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Eocene warmth, Drake Passage and the hydrological cycle

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The absence of the Drake Passage (DP) gateway in coupled models generally leads to vigorous Antarctic Bottom Water (AABW) formation, Antarctic warming and the absence of North Atlantic Deep Water (NADW) formation. Here we show that this result depends critically on atmospheric moisture transport by mid-latitude storms. We use coupled model simulations employing geometries different only at the location of DP to show that oceanic circulation similar to that of the present day is possible when DP is closed and atmospheric moisture transport values appropriate to the present day are used. In this case no Antarctic warming occurs in conjunction with DP closure. This result arises from enhanced atmospheric moisture transport at the mid latitudes of the Southern Hemisphere (SH). In contrast, homogeneous moisture diffusivity leads to strong SH sinking and the absence of a stable NH overturning state, a feature familiar from previous studies. Our results show that the formation of Northern Component Water, the precursor to NADW, may have been possible before the opening of the DP at the Eocene/ Oligocene boundary, and that its presence depends on an interplay between the existence of the DP gap and the hydrological cycle. The existence of multiple equilibria is also explored.