

Determination of the Onset, Withdrawal and Duration of Sistan wind using a Change Point Approach

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1. Introduction

Wind is one of the important meteorological parameters which have an extensive application in environmental studies. The winds have various spatial and temporal scales regarding to their characteristics and structures. Sistan wind as an outstanding low level flow in eastern Iran is playing an important role to creation of local and regional climatic features. The Sistan wind initiates and ends with an abrupt change in wind speed and wind direction which mostly related to a regional scale atmospheric circulation pattern.

2. Study Area

The Sistan area is located at the tail end of a large closed inland basin (Fig. 1), in one of the driest regions of the world (Smith, 1974). The area has very varied climatic conditions. The annual precipitation in the lower Sistan basin is about 50 mm. The Helmand river plays a major role in the Sistan region by draining the snowmelt waters from the mountains of the southern Hindu Kush. The basin has no outlet and receives drainage from an area of about 335,000 sq km. Its floor occupies about a third of this area and lies at elevations that range from 500 to 900 m., the west end of the Hindu Kush, with peaks more than 4000 m a.s.l., borders the basin on the north. Mountains as much as 2000 m high border the basin on the west, south and east. The climate of this area is arid. Mean monthly low temperatures are near 5°C, and mean high monthly temperatures are near (35°C).

3. Material and Methods

This research aims to clarify the onset and the withdrawal dates of Sistan wind by using a change point approach. The meteorological dataset, i.e. surface wind at 10 m above ground level (agl), was obtained from the Zabol meteorological station, located well within Sistan basin and in close proximity (~10 km) from the Hamoun lakes. The dataset corresponds to 3-hrs and/or daily-averaged observations covering the whole period 1972-2012 with specific emphasis on wind velocity and wind direction. Three

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most popular change point techniques including *Pettitt*, *SNHT* and *Buishand* were applied to estimate the onset and withdrawal dates of Sistan wind during the whole period of the time. All three techniques are used wind velocity time series to clarify the specific time for each year. Also, the wind direction time series were used to confirm the results which obtained by change point techniques.

4. Results and Discussion

The result indicates that the wind over the Sistan basin experiences two types of abrupt changes during the warm period of the year. The first type of abrupt change is related to the eastward movement of synoptic systems originated from extra-tropics which can affect the region for a short term (i.e. for a couple of days). In contrast, the second type of the abrupt change can recognized as a sign of the onset and withdrawal of Sistan wind over eastern Iran. In the beginning of summer, when the wind over Sistan basin suddenly changes from an irregular and low intensity wind to a stable and strong northwesterly wind, one can suppose that the onset of Sistan wind is occurred. On the other hand, the withdrawal of Sistan wind is related to an abrupt change in direction and the intensity of wind where the stable and strong northwesterly wind replaces by an irregular and low intensity wind over the Sistan basin only during a few days at the end of warm period of the year.

5. Conclusion

The results indicate that the *Pettitt* is the most reliable method among three change point techniques, regarding to estimation of onset and withdrawal dates of the Sistan wind. The Sistan wind is initiated on 122nd Julian day (May 2), and is ended on 287th Julian day (October 14), on the base of *Pettitt* method. Therefore, the average duration of Sistan wind blowing is about 165 days in the year which is apparently longer than the duration which former researchers has been estimated. The results also indicate that the inter-annual variations of Sistan wind intensity are significantly high. Also, it should note that, there is no any significant trend in the behavior of Sistan wind, (i.e. onset, withdrawal and wind blowing duration), when the wind velocity and direction of Sistan wind is analyzed. It should also conclude that the inter-annual variations of wind velocity and its onset and withdrawal times over Sistan basin are mostly related to the variation of regional to large scale atmospheric circulation over southwest Asia.

Key Words: Sistan Wind, Change Point, Onset, Withdrawal, Wind blowing duration.