The relationship between Sea Surface Temperature and Maximum Intensification Rate of Tropical Cyclones in the North Atlantic

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Abstract

An empirical relationship between sea surface temperature (SST) and the maximum potential intensification rate (MPIR) of tropical cyclones (TCs) over the North Atlantic has been developed based on the best track TC data and the observed SST during 1988–2014. Similar to the empirical relationship between SST and the maximum potential intensity of TCs previously documented, results from this study show a nonlinear increasing trend of the MPIR with increasing SST, with a more rapid increasing trend when SST is higher than 27℃. Further analyses indicate that about 28% of intensifying TCs over the North Atlantic reached 50% of their MPIR and only 7% reached 80% of their MPIR at the time when they were at their lifetime maximum intensification rates. Moreover, a TC tended to have a larger intensification rate when it was located in regions with higher SST and lower vertical wind shear (VWS). This indicates that although the MPIR-SST relationship is much stronger than that for the IR rate versus SST for most TCs, the actual intensification rate of a TC is determined by not only the SST but also other environmental effects, such as VWS. Additional results from a simplified dynamical system previously developed for TC intensity prediction suggest a similar SST-dependent TC MPIR with that fitted from observations. However, the MPIR obtained from the observational fitting seems to underestimate the MPIR in regions with low SST at higher latitudes where VWS is often large. Nevertheless, this study provides the observational evidence for the existence of the MPIR for TCs.