

Supplementary material

Figure 1S: Monthly satellite-derived PIC values (NASA Ocean Biology Processing Group 2022) in the New Zealand transect corresponding to (a) December 2004 and (b) January 2005, over a bathymetry background (GEBCO Compilation Group, 2022). White lines indicate the ACC fronts (Orsi and Harris (2019) from north to south: SAF (Subantarctic Front), PF (Polar Front), sACCf (Southern ACC Front) and BDy (Southern Boundary). The Southern Ocean zones are labelled on the side of each map: STZ, Subtropical Zone; SAZ, Subantarctic Zone; PFZ, Polar Frontal Zone; AZ, Antarctic Zone.

Figure 2S: Monthly satellite-derived PIC values (NASA Ocean Biology Processing Group 2022) in the Drake Passage corresponding to (a) February 2016 and (b) March 2016, over a bathymetry background (GEBCO Compilation Group, 2022). White lines indicate the ACC fronts (Orsi and Harris (2019) from north to south: SAF (Subantarctic Front), PF (Polar Front), sACCf (Southern ACC Front) and BDy (Southern Boundary). The Southern Ocean zones are labelled on the side of each map: STZ, Subtropical Zone; SAZ, Subantarctic Zone; PFZ, Polar Frontal Zone; AZ, Antarctic Zone.

Table S1: Morphometries of *Emiliana huxleyi* in the New Zealand transect. Type of *E. huxleyi* (*), researcher who performed the measurements, station, latitude, longitude, name of the image used / reference, coccolith length (major, in μm), coccolith width (minor, in μm), number of T-elements, distal shield element width (ray.width, in μm), tube width (tube.width, in μm), shape factor and calculated coccolith mass following Young and Ziveri (2000) (in pg). (*) “Bilay” indicates bilayered coccospheres and “diss”, dissolution observed.

Table S2: Morphometries of *Emiliana huxleyi* in the Drake Passage transect. Type of *E. huxleyi*, researcher who performed the measurements, station, latitude, longitude, name of the image used / reference, coccolith length (major, in μm), coccolith width (minor, in μm), number of T-elements, distal shield element width (ray.width, in μm), ray.flag (i.e. if the coccobiom2 t-element count is reliable (0) or not (-1)), tube width (tube.width, in μm) shape factor, and calculated coccolith mass following Young and Ziveri (2000) (in pg).

Table S3: Morphometries of *Calcidiscus leptoporus* in the New Zealand transect. Sample, coccosphere diameter (in μm), coccolith diameter (in μm) and number of elements.

Table S4: *Emiliana huxleyi* data in the Drake Passage transect. Sample, name of the image, layers (nothing denotes a single layer and bilayered, at least two layers of coccoliths), SEM picture number (for reference), coccoliths counted and number of coccoliths per coccosphere.