Climatology of Winter and Summertime Extreme Rainfall Events over Northern Japan

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The synoptic-scale atmospheric circulations are crucial for extreme rainfall events in Northernmost Japanese island Hokkaido. We used PCA and K-means clustering as a computer-assisted multivariate statistics method to interpret three major circulation patterns that describe extreme or topmost 100 snowfall intensity days (SFI_{days}) from 1992 to 2011. For the extreme snowfall events i.e., extreme wintertime rainfall events the most common characteristics among the obtained three circulation patterns are the advective situation from north or northwest, moisture is brought to Hokkaido from the Japan Sea, and existence of stationary low pressure system at surface and at 500h Pa level. The circulation patterns leading to the most extreme (1-7 SFI_{days}) snowfall events were governed by the advection of very cold airmass from eastern Siberia due to presence of active and stationary Pacific low pressure system over southeast of Hokkaido. The combination of anomalously larger amount of moisture, and northerly strong wind enhances vertical motion associated with orographic barrier that support 500 hPa deep cold-core low developments over southern Hokkaido. The finding implies that the differences among these patterns in terms of specific positions, the intensity, and the trajectories of the circulation systems may play a vital role determining extreme snowfall events.

A similar approach is applied to summertime extreme rainfall events i.e., on line-shaped rainbands over northern Japan where the line-shaped rainbands (LRBs) are defined as the severe storm events that cause torrential rainfall across the mid-latitudes by their stationary characteristics. Over Hokkaido, a line-shaped rainband (LRB) brought severe rainfall of 42 mm/h between 23 and 24 August 2010 that crossed a 53-year recorded rainfall in Sapporo City. According to Yamada et al. (2012), number of LRBs in 2010 between June and August (JJA) was 21 against 7 LRBs in the same season between 1990 and 2009 by analyzing radar precipitation data from the Automated Meteorological Data Acquisition System (AMeDAS). However, the meso and synoptic scale meteorology are under investigation to characterize LRBs based on AMeDAS radar rainfall data, weather maps provided by Japan Meteorological Agency (JMA), NCEP-NCAR reanalysis dataset.