A study on spatial and temporal variability of sediment in rivers using global sediment transport model

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There have been a number of studies about sediment transport processes in particle scale to basin scales, but only few studies so far in a global scale. Particularly, there is no study that utilizes a single model to simulate sediment transport in all rivers in the globe. Furthermore, this sort of model should be of importance with regards to the Earth System Model (ESM) development, since ESMs are now being implemented with biogeochemical processes in the atmosphere, land, and ocean. To link between those, riverine transport process needs to be taken into account. That is our motivation to develop the global sediment transport model, CaMa-SED. In CaMa-SED, yield, erosion, transport, and sedimentation processes of soil particles are implemented. Those processes are highly dependent with soil particle diameters, so that the representative diameters of clay, silt, and sand are taken into account. Sediment yield is estimated depending on slope and precipitation rate. The horizontal transport is divided into two; suspended flow and bedload flow. Deposition and re-suspension processes are also implemented. The preliminary results show a good agreement in total sediment transport in major rivers and more importantly, reasonable characteristic of diameter-depended sediment distribution from upper to lower reaches. Furthermore, the hysteresis between river discharge and sediment transport in Amazon river was reasonably simulated. That is quite new feature of the model because the classical sediment regime, i.e., relationship between discharge and sediment, could not explain the hysteresis behavior. A set of sensitivity tests revealed that the total amount of sediment transport is highly influential to the deposition rate for smaller particles such as silt or clay.

Keywords: global sediment transport model, suspended flow, sediment regime