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Impact of opening of the Central America Seaway on climate in a coupled atmosphere-ocean-sea-ice model

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We investigate the climatic impact of opening the Central America Seaway (CAS) in a coupled atmosphere-ocean-sea-ice model. A highly idealized land distribution is employed in which two meridional barriers extend from the North Pole in to the southern hemisphere, thus dividing the ocean in to a large basin, a small basin and a circumpolar flow around the South Pole. Such a configuration captures the essential zonal and inter-hemispheric asymmetries of the current climate. These simple geometrical constraints are sufficient to localize the deep-reaching meridional overturning circulation (MOC) to the northern extremity of the small basin.

Given this reference experiment, we open up an analogue of the Central America Seaway on the western margin of the small basin north of the equator. Both deep and shallow passageways are considered. We find that although a major reorganization of ocean circulation occurs, along with significant local water-mass changes, global heat and freshwater meridional transports are largely unchanged, as are temperatures over the North Pole. In particular we do not observe a weakening of the MOC in the small basin, with salinity exchange between the large basin playing only a minor role.

The simplicity of the geometrical configuration used in our experiments enables us to tease apart exactly what is going on. Experiments in which the salinity and temperature states of the small and large basins are interchanged, for example, show that our solutions are robust, with deep convection returning to the small basin after 800 years or so.

Our experiments suggest to us that the closing of the CAS alone is not sufficient to lead to the onset of northern hemisphere glaciations 2 Ma years or so ago.