Geophysical Research Abstracts
Vol. 16, EGU2014-12450, 2014
EGU General Assembly 2014

Evaluation of six satellite rainfall products over the Great Horn of Africa

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Satellite precipitation products are used in various application fields, as extreme event monitoring (flood and drought), generation of time series for regional or global climatological studies, and assimilation in hydro-meteorological models. They are particularly necessary in regions with very sparse rain-gauge networks to augment the observational capabilities, such as in the Great Horn of Africa (GHA). GHA is characterized by a complex topography and highly varying climatic conditions ranging from the wetter mountainous and coastal regions to the arid lowlands, which can greatly affect the quality of satellite rainfall estimations. Moreover GHA is characterized by very frequent drought events, whose monitoring and forecast can benefit from satellite rainfall estimations. All that justifies the importance of satellite product validation and inter-comparisons in order to assess their reliability and application domain.

The monthly accumulated precipitation from six satellite products, TAMSAT, GSMaP, CMORPH, PERSIANN, RFE, and TRMM-3B42, are analysed for the time period 2003 - 2009, by dividing the studied region (5°S – 20°N, 28°E – 52°E) in six sub-areas (clusters) characterized by a different annual cycle. The measurement uncertainties in satellite products are evaluated by computing the variance from the ensemble of the six satellite products at the resolution of 0.25°. The annual cycle characteristics of each cluster are correctly identified by each satellite product, whereas marked differences can be seen in the precipitations amount. GSMaP, PERSIANN and CMORPH provide larger amount of precipitation on South Sudan and West Ethiopia and North Uganda and the coastal region of North Somalia with respect to the other products. The regions with higher variability among satellite products are mountainous West Ethiopia, during summer (wet season) and for heavy precipitation (> 200 mm), South Sudan during summer and fall, and the Lake Victoria region.

Comparisons (correlation coefficient, mean error, root mean square error, and efficiency coefficient) are carried out with respect to the GPCC Full Data Reanalysis at 0.5° resolution. From this analysis TRMM-3B42 stands out as the satellite product with the better performances, generally followed by TAMSAT and RFE. PERSIANN and GSMaP have the lowest efficiency coefficients. CMORPH provides good results for the central part of Ethiopia.

Finally, monthly anomalies between the satellite products and the GPCC Climatology Version 2011 product at 0.25° are computed to evaluate the potential of satellite products for identifying drought periods.