

## **Synoptic climatological study on the long-term change in the snowfall around Hokuriku District in Central Japan during the recent 45 years with special attention to the atmospheric conditions on the extreme heavy snowfall days**

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It is well known that the total snowfall amount in winter in the Japan Sea side of the Japan Islands, especially around Hokuriku District, decreased considerably after around 1987, in coincidence with the Global Warming together with the inter-decadal variation. Although the snowfall there is brought mainly in association with the cold air outbreak situation from the Siberian Continent over the warm underlying sea (so-called in the “winter pressure pattern”), the daily snowfall amount fluctuates greatly depending on the variety of detailed features of the “winter pressure pattern”. In order to understand the processes of the climatological decrease in the total snowfall amount there in midwinter, it is necessary to pay attention to the long-term change in the characteristics of the dominant “winter pressure pattern”, especially to those associated with the extreme heavy snowfall days. Thus the present study examined the synoptic climatological features of atmospheric fields relating to the extreme heavy snowfall days associated with the long-term change in the snowfall around Hokuriku District in Central Japan, based on the daily operational observation data by the JMA in the Hokuriku District and the NCEP/ NCAR re-analysis data with every 2.5 degrees latitude/longitude interval for the January of 1972- 2015.

The decrease in total snowfall amount after around 1987 in the Hokuriku District (in this study, the averaged values for the 4 coastal stations Takada, Toyama, Kanazawa and Fukui were examined) was greatly reflected by that in “heavy snowfall days” with more than 30 cm/day, although the appearance frequency of the total “winter pressure pattern” extracted after Yoshino and Kai (1977) and that of the strong “winter pressure pattern” with larger eastward pressure gradient around the Japan Sea area did not change so much even after around 1987. In other words, the mean snowfall amount per a day of the strong “winter pressure pattern” was rather larger before around 1986, resulting in the long-term change in total snowfall amount there.

According to the composite analyses of the atmospheric fields, the extremely heavy snowfall events mentioned above was not only due to the instantaneous strong cold air advection over the Japan Sea in the lower layer but also relating to the strong cold vortex in the middle troposphere (e.g., at 500 hPa level) simultaneously. In that situation, the convective mixed layer in association with the air mass transformation processes then was more deepened around the Hokuriku District (the downstream side of cold air outbreak over the Japan Sea). Besides, such situations, which appeared mainly before around 1987, tend to persist longer (for a several days or more) than in the other “winter pressure pattern” days. Thus the present results illustrate that we should pay attention to the role of the extreme heavy snowfall days in the long-term change in “total snowfall” there, although the appearance frequency of such events is rather low compared to that of the “winter pressure pattern” days.