Assimilating landscape freeze/thaw information in the NCEP Global Forecast System: Exploring the potential of the SMAP Freeze-Thaw product for weather and climate forecasting

Kibrewossen Tesfagiorgis[a], Weizhong Zheng[b], Marouane Temimi[a], Xiwu Zhan[c], Michael Ek[d], and Kyle McDonald[a]

[a] *NOAA-CREST Institute, City College of New York, New York, ktesfagiorgis@ccny.cuny.edu,*
[b] *IMSG, USA, NOAA/NCEP/EMC,USA,* [c] NOAA/NESDIS/STAR, USA, [d] NOAA/NCEP/EMC, USA

The goal of this study is to facilitate the assimilation of landscape freeze-thaw (F/T) state data into the National Centers for Environmental Prediction (NCEP) global forecast system (GFS). We focus on northern latitudes where landscape surface state transitions between predominantly frozen and thawed conditions during the spring and autumn are critical to hydrological, meteorological and ecological processes. The ability to characterize these transitions using of satellite active and passive microwave data sets has been well-established. NASA's Soil Moisture active/Passive (SMAP) mission, scheduled for launch in October 2014, will provide a global 3km-resolution F/T state product covering the high latitudes (>40 deg N) with 1-2 day temporal fidelity. The advent of new missions like SMAP will allow for better monitoring of the surface freeze/thaw and associated soil moisture phase (liquid or frozen), offering the potential to improve the performance of weather and climate models through direct assimilation of the F/T state variable. In this study, information on F/T state and the extent of frozen ground will be assimilated using a simplified EnKF in the GFS through a coupling with the Noah land surface model. This ensemble Kalman filter method is developed and currently installed in the GFS to test the assimilation of future SMAP soil moisture data [1]. The impact of the proposed improvements will be assessed using the F/T data record currently derived from SSM/I microwave observations and available from the NSIDC website. It is expected that the assimilation of F/T complements the improvement that soil moisture assimilation has achieved especially in northern regions.

References

[1] Zhan, X., Zheng, W., and Ek, M., "Using the Extended Kalman Filter to Assimilate Soil Moisture Observations in NCEP Global Forecast System," *Remote Sensing and Hydrology 2010 Symposium*, Jackson Hole, Wyoming. (Journal Article)