Geophysical Research Abstracts
Vol. 12, EGU2010-14226, 2010
EGU General Assembly 2010

Biologically-defined extremes: survival and ecosystem shifts under climate change

Amilcare Porporato, Stefano Manzoni, Annalisa Molini, James R. Rigby, and Giulia Vico
Duke University, Civil and Environmental Engineering, Durham, United States (amilcare@duke.edu)

Extreme events causing damage or mortality in ecosystems may either be the result of a single (possibly multivariate) external event or of the integration of several factors each of them not necessarily extreme. Traditional approaches in engineering and geosciences have focused on the first type of causes, and described them using the classical extreme value theory. The second type of causes becomes important in systems with increasing complexity and diversity (or redundancy), especially when undergoing progressive changes in external forcing, such as those related to climate change. Thus risk analyses in managed and natural ecosystems should increasingly consider also these more complex, biologically-defined extreme events. We propose a description of a theoretical framework to analyze such extreme events, which is based on the crossing properties of stochastic processes, renewal theory and reliability analysis. We discuss several examples (spring frost risk to vegetation, effects of shifts in seasonal behavior of precipitation and temperature on early snowmelt, growing season changes in Mediterranean ecosystems and flood formation, fire events and tree mortality by drought) stressing the common dynamic underlying their occurrence.