Supplementary Materials

METHODS

Sea Surface Temperature Image

A sea surface temperature (SST) image was acquired from the NASA ocean color web page (https://oceancolor.gsfc.nasa.gov/) for neap tide (Figure 2b). This product (MODIS-Aqua Level-2) uses the standard MODIS 11 µm nonlinear sea surface temperature (NLSST) algorithm with coefficients derived by the Rosenstiel School of Marine and Atmospheric Science (RSMAS) and input SST guess from Reynolds Optimum Interpolation Sea Surface Temperature (OISST) product (https://www.ncdc.noaa.gov/oisst).

Density Structure During Spring Tide

The average surface potential density was estimated for spring tide, but in this case the frontal position is following bathymetry and the density gradient, and eddy-like structures as observed during neap tide were not observed in this period (see Figure S1).

Nutrient Analysis

Nutrients were determined on GF/F filtered seawater using an autoanalyzer (Skalar Analytical BV, 2005) at the Centro Nacional Patagónico (Puerto Madryn, Argentina) following Strickland and Parsons (1972).

Chl-*a* Analysis

In addition, 100 ml discrete water samples from Chl-*a* maximum depth were fixed with acidic Lugol (final concentration 4%) and stored at 4°C in the dark for phytoplankton composition, abundance and biomass studies.

Cell and Phytoplankton Carbon Content Quantification

Replicate 5 ml samples were taken for phytoplankton and bacterioplankton flow cytometry studies, fixed with 20 µl 25% glutaraldehyde and stored at −80°C in the dark. Microplankton was identified to the lowest possible taxonomic level using a Zeiss Axiovert100 microscope. We classified both phytoplankton and heterotrophic organisms following Olenina et al. (2006) to understand the contributions of the different microbial groups to the carbon pool (Figure 6). Dinoflagellates were grouped into autotrophs, including *Ceratium lineatum*, *Prorocentrum micans*, *Alexandrium* sp., and heterotrophs plus mixotrophs, including *Gymnodinium* sp, *Dynophisis acuminata*, *Protoperidinium* sp, *Gyrodinium* sp. Cell abundance was determined according to Utermöhl (1958). Organisms <20 µm were studied with an EPICS® ALTRA™ flow cytometer. Nanophytoplankton (2–20 µm), picophytoplakton (0.2–2 µm), and cyanobacteria cells densities were determined. Picoeukaryotes and bacteria were converted to carbon

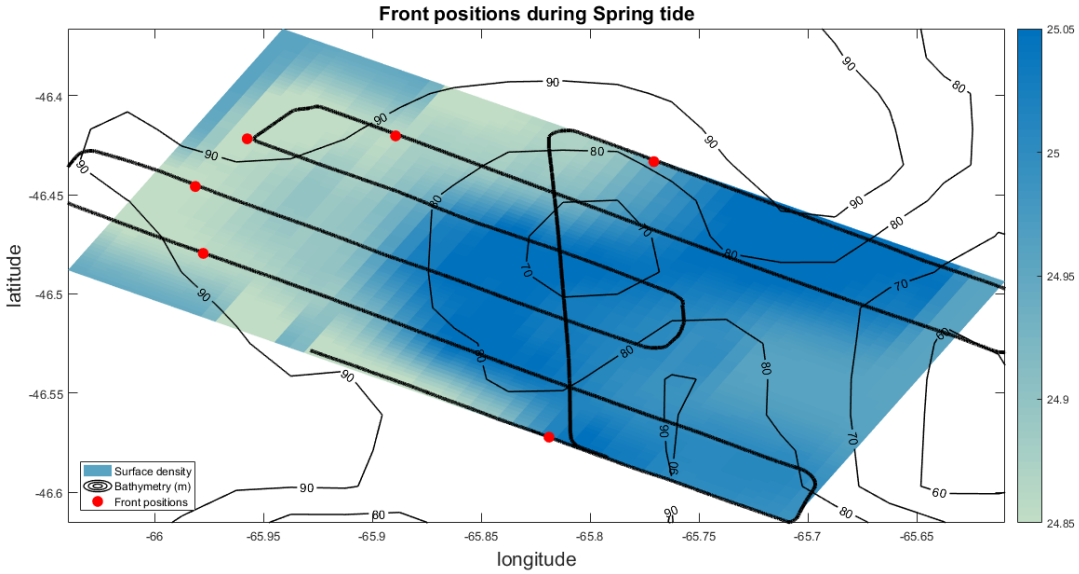

FIGURE S1. Frontal positions in San Jorge Gulf during spring tide (red points) over potential density between 3 m and 10 m depth (gradient color) and bathymetry lines.

according to Zubkov et al. (2000). Average biovolume for microplankton, nanoeukaryotes, and cyanobacteria was calculated after Hillebrand et al. (1999) and transformed to carbon following Menden-Deuer and Lessard (2000). Cell carbon of ciliates was calculated after Børsheim and Bratbak (1987). Nanophytoplankton average biovolume was computed (Belzile and Gosselin, 2015) and carbon content calculated (Tarran et al. 2006). Finally, average biovolume and carbon conversion for cyanobacteria was estimated following Bertilsson et al. (2003).

Estimating the Physiological State of Photosynthetic Cells

Five-milliliter samples were kept in the dark for 30 min at sea surface temperature before measurements following a multiple turnover protocol. Induction of Chl-*a* variable fluorescence was done with 100 flashlets at 1 µs intervals (total saturation time 200 µs). The interval between acquisitions was 2 s and the relaxation phase was set at 1 ms. Samples were taken on both sides of the frontal zone, characterized by water column structure, nutrient availability, and euphotic depth.