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Sensitivity of tropical cyclone intensity simulation on SST forcing uncertainties

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Among all of the uncertainty sources of tropical cyclone (TC) intensity forecast error, sea surface temperature (SST) uncertainty has been shown to play an important role. In the present study, we determine the SST forcing errors that will cause largest forecast error of TC intensity, which represents the nonlinear forcing singular vector (NFSV)-type error of the time-dependent SST forcing term of the WRF model. Results shown that the NFSV-type errors of 12 TC cases associated with SST forcing have a consistent structure: positive (or negative) SST errors locate at the track of TCs, which indicates the TCs forecast errors are more sensitive to the local SST forcing errors. The space-dependent sensitivity of TC forecast errors on SST forcing errors is examined. It is shown that the spatial patterns of the correlation coefficients between the TCs intensity forecast errors and SST forcing errors bear great similarities to the NFSV structure. One implication is that the region of high correlation coefficients correspond to that where the NFSV-type errors is of large values. The region of large NFSV-type errors is shown to locate at the track of TCs. Especially, it often arises during the period of TCs undergoing intensifying and slowly moving speed. It is demonstrated that the larger vertical velocity, inflow velocity, and inertial stability during this period lead TCs intensity to be more sensitive to the SST forcing errors in the regions of large NFSV-type errors. It is inferred that the region of large NFSV-type errors represents the one where the forecast errors of TCs intensity are aggressively sensitive to the SST forcing errors. If one preferentially makes the SST there more accurate, the forecast skill of the TCs intensity could be much greatly improved.