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Understanding and analyzing the exceptional and the flash flood of novembre 2018 in the Ouzoud- High atlas-Morocco

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Abstract

Flash floods are among the most important, compound and complex hydromagnetic phenomena. These Flash floods have profound effects that cause human, material and natural losses. The river basin of the Ouzoud Valley is located in the Middle Atlas covering an area of 315,6 km². This basin is characterized by the appearance of thunderstorms that are concentrated during the summer. Due to the absence of hydrological data, we carried out a set of field outputs to identify the field and also installed the measurement scale in order to measure and track the rise of the water level in Ouzoud Valley during 2018 and 2019 as well as do a set of outputs to measure the throughput of Ouzoud Valley in a set of points throughout the search period and during different periods of the year. After obtaining a database about the elegant throughput of Ouzoud Valley, we were able to extract a sudden increase during the month of November 2018 with a throughput of 4600 liters per second. In this scientific work, we will try to stand by studying these Flash floods and knowing the natural and climatic characteristics that help its occurrence and also determining its effects on Ouzoud.

Key Words*:* watershed Ouzoud, floods, limnimetric sca, flow measuremen, gauges.

Comprendre et analyser la crue exceptionnelle et éclair de novembre 2018 dans l'Ouzoud-Haut Atlas-Maroc

Résumé

Les crues éclair sont parmi les phénomènes hydromagnétiques les plus importants, composés et complexes. Ces crues éclair ont des effets profonds qui causent des pertes humaines, matérielles et naturelles. Le bassin fluvial de la vallée d'Ouzoud est situé dans le Moyen Atlas et couvre une superficie de 315,6 km². Ce bassin se caractérise par l'apparition d'orages qui se concentrent durant l'été. En raison de l'absence de données hydrologiques, nous avons réalisé un ensemble de sorties de terrain pour identifier le terrain et également installé l'échelle de mesure afin de mesurer et de suivre la montée du niveau d'eau dans la vallée d'Ouzoud au cours des années 2018 et 2019 ainsi que de faire un ensemble de sorties permettant de mesurer le débit de la vallée d'Ouzoud en un ensemble de points tout au long de la période de recherche et durant différentes périodes de l'année. Après avoir obtenu une base de données sur le débit élégant de la vallée d'Ouzoud, nous avons pu extraire une augmentation brutale au cours du mois de novembre 2018 avec un débit de 4600 litres par seconde. Dans ce travail scientifique, nous essaierons de nous tenir debout en étudiant ces crues éclair et en connaissant les caractéristiques naturelles et climatiques qui favorisent son apparition et aussi en déterminant ses effets sur Ouzoud.

Mots Clés : bassin versant Ouzoud, crues, sca limnimétrique, débitmètres, jauges.

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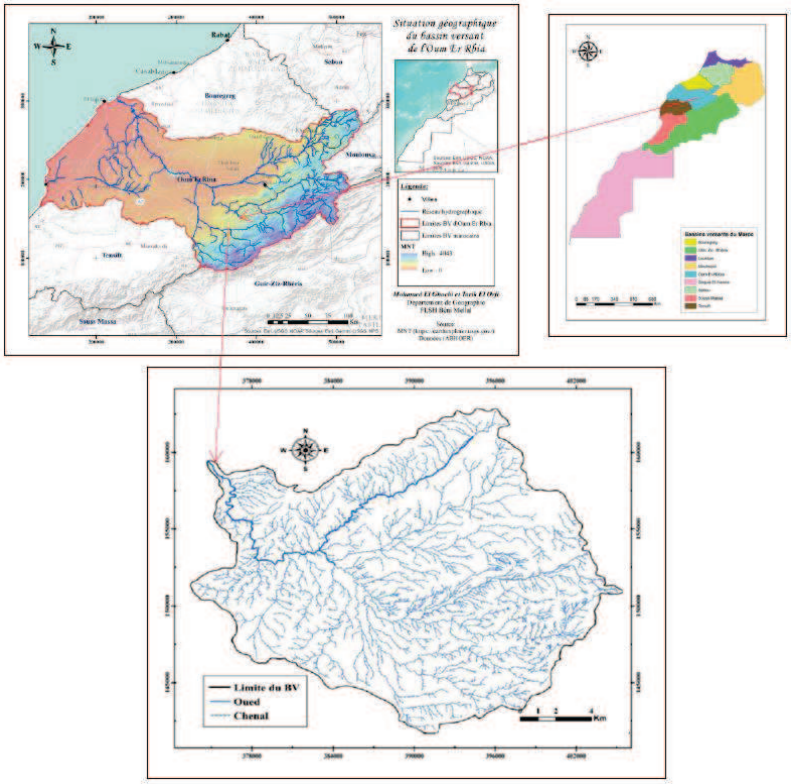
INTRODUCTION

Climate change nowdays is a largely known fact in scientific research. Regardless of its impact or hydrologic extremes, this climate change leads to the emergence of floods. These hydrologic extremes pose a big problem for citizens. This phenomenon of flash floods is considered among the hydrologic phenomena that require a study and an analysis because of its big impact on the occurrence of other more dangerous phenomena, namely the floods which are involved in the material and human damages especially with the climatic changes across the globe. The waterfalls of Ouzoud is considered one of the most attracting areas for tourists from inside and also outside the country, but this falls suffers from hydrologic extremes especially flash flood, these hydrologic extremes respond to a strong rainfall, concentrated in time and space with torrential character. These current flash floods are not studied in a strict hydrologic way that respects the principles of scientific research and that these studies are also carried out in a descriptive and superficial way, concentrating only on results and the effects of this phenomenon instead of investigating the main reasons that lead to the emergence or occurrence of this phenomenon. In this scientific contribution, we will put emphasis on the flash floods by means of a field work so as to understand its existence, determine its mechanism, and analyses its impact on the water falls of Ouzoud.

Area of study: The water falls of Ouzoud is a part of other stream named Oued El abid river, one of the big water courses of OumER rbia. It is situated in Azilal, area province). It covers a surface of 315,6 km. It stretched over six rural communes (Ait Taguella, TamdaNoumarcide, Agoudin'Lkhir, Tabia, Tanant) and a urban commune of Azilal. It is part of high chalky Atlas where the relief with series of anticlinal and synclinal, cut with narrow and deep valleys. The centre of Ouzoud exists in the height of 800 m. This area is mountainous and its heights are between 644 and 2123m. In this context. The river of Ouzoud received important sources of water in the high Atlas chain. The river that falls in Ouzoud waterfalls is subjected to a type mountainous Mediterranean climate and has oceanic impact. It is characterized by q spatiotemporal irregularity of rain that centers in autumn or winter.

Data and Tools: Each study necessitates a climatic and hydrometric data, especially the hydrologic extremes. For this study, we have used climatic data, these pluviometric data that were collected and exploited in this study comes from the agency of hydraulic basin of OumEr-rbia, and also a database of the daily constant flow rate of Oued Ouzoud during « 30/07/2018 to 31/05/2019» that we recorded during this period of the research. To frame very well this issue, we rely on the most important techniques and computer systems used in the analysis of statistics (Excel) so as extract the different forms and signs that explains the flash floods.



Carte 1: the geographical situation of d'Ouzoud basin

METHODOLOGY

According to hydrologist, the pursuit of the stream during the period of study provides a good methodology to study the extremes hydrological phenomenon (Lahlou and El Ghachi 2017). This scientific contribution was based in large part on a fieldwork for the sake of the diagnostic of different parts of the basin and we have found that there was an absence of hydrometric equipments so as to achieve a study about flash floods. We have installed a staff gauging scale. It is intended to measure the rise of water heights relative to level 0. A lot of gauge campaigns were done, from 2018 to 2019 with daily pursuit of the heights of the stream. The goal was to produce hydrometric data of the constant flow, this allows us to extract and understand the flash floods in the basin of Ouzoud.

The pursuit of water heights, measures of water flow and the creation of rating curve

Concerning the pursuit and the observation of water heights of Oued Ouzoud, it is a field work. A daily and permanent one that necessitates a physical absence on the river Oued Ouzoud, to read water height with the capture of a photos for the recorded side. Concerning the gauging, we have done a group of campaign so as to measure the flow of Oued Ouzoud during the periods of more or less water that allows us to create a rating curve of Ouzoud River.

The extract of the exceptional flash flood of novembre 2018: After the implementation of the rating curve of Oued Ouzoud another task that includes converting water height to flow (débit).using three mean elements, the extract of the flow, and the review of the results of recording the database base on the daily and constant flow of Oued Ouzoud to extract the exptionel flash flood of November 2018.

Analyses of pluviometric flow of novembre 2018: The exceptional flash floods is considered among the complicated hydrologic phenomenon, a lot of climatic and meteorological factors intervene in its occurrence and also natural characteristics of rainfall, pressure, climate disruption and also the characteristics of the waterfalls. So, were going to study the meteorological situation of Ouzoud waterfalls during the occurrence of November flash floods, based on the rain fall and the constant flow of Ouzoud river during the November flash floods.

RESULTS

Flash floods are floods whose onset is sudden, often difficult to predict, with a rapid rise time and a relatively large specific flow. These flash floods are therefore generally linked to intense rainfall episodes and often occur in basins of moderate size ". (UNESCO 1974). In this scientific contribution, we decided to go beyond all that usual starting from a deep study of the phenomena of the floods during its first phases, studying another hydrological phenomenon which is considered itself as the main cause of the latter which is the phenomenon of flash floods which seen similarly as a problem for developed countries. Thus, we got the following results:

Tracking of water heights, flow measurements and creation of a rating curve: For the monitoring or tracking and observation of the water levels, we put an observer to note the increases of the Oued of Ouzoud five times a day a scale installed on the bridge of the Oued d'Ouzoud. We made a set of companions with the help of the technician of the Hydraulic Basin Agency of Oum Er-Rbia to measure the flow of the Ouzoud river during the period from "07/30/2018 to 05/31/2019 " .

Photo sheets 1: installation and monitoring of the limnimétrique scale

According to dozens of gauging campaigns that measured the flows of the Ouzoud river, they created a database during the more water phases and the less water phases, the Excel software was used for the construction of the curve. Taring of the oued Ouzoud.

The extraction of the exceptional flash flood from 23/10/2018 to 05/11/2018: According to the creation of the rating curve and the extraction of a too fine hydrometric database of the Ouzoud river, we based on a database of instantaneous daily flows of the Ouzoud river during the period between "07/30/2018 and 05/31/2019" to extract and analyze the variation in instantaneous flows of the Ouzoud river during the period of the exceptional flash flood of October, as shown in the figure below.

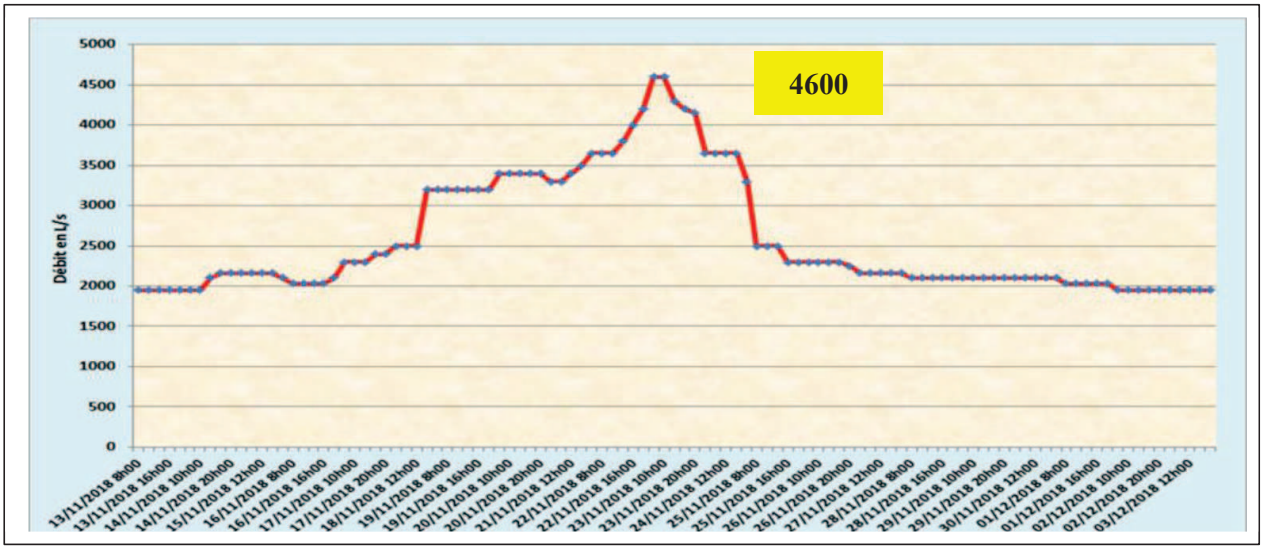
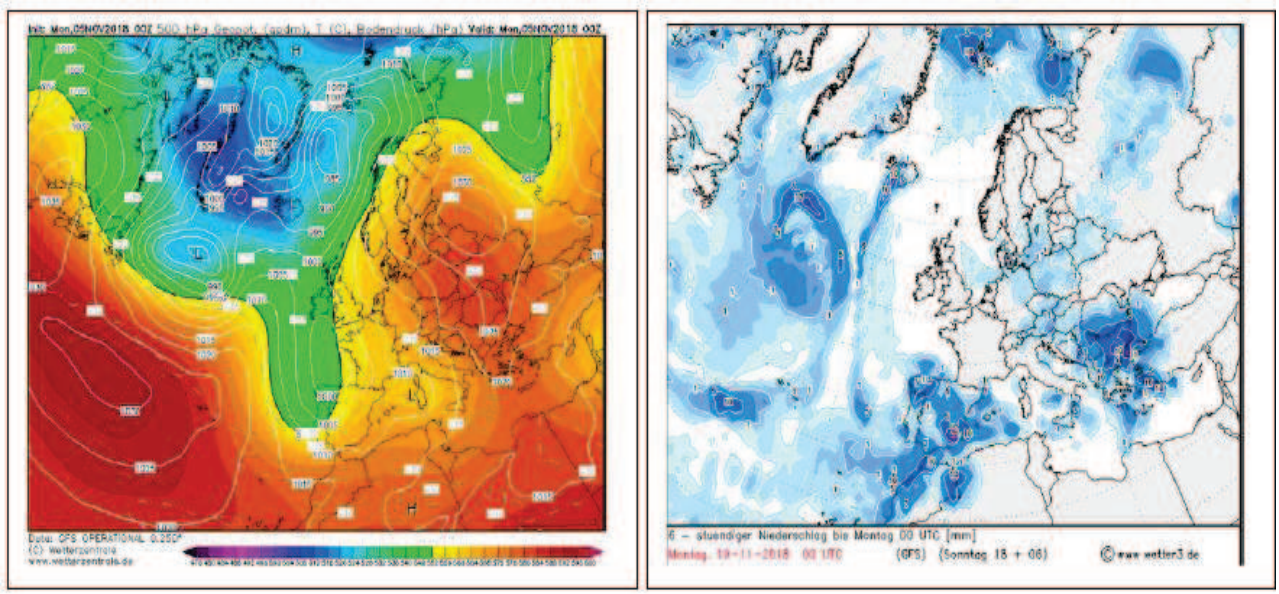


Fig.1: Analyzing the exceptional flood thunder of Ouzoud Oued taking place in 13/11/2018 to 03/12/2018

Analysis of rainfall for the episode from 10/23/2018 to 11/05/2018: Regarding the analysis of the October flood, we found that this exceptional flash flood extends between 23/10/2018 and 05/11/2018 with a peak flow which equals 5600 L / S during the period of this flood. 14 days. From maps of the synoptic situation of altitude at 500 Hpa and isobaric situation on the ground, Morocco has experienced atmospheric pressures which come from the north at the 500 Hpa level, a cold advection slipped from the European South on the southern slope of a ridge warm, centered on the North Atlantic, arrived in the vicinity of Morocco. This will lead to rainfall which will increase the flow of the river.



Carte 1 : the synoptique situation of the altitude à 500 Hpa and the isobarique situation to sol until 19 Novembre 2018

From 13/11/2018, , the Ouzoud river watershed recorded rainfall exceeding 35 mm on 23/11/2018 which led to an increase in the flow of the river which exceeds 4600 L / S. This was the very important cause that Oued d'Ouzoud experienced for a period of 14 days.

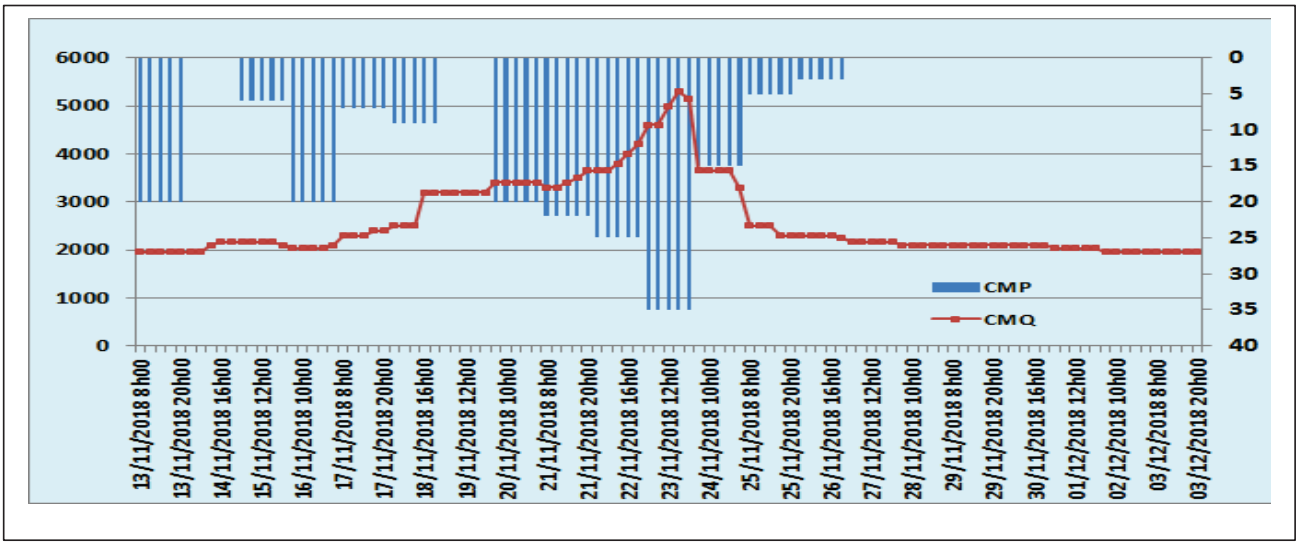


Figure 2: analyzing dthe precipitation and the instantaneous debit of Ouzoud bassin «23/10/2018until 05/11/2018 »

It was noted that there are atmospheric disturbances reaching Morocco which may be the main cause of the rainfall that the basin in which this study was done experienced during the period of the flood. Besides,the basin is characterized by physical characteristics (slopes, impermeable geology, ..) which favor the onset of the October flash flood.

CONCLUSION AND DISCUSSION

The Ouzoud site constitutes a tourist hub in the province of Azilal and the region of Béni Mellal Khenifra, because it contains an exceptional wealth in terms of fauna, flora, water (Sources, rivers and Waterfalls) and landscapes. Nevertheless, these waterfalls suffer, almost every year, from the risk of flash floods. Flash floods are difficult to predict. They follow violent localized rains, the development of which is sudden and of short duration, and whose impacts on humans and socio-economic have serious consequences. It is believed that major flash floods can occur during any month of summer and fall. So the only explanation for these cases is related to thunderstorms, with heavy and concentrated precipitation, which contributed to increase the flow.

Declaration of competing interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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