Summary

During the last decades, the world's population witnessed an exponential intensification of Natural Hazards, such as floods, droughts, fires, and landslides, affecting urban and natural areas. Most of these phenomena have been attributed by the scientific community to the effects of climate change and the lack of environmental planning and management. In planning for natural risk reduction and prevention, monitoring the most vulnerable areas has become crucial for policymakers. Mainly, high-resolution analysis plays a pivotal role in forecasting natural hazards and in understanding resilience-related processes. Nevertheless, monitoring activities can be resources consuming and limited by extreme conditions. This is particularly true in those areas of the world characterized by a lack of infrastructures, peculiar land morphology, extreme climate conditions, and large-scale homogeneous land cover. In these critical areas, emerging technologies can be a powerful tool to monitor the processes taking place in areas affected – and potentially affected – by natural hazards and detecting Land Cover (LC). This research aims to propose a methodology for the multi-spatial, multi-temporal, and multi-thematic analysis of LC in the spotlight of natural hazards, providing a very high-resolution land cover atlas of the areas of the world that are considered critical for the reasons mentioned above.

The atlas has a new level of detail to ensure meaningful information to data users. The maps are built upon the data collected through emerging technologies and analyzed through machine learning algorithms. The methodology is tested for two natural hazards: floods and rockfalls. The areas selected for the testing are Tillabery in the sub-Saharan region of Niger and the subalpine regions of Alpine Arch. Specifically, six land cover maps were created following the same LC classification methodology. The classes of LC were identified according to the users' needs. The analyzed optical data sources used for LC generation are multispectral optical sensors embedded in fix-wing Unmanned Aerial Vehicles (UAVs) and satellite optical imagery (Sentinel-2 mission). The entire methodology was checked in its replicability and went through several optimization processes to reduce computational time and power. Part of the analysis is realized on the Google Earth Engine platform and uses low-cost instruments ad hoc build (Raspberry Pi devices). The accuracies achieved by the methodology ranges between 0.7 and 0.9. Such results prove the effectiveness of the method, regardless of the type of environment analyzed.