SPATIAL-TEMPORAL DAILY RAINFALL MODELLING IN A SEMI-ARID AREA IN IRAN

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THE PROBLEM

Arid and semi-arid areas are suffering from both destructive **floods** and **droughts**.

In these areas, annual rainfall is small, very variable in time and space & occurs in just a few events.

Rainfall processes in these areas are poorly understood and the applied models are usually those which are developed for humid areas.

FIGURE 1- Threats to arid and semi arid areas

AIM & OBJECTIVES

The threats can be mitigated using an effective **management** of available water. It requires a decision support system, which includes:

•Understanding the **rainfall characteristics** in the region and its variability in time and space.

•**Modelling** and simulating the rainfall sequences using **GLMs** and a stochastic spatial-temporal simulation technique (Chandler & Wheater, 2002).

STUDY AREA

A typical semi-arid region of 2500km^2 including 14 raingauges in North east **Iran** was selected.

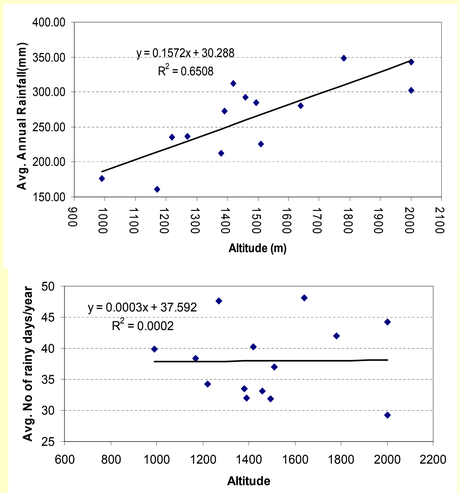

FIGURE 2- Annual Rainfall-Elevation correlation for (top) rainfall amount & (bottom) rainfall occurrence

RAINFALL CHARACTERISTIC

While spatial **correlation** of different sites at the monthly and annual scales are good, it is rather low to moderate at the daily scale. Some more characteristics are reflected in the following table:

Rainfall feature	Cyclical trend		Annual Rain- Elevation correlation coefficient	Average Annual	Fitted distribution
	Annual	Seasonal			
Amount	≈ **5.5** Years	√	0.81 ↑	267mm	Gamma
Occurrence		√	0.01 ↓	38.5 days	Logistic reg.

MODELLING

Generalised Linear Models (**GLMs**), were first fitted to the daily rainfall data at all sites to represent both rainfall occurrence and amount. They are then applied to simulate daily rainfall sequences. The GLIMCLIM software package (Chandler, 2006) was used for this purpose.

MODELLING & SIMULATION RESULTS

Spatial correlation of daily data for both occurrence and amount is rather **low** to **moderate**: The Beta-binomial distribution for the number of wet sites has a shape parameter of 3.195. The Anscombe residual correlation between all sites is 0.355.

Importantly however, including the spatial dependence effects in the modelling, led to a significant improvement in the simulation.

CONCLUSIONS

In the study area:

Rainfall follows a cyclical annual and seasonal pattern.

While rainfall amount is elevation-dependent, occurrence is not.

Including the spatial dependence effects in the modelling led to a significant improvement in the simulation.

Rainfall properties are well captured by the models (Figure3).

The results of the modelling will be used in rainfall-runoff modelling.

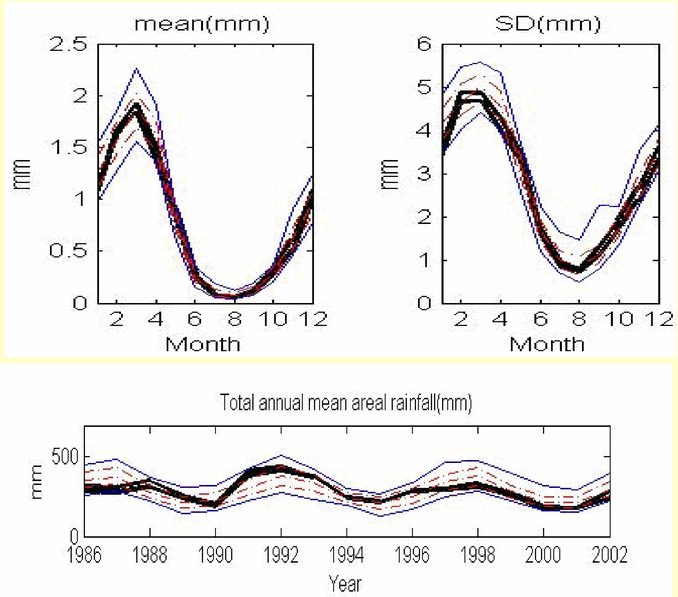

FIGURE 3- Observed and simulated data for all gauges. **Top:** monthly mean & standard deviation. **Bottom**: Annual rainfall time series. **Tick** lines shows the observed data statistics; **light** lines indicate the envelopes for simulated statistics and **dashed** lines from down to top show the 10, 50 and 90 percentiles for the simulated statistics.

ACKNOWLEDGEMENT

Thanks the Khorasan Regional Water Authority for providing the data required for the research.

REFERENCES

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