國立中央大學大氣物理研究所書報討論

Date：2025/12/12
Location：S1-713
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Bridging the polarimetric structure and lightning activity of isolated thunderstorm cells during the cloud life cycle

Polarimetric structures detected by radar can characterize cloud microphysics and dynamics. Recently, more and more studies focus on differential reflectivity (ZDR) and specific differential phase (KDP) columns, which can serve as proxies for updraught strength, are related to lightning activity. This paper using a “3D mapping columns” method to identify and quantify the ZDR KDP columns, and apply polarimetric variables to Hydrometeor identification method and microphysical process diagnostics, try to bridge lightning activity and microphysical structure evolution in 15 isolated thunderstorms throughout their whole life cycles. The result showed intensification of riming processes corresponds to increased lightning activity. Moreover, ZDR column volume provides a effective lead time of approximately 12 minutes for lightning activity, highlighting the strong connection between cloud microphysics, storm dynamics, and electrical activity.

Keywords:

Lightning (閃電)

Reference:

Zhao, C., Zhang, Y., Zhai, H., Li, Z., Zheng, D., Peng, X., Yao, W., Du, S., and Du, Y.: Bridging the polarimetric structure and lightning activity of isolated thunderstorm cells during the cloud life cycle , Atmos. Chem. Phys., 25, 13453–13473, https://doi.org/10.5194/acp-25-13453-2025, 2025