# Assimilation of FY-3B Soil moisture Products into Noah-MP Land Surface Model

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## Introduction:

It is widely known that soil moisture plays an important role in meteorological, agricultural and hydrological fields. Both soil moistures retrieved from remotely sensed microwave measurements and predicted from land surface models have advantages and shortcomings. Assimilation of soil moisture satellite retrievals into land surface models is considered as an effective approach to estimate soil moisture with lower errors than satellite retrievals or land surface models only. There has been a lot of research in the assimilation of near surface soil moisture retrieved from satellite sensors such as SMOS (Soil Moisture and Ocean Salinity) and AMSR-E (Advanced Microwave Scanning Radiometer – Earth Observing System). The microwave radio imager (MWRI) onboard of the Fengyun-3B satellite (FY-3B) which was launched in November, 2010 by Chinese Meteorological Administration (CMA), observes the Earth at the similar frequency with AMSR-E. We intend to assimilate MWRI soil moisture retrievals into the community Noah land surface model with multi-parameterization options (Noah-MP). Firstly, MWRI surface soil moisture was rescaled by matching its cumulative distribution function (CDF) to that of land surface model simulations. Then the scaled MWRI retrievals are assimilated into Noah-MP using an Ensemble Kalman Filter. Two experiments were performed, one with assimilation and the other one without. Validation against in-situ observations shows that the assimilation of MWRI soil moisture retrievals improves the soil moisture performance than unassimilated ones.

## Forcing Data from CLDAS

CLDAS forcing data were used in this study to drive Noah-MP model. The forcing data include:

- **Temperature**: NCEP/GFS + automatic surface observation s
- **Pressure** : NCEP/GFS + automatic surface observation s
- **Humidity** : NCEP/GFS + automatic surface observation s
- **Precipitation** : produced by merging more than 30000 rain gauge data and CMORPH product.
- **Solar radiation** : Retrieved from FY2 series geostationary meteorological satellites.

## FY-3B Soil Moisture Retrievals

FengYun-3B was launched in Nov. 2010 by CMA. It observes the earth at 10.65, 18.7,23.8, 36.5 and 89.0 GHz frequency in a sun-synchronous orbit.

FY3B soil moisture product gives the global volume water content in surface soil (in cm3/cm3) at the resolution of 0.25° x0.25° in Equal-Area Scalable Earth Grid (EASE-Grid).

Fig. 1 shows the FY-3B soil moisture product on May 10, 2012. The left one is ascending data, while the right one is descending data.

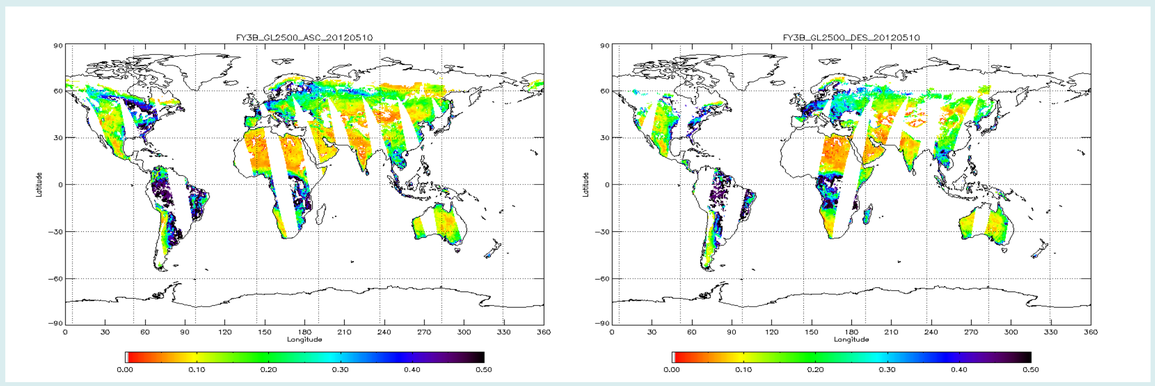


Fig. 1 FY-3B soil moisture on May 10, 2012

## Evaluation of FY-3B Soil Moisture

FY-3B soil moisture retrievals was validated against in-situ observations. Fig. 2 shows the correlation is decrease from north to south over China. This may be caused by the different land cover type and vegetation fraction.

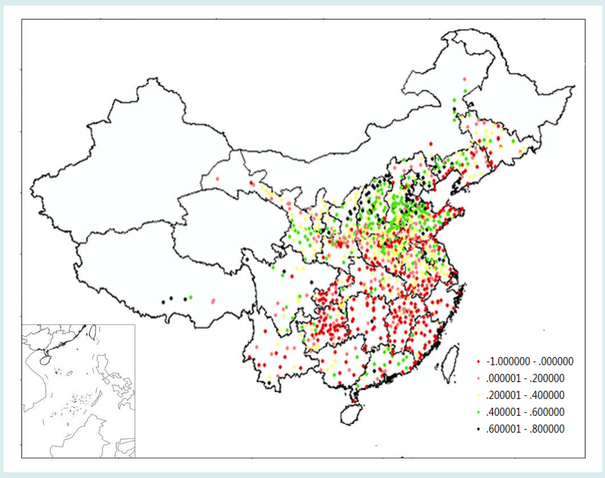


Fig. 2 Correlation between FY-3B SM and in-situ observation.

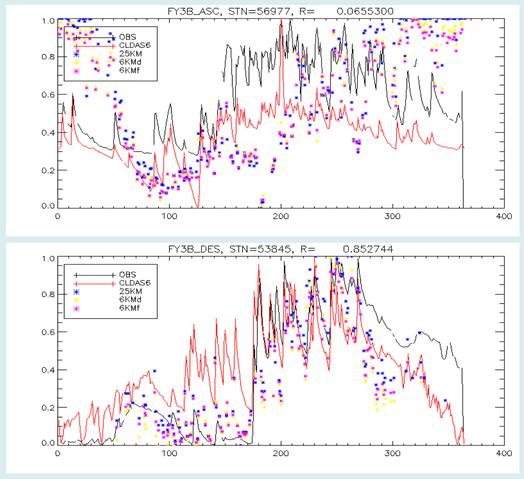


Fig. 3 Comparison of normalized soil moisture in grassland and forest stations.

## Methodology

(1) Scaling the MWRI near surface soil moisture retrievals to the model climatology using cumulative distribution function (CDF) matching technic.

(2) Generate precipitation forcing ensembles by perburbing CLDAS precipitation forcing which are produced by merging gauge data and CMORPH product using a precipitation error model.

(3) Perform ensemble Kalman filtering to soil moisture ensemble forced by the perburbed precipitation ensemble and satellite retrievals.

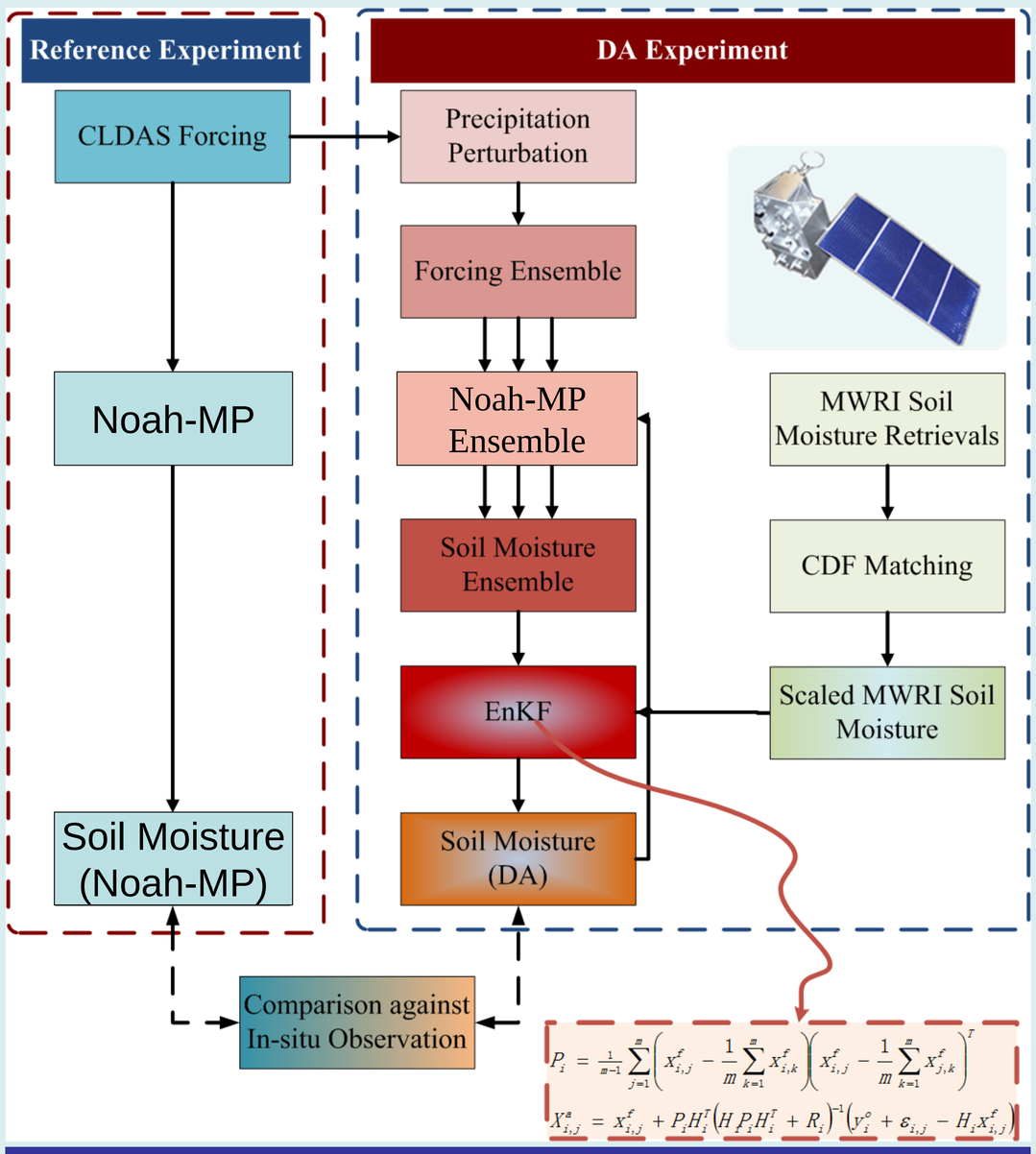


Fig. 4 Flow chart of soil moisture assimilation

## FY-3B Assimilation Results

We performed two experiments, one with assimilation of FY-3B soil moisture retrievals and the other one with out assimilation. Fig. 5 shows the time series. The black line is the observation, and the red line refers to the results of experiments without assimilation, while the blue line means the assimilation one. Validation against in situ observations shows that the assimilation of FY-3B soil moisture retrievals improves the soil moisture estimation performance than unassimilated ones.

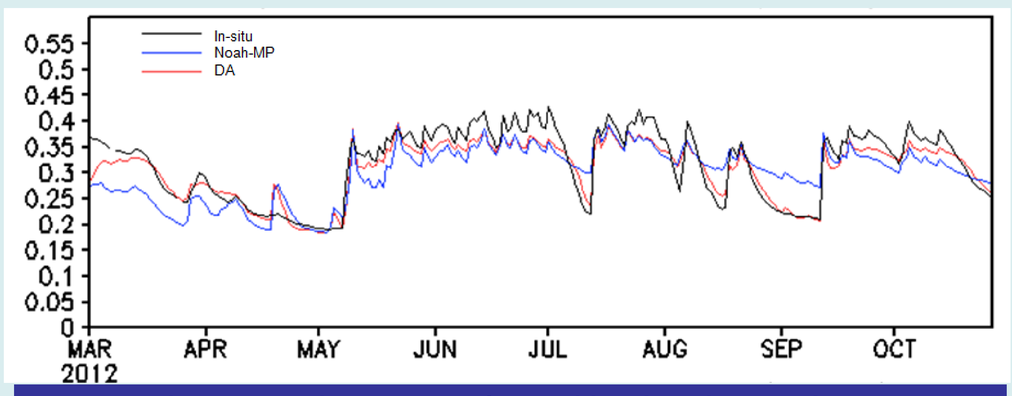


Fig. 5 Experiments results and in-situ observations

## Acknowledgements

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