

Are outer tropical cyclone rainbands similar to squall lines?

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Tropical cyclone rainbands (TCRs) are not only one of the most striking and persistent features of tropical cyclones (TCs) but also one of the major causes for extreme floods as TCs approach or encounter the land area. TCRs have been traditionally considered as manifestations of atmospheric waves initiated near the eyewall or close to the TC center. In this context, the convective initiation and development of TCRs are primarily governed by wave-induced vertical motions and/or disturbances and have been usually thought to be distinctly different from those of ordinary convective rainbands such as squall lines. This long-standing, traditional belief has been shaken lately by the limited research evidence showing the possibility for TCRs to develop squall-line-like characteristics in the outer region of TCs. However, whether this appealing similarity emerges as a common or exceptional case has not been identified nowadays because only very few outer TCRs have been thoroughly studied and reported in the literature. In this study, the degree of the prevalence for this similarity is explored by dual-Doppler radar analyses and surface observations from a large set of 50 outer TCRs associated with 22 TCs as they approached Taiwan. The results indicate that around 58% of outer TCRs exhibit convective structures similar to squall lines. These outer TCRs are generally characterized by convective precipitation, an obvious convergence zone between the band-relative rear-to-front flow and front-to-rear flow at low levels, either frontward or rearward tilting updrafts, and a surface cold pool signature. The frequent similarity between the outer TCRs and squall lines documented in this study provides important insights into the formation and organization of heavy precipitation associated with TCs.

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