Identification of the main natural and anthropic variations affecting costal SAT systems -example of the Agon-Coutainville SAT (France)

Quentin Guillemoto, Nicolas Devau, Géraldine Picot-Colbeaux, Danièle Valdes, Frédéric Mathurin, Marie Pettenati, Denis Neyens, Jean-Marie Mouchel, Wolfram Kloppmann

Identification of the main natural and anthropic variations affecting costal SAT systems – example of the Agon-Coutainville SAT (France).

Guillemoto Q.[1,2], Devau[1] N., Picot-Colbeaux G.[1], Valdes D.[2], Mathurin F[1], Pettenati M.[1], Neyens D.[3], Mouchel J-M.[2], Kloppmann W.[1]

[1]French Geological Survey (BRGM, France); [2]Paris Sorbonne University (France) ; [3] IMAGEAU (France)

Managed aquifer recharge (MAR) systems are often applied to coastal area to limit seawater intrusion and improve water quality for irrigations purpose (Tzoraki et al., 2018) or drinking water purpose (Van Houtte and Verbauwhede, 2012). These MAR systems are integrated into the hydrosystem in which groundwater flows may be subject to variations caused by meteorological events and tides, but also by human activities such as secondary treated wastewater (STWW) discharges from wastewater treatment plants (WWTP). These natural and anthropic activities could influence groundwater flow velocities and hence the efficiency of the MAR system, notably when it is combined to Soil Aquifer Treatment (SAT).

In this study, we have identified the environmental and human forcing factors influencing the SAT system implemented in Agon-Coutainville (Normandy, France), which is part of the full-scale operational WWTP sustainably integrated within the municipal wastewater treatment line since 14 years along the English Channel coast. The STWW discharge 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 avoided to guaranty the sustainability of the shellfish production and preserve the touristic economy along the coast (Picot-Colbeaux et al., 2021).

To identify major natural and anthropogenic forcing factors driving this SAT system, time series analyses were carried out on environmental data such as sea tides, natural recharge estimated by Potential Evapo-Transpiration (PET) and rainfall records, STWW flow discharge in the three infiltrations pounds. The same analyses were carried out on groundwater level and electrical conductivity monitored in several observation wells. Then, these results were compared/correlated to give evidence of the impact of each factor in this SAT system.

The results show that all groundwater levels and electric conductivity are influenced by natural recharge but also locally by sea tides and STWW flows. A spatial information of the main forcing effects on groundwater is highlighted. Annual variations of natural recharge affect all the observation wells. STWW daily flow effects are identified on the closest piezometers of the infiltrations pounds. Relationship between STWW flow and natural recharge is also identified especially during winter periods showing that a large part of parasitic water was drained through sewer system, which have increased STWW flows in the SAT system. For tides, important monthly and/or diurnal effects are identified on the infiltration pound closest to seashore.

These results demonstrate that several environmental forcing factors affect the studied MAR/SAT system, potentially jeopardizing its efficiency. We hypothesized that changes in ; water level from natural recharge and STWW flow could modify vadose zone thickness, affecting groundwater flows and geochemical processes, as well for seawater intrusion.