

Atmospheric Circulation and Water Vapor Characteristics of Snowstorm Anomalies in Northern Xinjiang

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abstract

Northern Xinjiang has deep and long-standing winter snow. It is one of regions that have the most abundant snow. Snowstorm with huge amount of snow frequently induced snow disaster which deeply affects agriculture, animal husbandry, and transportation. Northern Xinjiang, a vast and complicated terrain, snowstorm forecast has been intricate. Because snowstorm's loading area directly affects the disasters prediction and disaster relief, the depth analysis of Xinjiang snowstorm is necessary.

1. Climatic characteristics of snowstorm in northern Xinjiang

There are four high-incidence areas in northern Xinjiang region: Ili River Valley, northern Tacheng, Northern Tianshan Mountain, and Altay regions.

In a general way, the snowstorms in northern Tacheng and Altay are warm sector snowstorm, and the snowstorms in Ili River Valley and Northern Tianshan Mountain are cold front snowstorm.

From the inter-decadal and inter-annual variation of the snowstorm in 50 winters, the number of snowstorm in northern Xinjiang tends to increase linearly.

From the month-by-month distribution of snowstorm in northern Xinjiang, we can see that the snowstorm mainly occurs in early winter and spring season.

The amount of each station snowfall show that the maximum daily snowfall is occurs in Ili River Valley, Bortala State and the northern Tacheng.

2. Weather characteristics of snowstorm in northern Xinjiang

2.1 large-scale circulation

(1)The polar frontal zone move towards the south, and the subtropical frontal zone move towards the north with high activity.

The polar vortex stay in the northeast hemisphere, and the polar front zone is always in the area of nearby 50 °N. The subtropical frontal zone moved towards the north and these two frontal zones interacted in Central Asia.

(2)Ridge in high latitudes from Europe to Siberia

The snowstorm accompanied by the establishment of European ridge, the Ural ridge or the West Siberian ridge, cold air south down and front zone became stronger which resulted in the long-stand heavy snow.

2.2 interaction of low-level jet and upper-level jet

Low-level jet and upper-level jet prompt lower-level convergence and upper-level divergence, and updraft enlargement.

In summary, the interaction of weather systems and topography in the winter snow forecast cannot be ignored. The role of convergence and uplifting of low level

are more significant. When snow occurs, western air flows are present in both Ili River Valley and Tacheng areas. There are southeastern air flow in Altay and northern air flow in Urumqi. Snowstorms are always accompanied with jet higher than 10m / s.

2.3 mesoscale system

It is shown that the mesoscale shear line at the low and middle levels are the dynamic factors which triggered and maintained the snowstorm. It is warm shear in northern Tacheng and Altay, and cold shear in Ili River Valley and northern slope of the middle Tianshan Mountain.

There is convergence line in low level during snow period, and its strength is well related to snowfall intensity.

The duration and snowfall is proportional to the amount of mesoscale cloud clusters. Snowstorm is occur in the margin area of mesoscale cold cloud clusters which TBB is less than -60 degrees Celsius, or the front of the biggest TBB gradient region.

2.4 water vapor transfer

The cradle of transporting vapor of snowstorm in northern Xinjiang mainly contains the Mediterranean and the Red Sea or the Persian Gulf.

The water vapor of the snowstorm in northern Xinjiang is transfer in a relay, and the location and intensity of the Iran subtropical high is crucial for water vapor transfer of snowstorm.

The biggest vapor transfer lies in 650-750hPa(about 2-5km).

3. Forecast Index of Snowstorm in northern Xinjiang

During snowfall, the location and intensity of jet stream on 500hPa is close relations to snowfall drop area. There is obvious shear or convergence on 700hPa. Wind convergence on 850hPa and topographic lifting are key index of snowstorm area.

In Northern areas of northern Xinjiang, snowfall mainly happened in warm areas. Along with the strong snowfall, in terms of meteorological elements, a sharp decline in air pressure, temperature rising, and thermal inverted trough or the entering of Central Asia air are commonly observed. When the negative pressure is the highest, the heavy snowfall will happen. Therefore when pressure drop becomes the most obvious, it can be considered as the period having a heavy snowfall. This can be used to forecast the beginning and the end of heavy snowfall.

Cold front snowfalls typically dominate in Yili River Valley and the northern areas along the Tianshan Mountain. Opposite to the warm area snowfall, when pressure rising is intense, cold high pressure will enters rapidly. Heavy snowfall often happens when the changes of air pressure are the most dramatic.

Key words: snowstorm, northern Xinjiang, Climatic characteristics, circulation characteristic, forecast index