MODIS AND LANDSAT ETM+ SCALING STUDY ON THE DAILY EVAPOTRANSPIRATION OVER HETEROGENEOUS LANDSCAPES

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Routine (i.e., daily to weekly) monitoring of surface energy fluxes, particularly evapotranspiration (ET), using satellite observations of radiometric surface temperature has not been feasible at high pixel resolution because of the low frequency in satellite coverage over the region of interest (i.e., approximately every 2 weeks). Cloud cover further reduces the number of useable observations of surface conditions resulting in high-resolution satellite imagery of a region typically being available once a month, which is not very useful for routine ET monitoring. Radiometric surface temperature observations at more than 1km pixel resolution are available multiple times per day from several satellites. However, this spatial resolution is too coarse for estimating ET from individual agricultural fields or for defining variations in ET due to land cover changes.

In this paper, MODIS and Landsat ETM+ data are combined used to improve the accuracy of evapotranspiration estimation based on MODIS spatial and temporal resolution. Furthermore, the simplified model to estimate daily ET is revised considering the scaling effect on heterogeneous region. The method we used is the following:

1. Satellite data in the visible and near-infrared wavelengths, used for computing vegetation indices, are available at resolutions an order of magnitude smaller than in the thermal-infrared,

and hence provide higher resolution information on vegetation cover conditions. A number of studies have exploited the relationship between vegetation indices and radiometric surface temperature for estimating model parameters used in computing spatially distributed fluxes and available moisture. In this paper, the vegetation index–radiometric surface temperature relationship is utilized in a disaggregation procedure for estimating subpixel variation in surface temperature with MODIS and Landsat ETM+ imagery collected during the winter wheat growing period. The disaggregated surface temperatures estimated by this procedure are compared to actual observations at this subpixel resolution. In addition, a remote sensing-based energy balance model is used to compare output using actual versus estimated surface temperatures over a range of pixel resolutions. From these comparisons, the utility of the surface temperature disaggregation technique appears to be most useful for estimating subpixel surface temperatures at resolutions corresponding to length scales defining agricultural field boundaries across the landscape.

2. An aggregation model is used for the surface flux calculation. Satellite-based input maps from satellite on land cover type, NDVI and radiant surface temperature are used. By using in-situ meteorological observations, the local roughnesses of all land cover types are known and the values are assigned to the land cover map in order to obtain a local roughness maps. The sensible and latent heat fluxes are compared to field observations. The comparisons show that the model result based on land cover image and the local roughness maps from Landsat ETM+ gives the best agreement with the in-situ observations in a coarse resolution.

3. Finally, the so-called Simplified Method for determining the accumulated daily evapotranspiration from remote surface radiant temperature measurements was used. This model required several parameters: the surface radiant and the air temperatures at 1300 local time, and the normalized difference vegetation index (NDVI). Based on the above analyze of scale effect on heterogeneous landscapes, we modified the input parameters of the so-called Simplified Method. The result is then more reliable.