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Off to new shores: Modeling the potential distribution and future range expansion of larger foraminifera

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The distribution of larger foraminifera is strongly controlled by environmental variables, especially temperature. Most of today's taxa of larger foraminifera are restricted to tropical and subtropical regions (between 30° N and 30° S) and their minimum temperature limits are governed by the 14 to 20° C isotherms. However, during times of extensive global warming (e.g. the Eocene and Miocene), larger foraminifera have been found as far North as 50° N (North America and Central Europe) as well as towards 40° S in New Zealand. It has been stated that larger foraminifera are more tolerant of rising sea surface temperatures than reef-building corals. As such they may play a more prominent role as future reef framework and carbonate producers in a steadily warming ocean. During the last century, sea surface temperatures have been rising significantly due to higher CO_2 concentrations in the atmosphere. This trend is expected to continue and climate change scenarios for 2100 suggest a further increase by 1 to 6° C (IPCC Synthesis Report, 2007).

We applied Species Distribution Models (SDMs) on several taxa of larger foraminifera in order to evaluate their potential distribution under current climate conditions and to predict range expansions within the next 40 years. The studied taxa include *Archaias angulatus*, which is regionally distributed within the Caribbean region, *Calcarina* spp., which occurs in the Indo-Pacific area and the true circumglobal taxon *Amphistegina* spp. Under present climate, *Amphistegina* spp. shows the widest distribution range due to its greater temperature tolerance. Both *Archaias angulatus* and *Calcarina* spp. display potential distributions that cover currently uninhabitet regions, suggesting that weak dispersal abilities are major reasons for their limited distributions. Under future climate, *Archaias angulatus* and *Calcarina* spp. show an increase in habitat suitability within their native occurrence ranges, suggesting that their tolerance for maximum temperatures has not been fully exploited yet. Furthermore, all taxa display an expected latitudinal range expansion by 1 to 3 degrees both north- and southward. Our findings suggest an increased role of larger foraminifera as carbonate producers and reef framework builders as well as the colonization of biogeographic regions so far unsuitable for larger foraminifera.