

The Synoptic Activity Centers and Pressure Patterns of Heavy Snowfall in Northwest of Iran

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1. Introduction

The position of Iran in the subtropical region that has made its arid and semiarid climate and the topographic diversity changes this trend of climate. Therefore, climate hazards such as frost, flood, dust storm, drought, temperature anomalies, heavy rainfall, avalanches, snow, sleet, etc occur in Iran. The Northwest of Iran experiences the above conditions following the arrival of west winds, cool and humid polar air mass from the East Europe, and the complex topography (mountain nodes of Iran). The relationships among climate hazards, and the weather patterns and identifying climate anomaly patterns of activity can mitigate the effects of climate and forecasting atmospheric phenomena, which helps the planners and managers. Much research has been done in this regard, including the planetary-scale circulation anomalies compared with synoptic-scale anomalies associated with higher intensity of extreme weather events are in America (Konrad, 1995, p. 1067) and the atmospheric circulation patterns associated with heavy snowfall in Montana of America, with a deep trough in the west winds and the cold flow from northwest, and with temperatures below zero (Birkland & Mock, 1996, p. 281). The flow pattern in the Great Lakes Basin winter severity Lorentz in the period of 1950-1998 were shows to the prevailing winter circulation patterns in the three synoptic type associated with the winter cold, temperate and hot identified, each of them during the rule of a special circular pattern (Rodionov & Assel, 2000, p. 601). The daily circulation patterns causing heavy snowfall in Poland using principal component analysis are related to strong positive anomalies in the Nordic and North Atlantic sea-level pressure, with positive anomalies of Iceland and the Azores high pressure weak anomalies (Bednorz, 2008, p.133). The aim of this study is identified the atmospheric important index of heavy snow in the middle levels in Northwest of Iran.

2. Study Area

The Northwest of Iran locates in the East latitude of 36. 4 and 39. 2 and North longitude of 49. 2 and 44. 26. The mountains of Alborz and Zagros connected together and one of the largest lakes in the world is locate in this area. Also the cold and wet air masses from the Arctic, Northern Europe and Eastern Europe come to Iran from this

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area. With this feature the lowest temperatures throughout the year and most snow is falling in this region.

3. Material and methods

In connect to aim of study, to determine of the Synoptic snow days, the daily data of precipitation and temperature since 1989-2010 of twelve synoptic stations received of Iran Meteorological Organization. The identify of heavy snowfall according to definition of the World Meteorological Organization, rainfall of 15 inches of snow in 24 hours, and considering that 15 inches of snow is equal to 12.5 mm of precipitation done (Alizadeh,1999). Because of the lack of long-term statistics height of fresh snow, the rain days with 12 mm of precipitation or more and the minimum temperature of zero or less is snow day. In order to more accurately in determination of snow day used snow coefficient (Bairoodain, 2003, p. 320). In order to determine of the activity centers associated with the heavy snowfall, first to receive of the digital data was selected the geographic window to the North latitude of 10-60 and East longitude of 15-80. Therefore the daily data for the height of 500 hPa, sea level pressure, Omega of 850 and temperature of 700 of the Centers for Environmental Prediction and Center for atmospheric research were received. The principal component analysis (PCA) was used to determine of the activity centers of heavy snow at level of 500 hPa.

4. Results and discussion

The seven of action center was identified that account for 79% of the total variance in the original data. The first five Center of action are the most important, the first centers to 18% of the variance locate on the Arabian Sea and North Pole, this pattern shows westerly winds and the general circulation. The second center (14%) with two West-East of center represents meridional movements in Western Europe and Central Siberia. The third center (13%) locates on Eastern Europe and the northern Black Sea (Balkan). The fourth of action center (12%) is located on the central Asia. The fifth center (9%) is on the Anatolia area, Turkey and Northwest of Iran. The pattern of the atmosphere of first center is associated with the polar vortex from Western, Eastern Europe and the Mediterranean with height of 5480 m and the deep trough to cut off low locate on Turkey with height of 5450 meters. The pressure pattern of the surface is Siberian high pressure and southern Europe that combined in the region. The pattern of the second center is the deep trough in the northern Siberia. The strong blocking is located on the Mediterranean and Europe. The surface pattern is low pressure in the Arctic, North Asia and the Caspian Sea and the high pressure center is locate on the southern Europe and the extension to Iran and South Asia. The pattern of the third center is associated to ridge on the central Mediterranean, at the same time, cutoff low in the Caspian is caused deep trough in East Mediterranean. The cutoff low in Caucasus and ridge of European caused flows from northern Europe and Scandinavia to the Black Sea and Iran. Also at ground level, extreme high pressure on Europe combined to Siberian high pressure. In this pattern, isobar of 1035 hPa in Black Sea and isobar of 1023 and 1026 pass of the Northwest of Iran. The pattern of the fourth of action is connected to the west winds in southern Europe, the Middle East, Northern Europe and northern Asia. The ridge of

Southern Europe and cutoff low locate on the Caucasus, caused deep trough in the westerly winds in the East Mediterranean. At the same time, Siberian high pressure and Europe to 1020 hPa is evident. The pattern of the fifth of action center is related to meridional flow and the ridge on Europe and height of 5700 meters is located on the north of the Mediterranean and southern Europe. In surface, the deep trough of westerly winds of the north-western Russia continues to southern Egypt. In this pattern, the polar vortex is located on the Scandinavia, Black Sea, Turkey, Iraq, north and Northwest of Iran. The pattern of the Earth's surface is connect to high pressure of western Mediterranean and high pressure of Siberia in East Iran and low pressure in northern Europe to Iran.

5. Conclusion

The climatic indices of heavy snow in the Northwest of Iran is locate in northern Siberia, Central Siberia, Balkan, Central Asia and the Anatolia. The of upper atmospheric patterns of these indicators are associate with meridional westerly winds, blocking of southern Europe, ridges in central Asia, eastern Europe, east Mediterranean sea, central Asia and cutoff low on Turkey. The blocking and long ridges related to air masses of the north Atlantic over Europe by crossing of the Black Sea and persistence of the cutoff low on Balkans is caused heavy snowfall. At ground level are a combined high pressure of Siberia and Europe. So that the Isobaric 1017 and 1020 hPa passes through the Northwest of Iran to the cold air masses in heavy snowfall days. The Siberian high pressure in the East and Northeast of Iran causes continued rainfall in northwestern of Iran. the lowest temperature in the middle levels of atmosphere experience in the days of heavy snow with -10°C and isotherm of zero is on the Persian Gulf in southern of Iran, Therefore, fluctuations in temperature in Iran is above 15 degrees Celsius.. Also local and geography phenomena, including high elevation and local high pressure are affective.

Keywords. Heavy snow, principal component analysis, action centers, pressure pattern, Northwest of Iran.

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