A conceptual approach on optimising lead time for the forecasting of landslides using remote sensing systems

Markus Keuschnig\textsuperscript{1}, Doris Hermle\textsuperscript{2}, and Michael Krautblatter\textsuperscript{2}

\textsuperscript{1}GEORESEARCH Forschungsgesellschaft mbH, Wals, Austria
\textsuperscript{2}Technical University of Munich, Chair of Landslide Research, Munich, Germany

New remote sensing systems offer an increased spatiotemporal resolution and accuracy. These systems increase the chance of snow- and cloud-free multispectral images to detect and monitor landslides for early warning issues. Various studies showed the applicability of multispectral remote sensing systems for landslide detection and monitoring. However, a systemic evaluation of the remote sensing systems especially in respect to early warning is still missing. In this study we present a new conceptional approach to evaluate the capability of different systems for early warning issues based on a well suited case study located in the Hohe Tauern Range, Austria.

The Sattelkar is a highly dynamic west-facing deglaciated high-alpine cirque in the Großvenedigergruppe, Austria. The abundant rock debris exhibits high movement rates and showed massively enhanced landslide activity after ongoing heavy precipitation in 08/2014, resulting in a 170,000 m\textsuperscript{3} debris flow event. We estimated time demands for three successive steps consisting of (i) image collection, (ii) processing with motion delineation and (iii) the final evaluation. Digital image correlation, an established tool in landslide remote-sensing research, was used to derive displacement patterns and assess the capabilities of the multispectral images in terms of spatiotemporal resolution and data quality. For our study we used Sentinel-2, RapidEye and PlanetScope images and compared their deduced motion patterns and rates to those from accurate UAV data as well as manually digitized boulder tracks (≥10 m in diameter).

Within a reasonable amount of processing time, some satellite data revealed similar clustered motions identifiable in the UAV images. However, our analysis also showed identification limitations due positional inaccuracy, image errors and spatiotemporal resolution of the data. On that account, certain processing steps reduce the forecasting window and as a result the lead time, i. e. the remaining time to take action. We postulate that remote sensing data has the ability to support landslide monitoring, but the pre-selection of usable and sound data is essential as it directly influences the forecasting window. Sound knowledge of its different application possibilities enhances overall steps of image collection, processing and final analysis. The critical selection of which data source is best can lead to faster response times for landslide events. This increases the forecasting window, hence the time to take action until a landslide occurs.