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Estimation of suspended sediment concentration from turbidity measurements for agrarian watersheds of Navarre (Spain)

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Studies of soil erosion at watershed scales have addressed this phenomenon from a holistic perspective, linking and prioritizing the dominant influence of the different factors involved in this complex process. Thus, the pattern of sediment transport in a watershed is an excellent indicator of the type and intensity of the dominant erosion processes as well as of the relationships between precipitation, infiltration and runoff. An optimal characterization of the dynamics of sediment requires reliable measurements and recording of the suspended sediment concentration (SSC) at the watershed outlet at a small time scale (minutes) since SSC normally fluctuates rapidly during storm events. But the latter is economically feasible only through indirect measurements; for example, by using turbidimeter. In fact, turbidity is a common subrogate of suspended sediment concentration; but for this purpose it is necessary first to define a suitable (empirical) turbidity-SSC model. But this is not an easy task since the wide range of possible suspended particles of different nature and composition (e.g., silt, clay, organic matter and microorganisms) often lead to a weak association between SSC and turbidity.

In Navarre (Spain), soil erosion is an important problem affecting agricultural land. For this reason, the local Government owns and maintains a network of four experimental watersheds to assess the impact on the environment of typical agrarian activities. So that, the amount of sediment and solutes evacuated at the exit of each watershed has been recorded, along with other relevant hydrological and meteorological data. Furthermore, turbidity has been measured every ten minutes. But turbidity-SSC model – determined from average daily data of SSC– currently in use is unsatisfactory, especially for spring and summer events.

The aim of this study is to find an appropriate turbidity-SSC relationship for (each of) the agrarian experimental watersheds of Navarre. Regression analysis and neural networks will be applied.

To this end, there is a complete database of turbidity –taken every ten minutes– and sediment concentration –and in some cases, the granulometry of this sediment– registered along a single event above a certain magnitude. In addition, there are turbidity measurements of water-sediment samples from some of those events carried out in the laboratory. The latter are compared with the turbidity measurements registered by the turbidimeter in the hydrological stations. First results show that the turbidity-SSC relationship has an accuracy that varies throughout the year following a roughly seasonal pattern. Thus, the best fit will be achieved by defining a turbidity-SSC model according to the type of event. Furthermore the water-sediment sampler eventually collect bedload sediment while turbidemeters only register suspended sediments. This fact is somehow spoiling the turbidity-SSC relationship.