EMS Annual Meeting Abstracts
Vol. 14, EMS2017-809, 2017

At which spatial and temporal scales can precipitation be measured? On the effective resolution of observation systems

Clément Guilloteau (1), Rémy Roca (2), Efi Foufoula-Georgiou (1), and Marielle Gosset (3)

(1) University of California Irvine, Irvine, United States, (2) Laboratoire d'Etudes en Géophysique et Océanographie Spatiales, CNRS, Toulouse, France, (3) Géosciences Environnement Toulouse, IRD, Toulouse, France

Rain gauges and weather radar are conventional systems for the observation and measurement of precipitation used for several decades. The satellite era allowed a new way to observe precipitation. Today, various ground-based and spaceborne observation systems are used to generate numerous quantitative estimation products, covering various areas of the globe, various time periods, with a wide range of spatial and temporal resolutions.

Intercomparison studies of these products have revealed more or less strong discrepancies between them. The amplitude of these discrepancies strongly depends on the resolution at which is performed the comparison. This raises the following issue: at which spatial and temporal scales the variability of precipitation can be captured by the observation systems? It is generally observed that the finest the resolution, the most challenging the retrieval. We define the effective resolution of a product as the finest spatial and temporal scale at which it can accurately reproduce desired properties of precipitation fields. While the issue of the effective resolution of numerical atmospheric models is commonly assessed, the same question is often eluded when it comes to observations.

The question of the effective resolution is particularly relevant when considering satellite estimates, derived from observation of radiances absorbed, emitted, reflected and scattered by clouds and hydrometeors at optical and microwave frequencies, through parametric radiative models or empirical contingency. In this case, the question of the retrieval's effective resolution goes beyond the instrumental resolution and the spatial and temporal sampling of observations; it also depends on the computational method used to derive precipitation intensity from the measured radiances. For satellite estimation products, the effective resolution may differ from the nominal resolution by several orders of magnitude. This is even more true for multisensor estimation products merging the information provided by heterogeneous sensors.

For numerical models spectral analysis of the outputs is generally used to assess the effective resolution. Here, we present a spectral and cross-spectral analysis of several precipitation products based on discrete wavelet transforms along spatial and temporal dimensions. The method allows to determine the scales which for the products agree and the scales which for they diverge. Instantaneous rain rates derived from passive microwave satellite observations (through the GPROF algorithm) and multi-satellite estimates of time-accumulated rain depth are compared to radar data, globally and at regional level (in North America and West Africa). Spatial scales down to 3km, instantaneous rain rates and 30min to daily cumulated depth are considered.