Geophysical Research Abstracts
Vol. 16, EGU2014-10548, 2014
EGU General Assembly 2014

Estimating of suspended sediment loads of rivers in the Seine downstream basin and coastal rivers in Southeastern Channel

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Sediment exports in rivers constitute the essential of materials transfer from the land surface to the ocean and contribute significantly to the transfer of nutrients, pesticides, heavy metals which can affect water quality. Such problems of water pollution are particularly present at the Norman loess plateaus because soil erosion is a frequent phenomena and mudslides are common. In this context, the quantification of sediment load, as well as the short and long term variability analysis are a key component for any sustainable management project of water resources. The quantification of sediment fluxes is based on turbidity, suspended sediment concentrations (SSC) and discharge measurements. These measurements must be made with sufficient high frequency for integrating temporal variability of SSC and flows. However, the cost of a high frequency monitoring limits their use at large scale. In France, discharges are monitored using daily frequency (Banque Hydro), while SSC are measured in monthly or bimonthly frequency under the national water quality survey system (RNB). With these low frequency measurements, an algorithm must be used to reconstruct SSC temporal variability and to estimate a sediment flux. Many estimation algorithms have been developed in recent decades, from the simplest to the most elaborate, but no consensus has been reached on the use of a particular algorithm because of the complexity of SSC-discharge relationship.

In this study, the analysis focuses on eight Channel coastal watersheds and nine Seine watersheds in the downstream part. We have a several years of high-frequency measurements on nine watersheds with highly variable area (10 km^2 to 10,000 km^2) and low-frequency measurements for all watersheds. From these data, we compared the statistical performance of eleven algorithms to estimate sediment fluxes conventionally used in the literature. These algorithms are: averaging estimator, ratio estimator, linear interpolation, rating curve and multi sediment rating curve (MRC). From the results, the MRC algorithm had the best performance in terms of bias and precision between real and estimated sediment loads. This algorithm has been used to determine the sediment loads of all watersheds. On the Seine downstream basin, sediment fluxes from tributaries range from 171,000 t/year to 945,000 t/year depending on the year. This represents between 3% and 9% of sediment fluxes passing into the Seine. Finally, the long term variability analysis showed a high variability from year to year depending on climatic conditions. This study suggests the need to investigate fluxes over several years, to extract representative orders of magnitude and to quantify uncertainties.