**Supplementary Information**

* 1. **Assessment of the sea-ice carbon pump: Insights from   
     a three-dimensional ocean-sea-ice-biogeochemical model (MPIOM/HAMOCC)**

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**Supplementary Text S1: Changes in the biological production**

The simulated biological production is driven by the availability of nutrients and light, neither of which is affected by the applied changes in the sea-ice chemistry. Consequently, within each idealized climate scenario, no changes in the biological production are expected. Nevertheless, we find within each climate scenario that the SICP experiments induce changes in the sediment pore-water pH, which influences remineralisation of POC in the sediment, and correspondingly leads to small changes in the oceanic nutrient cycling, and hence the biological carbon pump. These changes in the biological carbon pump (Supplementary Figure S1), however, are up to three orders of magnitude smaller than the effects of the SICP on the air-sea CO2 flux (Supplementary Fig. S4, S5). Thus, these biologically driven changes are insignificant compared to the effects of the SICP; consequently we can clearly separate the effect of the SICP on the air-sea CO2 flux within each climate scenario.