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Understanding slope behavior through microseismic monitoring

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It is well known that microseismic activity originates as an elastic stress wave at locations where the material is mechanically unstable. Monitoring techniques focusing on this phenomenon have been studied for over seventy years and are now employed in a wide range of applications. As far as the study of unstable slope is concerned, microseismic monitoring can provide real-time information about fracture formation, propagation and coalescence and may be an appropriate solution to reduce the risk for human settlements when structural mitigation interventions (e.g., rock fall nets and ditches) cannot cope with large rock volumes and high kinetic energies. In this work we present the datasets collected in a 4-year period with a microseismic monitoring network deployed on an unstable rock face in Northern Italy. We mainly focus on the classification and the interpretation of collected signals with the final aim of identifying microseismic events related to the kinematic and dynamic behavior of the slope. We have analyzed signal parameters both in time and frequency domains, spectrograms, polarization of 3-component recordings supported by principal component analysis. Clustering methodologies have been tested in order to develop an automatic classification routine capable to isolate a cluster with most of the events related to slope behavior and to discard all disturbances. The network features both geophones and meteorological sensors so that we could also explore the correlation between microseismic events and meteorological datasets, although no significant relationships emerged. On the contrary, it was found that the majority of the events collected by the network are short-time high-frequency signals generated by electromagnetic activity caused by near and far thunderstorms. Finally, we attempted a preliminary localization of the most promising events according to an over-simplified homogeneous velocity model to get a rough indication about the regions of the monitored area that could be prone to collapse.