Geophysical Research Abstracts
Vol. 20, EGU2018-12657, 2018
EGU General Assembly 2018
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The use of the SHYFEM numerical model to assess the improvement in the hydrodynamics and in the water renewal of the Nador Lagoon (Morocco) after the construction of a new inlet

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The numerical model are useful instruments to assess quickly and with a high rate of reliability the changes in morphology of the water bodies. For this reason, a numerical model of the Nador Lagoon (Morocco) based on the SHYFEM code (a finite elements shallow water equations model) was implemented and calibrated to assess the improvement of the water circulation inside the lagoon and the exchange with the sea.
Two numerical grids where created, one with the new inlet configuration and another with the old inlet configuration, differing only in a restricted area where the inlets were changed to avoid calculation errors due to different grid representation. A one-year long period (measured tide and wind from Jul 2016-June2017) was simulated with a 3D hydrodynamic setup, the water renewal time (WRT) was calculated every 40 days and model (new inlet configuration) was calibrated with current measurements in the inlet. The same period with the same model setup was simulated with the old inlet configuration.
The new inlet generates a tidal prism 4 times bigger than the old one and the resulting current field is a dipole structure, clearly visible even in the residual circulation. The hydrodynamic field is a more lively with respect to the past, nevertheless during spring tide in the 65% of the lagoon area the the current speed does not exceed 5 cm s-1. The damping of the tidal range is strongly reduced from 60% to 5% and the tidal signal is propagated in 15 minutes, with basically no modification, from the inlet to the outermost areas of the lagoon.
After the construction of the new inlet the average WRT decreased from 60 to 16 days with an increasing trend during summer periods when the prevailing wind is a moderate NE breeze, and the variability was halved. Despite the lower WRT values with respect to the past, their pattern is basically the same. Lowest values are present in a restricted area close to the inlet where tidal flushing is highest. A steep gradient lead to higher WRT values toward the northern and southern basin where the residual circulation is negligible and the WRT variability is highest.