



Watershed sediment balance and local denudation rate based on hydropower reservoir sedimentation data

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Hydropower reservoirs built in the lateral valleys of Valais (Switzerland) trap the sediment flux, so that their catchment areas become a sedimentary almost closed system, depending on hydrological regime and storage capacity. The rate of sediment infilling supplies data of sediment balance on the watershed. In this study, data of sediment volumes accumulated behind 11 hydropower dams and 3 settling basins were collected through bathymetrical surveys and camera or visual observations. Data analysis allows quantifying the sediment flux deposited since the time of dam construction and a local mean denudation rate can be assessed from a geographic information system. Estimated volumes are corrected according to the sediment trap efficiency of the reservoirs. The conversion of sediment volume into denudation rate is obtained according to the ratio of dry bulk density of the deposited material to solid bedrock density. Hence, density of loose sediment stored in the reservoir is estimated through grain-size distribution and degree of compaction. In some reservoirs, this evaluation was strongly restricted due to fragmentary information in space and time, so that the interpretation was limited to a general overview. In three watersheds, however, more data is available. A short-term trend of the sediment supply magnitude in the lake could be reconstructed. Local mean denudation rates range between 0.39 mm/y to 0.62 mm/y for 7 of 12 of the investigated watersheds. 2 highly-glaciated watersheds show a mean denudation rate of about 1.5 mm/y and 2 other have a rate below 0.15 mm/y. The overall mean denudation rate of the considered catchment areas is about 0.7 mm/y, which corresponds of an eroded mass of about 2'000 t/km² per year. Results are compared to characteristic surface processes and discussed according to the geomorphology, the recent glacial retreat and the fluvial network connectivity.

Quantitative data analysis of hydropower reservoir sedimentation is a complementary approach to existing methods, such as measurement of river sediment load and debris trap structures. The watershed sediment balance is fundamental information for the classification and understanding of slope erosion processes, as well as the inception condition of debris flows, which are key parameters in hazard assessment and reservoir management.