

Precipitation enhancement via the interplay between atmospheric rivers and cutoff lows

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A significant precipitation enhancement can result from the interplay between two independent, largescale phenomena: an atmospheric river (AR) and a cutoff low (COL). An AR is a long, narrow area with a deep moist layer. A COL is an upper tropospheric cyclonic disturbance isolated from the meandering upper-level westerly jet. Here, we construct composites of COLs which are close to an AR (AR-close category) and of those which are distant from an AR (AR-distant category) over a 14-yr period across the western North Pacific. We assume that the interplay enhances precipitation around COLs in the AR-close category and the interplay has little effects on COLs in the AR-distant category. A comparison between the two categories shows an enhanced precipitation area to the northwest of the COL and to the south of the AR axis in the AR-close category. The horizontal formation among the AR, COL, and enhanced precipitation area in the composite coincides with that in a rainfall event occurred in Hiroshima, Japan, in 2014. The deep moist layer related to the AR, and the destabilization and isentropic up-gliding effect related to the COL are also observed both in the composite and in the Hiroshima rainfall cases. Moreover, we evaluate the distribution of quasi-geostrophic forcing (Q-vector divergence) for vertical motion. The result demonstrates that warm air advection associated with the AR overcomes the descending forcing inherent in the northwest of the COL and makes the instability and up-gliding effect in that region more effective. These results indicate that the interplay between ARs and COLs is a common mechanism in the enhancement of precipitation and the Hiroshima rainfall case is an extreme precipitation event caused by this interplay.

Key words: atmospheric river, cutoff low, rainfall event

References

Tsuji, H., and Takayabu, Y. N. (2019) Precipitation Enhancement via the Interplay between Atmospheric Rivers and Cutoff Lows. *Mon. Wea. Rev.*, **147**, 2451–2466, doi:10.1175/MWR-D-18-0358.1.