Assessing the potential of Landsat images to detect and map agricultural land abandonment in Kyzyl-Orda (Kazakhstan)

Elisabeth Fliemann, Fabian Löw, and Christopher Conrad

Department of Remote Sensing, University of Würzburg, Germany, fabian.loew@uni-wuerzburg.de

Land degradation and agricultural land abandonment in the irrigated areas of Central Asia became widespread, in particular after the collapse of the former Soviet Union. It has strong socio-economic and ecological consequences, but unfortunately data and methods to map and monitor abandoned agriculture accurately over many regions in CA, e.g. Kyzyl-Orda in Kazakhstan, are still lacking. Remote sensing (RS) can potentially fill this gap, yet RS detection of agricultural land abandonment, most often characterized by shrub encroachment, is difficult and requires the availability of multiple images during the growing season. Also, sufficient reference data must be available for accurate classifier algorithm training. Hence the major aims of this study were to elaborate the effect of the number of Landsat-5 TM images on the accuracy of classification of land abandonment, and further how the choice of classifier algorithm (Random Forest and Support Vector Machine) and amount of training data affect the accuracy of the results. Multi-seasonal time series of Landsat-5 TM images were classified in pre-abandonment-time (1988) and post-abandonment-times (2000, 2009, 2010, 2011). Five images per year were used as classification input. Generally both algorithms performed equally well, and classification accuracies ranged from 84% to 91%. Classifications with fewer than five image dates resulted in a substantial decreases of overall classification accuracies (from 91% to 66%). Next to the number of images the seasons captured also had an impact. In general, the best image combination contained at least one image in late summer, plus another image in spring. In general, the choice of images (number and season) had a much stronger impact on the results than the choice of the classifier algorithm. The five multi-annual classifications resulted in a temporal sequence of five land uses for each agricultural field, which allowed to back-trace land use change between 1988 and 2011. Land abandonment was found on almost 20% of the fields investigated in Kyzyl-Orda. It was shown that RS can be used to analyse the spatio-temporal pattern of agricultural land abandonment in Kyzl-Orda and to support decisions on mitigating cropland degradation. However, the results also demonstrated that limited image date and reference data availability can seriously impact the accuracy of agricultural land abandonment detection.