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Using IMERG precipitation patterns to index climate at the mesoscale: A basis rotation method based on climate bistability - an update

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As communities observe recurring regional weather patterns they will often ascribe colloquial names to them such as the Meiyu in East Asia or the Santa Ana winds of California. However, attaching quantitative characterizations to these same names often proves challenging. Classically heuristics have been developed for particular locations and climate phenomena, but their inherent subjectivity undermine the robustness of any subsequent quantitative analysis. To develop a neutral universal mesoscale metric we start by observing that the spatial distribution of rain in a given region is controlled by the interplay between the meteorological parameters (humidity, wind, pressure etc.) and the Earth's topography. As a result, each recurring climactic phenomena exhibits a unique regional signature/distribution. Unlike at the synoptic scale, mesoscale climate patterns are largely stationary and an accumulation of two decades of high resolution satellite observations means that these patterns can now be reliably numerically extracted. The key additional observation is that at the mesoscale climate phenomena typically have either one or two non-co-occurring stationary states. This allows us to isolate patterns by a simple bifurcating of the subspace of the first two singular vectors. The end result behaves like a trivial Empirical Orthogonal Function (EOF) rotation that has a clear interpretation. It isolates the climate patterns as basis vectors and allows us to subsequently estimate the presence of the climate phenomena at arbitrary timescales. As a case study we use gridded precipitation data from NASA's Global Precipitation Measurement (GPM) mission (compiled in to the IMERG dataset) in several regions and timescales of particular interest