

Climate change and water management problems in Central Asia: Analysing the phenology of croplands and wetlands in the Amu Darya Delta using MODIS data

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Water is a critical issue in Central Asia not only because of the very dry climate in the inner Aral Sea Basin but also because of the international upstream-downstream conflicts after the break-up of the former Soviet Union, and increasing water demands of Afghanistan after the long war period. The Pamir and Tien Shan mountains contribute most of water to the Aral Sea Basin, in particular to 8 Mio hectar of irrigated land. In recent years, the warming of the atmosphere accelerates the melting of the glaciers in the upstream regions. Despite the sufficient water availability, water especially from the Amu Darya River hardly arrives to the Aral Sea (Roll et al. 2006). It is well known, that a combination of both, water management problems and climate change, will lead to severe problems, especially in the downstream regions of the Amu Darya River (Perelet, 2008).

The aim of this study is to analyse intra-annual and inter-annual variations in phenology in the Amu Darya Delta. The effects of water availability of the Amu Darya River on irrigated agro-ecosystems and the severely drought affected wetlands close to the former shore line of the Aral Sea are investigated.

Time series of MODIS land surface reflectances (MOD09 product, collection five) with a spatial resolution of 250m were analyzed between 2000 and 2008. Using the Time Series Generator (TiSeG, Colditz et al 2008) software the data quality during time series generation was analysed and meaningful time series were generated. Mean values of NDVI metrics contributed relative benchmarks to assess intra-annual variability of both types of ecosystems (Klein and Roehrig 2006). Multi-annual classifications of agrarian land use in the irrigation systems of Khorezm (Southern part of the Amu Darya Delta, Conrad et al. 2007), and GIS information on the extensive irrigation canal system and the wetlands served for delineation of the study areas. The results are analysed in respect to water availability, expressed by 10day water releases from the Tuyamuyun reservoir south of the Amu Darya Delta (available by the scientific information system of the Interstate Commission on Water Coordination in Central Asia, SIC-ICWC 2009). Precipitation during the winter season is also included in the analysis. The results clearly show weak responses of the NDVI to water availability in the irrigation systems between the years. But the wetlands significantly reacted to annual and seasonal variations in water availability.

In principle, water availability is related to the inter-annual variability of the climate. However, nine years of MODIS data were found insufficient to distinguish between climate change and inter-annual variability. Water management has the highest impact on phenology especially in fully irrigated systems such as the southern Amu Darya Delta. But taking into account, that the current high water availability in that region is caused by melting glaciers, the situation found in the wetlands clearly indicate that water use in the irrigation systems of the Amu Darya has reached its limits.

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