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Study of the Sedimentary Contribution During Hot-Moments in Upper Tafna: Case of the Upstream Part of the Oued Sebdou Sub-Watershed, North-West Algerian

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ABSTRACT

This work focuses on flood phenomena generating abudant suspension solid transport in the upper part of Tafna (upstream part of the basin of Oued Sebdou). To better understand sediment dynamics in this basin, the study was based on analysing data procured by the ANRH of liquid flow and suspension matters concentration at an instantaneous scale. The most important ans representative floods, of a 30-year period from 1970 to 2000, were chosen to establish hysteresis relationships that allow a floods classification and classifying them in 5 categories, wich allows presenting very different transfert dynamics deponding on floods. The results obtained in this work showed that dominant floods are those of class 2, whose hysteresis is of sinister form (Clockwise direction). Furthermore, class 3 floods wich present dextral form of hysteresis (counterclockwise direction), bring the maximium values of solid and liquid flow : 37% of suspended charges against 29% of liquid flow.

Keywords : Algeria -Sebdou – Solid Transport- Floods- Hysteresis- Monthly contibution.

1 Introduction

In semi-arid zones characterised by very irregular and often intense rainfall, climatic factors have considerable influence on the removal of particles from the ground and in fine on mechanical soil erosion. These particles are transported to wadis primarily by surface runoff. They can then be deposited temporarily along the course of the wadi or as sediment behind the barrages and dams, causing them to silt up. Some of these eroded soil particles will reach the Mediterranean Sea, accompanied by various pollutants that are adsorbed or complexed by the suspended particulate matter, thus contributing to the pollution of coastal areas. Research undertaken on mechanical soil erosion and sediment transport in rivers shows that the specific erosion of the Maghreb's watersheds is significant, ranging from 1000 to 5000 tonnes per km2 per year [1]. Erosion varies considerably from one basin to the next and can reach up to 7200 t.km-2.yr-1, as in the case of the Oued Agrioun in Algeria [2]. As a consequence of this significant erosion in watersheds in Maghreb countries, the discharge of sediments carried on average every year to the Mediterranean Sea is estimated to be 100 million tonnes [2].
In these Mediterranean regions, mechanical soil erosion and the transport of sediment in rivers are mainly controlled by extreme climatic events, generally of considerable intensity and short duration, that generate significant surface runoff on watershed soils and sometimes intense flood flow in the wadis [3].

2 Experimental

Generally the most widely used regression between instantaneous measurements of concentrations of suspended particulate matter in relation to flow rate is the log-log model [4].

$$C=aQ^b \quad (1)$$

Where parameters a and b are regression coefficients. Although the appropriateness of this approach has been debated by [26], its application appears suitable in several case studies and for different aims. It is based on the transformation of values into logarithms to reduce the polarisation presented in calculations [5]. Another empirical relationship, known as the curve of solid transport [30] that links sediment discharge with flow discharge has classically been used [6]. Its calculation

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offers the best adjustment and allows daily values of sediment discharge flow Qs to be evaluated from the flow discharge Q observed, and the study of flow/sediment discharge relationships and the influence of flow discharge on sediment transport over different timescales: annual, monthly and seasonal :

$$Qs=aQ^b \quad (2)$$

3 Results and Discussion

After extracting the instantaneous values of C and Q, sediment discharges can be calculated and the log-log type relationships between C and Q and between Qs and Q established (Figure 1). The log-log model frequently used then allows parameters a and b to be determined that are specific for each watershed and watercourse, and gaps filled when there are no measurements by simulating the missing values.

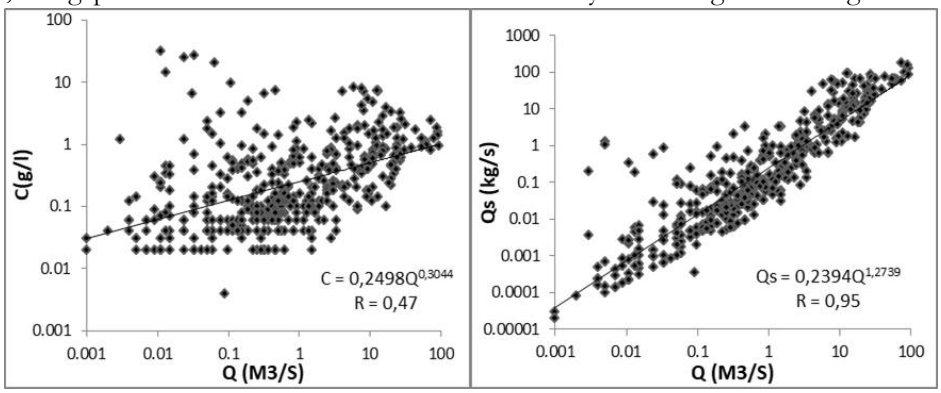

Figure1: Relationships between concentration-flow discharge (left) and sediment-flow discharge.

4 Conclusions

In a hydroclimatic region where flood events play an important role in erosion and river transport, this article focused on the study of flood events and their contribution to suspended sediment transport in the Oued Sebdou. A typology of flood events was established based on a study of 45 floods over the past 25 years (period 1990-2014), by examining the relationships between concentrations (C) of suspended particulate matter and flow discharge (Q). This typology allowed seven flood event categories to be defined, of which one presented linear C-Q or log-log relationships while the other six highlighted phenomena of hysteresis between the rise and fall of the flood events that were dextral (Categories 2 and 4), sinistral (Category 3) or complex in a figure of eight (Categories 5, 6 and 7). These phenomena can be attributed to different erosion-transport-sedimentation mechanisms that vary by season and by the nature of the flood events. 84 % of the floods studied occurred in winter (53 %) and spring (31 %). With the exception of Category 1, the contribution of sediment transport for each of the categories was proportionate to the percentage of water flow volume. The most frequent floods (22 %) were in Category 1 (winter and spring), flood events where a linear C-Q relationship was observed but with sediment transport of just 8.5% of all the floods, despite significant volumes of water (>30 %). Meanwhile for Category 6 flood events, which only represented 11 % of the flood events, the contribution to total volumes of water and sediment transport was significant at more than 43 %. These Category 6 floods were mainly observed in winter (four floods) with a single flood in spring. They generally consisted of two phases, one of remobilisation and transport of sediment previously deposited on the wadi bed and a second of erosion and transport of sediments from the sides.

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