Supplementary Materials

MATERIAL AND METHODS

1. Physical Model and Configuration

San Jorge Gulf density and hydrographic conditions were characterized during the PROMESse cruise on R/V *Coriolis II* using a CTD profiler and a Scanfish remotely operated vehicle. Scanfish transects were conducted to precisely locate the tidal front, and CTD stations on each side of the front provided geographical references (for a complete description, see Flores Melo et al., 2018, in this issue). For each experiment, initial profiles were set as two layers, one for salinity and the other for temperature.

The model is initialized by simulations that begin on August 1, 2012, and end on July 31, 2015, 12 months before the contamination experiment. We chose to begin our simulations during the austral winter in order to evaluate the interannual evolution of variables and the effects of hydrocarbons (HC) on the austral spring and autumn phytoplankton blooms. Atmospheric forcing was obtained from European Centre for Medium-Range Weather Forecasts (ECMWF) reanalysis data sets at six-hourly intervals with a spatial resolution of 80 km. Longitude and latitude were set in the General Ocean Turbulence Model (GOTM) using geographical positions acquired during Leg 2 of the PROMESse expedition. The stratified experiment (46°29'39.48"S; 66°0'55.079"W) and the well-mixed experiment (46°35'49.499"S; 65°46'49.079"W), separated by 21.4 km, correspond to stations F6 and F10, respectively.

For each experiment, a specific barotropic mean flow representing the pressure gradient was forced by prescribing an external sea surface elevation gradient oscillating at the M_2 frequency, the dominant tidal constituent in the area (Palma et al., 2004). The amplitudes of this gradient (Figure S1) were tuned to obtain current velocity of the order of those measured by the onboard ADCP during the PROMESse expedition, and derived from their model results (Palma et al., 2004).

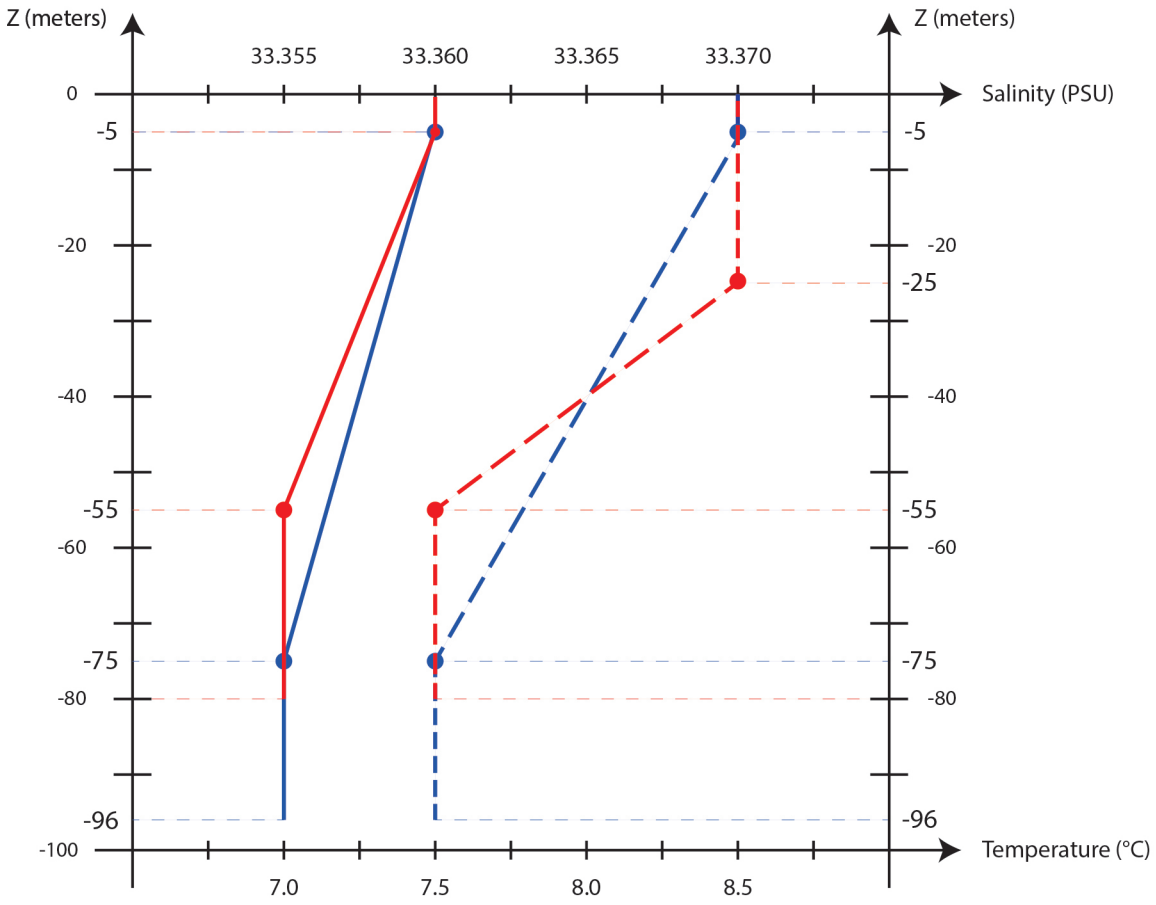
2. Biogeochemical Model and Configuration

Nitrate is initialized at the beginning of the simulations at 15 mmol N m^{-3} in the upper layer (0–30 m) and 30 mmol N m^{-3} in the bottom layer (−66 m to bottom). A relaxation time of 365 days is applied to the bottom layer only. Ammonium is initialized at the beginning of the simulations at 0.20 mmol N m^{-3} in the upper layer (0–25 m) and 0.01 mmol N m^{-3} in the bottom layer (−35 m to bottom). In order to set low concentrations of ammonium during the entire simulation, a relaxation time of three months is applied to the two layers. The ammonium transformation to nitrate is an existing flux included in the model. Nevertheless, because the nitrate and ammonium compartments are parameterized with relaxation times, we decided to keep the nitrification rate at 0.0 day^{-1}.

LDON accounts for the portion of broken molecules identified within the dissolved organic nitrogen pool that can be rapidly used by bacteria to enhance remineralization. This compartment is supplied by the six biological compartments (DIA, FLA, MSZ, MCZ, BAC1, and BAC2) through exudation and by breakdown of sinking detritus.

TABLE S1. References for the simulations described in this study. CST: Complete model version for the STratified experiment. CWM: Complete model version for the Well-Mixed experiment.

Simulation Reference	Experiment Conditions	Model Version	Perturbation Concentration (in mmol N m^{-3})
CST_{00}	Stratified	Complete	00
CST_{10}	Stratified	Complete	10
CST_{20}	Stratified	Complete	20
CST_{50}	Stratified	Complete	50
CWM_{00}	Well-mixed	Complete	00
CWM_{10}	Well-mixed	Complete	10
CWM_{20}	Well-mixed	Complete	20
CWM_{50}	Well-mixed	Complete	50



Param. \ Exp.	Stratified	Well-mixed
Temperature	———	———
Salinity	– – –	– – –
Depth | z | (in m)	96	80
Number of levels (vertical resolution)	48	12
Amplitude of elevation gradient	2.5×10^{-7}	2.5×10^{-5}
Time steps (in sec)	120	80

FIGURE S1. Physical environment parameters (Param.), simulation conditions, and initial profiles of salinity and temperature applied to the stratified (blue curve) and the well-mixed (red curve) experiment (Exp.).

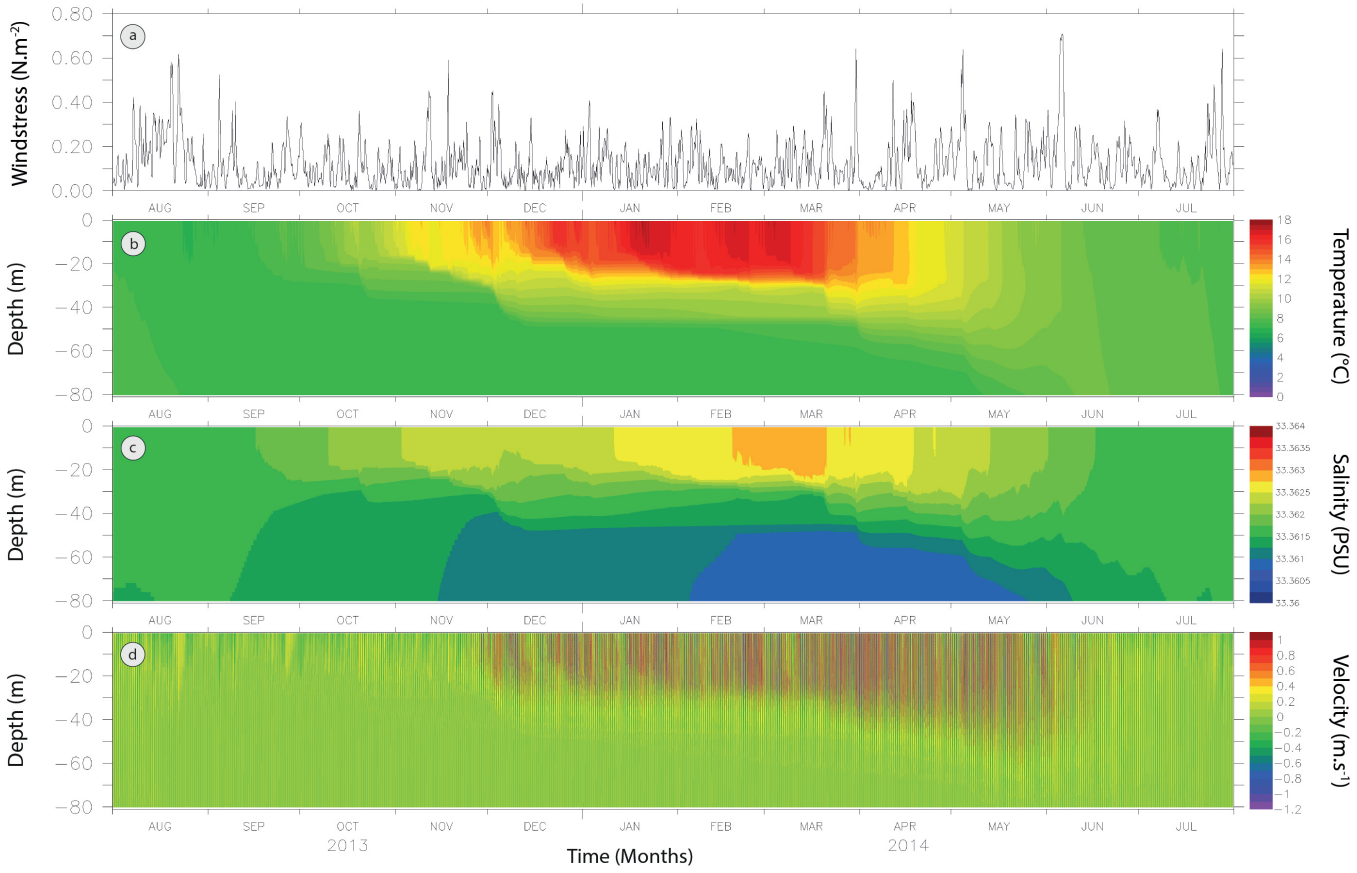


FIGURE S2. 2013/2014 annual cycle of (a) sea surface wind stress calculated from ECMWF reanalysis database (in N m^{-2}), (b) simulated temperature (in °C), (c) simulated salinity (in PSU), and (d) simulated horizontal current speed *U* for the CST experiment (in m s^{-1}).

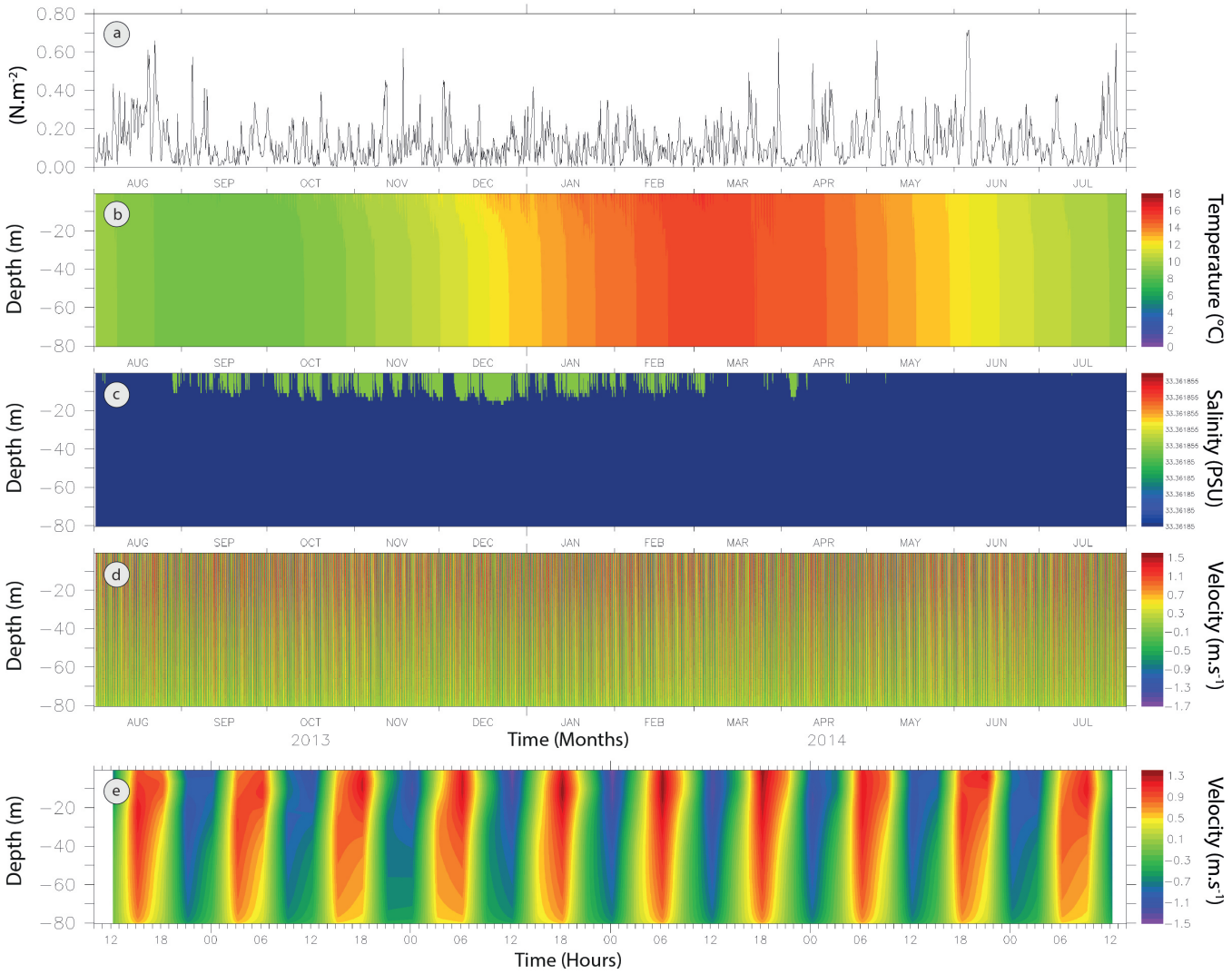


FIGURE S3. 2013/2014 annual cycle of (a) sea surface wind stress calculated from ECMWF reanalysis database (in N m^{-2}), (b) simulated temperature (in °C), (c) simulated salinity (in PSU), (d) simulated horizontal current speed *U* (in m s^{-1}), and (e) simulated horizontal current speed *U* (in m s^{-1}) with x-axis emphasis from January 28 to February 3, 2014, for the CWM experiment.

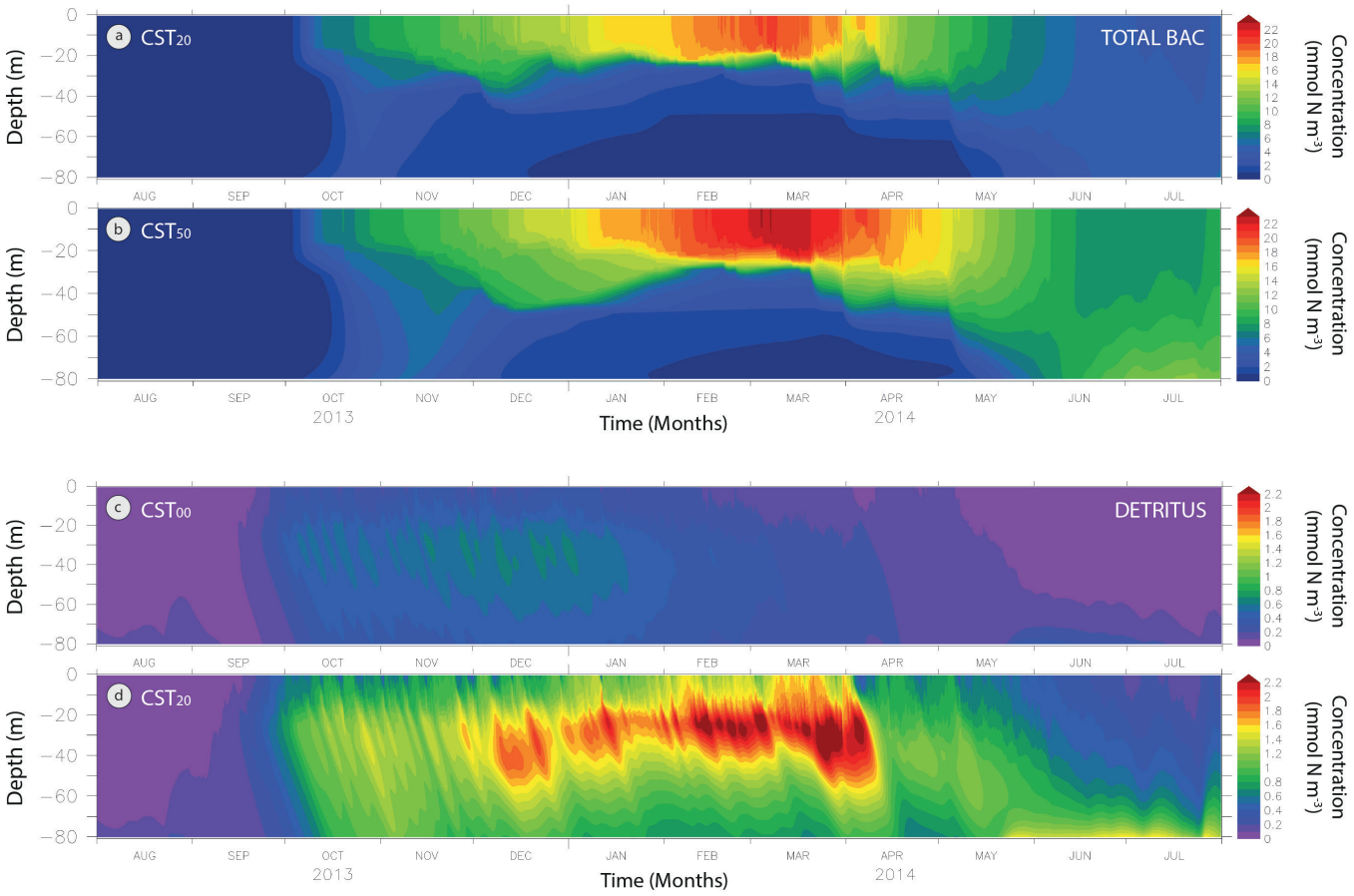


FIGURE S4. 2013/2014 annual cycle of simulated total bacteria (BAC1+BAC2) from (a) CST_{20} and (b) CST_{50} simulations, and simulated detritus from (c) CST_{00} and (d) CST_{20} simulations.

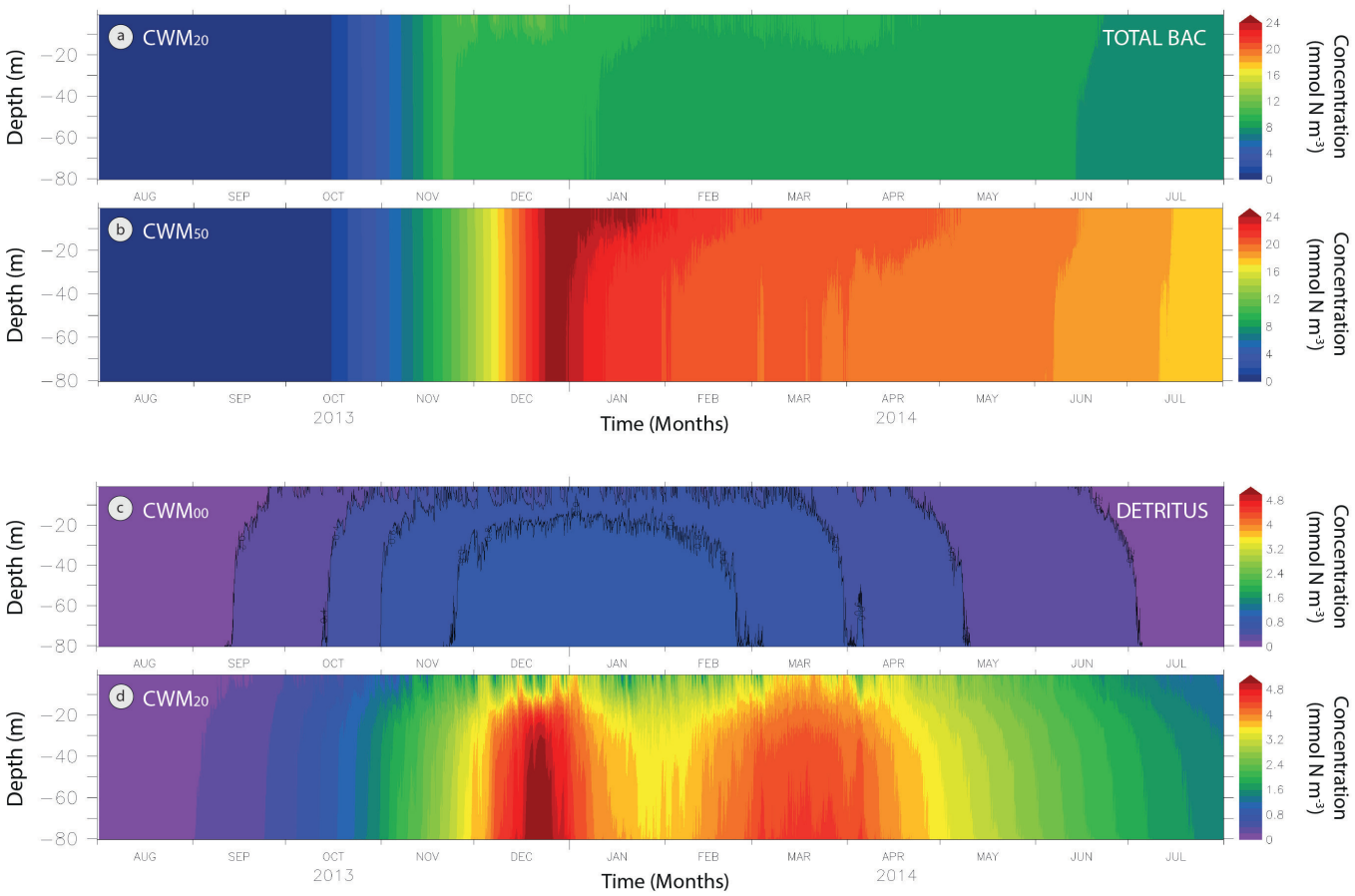


FIGURE S5. 2013/2014 annual cycle of simulated total bacteria (BAC1+BAC2) from (a) CWM_{20} and (b) CWM_{50} simulations, and simulated detritus from (c) CWM_{00} and (d) CWM_{20} simulations.