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Landslide Early Warning System based on Machine learning and radar data

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In the area of Casamicciola, on the island of Ischia, in the Gulf of Naples, on November 26, 2022, heavy rain triggered landslides that killed people and caused great damage to buildings and roads. Rain gauges on the island recorded heavy rainfall starting at midnight on November 25. The 6-hour cumulative rainfall (between 00:00 on 25/11 and 06:00 on 26/11) resulted 126 mm. The peak hourly rainfall at the two nearest rain gauges was 51.6 mm in Forio and 50.4 mm in Monte Epomeo, attained just before the triggering of the major landslide. The attainment of critical rainfall depth was so sudden, that rain gauges recordings did not allow deploying timely risk mitigation measures. In this context, an effective Landslide Early Warning System (LEWS), based not only on rain gauges, would be an important tool to mitigate the impact of landslides. The goal of a LEWS is to provide timely information to individuals and organizations, so that they can take appropriate actions to reduce the risk. These systems typically use a combination of monitoring networks and modeling techniques, to issue real-time warnings when the probability of a landslide becomes high. A well-designed LEWS can save lives, reduce property damage, and minimize the economic impact of the events.

In this paper, a novel approach to LEWS, based on machine learning and radar data, is proposed. Specifically, a random forest model is trained to define pre-alarm thresholds based on radar measurements available on the portal MISTRAL (Mistral portal Meteo Italian SupercompuTing poRtAL), and on rainfall measurements from four rain gauges on the island of Ischia. Two concentric monitoring areas around the island of Ischia are divided into 16 sectors, and the model evaluates every five minutes the percentage of nodes in each sector where the rainfall height detected by the radar exceeds assigned thresholds, corresponding to pre-alarm stages. Preliminary results show the prospects of using machine learning in LEWS.