1D Morphodynamic model for a gravel bed reach

Model description:

This model is developed/applied to an alpine gravel bed river in SE France (Buech River). The lower Buech river is bound by St. Sauveur dam and the confluence between the Buech and the Durance River. The dam was built in 1992 for diverting flow for hydroelectric purposes which has caused flow and sediment deficit to the lower Buech river. In 2016, it was decided to reinject sediment from upstream to immediately downstream of the dam. This model attempts to predict the long-term impacts of the reinjection on the morphodynamics of the river and study other possible scenarios such as periodic reinjections[1].

The model is run 2 times. 1) pre-dam run (equilibrium) in order to obtain initial condition of the post-dam run. 2) post-dam run which starts from 1992 (dam closure) to 2082 (is believed to reach post-dam equilibrium condition). The bed surface elevation and grain size distribution of the surface sediment from the pre-dam run are used as initial conditions of the post-dam runs.

The post-dam runs have an option in the model where the user can impose the reinjection in any time (2016 in this specific case) by increasing the bed elevation in the first two nodes and creating a wedge with the volume equal to the reinjection volume. The bed elevation increase should be calculated and put in by the user (line 455-464)

Model Inputs:

“input_eta”: the initial bed elevation obtained from pre-dam run

“fa_input”: the fraction of each grain size on the bed surface obtained from pre-dam run

“upstream_rating_curve_pre-dam”: the rating curve used for the pre-dam run for the most upstream node

“upstream_rating_curve_post-dam”: the rating curve used for the post-dam runs for the most upstream node

“Meouge_rating_curve”: the rating curve for the Meouge branch that joins the Buech at ~ 12km upstream of the outlet.

“catchment_area”: the fraction of the sub-catchments areas contributing to each node

[1] This model is specifically developed for the Buech river. It needs to be carefully updated/edited in order to apply to other cases.

Model Outputs:

“etaa1-8”: bed surface elevation. The first column of the first file is the distance from the dam in meter, the second column of the first file is the initial bed elevation i.e., 1992 and the rest of the columns are the bed surface elevation in each 3 years i.e., 1995, 1998, 2001 etc.

“dgf1-8”: geometric diameter of the surface sediment. The format is the same as bed surface elevation.

“d90-1-8”: d90 of the surface sediment. The format is the same as bed surface elevation.

“d50-1-8”: d50 of the surface sediment. The format is the same as bed surface elevation.

“Water surface1-8”: water depth. The format is the same as bed surface elevation.

“slope1-8”: bed slope. The format is the same as bed surface elevation.

“fa_output”: the fraction of each grain on the bed surface. The output of pre-dam run should be copied and pasted in fa-input of the post-dam run.

“sediment_volume_1-8”: Total volume of sediment passing through each node over 3 years. For example, the last node represents the total volume of sediment going out of the reach within each 3 years increment. The format is the same as bed surface elevation except there is no initial condition. The second column in these files are the first printing time i.e. 1995.

“qbiv2019_1-4”: grain size specific volume of sediment passing through each node for the year 2019. The first column is the distance from the dam. Each column represents one grain size range starting from the smallest grain.

“qbiv2028_1-4”: grain size specific volume of sediment passing through each node for the year 2028. The first column is the distance from the dam. Each column represents one grain size range starting from the smallest grain.

“qbiv2031_1-4”: grain size specific volume of sediment passing through each node for the year 2031. The first column is the distance from the dam. Each column represents one grain size range starting from the smallest grain.

“qbiv2082_1-4”: grain size specific volume of sediment passing through each node for the year 2082. The first column is the distance from the dam. Each column represents one grain size range starting from the smallest grain.