Geophysical Research Abstracts
Vol. 15, EGU2013-6929, 2013
EGU General Assembly 2013

Evaluation and Bias Adjustment of Multiple Satellite-based Rainfall Products over Complex Terrain

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Reliable quantification of spatio-temporal distribution of rainfall is a pre-requisite for any hydrological modeling study. However, challenges in estimation of rainfall persist specifically over complex topography. Difficulties in representation of high rainfall variability using rain gauges make satellite-based rainfall retrieval algorithms potentially attractive for basin scale hydrologic studies over these regions. Even though satellite-based rainfall measurements are quasi global and high resolution, these products has limitations that necessitates a bias adjustment or merging procedure using more accurate rainfall products. This study evaluates three different satellite-based rainfall retrieval algorithms, namely, Tropical Rainfall Measuring Mission Multi-satellite Precipitation Analysis (TMPA), NOAA/Climate Prediction Center Morphing Method (CMORPH) and EUMETSAT's Multi-Sensor Precipitation Estimate (MPE) using a relatively dense rain gauge network within topographically complex Filyos Basin in Turkey. The evaluation is performed at multiple time and space scales using quantitative, categorical and graphical measures. Our results indicated that satellite-based products significantly underestimated the rainfall in regions characterized by orographic rainfall and overestimated the rainfall in the drier regions with seasonal dependency. Further, we propose a bias adjustment algorithm for the satellite-based rainfall products based on the "physiographic similarity" concept. The premise of the algorithm is that, the rain gauges within physiographically similar regions are grouped to calculate weights of the bias adjustment procedure rather than the rain gauges in proximity. The performance of the proposed bias adjustment algorithm is than compared to statistical bias correction algorithms. We will conclude with a discussion of the utility of satellite-based rainfall algorithms as input to hydrologic models in topographically complex regions.