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Can Regional Climate Models be used in the assessment of vulnerability and risk caused by extreme events?

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Extreme meteorological events played an important role in catastrophic occurrences observed in the past over densely populated areas in Brazil. This motived the proposal of an integrated system for analysis and assessment of vulnerability and risk caused by extreme events in urban areas that are particularly affected by complex topography. That requires a multi-scale approach, which is centered on a regional modeling system, consisting of a regional (spectral) climate model coupled to a land-surface scheme. This regional modeling system employs a boundary forcing method based on scale-selective bias correction and assimilation of satellite-based precipitation estimates. Scale-selective bias correction is a method similar to the spectral nudging technique for dynamical downscaling that allows internal modes to develop in agreement with the large-scale features, while the precipitation assimilation procedure improves the modeled deep-convection and drives the land-surface scheme variables. Here, the scale-selective bias correction acts only on the rotational part of the wind field, letting the precipitation assimilation procedure to correct moisture convergence, in order to reconstruct South American current climate within the South American Hydroclimate Reconstruction Project. The hydroclimate reconstruction outputs might eventually produce improved initial conditions for high-resolution numerical integrations in metropolitan regions, generating more reliable short-term precipitation predictions, and providing accurate hidrometeorological variables to higher resolution geomorphological models. Better representation of deep-convection from intermediate scales is relevant when the resolution of the regional modeling system is refined by any method to meet the scale of geomorphological dynamic models of stability and mass movement, assisting in the assessment of risk areas and estimation of terrain stability over complex topography. The reconstruction of past extreme events also helps the development of a system for decision-making, regarding natural and social disasters, and reducing impacts. Numerical experiments using this regional modeling system successfully modeled severe weather events in Brazil. Comparisons with the NCEP Climate Forecast System Reanalysis outputs were made at resolutions of about 40- and 25-km of the regional climate model.