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Statistical Analysis of 24-Hour Rainfall Pattern in Tehran Metropolitan Area

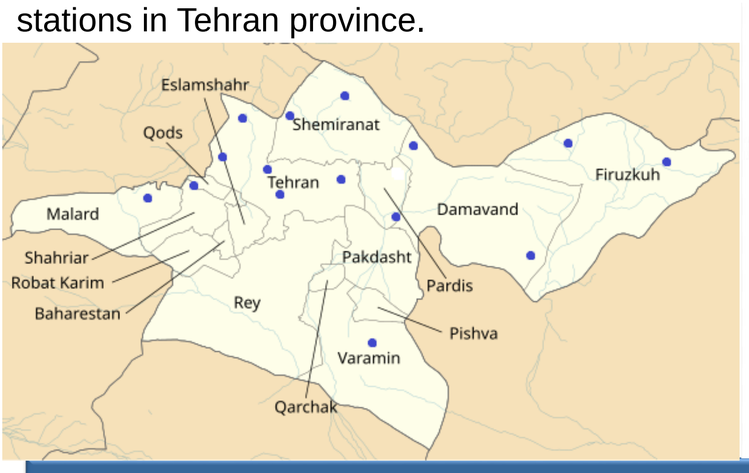
Sara Ghaznavinia [†], Seiyed Mossa Hosseini [††]

[†] BS Student of Geography, University of Tehran, P.O. Box 14155-6465, Tehran, Iran.

[††] Associate Professor, Physical Geography Department, University of Tehran, P.O. Box 14155-6465, Tehran, Iran. Corresponding Author, Email: smhosseini@ut.ac.ir, ORCID: 0000-0001-7161-8711

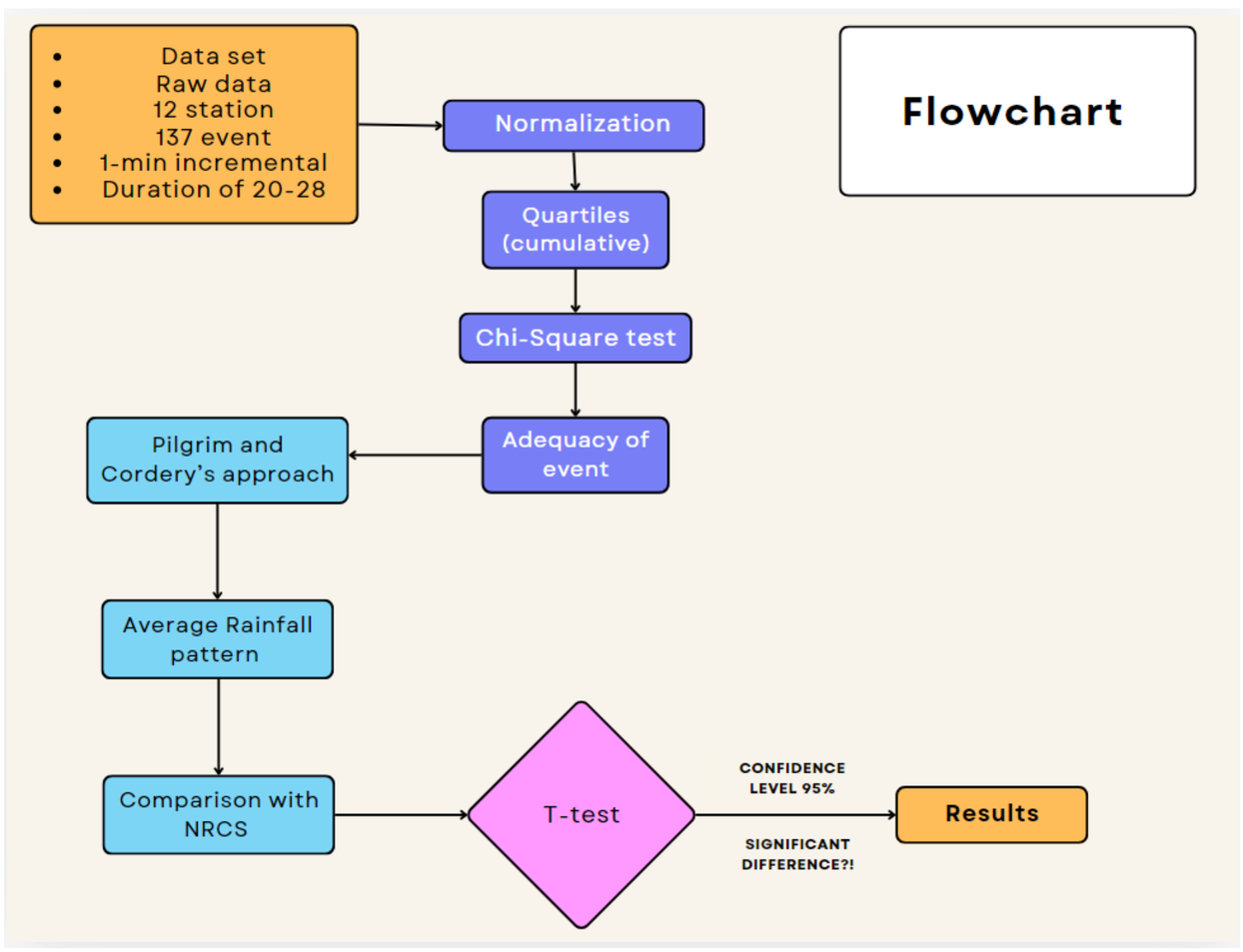
INTRODUCTION & AIM

Determination of temporal distribution of rainfall pattern is crucially important for the monitor and management of hydro systems, hydraulic structures and hydrological project, such as designing urban run-off drainage systems, constructing of intensity, duration and frequency curves, and appropriate drainage systems for floods. In contrast to tropical and monsoonal lands, where the diurnal rainfall pattern shows a clear cycle with a rainfall depth peak in the afternoon hour, in extra tropical regions like Iran, it is hard to find any clear temporal distribution pattern in rainfalls related to frontal zones and mid-latitude cyclones. To develop a comprehensive understanding of rainfall modification due to urbanization, an investigation is undertaken. The physical and population expansion of Tehran, accompanied by high-density construction and demolition of buildings, vehicle traffic, and human activities in the metropolitan area, has altered the natural levels of aerosols, hence impacted the temporal distribution of rainfall patterns. So we decided to find the temporal distribution of 24 hour rainfall from 137 events which are adapted from 12 weather stations in Tehran province.



METHOD

The need for higher resolution of the temporal and spatial distribution of rainfall data has become more essential in most of the water resource assessment studies all over the world. Minute to minute rainfall process data, also known as the mean rainfall process data at a time step of one minute is the best indicator for analyzing the rainfall patterns. Fine temporal resolution rainfall data could meet the requirements of reliability, consistency, and representation. Normalization method can change the number into decimal between 0-1 mainly for the convenience of data processing. Mapping the data into the range of 0-1 is more convenient and fast. In this study, Pilgrim & Cordery's (1975) method is used to places the rain peak period at the position where the probability of accuracy is greatest.



RESULTS & DISCUSSION

Results are presented based on fine temporal resolution, with one-minute time intervals during 31 consecutive period of time.

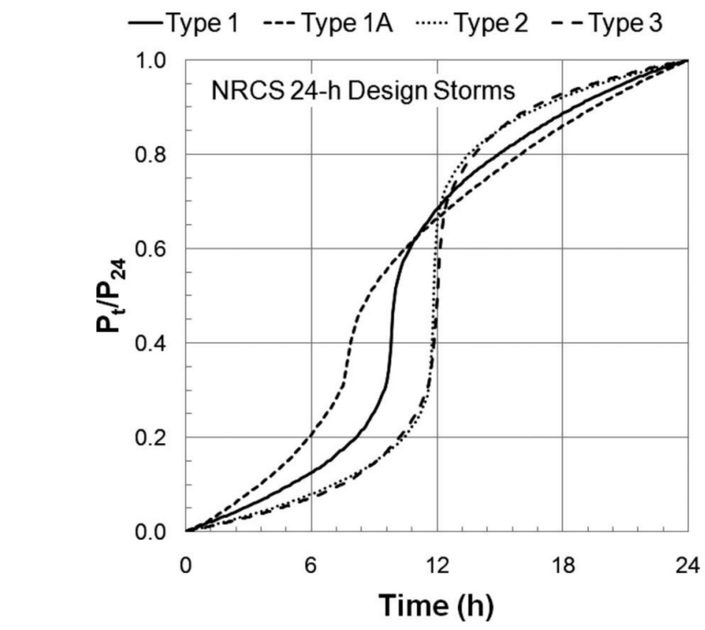


Fig. 1. NRCS design storm cumulative rainfall distributions where accumulated rainfall is presented as a ratio of the total rainfall depth

We also conducted an NRCS pattern, a well-known pattern in USA which can figure out is there any significant difference level between temporal distribution of rainfall patterns in Tehran's stations and NRCS 24-h design storms.

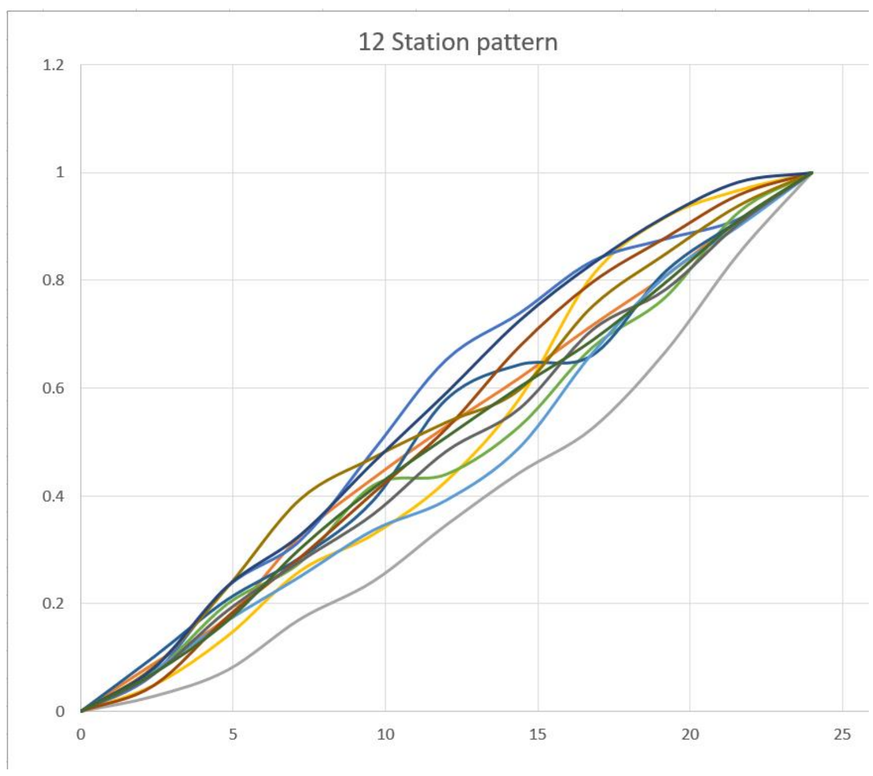


Fig. 2. Tehran stations design storm cumulative rainfall distribution

CONCLUSION

The results indicated that in most cases, the maximum amount of rainfalls occurs in the last 25% of the rainfall duration, accounting for 37% of the total storm events. Additionally, statistical tests revealed a significant difference between the charts of Tehran stations and between Tehran and the NRCS data. Therefore, the NRCS model cannot be applied to Tehran province.

FUTURE WORK / REFERENCES

Pilgrim, D.H and I. Cordery. 1975. Rainfall temporal patterns for design floods. Journal of Hydraulic Division, Am. Soc. Civ. Eng., 101:81-95.Abdullah Saad Al-Wagdany _ Construction of IDF curves based on NRCS synthetic rainfall hyetographs and daily rainfall records in arid regions-2021Al-Rawas GA, Valeo C (2009) Characteristics of rainstorm temporal distributions in arid mountainous and coastal regions. J Hydrol 376(1-2):318–326