Geophysical Research Abstracts
Vol. 15, EGU2013-5959, 2013
EGU General Assembly 2013

A rill erosion-vegetation modeling approach for the evaluation of slope reclamation success in water-limited environments

Mariano Moreno de las Heras (1), Ruben Diaz Sierra (2), Jose M. Nicolau (3), and Miguel A. Zavala (1)

(1) Department of Life Sciences (Area of Ecology), Faculty of Sciences, Alcalá University, Alcalá de Henares (Madrid), Spain, (2) Mathematical and Fluid Physics Department, Faculty of Sciences, UNED, Madrid, Spain, (3) Department of Agricultural and Natural Sciences, Technical School of Huesca, Zaragoza University, Huesca, Spain

Slope reclamation from surface mining and road construction usually shows important constraints in water-limited environments. Soil erosion is perceived as a critical process, especially when rill formation occurs, as rills can condition the spatial distribution and availability of soil moisture for plant growth, hence affecting vegetation development. On the other hand, encouraging early vegetation establishment is essential to reduce the risk of degradation in these man-made systems. This work describes a modeling approach focused on stability analysis of water-limited reclaimed slopes, where interactive relationships between rill erosion and vegetation regulate ecosystem stability. Our framework reproduces two main groups of trends along the temporal evolution of reclaimed slopes: successful trends, characterized by widespread vegetation development and the effective control of rill erosion processes; and gullying trends, characterized by the progressive loss of vegetation and a sharp logistic increase in erosion rates. Furthermore, this analytical approach allows the determination of threshold values for both vegetation cover and rill erosion that drive the system's stability, facilitating the identification of critical situations that require specific human intervention (e.g. revegetation or, in very problematic cases, revegetation combined with rill network destruction) to ensure the long-term sustainability of the restored ecosystem. We apply our threshold analysis framework in Mediterranean-dry reclaimed slopes derived form surface coal mining (the Teruel coalfield in central-east Spain), obtaining a good field-based performance. Therefore, we believe that this model is a valuable contribution for the management of water-limited reclaimed systems, as it can play an important role in decision-making during ecosystem restoration and provides a tool for the assessment of restoration success in severely disturbed landscapes.