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Modelling faecal coliforms and streptococci dynamics in an intermittent French river with Mohid River Network

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The sanitary microbiological condition of Mediterranean coastal rivers is a growing concern because of its impacts on the compliance of receiving coastal and transitional waters which are of high recreational and economic values. Due to strong anthropogenic pressures, coastal rivers do not often meet the required standards and guidelines, expressed in terms of coliforms and streptococci abundances. These indicator bacteria themselves are usually not pathogenic, but they allow the tracking of recent faecal contamination and the possible presence of pathogenic micro-organisms in rivers, in an easier and less costly way.

Mediterranean coastal rivers are subject to long dry periods cut by short duration flush flood events. During dry and low flow period, faecal bacteria often bound to particulate matter tend to settle in the riverbed and to constitute an in-stream store in which bacteria are able to survive for long durations and even to multiply. During intense rainfall events and floods, peaks of faecal contamination occur in rivers due to entrainment of stored bacteria in river channels by the flood.

Modelling these intermittent rivers poses a numerical challenge due to the high spatial and temporal gradients and proximity of zero value. These conditions are not well handled or not simulated at all in most of the currently available watershed and rivers models.

The objective of this work is to simulate the transfer and fate of faecal coliforms and faecal streptococci in an intermittent river, considering a dry period followed by a flash flood. The river considered is the French river "La Vène", close to Montpellier, for which data of several dry periods and floods are available. The model considered is Mohid River Network (MRN), (www.mohid.com). MRN is a 1D hydrodynamic model that considers a network of tributaries and allows for dynamic time step. It can also compute properties transport, such as faecal bacteria, and compute water storage in pools, transmission losses and evaporation fluxes with the fine spatial and temporal discretisation required by temporary waters.

In a first step an analysis of sensibility has been performed to assess the effect of the uncertainties in the input data on the results of the model. These uncertainties can for example be due to insufficient temporal and/or spatial resolution.

For dry periods, we have then adapted the decay laws of the bacteria in the bed and the surface water to better simulate the fate of the bacteria. During flash floods, the hypothesis that the bacteria will be transferred from the river bed to the surface water and from the surface water to the river bed according to the sediments erosion and deposition fluxes leds to relatively good results. An important parameter for the simulation is however the particular / dissolved ratio of CTT and SF in the surface water.