Geophysical Research Abstracts
Vol. 13, EGU2011-8607-1, 2011
EGU General Assembly 2011

Optical and radar remote sensing for quantitative analysis of landslide activity in Southern Kyrgyzstan, Central Asia

Sigrid Roessner (1), Mahdi Motagh (1), Robert Behling (1), Kanayim Teshebaeva (2), Hans-Ulrich Wetzel (1), and Hermann Kaufmann (1)

(1) GFZ German Research Centre for Geosciences, Section 1.4 - Remote Sensing, Potsdam, Germany (roessner@gfz-potsdam.de), (2) CAIAG Central Asian Institue for Applied Geosciences, Bishkek, Kyrgyzstan

Southern Kyrgyzstan represents an area of active tectonics and pronounced topographic relief where high landslide activity is a widespread phenomenon and one of the biggest natural hazards to the population. The mountainous landscape of this region, formed tectonically as a result of the collision between Indian sub-continent and southern Eurasia, provides great volumes of weakly consolidated sediments favoring frequent occurrence of mass movements, ranging from episodic large to subtle landslides. Since in this area human living space is scarce, local authorities responsible for disaster management and risk reduction have a big need for objective and spatially differentiated hazard assessment as an important prerequisite for efficient and sensible decision making related to precaution and mitigation.

The presented research is part of the Potsdam Research Cluster for Georisk Analysis, Environmental Change and Sustainability (PROGRESS) and investigates the potential of optical and radar remote sensing for gaining an improved process understanding at different temporal and spatial scales in an area of high landslide activity along the Eastern rim of the Fergana Basin in Southern Kyrgyzstan. Optical remote sensing is used to establish a landslide inventory for the last 25 years of landslide occurrence and derive quantitative characteristics of past events within an area of approx. 100 by 80 km. This inventory is based on the available optical mid- and high-resolution satellite remote sensing data obtained by Landsat-(E)TM, SPOT, IRS-C, ASTER, RapidEye and ALOS AVNIR sensors. The existing data coverage allows assessment of landslide activity at a regional scale with at least annual temporal resolution starting from the years of 1996/1998 including the opportunity to analyze seasonal variations in landslide activity. The high amount of data and the large size of the area affected by landslides require the development of automated methods for change detection which are capable of incorporating data from various sensors and integrating additional spatial knowledge about factors predisposing landslides using GIS techniques. The resulting spatio-temporal inventory of landslide events will contribute to a better quantitative understanding of landslide activity at a regional scale and form the starting point for its future regular monitoring which can be facilitated among others by the already operating RapidEye as well as the future Sentinel-2 satellite missions.

Additionally, the capability of SAR interferometry for quantitative monitoring of slope movements is investigated. For this purpose the potential of X-band (TerraSAR-X) and L-band (ALOS PALSAR) data is evaluated. First analysis has shown that the fringe visibility of the 11-day TerraSAR-X (TSX) interferograms is good which demonstrates the capability of these high-quality radar data for systematic monitoring of slope movements in Southern Kyrgyzstan. In a number of cases it has been possible to detect locations of previously unknown landslide activity in the region. Although coherence of TSX interferograms is generally good enough for short-term summer interferograms, it degrades quickly in the winter season even for images separated by a single repeat cycle of TerraSAR-X satellite (11 days), presumably because of continuous snow cover. In contrast to short wavelength X-band interferograms, longer wavelength investigations using L-band ALOS PALSAR data in the same area have shown that interferograms maintain good coherence over longer time intervals of observations. In our future work we will exploit more synergies between X-band and L-band interferometry and perform multi-temporal advanced InSAR analysis (SBAS and PS techniques) in order to assess the potential of these techniques for regular monitoring of slope movements over large areas in Southern Kyrgyzstan.