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Assessing the impact of landuse change, climate change and reservoirs on suspended sediment load in Da river (China-Vietnam)

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Sediment issues have critical implications for aquatic ecology, agriculture, water supply and river navigation. Recently, with the construction and operation of several reservoirs in Da river basin (China-Vietnam), such as Hoa Binh, Lai Chau, Son La and so on, this issue has risen high interest and concern. Reservoirs have been built to meet several important needs, including increasing energy, irrigation, and drinking water demand. However, the decision maker should pay attention to the effects on sediment load, namely trapping of sediments, reduction of sediment concentration downstream reservoirs, increasing riverbank erosion, and localized erosion nearby hydraulic structures. In addition, land use changes, and climate changes are also to be considered as causing effect on sediment erosion and transport. The aim of this work is to evaluate the effects of separate factors (reservoirs, land use change, and climate change) on sediment load in the Da river basin. To this purpose, an updated and enhanced version of the soil erosion and transport model at the catchment scale, namely DIMOSHONG_RUSLE is applied to the Da river basin. More than 50 years of monthly precipitation, runoff and suspended sediment load data are processed. Two historical (1983, 2000) land use maps were generated based on statistic data of the government. The effect of land use change, and reservoirs is assessed on the basis of trends observed in the last decades. To develop the DIMOSHONG_RUSLE model in the period 1961-1985 with land use 1983 (before Hoa Binh reservoir was constructed completely) an updated version of the parameters of the RUSLE equation is determined according to the space variability on the soil types base on experimental data. Then, using chosen optimized parameter of RUSLE, suspended sediment load for the period 1986-2005 (with the Hoa Binh reservoir built and in operation) corresponding with land use in 2000 are calculated. The results are in good agreement with observed data. In the period 1988-2005, when Hoa Binh reservoir was at fully normal water level, the sediment load reduced dramatically (90%). During 1986-2005, the sediment yield of Lai Chau gauging station and Ta Bu station was also reduced by forest, agricultural, development areas; grassland, shrubland, and mixed shrubland were being decreased. The impact of climate change on sediment load was then analyzed by feeding the model with properly downscaled climate scenarios from two GCMs (EC-EARTH, and CCSM4), and three SRES emission scenarios (RCP2.6, RPC4.5, and RPC8.5). The simulation results under climate change scenarios and year 2000 land use show mostly sediment load increase in Lai Chau, Ta Bu, Hoa Binh, Ban Cung, except for the scenario RCP2.6, showing a reduction at Ta Bu. The combination of climate change, land use change and impact of reservoirs in the catchment leads, for all the scenarios considered, to decreases in sediment load, with a maximum (96.67%) for EC-Earth RCP2.6 model in 2080-2099.