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Research Paper

Temporal-Spatial Changes of Maximum Wind in the Coastal Areas of Iran

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Abstract

Severe coastal winds, either directly or by flooding the coastal waters, can damage installations or cause disorder in various human activities such as shipping, commerce, recreation, etc. This study investigated the temporal-spatial variability of maximum coastal winds using the maximum wind data from stations in Iran's northern and southern coasts. Statistical analysis of the average maximum wind speed showed that the Persian Gulf coast had the highest speed. The monthly changes of the maximum wind indicated that the maximum monthly average is related to November in Anzali port and the minimum rate is for Chābahār station in all months. Generally, the variability of summer and autumn months is less than spring and winter. The maximum wind direction on the shores of the Persian Gulf and the Caspian Sea has a clockwise shift from east to west. Linear regression analysis was used to study the trend of maximum wind speed, which indicated the heterogeneity of the line slope of the stations on the southern coasts and the homogeneity of the northern coast stations with a positive slope.

Keywords: Maximum wind, Linear Regression, Temporal-Spatial variation, Coastal areas.

Highlight

- The maximum average monthly is related to November in Bandar-e-Anzali and the minimum speed is related to Chabahar station in all months and the variability of summer and autumn is less than spring and winter seasons.
- The topography altitude in the coastal areas and their distance to the coast, play a decisive role in the direction of maximum winds.
- Linear regression analysis shows the maximum wind time series have a negative slope on the south coasts (except Chabahar and Abadan stations) and a positive slope on the north coasts.

Extended Abstract

Introduction

Coastal areas are the confluence of hydrosphere, atmosphere and litosphere, and this triple link provides special biological conditions for humans and other living organisms. Due to the special characteristics of coastal areas, human life and activity in these areas are affected by the intense functions of natural factors. One of the most important natural factors in these areas is wind, and as the intensity of these winds increases, the effects increase. Severe coastal winds, either directly or by flooding the coastal waters, can damage installations and disorder in various human activities such as shipping, commerce, recreation, etc.

In this study, the monthly data of speed and direction of maximum wind of the Meteorological Organization for coastal stations on the coasts of Oman, Persian Gulf and Caspian Sea were used in the thirty-year period of October 1992 to October 2021.

Methodology

First, descriptive statistics related to each station were calculated. The maximum wind vane of each station was plotted. The frequency of wind vector events for each station was calculated and plotted. Linear regression related to each station was calculated to determine the temporal variations of maximum wind in each station.

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Results and discussion

The study of the average maximum wind speed shows that the Caspian Sea coasts with an average of 12.75 meters per second have the highest and the Oman Sea coasts with 10.97 meters per second have the lowest average maximum winds; this amount in the Persian Gulf coasts is about 12.3 meters per second. Investigation of monthly changes of maximum wind shows that the maximum average monthly is related to November in Bandar-e-Anzali and the minimum speed is related to Chabahar station in all months and the variability of summer and autumn is less than spring and winter seasons. The severe winds direction in Chabahar station are from the west-southeast and in Jask station are from the west-eastern. The direction of the maximum wind on the shores of the Persian Gulf changes clockwise from east to west stations, so that from the south in Bandar Abbas, finally it turns north in Abadan; in the shores of the Caspian Sea, from east to west (Gorgan to Astara), the prevailing wind, like the shores of the Persian Gulf, moves clockwise and changes from west to north. On the shores of the Caspian Sea from east to west (Gorgan to Astara) the prevailing wind, like the shores of the Persian Gulf, has a clockwise movement and changes west to north (except Astara). In general, due to the maximum winds are the result of pressure daily changes and considering the clockwise changes in wind direction from east to west on both the north and south coasts of Iran, it can be concluded that the topography altitude in the coastal areas and their distance to the coast, play a decisive role in the direction of maximum winds. As a result, in areas where the altitudes are low or far from the coast, high pressures are formed in the water zones and therefore the direction of maximum winds are from the sea to the land. Linear regression analysis shows the maximum wind time series have a negative slope on the south coasts (except Chabahar and Abadan stations) and a positive slope on the north coasts. The highest line slope is related to Gorgan station in the easternmost part of the Caspian Sea coast.

Conclusion

Overall it can be said that with more concentration of human activities on the coast and an increase extreme climate events, including severe winds, the probability of human and financial losses on the coast has increased and the need for identification and planning to prepare with such hazards is inevitable. According to the results of this study, which shows the increasing trend of severe winds in the northern regions, and also due to the intense concentration of population on the northern coasts, this hazard must be taken seriously. The use of coastal meteorological stations to predict and warn of severe winds, the correct location of piers, strengthening of coastal structures and construction of coastal walls to deal with strong waves caused by severe winds and Educate local residents to deal with severe winds can reduce the risk of severe damage during these events.

Keywords: Maximum wind, Linear Regression, Temporal-Spatial variation, Coastal areas.

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