Future and past impacts of rising atmospheric CO2 on the biogeography of planktonic Foraminifera.

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Résumé

Planktonic foraminifera (forams) are responsible for between 30% and 80% of the global carbonate flux. The global distributions of planktonic foraminifera species are largely driven by temperature, food availability, and light (for species with algal symbionts). Present (2000–2010) and future (2090–2100) 3D distributions of the growth-rates and abundances of eight well-studied foraminifera species are simulated using an ecophysiological foram model, FORAMCLIM. The empirical model is driven with temperature, food, and light from a coupled climate-carbon cycle Earth system model that has been forced with historical CO2 emissions, and future emissions from the IPCC A2 scenario. A key strength of the foram model is that it is observation-based: the growth-rate relationships are derived from laboratory experiments and the abundance relationships are calibrated using data from multi-depth plankton tows. The simulated foram distributions agree well with the dominant species observed in surface waters and the relative foram species abundances in top-core samples from deep-ocean sediments. In response to climate change i) foram species diversity decreases in the tropics and increases towards the poles, and ii) tropical species shift both deeper in the water column and towards the subtropics as thermocline waters become to warm to sustain high growth rates. High-latitude species are most vulnerable to climate change: both their abundance and their potential available habitat decrease in response to warming and decreased food availability. In response to ocean acidification i) the carbonate concentration drops throughout the habitat of all foram species and would be expected to cause a large-scale reduction in calcification, and ii) about 10% of the habitat of high-latitude species drops below the calcite saturation concentration. Foram distributions during the last glacial maximum have recently been simulated using an Earth system model and FORAMCLIM: preliminary results will be presented.

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