Evaluation of surface water quality of Tensift River using water quality indexes

Évaluation de la qualité des eaux de surface de la rivière de Tensift à l'aide d'indices de qualité des eaux

Introduction

The Tensift River (Morocco) is exposed to intense pollution. The main sources of pollution are urban wastewater, olive mills waste and overfertilization. The Water Quality Index (WQI) used to evaluate water for human consumption has the ability to summarize a large amount of data into a single number that describes the global state of water quality. In addition, three indicators, SAR, PI and RSC were selected to assess water quality for irrigation use

Study area

- The study area is located in the east of the Tensift watershed(near Marrakech), which has an area of 24 800 km^2
- The Tensift River crosses the watershed over a distance of 260 km and flows into the Atlantic Ocean (see fig 1)

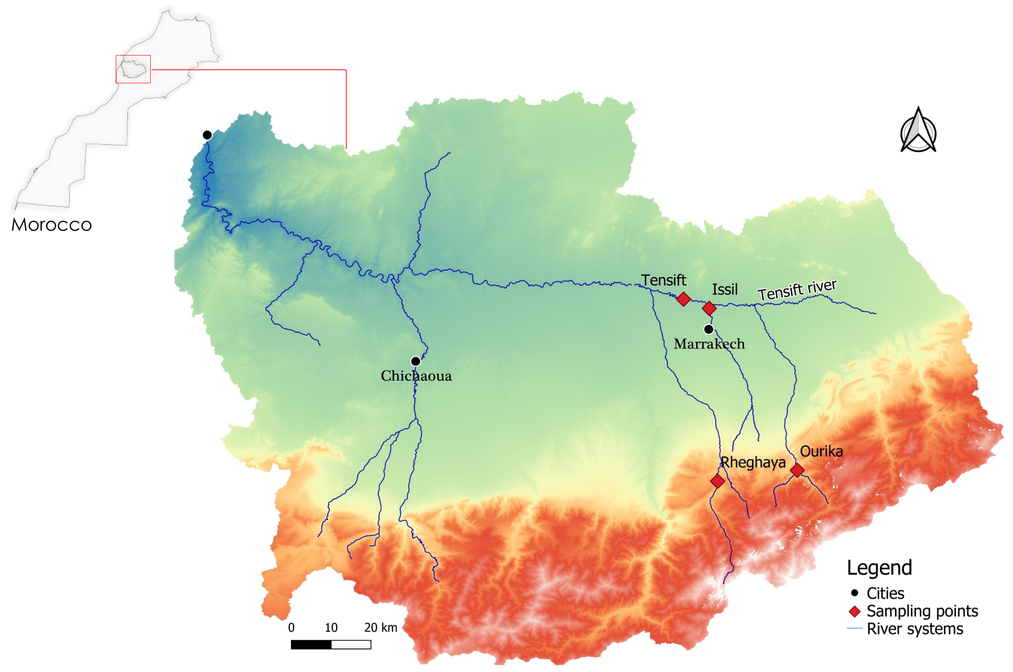

Figure 1 : Location map of the Tensift watershed and the study area

Objectives

- Identify the level of contamination of the Tensift River and its tributaries (Ourika, Rheghaya and Issil) using a water quality index
- Define the risks of using the water for irrigation, with SAR, PI and RSC indexes

Methods

- Four sampling campaigns were carried out in 2015
- The measured parameters are T°, O_2, pH, EC, BOD_5, NH_4^+, NO_3^- and NO_2^-
- To evaluate the water quality regarding the water consumption, we used a water quality index calculated by the equation $WQI = \frac{\sum Q_i W_i}{\sum W_i}$, with W_i is the relative weight and Q_i is the quality rating scale
- To evaluate the suitability of water for irrigation we needed to use three indexes which determine :

1. The risk linked to sodium by the sodium adsorption ratio $SAR = \frac{Na^+}{\sqrt{\frac{(Ca^{2+}+Mg^{2+})}{2}}}$
2. The risk linked to soluble salts by the permeability index $PI = \frac{Na^+ + \sqrt{HCO_3}}{Ca^{2+}+Mg^{2+}+Na^+} \cdot 100$
3. The risk linked to a high concentration of bicarbonate by the residual sodium carbonate index $RSC = [HCO_3^- + CO_3^{2-}] - [Ca^{2-} + Mg^{2+}]$

Evaluation of water quality

- The spatial-temporal variation is clear (see fig 2)
- The upstream (Rherhaya and Ourika) is characterized by a low population and a rugged topography. This reduces the extension of soil occupation, which explains the low water pollution
- The physicochemical parameters responsible for the degradation of water in the downstream part(Issil and Tensift) are mainly BOD_5, O_2, NH_4^+ and to a lesser extent NO_3^- and NO_2^-

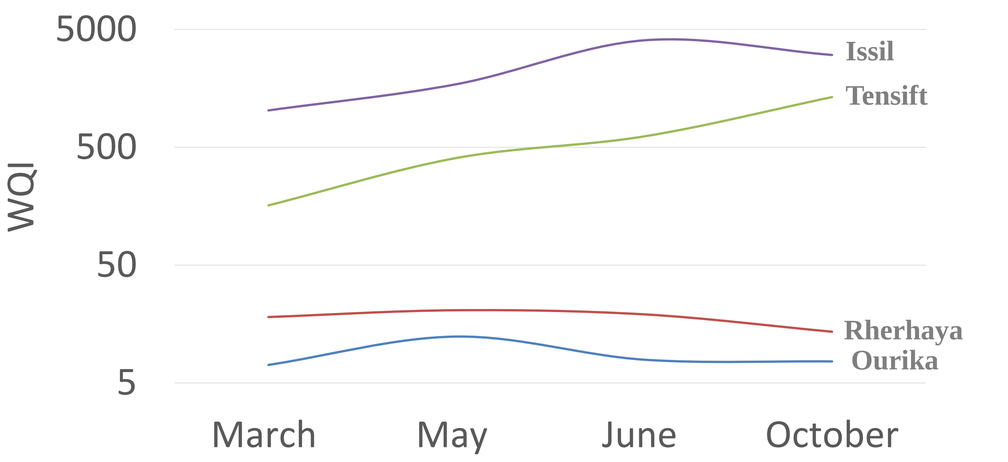

Figure 2 : The evolution of the water quality index WQI during the year 2015

	Ourika (upstream)	Tensift (downstream)	Limits
SAR	0.45	6.8	9
PI (%)	70%	65%	Less 25%
RSC (mEq/l)	-0.27	-11.37	2.5

Table 1 : Average values of irrigation water quality assessment parameters

Figure 3 : Ourika River

- The degradation of water quality is caused specifically by the discharge of domestic wastewater, which increases the concentrations of BOD_5 and NH_4^+ in the water
- The values of the irrigation water quality indexes do not exceed the recommended limits, as a result, the water does not present a risk for irrigation use (see tab 1)

Conclusion

We also suggest to use modeling tools. In fact, monitoring systems based on measurements are expensive and provide a limited information in space and time. Once calibrated/validated, the use of modeling tools like Pegase* (see fig 4 and 5), allows to improve those monitoring networks, and bring complementary and smart information on the water quality in the whole hydrographic network and its temporal evolution

* www.pegase.ulg.ac.be

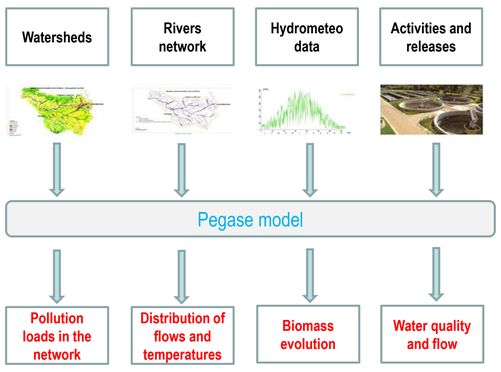

Figure 4 : Representation of the input data and the results of the Pegase model

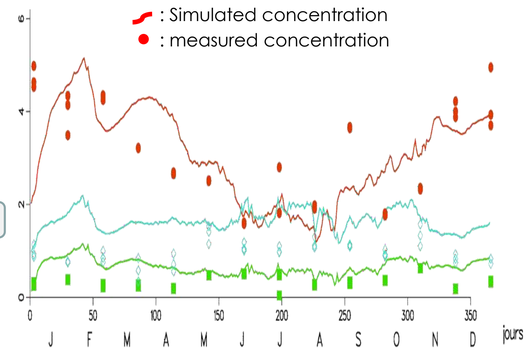

Figure 5 : Example of validation simulation. Nitrate, nitrogen and ammonium concentration simulated with the Pegase model compared to field measurements

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