ESTIMATING EVAPOTRANSPIRATION BY SATELLITE SENSORS OVER A HETEROGENEOUS LANDSCAPE

Yani Liu[1], Xiaozhou Xin[1], Qinhuo Liu[1]

1. State Key Laboratory of Remote Sensing Science, Institute of Remote Sensing Applications, Chinese Academy of Sciences, Beijing, China , 100101

Address:

Yani Liu, Xiaozhou Xin, Qinhuo Liu; State Key Laboratory of Remote Sensing Science, Institute of Remote Sensing Application, Chinese Academy of Sciences, P.O. BOX 9718 Beijing, 100101, China.

Email: eliuyani@163.com; xin_xzh@sohu.com; qhliu@irsa.ac.cn

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The calculation of evapotranspiration and its components transpiration are of crucial importance in dynamic crop-weather models, irrigation models and SVAT models. Compared with other methods (micrometeorological, climatological, or hydrological method), remote sensing-based land surface models have demonstrated ability to provide spatially distributed estimates of energy fluxes/evapotranspiration (ET) over large areas. However, the ability to capture the full range of variability in the fluxes is dependent on the resolution of the remote sensing data.

Over the last few decades, there has been a focus on better determining evapotranspiration and its spatial variability, but for many regions routine prediction is not generally available at a spatial resolution appropriate to the underlying surface heterogeneity. Over agricultural regions especially in China, this is particularly critical, since the spatial extent of typical field scales is not regularly resolved within the pixel resolution of satellite sensors. Clearly, for landscapes with significant variability in vegetation cover, type/architecture, and moisture, the spatial resolution of the remote sensing data is crucial for discriminating fluxes for the different land cover types and hence avoiding significant errors due to application of a land surface model to a mixed pixel containing large contrasts in surface temperature and vegetation cover. High resolution remotely sensed data is seemly to discriminate the differences over heterogeneous landscape, but we are inclined to use MODIS data (high temporal resolution, free of charge) to estimate regional ET. At such coarse spatial resolutions, the capability to monitor the impact of land cover change and disturbances on ET or to evaluate ET from different land covers is severely hampered. So, understanding the role of landscape heterogeneity and its influence on the scaling behavior of surface fluxes as observed by satellite sensors with different spatial resolutions is a critical research needed.

In this study, we are inclined to use the classified data provided by high-spatial-resolution remotely sensed image to improve regional ET from coarse-spatial -resolution data. Firstly, data from Landsat-ETM (60m) and MODIS (1km) satellite platforms combined with meteorological data are employed independently to estimate evapotranspiration by energy balance model. Secondly, area proportions of different land cover type statistics are made in 1km pixels. Thirdly, soil heat flux and sensible heat flux of 1km-pixel-resolution are calculated by contributed classified types plus their corresponding area rations. The better agreement between the estimates and the tower flux measurements indicates that the remote sensing model is appropriate for estimating regional evapotranspiration over heterogeneous surfaces. Histograms of the flux distributions and resulting statistics at the different pixel resolutions are compared and contrasted. The results showed that the estimatied ET by the aid of Landsat ETM+ data MODIS 1km pixel resolution is improved remarkable. The differences between ETM+-1km-simulated fluxes with MODIS data can be regarded as the “spatial scale error” of ET at lower resolution.

Additionally, high resolution VIS/NIR data were used to derive the probability distribution function (PDF) of surface temperature at the coarse pixel. At last, the latent heat flux of the pixel is derived. The results showed that the method using multi-resolution data to reduce the spatial scale error of the remotely sensed ET is quite promising and can also be used to study the spatio-temporal effect of remotely sensed ET, which is going to be carried out in the future.