Geophysical Research Abstracts
Vol. 12, EGU2010-15260, 2010
EGU General Assembly 2010

Quantification of accuracy of precipitation estimates from MSG data suing using CloudSat satellite observations in Europe and Africa

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Availability of fresh water supply is an essential important to humans and all forms of life. Precipitation, being the source of most of fresh water plays an important role in the socio-economic activities as human settlement is often found in regions abundant with this precious commodity in its various forms either sourced directly from rainfall or from rivers, lakes, springs, etc. A good estimate of the amount of precipitation in any place assists the population in better planning of their activities that may include agriculture, infrastructure development and maintenance, flood and forest fire monitoring, etc.

Several remote sensing based rainfall monitoring schemes are currently in existence. One of the best known is the Meteosat Second Generation, MSG's Multi-sensor Precipitation Estimate (MPE). The MPE product relies mainly on the cloud top temperatures, a proxy for the cloud top-height, to estimate the rainfall intensity emanating from particular kinds of clouds with large vertical extent. The MSG has been useful in the estimation of rainfall intensity estimates especially for remote places over Africa and over the oceanic areas, however the accuracy of these products remains to be established using more quantitative . measurements, like the weather radar systems in Europe. On the other hand, as opposed to their counterparts in Western Europe, most of Africa is not covered by weather radar. This is attributed to affordability as these radars are costly. The weather radars which have been known to give more accurate rainfall intensity estimates than the MSG. , as opposed toThis approach is feasible in Europe which is endowed with a network of weather radars under the OPERA network. An advantage of the radar technology is that it penetrates into the cloud to examine the water and ice and considers them in estimation of rainfall intensities. On the other hand, as opposed to their counterparts in Western Europe, most of Africa is not covered by weather radar. This is attributed to affordability as these radars are costly, thus an alternative approach is urgently needed..

The CloudSat satellite was introduced into orbit by NASA on 26 April 2006 as polar-orbiting experimental satellite. It applies active radar to penetrate the cloud and analyze its internal cloud properties. This satellite radar technology can be used to improve on the rainfall intensity estimation especially for those countries that are yet to acquire ground radar technology. However, being polar orbiting, the satellite also has its limitations, one which is its poor temporal resolution with a return cycle of between 14 – 16 days. Nevertheless, a synergetic use of the CloudSat and MSG products can be used to enhance the accuracy rainfall forecasts.

In this study, data from different clouds in several countries of Western Europe during the summer season was used, due to their advantage of having a network of weather radars under the OPERA system. Different cloud classes were tested, and the results showed that some properties of the clouds, namely the cloud ice water path (IWP), ice water content (IWC) and ice effective radius are important in the confirmation of rainfall clouds. The thresholds were computed as IWP $\geq$ 30 gm^{-2}, IWC$\geq$ 4.2 mgm^{-3} and ice effective radius $\geq$ 5.6 μm to sufficiently classify a cloud as a "rainy" cloud.

The methodology was tested for the case of the Ewaso Nyiro catchment in the Kenya. The thresholds were tested for one rainy day, 24 October 2006, where the hypothesis was confirmed. More similar tests could, however not be carried out due to lack of sufficient data.