

Towards an integrated and cooperative management of fine sediment fluxes in a large transboundary basin: the case of Upper Rhône River

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The objective of this abstract is first to present the French-Swiss Upper Rhône River context regarding fine sediment fluxes. Then, the approach followed and the evolutions planned recently to define an integrated management scheme are highlighted.

The Rhône River originates from the Swiss Alps and flows through the French territory down to the Mediterranean Sea. In its upper part, most of the sediments eroded from the steep surrounding mountains settle in the Lake Geneva, such as only clear water is released further downstream. The torrential Arve River joins the Rhône in Geneva and is the main sediment supplier in that part of the basin. Downstream of the confluence and on both sides of the international border, a cascade of dams is operated, respectively by Swiss and French operators. Due to the Arve River sediment supply, Swiss reservoirs experience adverse silting processes that lead to bed aggradation and possible over flooding hazards for the riverine people in Geneva. As a result, Swiss operators have been used to organize regular flushing operations until 2012, usually every 3 years.

During those operations, uncontrolled releases of fine suspended sediments due to the Swiss reservoirs emptying caused huge damages to the aquatic ecosystems (e.g. high fish mortality) and led to adverse impacts on river-related developments. On the French Upper Rhône, Compagnie Nationale du Rhône (CNR) had to deal with all river-connected issues including mainly the preservation of (1) natural sections of the Rhône River recently restored by CNR for environmental purposes, (2) water intakes for nuclear plant as well as for well-fields dedicated to drinking water and (3) reservoirs managed by CNR likely to be exposed to siltation. So as to maintain acceptable conditions for the river ecosystem and the riparian interests located further downstream, solid fluxes released from Swiss dams were significantly regulated into the upper reservoir operated by CNR (Génissiat dam). This regulation was achieved thanks to an appropriate management of the reservoir water level and by opening the specifically designed dam hydraulic facilities so as to maintain the suspended-sediment concentration released further downstream below rates possibly critical for the fish fauna. As a result, the Génissiat reservoir experienced a steady sedimentation that could impair its sustainability in the long run despite

operation rules defined to mitigate as much as possible such processes. Moreover, environmental hazards possibly induced by this kind of operation could engage CNR responsibility through prosecution procedures.

Following 2012 operation, discussions have been launched between the dam operators and the regulation authorities of both countries in order to account for all issues at stake from an equal and consistent manner on each side of the border. Those discussions have led finally to the definition of a transboundary integrated management scheme for sediment fluxes. Recommendations have been formulated after evaluating and comparing the impact of the 7 following options: (1) Passive management of reservoirs, (2) Sediment routing during Arve River flood by a partial drawdown of all reservoirs, (3) Sediment routing during Arve River flood by supplying an extra discharge from Lake Geneva and by a slight drawdown of Swiss reservoirs, (4) Sediment flushing with complete drawdown of Swiss reservoirs every 3, 5 or 10 years; (5) Eco-friendly sediment flushing with partial and precautionous drawdown of all reservoirs every 1, 2 or 3 years so as to maintain suspended-sediment concentrations below values potentially critical for the fish fauna; (6) Quasi-continuous dredging of deposits accumulated in reservoirs and (7) Combined scenarios including sediment routing during Arve River flood by supplying an extra discharge from Lake Geneva, sediment dredging and eco-friendly sediment flushing with partial and precautionous drawdown of all reservoirs every 3 years.

An evaluation of the above mentioned options has been performed in 2013-2014. This benchmarking approach takes into account the following concerns: environmental impact compared to current management scheme, direct costs for operators, repercussions on social, ecological and industrial issues and technical feasibility. Following a broad consultation, the main conclusions are to favor the option combining sediment routing, eco-friendly flushing with a 3 year frequency and dredging. This mixed scheme appears indeed to be the less impacting regarding all issues at stake.

References: [1] Joint French-Swiss technical committee. (2014) New sediment management of Upper Rhône River in France and Switzerland.