Geophysical Research Abstracts
Vol. 17, EGU2015-5240, 2015
EGU General Assembly 2015

Correction of Real-Time Global Precipitation Measurement with multi-sensor satellite observations

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Precipitation is an important hydro-meteorological variable, which has an impact on large parts of the water cycle. In large parts of the world, real time ground-based observations of precipitation are sparse and satellite derived precipitation products provides a solution.
We used changes in satellite derived soil moisture (SM) and land surface temperature (LST) to reduce uncertainties in the Tropical Rainfall Measuring Mission Multi-satellite Precipitation Analysis product – Real Time (TMPA-RT). The Variable Infiltration Capacity (VIC-model) was used to model the response of LST and SM on precipitation and a particle filter was used to update TMPA-RT. Observations from AMSR-E (LPRM and LSMEM), ASCAT, SMOS and LST from AMSR-E were used to correct TMPA-RT over the continental United States. The corrections in TMPA-RT were evaluated against NLDAS-2 precipitation dataset. A synthetic experiment showed the potential of both SM and LST observations to reduce uncertainties in TMPA-RT.
Corrections with SM observations reduced the false alarm rate (FAR) from 0.09 to 0.01 and the error in the retrieved rainfall volumes per event. The probability of rainfall detection (POD) was reduced compared to the original TMPA-RT product (0.46 to 0.34). Noise in the retrieved SM changes resulted in a relatively low potential to reduce uncertainties.
Correction with LST observations resulted in an increased POD (0.46 to 0.51) and reduce FAR (0.09 to 0.03), indicating an improved rainfall detection skill. Additionally, an improved Brier Score was found after correction (0.32 to 0.26). The annual precipitation totals after correction with LST were closer to the observed precipitation. When both soil moisture and LST observations were combined, results showed no significant improvement compared to original TMPA-RT.
This study show the potential for reducing the uncertainties in TMPA-RT estimates over sparsely gauged areas where TMPA-RT is used for monitoring and forecasting of floods and drought.