Residence Time patterns of lagrangian drifters at Mirim Lagoon, Brazil

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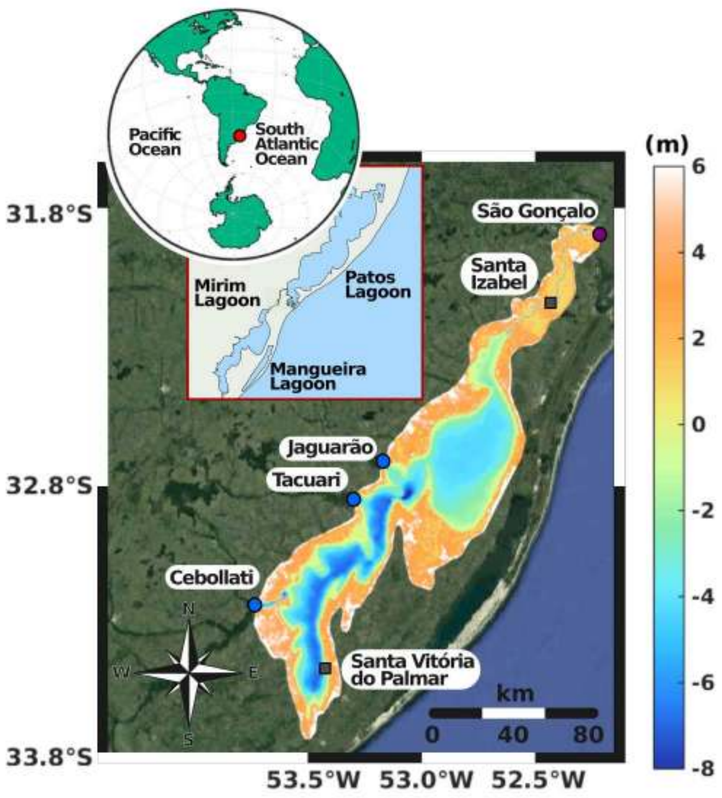
Introduction

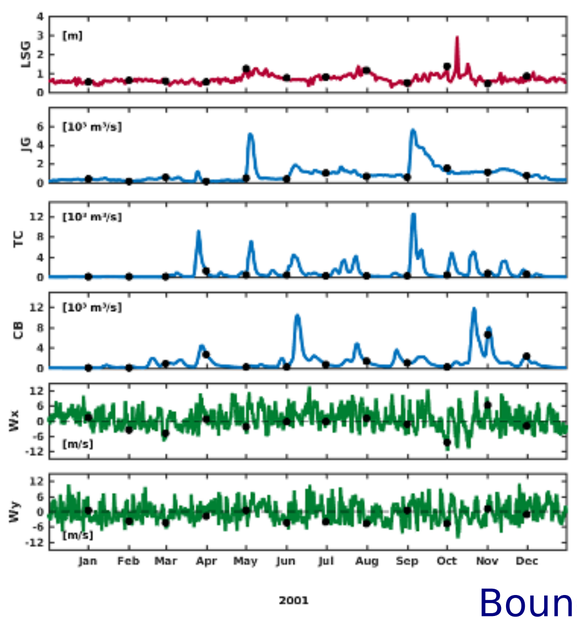
The circulation patterns variability of lagoons have consequences on water quality and other chemical characteristics of water. These characteristics are reflected by the residence time (RT), which is the time scale required to occur the complete renewal of the volume of a water parcel of a reservoir.

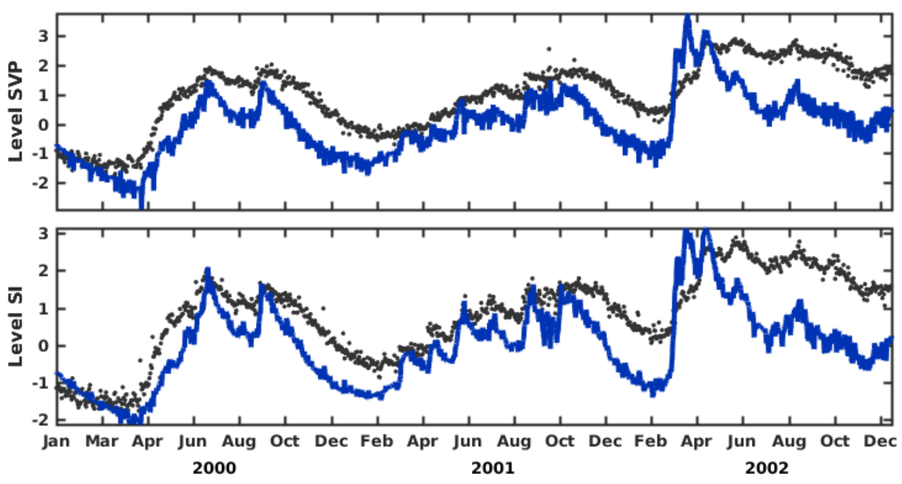
Choked lagoons exhibit strong spatial gradients of RT which increases with the distance from the inlet and decreases seaward, where gradients are associated with the distribution of species and sediment size. Hence, the RT is well correlated with biogeochemical variables, enabling to understand other processes.

This work aims to estimate the spatial distribution and variability of RT of the Mirim Lagoon (ML), located at the extreme South of Brazil. In the last years, surrounding lagoons showed an increase in their eutrophication state, and recent monitoring also indicates that the ML is suffering the same process. This work provides insights into understanding the fate of materials that arrive at ML.

Study area







Boundary conditions and validation

Material and Methods

The present work was developed using the two-dimensional hydrodynamic module Telemac-2D (www.opentelemac.org) and the drifter module based on the release of Lagrangian passive tracers.

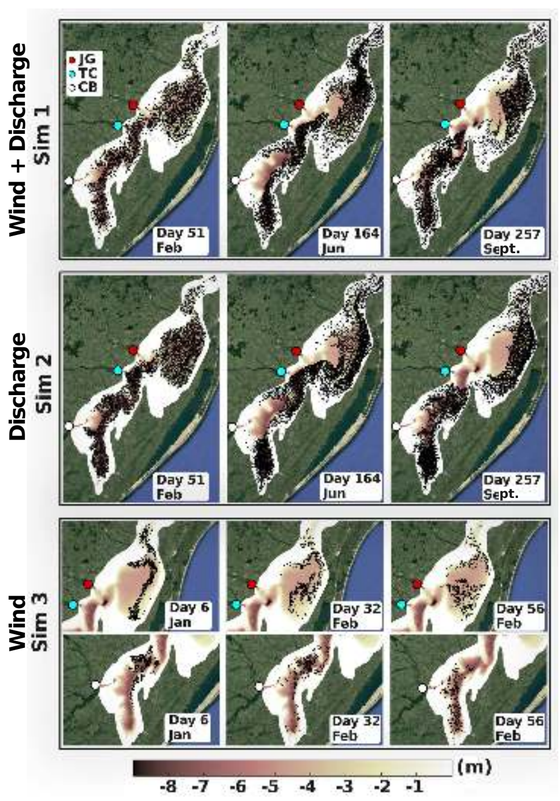
Daily riverine discharge at Jaguarão River, Tacuari River, and Cebollati from the National Water Agency.

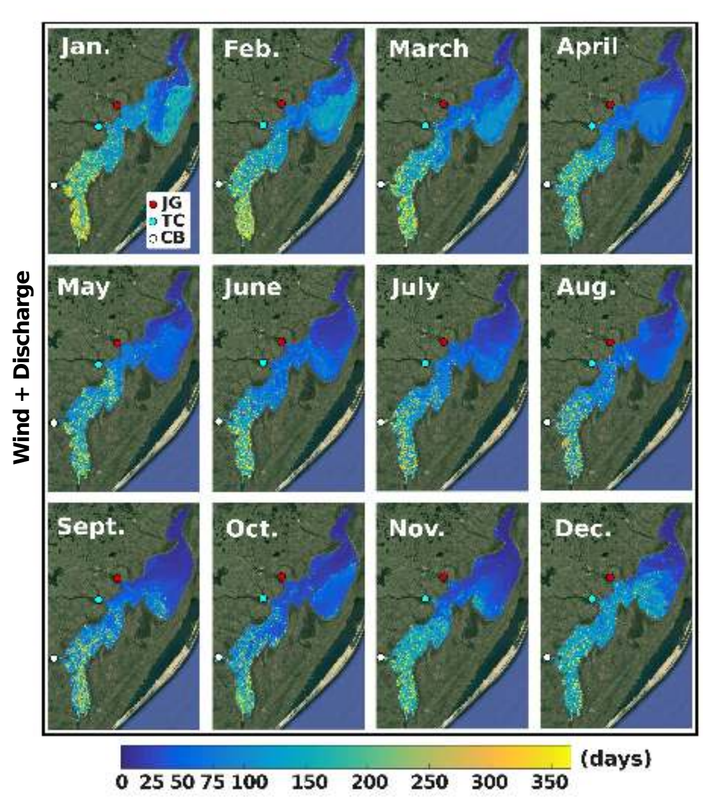
The superficial boundary was forced by wind velocities, atmospheric pressure and air temperature data from the ERA-Interim reanalysis set, with six-hour temporal

Results

The transport pattern of the ML is controlled firstly by the riverine discharge and secondly by the wind. The discharge carries the drifters from the west margin to further away into the eastern margin, when the discharge is high causes retention upstream. The wind contribution to the transport is through the wind-setup and levels gradients, being the wind-driven circulation highly variable along the north-south and the east-west axes, acting on the individual sectors recirculation. Wind forcing also produces gyres, mainly in the north sector, creating high retention at specific periods.

Mirim Lagoon residence time spatial and temporal variation, for 2001, was marked by expressive ranges, up to twice if the time. The basin geometry, rivers locations, discharge oscillations and the wind are highly synergistic on the control of the RT, due to the control on the retention of the water at a specific sector. Our results show that the same region can present values of RT distinct due the pattern change in circulation. This outcome highlights the need for simulations with longer periods to assess critical regions for vulnerability to pollutants and eutrophication.





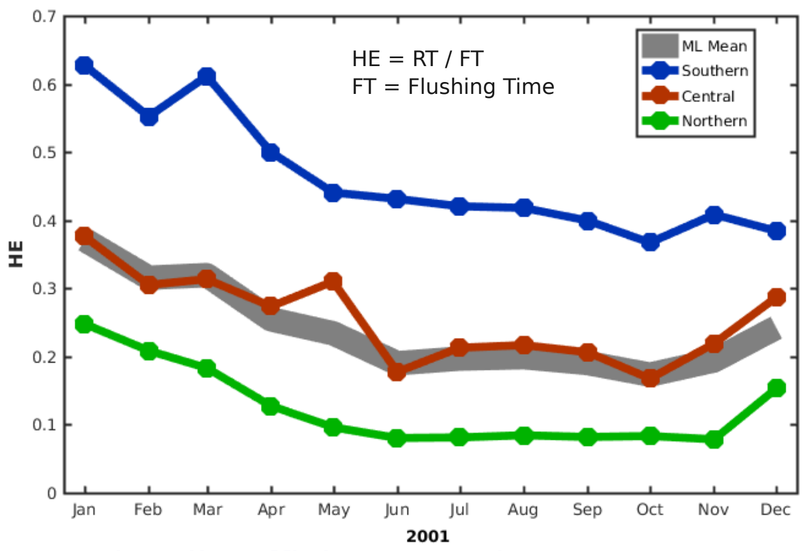
Trajectories and residence time results

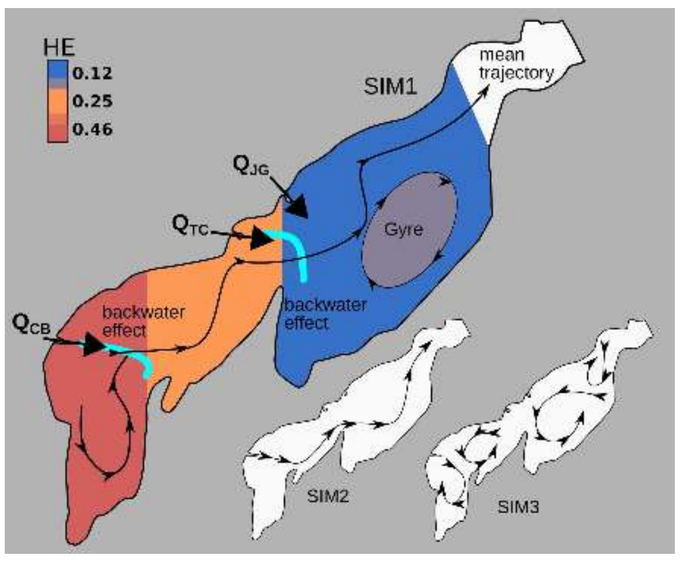
Conclusions

This work evaluated the transport patterns and residence time of the ML using numerical simulations forced by time series of the tributaries discharge and by reanalysis atmospheric data.

The results indicate a mean residence time of 180 days, presenting spatial and temporal variations of up to 100 days. The discharge conditions and the wind regime are the cause of such high variability on the distribution of residence time at Mirim Lagoon.

This high variability indicates that specific periods are more susceptible to be impacted by exogenous contaminants.





Hydraulic efficiency and summary

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