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How does dry air influence the precipitation of landfalling tropical cyclones

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The vertical structure of precipitation and its evolution during mid-level dry-air intrusion (DAI) for landfalling tropical cyclones (LTCs) over China in the past 10 years were examined using several observed TRMM PR products and a reanalysis dataset. We show that in the outer region where the environmental mid-level dry air intrudes more easily, the process of environmental DAI has an important effect on the vertical structure and precipitation of LTCs through promoting substantially stratiform precipitation while inhibiting infrequent intense convective precipitation. Although the total mean rain rate does not change much during the DAI period, both the mean rain rate and area of stratiform precipitation are almost doubled, while the convective precipitation halves compared to the situation prior to the DAI period. Also, the vertical structure of precipitation relative to the vertical wind shear (VWS) is modulated by the dry air, with a clear stratiform precipitation structure in the DAI region, though the dry-air distribution of LTCs does not depend on the direction of the VWS but rather on the synoptic environmental collocation. Further analysis shows that the mid-level DAI is favorable to the generation of stratiform precipitation through producing moderate mid-level convergence and less intense low-level subsidence, which contribute to the mid-level spin-up without spinning down the low-level circulation. At the same time, it helps maintaining the uniform stratiform precipitation above the melting layer and homogenizing the low-level circulation, and thus boosts the development of stratiform precipitation in intensity and area in the outer region.