanned Aerial Systems (UAS) with accurate direct georeferencing systems facilitates this task. The objective of this work is to test the performance of different 3D data acquisition strategies in coastal cliffs, specifically RGB and LIDAR sensors on board UAS platforms equipped with direct georeferencing instruments based on Global Navigation Satellite Systems (GNSS: Real Time Kinematic-RTK and Post-Processing Kinematic-PPK approaches). Two UAS were used to capture data and produce point clouds of a coastal cliff in the Cantabrian Coast (Gerra beach, North Spain): a DJI Phantom 4 RTK (P4RTK) and a MD4-1000 LIDAR. The P4RTK may receive corrections to estimate accurate positions of the UAS during the acquisition of images (P4RTK processing approach), but also may record the trajectory of the UAS to carry out a PPK approach later to correct and estimate the location of the camera at every shot (P4RTK-PPK processing approach). Two GNSS receivers (Leica 1200 working as base and rover) were used to survey 31 points distributed in the study area. The surveyed points were used in different number (from 0 to 10) as Ground Control Points (GCPs: to support the production of the point clouds) or Check Control Points (CCPs: to independently test the geometrical accuracy of the point clouds) in the photogrammetric processing (using two parallel pipelines with Agisoft Metashape and Pix4Dmapper Pro software packages). The MD4-1000 LIDAR is a quadcopter UAS equipped with the following instruments: a LIDAR sensor SICK LD-MRS4 (to capture the point cloud), a Ladybug RGB camera (to acquire images and colour the point cloud), and a GNSS antenna (Trimble APX-15v3) with an integrated Inertial Measurement Unit. The trajectory of the UAS recorded by the GNSS may be corrected using observations registered by a GNSS base station to obtain the accurate pose of the UAS using a PPK approach.

Additionally, a benchmark point cloud was acquired by a Terrestrial Laser Scanner (Leica ScanStation C10) placed at 5 locations. The resulting point cloud showed 23,4 million points with a registration error of 7 mm. Three parameters were used to test the quality of the resulting point clouds: point cloud density and coverage, distance to the benchmark point cloud and RMSE of CCPs. The results showed that any of the strategies produced very accurate point clouds with a geometrical accuracy <10 cm. The P4RTK (RTK, PPK or using GCPs) produced more accurate and

denser point clouds than the MD4-1000 LIDAR system (only PPK approach). The use of GCPs did not improved substantially the point clouds produced by photogrammetry (and RTK or PPK approaches) if an oblique pass is included in the flight plan to improve the camera focal estimation and corrections are available.