Geophysical Research Abstracts
Vol. 13, EGU2011-9389, 2011
EGU General Assembly 2011

Maximum Entropy Macroscale Prediction of the Occurrence and Size of Landslides Driven by Climate Change Rainfall Variation

Matteo Convertino (1), Filippo Catani (2), and Alberto Troccoli (3)

(1) ABE Dept.-IFAS University of Florida, USA, (2) University of Firenze, Earth Sciences Dept., Firenze, Italy (filippo.catani@unifi.it, +39 055 2756223), (3) Weather & Energy Research Unit - CSIRO Marine and Atmospheric Research, Canberra, AU

Landslides are one of the major geohazards for human populations as well as one of the most important and rapid geomorphic elements shaping landscapes. The study focus on a preliminary general probabilistic tool that allow the prediction of landslide occurrence and size, conditioned to the knowledge of previous events' locations, geomorphological and climatological controlling features. The purpose is also to investigate at the macroscale the effect of climate change on riverine ecosystems. The method is based on the maximum entropy principle constrained by the environmental variables. The key variables for describing the historical patterns of landslides in the test basin of the Arno river (Tuscany, Italy) were identified in order to perform landslide forecasts. Landscape categorical features, fluvial geomorphological features and climatological features were considered. Landslides have been observed closer to streams of Strahler order 2 and 3 and for values of the slope in the range (0.1;0.3). The probability of landslide occurrence is higher for small-medium elevation, small hillslope to channel distance, small-high diameter, and high rescaled distance. The hillslope to channel distance (hcd) was considered as a measure of the drainage density. Empirical relationships were found between hcd and the erodibility, vegetation cover, and the landslide susceptibility.

The calibration by comparison with the historical landslide pattern has been performed calculating the geomorphological variables for three different networks extracted with three different criteria (area-threshold, slope-area threshold, slope-area threshold only on the concave cells). The landslides appeared more frequently for medium vegetated land cover and for medium erodibility areas. The slope, the elevation, the hillslope to channel distance, the rainfall of 12 and 48 hours with return time of 10 years are the only explanatory variables retained after calibration to forecast landslide events in time. The probability of a landslide is high for low value of the 12 h rainfall, and high for high value of the 48 h rainfall. The predictions of landslide location and size were performed from the year 2010 to 2100. Probability maps of landslide susceptibility were produced every year and landslides were identified as patches that are ensembles of sites with triggering probability greater than 0.6. We matched the historical patterns of landslides and the predicted patterns calculated via an Artificial Neural Network. The variation in slope of the powerlaw exceedence probability of the landslide size has been considered as indicator of climate change variation. The assumption is the stationarity of the main fluvial network of the Arno basin. Monthly rainfall predictions are downscaled to 500 m from the 0.5 deg lat/long resolution of the downscaled GFDL-CM 2.1 WCRP CMIP3 dataset A1B scenario, and averaged to the year scale. First results show that in the period 2010-2100 the position of the occurrences of landslides is not going to vary considerably. However meaningful variations in the landslide size is observed. Dry years show a smaller probability of large landslides and a higher probability of small landslides than in wet years. The slope of the probability of exceedence of the landslide size is assumed as a meaningful indicator of climate change. Future comparisons will consider other WCRP CMIP3 models and scenarios. We underline the importance of the study for landscape management plans in order to reduce the human-risk from landsliding.