



Challenges and Opportunities in Physically-Based Downscaling of Rainfall – Toward Hydrological Consequence

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One challenge to the utility of rainfall observations from satellite-based sensors and from mesoscale weather models is the scale separation between the canonical scales of the model and, or the measurement system and the scales of hydro-eco-geomorphological consequence, that is the scales at which flooding and landslides for example take place. Here, we first review a decade of research in the application of simple fractal and multifractal algorithms with and without physical constraints to raingauge, satellite and model data. Second, we present a synthesis survey of space-time modes of variability of orographic precipitation from the summit to the plains in major mountains ranges including the Himalayas, the Andes and the Western Cordillera of South America down to Mexico. Third, we argue that, perhaps contrary to intuition, it is easier to incorporate physical constraints for downscaling in the case of orographic precipitation that exhibits strong stationary modulation by landform than in the case of mesoscale convective systems in relatively smooth terrain (e.g. the Central Plains in the US). Finally, we present a framework for data-on-data assimilation of these multiscale modes of variability in existing downscaling algorithms.