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Satellite rainfall monitoring over Africa using multi-spectral MSG data in an artificial neural network approach

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Rainfall monitoring over Africa is crucial for a variety of humanitarian and agricultural purposes, and satellites have been used for some time to provide real-time rainfall estimates over the region. Several recent applications of satellite rainfall estimates, such as flash-flood warning systems and crop-yield models, require accurate rainfall totals at daily timescales or below.

Multi-spectral Meteosat Second Generation (MSG) data provide information on cloud properties such as optical depth and cloud particle size and phase. These parameters are all relevant to the probability of rainfall occurring from a cloud and the likely intensity of that rainfall, so the use of MSG data should lead to improved satellite rainfall estimates.

An artificial neural network (ANN) using multi-spectral inputs from MSG has been trained to provide daily rainfall estimates over Ethiopia, using daily rain-gauge data for calibration. Although ANN methods have previously been applied to the problem of producing rainfall estimates from multi-spectral satellite data, in general precipitation radar data have been used for calibration. The advantage of using rain-gauge data is that gauges are far more widespread over Africa than radar networks, so this method can be easily transferred and if necessary re-calibrated in different climatological regions of the continent.

The ANN estimates have been validated against independent Ethiopian gauge data at a variety of time and space scales. The ANN shows an improvement in accuracy at daily timescale when compared to rainfall estimates from the TAMSAT algorithm, which uses only single channel MSG data.