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Merging different satellite measurements of rainfall using multi-scale imagery technique

Seyed Hamed Alemohammad[†]; Dara Entekhabi
[†] Massachusetts Institute of Technology (MIT), USA
Leading author: hamed_al@mit.edu

Satellite-derived retrievals of precipitation have increased in availability and improved in quality over the last decade. There are several passive microwave satellites orbiting the Earth with instruments capable of some precipitation retrieval. These retrievals have the advantage of almost full global coverage when compared to surface gauges. However, they have a low temporal revisit as they are in low Earth orbit platforms. Moreover, in some cases they have missing data over some regions where retrieval is confounded by other influences. Therefore, in order to obtain a reasonably accurate rainfall estimation and with a good spatial and temporal sampling resolution, useful for studies of climate change and large-scale hydrological processes, it is necessary to merge different types of measurements. Image fusion is a useful technique to fill in the gaps of one image (one satellite measurement) using another. The proposed method uses an iterative fusion scheme to integrate information from multiple images. This method can be applied to satellite monitoring of rainfall to enhance the remotely sensed analysis of precipitation fields by merging different measurements together. This paper investigates the use of three multi-scale pyramids (Steerable, Laplacian, and Gaussian) in order to merge different satellite measurements. Furthermore, a nonlinear operator that combines the detail of one image with the local appearance of another one is applied to generate a smooth analysis precipitation field. The study region is the Continental United States covered by several satellite systems. A large number of merged measurements from these satellites are analyzed and the results are validated by comparing them with the independent surface-based radar and gauge measurements.