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Model study of the Miocene Mediterranean Sea and Paratethys: closure of the Indian gateway

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The proto-Mediterranean Sea and Paratethys were both connected to the Indian Ocean until the Middle Miocene, when the convergence of the Eurasian plate and African-Arabian plate caused the constriction and closure of the Indian gateway. This interrupted the water exchange with the Indian Ocean and gave birth to the present-day Mediterranean basin. Although there are lots of uncertainties concerning the timing of the closure and the consequences that this entailed, it is broadly accepted that it had had a large effect on water properties and ocean dynamics on the regional and global scales, and in that way may have also played a role in the evolution of climate.

While, from a modeling perspective, considerable research has been devoted to the Late Miocene period on the Mediterranean region, rather less attention has been paid to the Early and Middle Miocene. The purpose of this work is to investigate the palaeocirculation of the Mediterranean Sea and Paratethys during the different stages of closure. For this purpose we use of a regional ocean model and a Burdigalian (about 20 Ma) palaeogeographic map from the Peri-Tethys Atlas. In the interest of gaining insight into the first-order effects of the gateway evolution on marine circulation, different experiments, ranging from a deep gateway to a completely closed one, have been carried out. In addition, different sets of values for the atmospheric forcing have been applied in order to understand the role of the temperature and net evaporation on the marine circulation and the strait dynamics.

The series of experiments allows us to analyze different scenarios, helping us to understand the evolution of such a complex system, and sheds a new light on the interpretation of the sedimentary record. Consequently, the information derived from this work can be useful for other studies focused on strait dynamics and could be a valid starting point for subsequent research on this gateway.