Salinity dynamics in the upper Tagus estuary

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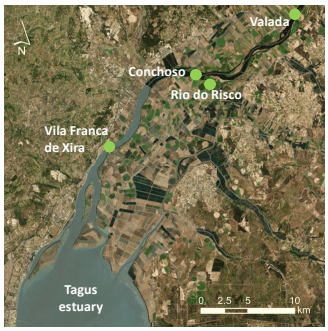
Motivation and goals

Estuarine uses and activities may be negatively affected by climatic variability and climate change. The upper Tagus estuary, in particular, is bordered by an important agricultural area, which main water abstraction is located close to the salinity propagation limit. A reduction of the Tagus river flow or the sea level rise may foster saltwater intrusion and have negative social, economic and environmental impacts.

This study aims to assess the salinity dynamics in the upper Tagus estuary resulting from changes in river flow and sea level rise (SLR).



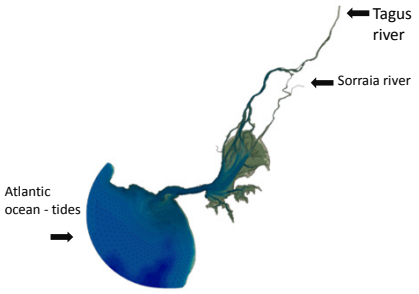
Upper Tagus estuary. *Detailed view of the upper Tagus estuary and location of the stations. The main water abstraction for irrigation is located in Conchoso.*

Methods

A numerical model was used to assess the salinity dynamics in the Tagus estuary. The model was extensively validated against field data (Rodrigues and Fortunato, 2017) and is further validated herein in the upper Tagus estuary for drought conditions (July 2017). To evaluate the salinity propagation during droughts five scenarios of river flow and SLR were established for the summer season. The atmospheric forcing was similar in all the simulations.

Validation of the numerical model of the Tagus estuary (SCHISM 3D)

Simulation of scenarios: river flow and SLR

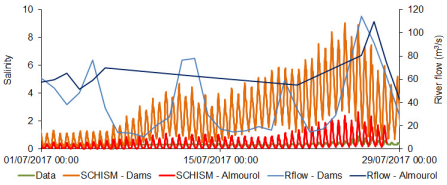


Scenario	River flow – Tagus river (m^3/s)	Mean SLR (m)
S1, climatological	132	0
S2, worst recent drought	22	0
S3, minimum river flow	16.5	0
S4, worst case scenario	8	0
S5, mean sea level rise	22	0.5

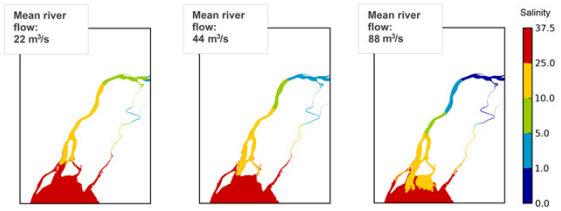
Methods*. Model validation and simulated scenarios.*

Model validation for droughts

Validation assessments suggest that, using the Almourol flow data, the model tends to overestimate the salinity by about 2 in the upper reaches of the estuary. The river flow data used to specify the boundary conditions is a major source of uncertainty in the model results (BINGO, 2018).



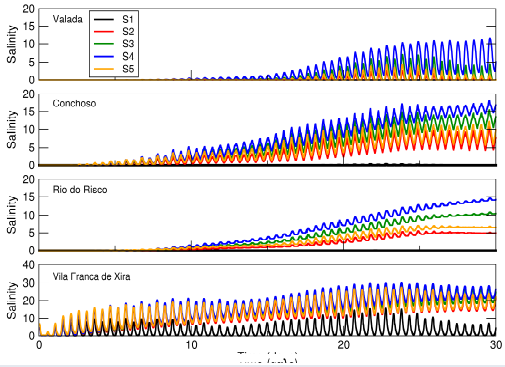
Model validation*. Model-data comparison of salinity model in the upper estuary (Conchoso) for low river flow conditions, considering two alternative input river flows.*



Sensitivity to the river flow*. Influence of the river flow in the mean salinity in the upper estuary.*

River flow and SLR scenarios

For climatological conditions (S1) salinity does not reach the Conchoso station. For scenario S2 salinity reaches about 10 at Conchoso and exceeds the threshold acceptable for irrigation. Salinity differences for the SLR scenario (S5) are small when compared with the differences between the various river flows. For the remaining river flow scenarios salinity increases. The salinity intrusion in the upper estuary depends not only on the river flow, but also on the duration of the droughts.



Scenarios*. Time series of salinity for the simulated river flow and SLR scenarios.*

Conclusions

The river flow is the main driver of the salinity in the upper Tagus estuary. For the analyzed scenarios, salinity reaches concentrations that are inadequate for irrigation during some periods and increases with the duration of the droughts. These results contribute for the management of the agricultural activities in the upper Tagus estuary.

Acknowledgments

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References

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Rodrigues M., Fortunato A.B., 2017. 'Assessment of a three-dimensional baroclinic circulation model of the Tagus estuary', *AIMS Environmental Science*, 4(6), 763-787.