Assimilating AMSR-E data for soil moisture estimation

X. Li (1), T. Koike (2)

(1) Cold and Arid Regions Environmental and Engineering Research Institute, Chinese Academy of Sciences, Lanzhou, China

(2) Department of Civil Engineering, the University of Tokyo, Japan

In the last decade, we see a blooming of developing and applying of land data assimilation systems (LDAS). This technique, by integrating both in situ and remote sensing data into the dynamics of land surface model, is capable of producing the evolution of land surface state, such as soil moisture, soil temperature and snow water equivalent, in physical and spatiotemporal consistence.

In this paper, we introduce a few numerical experiments of assimilating the Advanced Microwave Scanning Radiometer (AMSR-E) brightness temperature data by using the LDAS we have developed. The data assimilation method being used is the ensemble Kalman filter, which is a Monte Carlo based sequential filter method. The land model is the JMA (Japan Meteorological Administration) new SiB, which originates from the Simple Biosphere (SiB) model but is reformulated with explicit snow and soil freeze/thaw processes. The observation operators are radiative transfer models of soil. We used the semi-empirical Q/h model in this study.

The system was tested using many observations collected during CEOP (Coordinated Enhanced Observation Period, a Global Energy and Water Experiment), particularly at a semi-arid region site, Mongolia and a cold region site, Tibet-east. The results showed that: (1) The system can estimate land surface variables, i.e., soil moisture, soil temperature and snow much more reasonable than free-loop modeling. (2) From the view point of remote sensing, the soil moisture and temperature profiles can be retrieved successfully with the aid of additional information from modeling. (3) Spatiotemporal and physical consistent data sets of land surface variables can be obtained from the LDAS. This is not possible to be achieved by modeling and remote sensing alone. (4) The system is very effective in terms of computation cost.

There are also some drawbacks of the system. The soil moisture estimation is too sensitive to surface roughness. If there is not good a prior information of effective roughness, the moisture estimation can be much biased. In addition, the canopy and atmospheric effects need to be more quantitatively evaluated. Therefore, hybrid system for estimating parameters and assimilating state variable simultaneously should be developed in high priority.