



Water Crisis and Extreme Climate: Recognize Anthropogenic Disasters

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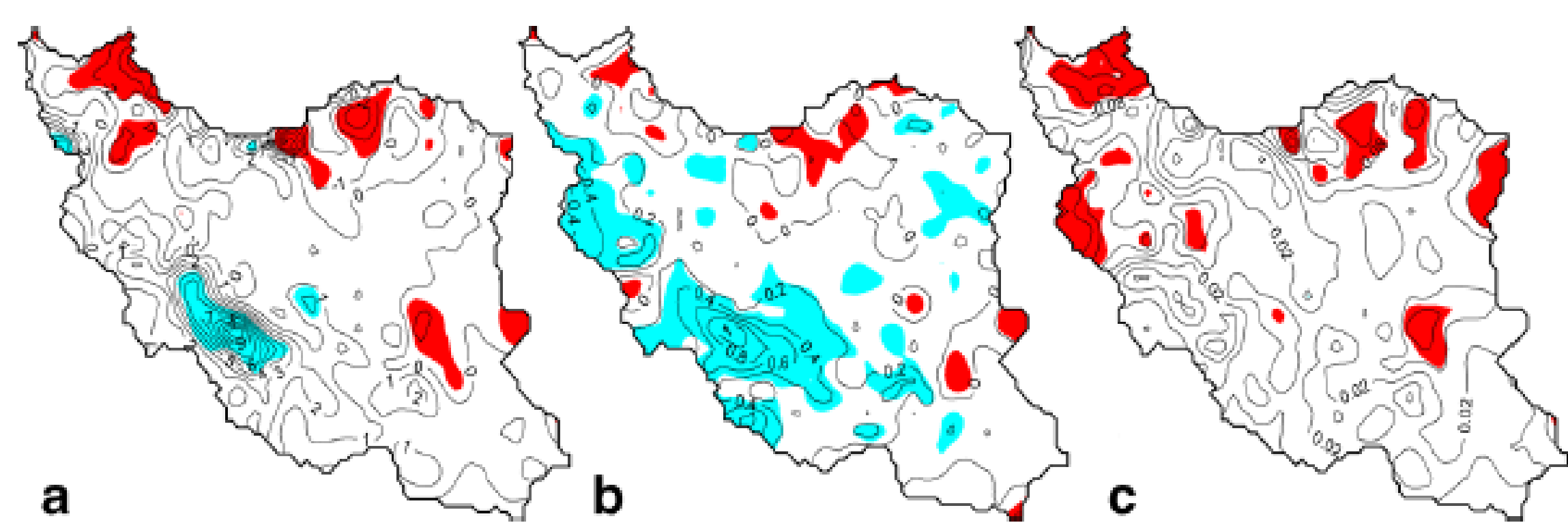
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Abstract

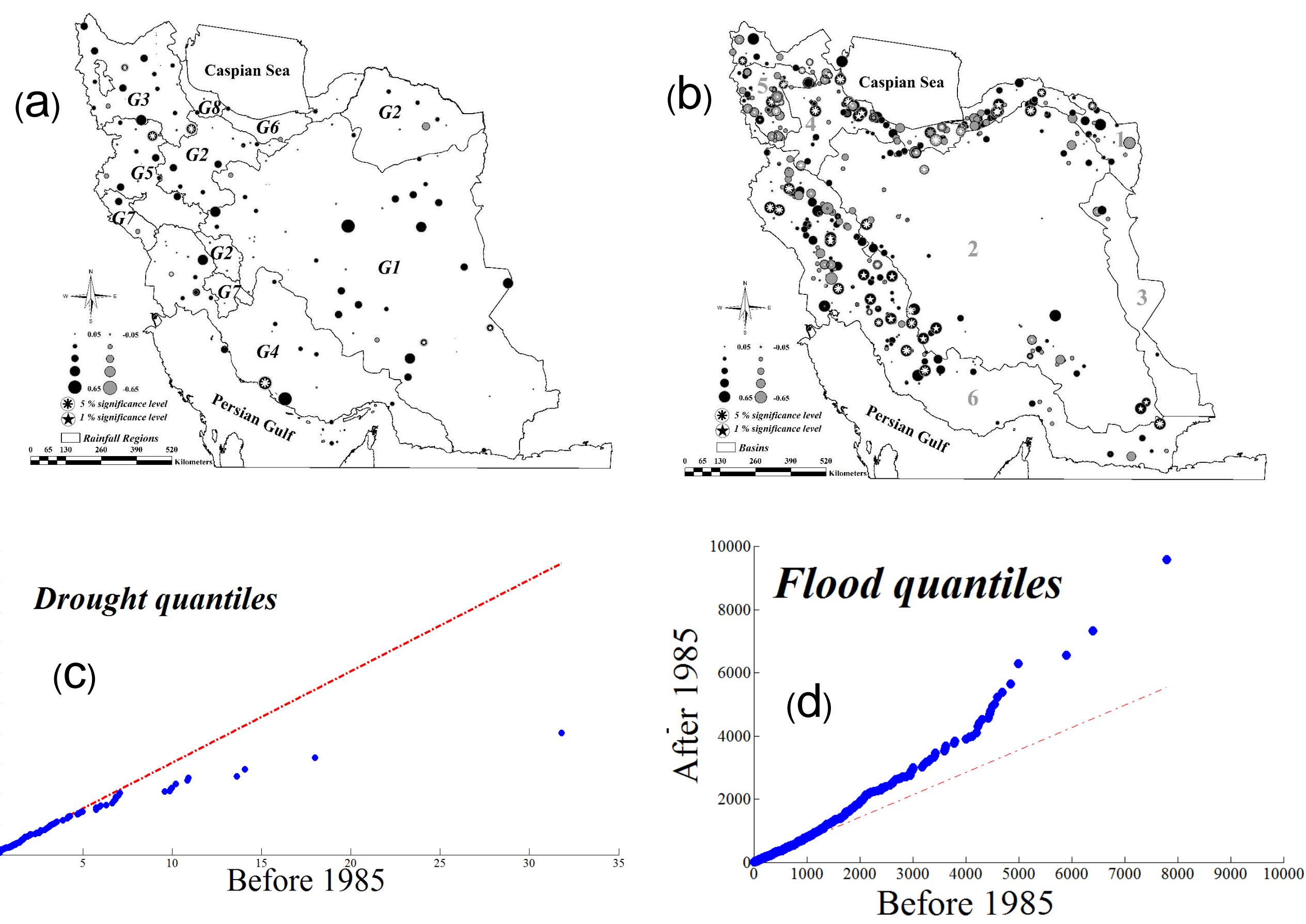
A series of comprehensive studies demonstrate how anthropogenic activities and extreme climates have triggered and aggravated extreme disasters all across the country of Iran during last decades. These studies carried out on different processes, including precipitation, flood, and meteorological drought, ground water level, maximum rainfall and hydrologic drought reveal that extreme hydro-meteorological events are increasing and threatening the availability of surface and ground water resources as a serious challenge to this country. In addition two studies of climate change impact assessment on drought and maximum rainfall showed a possible change in probability of extreme events in near and far future under different climate models and scenarios. The results prioritize different regions that are under influence of hydro-climatic disasters. Effective and long-term strategies are proved to be a real need to better manage water resources and mitigate adverse consequences arising from extreme climate and man-made disasters.

Case Study 1- Change detection in Rainfall characteristics^{1,2}



This study investigates changes in rainfall indices in Iran during 1961-2004. The total annual rainfall and number of rainy days seem to be decreasing (a,c) while maximum rainfall seems to be increasing (b). Other indices such as relevance index for small to moderate percentiles show decreasing trend while higher percentiles show increasing trend.

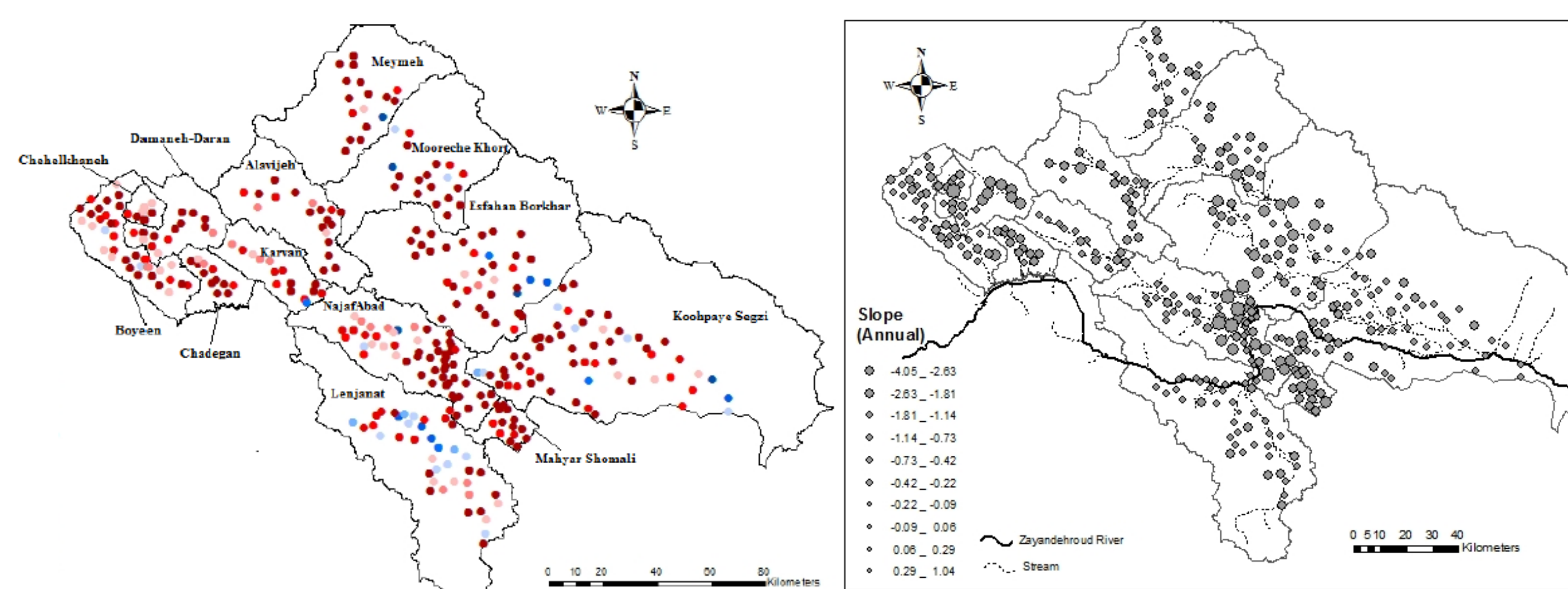
Case Study 2- Change detection of Extreme Droughts & Floods³



This study investigate changes in extreme flood and drought events in Iran during 1950-2000.

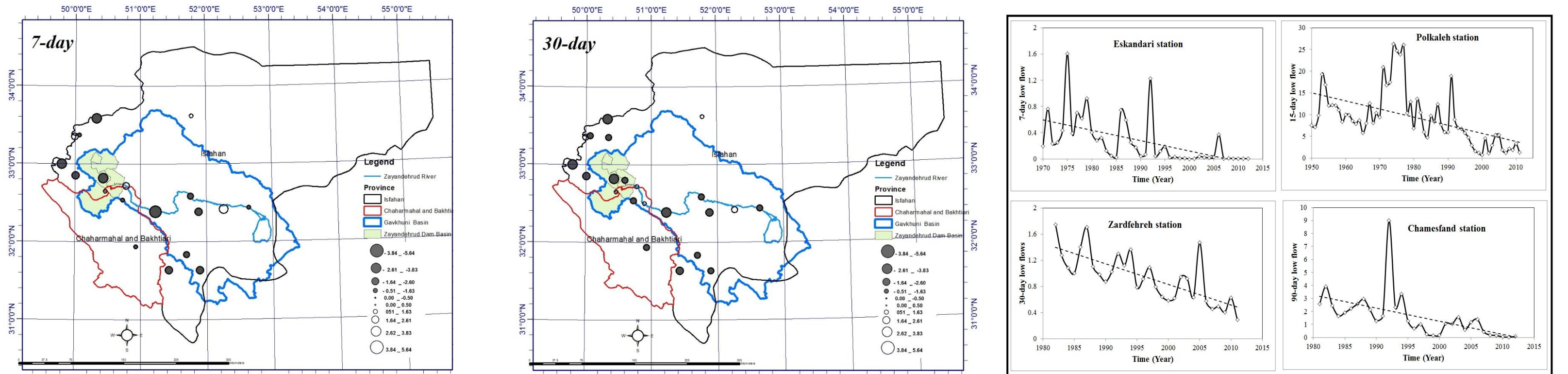
Results showed both increasing and decreasing trend for drought severity-duration index (panel a) and increasing peak flood (panel b). However, the increasing ratio of increasing flood peaks is much higher than the increasing ratio of drought extremes. The change point detection methods revealed a change point in flood peak and drought severity magnitude in 1985. The qq-plot of drought (panel c) and flood peak (panel d) reveal that the changes in drought quantiles are not very strong while the changes in flood peaks in very critical levels. Though we may consider water deficit as a major water crisis in Iran, this water crisis has another face of extreme destructive floods which may be ignored in our water resource management policies.

Case Study 3- Change detection of Ground water level⁴



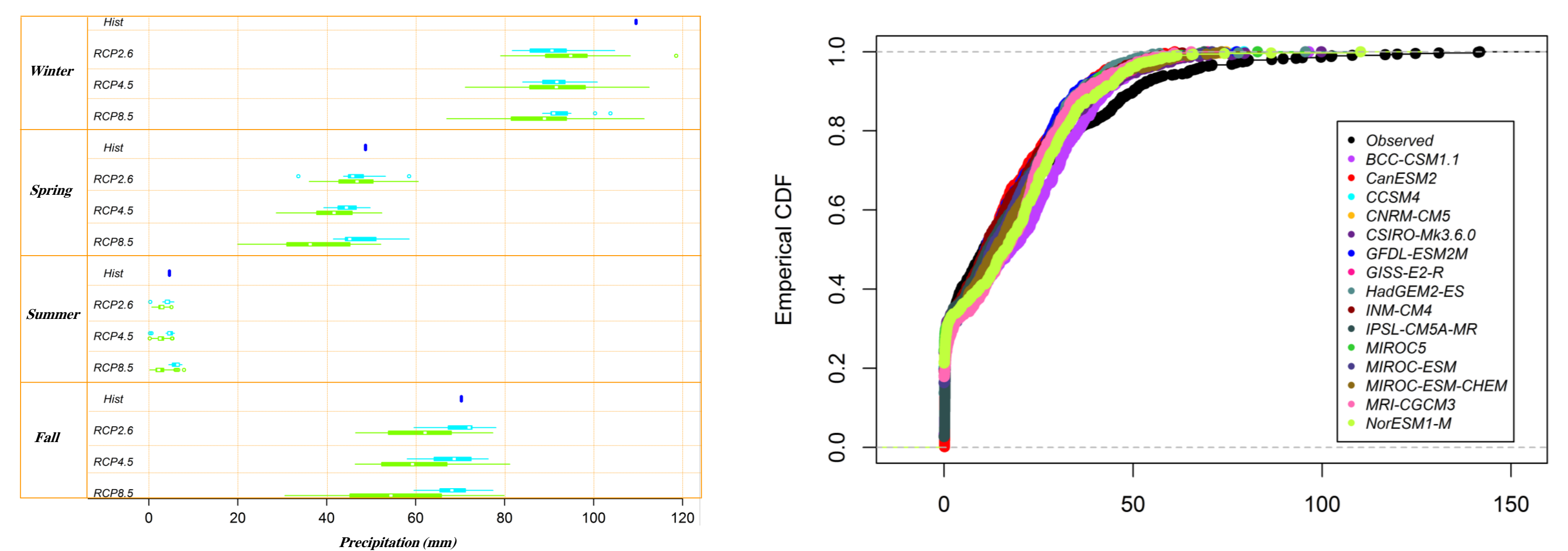
The change of ground water level over Isfahan Province were examined using water table of 310 piezometric wells in 13 plains. Results showed strong decreasing water level almost everywhere (left panel). We can also see that the annual range of change varies between 0.09 to 4 meters/year. The concentration of decreasing water table around agricultural centres indicates an anthropogenic effect and overexploitation of ground water in Isfahan Province.

Case Study 4- Change detection of hydrologic drought indices⁵



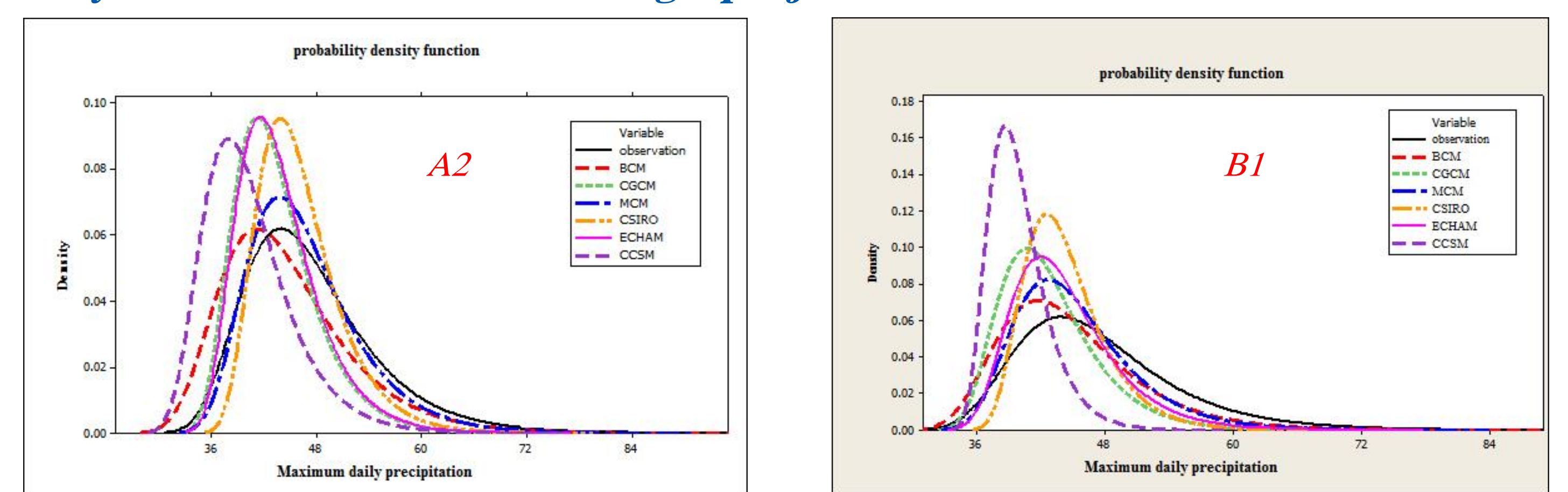
This study detects changes in hydrologic drought indices (HDIs) including magnitude (i.e. daily mean, low flows and flow quantiles), variability (i.e. coefficient of variation) and duration at 22 stations over Isfahan province and Zayandehrud basin, Isfahan province, Iran. The results indicate decreasing trend for average, low flow indices (1, 7, 15, 30 and 90-days) and flow quantiles (q25, q75, q95 and q99). These results indicate an increasing risk of water supply deficit for a large semi-arid region and drinking water for a number of metropolitan cities in this region of Iran. In addition, considering other types of water resources such as ground water table and water demands such as agricultural water use, this increasing risk can be attributed to anthropogenic effects, though we need more evidences and studies to prove this.

Case Study 5 - Rainfall change projection for Tehran⁶



To project the impact of climate change on the future precipitation behavior of **Tehran**, 15 different GCMs of the CMIP5 multi-model ensemble are used under three different forcing emission scenarios. The majority of the models indicate a steadily decreasing precipitation trend in the twenty-first century under each climate change scenario. The results of seasonal projections also indicate a decrease of precipitation especially for spring and winter. Compared with the historical records (1951-2011) the mean reduction of projected precipitation in winter ranges from -6.10% to -17.71% over near (2015-2040) and long-term (2015-2100) periods.

Case Study 6- Maximum Rainfall change projection for north of Iran⁷



The change in future maximum daily rainfall in the North of Iran was investigated using 22 stations and historical data between 1981-2012. In this study, 6 climate models and two scenarios, A2 and B1 were selected to project changes in maximum rainfall for 2020-2049. The Probability Density Functions of historical and projected rainfall indicate a remarkable change in the shape and scale of the rainfall in the near future comparing with historical period.

Conclusion

The results of the studies demonstrate an ongoing and future critical situation for the country in terms of extreme hydro-climatic phenomena. The co-occurrence of having inappropriate management policies with soaring global warming influences will increase water demand and the challenge of water resources allocation for various sectors in the near future. It is therefore of crucial importance to water resources authorities in Iran to act immediately and follow practical and effective strategies to mitigate adverse consequences of current and future water crisis arising from extreme anthropogenic hydro-climatic disasters. Infrastructure adaptations, demand management, improving water-conservation technologies, developing an advanced prediction-monitoring system, raising awareness and public perception, and long-term water policy reforms could be some management long-term mitigation strategies for the country.

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