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Comparative analysis and validation of remotely sensed estimation of actual evapotranspiration in cotton ecosystems of Middle Asia

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Detailed knowledge of land surface fluxes, especially latent and sensible components, is important for monitoring the climate and land surface, and for agriculture applications such as irrigation scheduling and water management. Accurate estimation of evapotranspiration (ET) plays an important role in quantification of the water balance at the watershed, basin, and regional scale for better planning and managing water resources. The growing interest in quantifying regional actual ET for water resource and irrigation management led to the development of numerous methods to estimate ET from remote sensing data. The objective of this study was to compare the performance of the established surface energy balance algorithm for land (SEBAL) approach for estimating the energy balance using input data with different temporal and spatial resolution (Landsat/MODIS). Input data to the model are basically surface reflectance, land use classification and meteorological data of the years 2009 and 2010. The study is primarily concerned with the irrigation farming of cotton ecosystems in Middle Asia, in particular with the situation within Khorezm Oblast in Uzbekistan. Regional problems of Khorezm Oblast are e.g. high groundwater levels, soil salinity, and non sustainable use of land and water. Cotton is the major crop in Khorezm region. About 46% of the agricultural area was covered with cotton in 2009 and 2010, among the other main crops winter wheat (30%) and rice (5%). Due to the low level of precipitation (<100 mm p.a.) irrigation is the only available water source for the crops. The water for irrigation is taken from the Amu Darya River and then canalled to the agricultural fields. The available water in Khorezm depends on the water demand in the upstream regions. Because of this variation and the historical annual shortage of available irrigation water a sustainable use of water is highly important for the regional water management in Khorezm. Input parameters and estimations of the surface energy fluxes are calibrated and validated with ground measurements of an eddy-covariance (EC) flux station and four agro-meteorological stations. To identify the relevant pixel of the remote sensing dataset the source area of the energy fluxes is computed and used for validation. First results show that the MODIS based SEBAL approach leads to good estimations of the seasonal behavior of actual ET in the study area. However, validation of the results with the EC flux station indicates that the more reliable regional instantaneous ET estimations are performed with higher resolution input data. On the contrary, the temporal resolution of the available Landsat data, especially during the main irrigation periods, is insufficient for calculating reliable seasonal catchment ET for Khorezm region.