

4th International workshop on Hydrological Extremes.
15-17, Septembre 2011, Cosenza, Italy.

Uncertainties mitigation in the estimation of urban stormwater discharge by an approach based on partial duration series (PDS) /

Réduction des incertitudes sur l'estimation du débit pluvial urbain par une approche basée sur les séries de durées partielles (SDP)

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Outline

- Context / Problem / Aim / Methodology.
- IDF curves establishment.
 - AMS approach.
 - PDS approach.
- IDF curves as tool to elaborate synthetic hyetographs.
- From the Rainfall to the Runoff.
 - The SCS-CN.
 - Linear reservoir.
- Results / Conclusion.

- Context / Problem / Aim / Methodology:



Small magnitude flood:
Traffic slowed.

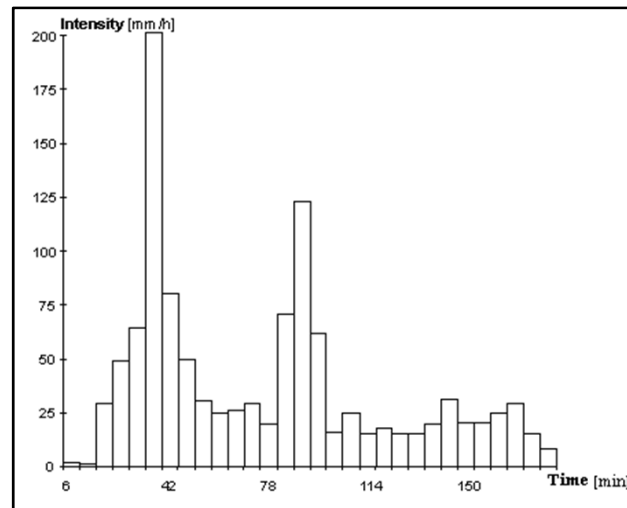


High magnitude flood.
Flooded residential area



- Context / Problem / Aim / Methodology:

Lifting of the cover slab of storm water duct after slightly high rainfall.

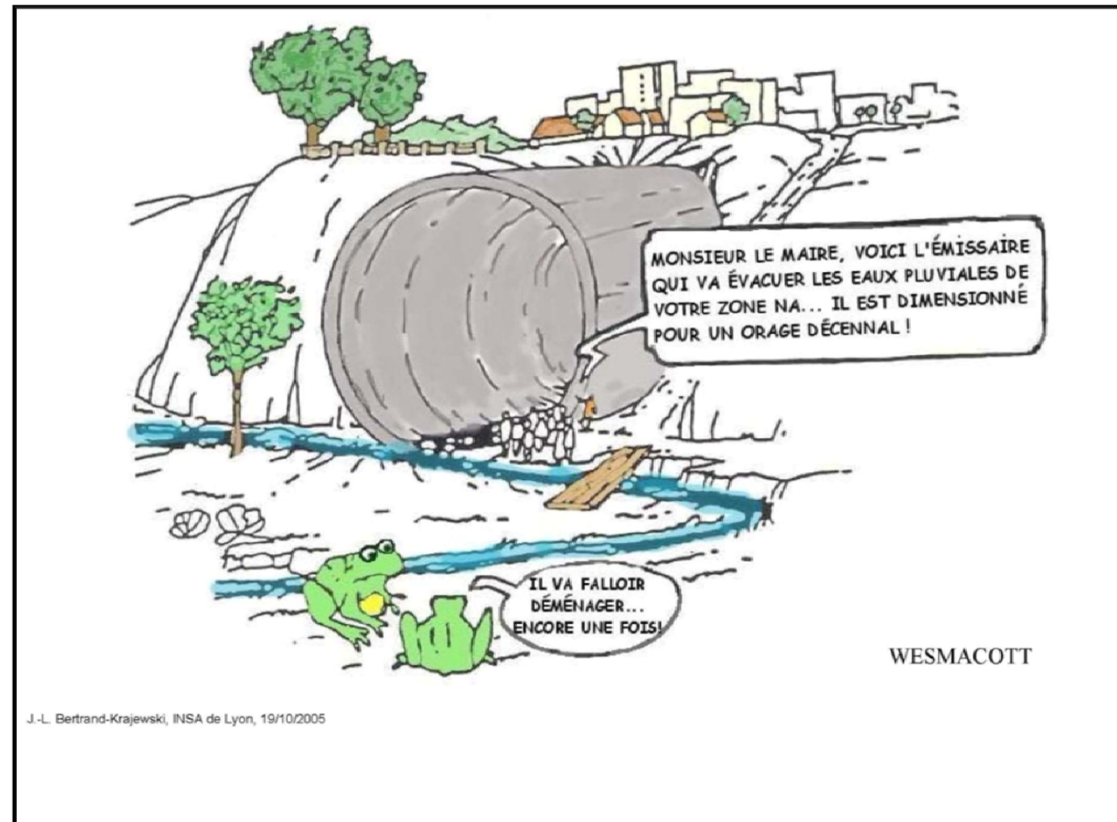


Lack of exhaustive studies on extreme rainfall events



- Context / Problem / Aim / Methodology:

This study aims to demonstrate the risk of underestimation or overestimation of discharges of the runoff calculated on the basis of IDF curves established from AMS of inappropriate length (lower than 30 years)



- Context / Problem / Aim / Methodology:

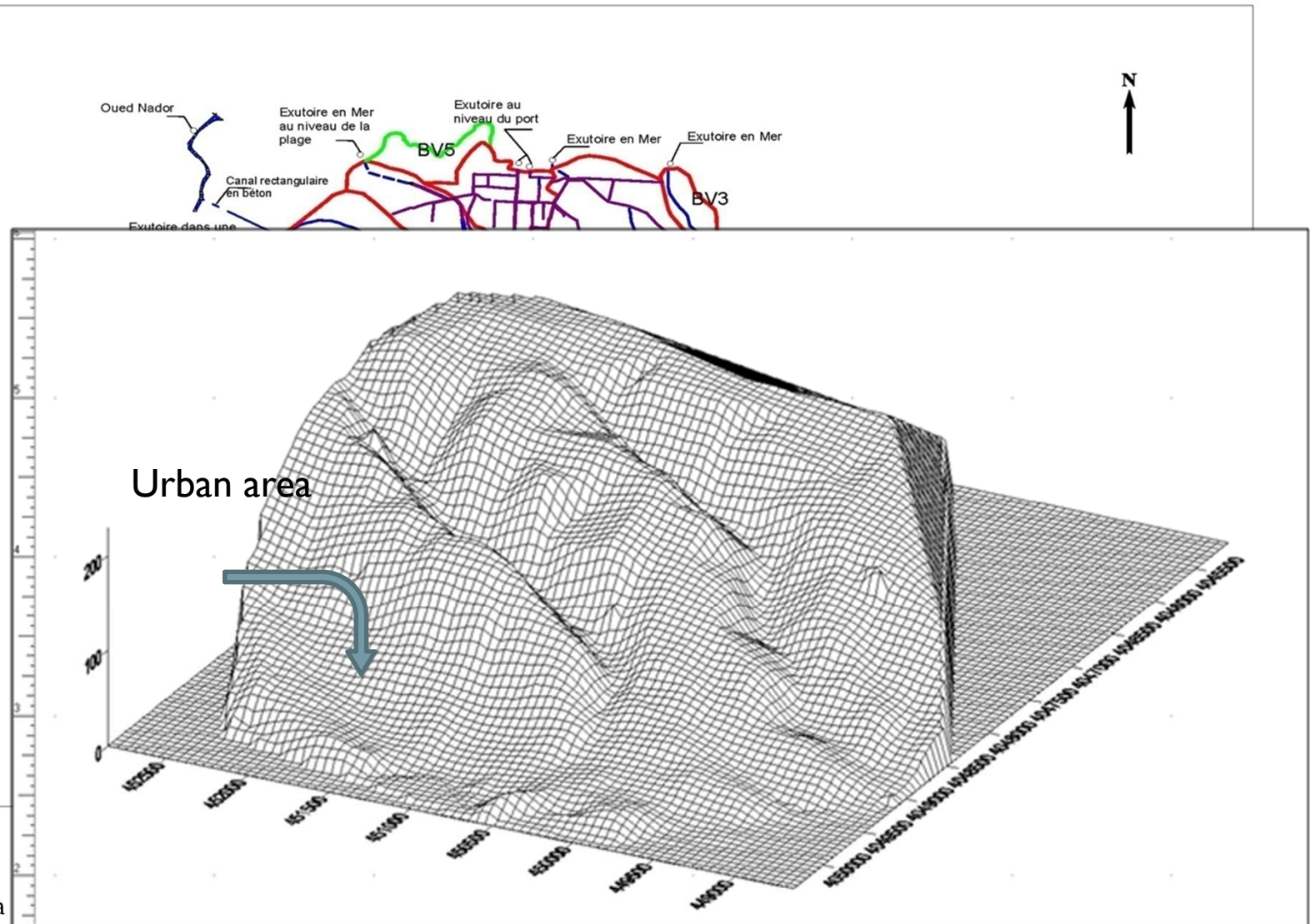
Comparing:

- Stormwater discharges, calculated on the basis of IDF curves derived from AMS.

And

- Stormwater discharges, calculated on the basis of IDF curves derived from PDS

- Study area location



- IDF curves establishment.

Koutsoyiannis & al Model (1998): called **Global Frequency Model**

1. Annual Maximum Series (AMS).
2. Partial duration Series (PDS) or POT series

Previous work (Boukhefifa & al, 2011) has shown that the use of mean number of threshold exceedances per year, $\lambda = 1$:

- Allows exhaustive use of the extreme precipitation data.
- Ensures the independency of the series.
- Gives the best fit to Generalized Pareto Distribution (GPD).

- IDF curves establishment.

19 years data recording raingauge

AMS:

$$i_{T,d}(\alpha^*, \xi^*, \kappa, \theta, \eta) = \frac{\alpha^* \left\{ \frac{\xi^*}{\alpha^*} - \frac{[-\ln(1 - \frac{1}{T})]^\kappa - 1}{\kappa} \right\}}{(d + \theta)^\eta} \quad i_{T,d}(\alpha^*, \xi^*, \kappa, \theta, \eta) = \frac{0.75 \left\{ \frac{3.23}{0.75} + \frac{[-\ln(1 - \frac{1}{T})]^{-0.15} - 1}{0.15} \right\}}{(d + 4.646)^{0.600}}$$

PDS:

$$i_{T,d}(\alpha, \xi, \kappa, \theta, \eta) = \frac{\xi + \frac{\alpha}{\kappa} (1 - T^{-\kappa})}{(d + \theta)^\eta} \quad i_{T,d} = \frac{2,22 - \frac{1,02}{0,15} (1 - T^{0,15})}{(d + 1,512)^{0,571}}$$

where: κ = Shape parameter (dimensionless);

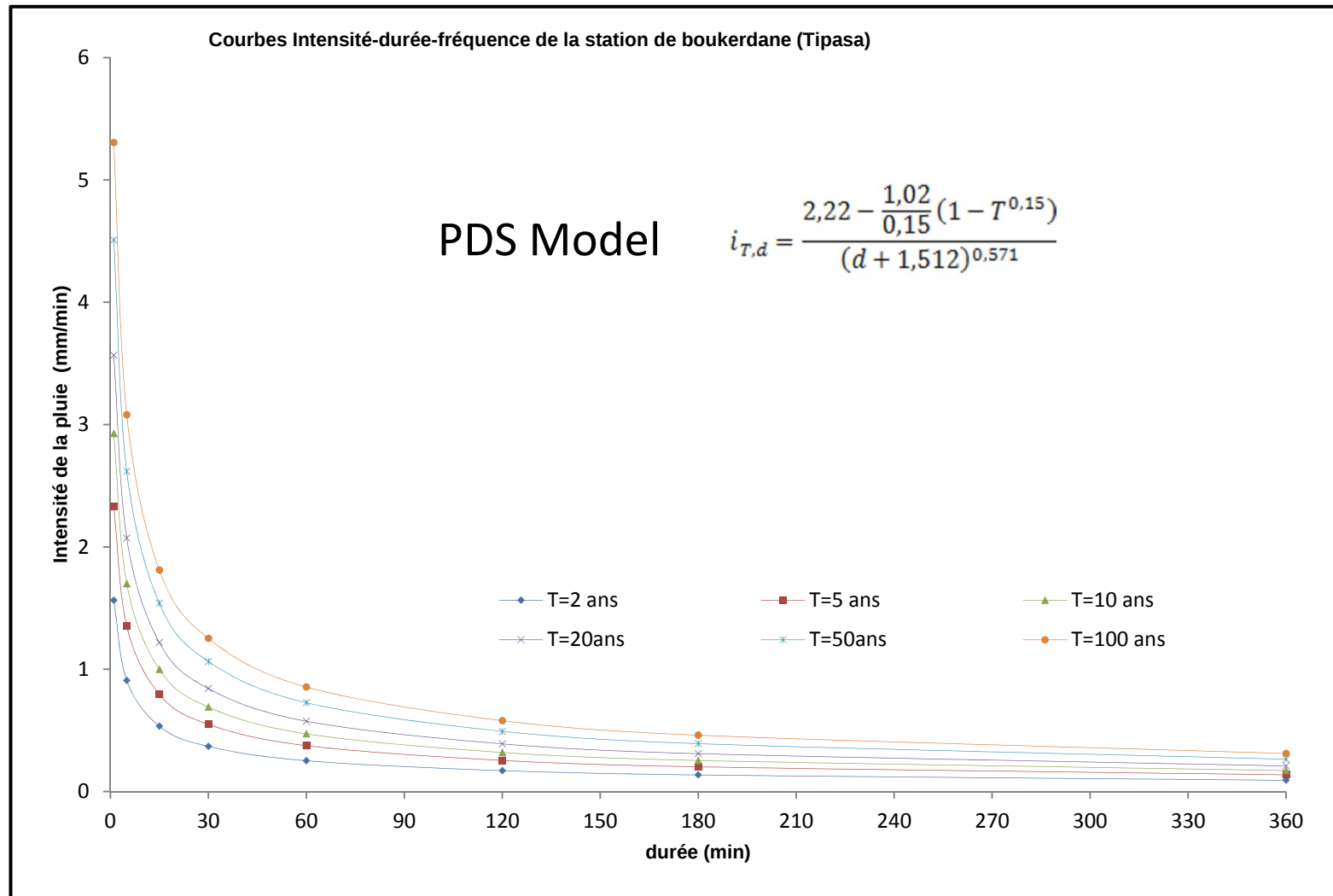
α = Scale parameter (mm);

ξ = Location parameter (mm);

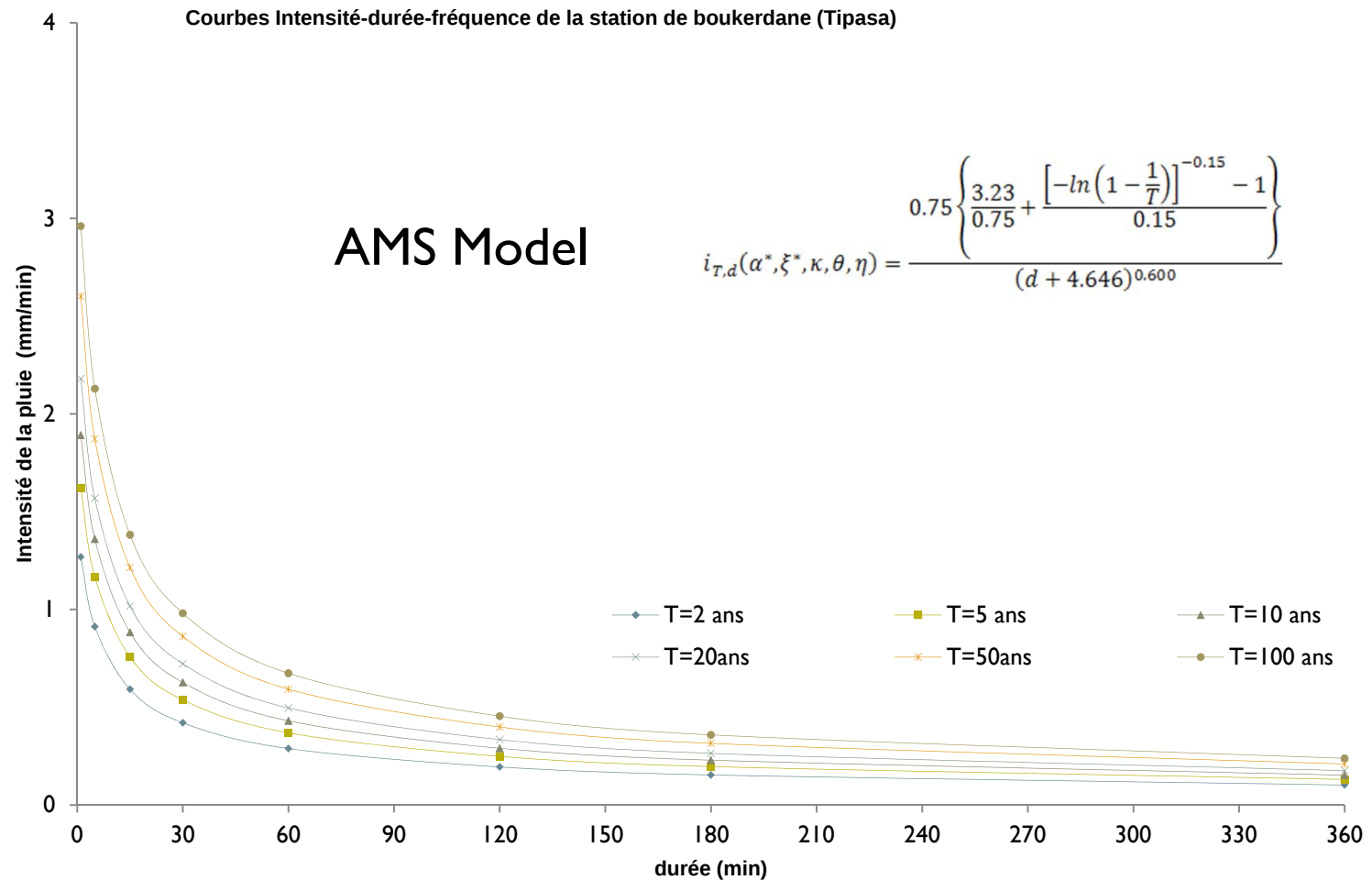
(*) Referring to the AMS;

η, θ = Parameters depending on the functional dependence of the intensities on duration

- IDF curves establishment.



- IDF curves establishment.



RMSE = 0.61

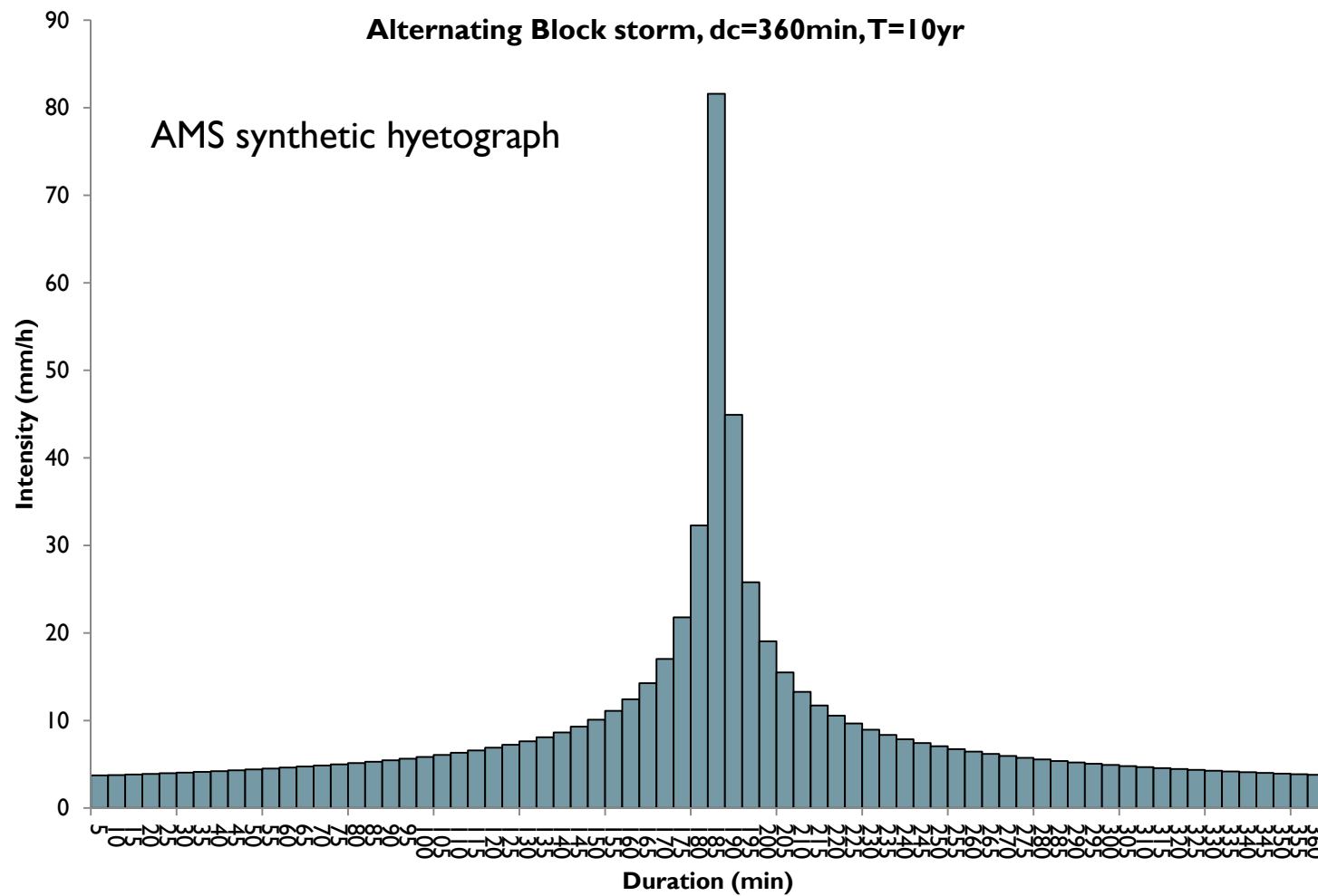
- IDF curves as tool to elaborate synthetic hyetographs.

Alternating Block method, also called Balanced storm method

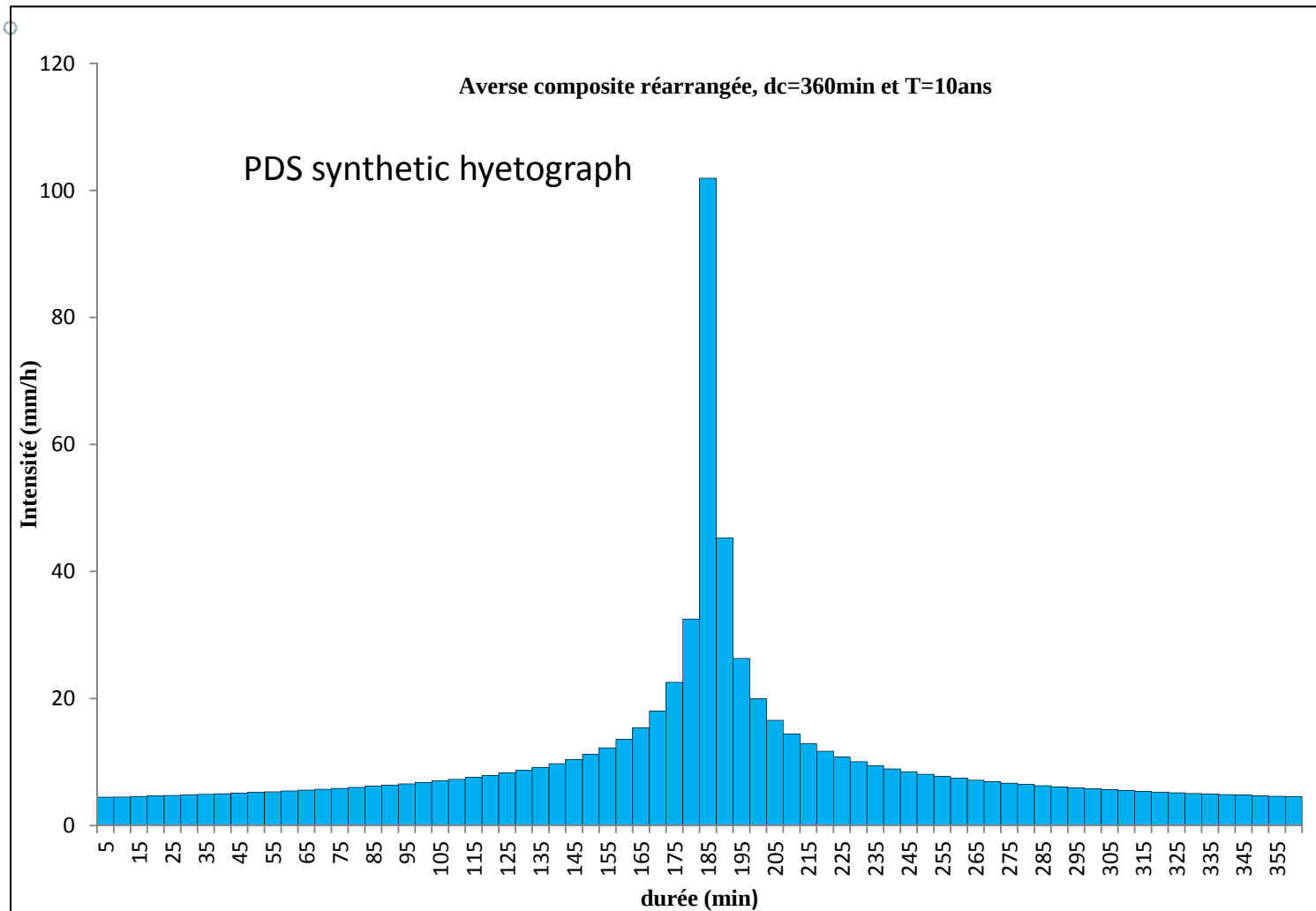
Historical analysis has shown (Boukhelifa, 2010):

- Critical rainfall duration: 6hrs.
- Location of the highest intensity: Central.
- Duration interval, close to the time of concentration of the urban watersheds : 5min.

- IDF curves as tool to elaborate synthetic hyetographs.



- IDF curves as tool to elaborate synthetic hyetographs.



- From the Rainfall to the Runoff.

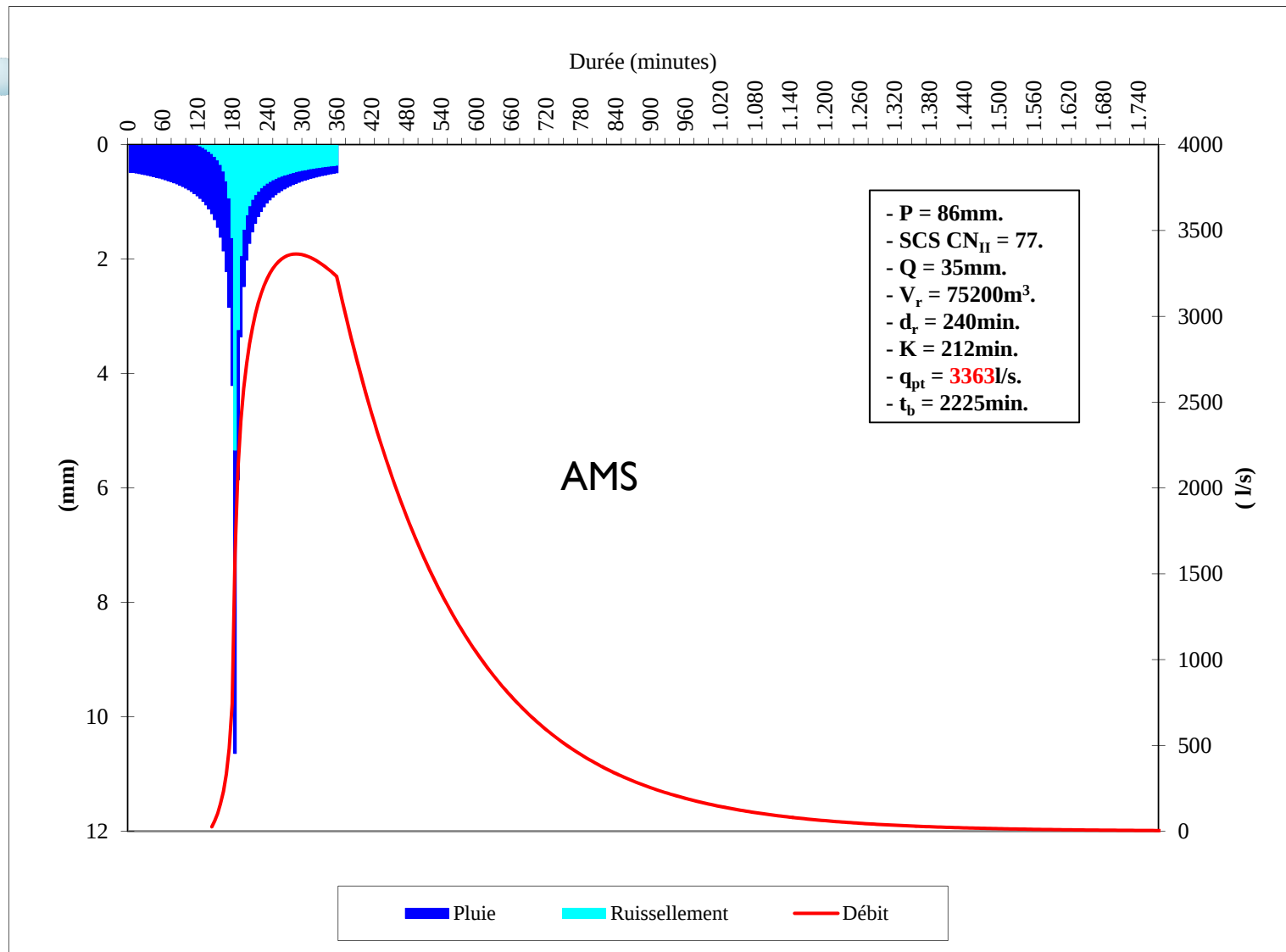
Production function: derived from SCS-CN procedure.

- Simplicity
- Taking into account Runoff from, connected impervious, unconnected impervious and pervious areas.
- Logical area grouping: weighted Curve Number CN (Hydrodynamics of the soil)

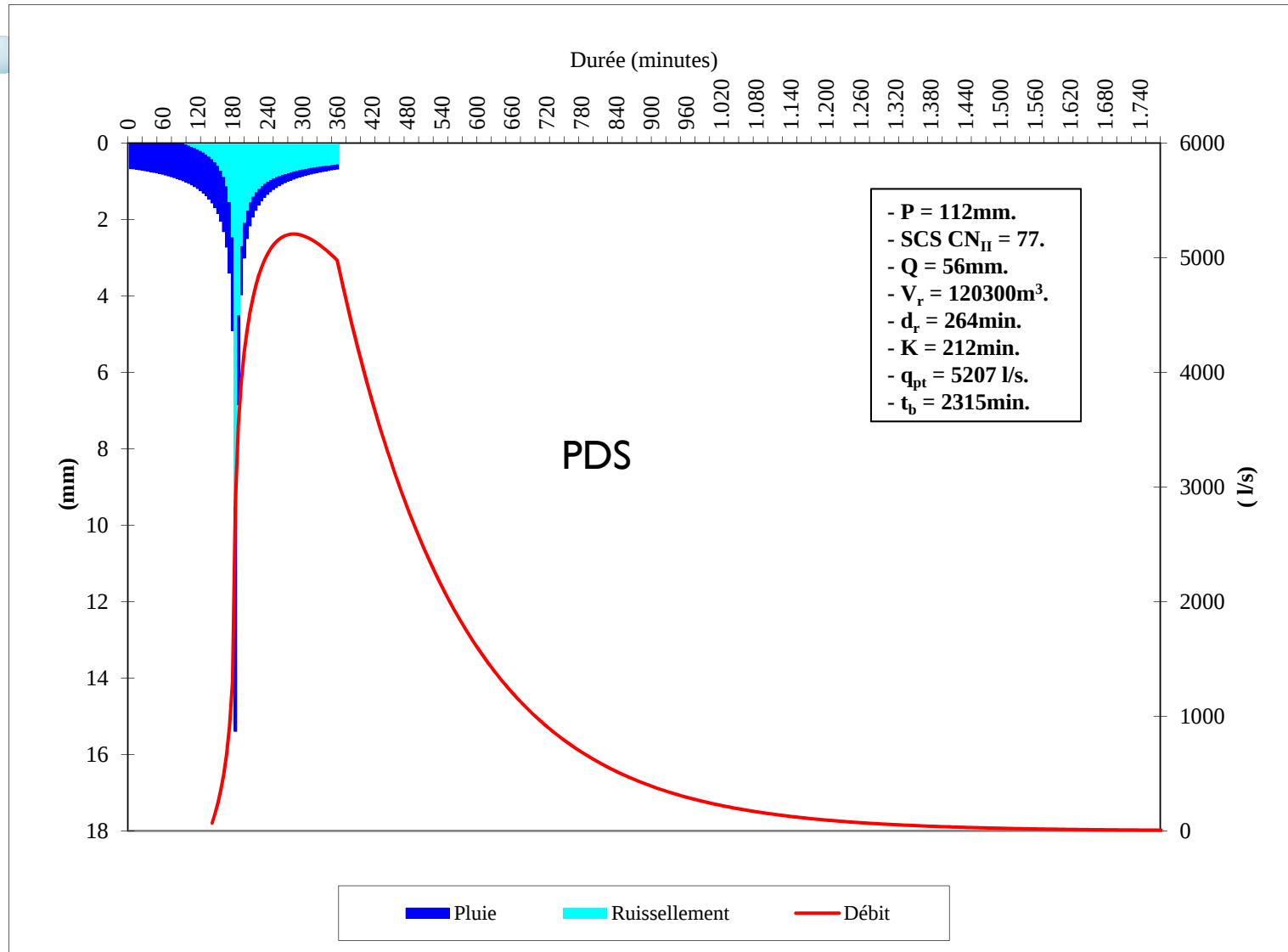
Transfer function: Linear Reservoir.

- Simplicity.
- Unavailability of discharges measurements: Empirical definition of the lag time.
- Imperfect knowledge on the geometry of the stormwater drainage network: lumped description of the urban watersheds

- From the Rainfall to the Runoff.



- From the Rainfall to the Runoff.



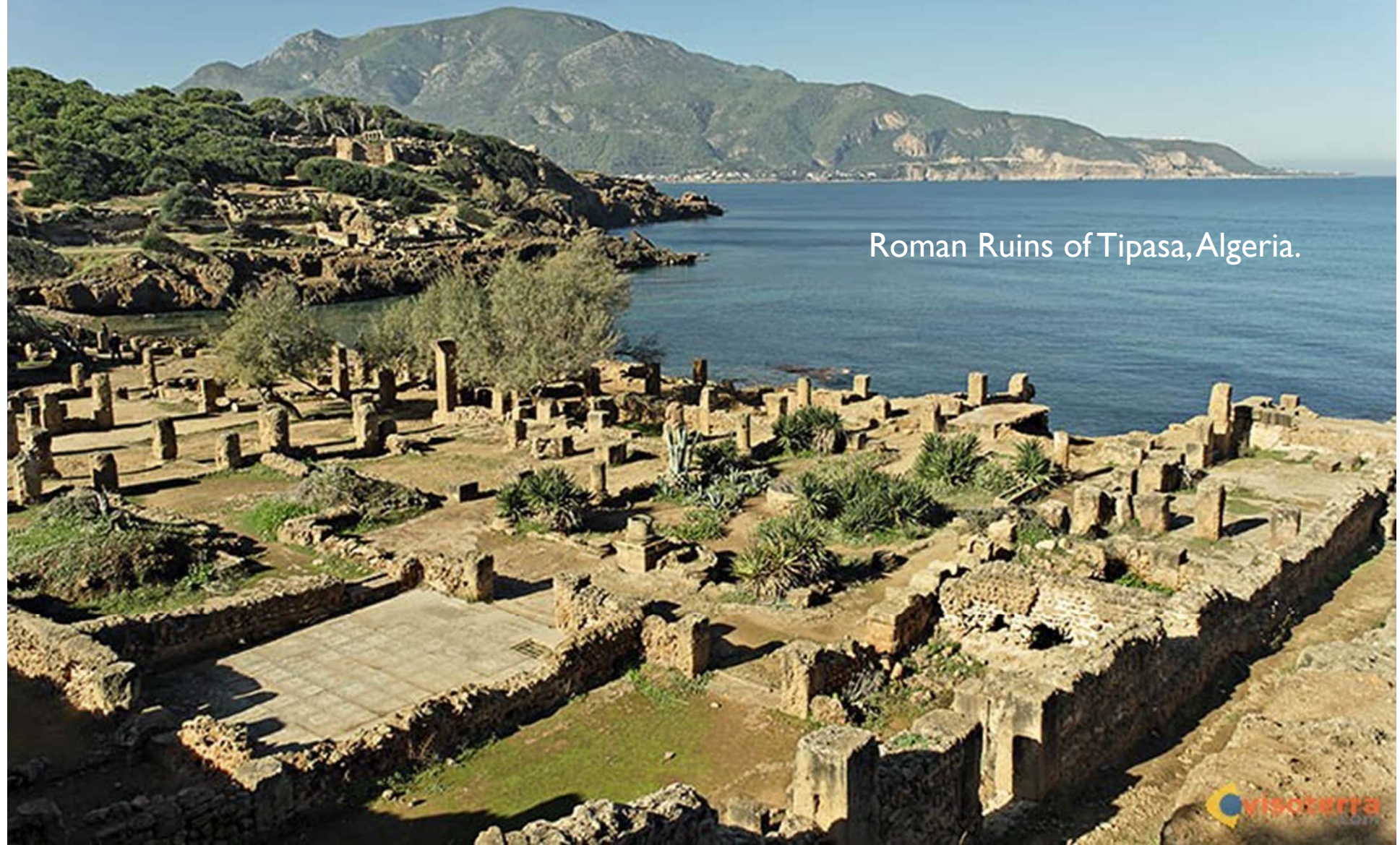
- Results / Conclusion.

Return Period	10 years	50 years	100 years
SubCath	Qpds/Qams	Qpds/Qams	Qpds/Qams
SubCatch. 1	1.3	1.4	1.5
SubCatch. 2	1.3	1.5	1.6
SubCatch. 3	1.4	1.5	1.6
SubCatch. 4	1.3	1.4	1.5
SubCatch. 5	1.2	1.3	1.4

- Results / Conclusion.

- It becomes clear, that the lack of exhaustive studies on extreme precipitations lead to inappropriate stormwater drainage systems design;
- Also the use of AMS over an inappropriate records length (less than 30years), lead to undersize the stormwater drainage systems;
- This study allows to identify one of the main cause of floods in the city of Tipasa;
- Whatever the applied rainfall-runoff model, for a reliable stormwater drainage systems design, an exhaustive use on the extreme precipitations data must be done.

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Roman Ruins of Tipasa, Algeria.

Thank you!