

SPATIAL AND TEMPORAL VARIABILITY OF STREAMFLOW AND SOLID YIELDS IN SEMIARID AREAS: CASE OF THE OUED MINA BASIN (NORTHWEST ALGERIA)

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Abstract :

Mediterranean and semi - arid zones are characterized by an aggressive climate and by irregular and violent rainfall events. Water-induced erosion in river basins and river sedimentation constitute a complex phenomenon, which poses many problems for the engineers responsible for development projects. This phenomenon constitutes a major constraint limiting agricultural development in Algeria. We propose a statistical approach to quantify the solid yield at different gauging sites. The data were collected at five sites in the Oued Mina basin (upstream of the Sidi Me hamed Ben Aouda dam). The observation period covered 22 years, from 1973 to 1995. The results showed a high inter-annual and annual variability of the liquid discharge and solid yields; the coefficient of variation exceeded 60% in all cases. In addition to this temporal variation, we noted a variability of the solid yields and liquid discharge among the different sites. Analysis of the monthly solid yields shows that the autumn season contributes a large proportion of the annual solid yield (more than 40%) for the different basins. Transport of solids in the Oued Mina and its effluents is highly variable in space and time. This variability is due primarily to the pluviometric regime, the vegetation cover and the lithology. In general, the seasonal variations of the solid contributions follow those of the liquid flow. The maximum values of the solid discharges, for all basins, are observed at the beginning of autumn and the end of spring. Generally, the monthly minimal solid yields are recorded in summer. This season is characterized by low rainfall and consequently a weak surface flow. However, the minimal solid yields do not necessarily correspond to the month characterized by the lowest liquid discharge. The autumn contributes 31% to the annual liquid flow and 51% to the annual solid yields of the Oued Mina area at Wadi El Abtal station; corresponding values are (26 %, 33 %), (33%, 53 %), (29%, 46%) and (36%, 48 %) at the stations of Sidi A.E.K Djillali, Ain Hamara, Kef Mehboula and Takhmaret, respectively. The autumn solid transport remains highest, significantly exceeding the other seasons. This variability is explained by the variation in vegetation cover (bare ground) during the year and the aggressive nature of the autumn rains. Because of these two factors, the first autumn flood transports considerable quantities of sediments after a long dry season characterized by high temperatures and destruction of the

soil aggregates by these temperatures. The energy produced by the first rains and the low degree of vegetative cover rate in this season also contribute to this increase in autumn. The Oued Haddad basin presents a high specific degradation compared to the other basins ($D_s=212$ t/km²/an). This impoverishment of the soil is very visible at this site. It is due to factors favouring erosion : steep topography and discontinuous vegetative cover, which protects the ground poorly. The Oued That basin, which has a topography favouring surface flow and abundant rains, has a specific degradation lower than the Oued Haddad basin ($D_s=191$ t/km²/an). The basins of Oued El Abd present a specific degradation about 117 t/km²/an at Ain El Hamara station and about 65 t/km²/an at Takhmaret station. The Oued Mina at Sidi M'hamed Ben Aouda dam gives a specific degradation about 396 t/km²/an.

The runoff coefficient explains a large part of the variance of the solid yield (more than 60%). This coefficient depends intrinsically on lithology, geology, vegetative cover, topography and the hydrological and pluviometric regimes. By the introduction of this parameter, we sought to explain solid transport by the explanatory variables of this phenomenon. The result was very encouraging, considering the percentage of the explained variance (more than 60%). Following this analysis, mathematical models are proposed, connecting the solid yield to the runoff coefficient. The determinations coefficients are equal to : 0.79; 0.61; 0.64; 0.78; 0.65 for the stations of oued Al Abtal, Sidi Abdelkader Djillali, Ain Hamara, Kef Mehboula and Takhmaret, respectively.

Keywords: Liquid discharge; solid yield; erosion; spatial and temporal variability; statistical model; Oued Mina; Algeria