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Better landslide prevention along transportation lines by establishing synergy between regional forecasts and local warnings

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Each year debris flows and debris avalanches create problems for Norwegian transportation infrastructure, with over 30 damaging events recorded yearly. These damages have a huge economic cost, and with the steep Norwegian topography, it is impossible to completely secure the infrastructure by using only physical mitigation measures. This is why good and reliable landslide forecasting is necessary to reduce economic losses along roads and railways. Future climate change scenarios predict rising temperatures and increased rainfall that will trigger more landslides, and consequently landslide damages are expected to increase.

On a daily basis, the forecasting and warning system at the Norwegian Water Resources and Energy Directorate (NVE) produces a regional landslide forecast by assessing where hydro-meteorological conditions (e.g., rainfall, snowmelt and water saturation in the soil) can lead to landslide occurrence. The receivers of these warning messages, such as road and railway authorities, combine this information with local knowledge to define the local level of alert and the most appropriate mitigation action to take before the event occurs. The communication chain from national/regional forecast to a local analysis and the initiation of an alert is complex, with many steps involved, many tools that may be used, and several institutions and authorities that are included in the process. This can lead to complications and confusion, which in turn raises questions about the effectiveness of the process. What happens on the local level after NVE sends out a regional warning? Do the local institutions understand this warning? Which are the most important steps to follow after a regional warning is sent? Which tools are available? Are regional warnings enough to make decisions at local levels, or should local monitoring and warning systems be implemented? If yes, where? How many? Should local systems be organized independently or should they be incorporated in a national system?

The aim of this study is to bridge the gap between national and local warning systems by creating procedures and tools to be used by users during an emergency, and by creating a better synergy between participants/stakeholders. The procedures will be tested first in a selected sector, Vaksdal (Bergen – Voss) in western Norway, where both road and railway are frequently exposed to floods, debris flows and debris avalanches. We will analyze the landslide history and the warning history of the selected sector, as well as existing mapping tools (e.g., hazard maps, risk maps, maps of critical sites), and the monitoring history. We will evaluate the performance of the system by comparing the regional warnings sent and the local emergency responses over the period 2011-2018. Our goal is to determine whether today′s warning system is good enough, or if the sector needs more local surveillance or even a separate local warning system is necessary, depending on the frequency and magnitude of landslide events.