Experiments of land surface soil moisture data assimilation system based on Ensemble Kalman Filter，the microwave complex land emissivity model and the Community Land Model*

Shenglei Zhang [1#]，Jiancheng Shi [1,2]，Zhenghui Xie[3]，Lingmei Jiang[4]，Liang Chen[1]

[1] State Key Laboratory of Remote Sensing Science, Institute of Remote Sensing Applications of Chinese Academy of Sciences and Beijing Normal University , Beijing 100101, China

[2]Institute for Computational Earth System Science, University of California, Santa Barbara 93106,U.S.A

[3]Institute of Atmospheric Physics, Chinese Academy of Sciences, Beijing 100029, China

[4]State Key Laboratory of Remote Sensing Science, Beijing Normal University, Beijing 100875, China

Abstract

Soil moisture, as one of the key variables in the physics of land surface processes, it plays an important role in the water and energy cycles of land-atmosphere system, climate and regional environment change. Both field soil moisture measurements and estimates from modeling have their limitations. Remote sensing is becoming a practical method to estimate soil moisture globally. However, the quality of current soil surface moisture products needs to be further improved in order to meet practical requirements. The land data assimilation is a promising approach to consistently merge dynamic models and remote sensing observations, which is very important to understand the land-atmosphere interactions and improve climate predictions. In this study, a land surface soil moisture data assimilation system in consideration of the effects of the model subgrid-heterogeneity is presented to estimate the spatial and temporal variations of soil moisture profile from AMSR-E brightness temperature. The system consists of a land surface model, the NCAR Community Land Model version 2.0 (CLM 2.0), used to calculate soil moisture, a microwave complex land emissivity model, which can quantify the land emissivity over various surface conditions, such as snow, vegetation, lake, bare soil, used to estimate the microwave brightness temperature, and Ensemble Kalman filter (EnKF) assimilation algorithm. We conduct numerical experiments to validate the assimilation scheme by assimilating in situ soil moisture measurements and low-frequency passive microwave remote sensing data into CLM Model, respectively. The results indicate that the assimilation scheme can significantly improve the soil moisture estimation, and with the improvement of soil moisture simulation, the soil temperature-simulated precision can be also improved to some extent, which shows that the scheme is reasonable. The comparison experiments indicate that the results accounted for subgrid-heterogeneity of observations are better than that without considering subgrid-heterogeneity of observations.

Key words：land data assimilation，soil moisture，microwave land emissivity model，ensemble Kalman filter，CLM model，AMSR-E

Corresponding Author: Shenglei Zhang

Shenglei Zhang
Mailing Address: State Key Laboratory of Remote Sensing Science, Institute of Remote Sensing Applications of Chinese Academy of Sciences and Beijing Normal University , Beijing 100101, China
E-mail: zhangsl@irsa.ac.cn
Jiancheng Shi
E-mail:shi@icess.ucsb.edu
Zhenghui Xie
E-mail:zxie@lasg.iap.ac.cn
Lingmei Jiang
E-mail:jlinmei@263.net
Liang Chen
E-mail:chenliangrs@163.com