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Validation of 1D and 2D numerical models for sand transport: the real case of the Escaumel dam emptying

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Abstract:

Reservoir emptying is one of the biggest issues for dam manager. An emptying operation has to be efficient enough to remove sediments out, but it has also to be controlled in order to limit the environmentalimpact on the downstream part of the river bed. To help dam managers, numerical tools of sediment transport could be used. But these numerical tools have to be validated on real cases in order to be predictable.

In this study, we focused on a real case of emptying operation, which have been performed in summer 2013 on the Escaumel dam, in the Massif Central region in France. During this two-months-long emptying operation, a large quantity of sand have been eroded and transported along the downstream part of the river bed (3 kilometers long),

First a large work has been done in order to understand and quantify all the hydrological events that occurred during the total emptying period :

- two successive emptying operations,
- two natural floods that occurred between the emptying operations
- and finally two flash floods that occurred at the end of the second emptying operation.

These successive events have been defined as boundary conditions for Courlis (1D) and Sisyphe (2D) numerical models.

Courlis and Sisyphe numerical codes have been used to reproduce the sediment transport dynamic in the reservoir and the downstream part of the river bed. The results show how both 1D and 2D codes reproduce the eroded quantity of sand in the reservoir, as well as the propagation dynamic in the downstream part of the river bed. 1D and 2D results are compared in terms of eroded volume of sand, morphological changes, numerical stability and robustness. Finally the study shows that, under appropriate conditions, the use of numerical codes may better anticipate the environmental impact of such dam operations.