

***Determination and Investigation about Beginning and End Dates of
Early and Late Freezes and Possibility of its Continuity, Intensity and
Succession in Ardabil Province***

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Extended Abstract

Introduction

Freeze is one of the serious climatic phenomena that influence different aspects of human life including agriculture, transportation and energy. The effects of freeze in agriculture are more than other activities. The effects in agriculture section appear more than its earliness or lateness aspects. In Ardabil Province, in most years, early and late freezes have caused serious damages to agricultural products. For example, in April 2014, the gardens in Ardabil Province experienced a loss of more than 4 billion Rials due to late spring cold. Due to this cold, 21000 Hectares of the gardens were damaged.

One of the the causes of enormous losses resulted from climatic phenomena like freezes is unknown remaining of dimensions and nature of this phenomenon. In occasions of occurrence of early and late freezes, to decrease the losses, it is needed to have a coherent management program. To prepare this program, it is required to know different aspects of this phenomenon. In this research, it is tried to determine beginning and end dates of early and late freezes and to investigate several cases of properties of these freezes along with its possibility.

Materials and methods

Data used in this study is minimum daily temperature in a 15-year statistical period (from 1996 to 2010) in the stations of Ardabil Province. After collecting the data, a series of data were planned so that the first day-counting of data was considered October to analyze the beginning and end dates of the freezes (lack of temperature to zero and under zero Centigrade). In this research, we used knowledge of possibilities and also an approach called Markov's Chains.

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Accordingly, continuity and possibility of occurrence of early and late freezes are considered in different continuities. We investigated various intensities of early and late freezes and possibility of its occurrence and succession of different states.

Results and discussion

Analysis of the beginning and end dates of occurrence of the freezes shows that general trend of day-counting of beginning date of freezes in Parsabad Station is decreasing and moves toward hot season. In stations of Ardabil and Khalkhal, this trend is increasing. In Khalkhal Station, the beginning dates of freeze moves toward cold season with intensity of 1.07 day per year.

Investigation about the end dates of freezes according to regression analysis shows that general trend of day-counting was decreasing by 0.517 day per year in Parsabad Station and was increasing by about 0.29 and 0.14 day per year in stations of Ardabil and Khalkhal, respectively.

Early freezes start in November in Parsabad Station and in October in the stations of Ardabil and Khalkhal. The continuity of early freezes in Parsabad Station is less than other stations so that in this station freezes are not lasted more than 2 days. In Khalkhal Station, continuity of freezes is more than other stations.

In Parsabad Station, due to lower elevation, temperature was higher than other stations and intensive freezes are not observed. In Khalkhal Station, number of freezes is more than other stations. In this station, 11 intensive freezes lower than -3 centigrade has occurred that there is 2.37 per cent of possibility of its occurrence in October.

Conclusion

The most important conclusions can be made of the discussion are as follow:

- Day-counting trend of beginning of early freezes is decreasing in Parsabad Station and is increasing in Ardabil and Khalkhal. Day-counting trend of late freezes is decreasing.
- Early freezes begin in November in Parsabad Station and in October in Ardabil and Khalkhal. Late freezes are in April in Parsabad Station and in May in Ardabil and Khalkhal.
- Continuity of early freezes in Parsabad Station is less than other stations; and in Khalkhal Station the continuity of freezes is more than other stations. In late freezes in Khalkhal Station, continuity of freezes has been less than other stations.
- In terms of intensity of freezes, early intensive freeze has not happened in Parsabad Station. In this area, due to low elevation, temperature is also more than other stations and intense freezes are not observed. In Khalkhal Station, number of intensive freezes with possibility of occurrence of 2.37 percent in October is more than other stations.
- In terms of succession of different states of freeze, in early dates there is the highest possibility of occurrence of freeze after freeze in Khalkhal Station with 63.31 percent. In late dates in Ardabil Station, the occurrence of freeze is with 61.54 percent after the state of without freeze.

Keywords: *Ardabil Province, continuity, early and late, intensity, possibility, succession.*