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An improved correlation model for sediment delivery ratio assessment

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Abstract In the present work, a new simplified model approach for sediment delivery ratio (SDR) assessment is proposed. Modelling and assessing SDR is still an open question. Difficulties rise from the lack of sufficient data availability, on one side, and, on the other, from the inherent uncertainties including spatial variability and temporal discontinuity of the land cover, climatic, hydro-logical and geomorphological variables involved. The proposed SDR_{SIM} model tries to skip over the limitations observed in other models generally adopted. A comparison with two different selected models amongst the most widespread simplified models, i.e. the area-model and the slope-model, is showed in application to a wide range of catchments extensions across different landscapes of Italy. The SDR_{SIM} estimates were also evaluated against observed SDR over a validation dataset of 11 basins sparse over different regions of the world. The results showed the effectiveness of the proposed model approach based on easily available catchment parameters.

Keywords Sediment delivery · Prediction models · Catchments · Italy

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Introduction

Soil erosion rate and river sediment yield are key-factors whose estimate is essential in land and river systems management aimed to achieve the environmental sustain-ability of human activities. Often, given the lack of direct data, estimates are made by means of prediction models allowing to evaluate soil loss or sediment yield separately. There are a number of prediction models, conceptual, empirical or physically based which can help in this task that have been successfully tested and are currently used in different parts of the world. Therefore, one can conclude that modelling such processes is now an almost achieved result. On the contrary, linking the two processes of sedi-ment production and delivery is still an open question.

In fact, it is not unusual that one, being provided with catchment soil loss data, has the need to convert these data in sediment yield delivered at a given river section or vice versa. Nevertheless, to date, there is not a general agree-ment about an universal model which can suitably explain the relationship between sediment yield and related upland soil erosion allowing to convert one quantity into the other as needed.

The river sediment yield can be defined as the total quantity of sediments eroded from the upland catchment area (referred to as gross erosion) which is routed to the basin outlet by the watercourse in a definite time period. The sediment yield per unit catchment area is the specific sediment yield (SSY). Considering that only a partial amount of gross erosion is routed to the basin outlet (otherwise referred to as the net erosion), knowing the ratio between the net erosion and the gross erosion amounts, which is worldwide known as the sediment delivery ratio or SDR, is crucial for scientific and management purposes. As already pointed out by Lu et al. (2004), methods for