GLOBAL LAND SURFACE EVAPOTRANSPIRATION ESTIMATION FROM MERRA DATASET AND MODIS PRODUCT USING THE SUPPORT VECTOR MACHINE

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ABSTRACT

Linking the terrestrial water cycles, carbon cycles and energy exchange, evapotranspiration (ET), which combines the surface evaporation and plant transpiration, is a key land surface parameter in water and heat balance of land, lake or river surface, and is central to earth system science. In this study, based on the MERRA reanalysis dataset and MODIS NDVI and LAI product, a support vector machine was used to estimate the land surface ET at sites and global scales. The results showed that, the support vector machine model probably could explain 60%-80% of the land surface ET change at 242 global FLUXnet sites when ten indicators while 56%-79% when five indicators were used to drive the model. For different vegetable cover sites, compared with EC observations, the results of evergreen broadleaf forest was worse than others.

Index Terms**—**evapotranspiration, support vector machine, MERRA

1. INTRODUCTION

As the main process parameter of water and energy exchange in hydrosphere, atmosphere and biosphere, evapotranspiration (ET) is defined as the water being converted from liquid to gaseous and from land surface to atmosphere, which combines the coinstantaneous surface evaporation and plant transpiration [1-3]. It is central to earth system science and water and heat balance for linking the terrestrial water cycles, carbon cycles and energy exchange [4-5]. Nowadays, lots of studies have been developed on evapotranspiration models and products [6-8]. Though a lot of traditional estimation models had a strong physical basis, their applications generally require some degree of calibrations for different regions. Existing researches showed that models have large uncertainties and mean annual ET from different global ET products have large range spans [9-10]. In consideration of its advantages on non-liner regression, we selected a support vector machine (SVM) model to estimate the global land surface daily ET from the MERRA reanalysis dataset and MODIS NDVI product and validated the model accuracy at 242 FLUXnet flux tower sites during 2000 to 2009.

2. DATA SOURCES AND METHODS

2.1 Data

Daily mean air temperature, relative humidity, net radiation, wind speed, shortwave radiation, daily maximum air temperature, daily minimum air temperature, daily air temperature difference from MERRA reanalysis dataset, NDVI from MODIS product (MOD13A2, 16-day), land cover from MODIS product (MDC12C1, yearly), site elevation and observational data of eddy covariance system (ECOR) from the global FLUXnet flux tower sites during 2000 to 2009 were used in this study. All data at regional scale in this study were resampled to 0.05° .These global sites included nine different vegetation covers: cropland (CRO, 35 sites), deciduous broadleaf forest (DBF, 28 sites), deciduous needleleaf forest (DNF, 4 sites), evergreen broadleaf forest (EBF, 19 sites), evergreen needleleaf forest (ENF, 62 sites), mixed forest (MF, 11 sites), grass and other types (GRA, 57 sites), shrubland (SHR, 17 sites) and savanna (SAW, 9 sites). As the most popular method in global measurement experiment to measure the heat fluxes between terrestrial ecosystems and the atmosphere, the eddy covariance method has a problem that the sum of the measured sensible heat and latent heat undermeasures the available energy, i.e. energy balance is not closed at eddy covariance sites [11-12]. The following formula can be used