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# Development of a satellite land and cloud data assimilation system coupled with WRF, and its application to Kanto area

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For flood prediction and optimized dam control, it is crucial to predict whether a rain area will be over the river basin or not after few hours, and this needs very fine prediction of time and space distribution. For system development focusing on the ‘location‘ of rain areas, it is effective to introduce the information of cloud distribution from the observations into the model as initial conditions. Clouds can be observed by microwave remote sensing by satellite. But it is not easy to observe the cloud over the land from the satellite because emissivity of clouds is so week compared to that of land surface.

In order to observe cloud over the land, we at first have to adequately represent the heterogeneity of land state, especially soil moisture distribution, which has large effect on emissivity of the land, and estimate the surface emissivity, then remove it as background information for cloud observation. Therefore, we developed a satellite-based land and cloud data assimilation system coupled with the Weather Research and Forecasting Model (CALDAS-WRF) and applied it to the Kanto area.

The CALDAS-WRF includes Simple Biosphere model version 2 (SiB2) as a land surface driver, radiative transfer models for soil and atmosphere as observation operators, and Ensemble Kalman Filter (EnKF) and 1DVAR as assimilation algorithms for land and cloud, respectively.

The CALDAS-WRF first initializes the whole system, integrates the WRF and the SiB2 repeatedly until observations are available, and then assimilates the soil moisture heterogeneity, using passive microwave brightness temperature (Tb) at lower frequency, which has a high sensitivity to soil moisture. Then the CALDAS-WRF assimilates cloud over the land, using Tb at higher frequency, which is sensitive to cloud, and optimized emissivity of land as a background information.

We applied the CALDAS-WRF to the Kanto area, and the system effectively assimilated information of clouds and largely improved the representation of cloud distribution. Precipitation areas were also reproduced in the correct locations and consistent atmospheric fields were generated around the cloud areas through dynamical and physical processes in the atmospheric model. However the precipitation amount and duration were not enough, which will be the next target of our development.

Keywords: cloud, soil moisture, satellite microwave data assimilation, Kanto area, heavy rain prediction