Sub-pixel analysis to enhance the accuracy of evapotranspiration determined using MODIS images

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Abstract: A study was carried out to estimate the actual evapotranspiration (ET) over a 1074 km^2 of the humid area of Perak State (Malaysia), where water and evaporation cycle deeply influences the climate, natural resources and human living aspects. Images from both Terra and Aqua platforms of the Moderate Resolution Imaging Spectroradiometer (MODIS) sensor were used for ET estimation by employing the Surface Energy Balance Algorithm for Land (SEBAL) model. As a part of the accuracy assessment process, in-situ measurements on soil temperature and reference ET (ET_0) were recorded at the time of satellite overpass. In order to enhance the accuracy of the generated ET maps, MODIS images were subjected to sub-pixel analysis by assigning weights for different land surface cover (urban, agriculture and multi-surface areas) reflections. The weighting process was achieved by integrating ET from pure pixels with the respective site-specific ET_0 of each land cover. The enhanced SEBAL model estimated ET exhibited a good correlation with the in-situ measured Penman-Montieth ET_0, with R^2 values for the Aqua and the Terra platforms of 0.67 and 0.73, respectively. However, the correlation of the non-enhanced ET maps resulted in R^2 values of 0.61 and 0.68 for the Aqua and the Terra platforms, respectively. Hence, the results of this study revealed the feasibility of employing the sub-pixel analysis method for an accurate estimation of ET over large areas.

Keywords: evapotranspiration, sub-pixel analysis, MODIS image, MODIS sensor, remote sensing, land surface cover
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1 Introduction

Evaporation and transpiration are two processes that concurrently take place and cannot be differentiated. The amount of evaporation from croplands is principally based on the solar radiation fraction that hits the soil surface. This fraction is decreasing as the crop evolves and grows, where the crop canopy increasingly shades the ground surface beneath the plant. Water is mainly lost through soil evaporation at germination and early stages of plant growth. When the crop is well toned and totally covers the soil surface, the transpiration, which acts at the plants' leaves and stomata, becomes the dominant water losses process from croplands[1].

Investigating ET at regional scale becomes an important matter as it helps in understanding the global changes in the environment as well as when planning to develop water supplies for agricultural schemes or/and other related activities. In addition, ET analysis is always required to develop a hydrological model at any scale for a specific region[2-7].

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