Estimation of Regional Evapotranspiration by ASTER

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Estimation of spatial distribution of evapotranspiration (ET) by combining remote sensing data and a physically based surface flux model is applied over a heterogeneous area of Nagoya, Japan. Advanced Spaceborne Thermal Emission and Reflection Radiometer (ASTER) data are used with the local meteorological data to estimate regional evapotranspiration using radiometric surface temperature and fractional vegetation cover as main input parameters. Our goal is to estimate ET within an accuracy of 50 W/m^2.

Higher resolution remote sensing data such as ASTER potentially can distinguish between dominant land surface types, such as clusters of vegetation, bare soil, and water bodies, and thereby derive plausible values for surface properties, such as aerodynamic roughness. Data from ASTER sensor are particularly well suited to the task, as it collects high spatial resolution (15-90m) images in visible, near-infrared, and thermal infrared bands simultaneously. Data in these bands yield estimation of surface temperature, vegetation cover density, and land-use types, which are all critical inputs to surface energy balance models for estimating evapotranspiration. ASTER is currently the only satellite sensor collecting high resolution multispectral thermal infrared images that allows for a more accurate determination of the variable spectral emissivity of the land surface and, hence, a more accurate determination of thye land surface temperature. Moreover, high spatial resolution of ASTER data allows direct comparisons against ground measurements and facilities detection of modeling limitations.

In this study a well-known two-source energy balance (TSEB) model, developed by Norman et al (1995) and modified by Kustas and Norman (1999), is used in combination with the ASTER data for the instantaneous estimate of ET over a heterogeneous area of Nagoya, Japan. Remote sensing data as well as meteorological data from 2003, 2004 and 2005 are used for different periods of time in TSEB model for estimating instantaneous ET. Radiometric surface temperature observations from ASTER are used in TSEB for predicting component latent heat fluxes from soil and vegetation, which are combined to get the total latent heat flux from the mixed area. Finally evapotranspiration is estimated by calculating the ratio of latent heat flux and latent heat of vaporization.

The estimated results are compared with ground observation data measured form flux tower of Seto Flux Tower site within the study area for validation. We concluded that the TSEB model successfully gives the ET estimation within the accuracy of 50 W/m^2.