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Potential of remote sensing derived soil moisture for the estimation of actual evapotranspiration in cotton ecosystems of Middle Asia

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Actual evapotranspiration (ETact) is an essential component of the water balance and its determination for larger areas is difficult on regional scale. Here, remote sensing provides a powerful tool to estimate regional actual evapotranspiration to support regional water management. Particularly, in irrigation agriculture of Middle Asia decision makers have to handle limited water availability and to improve the efficiency of their regional water management systems. 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 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. 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. Cotton is the major crop in Khorezm region. About 46% of the agricultural area was covered with cotton in 2010 and 2011, among the other main crops winter wheat (30%) and rice (5%). The objective of this study was to investigate the potential of satellite derived surface soil moisture for the optimization of the estimated ETact. Actual evapotranspiration in this study is indirectly derived by solving the surface energy balance equation using the surface energy balance algorithm for land (SEBAL). Due to its high temporal resolution MODIS (1km) data is used to provide the input information to solve the equation. The results were compared with measurements of an eddy covariance station. Previous validation studies in this region using the SEBAL approach showed good results in the estimation of sensible heat flux, but weak results for the flux of latent heat. SEBAL calculates the latent heat as the residual of all other energy balance components. Thus, the accuracy of all single components has an effect on the accuracy of the residual. Soil heat flux was identified to be the most uncertain component, because of its empirical calculation equation in SEBAL. The optimization of remotely sensed estimated soil heat flux should improve the accuracy of the SEBAL derived latent heat and therefore the actual evapotranspiration. One of the main driver of the heat flux into the soil is the surface soil moisture. A physical model has been developed to use microwave surface soil moisture together with regional soil information as input data for the determination of the soil heat flux. The results indicate an improvement of the estimation of the ground heat flux by using microwave surface soil moisture.