1D-modelling of contaminant transport through a multi-channel large river system

Predicting contaminant transport in rivers close to drinking water wells is of huge interest for local authorities. The main pumping area for the water supply of Lyon, the second largest urban area in France, is located within a complex channel network of the Rhône River. It includes several man-made channels and many hydraulic works. The channel system was simulated using a 1D loop-meshed hydrodynamic model (MAGE code) with an advection-dispersion resolution for the solute (ADIS code). This model presents very low computational times, which allow for real-time simulation. Head losses were calibrated against available water level measurements distributed throughout the river network. The partitioning of discharges at diffluences was checked against stream-gauging measurements conducted during usual flow conditions. The longitudinal dispersion coefficients were calibrated using passive tracing data (Rhodamine WT). Several scenarios were tested depending on the upstream hydraulic conditions and on the location of the pollution. Also, the model was used to evaluate the best strategy for minimizing the clogging of the bed by fine sediment released during the Verbois dam flushing operation (Switzerland) planned in Spring 2011. The simulated velocities in pools along the reach close to the wells (Rest Rhône) are lower than 5-10 cm/s even if the upstream compensation discharge is increased to acceptable levels. Instead, reducing this compensation discharge to a minimal value minimizes the input sediment flux, thus the amount of sediment to be deposited throughout the reach. Next efforts will focus on the transport of hydrophobic contaminant (PCB, Hg), requiring erosion/deposition laws and sorption coefficient to be defined and parameterized.

Auteurs du document : Launay, M., Andries, E., Le Coz, J., Coquery, M., Faure, J.B., Camenen, B
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