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Catchment scale estimation of evapotranspiration from remote sensing data based on an energy balance approach: A validation study for the Rur catchment, Germany

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Being a major component of the hydrological cycle, evapotranspiration (ET) and its spatial and temporal distribution are of major importance for hydrological and meteorological applications. Owing to its dependency on the amount and duration of incoming solar radiations and other meteorological parameters, changes in ET may occur on short time scales (less than an hour). Therefore, monitoring the temporal and spatial anomalies in evapotranspiration is very important. Conventional methods for ET estimation are restricted to local measurements, and hence unable to capture the spatial distribution of ET on heterogeneous surfaces. However, they are useful for validating ET derived from remote sensing data over large areas. To estimate evapotranspiration on a regional scale, two main approaches are available i) Application of a water balance approach to ground-based catchment-scale measurements and ii) Application of an energy balance approach to remote sensing data. The energy balance approach is based on the distribution of energy on the earth surface and the availability of the amount of latent heat to cause evapotranspiration (transpiration and evaporation) from plants and soil surface. Several approaches have been presented in literature but in this study we used a two source model (TSM) approach to calculate surface energy fluxes (e.g., latent heat, sensible heat and ground heat fluxes) for canopy and soil. The TSM assumes that soil and vegetation affect the microclimate within the soil-canopy system and therefore separate resistances are calculated for heat exchange from canopy and soil. In TSM net radiations are partitioned in to soil and canopy components (Rns, Rnc) and have been revised several times for improving shortwave and longwave radiation exchange between canopy and soil. TSM uses satellite derived directional radiometric surface temperature [TR(θ)] as composite of the soil and canopy temperatures (TS and TC respectively). In this study, evapotranspiration derived from remotely sensed (energy balance) methods are validated with in-situ measurements from Eddy Covariance (EC) installed at various test sites in the Rur catchment, Germany.