

7/6

۳۵۳۴۵

IN THE NAME OF GOD

THE IMPACT OF NORTH ATLANTIC OSCILLATION ON
BOTH PRECIPITATION AND TEMPERATURE
FLUCTUATIONS IN IRAN

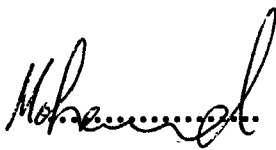
BY:
ABBAS PAYEDAR ARDAKANI

THESIS

SUBMITTED TO THE SCHOOL OF GRADUATE STUDIES IN
PARTIAL FULFILLMENT OF THE REQUIREMENTS FOR
THE DEGREE OF MASTER OF SCIENCE (M. Sc.)

IN
DESERT MANAGEMENT
SHIRAZ UNIVERSITY
SHIRAZ, IRAN

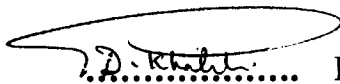
EVALUATED AND APPROVED BY THE THESIS COMMITTEE
AS: EXCELLENT



S. M. J. NAZEMOSADAT, Ph. D., ASSISTANT
PROF. OF IRRIGATION (CHAIRMAN)



S. A. A. MOOSAVI, Ph. D., ASSISTANT PROF.
OF IRRIGATION



D. KHALILI, Ph. D., ASSISTANT PROF. OF
IRRIGATION

MARCH 2001

۲۹۳۴۲

DEDICATED TO:

MY KIND PARENTS

MY SISTER, BROTHERS

AND

MY WIFE

WHO OFFER THEIR KINDNESS TO

ME IN ALL OF TIMES

ACKNOWLEDGEMENT

((The best and the most thanks is special for god))

I am very grateful to my supervisor, Dr. S. M. J. Nazemosadat for his guidance, suggestions and the use of facilities and equipment to conduct the research of this thesis.

I also wish to express my gratitude to the members of the graduate committee, Dr. S. A. A. Moosavi and Dr. D. Khalili for their useful suggestions in writing the manuscript.

Special thanks to my kind parents, sister, brothers and my wife for their patience and encouragement during the study period.

ABSTRACT

The Impact Of North Atlantic Oscillation On Both Precipitation And Temperature Fluctuations In Iran

BY:

ABBAS PAYEDAR ARDAKANI

During the last years, teleconnection patterns, i.e., the southern oscillation and its associated El Nino phenomenon (ENSO) have been the focus of broad attention. As a result, some of the characteristics, consequences and challenges of ENSO are now known to many scientists.

In the present research, an other phenomenon known as the North Atlantic Oscillation (NAO) and its influences on both precipitation and temperature has been investigated. Also an outline of the concept of the NAO, along with some of its history is presented.

In this study, correlation has been investigated between the NAO and both precipitation and temperature data of 38 synoptic stations in Iran.

Signification of obtained relationships and temporal stability are assessed by use of correlation analysis [(r), by use of common data and r(t) by use of total data] and Median of Sequential Correlation analysis (MdSC).

Fluctuations in both precipitation and temperature have been investigated on the seasonal basis. Obtained results show that the NAO phenomenon influences seasonal variations more than the monthly variations.

Winter precipitation is shown to be inversely related with the state of the NAO in the northwestern of Iran. Whereas, autumn precipitation with the NAO phenomenon were positively correlated for most parts of country (in 1% and 5% significance levels). In this research no relationship was found for both summer and spring precipitation in Iran.

On the other hand, both winter and autumn temperature have demonstrated a negative correlation with the NAO phenomenon for most parts of Iran (in 1% and 5% significance levels). But no significant relationship was obtained for both summer and spring temperature with the NAO phenomenon.

Iso- correlation line maps, were designed for the obtained results. These maps present regions that are influenced by the NAO phenomenon.

Also in this research, the response of both precipitation and temperature to the extreme phases of the NAO phenomenon was examined. The best results were found for winter and autumn. The results of this study show that the low phase of the NAO affects both winter rainfall and winter temperature. Also the high episode of the NAO has a significant effect on autumn precipitation in Iran.

Finally, it is necessary to emphasize that the NAO (as a main teleconnection pattern) has a major influence on both precipitation and temperature variability in Iran.

LIST OF CONTENTS

<u>CONTENT</u>	<u>PAGE</u>
ABSTRACT -----	IV
LIST OF TABLES -----	X
LIST OF FIGURES -----	XI
CHAPTER ONE: INTRODUCTION-----	1
CHAPTER TWO: LITERATURE REVIEW-----	5
2-1: The History of Rainfall in Iran -----	5
2-2: North Atlantic Oscillation (NAO) -----	6
2-2-1: The NAO Concept and Its History -----	6
2-2-2: NAO, Temperature and Precipitation-----	9
2-2-3: NAO and Westerlies -----	13
2-2-4: NAO and SST -----	15
2-2-5: Future Investigations on NAO-----	16
CHAPTER THREE: DATA AND METHODS-----	18
3-1: Precipitation, Temperature and NAO Data-----	18
3-2: Methodology-----	21
3-2-1: Correlation analysis -----	21
3-2-2: Median of Sequential Correlation (MdSC) Analysis	24

CONTENT

PAGE

CHAPTER FOUR: RESULTS AND DISCUSSION	----27
4-1: Relationships between Air Circulation, Precipitation and Temperature -----	27
4-2: NAO and Precipitation in Iran -----	29
4-2-1: NAO Effect on Seasonal Precipitation -----	29
4-2-1-1: NAO and Winter Precipitation -----	30
4-2-1-2: NAO, Spring and Summer Precipitation-----	35
4-2-1-3: NAO and Autumn Precipitation -----	36
4-3: NAO and Temperature in Iran -----	39
4-3-1: NAO Effect on Seasonal Temperature -----	39
4-3-1-1: NAO and Winter Temperature -----	39
4-3-1-2: NAO, Spring and Summer Temperature-----	45
4-3-1-3: NAO and Autumn Temperature -----	45
4-4: Effect of NAO on Monthly Precipitation and Temperature-----	50
4-5: The Influence of High and Low phases of NAO on both Precipitation and Temperature -----	50
4-5-1: The Influence of High and Low phases of NAO on the Rainfall in Iran-----	51
4-5-2: The Influence of High and Low phases of NAO on the Temperature in Iran -----	60
4-6: Important Points of the Obtained Results -----	64

<u>CONTENT</u>	<u>PAGE</u>
CHAPTER FIVE: CONCLUSION -----	68
Recommendations -----	71
REFERENCES -----	72

LIST OF TABLES

<u>TABLE</u>	<u>PAGE</u>
3-1: Name of stations, mean annual precipitation (P), period and record length (n), used in this research -----	19
3-2: Stations, correlation coefficient (r (NAO, winter precipitation)) and the total number of data (n) used in different parts of the Europe extracted from (Hurrell and Van loon, 1997) -----	25
4-1: The MdSC, r and r(t) values for winter precipitation in Iran -----	32
4-2: The MdSC, r and r(t) values for autumn precipitation in Iran -----	37
4-3: The MdSC, r and r(t) values for winter temperature in Iran -----	41
4-4: The MdSC, r and r(t) values for autumn temperature in Iran -----	46

LIST OF FIGURES

<u>FIGURE</u>	<u>PAGE</u>
2-1: NAO negative phase-----	10
2-2: NAO positive phase -----	11
3-1: The geographical locations of the selected stations in Iran -----	20
4-1: Iso-correlation lines map between NAO index and winter precipitation for Iran -----	31
4-2: Variations of NAO and precipitation for Oroomieh and Tabriz, in winter-----	33
4-3: Variations of NAO and precipitation for Khoy and Sanandaj, in winter -----	33
4-4: Variations of NAO and precipitation for Fasa and Kashan, in autumn -----	38
4-5: Variations of NAO and precipitation for Esfahan and Shiraz, in autumn -----	38

<u>FIGURE</u>	<u>PAGE</u>
4-6: Iso-correlation lines map between NAO index and autumn precipitation for Iran -----	40
4-7: Variations of NAO and temperature for Birjand and Bam, in winter-----	42
4-8: Variations of NAO and temperature for Kermanshah and Kerman, in winter-----	42
4-9: Iso-correlation lines map between NAO index and winter temperature for Iran -----	44
4-10: Variations of NAO and temperature for Shahrekord and Sanandaj, in autumn -----	47
4-11: Variations of NAO and temperature for Esfahan and Semnan, in autumn-----	47
4-12: Iso-correlation lines map between NAO index and autumn temperature for Iran -----	49
4-13: Correlation values of winter precipitation in the low phase of NAO for different stations of Iran-----	52

<u>FIGURE</u>	<u>PAGE</u>
4-14: Iso-correlation lines map between low phase of NAO index and winter precipitation for Iran -----	53
4-15: Concurrent variations of low phase of NAO and winter rainfall for Zanjan and Astara -----	54
4-16: Trend of variations in low phase of NAO, Zanjan and Astara precipitation. Correlation values for Zanjan and Astara are -0.80 and -0.76 respectively---	54
4-17: Correlation values of autumn precipitation in the high phase of NAO for different stations of Iran-----	56
4-18: Iso-correlation lines map between high phase of NAO index and autumn precipitation for Iran-----	57
4-19: Concurrent variations of high phase of NAO and autumn rainfall for Shiraz and Bam-----	58
4-20: Trend of variations in high phase of NAO, Bam and Shiraz precipitation. Correlation values for Bam and Shiraz are 0.79 and 0.72 respectively -----	58

FIGURE

PAGE

- 4-21: Correlation values of winter temperature in the low phase of NAO for different stations of Iran-----61
- 4-22: Iso-correlation lines map between low phase of NAO index and winter temperature for Iran-----62
- 4-23: Concurrent variations of low phase of NAO and winter temperature for Zahedan and Bam-----63
- 4-24: Trend of variations in low phase of NAO, Bam and Zahedan precipitation. Correlation values for Bam and Zahedan are -0.79 and -0.74 respectively---63