Research article for *Global Change Biology*

Coral reef suitability loss under climate change threatens tropical biodiversity hotspots

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Supporting information

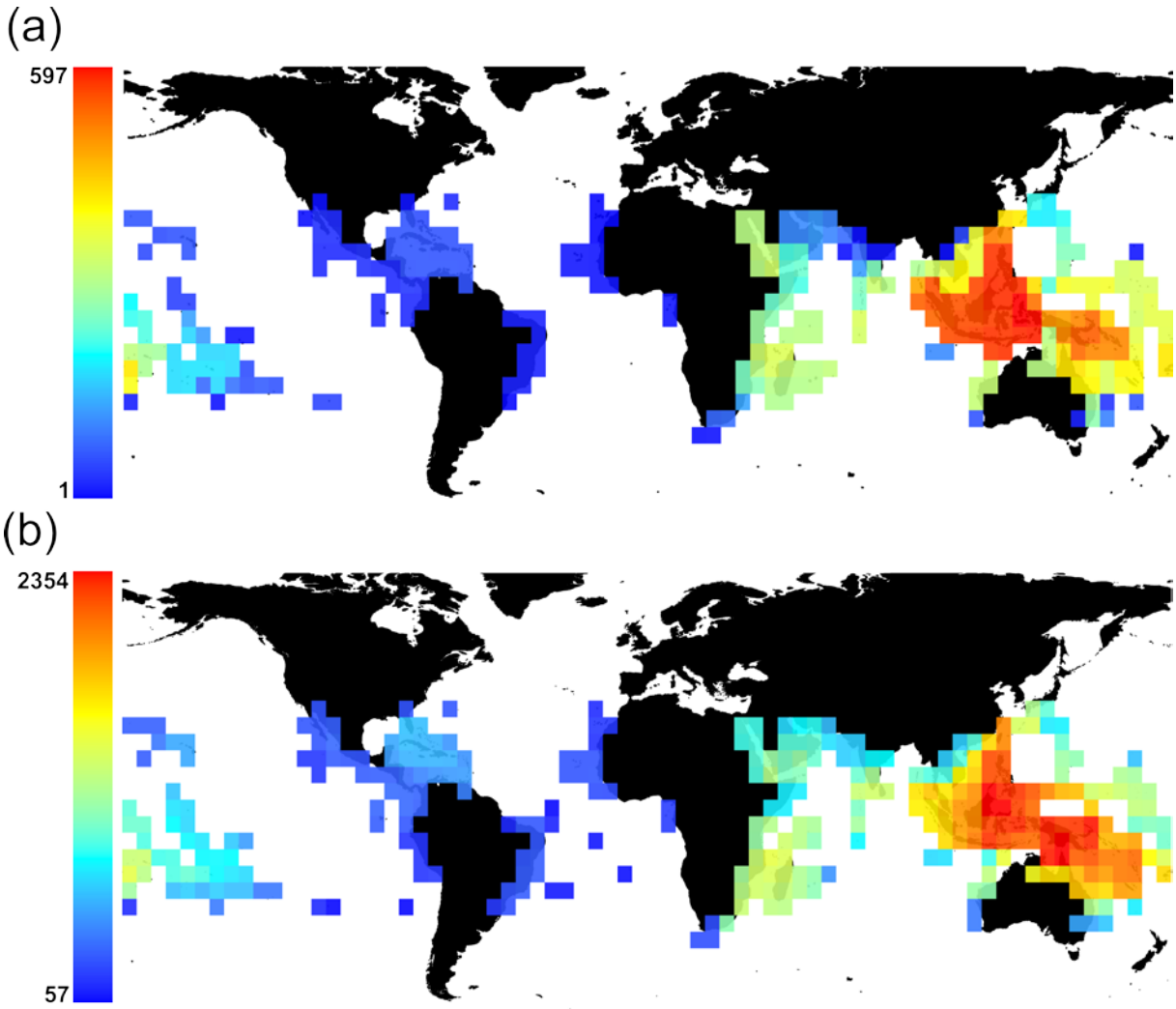

Figure S1. Species richness maps for (a) coral species and (b) reef fishes species. The richness of both groups peaks in the coral triangle, in the centre of the Indo-Pacific Ocean.

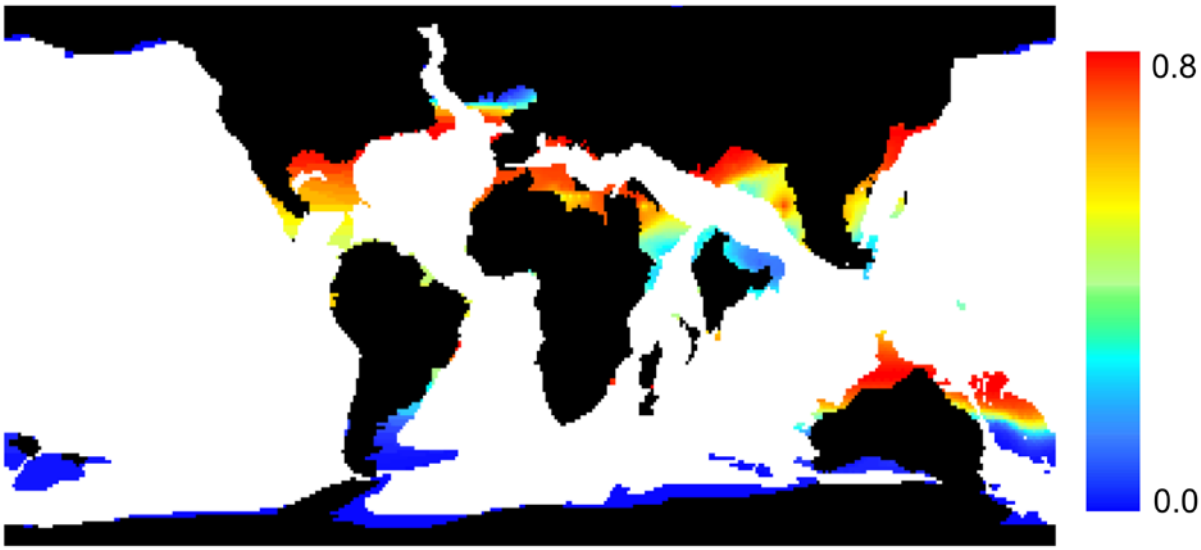

Figure S2. Thermal suitability for coral reefs hindcasted for mid-Eocene from the niche-based model. The colour gradient from blue to red corresponds to suitability for coral reefs. Blue indicate low thermal suitability for coral reef while red indicate high suitability for coral reef. Projected reef were limited to shallow water based on reconstructed shallow oceanic regions from paleogeographic environment data for the middle Eocene (45 Ma; Smith *et al.*, 1994). Continents are shown in their absolute reconstructed position using plate rotations based on Müller *et al.* (2008). Coral reefs reached latitudes of 50°N and 50°S during the middle to late Eocene corresponding to previous fossil studies (Wallace & Rosen, 2006). The projection also suggests that coral reefs were absent from the east Tethys sea. Highest temperatures occurred in the eastern Tethys around the Indian subcontinent and on the eastern side of Africa, up to North East Africa, while the western Tethys and paleo-Atlantic ocean would be immersed in relatively cooler waters, as were southern latitudes near Australia continent (Huber & Caballero, 2011).

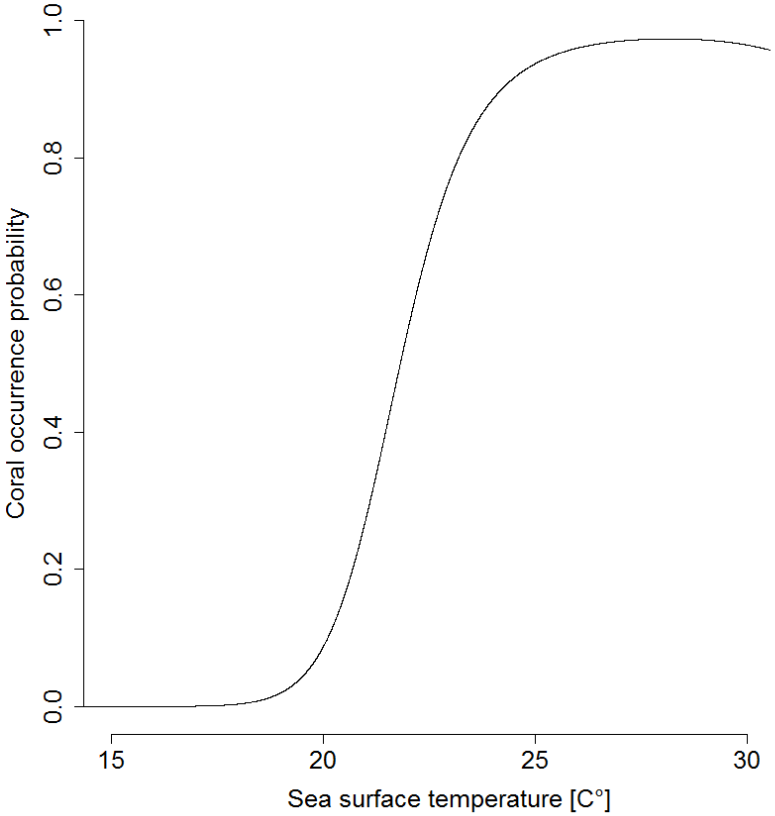

Figure S3. Response curve of the model in relation to sea surface temperature when calibrated on current species occurrences and mean annual sea surface temperatures. The modern model shows a truncated response curve limiting forecasts under climate change. When the niche-based model was calibrated using current species occurrences, the response curve was truncated limiting inferences beyond a threshold of 30°C corresponding to the maximum modern yearly average temperature. In contrast, when the model was calibrated using both current occurrences and fossil records spanning the broader combined SST gradient, the niche-based model calibrated a full hump-shaped response curve (Fig. 1).

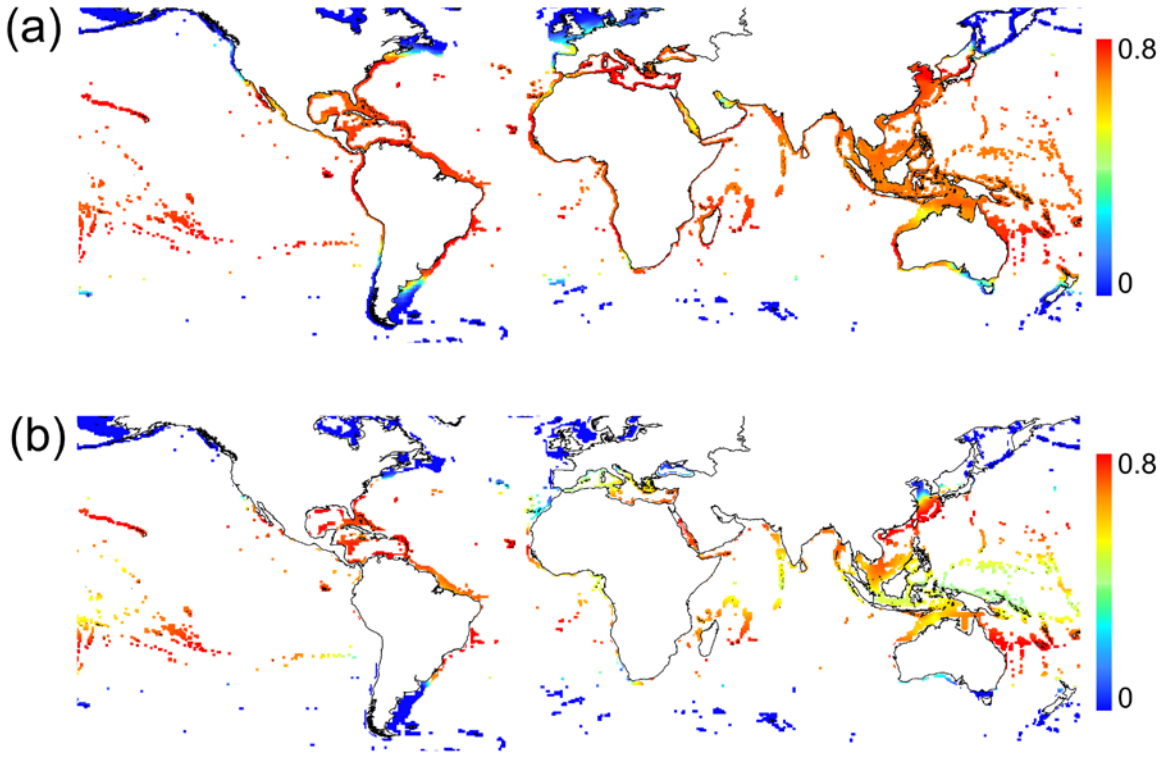

Figure S4. Coral reef suitability forecasted under (a) EC-earth RCP8.5 and (b) ISPL RCP8.5 climate change scenarios for the end of the century (2090-2100). Red values indicate high suitability for coral reef while blue values indicate low suitability.

References

Huber M, Caballero R (2011) The early Eocene equable climate problem revisited. *Climate of the Past*, **7**, 603–633.

Müller RD, Sdrolias M, Gaina C, Steinberger B, Heine C (2008) Long-Term Sea-Level Fluctuations Driven by Ocean Basin Dynamics. *Science*, **319**, 1357–1362.

Scheibner C, Speijer RP (2008) Late Paleocene-early Eocene Tethyan carbonate platform evolution — A response to long- and short-term paleoclimatic change. *Earth-Science Reviews*, **90**, 71–102.

Smith A, Smith D, Funnell B (1994) *Atlas of Mesozoic and Cenozoic Coast-lines*. Cambridge University Press, Cambridge, United Kingdom.

Wallace CC, Rosen BR (2006) Diverse staghorn corals (Acropora) in high-latitude Eocene assemblages: implications for the evolution of modern diversity patterns of reef corals. *Proceedings of The Royal Society B*, **273**, 975–982.

63