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Landslide detection from remote sensing images using statistical and ANN classification methods

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All landslide studies (susceptibility analyses, risk assessments) are based on accurate databases of existing landslides. However, such extended landslide databases are not always available, especially for remote areas with low population density. This study aims at developing an automated procedure for the detection of landslides and landslide-changes from high-resolution multi-spectral remote sensing images. A set of 2 SPOT (dating of 2003 and 2004) and 3 ASTER images (dating of 2001, 2002, 2004) covering the Gultcha area in Southern Kyrgyzstan, are used as input images. The main objectives are the automatic detection of the (1) landslide areas based on uni-temporal images using supervised classification techniques (2) changes of surface using multi-temporal images.

According to the type of landslide, the parameters for detecting the slope instabilities will differ. Spectral information (presence/absence of vegetation, clayey material, water content) is especially important for detecting mud-, earth- and debris-flows. Textural information (representing the grey level intensity variation in the spatial domain) determines the overall visual smoothness and roughness of the surface and can be used for the detection of the rock-type landslides. Moreover, the stereoscopic pairs of ASTER images (bands 3N and 3B) allow to create Digital Elevation Models, and thus to derive geomorphologic parameters (slope, aspect).

The several parameters are incorporated in the classification algorithm. In this study, we use a supervised maximum likelihood classification method, which shows positive preliminary results. It should be noted that this method implies some restrictive assumptions concerning the distribution functions which are not always met; in order to evaluate the accuracy and applicability of the method, the results will be compared with ANN classification.

A histogram-based thresholding allows us to segment the output image (with values comprised between 0 and 1) into landslide and non-landslide areas. Additional filtering using mathematical morphology and shape properties are tested. Validation of the results is done by comparison with manually defined landslides, and will allow us to determine the best method and the best input parameters.