BLENDING A HIGH DIMENSIONAL STATE SPACE MODEL WITH A DATA ASSIMILATION TECHNIQUE FOR EFFICIENT SIMULATION OF NON-STATIONARY TROPICAL CYCLONE PRECIPITATION PATTERNS

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To provide a reliable representation of the risk from Tropical Cyclone (TC) induced floods, one needs to conduct high spatial and temporal resolution simulations for tens, and even hundreds of thousands of seasons under specific climate conditions. Ultimately, this could be done by using a Numerical Weather Prediction (NWP) model, but this approach is not feasible in the catastrophe modeling context and, most importantly, may not provide TC tracks consistent with observations. Rather, we propose to leverage ensemble NWP output for the observed TC precipitation patterns (in terms of downscaled reanalysis) collected on a Lagrangian frame along the historical TC tracks. The ensembles from all 6-howrly simulation periods are then considered as a “dictionary” of stochastic models. Provided that the stochastic storm tracks with all the parameters describing the TC evolution are already simulated, a sequence of samples from the dictionary are chosen conditionally on the TC characteristics at a given moment in space and time. The samples are concatenated using a data assimilation technique, producing a continuous non-stationary precipitation pattern on a Lagrangian frame. The simulated precipitation for each event is finally distributed along the stochastic TC track and blended with a non-TC background precipitation. The proposed framework provides means of efficient simulation (100000 seasons simulated within a couple of weeks) of robust TC precipitation patterns consistent with observed regional climate and visually undistinguishable from high resolution NWP output. The framework is used to simulate a catalog of 100000 hurricane seasons and implemented in a flood risk model for US.