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The use of land- and satellite-based precipitation radar to forecast debris flows and high water discharge: case study from June 2nd, 2016 in southern Norway.

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The Norwegian flood- and landslide forecasting service at the Norwegian Water Resources and Energy Directorate (NVE) (www.varsom.no), has issued flood forecasts since 1989, and since 2013 the occurrence of many landslides events at regional level, due either to severe storms or intense snow melting, has been predicted.

High intensity and short duration (less than 1 hour) rainfalls may cause sudden and abundant runoff that can entrain large quantities of loose sediments and originate debris flows. Intense convective rainstorms often develop quickly, especially during summer, and they are difficult to forecast and even to observe with a standard (synoptic) network of precipitation gauges. In those cases, the forecaster on duty can send warning messages for a very large area (encompassing many counties and many municipalities), because of the large spatial uncertainty of the prognoses and amount of rain. A standard sentence in the warning message is always included, recommending to the population to monitor the evolution of the rainstorm with weather radar products, which are available on institutional websites. In other cases, especially when the convective rainstorm is spatially confined in a small area and highly uncertain, the forecaster may choose to not issue any warning. The first situation yields false alarms for some areas, while the second situation could result in a missing event, if a landslide actually occurs.

The Norwegian Meteorological Institute (MET) and NVE are working on a project to further promote the use of radar-derived products in landslides and flood forecasting. In this study, we focus on the description of a case study to present the potential of MET-NVE collaboration on the topic.

As a case study, we have chosen a short-lived rainstorm occurred on June 2nd, 2016 in Motland (Rogaland county, Southern Norway), which had triggered 2 debris flows that were not forecasted. Land- and satellite-based weather radar and lighting data were used to analyse and recreate the triggering conditions for these events. The closest rain gauges in the area show very low rain intensity that cannot explain the initiation of the landslides. This is in disagreement with the eye-witness that observed intense and very local showers. The analysis of rainfall intensity estimated by both land-based and satellite-based (IMERG) radar data confirms the eye-witness observations, and it results in significantly higher values for the areas where the debris flows were triggered, if compared to precipitation interpolated from gauge observations. This was also supported by discharge responses from three small catchments in the area. Our results indicates that weather radar and lighting data are useful complements to the traditional analysis of landslide events made only by means of gauges, moreover they can be used: a) in back analyses on rainfall and landslide events in order to improve landslide thresholds; b) has a potential to assist in now-casting operations as supporting tool of a regional warning, especially in summer season, and radar prediction can be used in the proximate hour to see the storm development.