EGU22-4787
https://doi.org/10.5194/egusphere-egu22-4787
EGU General Assembly 2022

Automated detection of gravitational instabilities by combining seismology, satellite data and machine learning - example over the European Alps.

Charlotte Groult, Clément Hibert, and Jean-Philippe Malet
Ecole et Observatoire des Sciences de la Terre / Institut Terre et Environnement de Strasbourg - , CNRS, EOST, 5 rue Descartes, F-67084 Strasbourg

Recent large landslides in many parts of the World (Nuugaatsiaq, Greenland; Taan-Tyndall, US; Culluchaca, Peru) as well as the increase in the frequency of gravitational instability in the European Alps (e.g. collapse of the Drus, Mont Blanc Massif, France) revealed the threat of such events to human activity. Seismology provides continuous recordings of landslides activity on long distances. High frequency time series of satellite imagery (Copernicus Mission Sentinel) provides relevant complementary information to locate, identify the type of gravitational instability and gather information on the volume of the event. The objective of this work is to present a new method to automatically construct instrumental landslide catalogs by combining seismological and satellite observations using machine learning approaches. This new type of landslide catalog will provide an unprecedented spatio-temporal resolution over a long time period allowing to explore possible correlations between landslide activity and forcing (meteorological, climatic, tectonic) factors.

The detection method applied to the seismological observations consists of computing the energy of the signal between 2 and 10 Hz on which a STA/LTA method is applied. Detections are refined by applying the Kurtosis picking method. Detections which are too close (< 2 min) are combined. For the processing of continuous seismic data, detections are considered as an event if at least 2 stations recorded them at the same time. Then, a supervised Random Forest classifier is used to identify the source of the event (earthquakes or landslides). The landslide database, used to train the Random Forest classifier, consists of 68 events that occured in the last 20 years over the entire European Alps. A database of 7914 earthquakes (of MLv > 0.1) that occured in 2020 has also been compiled in order to train the classifier in order to discriminate landslides and earthquakes. Thus, a dataset of 2502 seismological traces of landslides and 39540 traces of earthquakes is used to train and test the seismological detection and identification methods. First tests of our processing chain gave us a rate of good identification of around 80% for landslides and 99% for earthquakes.

The model is then applied to the archive of seismological observations (e.g. 1800 stations in 2021) acquired over the European Alps since 2000. To avoid having too many noise detections, we chose to keep an event in the new landslide catalog only if it is detected and classified as a landslide by at least two stations in a time window of 4 minutes. The derived instrumental catalog will be

presented, and the sensitivity of the method will be discussed.