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On the Combination of Physical Parameterization Schemes for Tropical Cyclone Track and Intensity Forecasts in the Context of Uncertainty

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The selection of physical parameterization schemes for tropical cyclone (TC) forecasts has required a substantial amount of effort. In general, the evaluation of physical parameterization schemes and their combined performance was based solely on the deterministic forecast, which had inherent limitations in representing the overall performance of physical parameterization schemes due to the model uncertainty. This study introduces an uncertainty-informed framework of evaluating and selecting the combination of physical parameterization schemes for TC forecasts, based on the ensemble forecast that could include the model uncertainty roles. The performance ranking of the scheme combination based on the ensemble mean error is found to be distinct from that based on the deterministic forecast error. Moreover, differences in both ensemble mean errors and ensemble spreads for various scheme combinations highlight the importance of considering two metrics concurrently, i.e., via the quality of the forecast distribution as a whole, to assess the forecast performance. Consequently, the ensemble Continuous Ranked Probability Score (eCRPS) is used to quantify the performance of the scheme combinations, and it is demonstrated that the performance is more comprehensive than that in the deterministic context. Finally, the well-performed scheme combination for the forecasts of six intense TCs is chosen from the evaluated schemes in the context of model uncertainty, based on the overall quality of TC track and intensity forecast distributions.