GQ 2019
10th International Groundwater Quality Conference
9-12 September 2019, Liege (Belgium)
http://aimontefiore.org/GQ2019

CROP-SCALE INVESTIGATIONS OF SOIL SALINIZATION PROCESS IN RELATION WITH SHALLOW SALTY GROUNDWATER IN THE SENEGAL RIVER DELTA

Abdoul Aziz Gning[1,3], Philippe Orban[1], Joost Wellens[2], Raymond Malou[3], Serge Brouyère[1]

[1] Hydrogeology & Environmental Geology, Urban & Environmental Engineering Research Unit, ULiège, Belgium

[2] Water, Environment & Development Laboratory; Environmental Sciences and Management Department, ULiège, Belgium

[3] Department of geology, Faculty of Sciences and Techniques, Cheikh Anta Diop University of Dakar, Senegal

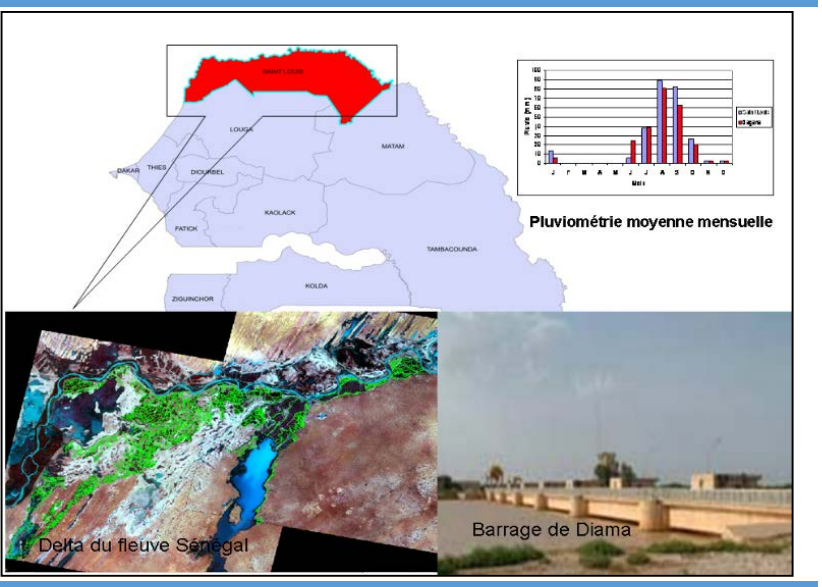
Context and objectives

The Senegal River Delta is located in northwestern Senegal, in the Saint Louis region. With an area of 3500 km2, it has significant hydro-agricultural potential, particularly with the establishment of the Diama anti-sands dam (26 km upstream from Saint Louis) which, in combination with the Manantali dam ensures the availability of water during the whole year despite a low rainfall (annual average 250 mm/year) and a high evapotranspiration.

The issue of water and land management remains one of the major challenges to achieving development goals. Indeed, if the availability of water is ensured, the salinity of groundwater and soil constitutes a major obstacle to the development of agriculture. This situation results mainly from the lack of control of the operation of the hydro-system as a whole, in particular of the relationship between surface water and groundwater. The optimization of the hydraulic scheme should make it possible to improve the availability of water in all hydro-agricultural developments, as well as the control of water quality in the face of salinization problems.

OBJECTIVES :

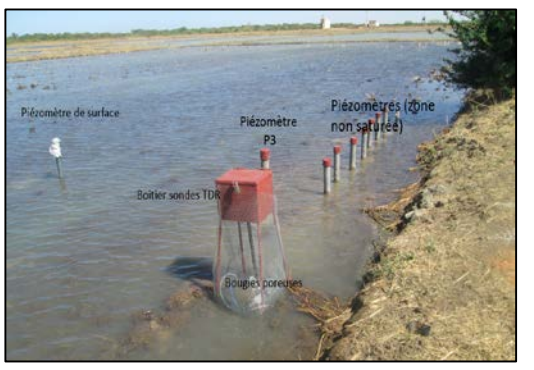
1. Establish the water and salt balance in the aquifer,
2. Characterize the dynamic of water and salt under irrigated plots,
3. Identify the role of irrigation in the risk of salinizatiion,
3. Control the risk of soil salinization;
4. Propose a model of rational management of the resource.



Experimental study

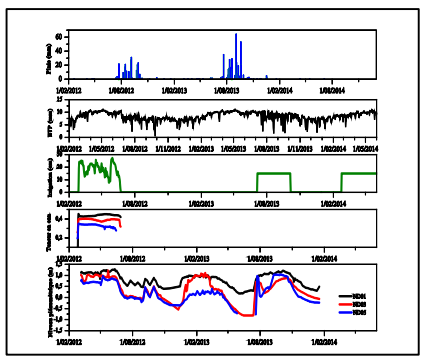
The experimental study of the behavior of the shallow aquifer under irrigation was conducted in two rice fields. The experimental set-up consists of:

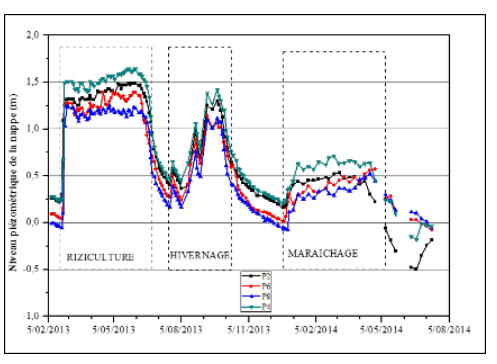
- pressure probes to monitor the surface water level in flooded rice plot,
- TDR probes for measuring soil moisture,
- measuring probes of the groundwater level and the EC of the groundwater,
- network of piezometers for monitoring the water table,
- Suction cup for monitoring the soil solution

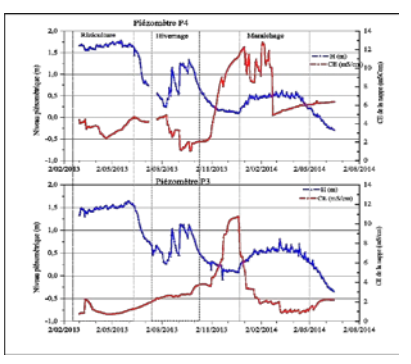


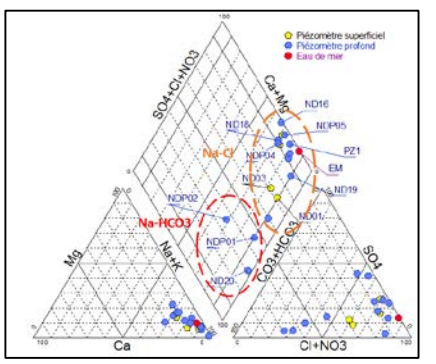
Main results

The experimental study allowed to characterize water and salt transfer processes in irrigated plots. Irrigation water contributes to recharge groundwater and to dilute the salinity of the soil and groundwater. However, when irrigation operations are stopped, groundwater levels decrease to their initial levels and salinity increases again in particular because of the evaporative recovery that appears to be the main driver of these processes. Thus, the transfer of water and solutes in the subsurface of the delta follows a charging-discharging and dilution-concentration cycles controlled by the global water balance,









Conclusions and perspectives

This experimental study constitutes a reduction of scale to better understand the interactions between irrigation / groundwater dynamics / soil degradation. It has made it possible to demonstrate that the waterlogging phenomena of soil saturation and upwelling are accompanied by chemical changes that can lead to capillary rise phenomena under the effect of evaporation.
These results were subsequently used for the development of a numerical flow and transport model in the variably saturated zone with the Hydrus 2D code..

The first author would like to warmly thank the Wallonie-Bruxelles International (WBI) office for having financed the PhD research and the accommodation costs during GQ2019. PACODEL-ULiège is also warmly tanked for having financed the travel costs from Senegal to Belgium to attend the conference.