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Prediction of north Indian Ocean Tropical Cyclones using WRF model: Sensitivity for perturbation and filtering on the initial condition

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The northern Indian Ocean (NIO) is known for tropical cyclones (TCs), likely to increase in the future. It occurs mainly in April-June (pre-monsoon) and October-December (post-monsoon) seasons, destructive for the coastal regions of India, Bangladesh, Pakistan, Oman. To provide reliable alerts and disaster warnings ahead of time, better forecasting of TC aspects (such as track, landfall, strength, rainfall, and so on) is a primary focus. The Weather Research and Forecasting (WRF) model is a mesoscale numerical weather prediction system used to forecast short and medium-range weather phenomena. The reliability of the skill of WRF prediction has been qualitatively enhanced with the successful implementation of some advanced methods and subjected to various constraints i.e. initial conditions, domain, parameterization, etc. In this study, the sensitivity of the initialization is accessed by deploying the digital filter initialization (DFI), and a stochastically perturbed physics-tendency (SPPT) based ensemble-mean techniques to anticipate the two NIO TCs, Tauktae (May 2021) and Nivar (November 2020). Compared to control simulations, the adoption of both DFI and SPPT-based ensemble-mean approaches in the model setup yields considerable gains, replicating closer to the observations, albeit with some deviations. The DFI technique significantly improved the TC's track prediction, while the SPPT-based ensemble-mean forecast approach increased the model's efficiency in predicting the TC's intensity.