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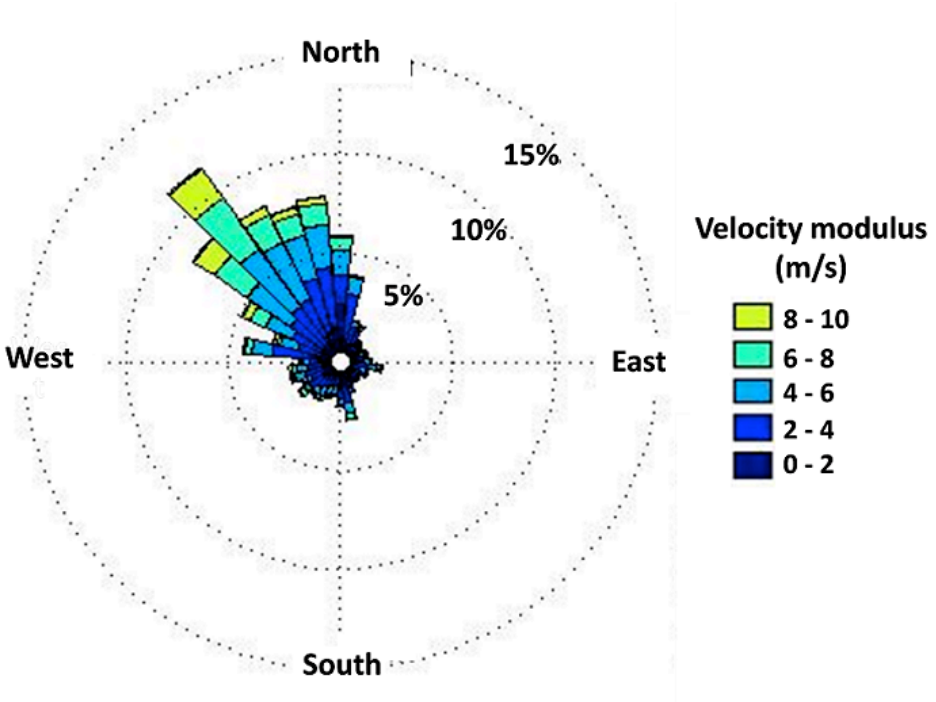
Salgueiro *et al.* (2015) - Modelling the thermal effluent of a near coast power plant (Sines, Portugal). *Journal of Integrated Coastal Zone Management / Revista de Gestão Costeira Integrada*, 15(4):533-544. DOI: 10.5894/rgci577 [Supporting Information]

Supporting Information I

Wind direction and intensity characterization



Wind direction and intensity from 2008 to 2013, recorded on Montes Chaos Sines synoptic station. Adapted from CWOP (2014).

Supporting Information II

Governing equations of the model

Governing continuity equations for MOHID water system assuming Hydrostatic equilibrium, Boussinesq approximation and Reynolds approximation:

$$\frac{\partial u}{\partial x} + \frac{\partial v}{\partial y} + \frac{\partial w}{\partial z} = 0 \tag{1}$$

$$\frac{\partial u}{\partial t} + \frac{\partial (uu)}{\partial x} + \frac{\partial (vu)}{\partial y} + \frac{\partial (wu)}{\partial z} = fv - g\frac{\rho_\eta}{\rho_o}\frac{\partial \eta}{\partial x} - \frac{1}{\rho_o}\frac{\partial p_{atm}}{\partial x} - \frac{1}{\rho_o}\int_z^\eta \frac{\rho'}{\partial x}dz + \frac{\partial}{\partial x}\left(\upsilon_H \frac{\partial u}{\partial x}\right) + \frac{\partial}{\partial y}\left(\upsilon_H \frac{\partial u}{\partial y}\right) + \frac{\partial}{\partial z}\left(\upsilon_V \frac{\partial u}{\partial z}\right) \tag{2}$$

$$\frac{\partial v}{\partial t} + \frac{\partial (uv)}{\partial x} + \frac{\partial (vv)}{\partial y} + \frac{\partial (wv)}{\partial z} = fu - g\frac{\rho_\eta}{\rho_o}\frac{\partial \eta}{\partial y} - \frac{1}{\rho_o}\frac{\partial p_{atm}}{\partial y} - \frac{1}{\rho_o}\int_z^\eta \frac{\rho'}{\partial y}dz + \frac{\partial}{\partial x}\left(\upsilon_H \frac{\partial v}{\partial x}\right) + \frac{\partial}{\partial y}\left(\upsilon_H \frac{\partial v}{\partial y}\right) + \frac{\partial}{\partial z}\left(\upsilon_V \frac{\partial v}{\partial z}\right) \tag{3}$$

$$\frac{\partial p}{\partial z} = -\rho g \tag{4}$$

Where x, y and z are the Cartesian axes, u, v and z are the velocities in the x, y, and z directions, t is the time , η is free surface elevation, f the Coriolis parameter, *patm* is the atmospheric pressure, g is the gravitational force, ρ is the volumic mass and ρ' its anomaly ($\rho = \rho o + \rho'$). νH and νv are the turbulent viscosity in the horizontal and vertical directions that are obtained by multiplying the turbulent viscosity by the velocity gradient.

The mass-balance equation that simulates the temporal and the spatial variations of salinity and temperature:

$$\frac{\partial C}{\partial t} + \frac{\partial (uC)}{\partial x} + \frac{\partial (vC)}{\partial y} + \frac{\partial (wC)}{\partial z} = \frac{\partial}{\partial x}\left(k_H \frac{\partial C}{\partial x}\right) + \frac{\partial}{\partial y}\left(k_H \frac{\partial C}{\partial y}\right) + \frac{\partial}{\partial z}\left(k_V \frac{\partial C}{\partial z}\right) + S_{ST} \tag{5}$$

Where C stands for salinity (S) or temperature (T). *SST* is the source term for the property in question, which are the exchanges at the air-sea interface and the discharges. kH and kV are the horizontal and vertical diffusivities respectively.

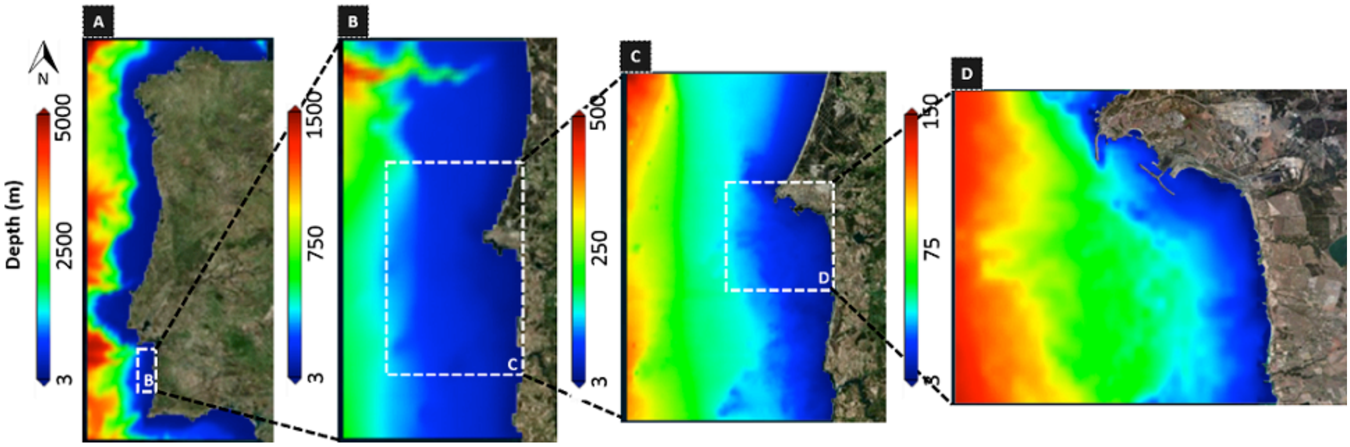
Density is solved with the UNESCO state equation as a function of salinity, temperature and pressure, to solve density:

$$\rho = \frac{(5890 + 38T - 0.375T^2 + 3S_a)}{(1179.5 + 11.25T - 0.0745T^2) - (3.8 + 0.01T)S_a + 0.698(5890 + 38T - 0.375T^2 + 3S_a)} \tag{6}$$

Equations 1-5 are solved using a finite volume method. With this methodology the governing equations are expressed as conservations laws in a control volume, by which the rate of accumulation inside a control volume equals to the sum of input and output fluxes, plus sources minus sinks (Chippada *et al.,* 1998; Martins *et al.,* 1998, 2000). Regarding temporal discretization, MOHID uses semi-implicit algorithms to compute the processes that have higher stability requirements, like vertical advection and diffusion, and explicit methods for processes less constrained to the stability problems, like horizontal transport (Neves, 2013). A more detailed description of the numerical algorithms can be found in Martins *et al.* (2001).

Supporting Information III

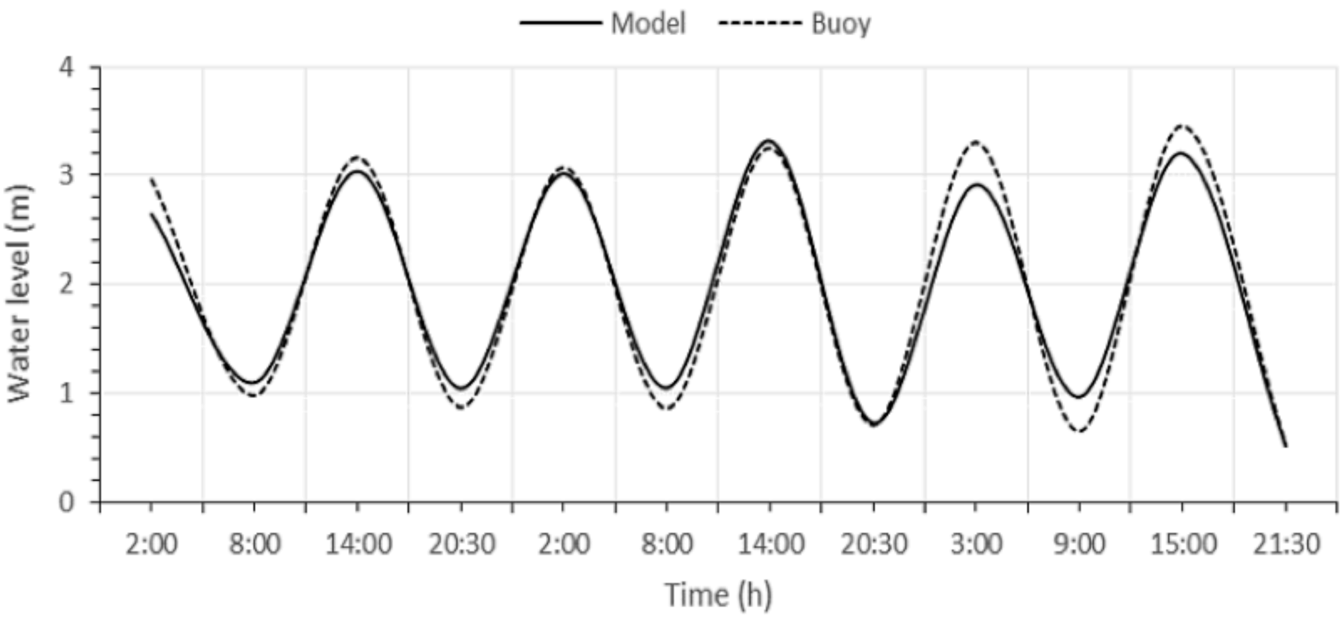
Downscaling methodology



Bathymetry of each nested level, with increasing resolution from A to D.

Supporting Information IV

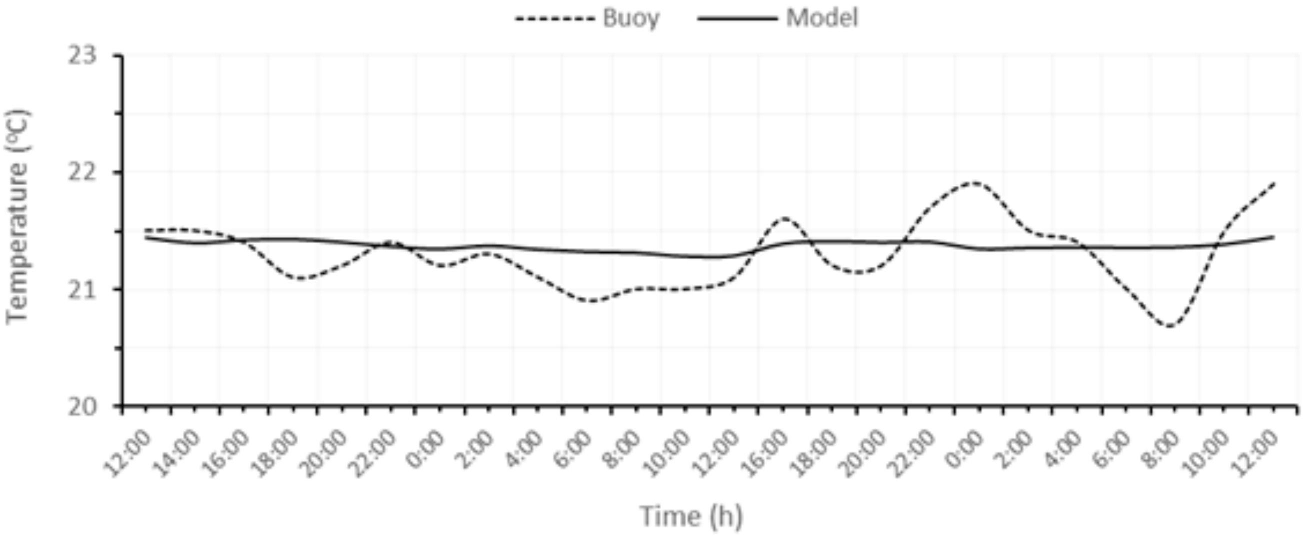
Model validation



Sea level: Sines coastal buoy data (Instituto Hidrográfico, 2014a) and model results from 2 to 4 October 2013.

Statistical parameters for the validation of the obtained water level against field data recorded from Sines coastal buoy data during the 2nd to the 4th October 2013.

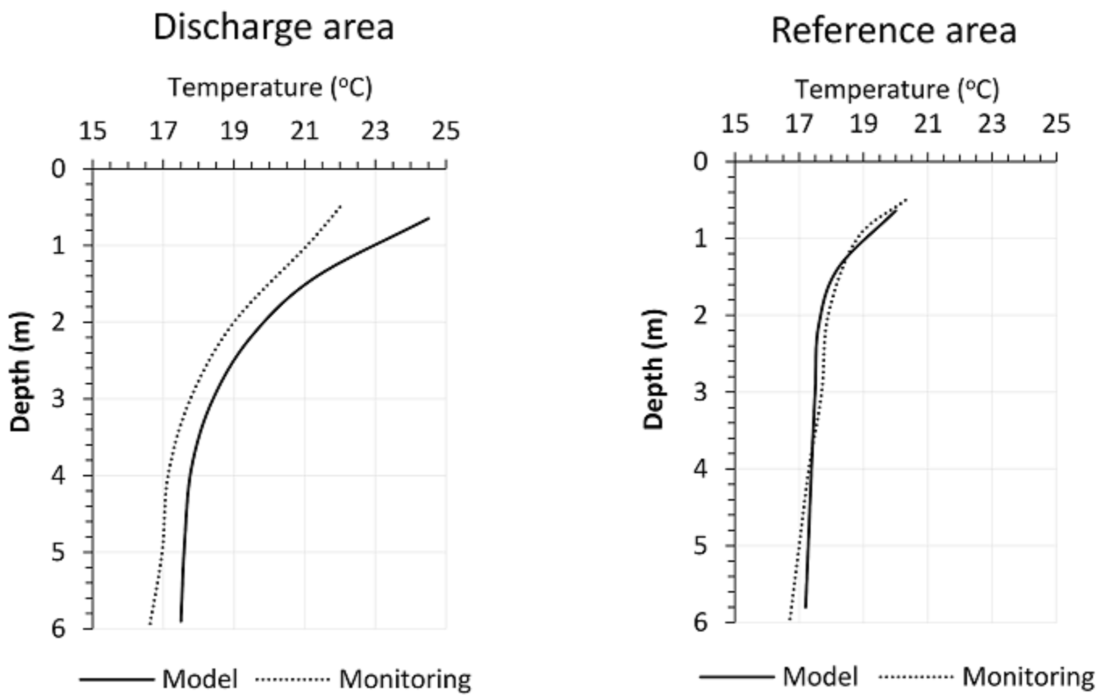
$x \pm \sigma$ **Model (m)**	**1.97 ± 1.05**
$x \pm \sigma$ **Buoy (m)**	1.98 ± 1.18
R	0.99
RMSE (m)	0.19
BE	-0.01



Sea Surface temperature: Sines coastal buoy data (Instituto Hidrográfico, 2014b) and model results from 2 to 4 October 2013.

Statistical parameters for the validation of the obtained sea surface temperature with field data recorded from Sines coastal buoy data from 2 to 4 October 2013.

$x \pm \sigma$ **Model (^{0}C)**	**21.37** ± **0.04**
$x \pm \sigma$ **Buoy (^{0}C)**	21.30 ± 0.30
R	0.48
RMSE (^{0}C)	0.17
BE (^{0}C)	-0.02



Field data against model results for temperature in-depth, on 4 September 2012.

Statistical parameters for the validation of the obtained in-depth temperature against *in situ* campaign, on 4 September 2012.

Discharge area		Reference area	
$x \pm \sigma$ **Model (^oC)**	19.51 ± 2.39	$x \pm \sigma$ **Model (^oC)**	17.89 ± 2.39
$x \pm \sigma$ **Monitoring (^oC)**	18.65 ± 1.98	$x \pm \sigma$ **Monitoring (^oC)**	17.96 ± 1.15
R	0.97	**R**	0.97
RMSE (^oC)	1.11	**RMSE (^oC)**	0.36
BE	0.93	**BE**	-0.07