FURTHER VALIDATION OF PASSIVE MICROWAVE REMOTE SENSING SOIL MOISTURE PRODUCTS IN THE YIHE BASIN OF CHINA

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1. EXTENDED ABSTRACT

The moisture content in the surface layers of the soil (SSMC) is of great importance to the discipline of hydrology as well as to the other relevant study and applications [1, 2]. It can interact with the atmosphere through evapotranspiration to affect the climate regime and water circulation over the surface. Meanwhile the moisture content in the soil root zone fluctuates in response to precipitation and evapotranspiration to affect the water exchanges between ground water and surface runoff. This moisture is only 0.005% of the total water on the earth's surface, but its seasonal variation accounts for a 1.4 cm variation in sea level. The SSMC information is mainly attained by means of in situ/remote sensing measurements or hydrological modeling. Compared with the remote sensing data, the in situ soil moisture measurement is time consuming and logistically difficult for maintenance, and the field measurements within large area is highly non-cost effective and infeasible. In recent years, with the quick advances of satellite remote sensing techniques, a number of useful remotely sensed data together with the physical model developments becomes available. This technology advancement for hard ware mainly attributed to the application of remote sensors such as the Advanced Microwave Scanning Radiometer for the Earth Observing System (AMSR-E), ERS-Scatterometer, ENVISAT ASAR and Soil Moisture and Ocean Salinity (SMOS) mission…etc, while for software the advanced integral equation model (AIEM) has proved a better accuracy and a much wider application range for surface roughness conditions in SSMC retrieving with those microwave sensors[3]. This has opened a way in SSMC retrieval for the research of large scale land atmosphere interaction and climate change at the regional and global scales.

Among the various microwave sensors available mentioned previously, the AMSR-E soil moisture data, owning to its high re-visit time (once per day) at any place of the Earth, favorite its applications of great potential in downscaling or assimilating studies at catchment scale hydrological modeling and four dimensional data assimilation purpose[4, 5]. At present, the AMSR-E SSMC products [6] has been opened for public, however, systematic validations of such global data product in regional scale, especially in China are seldom found in literatures. Located in the middle-eastern part of China of monsoonal Asia, studies on moderate and macro-scale water and energy cycle of this region is very important and meaningful for exploring unknown inherent mechanism of drought trend in North China [7].To expand the applications of passive microwave soil moisture data in the regional and catchment hydrological researches, the validation of remote sensing soil moisture product for the specific region is vital and also urgently needed.

In this study, we validated the AMER-E SSMC product using both field measurements and the ESSI distributed hydrological model[8] simulated SSMC of the study watershed (150*180 km^2 area) in the Yishushi River Basin located at the Linyi district, Shandong Province, China, where adequate SSMC observations were made available in recent years. This selected watershed characterizes a typical semi-arid rangeland with sparse vegetation, farm land and some small towns covered. We firstly conduct the validation of AMSR-E SSMC product using field observations. Total 22 sites of soil moisture measurements within the basin are used and the SSMC was regularly measured on 8th, 18th and 28th of each month of a year. The field measurements of SSMC within the gird of AMSR-E are averaged for comparison. The soil water index (SWI) proposed by Wagner [9] was adopted as a detective measure to evaluate the accuracy of the AMSR-E SSMC product compared to field observations. Comparison of SWI for both dataset was conducted for every AMSR-E gird located within the basin, and the RMS error and efficiency coefficient are investigated over the period of year 2006~2008. For further validations, the ESSI distributed hydrological model was also run for each 1*1 km^2 grid over the same period. The ESSI modeling results include surface and root-zone soil moisture. The AMSR-E derived soil moisture was directly compared with the ESSI modeled surface soil moisture, and also the RMS error and efficiency coefficient were calculated for the purpose of validation. To consider the effect of the modeling error, a sensitivity study was performed to quantify effect of modeling data noise level on comparison. Final results of comparison show a good correspondence between the field measured and AMSR-E surface soil moisture, while little worse correspondence between the AMSR-E surface soil moisture and modeled data which is strongly affected by the precision of precipitation interception. Till now, very few studies conduct validation of soil moisture estimates from remote sensing. This work will contribute to knowledge of accuracy of AMSR-E derived soil moisture and the compatibility between remote sensing soil moisture and model data, which is potentially vital for hydrological data assimilation studies using remote sensing data.

Key words: SSMC, AMSR-E, distributed hydrological model ESSI, validation, passive microwave remote sensing; soil moisture

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