

ESTIMATION OF ANNUAL AVERAGED EVAPOTRANSPIRATION BY USING PASSIVE MICROWAVE OBSERVATIONS

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ABSTRACT

As the main process parameter of water and energy exchange, evapotranspiration (ET) is defined as the water being converted from liquid to gaseous and from land surface to atmosphere. Potential evapotranspiration (ET₀) is defined as the evapotranspiration when water supply is sufficient of the land surface and reflect the ability of the surface to supply moisture. In this study, we explored the relationship between annual averaged ET (ET/ET₀) and annual averaged 36.5 GHz emission, and provided a new train of thought of how to use passive microwave data to estimate annual averaged evapotranspiration. We found a non-linear relationship with a R² of 0.52 between annual averaged 36.5 GHz emission and observed annual evapotranspiration at 28 flux tower sites of Asia and North America. We estimated ET and ET₀ of China and found a linear relationship with a R² of 0.51 between the annual averaged (ET/ET₀)^{1/2} and the annual averaged 36.5 GHz emission at 9 flux tower sites of China.

Index Terms—evapotranspiration, passive microwave, remote sensing

1. INTRODUCTION

Evapotranspiration (ET), consisting of the surface evaporation and plant transpiration [1] and linking the terrestrial water cycle, carbon cycle and energy exchange [2-3], is central to water and heat balance of land, lake or river surface [4], and is a key land surface parameter in earth system science [5]. Actually, actual ET could be considered to reflect the atmospheric demand for moisture from a surface and the ability of the surface to supply moisture [6]. When assuming there is no control on water supply, i.e. the

water supply is sufficient for the land surface, ET is called potential evapotranspiration (ET₀) [7-9]. Microwave remote sensing is to a certain degree unrestricted by cloud cover and can provide information about hydrologic variables such as water equivalent, rainfall, soil wetness and so on [10]. There have been fewer researches concerned on the relationship between microwave observations and ET (ET₀). In this study, we have three major objectives. First, we analyze the relationship between annual averaged 36.5 GHz emission and observed annual ET at 28 flux tower sites. Second, due to the fact that when ET is greater than 600 mm/yr, the satellite data appear to be insensitive to ET. In such case, we normalize the ET values by ET₀ at 9 flux tower sites of China and try to explore the relationship between them. We estimate the ET of China using a semi-empirical method and estimate the ET₀ of China using the Penman-Monteith (PM) method driven by gridded reanalysis datasets, and verify the accuracy of estimated ET at 9 flux tower sites of China. Finally, we analyze the relationship between annual averaged ET/ET₀ and annual averaged 36.5 GHz emission at 9 flux tower sites of China.

2. DATA SOURCES AND METHODS

2.1 Data

Observational data from 28 flux tower sites during 2003 to 2008 were used in this study. These flux tower sites are from Asia and North America and cover six vegetation types (CRO: 3, DBF: 5, DNF: 1, GRA: 12, MF: 3, SHR: 4). The effective observational days for these sites are all more than 280 days. Besides, observational data from 9 flux tower sites of China during 2002 to 2007 were used in this study. Measurement experiment to measure the heat fluxes between terrestrial ecosystems and the atmosphere at all these sites