RAINFALL MODELLING
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Research work

★Development of the Scaling Model of Storm Hyetograph

★Development of a disaggregation procedure for the rainfall process

★Analysis of storm-producing weather types

★Development of a conditional simulation scheme for stochastic rainfall forecasting

Data sets

River Basin	Aliakmon (Greece)	Reno (Italy)	Evinos (Greece)	Evinos (Greece)
Point or areal rainfall	Point	Areal	Point	Point
Event type	All	hourly depth >1 mm	hourly depth > 7 mm or daily depth > 25 mm	hourly depth > 7 mm or daily depth > 25 mm
Season	April	All year	Oct. - Apr.	May - Sep.
Record period	13 years (1971-1983)	2 years (1990-1991)	20 years (1971-1990)	20 years (1971-1990)
Number of events	89	149	200	93

Mathematical background for the scaling model

Main hypothesis

$$\{\xi(t,D)\} \overset{d}{=} \{\lambda^{-H}\xi(\lambda t, \lambda D)\}$$

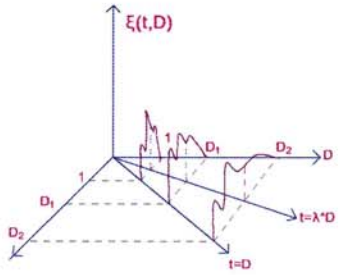
where $\xi()$: instantaneous rainfall intensity
D: duration of the event
t : time ($0 \le t \le D$)
H: scaling exponent

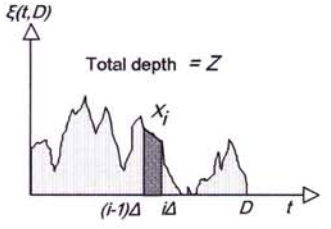
Secondary hypothesis: Weak stationarity (= stationarity within the event)

$$E[\xi(t,D)] = c_1 D^H$$

$$E[\xi(t,D)\,\xi(t+\tau,D)] = \varphi(\tau/D)D^{2H}$$

$$\varphi(\tau/D) = k(\tau/D)^{-\beta}$$

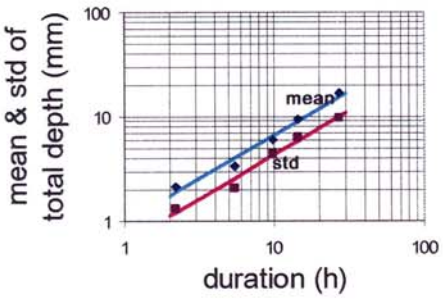




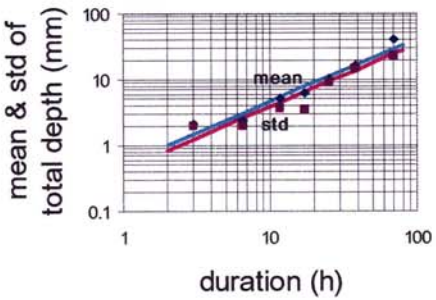
Perfomance of the scaling model. Some examples

Mean and standard deviation of total depth

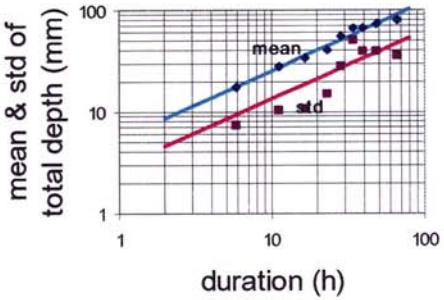
Aliakmon River



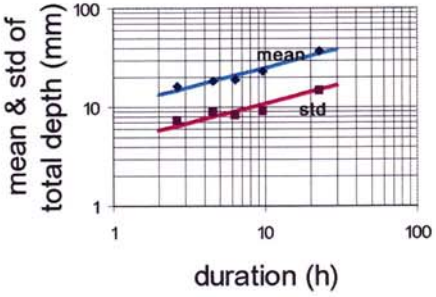
Reno River



Evinos River (winter)

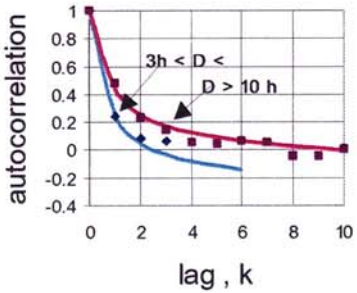


Evinos River (summer)

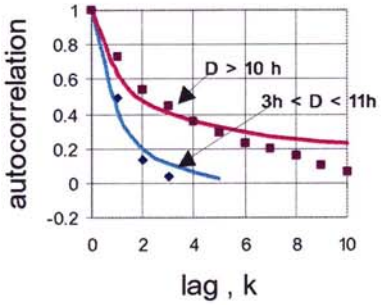


Autocorrelation function of hourly depth

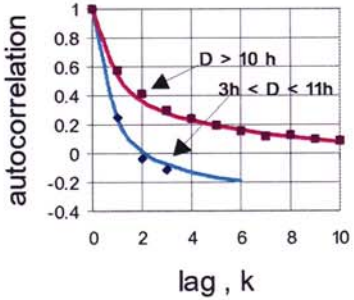
Aliakmon River



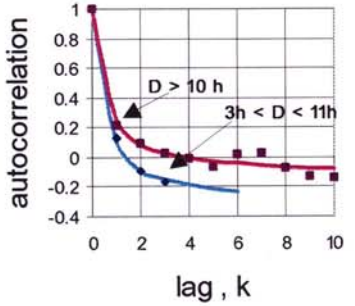
Reno River



Evinos River (winter)

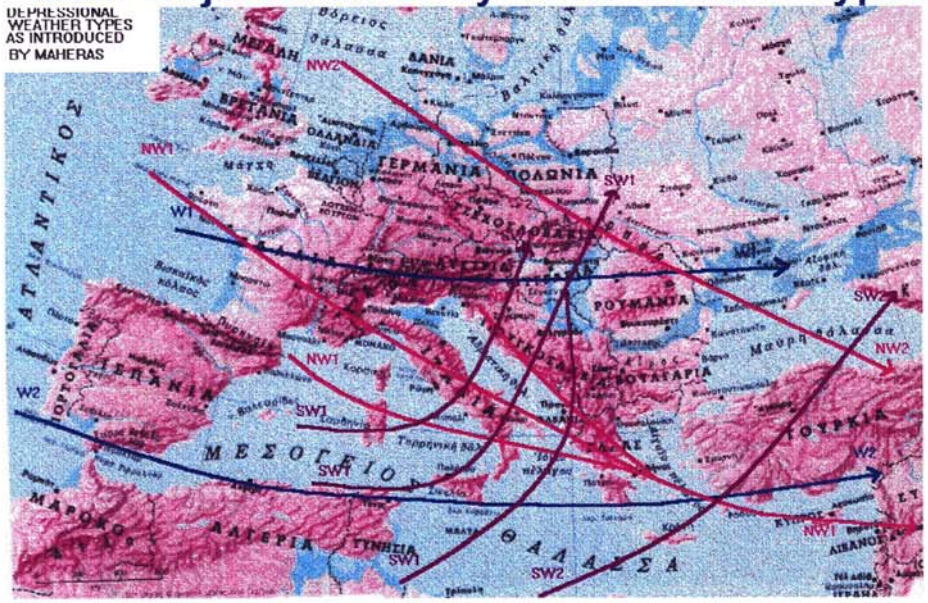


Evinos River (summer)



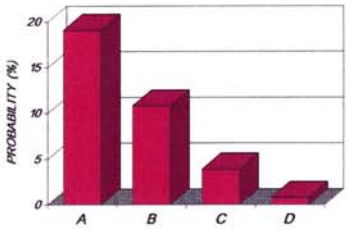
Analysis of weather types

Main trajectories of cyclonic weather types



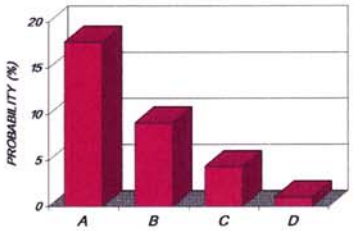
Probability of occurence of intense rainfall events per weather type

Wet season



A : W1, W2, NW1, SW1
B : SW2, NW2
C : MT2, DOR
D : A1-A5, MT1, DES, MB

Dry season



A : W2, NW1, DOR
B : SW1, SW2
C : W1, NW2, MT1, DES, MB
D : A1-A5, MT2

Classification of weather types

Definition and classification of weather types in Greece (by Maheras)

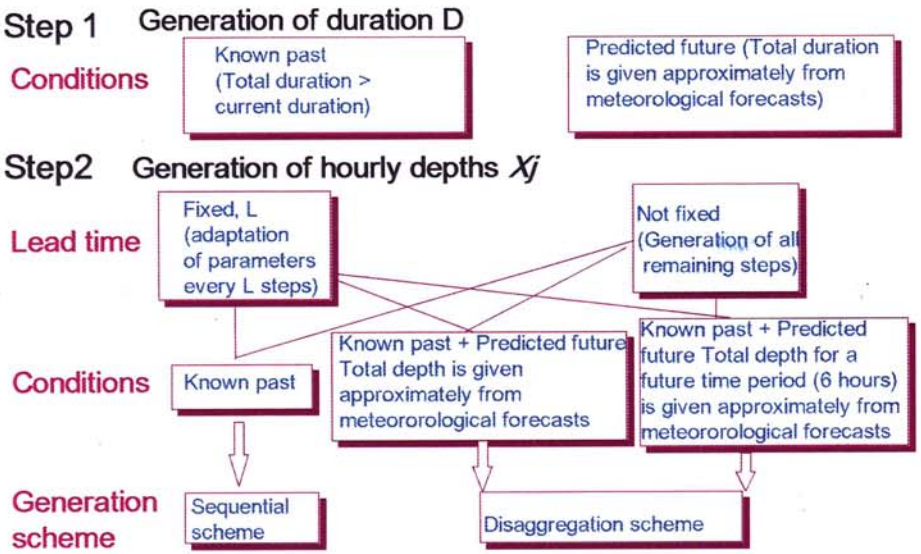
Criteria	The location of centers of anticyclones The main trajectories of cyclones Some special synoptic situations in surface and 500 mb level
Seasons	Wet (October - April) Dry (May - September)
Weather types	5 anticyclonic (A1, A2, A3, A4, A5) 6 cyclonic (SW1, SW2, NW1, NW2, W1, W2) 2 mixed (MT1, MT2) 3 characteristic (DES, MB, DOR)
Time period	Maheras developed a daily calendar of weather types in Greece for the period 1950-1990

Remarks

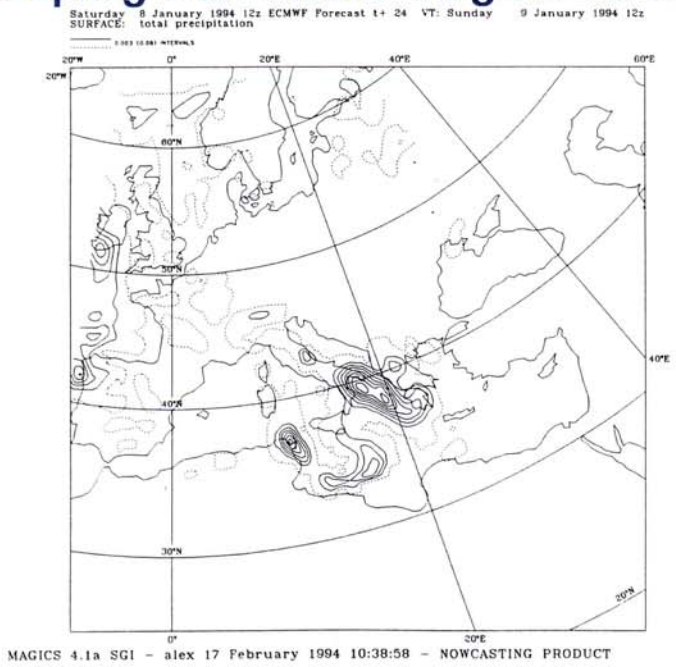
- ★ Statistically significant differences in the probability of occurrence of intense rainfall flood events, among the various weather types.
- ★ Large variance in all rainfall event characteristics, for all weather types.
- ★ Significant differences in the stochastic structure and characteristics of the intense rainfall events, between dry and wet season.
- ★ No statistically significant differences in the rainfall and flood event characteristics among the weather types of the wet season. Slight significant differences among the weather types of the dry season.
- ★ A small percentage of the total variance of rainfall characteristics, is explained by introducing the concept of weather type. The double percentage is explained merely by the duration of the event.

Forecasting by conditional simulation

Conditional simulation scheme

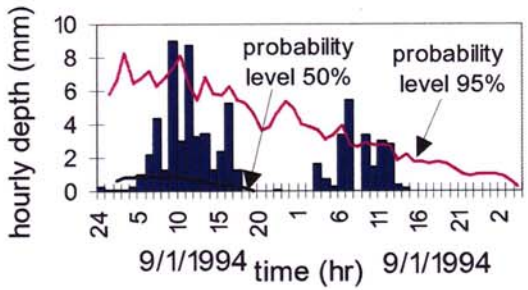


Coupling with meteorological forecasts

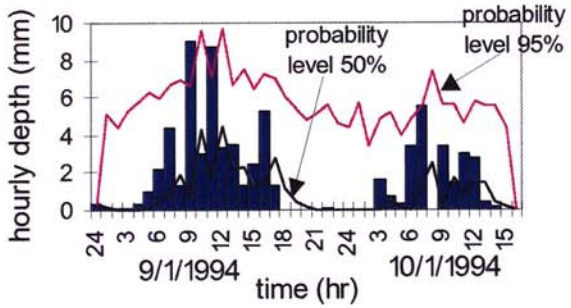


Application of the model

Case 1. Known past for duration and depth. Not fixed lead time.



Case 2. Known past for duration and depth. Fixed 1 hour lead time.



Case 3. Known past for duration and depth. Not fixed lead time. Estimates for future duration and total depth.