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Commercial multicopter unmanned aircraft system as a tool for early stage forest survey after wind damage

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In recent years unmanned aircraft systems (UAS) are objects of research in many areas. This trend can be seen also in forest research where researchers are focusing on height, diameter and tree crown measurements, monitoring of forest fire, forest gaps and health condition. Our research is focusing on the use of UAS for detecting areas disturbed by wind and deriving the volume of fallen trees for management purposes. This information is crucial after the wind damage happened.
We used DJI Phantom 2 Vision+ and acquired the imagery of one forest stand (5.7 ha). The UAS is a quadcopter "all in one" solution. It has a built-in camera with gimbal and a remote controller. The camera is controlled through the application (android/ios). The built-in camera has an image resolution of 4384×3288 (14 megapixels). We have placed five crosses within the plot to be able to georeference the point cloud from UAS. Their positions were measured by Topcon Hiper GGD survey-grade GNSS receiver. We measured the border of damaged area by four different GNSS devices - GeoExplorer 6000, Trimble Nomad, Garmin GPSMAP 60 CSx and by smartphone Sony Xperia X. To process images from UAS we used Agisoft Photoscan Professional, while ArcGIS 10.2 was used to calculate and compare the areas . From the UAS point cloud we calculated DTM and DSM and deducted them. The areas where the difference was close to zero (-0.2 to 0.2) were signed as potentially wind damage areas. Then we filtered the areas that were not signed correctly (for example routes). The calculated area from UAS was 2.66 ha, GeoExplorer 6000 was 2.20 ha, Nomad was 2.06 ha, Garmin was 2.21 ha and from Xperia was the area 2.24 ha. The differences between UAS and GPS devices vary from 0.42 ha to 0.6 ha. The differences were mostly caused by inability to detect small spots of fallen trees on UAS data. These small spots are difficult to measure by GPS devices because the signal is very poor under tree crowns and also it is difficult to find such small spots within the area. Based on the derived area and per hectare volume of the most common tree specie from forest plan (Fagus sylvatica 83%) we calculated the volume of damaged trees and compared the result with data from forest district. The forest district harvested all damaged trees and measured their volume. The volume derived from UAS and forest plan data was 918 m3 and volume measured by forest district was 775 m3. The difference was 143 m3 (18%). The next step of our research is to verify the use of fixed wing UAS for larger areas.