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Observing snow cover using unmanned aerial vehicle

Waldemar Spallek, Matylda Witek, and Tomasz Niedzielski
Institute of Geography and Regional Development, University of Wroclaw, Wroclaw, Poland (waldemar.spallek@uwr.edu.pl)

Snow cover is a key environmental variable that influences high flow events driven by snow-melt episodes. Estimates of snow extent (SE), snow depth (SD) and snow water equivalent (SWE) allow to approximate runoff caused by snow-melt episodes. These variables are purely spatial characteristics, and hence their pointwise measurements using terrestrial monitoring systems do not offer the comprehensive and fully-spatial information on water storage in snow. Existing satellite observations of snow reveal moderate spatial resolution which, not uncommonly, is not fine enough to estimate the above-mentioned snow-related variables for small catchments. High-resolution aerial photographs and the resulting orthophotomaps and digital surface models (DSMs), obtained using unmanned aerial vehicles (UAVs), may offer spatial resolution of 3 cm/px. The UAV-based observation of snow cover may be done using the near-infrared (NIR) cameras and visible-light cameras. Since the beginning of 2015, in frame of the research project no. LIDER/012/223/L-5/13/NCBR/2014 financed by the National Centre for Research and Development of Poland, we have performed a series of the UAV flights targeted at four sites in the Kwisa catchment in the Izerskie Mts. (part of the Sudetes, SW Poland). Observations are carried out with the ultralight UAV swinglet CAM (produced by senseFly, lightweight 0.5 kg, wingspan 80 cm) which enables on-demand sampling at low costs. The aim of the field work is to acquire aerial photographs taken using the visible-light and NIR cameras for a purpose of producing time series of DSMs and orthophotomaps with snow cover for all sites. The DSMs are used to calculate SD as difference between observational (with snow) and reference (without snow) models. In order to verify such an approach to compute SD we apply several procedures, one of which is the estimation of SE using the corresponding orthophotomaps generated on a basis of visual-light and NIR images. The objective of this work is thus to compare snow extents derived from orthophotomaps and non-zero SD layers.