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Multi-case analysis of ice particle properties of stratiform clouds using in-situ aircraft observations in Hebei, China

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This study investigates the size distribution, the mean diameter and the concentration of ice particles within stratiform clouds by using in-situ observations from 29 flights in Hebei, China. Furthermore, it examines the empirical fitting of ice particle size distributions at different temperatures using Gamma and exponential functions. Without considering the first three bins of ice particles, the mean diameter of ice particles (size range 100 – 1550 μm) is found to increase with temperature from -15 □ to -9 □ but decrease with temperature from -9 □ and 0 □. By considering the first three bins of ice particles using the empirical Gamma fitting relationship found in this study, the mean diameter of ice particles (size range 25 – 1550 μm) shows similar variation trend with temperature, while the turning point changes from -9□ to -10□. The ice particle number concentration increases from 13.37 L^{-1} to 50.23 L^{-1} with an average of 31.27 L^{-1} when temperature decreases from 0 □ to -9 □. Differently, the ice concentration decreases from 50.23 L^{-1} to about 22.4 L^{-1} when temperature decreases from -9 □to -12 □. The largest mean diameter of ice particles at temperatures around -9 □ and -10 □ is most likely associated with the maximum difference of ice and water supersaturation at that temperature, making the ice particles grow the fastest. These findings provide valuable information for future physical parameterization development of ice crystals within stratiform clouds.