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Estimating Actual Evapotranspiration Using Basin Scale Landsat Images in a Semi-Arid Region of Turkey

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Evapotranspiration (ET) is the process by which water is transferred from the soil and other surfaces to the atmosphere by evaporation and from plants by transpiration. ET is the element of the hydrological cycle which directly determines the partition in available surface energy through surface heat fluxes. The ET is calculated using the latent heat energy which is the diffusive moisture flux from the Earth's surface to the atmosphere. Here, the generation of the map of most accurate latent heat flux is critical. The satellite-based energy balance for mapping evapotranspiration with internalized calibration (METRIC) model (Allen et al. 2007b) is used for this purpose. The METRIC model calculates ET through a series of computations that provide net surface radiation, soil heat flux and sensible heat flux to the air. By subtracting the soil heat flux and sensible heat flux from the net radiation at the surface (omitting other energy components), a residual energy flux that represents the energy consumed by evapotranspiration can be estimated. EC150 open path eddy covariance system was set up in a natural vegetated semi-dry basin located in the mid-south of Turkey. Meteorological data, including wind speed and air temperature were automatically recorded at the nearby meteorological station. The mean annual precipitation in the basin is 350 mm and the mean temperature is 11oC, where the summer temperatures reach to 30oC. The Landsat-8 cloud free images acquired in 2017 (7 images) and 2018 (6 images) are used in METRIC model. ET values obtained from eddy covariance are compared to the model simulated ET values. In literature, the eddy covariance generally underestimates ET by 10-30% in semi-arid regions, in this study for some of the dates this percentage gets larger due to the non-closure of energy budget by eddy covariance system. The maximum difference between LE measured by EC150 and LE calculated from energy budget is observed in the afternoon between hours 13:00 and 15:00. The difference between ET values obtained from METRIC model and eddy covariance is lower for the months of April to June where natural green vegetation is available in the basin. The RMSE of the observed and modelled instantaneous ET values is calculated as 0.08 mm/hr. The maximum difference between the observed and modelled instantaneous ET is observed for 26.August.2018 which was a windy and a dry day. For the same day the measured LE values show the maximum fluctuations. The effect of the wind and temperature difference between the air and the soil on the observed ET values is also discussed. No significant effect of distributed wind in the METRIC model is observed for this basin.

Keywords: Actual Evapotranspiration, Energy Balance, METRIC, Remote Sensing