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Global variability of daily total suspended solids and their fluxes in rivers

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Abstract

The daily variability of river suspended sediment concentration (Cs) and related yield (Y) is studied at 60 global stations. The data set covers natural conditions (e.g. pre-reservoir data), ranging from the humid tropics to subarctic and arid regions, located in all types of relief (yearly runoff q* from 0.1 to 55 l s^{-1} km^{-2}). Basin area ranges from 64 km^2 to 3.2 million km^2. Survey lengths range from 1 to 20 years with a median of 3 years. Median values (Cs_{50}, q_{50}, Y_{50}) and discharge-weighted averages for Cs* and Y* range from 5 to 29 000 mg l^{-1} and 10 to 5000 kg km^{-2} day^{-1}, respectively. A set of indicators of variability are proposed for sediment concentration, water and sediment discharges including mean to median ratios (Cs*/Cs_{50}, Y*/Y_{50}), the percentage of sediment flux discharged in 2% of time (Ms_2), the percentage of time necessary to carry half of the sediment flux (Ts_{50}), and quantiles of Cs, q and Y distributions corresponding to the discharge-weighted averages. Since most of the sediment flux is discharged in less than 25% of the time, ''truncated rating curves'' metrics are proposed between the Cs vs. q relationship for periods of high flux.

Temporal variability decreases with increasing basin size, lake abundance, and is higher for basins influenced by glaciermelt and snowmelt. The least variable sediment flux regimes are noted for the Mississippi at its mouth, the Rhone Lacustre, the St. Lawrence and the Somme, a medium-sized French phreatic river. The most variable flux regimes were for small- to medium-sized basins (i.e. <1000 to 10 000 km^2) such as steep Andean Bolivian basins, Thai basins, the Eel (CA) and Walla Walla (OR) rivers. A proposed global scale typology is based on six classes key variability indicators.

Keywords: Sediment concentration; Sediment flux; River regimes; Global scale; Time variability

1. Introduction

Since the first detailed studies by agronomists (Mangon, 1869), limnologists (Forel, 1886), geomorphologists (Baeff, 1891; Hjulström, 1935) and river managers (Stabler, 1911; Howard, 1929), concentrations of total suspended solids (Cs) and their associated fluvial fluxes are known to vary enormously over time and space. Many authors (Müller and Förstner, 1968a; Walling, 1977; Meade and Parker, 1985; Syvitski and Morehead, 1999) have noted the quantitative role of rare or extreme events on the long-term average Cs flux, particularly in dry or semiarid conditions (Colombani and Olivry, 1984). These observations

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