لزوم نگرش نا ایستا در تحلیل ریسک وقایع حدی

ارائه دهنده: رضا مدرس

آنالیز و تدوین : مهندس پوریا محیط

Extremes

بارش‌های رگباری و سیلاب
Storm surge and Floods

- **بهار ۱۳۹۷**
(2019-Mar)

- **ستاد مدیریت بحران ایران:**
گلستان، مازندران، لرستان، شیراز، خوزستان، کرمان و ۱۶ استان دیگر در جدال با سیلاب

- **سازمان صلیب سرخ جهانی:**
"سیلاب‌های اخیر ایران ۱۰ میلیون تن را تحت تاثیر قرار داده و دست‌کم حدود ۲ میلیون نفر از آنان نیازمند کمک‌های بشردوستانه هستند."

آسیب شدید[۲]

آمار[۳]

کشته	۷۸
زخمی	۱،۱۳۷
مردم سیل‌زده	۱۲ میلیون
مردم نیازمند کمک‌رسانی	۲ میلیون
خانه‌های تخریب‌شده	۶۵،۰۰۰
خانه‌های آسیب‌دیده	۱۱۴،۰۰۰
برآورد خسارت	۴,۷ میلیارد دلار

Extremes

خشکسالی
Drought

- **تهران تایمز:**
  - ٪۹۷ از مساحت ایران تحت تأثیر خشکسالی با درجات مختلف می‌باشد.
  - پیشبینی می‌شود که تا انتهای سال ۱۴۰۰ بیش از ۵۰ میلیون نفر در کشور (حدود ۸۰ درصد جمعیت کشور) دچار کمبود آب آشامیدنی برای شرب خواهند شد.

- **سلامی و همکاران (۲۰۰۹):**

هزینه خسارات‌های مستقیم خشکسالی شدید اتفاق افتاده بین سال‌های ۱۹۹۹-۲۰۰۰ به بخش کشاورزی و زیر مجموعه‌های آن بالغ بر ۱۶۰۵ میلیون دلار خواهد بود.

Extremes

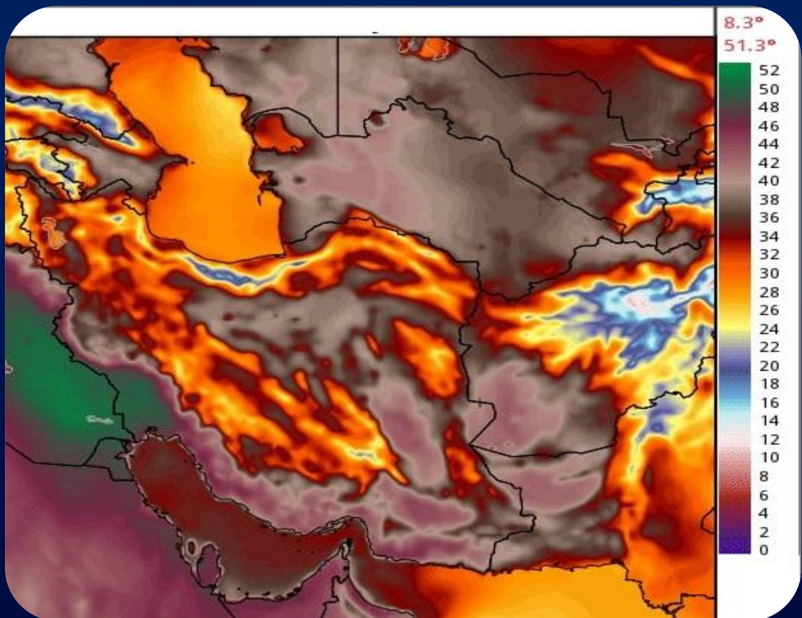
موج‌های گرما و سرما
Heat/Cold-Waves

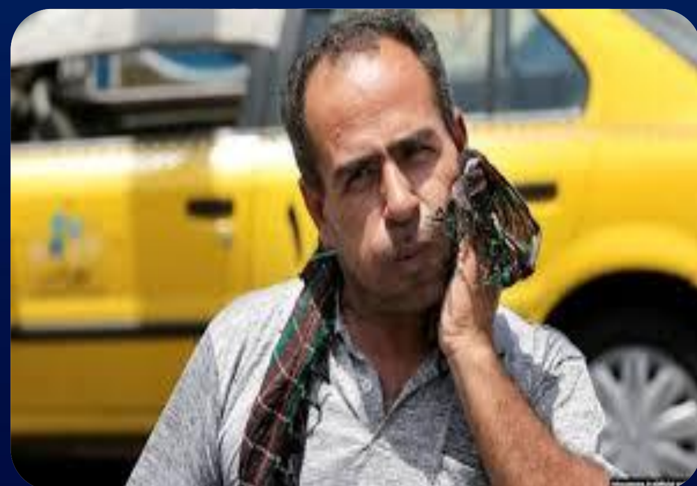
- **خبر گزاری مهر:**

  موج سرما زودرس در ۵ تا ۷ام آذر ماه ۱۳۹۵ اصفهان منجر به خسارت ۱۷۵ میلیارد تومانی به محصولات باغی و کشاورزی به ویژه انار و زیتون شد.

- **خبرگزاری جمهوری اسلامی ایران:**

  موج گرما در مرداد ماه ۱۳۹۲ بیش از ۷۵۰ هکتار از اراضی باغی و زراعی خراسان را دچار آفتاب سوختگی و خسارات جدی کرد.





تحلیل فراوانی برای مطالعه رویدادهای حدی
Frequency Analysis for Extremes

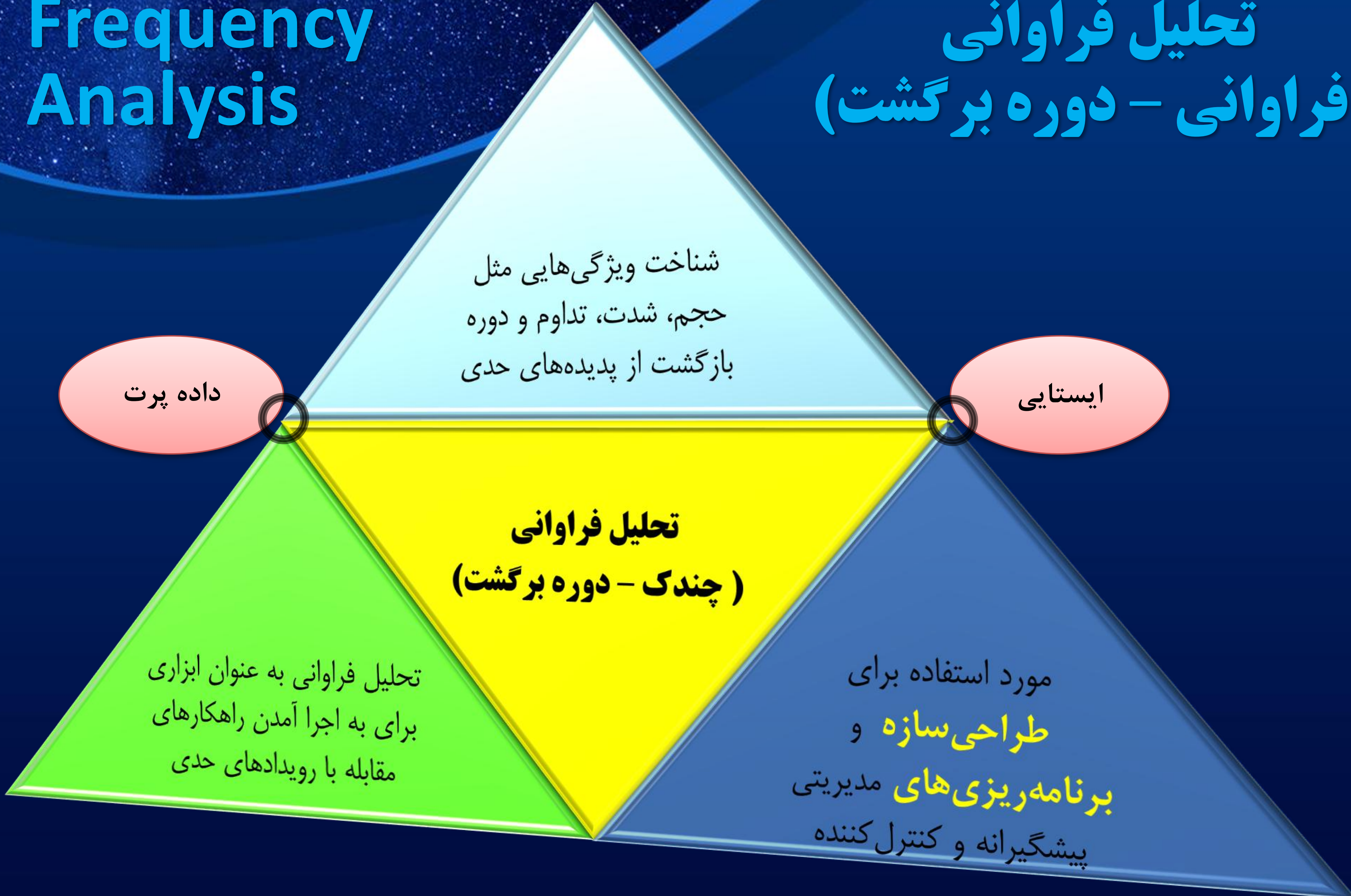
Hydro-climatic Extremes

سری‌های زمانی برای مطالعه رویدادهای حدی و تحلیل فراوانی

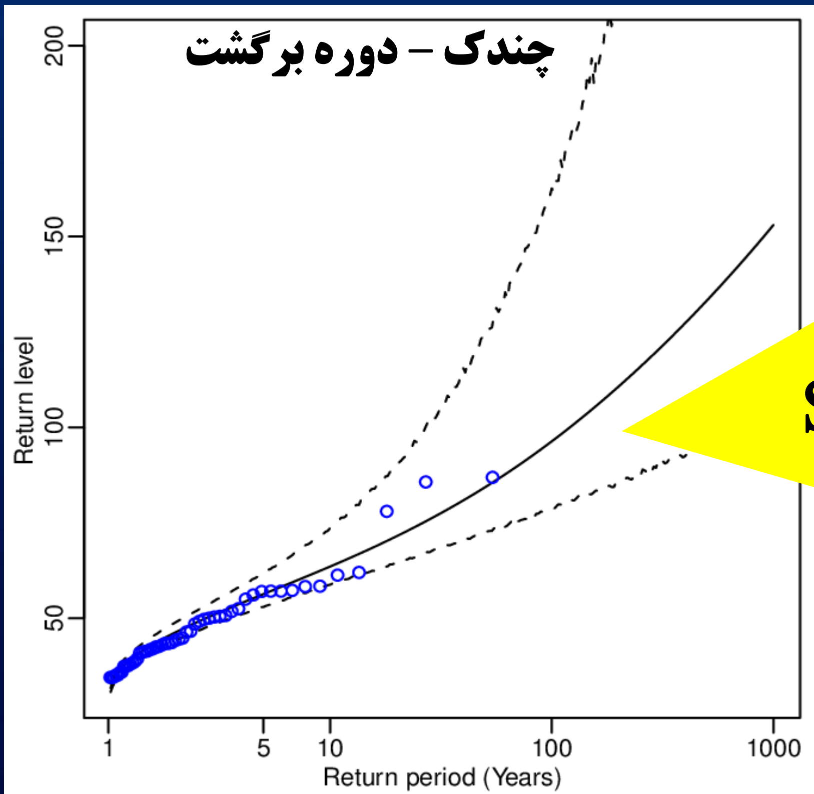
- سری‌های حداکثر بارندگی ۲۴ ساعته
- سری‌های حداکثر دبی لحظه‌ای
- سری‌های شدت و مدت بارش
- سری‌های تجمعی بارش ماهیانه
- سری‌های دما و تبخیر و تعرق
- سری‌های شدت و مدت خشکسالی
- سری‌های جهت و سرعت باد
- سری‌های حداکثر و حداقل دما

Frequency Analysis

تحلیل فراوانی
(فراوانی – دوره برگشت)



Stationary Frequency Analysis (SFA)



- **شرط اصلی برای تحلیل فراوانی پدیده‌ها استقلال و ایستای داده‌ها می‌باشد.**

شرط استقلال: مشاهدات مستقل از یکدیگر و مستقل از عوامل خارجی باشند.

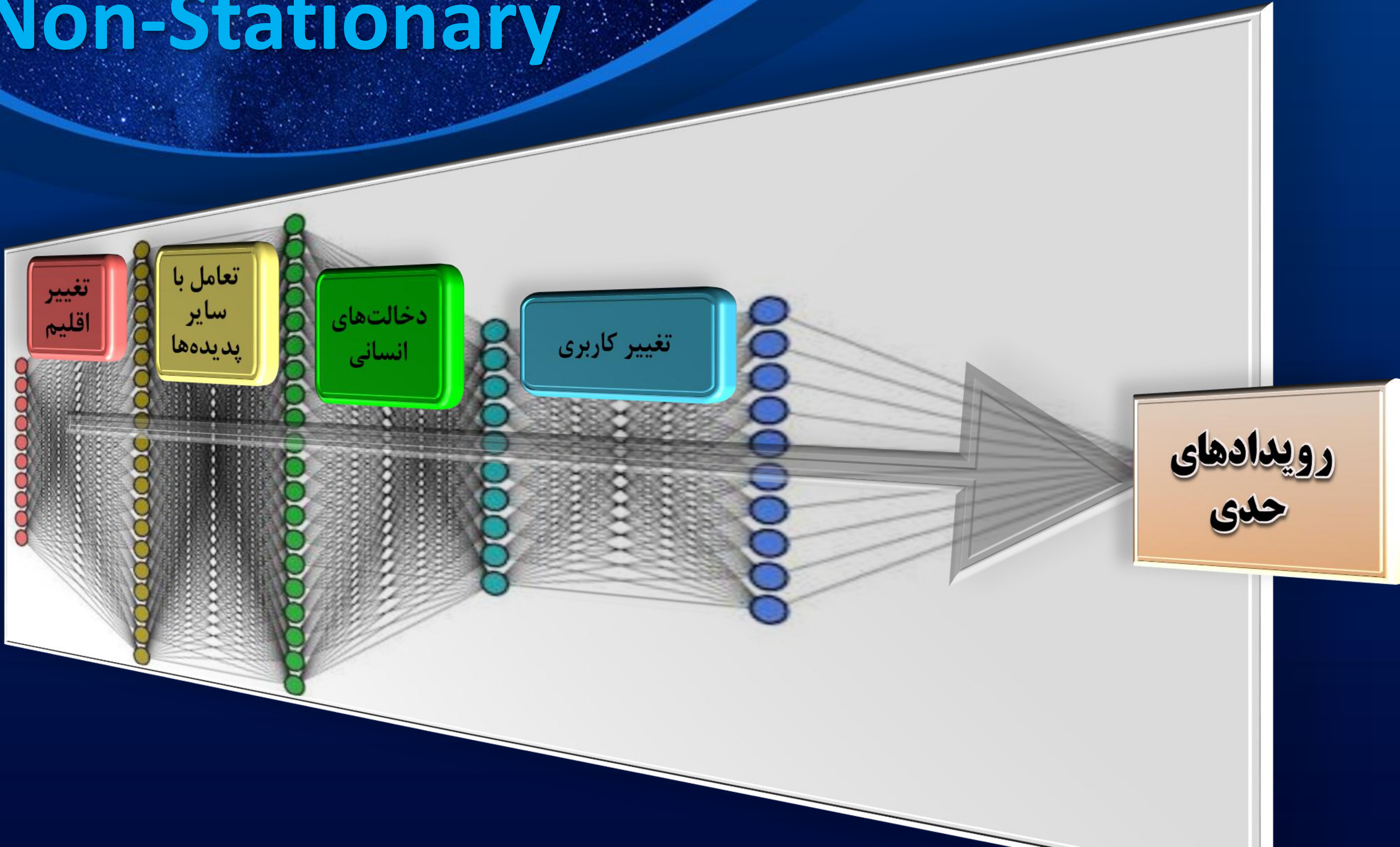
شرط ایستایی: پارامترهای داده‌ها مانند میانگین و واریانس در طول زمان ثابت باشند.

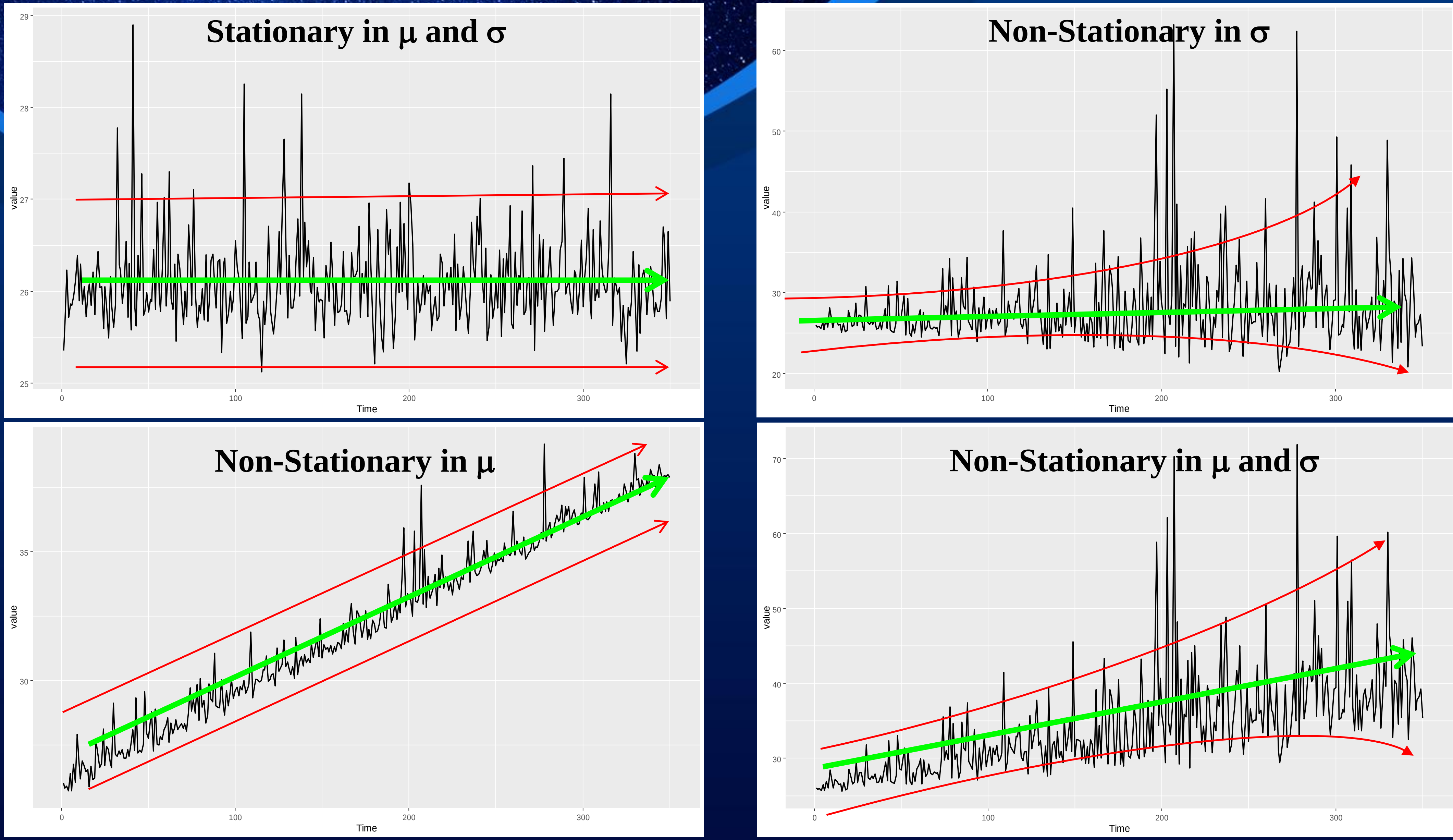
انواع نا ایستایی

- نا ایستایی ناشی از روند
- نا ایستایی ناشی از متغیر ثانوی (Co-variate)
- نا ایستایی ناشی از حافظه بلند مدت (کاربرد در مدل سازی سری های زمانی)

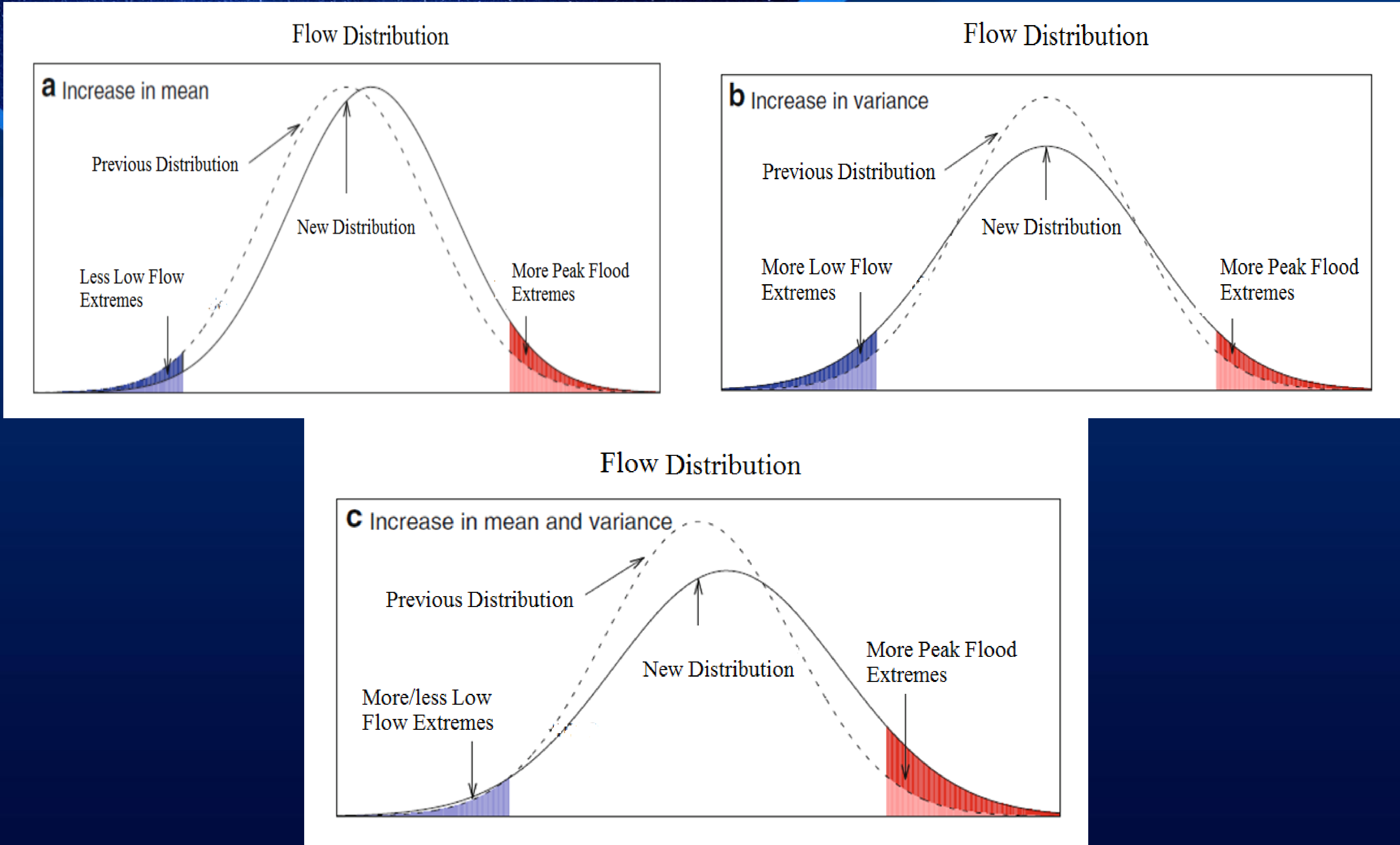

Non-Stationary Frequency Analysis
(NSFA)
تحلیل فراوانی نایستا

Non-Stationary





Stationary in μ and σ
Non-Stationary in σ
Non-Stationary in μ
Non-Stationary in μ and σ
value
Time


Flow Distribution
a Increase in mean
Previous Distribution
New Distribution
Less Low Flow Extremes
More Peak Flood Extremes
Flow Distribution
b Increase in variance
Previous Distribution
New Distribution
More Low Flow Extremes
More Peak Flood Extremes
Flow Distribution
c Increase in mean and variance
Previous Distribution
New Distribution
More/less Low Flow Extremes
More Peak Flood Extremes

Non-Stationary Scenarios

سناریوها و مدل‌های تغییر پارامترهای توزیع‌ها احتمال باوجود ناایستایی در طول زمان

سناریو	مدل
فقط پارامتر μ متغیر	$\hat{\mu} = \mu_0 + \mu_1 t$ $\hat{\mu} = \mu_0 + \mu_1 t^2 + \mu_2 t$
فقط پارامتر σ متغیر	$\hat{\sigma} = \sigma_0 + \sigma_1 t$ $\hat{\sigma} = \sigma_0 + \sigma_1 t^2 + \sigma_2 t$
فقط پارامتر κ متغیر	$\hat{\kappa} = \kappa_0 + \kappa_1 t$ $\hat{\kappa} = \kappa_0 + \kappa_1 t^2 + \kappa_2 t$
پارامتر μ و σ متغیر	$\hat{\sigma} = \sigma_0 + \sigma_1 t$ $\hat{\mu} = \mu_0 + \mu_1 t$

Non-Stationary
Example: 1
24h-Maximum Precipitation

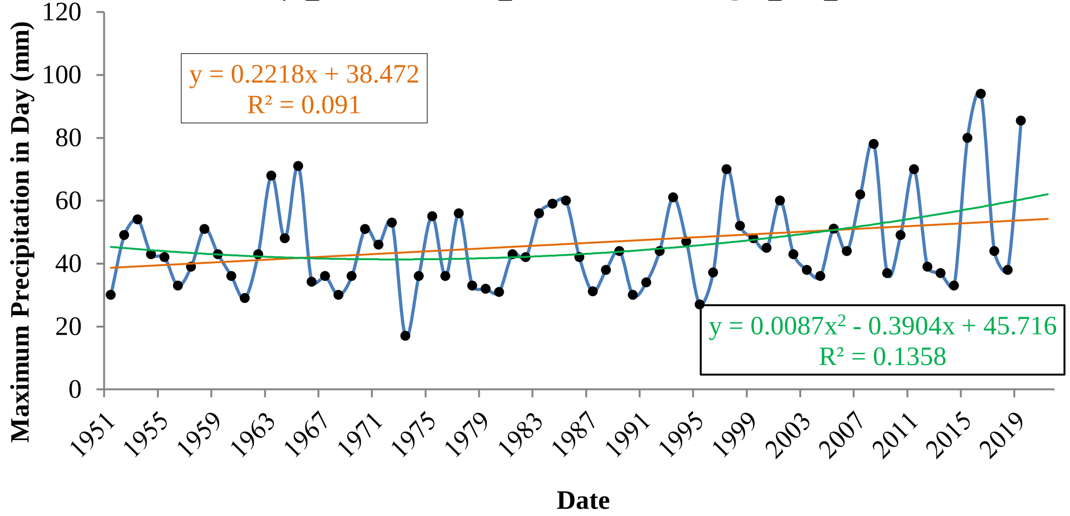
Stationary tests (p.values):
Wald-Wolfowitz: 0.274
Mann-Kendall: 0.040
F-test: 0.049
ACF(1) = 0.157

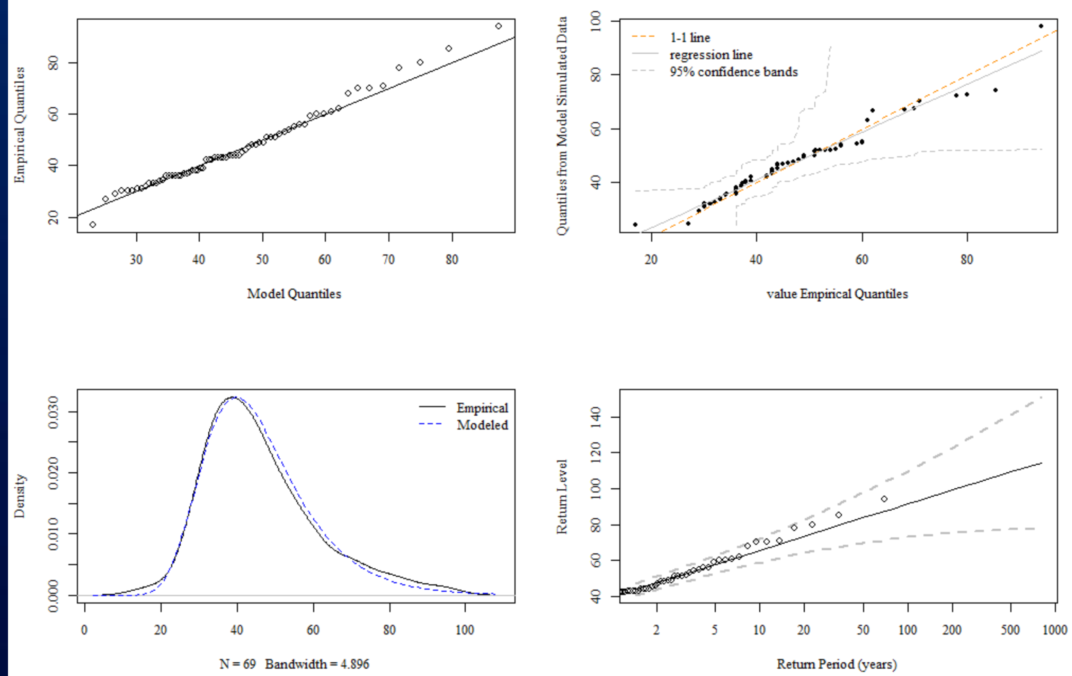
Stationary Approach Parameters
Mu: 37.713
Sigma: 11.379
Shape: -0.0054
Information Criterion:
AIC: 558.98
BIC: 565.68

Distribution: GEV

Non-Stationary Approach Parameters
Mu: $36.736 + 0.00207(t^2)$
Sigma: 11.06
Shape: -0.0144
Information Criterion:
AIC: 555.80
BIC: 563.71

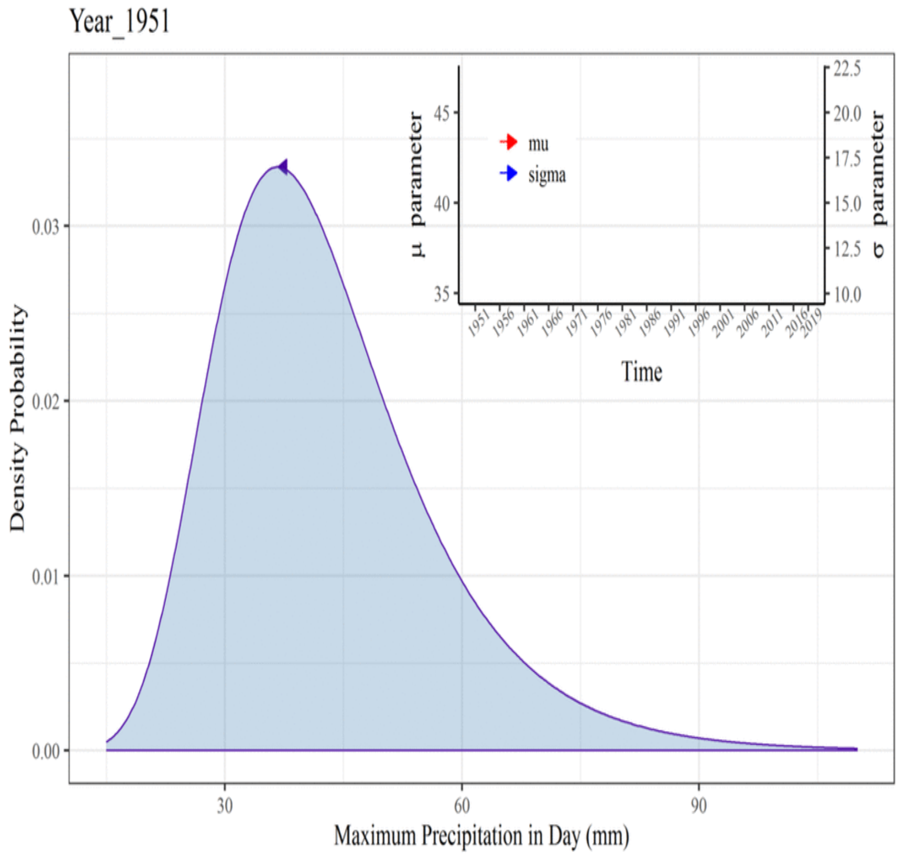
حداکثر بارش ۲۴ ساعته در ایستگاه خرم‌آباد

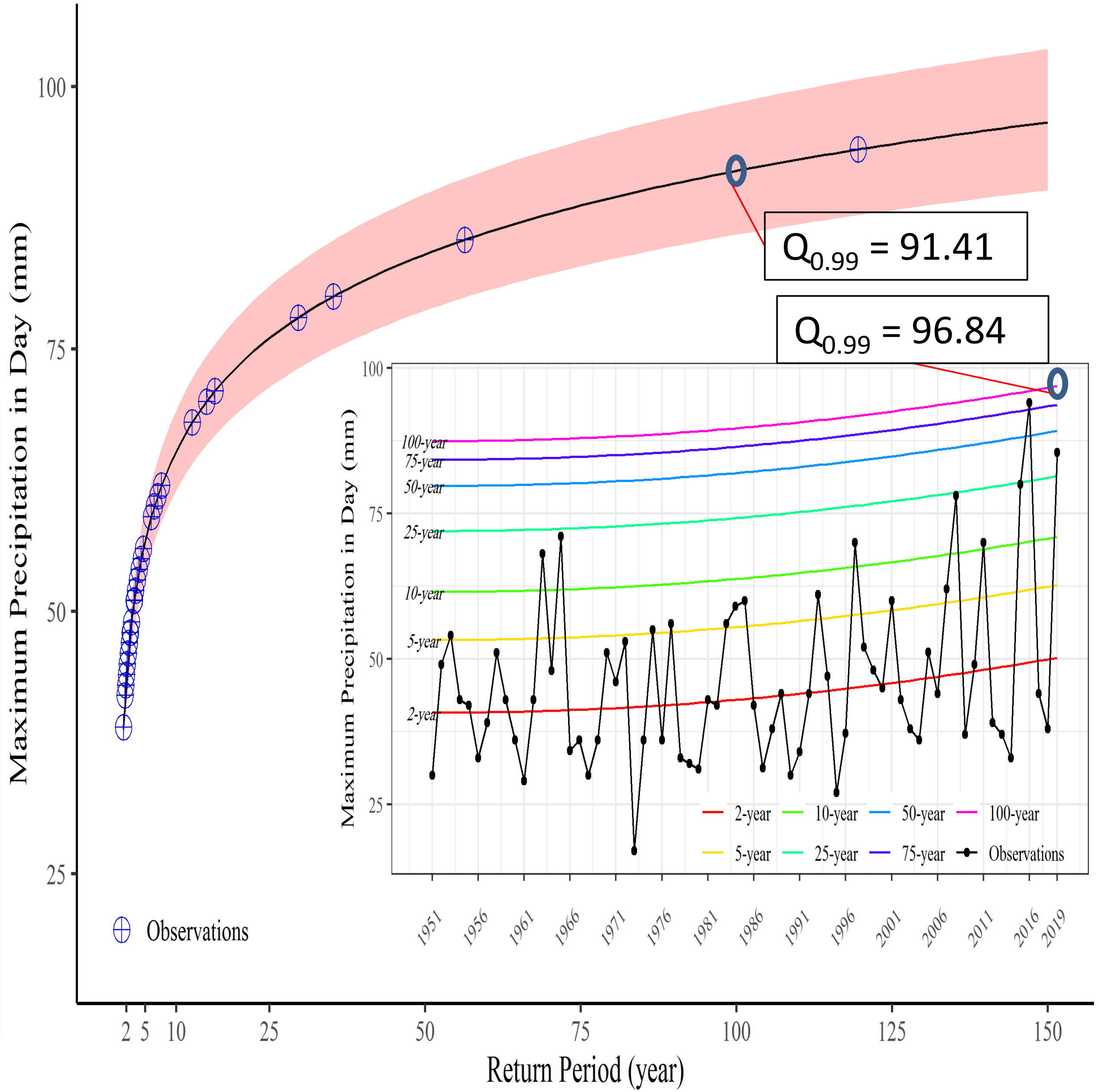




Non-Stationary Example: 1

24h-Maximum Precipitation





Non-Stationary Example: 2

Flood Peak

Stationary tests (p.values):

Wald-Wolfowitz: 0.0509

Mann-Kendall: 0.179

F-test: 0.0043

ACF(1) = 0.219

Distribution:

GEV

Stationary Approach

Parameters

Mu: 361.58

Sigma: 177.91

Shape: 0.251

Information Criterion:

AIC: 791.92

BIC: 798.05

Non-Stationary Approach

Parameters

Mu: 244.95- 0.1237(t^2)+9.173(t)

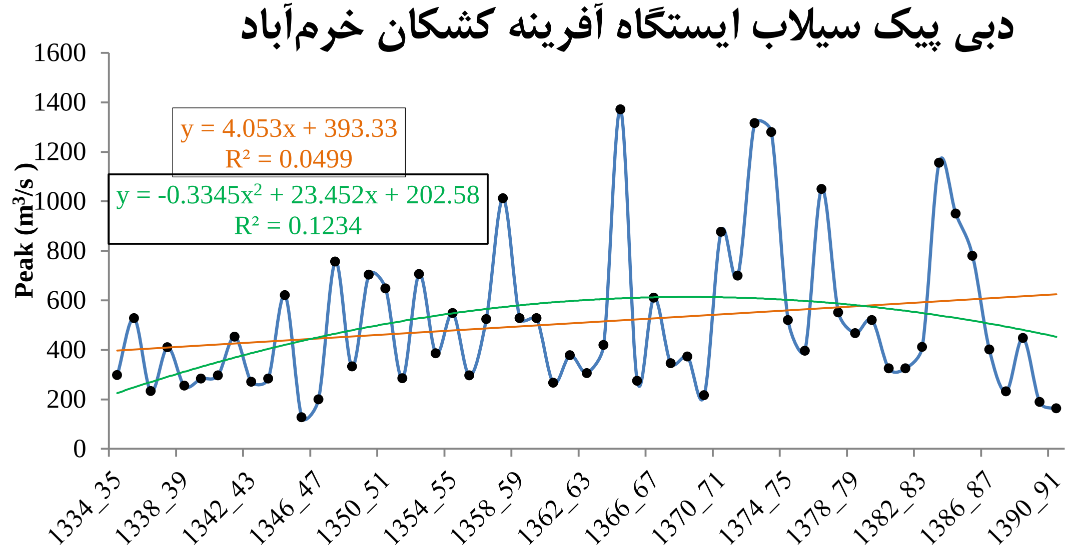
Sigma: 118.817 + 2.031(t)

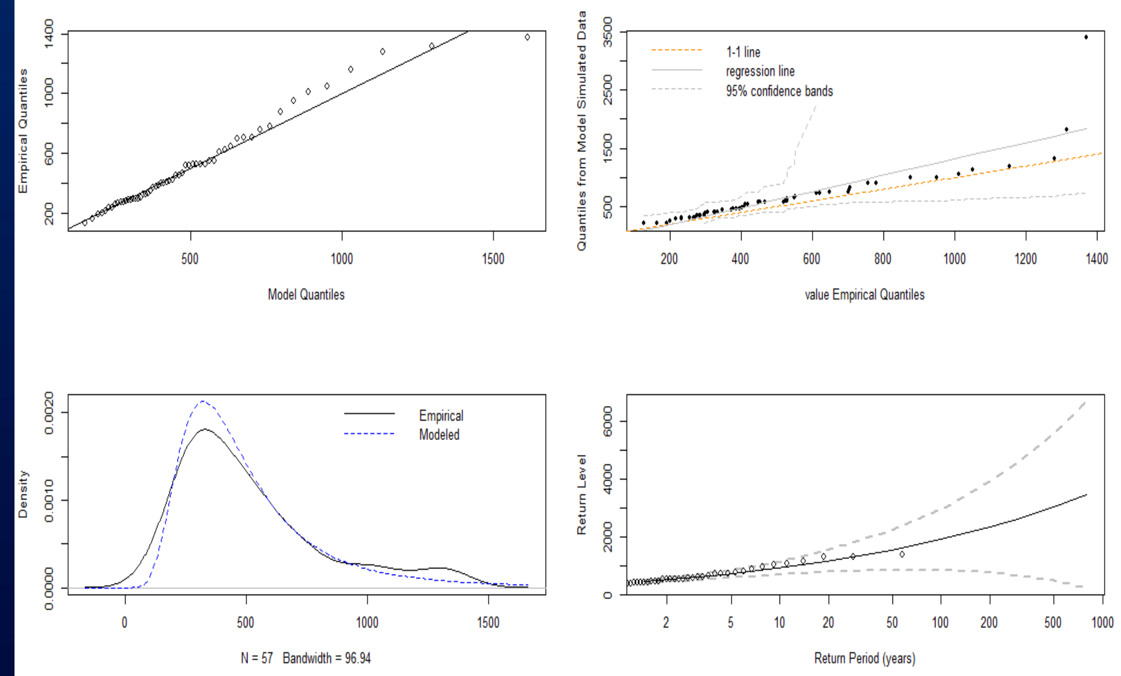
Shape: 0.1867

Information Criterion:

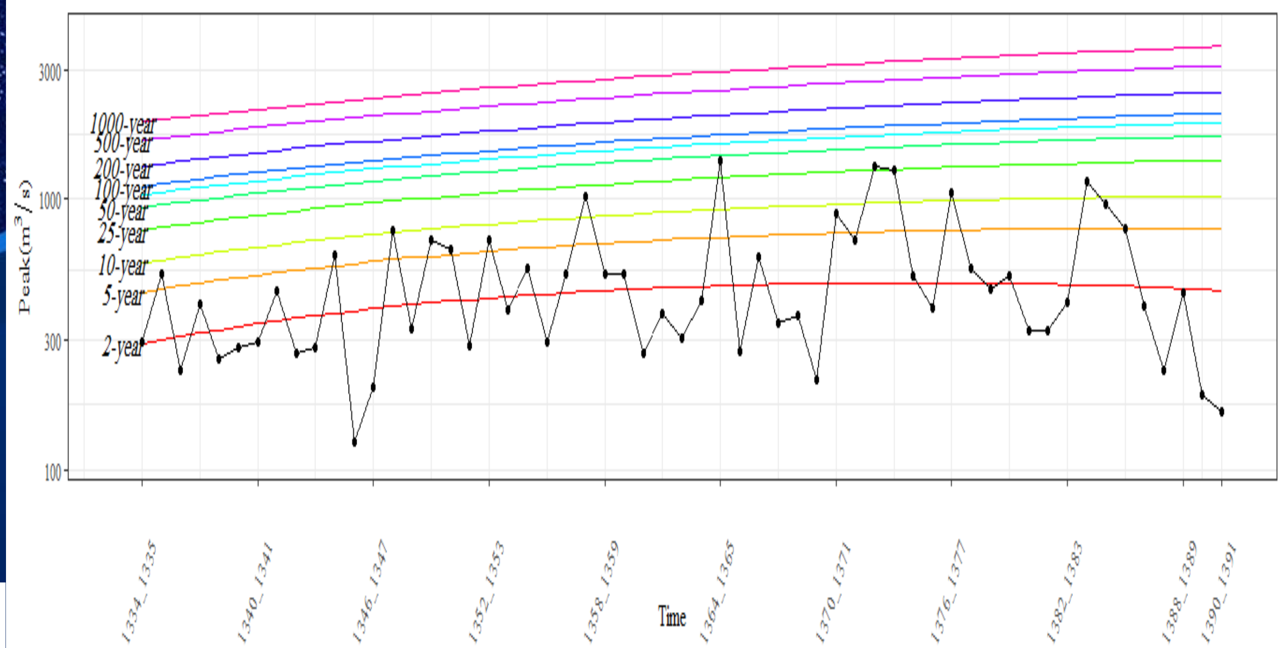
AIC: 789.60

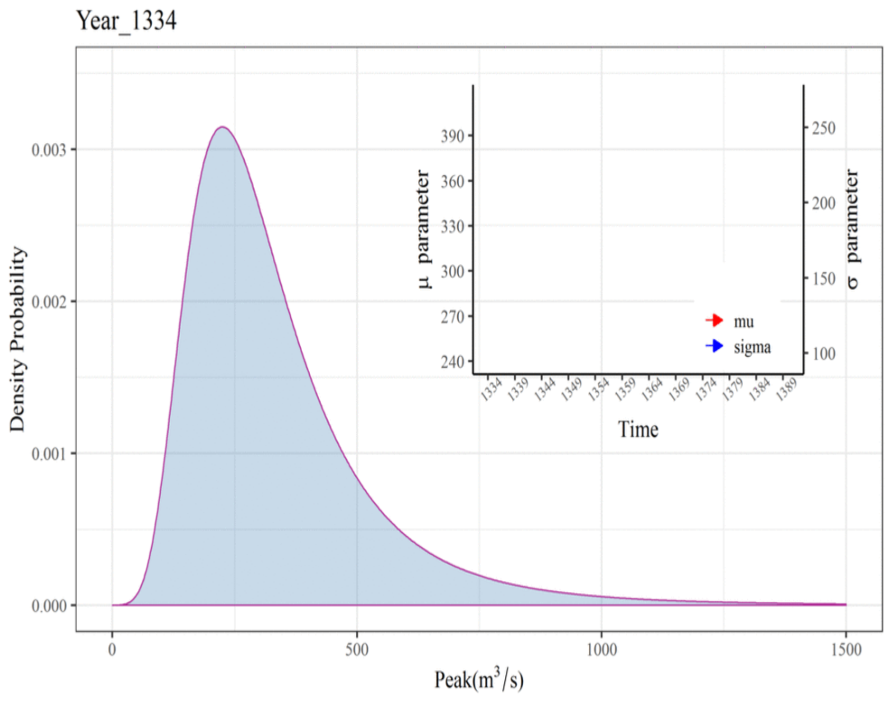
BIC: 797.53

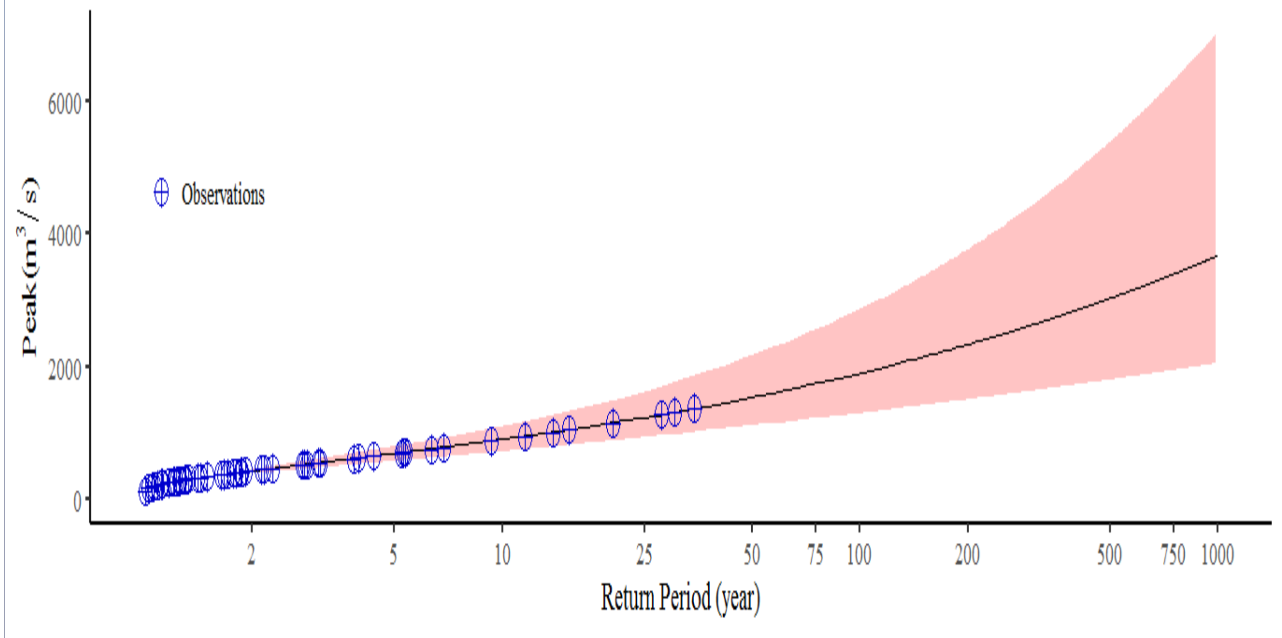




Non-Stationary Example: 2 Flood Peak

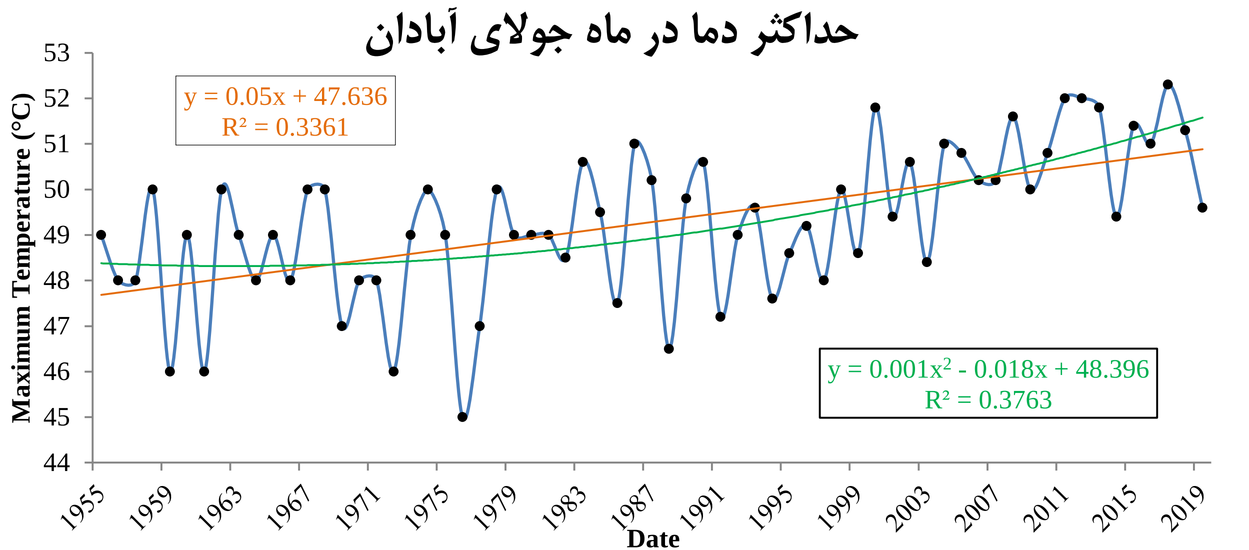


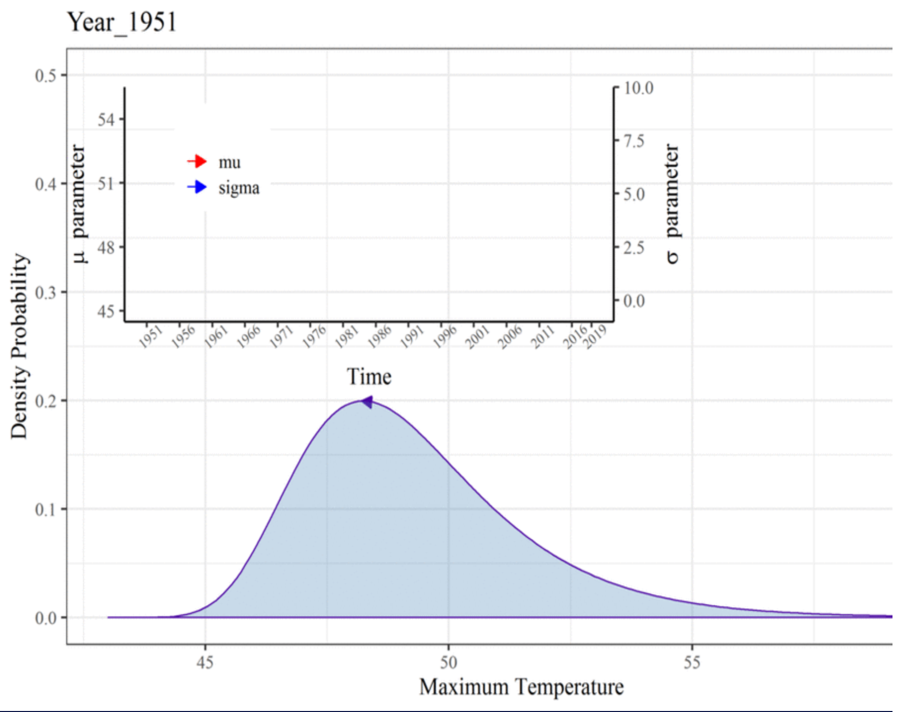


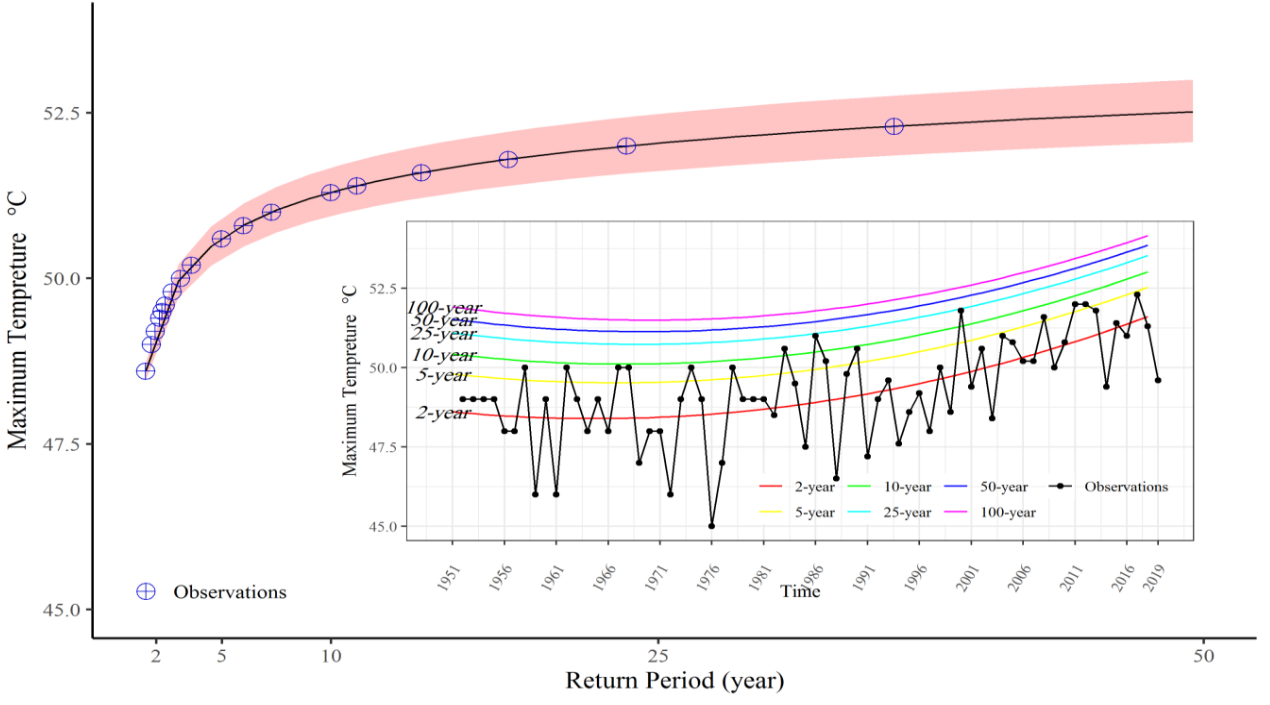


Non-Stationary Example: 3

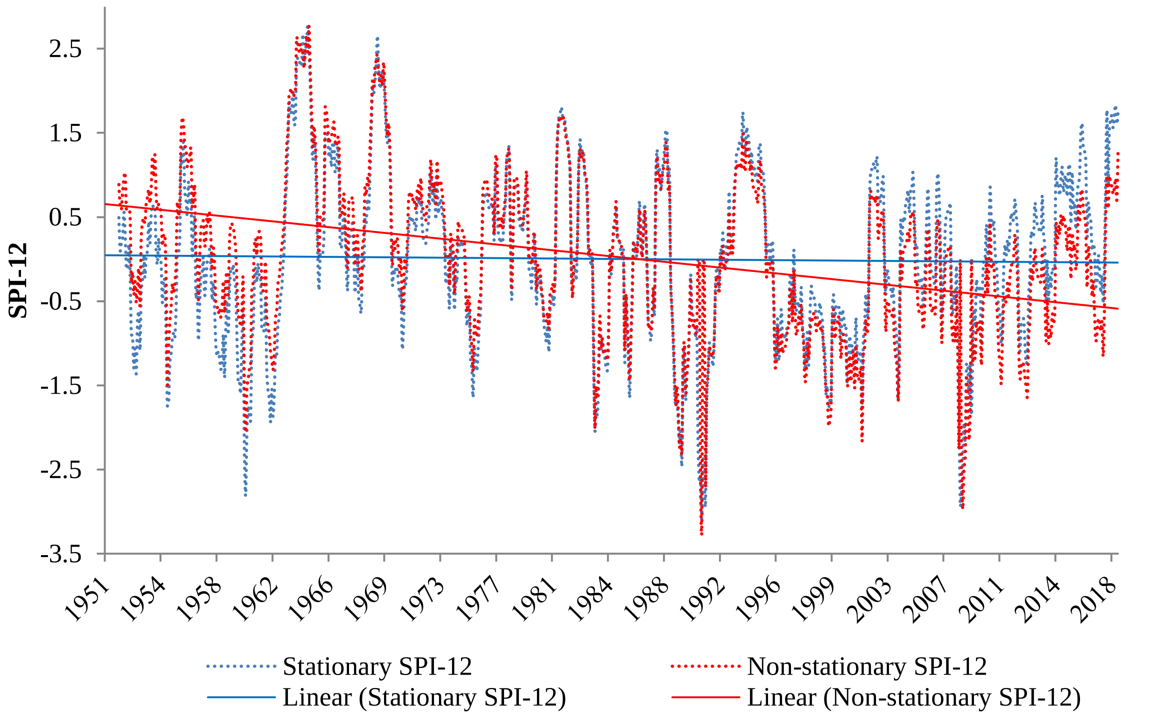
Temperature Extremes

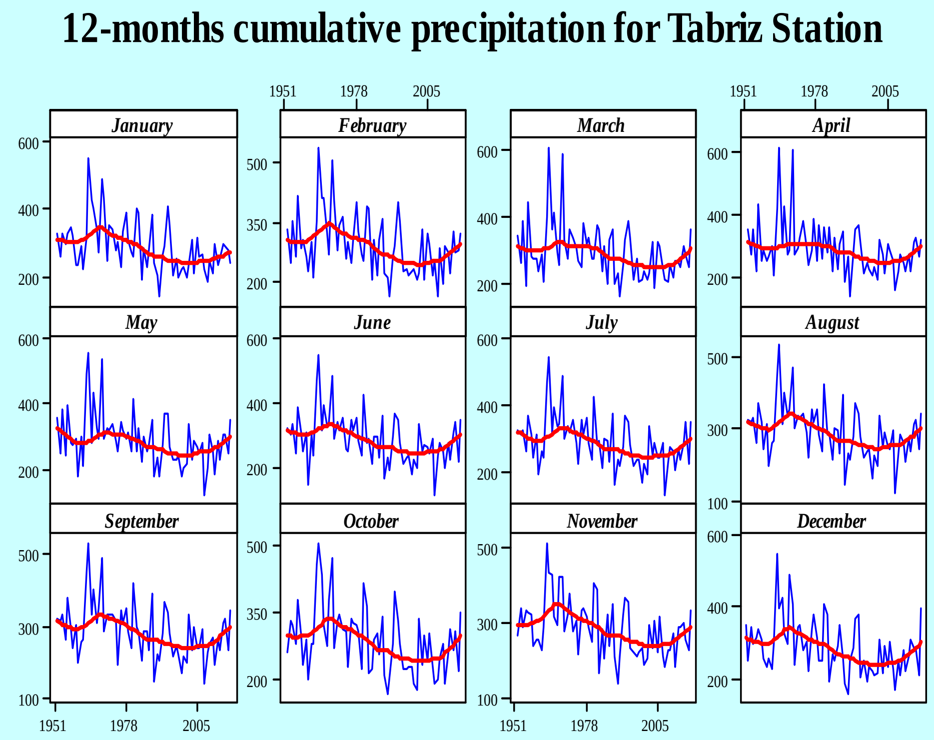




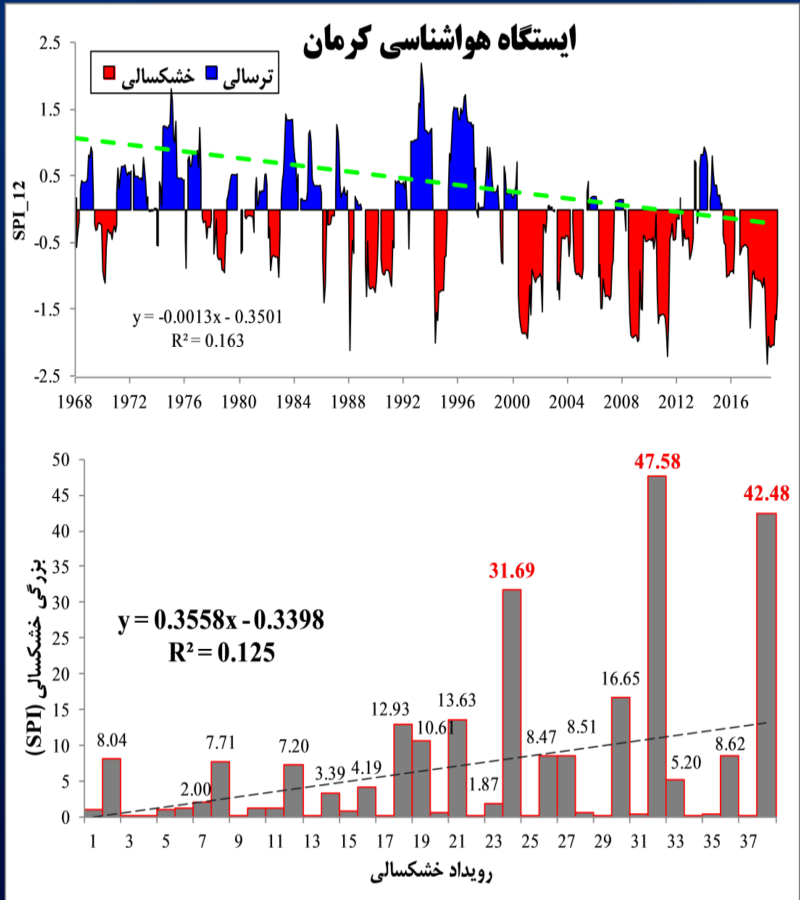


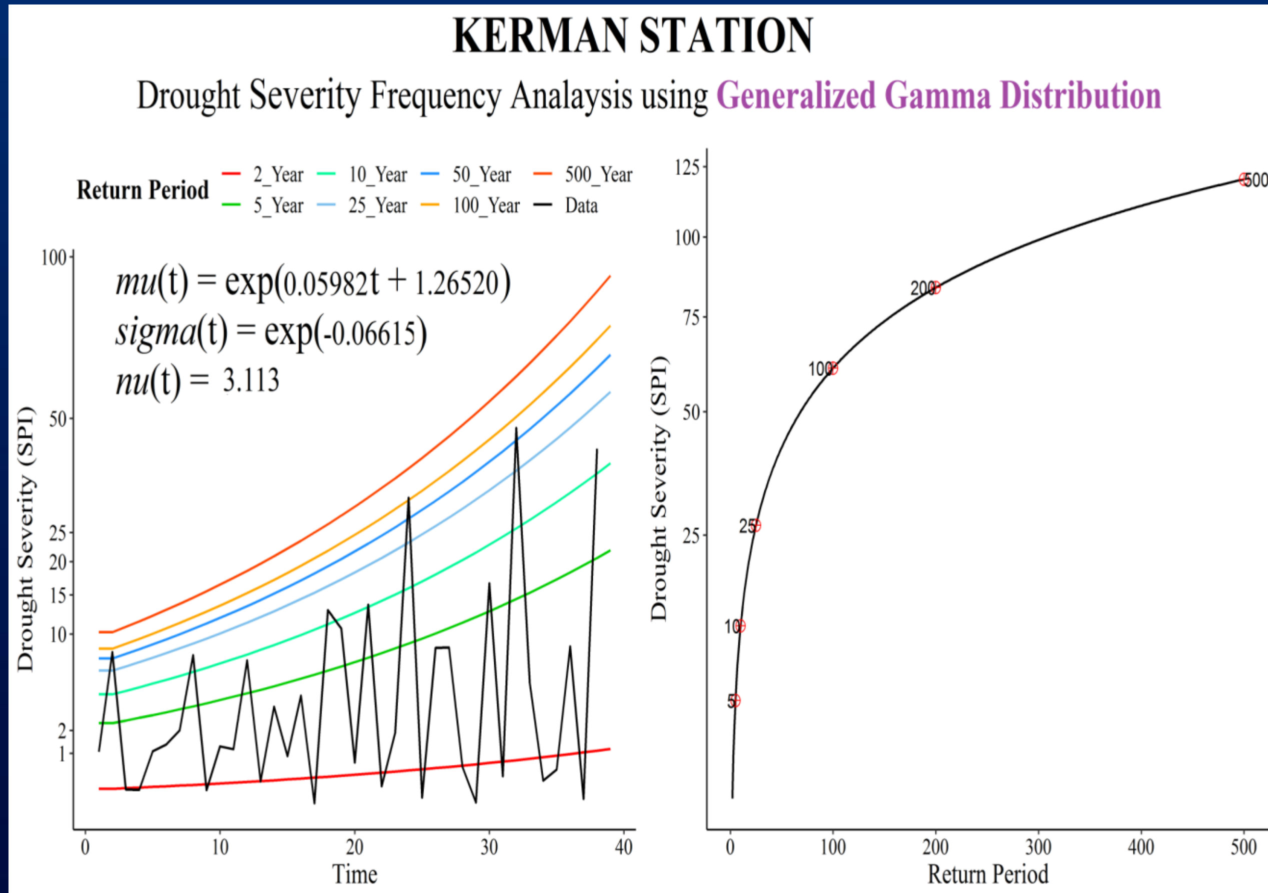
Non-Stationary Example: 4
Drought Indices





Non-Stationary
Example: 5
Drought Characteristics





مروری بر منابع نا ایستایی رویدادهای حدی در ایران

Literature for Non-Stationary of Extremes In IRAN

Literature for Non-Stationary of Extremes In IRAN

Global and Planetary Change 144 (2016) 67–81

Contents lists available at ScienceDirect

Global and Planetary Change

journal homepage: www.elsevier.com/locate/gloplacha

Changes of extreme drought and flood events in Iran

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ARTICLE INFO

Article history:
Received 22 March 2016
Received in revised form 17 July 2016
Accepted 20 July 2016
Available online 25 July 2016

Keywords:
Trend
Mann-Kendall
Serial correlation
Climate change
Flood
Drought
Iran

ABSTRACT

Located in an arid and semi-arid region of the world, Iran has experienced many extreme flood and drought events in the last and current century. The present study aims to assess the changes in Iran's flood magnitude and drought severity for 1950–2010, with some time span variation in some stations. The Mann-Kendall test for monotonic trend was first applied to assess changes in flood and drought severity data. In addition, to consider the effect of serial correlation, two Pre-Whitening Trend (PWT) tests were also applied. It was observed that the number of stations with statistically significant trends has increased after applying PWT tests. Both increasing and decreasing trends were observed for drought severity and flood magnitude in different climate regions and major basins of Iran using these tests. The increase in flood magnitude and drought severity can be attributed partly to land use changes, an annual rainfall negative trend, a maximum rainfall increasing trend, and inappropriate water resources management policies. The paper indicates a critical situation related to extreme climate change in Iran and the increasing risk of environmental changes in the 21st century.

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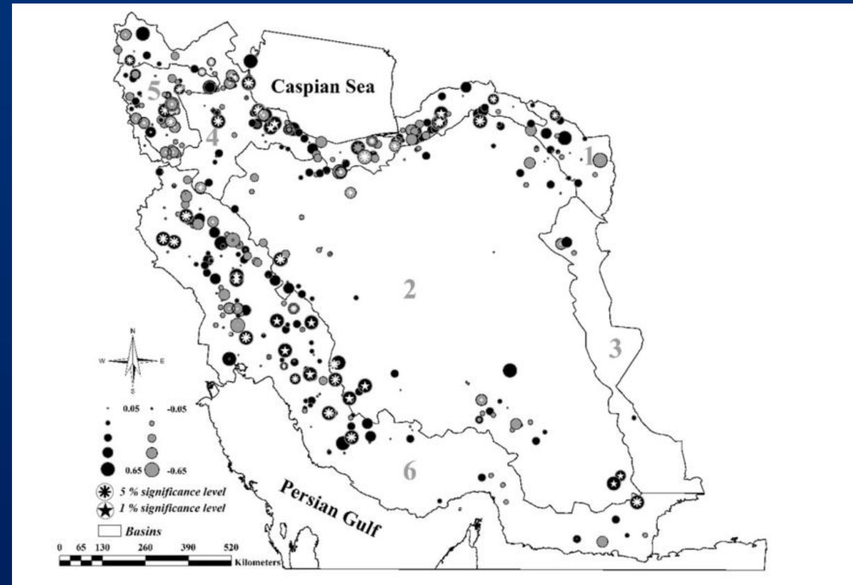
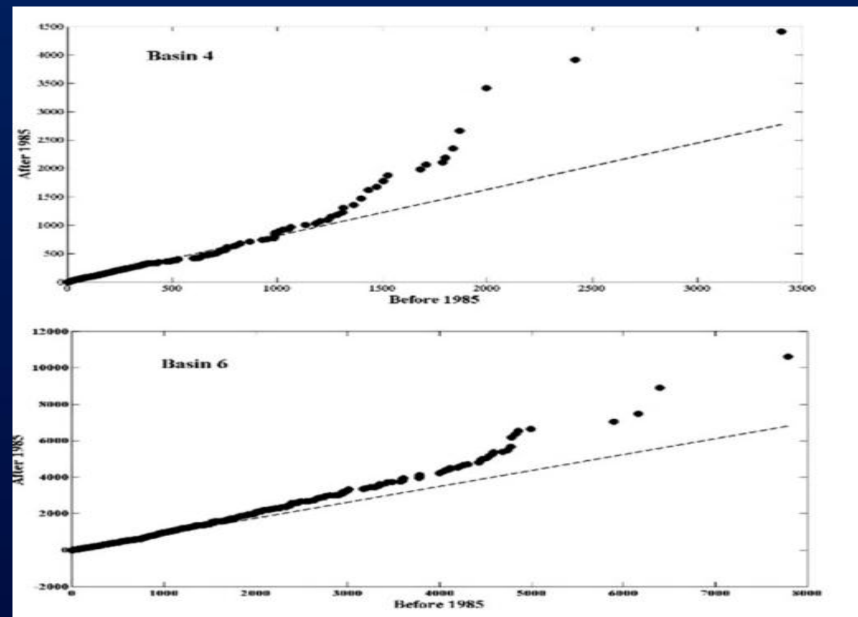


. Spatial pattern of PWT1-Kendall's Tau statistic for flood magnitudes of 462 gauged stations spanning from 1950 to 2010 within major hydrologic basins.



Literature for Non-Stationary of Extremes In IRAN

تحقیقات منابع آب ایران
Iran-Water Resources Research

سال شانزدهم، شماره ۳، پائیز ۱۳۹۹
Volume 16, No. 3, Fall 2020 (IR-WRR)
۲۷۶-۲۸۷

The Generalized Additive Models for Non-stationary Flood Frequency Analysis

*P. Mohit Isfahani[1] and R. Modarres[2]**

مدل‌های جمعی تعمیم‌یافته برای تحلیل فراوانی ناایستای سیل

پوریا محیط اصفهانی [1] و رضا مدرس [2*]

Station	Stationary Assumption $Q_{99\%}$ (m^3/s)			Nonstationary Assumption $Q_{99\%}$ (m^3/s)		
	95% Lower Confidence	Estimation	95% Upper Confidence	95% Lower Confidence	Estimation	95% Upper Confidence
Dashli_baroun	69.6	77.6	86.2	80.4	89.3	98.2
Ghatlish	534.5	893.9	1418.7	983.0	1372.3	1846.6
Haratbar	137.0	188.7	261.7	216.3	280.2	360.8
Hootan	645.5	886.53	1138.5	645.5	886.53	1138.5
Koshtargah	563.5	634.0	706.9	297.7	329.4	361.1
Nodehkhormao	358.0	1161.8	1491.6	977.1	2321.9	3617.2

Literature for Non-Stationary of Extremes In IRAN

METEOROLOGICAL APPLICATIONS
Meteorol. Appl. **25**: 314–321 (2018)
Published online 27 November 2017 in Wiley Online Library
(wileyonlinelibrary.com) DOI: 10.1002/met.1694

RMetS Royal Meteorological Society

Spatiotemporal trend and abrupt change analysis of temperature in Iran

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[a] *Young Researchers and Elite Club, Urmia Branch, Islamic Azad University, Urmia, Iran*
[b] *Department of Water Engineering, Faculty of Agriculture, Shahrekord University, Shahrekord, Iran*
[c] *Department of Water Engineering, Faculty of Agriculture, Urmia University, Urmia, Iran*
[d] *Department of Soil and Water Engineering, College of Agricultural Engineering & Post Harvest Technology (C. A. U. Imphal), Gangtok, India*

ABSTRACT: The long-term trends in temperature over Iran were examined over 34 synoptic stations during a 50 year period (1961–2010) on seasonal and annual time scales. Two methods, a modified version of the Mann–Kendall test by eliminating the effect of all significant autocorrelation co-efficients and the regional Kendall test, were used in trend identification. The results revealed that the temperature had experienced significant positive trends in autumn, spring and especially summer over the study area. On an annual time scale and in the winter, the highest increasing trends were observed at stations located in the southern and southeastern parts of Iran. For regional analysis of trends, the stations were divided into five clusters based on the *K*-means clustering method and the silhouette index. Subsequently, the regional trend of temperature was analysed on seasonal and annual time scales using the regional Kendall test. The results of the regional Kendall test also indicated the rising trends in temperature during the last 50 years throughout the country on both seasonal and annual time scales. After verifying the presence of an increasing trend in the temperature time series, the non-parametric Pettitt test was used to detect the change points in the annual and seasonal time scales. The results showed that the change point of average temperature began from the summer of 1972 (Sabzevar station) and continued until the summer of 1998 (Zahedan station). The most frequent change point occurrence was between the years 1986 and 1994.

KEY WORDS change point; Mann–Kendall test; Pettitt test; regional Kendall; temperature

Received 19 December 2016; Revised 19 June 2017; Accepted 20 July 2017

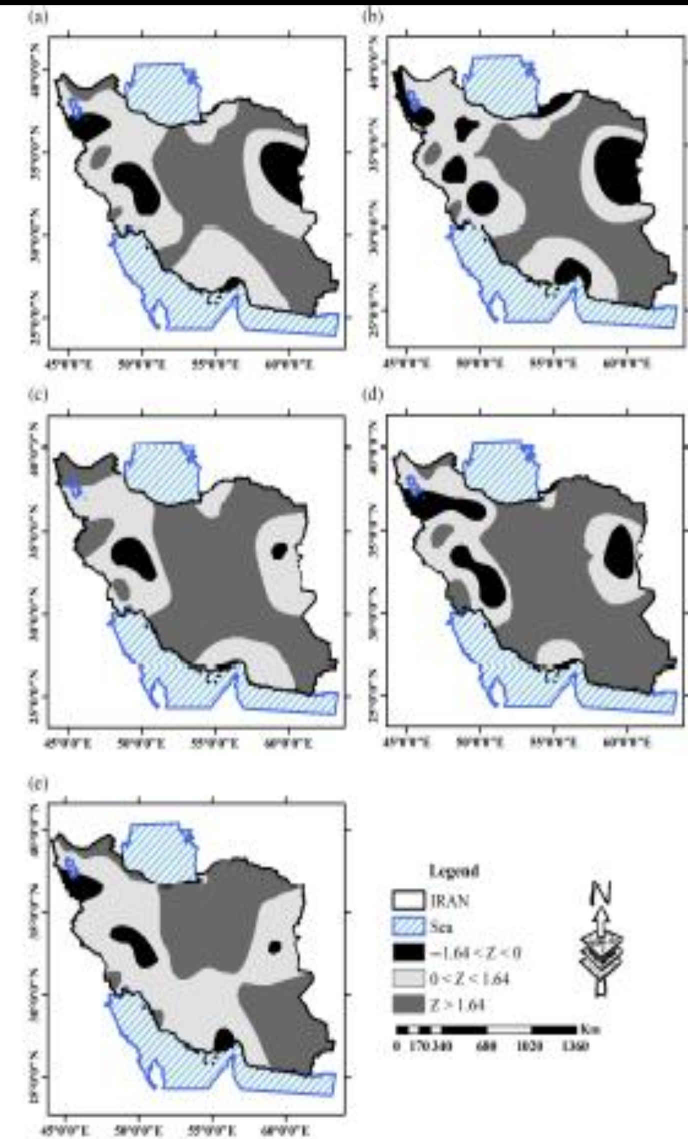

Figure 3. Spatial variation of the modified Mann–Kendall Z statistic for temperature across Iran in two annual and seasonal time scales (1961–2010): (a) annual, (b) winter, (c) spring, (d) summer and (e) autumn. [Colour figure can be viewed at wileyonlinelibrary.com].

Literature for Non-Stationary of Extremes In IRAN

Atmospheric Research 113 (2012) 1–12

Contents lists available at SciVerse ScienceDirect

Atmospheric Research

journal homepage: www.elsevier.com/locate/atmos

Spatiotemporal trends and change point of precipitation in Iran

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[b] Department of Water Engineering, Ayatollah Amoli Branch, Islamic Azad University, Amol, Iran

A R T I C L E I N F O

Article history:
Received 29 September 2011
Received in revised form 17 April 2012
Accepted 26 April 2012
Available online 2 May 2012

Keywords:
Precipitation variability
Statistical tests
Spatial analysis
Change point
Trend magnitude

A B S T R A C T

The analyses of the spatial and temporal trends of precipitation are pertinent for the future development and sustainable management of water resources of a given region. Annual and seasonal precipitation data from 28 synoptic stations of Iran (1967–2006) were analyzed to determine the spatial and temporal trends and approximate year of the beginning of the significant trends by using the Mann–Kendall and Mann–Kendall rank statistic tests, respectively. The trend free pre-whitening (TFPW) method was applied to eliminate the influence of serial correlation on the Mann–Kendall test, and the magnitude of the precipitation trends was obtained from the Theil–Sen's slope estimator. Over the 40-year period, negative trend in annual precipitation occurred at 22 sites (79%), while just three sites had statistically significant ($\alpha = 0.05$) negative trend in precipitation. The magnitude of the significant negative trends of annual precipitation at the 95% confidence level varied from (−)2.53 ± 0.69 mm/year at Tabriz station to (−)3.43 ± 0.81 mm/year at Khoy station. The change points of the annual precipitation at Khoy, Oroomieh and Tabriz stations were 1982, 1994 and 1981, respectively. In the seasonal series, the negative trends in spring and winter precipitation were larger compared with those in the other seasonal series, so that, five significant negative trends were detected in the winter time series. A noticeable decrease in the winter precipitation series was observed mostly in northern Iran, as well as along the coasts of the Caspian Sea. In summer precipitation, two significant positive trends were found at Mashhad and Torbateheydarieh stations, whereas no significant positive or negative trends were detected by the trend tests in autumn precipitation.
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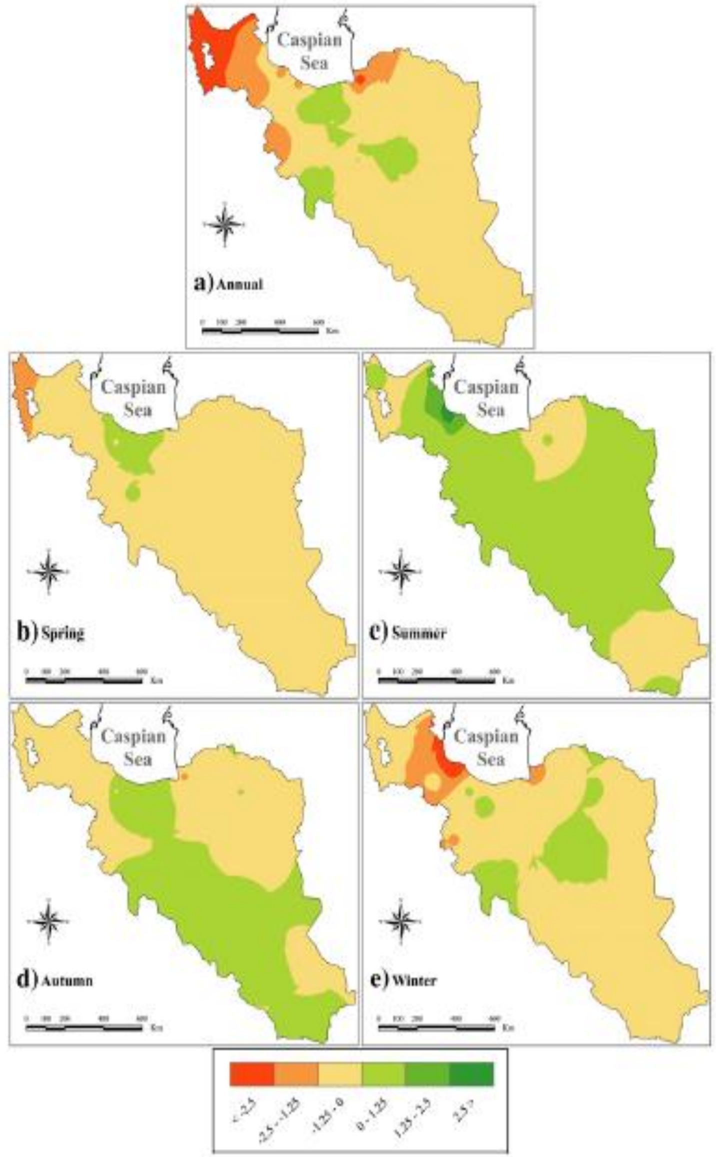

Fig. 3. Interpolated of annual and seasonal precipitation trends (Theil–Sen's estimator) during 1967–2006 at the 95% confidence level, the annual and seasonal trends are in mm/year and mm/season, respectively.

Literature for
Non-Stationary of Extremes
In IRAN

INTERNATIONAL JOURNAL OF CLIMATOLOGY
Int. J. Climatol. (2015)
Published online in Wiley Online Library
(wileyonlinelibrary.com) DOI: 10.1002/joc.4465

RMetS
Royal Meteorological Society

Trends in total precipitation and magnitude–frequency of extreme precipitation in Iran, 1969–2009

Mohammad Reza Najafi[a*] and Saber Moazami[b]
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ABSTRACT: Spatiotemporal changes in total precipitation as well as the magnitude and frequency of extreme precipitation events in Iran are assessed using 187 gauging stations with at least 41 years of records until 2009. The spatial distribution of extreme precipitation is evaluated based on the generalized extreme value (GEV) distribution fitted to the annual/seasonal maximum daily series at each location. Temporal trends of the magnitude of extreme precipitation events are also analysed using the annual/seasonal maximum daily series, while temporal trends of the frequency of extremes are assessed based on records exceeding the 99th percentile threshold. Results show an overall declining trend of the annual precipitation in particular in regions located on the north, west and northwest of Iran. Seasonal analysis shows the largest contribution of winter to this declining trend. In addition, precipitation has significantly decreased in the northwest during spring. Although the changes in the magnitudes of extreme precipitation events are insignificant, with increasing trends in 50% of the stations, the overall frequencies show significant declines in particular during winter. The magnitude and frequency of extreme precipitation have also significantly declined in the northwest region during spring.

KEY WORDS spatiotemporal trend; extreme precipitation; magnitude; frequency; generalized extreme value distribution; Poisson distribution; return level; Iran

Received 24 March 2015; Revised 29 June 2015; Accepted 7 July 2015

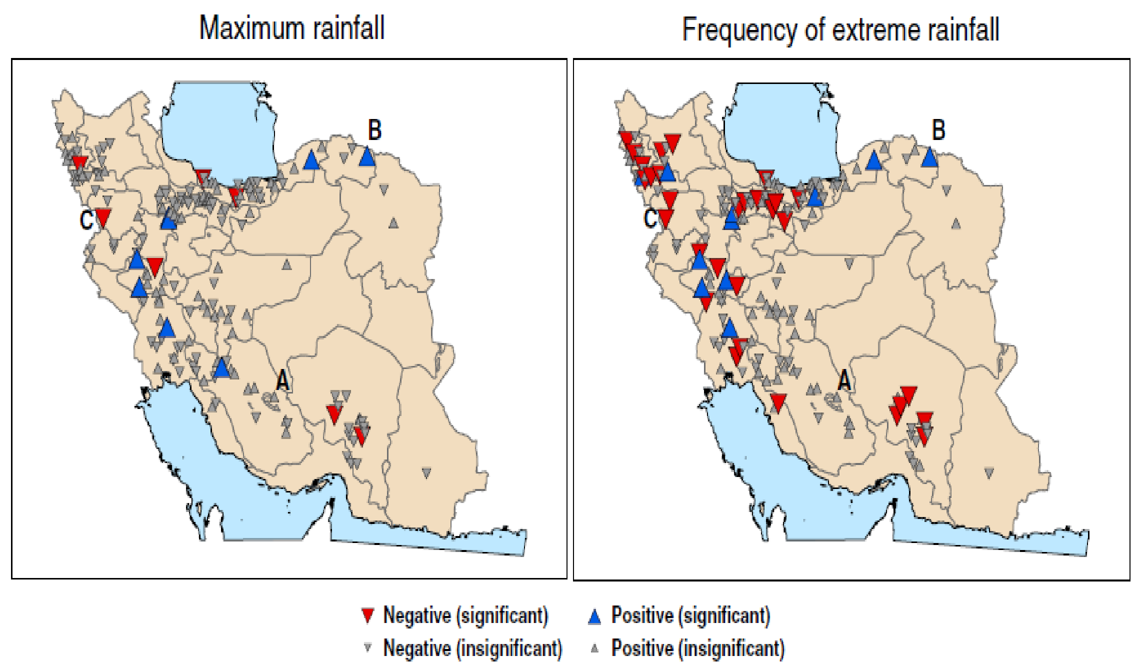

Figure 7. The trends of the magnitudes (left) and frequencies (right) of the annual extreme rainfall events obtained using the annual maximum daily rainfall events and the number of exceedances over the 99th percentile threshold, respectively.

Literature for Non-Stationary of Extremes In IRAN

International Journal of Biometeorology
https://doi.org/10.1007/s00484-018-1532-4

ORIGINAL PAPER

Future heat stress arising from climate change on Iran's population health

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Received: 22 April 2017 /Revised: 28 February 2018 / Accepted: 18 March 2018
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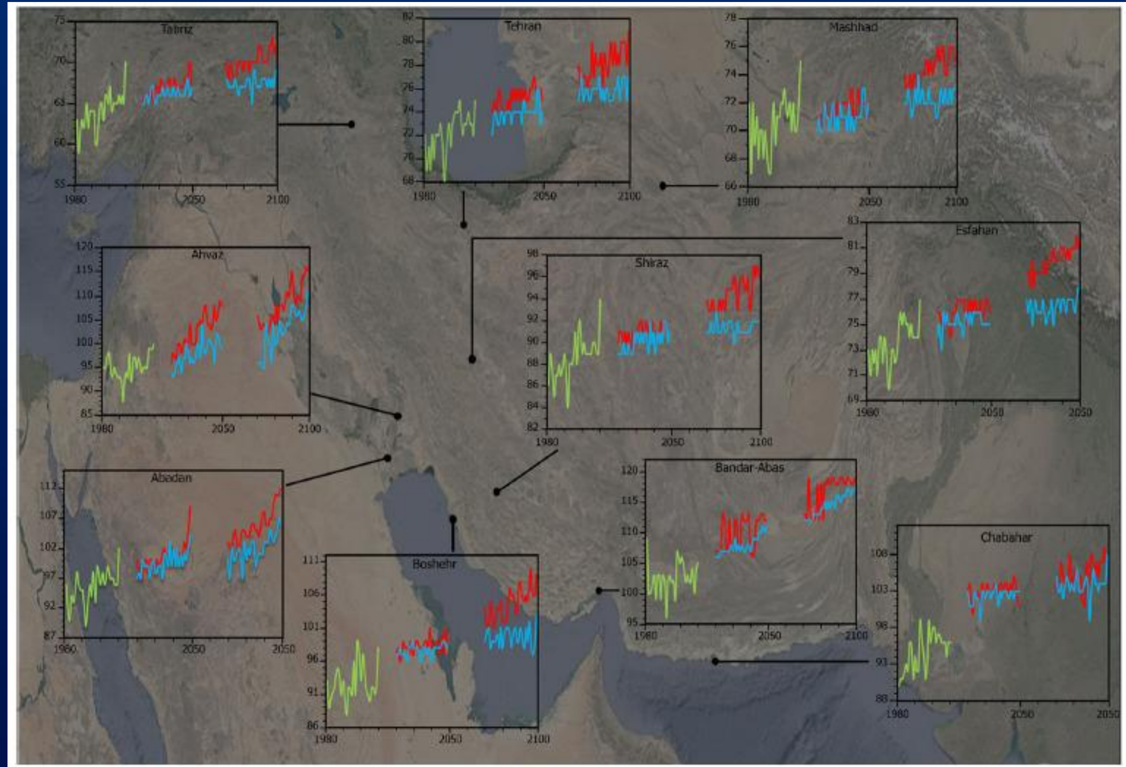
Abstract
Climate change-induced extreme heat events are becoming a major issue in different parts of the world, especially in developing countries. The assessment of regional and temporal past and future change in heat waves is a crucial task for public health strategies and managements. The historical and future heat index (HI) time series are investigated for temporal change across Iran to study the impact of global warming on public health. The heat index is calculated, and the nonparametric trend assessment is carried out for historical time series (1981–2010). The future change in heat index is also projected for 2020–2049 and 2070–2099 periods. A rise in the historical heat index and extreme caution conditions for summer and spring seasons for major parts of Iran are notable for historical (1981–2010) series in this study. Using different climate change scenarios shows that heat index will exceed the critical threshold for human adaptability in the future in the country. The impact of climate change on heat index risk in Iran is significant in the future. To cope with this crucial situation, developing early warning systems and health care strategies to deal with population growth and remarkable socio-economic features in future is essential.

Keywords Climate change · Heat stress · Health risk · Climate extremes · Biometeorology · Iran



ازتوجه شما سپاسگزاریم

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استادیار دانشکده منابع طبیعی و عضو قطب علمی مدیریت ریسک و بلایای طبیعی- دانشگاه صنعتی اصفهان
تلفن: ۰۳۱-۳۳۹۱۳۵۸۲
فاکس: ۰۳۱-۳۳۹۱۲۸۴۰

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