

Remote sensing signals of erosion and plant diversity in the Kazbegi national park region (Greater Caucasus, Georgia)

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Abstract

In the Greater Caucasus alpine grasslands have been used as pastures and meadows for centuries. An increasing demand for pasture land has supported clear-cuts and gradually lowered the tree line (NAKHUTSRISHVILI et al. 2006). In the subalpine zone most forests were replaced by agricultural ecosystems. Over the centuries the grazing management created heterogeneous landscapes with high plant diversity. During Soviet period intensive sheep husbandry had a long lasting effect to some sensitive mountain areas. High grazing intensity damaged the vegetation cover and its root soil system. On steep slopes the overgrazing had strong negative impacts on soil stability (DIDEBULIDZE & PLACHTER 2002). Today's vast erosion gullies originate from smaller damage spots during that period (KÖRNER 1980).

As a former country of the Soviet Union, Georgia has experienced an immense transformation since the restoration of national independence in 1991 (DIDEBULIDZE & URUSHADZE 2009). Structural and societal changes have resulted in a transformation of the agricultural system and Georgian land use (VOLZ et al. 2011). Since 1991 the loss of cheap energy supply from the Soviet Union is substituted by illegal logging (FUCHS et al. 2010). Clearance of protective forests increases the risk of mass wasting events. Climate change has an increasing effect on temperature and precipitation in Georgian mountain ecosystems (FAO 2009). Heavy rainfall events and snow melting in large gully erosions in the Kazbegi area (CAPREZ et al. 2011). These facts indicate continuation of erosion processes.

The Caucasus is among our planet's biologically most diverse and endangered ecoregions (MYERS et al. 2000). In the Greater Caucasus land degradation is considered as one of the main threats to plant diversity (NAKHUTSRISHVILI et al. 2009). Species loss is most evident at erosion edges with only about four species (CAPREZ et al. 2011), whereas up to 47 plant species per 25 square metre may occur in nearby grasslands (NAKHUTSRISHVILI et al. 2006). National and international policy and scientists have set up plans to protect the region's biodiversity (CEPF 2004, NBSAP 2005, SPEHN et al. 2010). Within this process, a red list assessment stated 60 % of the 2,950 Caucasian endemic taxa as being threatened (SCHATZ et al. 2009).

Mt. Kazbek (5043 m/16,541 ft.) is situated in the northern part of the Greater Caucasus, close to the Russian border. Kazbegi national park ranges from 1,400m up to 4,100m a.s.l. (Agency of protected areas 2013). Within the Kazbegi region some villages are highly exposed to the risk of eroded slopes. Our area of interest is located on the north facing slopes next to Mleta. This village has already experienced severe events of land degradation. Sample plots are located within a 10km² area which is composed of a homogenous geological layer of slate.

This study investigates the impact of erosion events on plant diversity in the Greater Caucasus with the use of remote sensing techniques. Remote sensing methods provide suitable techniques for inaccessible mountainous terrain. We aim to test relationships between plant diversity, nutrient availability, vegetation cover and canopy reflectance. Canopy reflectance can be used to determine floristic gradients in grasslands (SCHMIDTLEIN & SASSIN 2004).

In summer 2012, 50 plots were sampled with a handheld field spectrometer. Data was collected along gradients of land degradation and inclination. With a subset of three subplots we were able to define inner plot variation. Hyperspectral data will be related to vegetation data. The results can be of use for an early detection of erosion events via hyperspectral remote sensing. Soil samples were collected for further chemical analyses.

In summer 2013, more vegetation data will be collected from different stages of land degradation. Field data will be related to multispectral data of satellite images. Analyses to map fields of different plant diversity follow work done by FEILHAUER & SCHMIDTLEIN (2009).

Former Soviet Union countries like Georgia or eastern European countries have experienced tremendous transformations. To protect natural dynamic functions and diversity, research between environmental and

societal processes is necessary (WALDHARDT et al. 2011). In 2010 the interdisciplinary research project AMIES (Analysing Multiple Interrelationships between Environmental and Societal Processes in Mountainous Regions in Georgia) started at the University of Giessen. That project is studying the interrelationships between changes in land use, life quality, climate, erosion and biodiversity for the Kazbegi region. Further information available on <http://www.amies-net.org>

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