GSCAJ Geographical Studies of Coastal Areas Journal,2026,7(2), Serial 25, 1-24 https://hgscaj.guilan.ac.ir

Research Paper

# Analysis of the Relationship between Temperature Changes on the Southern Coasts of Iran and Teleconnections Indices

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DOI: 10.22124/GSCAJ.2025.26243.1280

Received: 2023/ 12/12

Accepted: 2025/ 12/04

## Abstract

In this study, the relationship between monthly temperature changes of stations located on the southern coast of Iran and the teleconnection patterns was investigated. The minimum and maximum monthly temperature data of 11 synoptic stations and 14 teleconnection patterns of the Atlantic and tropical Pacific Oceans over 1985-2024 were used. The possible relationship between the two temperature components in the studied stations and these teleconnection patterns was calculated using Pearson correlation analysis, analysis of variance, and regression analysis, and the spatial distribution of the correlation was plotted. The results showed that the highest percentage of correlation between the Pacific Ocean patterns and the minimum and maximum air temperatures of the coasts was with the AMO patterns (0.56), NTA (0.46), AMO (0.76), and ONI (-0.63) patterns, respectively. About 16-56 percent of the minimum temperature changes and 6-31 percent of the maximum temperature changes of the stations were explained by the teleconnection patterns. The NINO3, ONI (Tropical Pacific) and AMO (Atlas) models are more effective in explaining the minimum temperatures of the stations and the NINO3, AMO and AMM models are more effective in explaining the maximum temperatures of the stations. The highest frequency of significant correlations between the minimum temperatures of the stations was observed in January with TNA, in February with AMO and TNA, in March with NAO, in Orville with TSA, in June with WHWP, in July with TSA, in August with TNA, in September with WHWP and AMO, and in May, October, November and December with AMO.

**Keywords:** Temperature, Teleconnections, Regression, Southern Coasts of Iran, Correlation.

### Highlight

- The highest percentage of correlation between the Pacific Ocean patterns with the minimum and maximum coastal air temperatures was calculated with the AMO (0.76) and ONI (-0.63) patterns, and the AMO (0.56) and NTA (0.46) patterns, respectively.
- Multivariate regression models showed that tropical patterns are the most effective patterns in explaining temperature changes in at least two-thirds of the studied stations.
- The NINO3, ONI and AMO (tropical Pacific) patterns are effective in explaining the minimum temperature, and the NINO3 (tropical calm) and AMO (South Atlantic Tropical Index) and AMM patterns are effective in explaining the maximum temperature of these stations.
  The highest frequency of significant correlations between the minimum temperatures of the stations in the months of February, May, September, October, November and December is related to the AMO pattern.

## Extended Abstract

### Introduction

Temperature changes at the location of the teleconnection patterns can be the beginning of a series of changes in the general circulation patterns of the atmosphere and interconnected effects on climatic elements in other

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regions of the world. Therefore, this study aimed to identify the relationship between changes in minimum and maximum air temperatures in plain and coastal stations in southern Iran with long-distance patterns of the Atlantic and tropical Pacific Oceans based on long-term data.

## Methodology

The studied area in this study included the plain and coastal parts of the four provinces of Sistān and Baluchestān, Zāhedān, Bushehr and Khuzestān along with some Iranian islands that 11 stations with a suitable statistical period were selected and studied. In this study, the observational data of minimum and maximum air temperatures of the synoptic stations of the southern coast of Iran (as dependent variables) and the data of 14 tropical Pacific and Atlas indices including: NAO, NTA, AMO, AMM, TNA, TSA, TNI, QBO, WHWP, ONI, NINO4, NINO3.4, NINO3 and NINO1+2 (as independent variables) were used, and the length of the statistical period was determined as 40 years (1985-2024). To achieve the research aim, the monthly average data of minimum and maximum temperatures of the stations were converted into standard scores in SPSS. Then, the correlation of the patterns with the minimum and maximum air temperatures of the stations under study during the studed period was calculated in the form of a time series without time lag and for each month using the Pearson method, and correlation maps without time lag of the patterns and the two temperature components were drawn. Next, the relationship between changes in air temperature on the southern coast of Iran and the teleconnection patterns was examined and analyzed using backward multivariate regression relationships.

## Results and discussion

The results of calculating the correlation without time lag of the monthly temperature time series with the studied patterns showed that the highest percentage of average minimum temperature correlation was with the AMO pattern (0.56), NTA (0.5), TNA (0.46), WHWP (0.43), TSA (0.41), AMM (0.31), NINO4 (0.29), NAO (-0.22), TNI (-0.20), NINO3 (0.19), NINO3.4 (0.17), NINO1+2 (0.15), ONI (0.14) and QBO (-0.13) and the highest percentage of average maximum temperature correlation were obtained respectively with the AMO pattern (0.76), ONI (0.63), NINO3.4 (-0.50), TNA (0.4), TSA (0.38), NTA (0.37), WHWP (0.3), TNI (0.25), NAO (-0.24), AMM (0.23),. NINO3 (-0.18), NINO1+2 (-0.16), NINO4 (-0.14) and QBO (-0.14). Also, among the tropical Pacific patterns, the WHWP pattern and among the Atlas patterns, the AMO pattern have the highest correlation with the average of minimum temperature of the stations. Also, the highest correlation between this variable with the Atlas patterns is greater than their maximum correlation values with the tropical Pacific patterns.

According to the results of multiple correlation calculation for patterns and station temperatures, 12-56% of the changes in minimum temperature and 6-31% of the changes in maximum temperature of stations are explained by the patterns. The highest coefficient of explanation of minimum and maximum temperature is related to Ahvāz and Ābādān, respectively. Multivariate regression models showed that tropical patterns are more effective patterns in explaining temperature changes in at least two-thirds of the studied stations. The NINO3, ONI and AMO patterns are effective in explaining the minimum temperature of the stations, and NINO3, AMO and AMM are more effective in explaining the maximum temperature of these stations.

In general, the correlation between the patterns with the minimum temperatures of the stations in 12 months showed that the highest frequency of significant correlations was observed between the minimum temperatures of the stations in January with TNA; in February with AMO and TNA; in March with NAO; in Orville with TSA; in June with WHWP; in July with TSA; in August with TNA; in September with WHWP and AMO and in May, October, November and December with AMO. Also, the highest frequency of significant correlations at the 95 and 99 percent confidence level was obtained between the maximum temperatures of the stations in January with the TSA pattern, in February and May with the AMO pattern, in March with the NAO pattern, in April with the ONI pattern, in June and September with the WHWP pattern, in July with the AMO, TNA and TSA patterns, in August with the WHWP, AMO and TSA patterns, in October with the TNA pattern, in November with the AMM pattern and in December with the ONI, AMM and TNA patterns.

## Conclusion

The findings confirmed that the Atlas patterns (AMO, TNA and NTA) have a significant (incomplete direct) correlation with the minimum temperature of the stations in a large number of months compared to the tropical Pacific patterns. The findings also showed that there is an incomplete inverse correlation between the NAO pattern and the temperature of the southern stations of the country. The reason is that if the positive phase of the NAO prevails, the fall of cold and dry air from high latitudes towards the Mediterranean basin and Iran is an expected phenomenon, and its effect on the temperature of Iran is often in the form of a decrease.

Based on the regression models, the effectiveness of the NINO3, ONI, NINO4, and AMO patterns on the minimum and maximum temperatures of the stations indicates their high influence from the Pacific and Atlantic SST. In general, it can be said that the Atlantic and tropical Pacific patterns have an effect on the minimum and maximum temperatures of the southern coast stations. The way the patterns affect is that the effects of the

Atlantic patterns are manifested by their effects on the Mediterranean systems and the Mediterranean landing site and the Azores subtropical high pressure, as well as SST changes on the climatic elements of Iran, and the effects of the tropical Pacific patterns are also manifested through temperature changes in the continuous water surfaces of the Pacific and Indian Oceans and, consequently, in the Sea of Oman and the Persian Gulf.

## Funding
There is no funding support.

## Authors' Contribution
Authors contributed equally to the conceptualization and writing of the article. All of the authors approved the content of the manuscript and agreed on all aspects of the work

## Conflict of Interest
Authors declared no conflict of interest.

## Acknowledgments
We are grateful to all the persons for scientific consulting in this paper.

**Citation:**
Salāhi, B., Vatanparast Ghaleh Jug, F, Sāber, M., (2026). Analysis of the Relationship between Temperature Changes on the Southern Coasts of Iran and Teleconnections Indices. *Geographical Studies of Coastal Areas Journal*, 7 (2), pp. 1-24. DOI: 10.22124/GSCAJ.2025.26243.1280

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## Funding
There is no funding support.

## Authors' Contribution
Authors contributed equally to the conceptualization and writing of the article. All of the authors approved the content of the manuscript and agreed on all aspects of the work

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## Acknowledgments
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