NUMERICAL SIMULATION OF DISSOLVED OXYGEN IN ELGOUNA LAGOONS

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Abstract

Dissolved oxygen (DO) may be considered one of the most important parameters in relation to water quality. In this work, the water quality considering dissolved oxygen in artificial coastal lagoons located in El Gouna, Egypt, is investigated using the TELEMAC-2D WAQTEL module. The simulation focused on a sensitivity analysis of input parameters and the effects of the increasing water temperature on the quantity of DO, as lower levels of DO are expected in case of high temperatures. This may be considered a first step toward studying more water quality parameters in such artificial lagoons stressed by tourism activities.

Keywords: TELEMAC-2D, water quality, dissolved oxygen, coastal lagoons, WAQTEL.

Methods and Data

- DO production: air or photosynthetic processes (Watt, 2000).
- DO consumption: animals respiration or decomposition, organic & ammoniacal load.
- Predicted temperature increase: negative effect on DO (Anthony et al., 2009).
- Domain: 2 connected lagoons, perimeter ~ 4700 m , area 23000 m², water depth 2-3 m, exchange with the Red Sea, 3 water inlets/outlets (Fig. 1.)
- 2D TELEMAC model, coupled with O2 WAQTEL module to assess DO concentrations & sensitivity of input parameters.
- Bathymetric data, tide data (sinusoidal wave: amplitude 0.6 m, period 12 hours) and wind data (5.84 m/s, direction 322º) were considered from previous study (AlJabari, 2018).

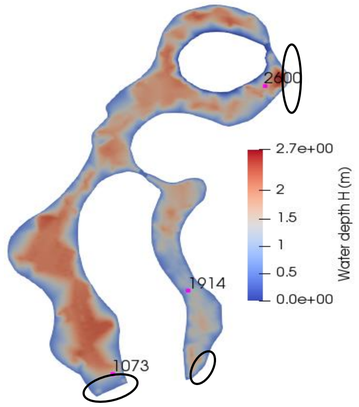

Figure 1: Lagoon's boundary conditions and control points

Results

The lagoon's DO is calculated under two water temperatures; 20°c and 30°c and the results are shown in Fig.2, 3, 4.

The increase in water temperature negatively affected the DO, in which the average DO decreased from 9.87 to 8.43 mgO2/l.

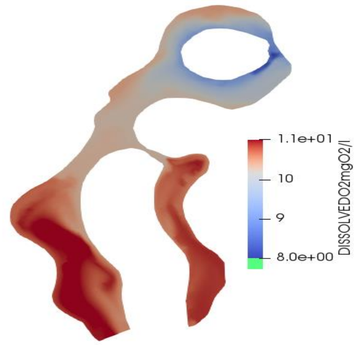

Figure 2: DO after eight days of simulation (20°c)

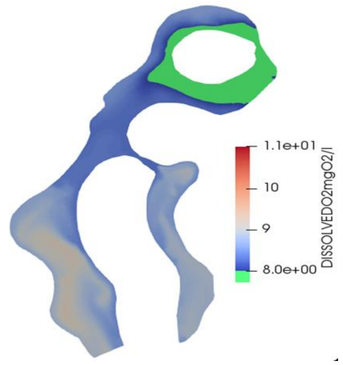

Figure 3: DO after eight days of simulation (30°c)

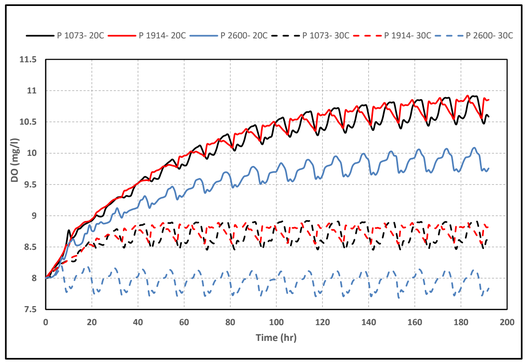

Figure 4: Comparison of DO values at three control points for the two compared temperatures

Sensitivity analysis:

Photosynthesis values P of 0.0, 0.3, 1, 9 mgO2/l were applied neglecting the effect of the organic load and the ammoniacal load.

Table 1: Average DO corresponding to different photosynthesis values

P (mgO2/l)	DO (mgO2/l)
0.0	8.60
0.30	9.03
1.00	9.59
9.00	27.1

It was found that the photosynthesis has an obvious effect on the average DO concentrations in the lagoons.

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