Supporting Information for "Southern Ocean calcification controls the global distribution of alkalinity"

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1. Figures S1 to S6

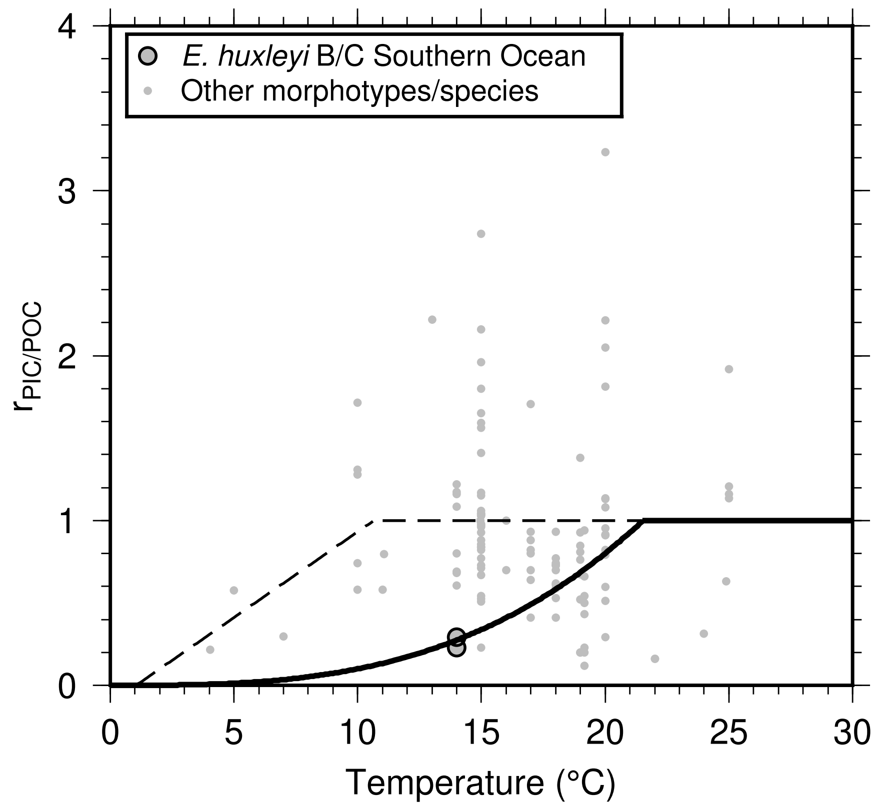

Figure S1. Refined particulate inorganic carbon (PIC) to particulate organic carbon (POC) production ratio in coccolithophore growth in CESM2 with coccolithophores. The new relationship is shown by the solid black line, while the relationship used previously (Krumhardt et al., 2019) is shown by the dashed line. Data points from experiments with the Southern Ocean *Emiliania huxleyi* morphotype are enlarged and outlined with black circles.

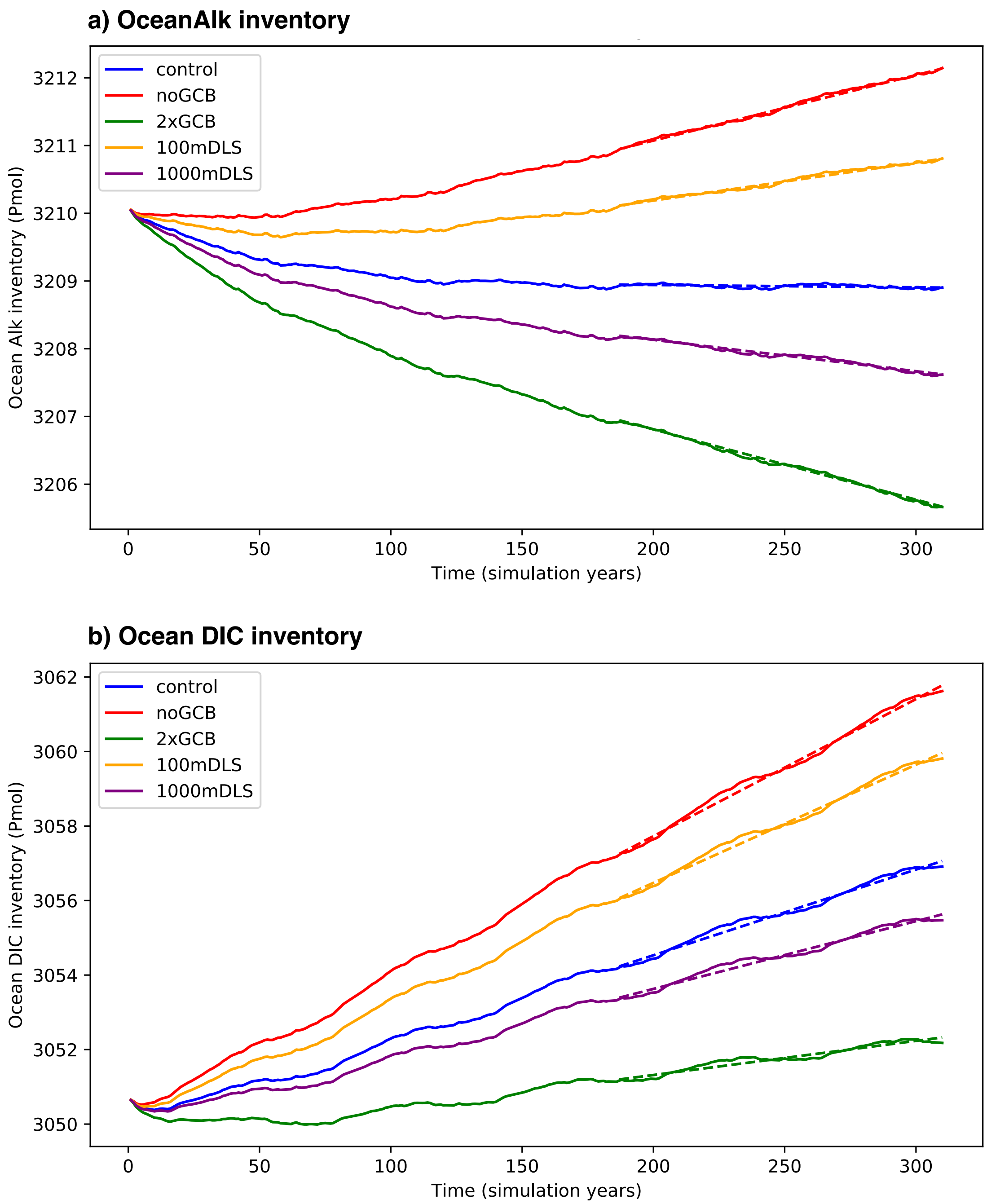

Figure S2. Ocean Alkalinity (Alk; panel a) and dissolved inorganic carbon (DIC; panel b) inventory time-series over the course of each experiment and the control. Least-squares regression lines were computed over the last two interannual forcing cycles (124 years), shown here in dashed lines. The slopes of these lines (Alk and DIC accumulation rates) are reported in Table 1.

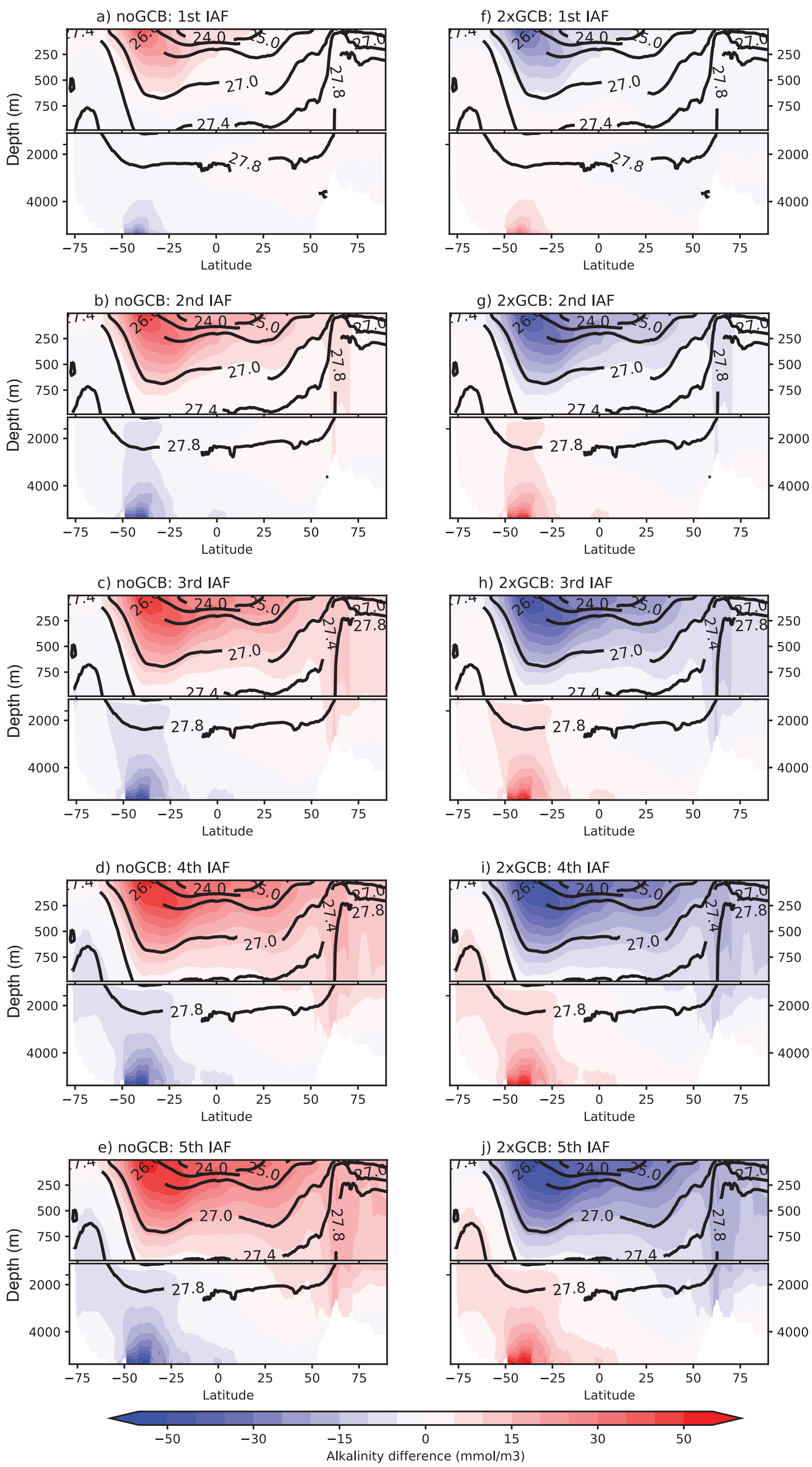

Figure S3. Zonal global mean differences in alkalinity between the control and the noGBC experiment (panels a-e) and the 2xGBC experiment (panels f-j). Each row is representative of a mean zonal difference for each interannual forcing (IAF) cycle (62 years/cycle), with the first IAF cycle on the top row and the fifth on the bottom. Isopycnal layers in σ_θ coordinates are

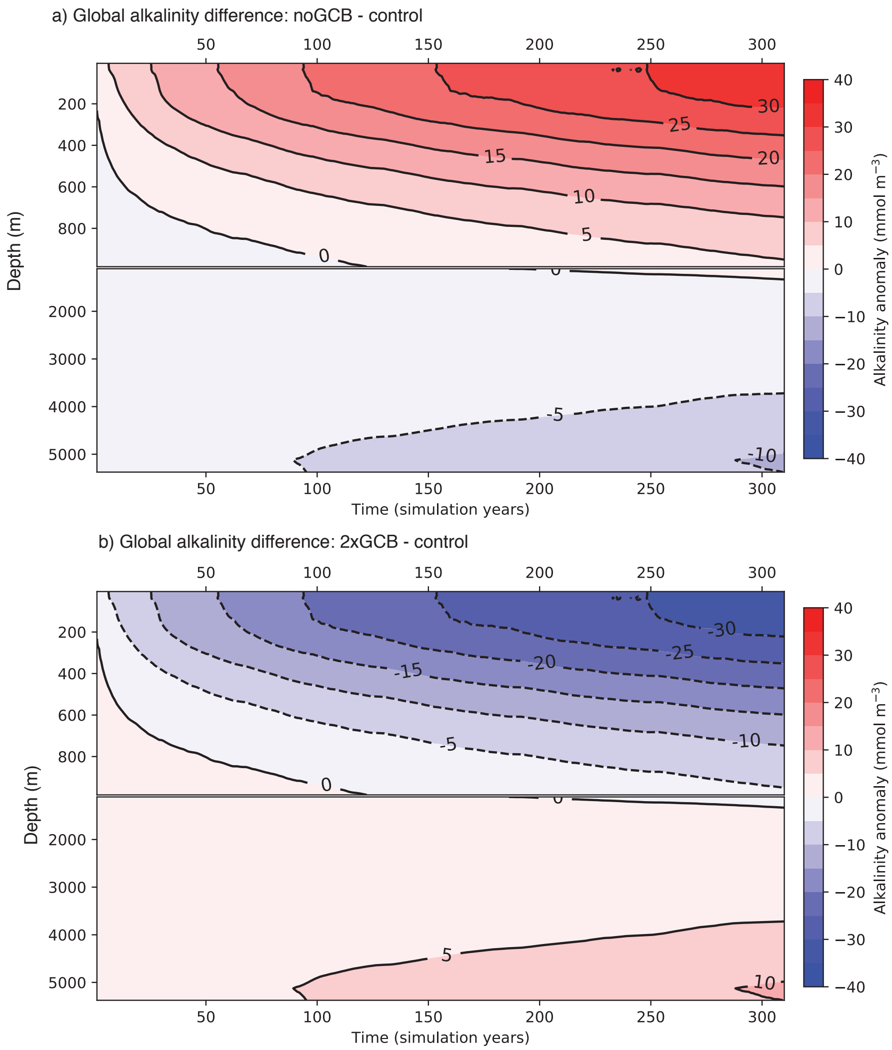

Figure S4. Global mean Hovmöller diagrams of alkalinity anomalies for the noGCB (a) and 2xGCB (b) experiments. Panels show alkalinity differences from the control in a depth versus time field for our 310-year CESM integrations. Note the explanded top 1000m depth axis.

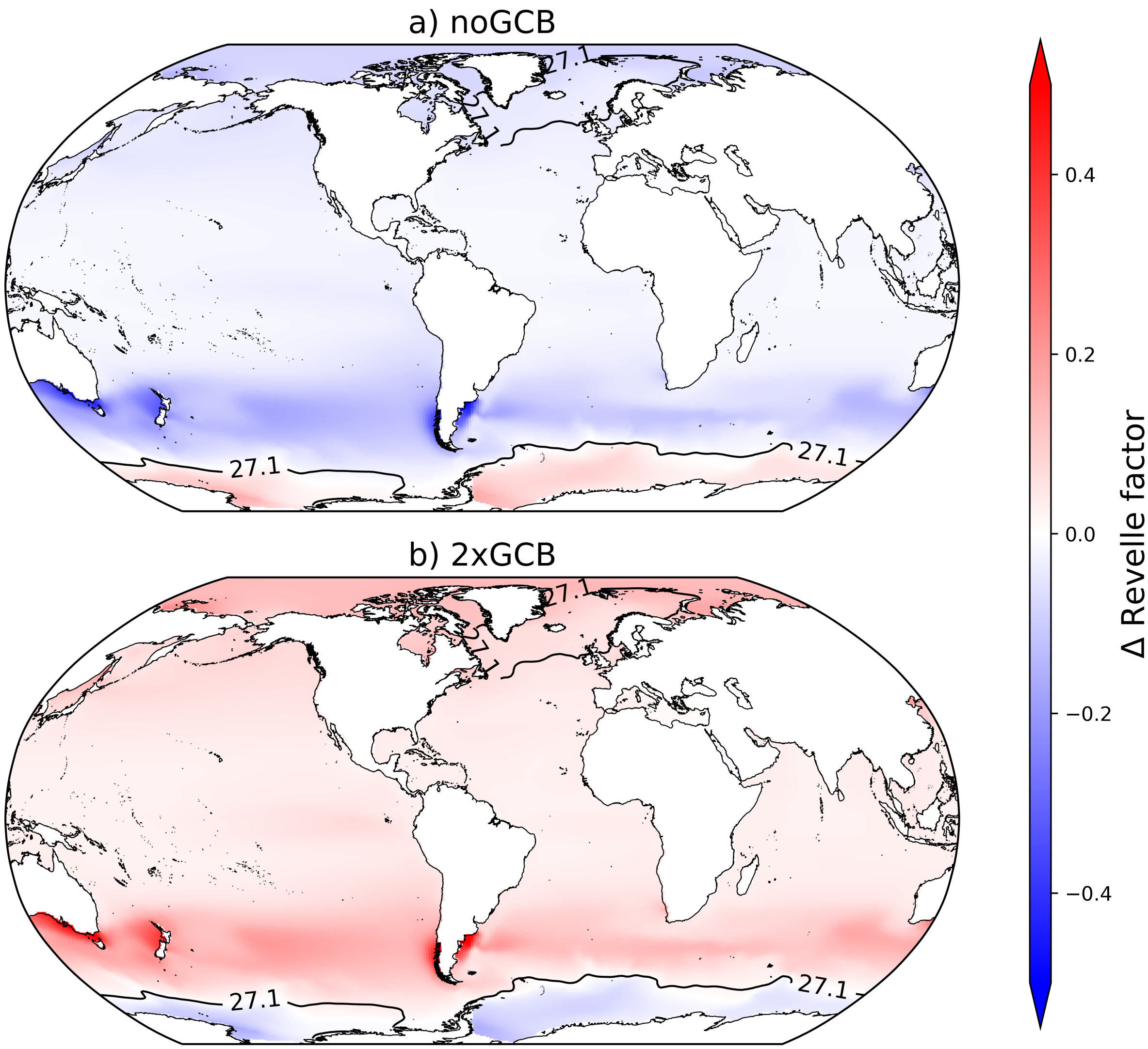

Figure S5. Changes in the Revelle factor relative to the control for the noGCB experiment (a) and the 2xGCB experiment (b).

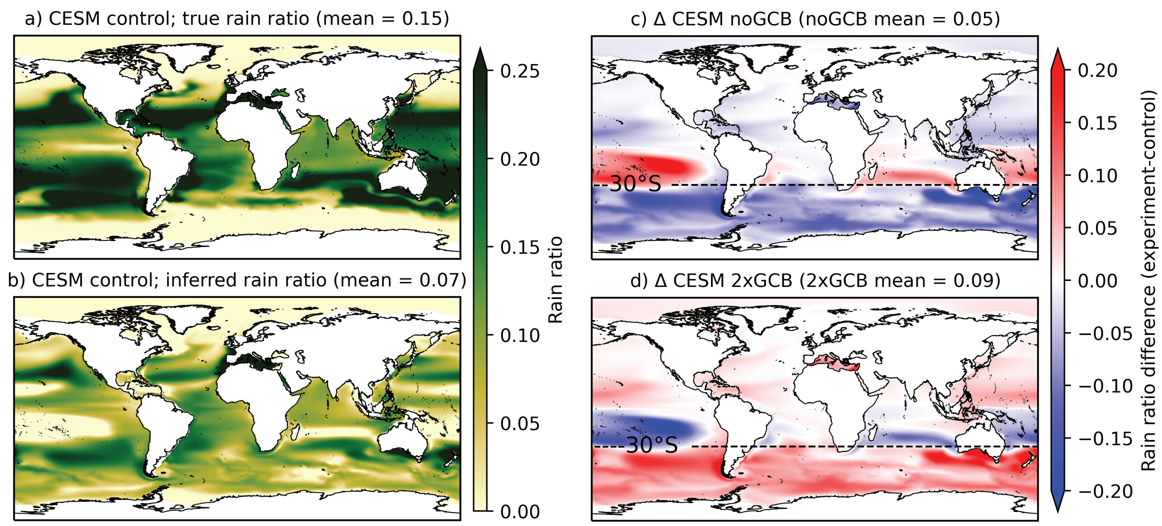

Figure S6. The true rain ratio (a) and inferred rain ratio (calculated as in Sarmiento et al., 2002) for the CESM control simulation, and changes in the inferred rain ratio for the noGCB (c) and 2xGCB (d) experiments, with reference to the control. The true rain ratio is the ratio of $CaCO_3$ flux and particulate organic carbon flux at 100 m. The inferred rain ratio is based on vertical gradients of salinity-normalized potential alkalinity and salinity-normalized nitrate (Sarmiento et al., 2002).