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Rainy Day: A Remote Sensing-Driven Extreme Rainfall Simulation Approach for Hazard Assessment

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Progress on the assessment of rainfall-driven hazards such as floods and landslides has been hampered by the challenge of characterizing the frequency, intensity, and structure of extreme rainfall at the watershed or hillslope scale. Conventional approaches rely on simplifying assumptions and are strongly dependent on the location, the availability of long-term rain gage measurements, and the subjectivity of the analyst. Regional and global-scale rainfall remote sensing products provide an alternative, but are limited by relatively short (∼15-year) observational records. To overcome this, we have coupled these remote sensing products with a space-time resampling framework known as stochastic storm transposition (SST). SST "lengthens" the rainfall record by resampling from a catalog of observed storms from a user-defined region, effectively recreating the regional extreme rainfall hydroclimate. This coupling has been codified in Rainy Day, a Python-based platform for quickly generating large numbers of probabilistic extreme rainfall "scenarios" at any point on the globe. Rainy Day is readily compatible with any gridded rainfall dataset. The user can optionally incorporate regional rain gage or weather radar measurements for bias correction using the Precipitation Uncertainties for Satellite Hydrology (PUSH) framework.

Results from Rainy Day using the CMORPH satellite precipitation product are compared with local observations in two examples. The first example is peak discharge estimation in a medium-sized (∼4000 square km) watershed in the central United States performed using CUENCAS, a parsimonious physically-based distributed hydrologic model. The second example is rainfall frequency analysis for Saint Lucia, a small volcanic island in the eastern Caribbean that is prone to landslides and flash floods. The distinct rainfall hydroclimates of the two example sites illustrate the flexibility of the approach and its usefulness for hazard analysis in data-poor regions.