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Supporting disaster risk reduction with satellite Earth Observation: Landslide hazard assessment for the Chin road corridor, Myanmar

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EO4SD (Earth Observation for Sustainable Development) initiative of the European Space Agency aims at facilitating the uptake and integration of satellite information products and services into development activities of international financial institutions and their partners in targeted countries. Its disaster risk reduction (DRR) cluster plays a crucial role when it comes to impacts of natural hazards on societies.

We present a recent service established within the EO4SD-DRR cluster, which aimed at providing evidence-based support to the design of reconstruction works on the road corridor in mountainous and landslide prone terrain between towns of Kalay and Hakha in Chin state, Myanmar. The whole service is constituted by an ensemble of analytical products and comprises four major components: (1) establishment of a landslide inventory, (2) derivation of landslide susceptibility, (3) slope instability analysis, and (4) overall landslide exposure assessment.

First, a landslide inventory of historic landslide events was derived from optical satellite imagery. Second, by linking the landslide inventory with geomorphological features derived from a digital elevation model as well as geological and land cover data, a comprehensive landslide susceptibility map was derived. This was accomplished by employing robust machine learning ensemble methods, inherently tackling the problem of class imbalance, and yielding not only the estimated susceptibility, but also its corresponding uncertainty. Third, a slope instability assessment was obtained via multi-temporal InSAR. Interferometric analysis provided estimates of terrain displacement velocities from Sentinel-1 data from ascending and descending trajectories and by leveraging both persistent scatterer and the small baselines methods. As the atmospheric phase screen could not be reliably estimated the area of interest had to be split into several sub-areas processed independently. Due to large amount of points with non-linear displacements and varying noise levels, InSAR measurement points were filtered using both coherence threshold and features representing length of reliable period derived by segmentation of displacement time series. Displacement velocities were converted from satellite line-of-sight to direction of maximum slope gradient and point attributes were supplemented with metadata indicating detected points' reliability based on combination of coherence and directional sensitivity. Finally, exposure of road segments to landslide hazard represented by susceptibility and estimated slope instabilities was

quantified and presented in dedicated web application to allow intuitive identification of hazard hot-spots.

Despite several methodological challenges products demonstrate robustness and utility of Earth Observation technology to address landslide hazard screening and to support targeting and protecting investments into landslide mitigation measures along the road corridor.