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On the impact of atmospheric vs oceanic resolutions on the representation of the sea-surface temperature over the South Eastern Tropical Atlantic

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In spite of the efforts of the modelling community to improve the representation of the sea-surface temperature over the South Eastern Tropical Atlantic (SETA), warm biases of up to 6ºC still persist. The reduction of these biases is of first-order importance to achieve an adequate representation of the dynamics of the Tropical Atlantic and to get more reliable future climate projections. In this work, we aim to gain insight into the role of the atmospheric and oceanic model resolutions in the regional distribution of the sea-surface temperature over the SETA. To that end, we use four different configurations of the fully-coupled AWI Climate Model (AWI-CM) which only differ in their oceanic and atmospheric grids. AWI-CM is composed by the atmospheric and oceanic models ECHAM6 and FESOM, respectively. A major advantage of FESOM is that it features an unstructured mesh which allows us to achieve higher resolutions in key regions such as the SETA without excessive computational costs. Our model setups allow us to distinguish between the effects of increasing the atmospheric and oceanic resolutions individually, and are optimal to analyse the impact of resolution on the dynamics of the system and the ocean-atmosphere feedbacks. Our results indicate that a sole refinement of the oceanic resolution alleviates warm biases further than a single increase of the atmospheric component. A refined oceanic resolution is required (i) to simulate more realistically the Agulhas Current and its associated rings; (ii) to intensify the northward-flowing Benguela Current and (iii) to enhance coastal upwelling. The best results are obtained when both resolutions are refined but, even in this case warm biases remain. This indicates that some processes and air-sea feedbacks are not well reproduced. Based on our results we conclude that overheating may not be caused by insufficient upwelling, but is rather due to upwelling of waters warmer, compared to observations, as a consequence of errors in the vertical distribution of temperature. In turn, the misrepresentation of vertical temperature may be associated with basin-wide feedbacks that entail both the South Atlantic Anticyclone and the oceanic circulation.