Identifying SAT efficiency by modelling its specific aquifer environment influenced by natural and anthropogenic activities -exemple of the costal SAT of Agon-Coutainville (France)

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Most of Managed Aquifer Recharge (MAR) sites in France allow to preserve groundwater, to support an over-exploited groundwater table as well as to prevent saline intrusion, to reduce environmental pollution or to complete water treatment, through soil aquifer treatment (SAT). Groundwater modelling can provide the possibility to preview de feasibility of MAR or SAT system in its regional context and give a tool to identify and optimise the choice for its implementation. The application of a model for testing the influence of projects and management actions on site conditions may provide a framework for stakeholders to screen and select appropriate strategies for the management of water resources and environment. Further on, model allow long-term predictions when it calculated forecasting effects resulting from the natural specific environment as climate change or human-related changes in water use (Rossetto et al., 2018; Criollo et al., 2018; Ringleb et al., 2016; Kloppmann et al. 2012).

On the coastal environment of Agon-Coutainville (Normandy, France), SAT efficiency is questioned by natural and anthropogenic activities that could modify groundwater in flow velocities and quality. This SAT is as part of the full-scale operational wastewater treatment plant (WWTP) and which is sustainably integrated within the municipal wastewater treatment line during more than 14 years along the English Channel coast. The secondary treated wastewater (STWW) of ~1600m^3/day is infiltrated alternatively into three natural reed bed areas of 35000 m^2 before reaching the sand dune aquifer. The direct discharge of STWW to the sea is thus avoided to guaranty the sustainability of the shellfish production and preserve the touristic economy along the coast (Picot-Colbeaux et al., 2021).

To forecast SAT efficiency in a such hydrosystem for which major natural and anthropogenic forcing factors change in time and space, an hydrogeological model included the SAT system is provided. First, a conceptual model is carried out based on the analysis of a significant amount of information that has been collected on five observation wells and on WWTP in order to identify the main factors driving this SAT system (Guillemoto et al. 2021). These data include geology, land-use, LIDAR digital elevation model, rainfall, potential evapotranspiration, streamflow, monitored groundwater levels and water quality, sea tides, as well as SAT functioning (STWW flow and quality, basin geometry and dynamic of infiltration). Second, a hydrodynamic and hydrodispersive numerical model for sustainable groundwater management is carried out on transient state based on the conceptual model and the data analysed. The model integrates SAT dynamic, atmospheric recharge, saline intrusion and river flow. Finally, the numerical model is calibrated with groundwater levels and groundwater quality before being used for simulating future natural and anthropogenic conditions. At each selected time step, the model calculates maps of the groundwater level and quality (solute concentration) that complete punctual groundwater observations, and then, it provides water balance and mass balance that is powerful to determine the efficiency of the SAT in producing fresh water on the surrounding brackish groundwater.