Sudden emergence of a shallow aragonite saturation horizon in the Southern Ocean

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Motivation

Models project that with current CO₂ emission rates, the Southern Ocean surface will be undersaturated with respect to aragonite by the end of the 21st century, resulting in widespread impacts on biogeochemistry and the ocean ecosystem.

Objective

Quantify the depth of the present-day Southern Ocean aragonite saturation horizon using hydrographic and ocean carbon chemistry observations and a large ensemble of simulations from the community Earth system model to track its evolution.

Depth of aragonite saturation horizon

- [a] observations normalized to year 2002  
- [b] CESM-LE ensemble mean, 2002  
- [c] CESM-LE ensemble mean, 2100

Emergence of shallow aragonite saturation horizon

- [a] Sudden emergence of a shallow aragonite saturation horizon in the Southern Ocean ecosystem.

Drivers of shallow horizon

- [a] Observations normalized to year 2002
- [b] CESM-LE ensemble mean, 2002
- [c] CESM-LE ensemble mean, 2100

Conclusions

- A new, shallow aragonite saturation horizon emerges in the Southern Ocean between now and the end of the century.

- Internal climate variability may affect the year of emergence.

- The new horizon is driven by the slow accumulation of anthropogenic CO₂ in the Southern Ocean thermocline.

- The new horizon is also apparent under emission-stabilizing scenario indicating an inevitable, sudden decrease in the volume of suitable habitat for aragonitic organisms.

References


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