AOGS 2006

Satellite-Sensed Distribution and Spatial Patterns of Flux Indices Related to Evapotranspiration Over a Forest Watershed in a Complex Landscape

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The key to understanding and predicting water cycle in a forest watershed lies in the explanation of mechanisms underlying observed patterns of individual components of water balance. As pointed out by Levin (1992), these mechanisms generally operate at different scales than those on which the patterns are observed. Therefore, we must understand how pattern and variability change with the scale of description, and develop pertinent protocols for scaling. Evapotranspiration (ET) is one of the primary components in the water budget equation for a given control volume and time. The variables controlling ET have their own temporal and spatial structures and the associated patterns. One of the main goals of HydroKorea and CarboKorea projects is to bridge the gap between in situ field measurements at plot scale (10^-2 $\sim$ 10^0 km^2) and the products of models and satellite image analyses at larger scale (10^0 $\sim$ 10^2 km^2). Perhaps the first step toward this goal would be to characterize the spatial structures of the satellite-sensed patterns of those variables related to ET. In this presentation, representative structural functions such as semivariogram and fractal were used to quantify spatial structures of ET-related variables obtained from LANDSAT ETM+ imageries and DEM over a montane watershed in Gwangneung forest in central Korea. The variables include normalized difference vegetation index (NDVI), simple ratio (SR), greenness index (GI), wetness index (WI), land surface temperature (LST), and topographic elements (i.e., elevation, slope angle, slope aspect). Our results show that these indices have the scale of heterogeneity that is of the order of 1 km and have multi-fractal characteristics. Their spatial structures generally change with seasons and such variations should be incorporated into modeling formulations at the hydrologic catchment and the grid scales of ecohydrologic models and satellite image analyses. These efforts may provide insights as to how various information is transferred across scales, and hence how to simplify and aggregate measurements, models and satellite products.

Acknowledgement

This study was supported by a grant (code: 1-8-2) from Sustainable Water Resources Research Center of 21st Century Frontier Research Program and the Eco-Technopia 21 Project from the Ministry of Environment, Korea.