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Flood Risk Evaluation Using Stochastic, Conceptual and Empirical Models

Case study of ungauged catchments in Northeast of Morocco

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Flood risk in the Northeast of Morocco

Morocco is taking steps to join other nations whose governments have created National Platforms for Disaster Risk Reduction to support policies for building resilience to disasters.

The Northeast of Morocco is submitted to important flooding that can be as well very prejudicial for the public or private infrastructures that for agriculture, and to cause numerous victims among the population. The problem of the flooding is not recent in these zones, but it began to be felt more strongly during the last decade, because of a part, the demographic growth, the economic boom and the urban, agricultural, industrial and tourist development that encourage an increasing occupation of the vulnerable zones, and on the other hand, of the increase of the occurrence of strong storms localized at the origin of fast and violent flash flood.

Statistics (1980-2010)*

	Value	Ranking
Flood occurrence reported	19	1st
Average flood per year	0.61	1st
Number of people affected	225,000	2nd (after drought)
Killed people	1035	1st

Motivation and objectives

Flood risk mitigation is usually based on design floods, which have a large magnitude when the potential damage is great. However, extreme flood estimation is a difficult task as it usually concerns a limited number of such events during a human lifetime. The current work aims to answers the questions of which decision makers always have needs for answers:

What is the frequency of the extreme events?
What is their return period?
And what are the rains of projects and the flows to dimension the hydraulic works?

To answer these questions, the current study aims :

Estimation of the design flood in the discharge system of each catchment's area and for various return periods (as well as volumes of flows and the streamed water through each watershed) by developing a suitable model;

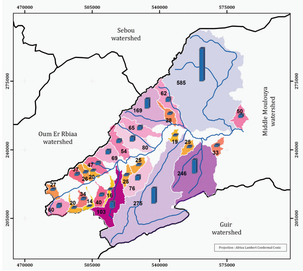
Development of a computer software able to do all necessary calculations to assist practitioners to evaluate flood risk in real time.

Brief description of the proposed model

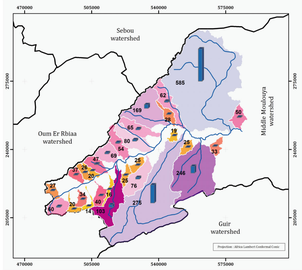
Flood estimation is a difficult task as it usually concerns a limited number of such events during a human lifetime. Further more, design flood estimation methods are directly linked to the geographic context which makes traditional methods imprecise for this area. This issue drives us to create a suitable model for the Northeast of Morocco by combining stochastic, conceptual and empirical models. Briefly, the model is based on flowing steps:

1. fitting of statistical distribution to annual maximum daily rainfall data;
2. modeling all recorded showers according to Montana model;
3. determination of physical parameters of the catchment area (slope, elevation, etc)
4. calculation of the design flood of reference using Caquot model;
5. choose a suitable unit hydrograph;
6. calculation of design flood, volume of water, runoff and runoff coefficient for each return period.

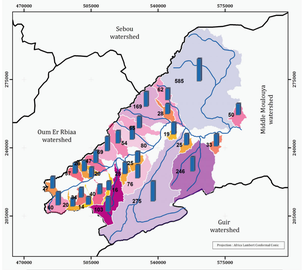
The method is considered applicable for return periods between 2 and 10,000 years for non-karst basins whose area ranges from 10 to 10,000 km^2.



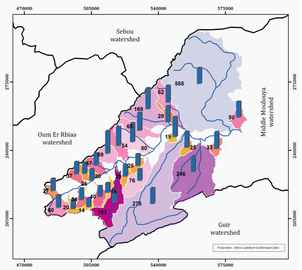
Design flood



Volume of water



Runoff

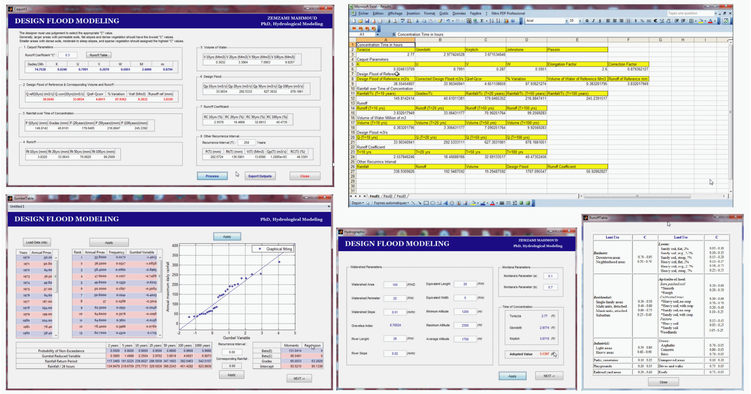


Runoff coefficients

HER-FA a flood risk software

HER-FA (Hydrologic Engineering River for Flood Analysis) is a software for engineers and practitioners involved in flood risk. It comes to meet the expectations of operational hydrology in the catchments of interest and support decision makers to best undertake flood risk management.

The software was designed to predict extreme floods in gauged and ungauged catchments based on the combination of stochastic, conceptual and empirical models. It allows the calculation of design floods, volume of water, runoff and runoff coefficients for extreme events in gauged and ungauged catchments. It incorporates many interfaces that enable storage and data entry, reporting with data tables and graphs, etc.



Perspectives

With the climatic changes and the growth of the extreme events, it is necessary to solve the problem of the zones to risk of flooding by order of priority to the regional level. The developed model can help trigger more coherent and systematic interventions.

It could also be integrated in a robust system for managing disaster risk forecasting and flood warning system;

Intends to link the software with GIS and develop a geographic information system containing data on flood hazards across the region and the country.

* Statistics of all flood events recorded across the country