Bioclimatic changes and landslide recurrence in the mountainous region of Rio de Janeiro: are we ready to face the next landslide disaster?

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Paleo-environmental studies point out an alternation of wet and dry periods during the Holocene in southeastern Brazil, marked by the expansion and retraction of the humid tropical rainforest in alternation with the campos de altitude vegetation ('high altitude grassland'); successive episodes of natural fire were recorded from 10,000 to 4,000 years BP in the mountainous region of SE-Brazil, reflecting warm-dry conditions. Present seasonal climatic variability is indicated by an increasing dry spell frequency throughout the XX and early XXI centuries together with an increasing rainfall concentration in the summer when extreme daily totals (above 100 mm) become progressively more frequent. Historical land use changes, at both regional and local scales, are mostly related to this climatic variability. Therefore extreme rainfall induced landslides have been responsible for severe disasters as recorded along the Atlantic slopes of Serra do Mar. The extreme one occurred in January 2011, affecting the municipalities of Nova Friburgo, Teresópolis and Petrópolis. Studies in Nova Friburgo shown the occurrence of 3.622 landslides scars within an area of 421 km^2; this rainfall event reached the expected average monthly rainfall (300 mm) in less than 10 hours. The D'Antas creek basin (53 km^2) was the most affected area by landslides; 86% of 326 scars where associated with shallow translational mechanisms among which 67% occurred within shallow concave up topographic hollows of 32º slope angle in average. Most of these landslide scars occurred in granite rocks and degraded vegetation due to historical land use changes (last 200 years) including secondary forest (64%) and grasslands (25%). The present-day association between extreme rainfall induced landslides and human induced vegetation changes seem to reflect similar geomorphic responses to natural Holocene bioclimatic changes; a common phenomenon between the two periods is fire (natural fire in the past time and man-induced fire nowadays). Despite all field evidences on the relevance of landslides on hillslope evolution in the mountainous domain, local communities at risk and governmental institutions are not yet ready to face the next extreme rain event. Since November 2014 a new governance and risk management model has been developed in the Córrego D'Antas basin, through a multi-institutional network integrating local communities, university and governmental institutions as will be presented in this paper.