

Synoptic-scale conditions with occurrence of winter lightning in the Hokuriku district of Japan

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Generally, almost all lightning is negatively charged, while the ratio of positive lightning increase in winter thunderstorm. Some studies have indicated that the positive lightning would be caused by strong vertical wind shear and/or weak updraft. This study examined difference of synoptic-scale atmosphere conditions between the negative and positive lightning with occurrence of winter lightning based on lightning data obtained by Lightning Location System in Hokuriku district of Japan and atmospheric data obtained by Japan Meteorological Agency Meso-Scale Model. The relationships among the causes were evaluated by composite analysis for 8 years from Oct 2006 to Mar 2014.

In the positive lightning cases, from December to March, Hokuriku district were located near the southern part of the cyclone passing over the Sea of Japan. Further, vertical wind shear was relatively strong and updraft was relatively weaken in the positive lightning cases, which are consistent with the results mentioned in some previous studies. In the negative lightning cases, negative and positive geopotential height anomalies appeared in the east and west the Sea of Japan, respectively, and there were the cold air anomalies in the mid-troposphere. In contrast, remarkable differences were not identified in the synoptic-scale atmospheric conditions between the positive and negative lightning cases in October and November.

Keywords: positive cloud-to-ground lightning, winter lightning, thunderstorm