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Estimation of the water fluxes, sediments and heavy metals in a retention-infiltration basin

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Approximately, 80% of the European population lives in urban areas and therefore urban soils are exposed to diverse anthropogenic contaminations that are composed mostly of particular phase (80%) (solid fragments, hydrocarbons, heavy metals, etc...). These sediments are partially transported by stormwater that in France, are frequently disposed in infiltration basins. These basins where initially build to limit the risk of inundations. Nevertheless, it was found that these basins have a cheap and good performance to remove pollutants from stormwater, due to the decantation of the pollutants that are trapped in the basin.

The management of retention–infiltration basin in a sustainable way such that they will not contaminate the groundwater is not well understood. This problematic is been tackled by the multidisciplinary research federation OTHU (Field Observatory on Water Management). In order to better handle and design the basins, one requires a better understanding of the physico-chemical processes of the pollutant trapped in the soil that are in continual mutations (fixing and releasing the heavy metals) and that migrate to the ground water.

To answer this problematic a long-term experimental site is selected in an industrial catchment zone (185 ha) that is situated in the suburb of Lyon (France). The stormwater is collected first in a retention basin (sedimentation basin) than the water drains into the infiltration basin. The infiltration basin (1 ha) is composed of heterogeneous

quaternary glaciofluvial formation with a deep water table. The underlying geology of fluvioglacial deposits, may generate preferential flow paths that may induce a long-term contamination at depths greater that may be expected from the hypothesis of a homogeneous deposit.

The different mechanistic and deterministic models that are been experimented are (1) CANOE (rainfall runoff in Urban areas); (2) RUBAR 20 (that solves the equation of Barré de Saint Venant predicts the water and sediment fluxes in the retention basin); (3) HYDRUS (1D, 2D and 3D water flow model in the unsaturated zone that predict groundwater recharge from the Richards' equation). Up to date these models work independently.

The stormwater rate coming from the urban catchment area is monitored or modelled to a reasonable accuracy by using the software CANOE developed by INSA-Lyon and SOGREAH. The model fluxes discharges into RUBAR 20 that successfully models the height of the water in the retention basin. This water flux is than transferred to HYDRUS as a boundary condition. The water fluxes of the cascading models will be validated.

The modelling of the sediment budget is not yet validated by CANOE. The modelling of the budget of the sediment in the retention basin by using RUBAR20 is shown to be difficult but can be used to optimize the design of the basin in order to maximise the sediment trapping. The sediment budget that escapes through the infiltration basin on the surface is not precise due to the lack of continuous measurements.

The determination of the reduction of the hydrodynamics properties due to sediment deposits is crucial in order to access the risks of flooding that is important for the management of the infiltration basin. The determination of the water fluxes in the infiltration basin, the HYDRUS model is used. HYDRUS requires the hydrodynamics properties of the surface of the basin and also the underlying matrix of the soil. The spatial surface variation of the hydraulic parameters will be determined by using the Beerkan infiltration method (Lassabatère et al., 2006). These results will be confronted by computing the average surface hydraulic parameters by calibrating against the level of the water in the infiltration basin by using the novel inverse modelling [Linking Test (Pollacco et al., 2007)]. According to the results, the simplest hydrological model will be chosen to determine the rate of flow, than a sediment flow/particle flow model will be implemented.

These sediments are highly contaminated by heavy metals and its impact on the aquifer is poorly understood. The removal of the sediments in the infiltration basin is expensive but it is not clear if leaving a fine layer of sediments is beneficial such that it reduces the infiltration rate and is a trapping for the contaminants.

The results obtained of the water fluxes and the knowledge of the variation of the hydrodynamique properties of the surface will permit the coupling of the physico-chemical module of the interaction of the water sediments and pollutants of the decantation-infiltration basin.