Clim. Past Discuss.,
https://doi.org/10.5194/cp-2020-120-AC1, 2020

Climate of the Past Discussions

Interactive comment on "Mid-Pliocene Atlantic Meridional Overturning Circulation simulated in PlioMIP2" *by* Zhongshi Zhang et al.

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Received and published: 13 November 2020

Since the modelling groups in the PlioMIP2 do not carry out consistent sensitivity experiments for the Arctic gateways, it remains difficult to compare the impacts of the gateways on AMOC. However, some sensitivity experiments done in several groups do show a clear model-spread. Here, we summarize some results from these sensitivity experiments.

1) Sensitivity experiments to the Bering Strait

With the PlioMIP1 boundary conditions, CCSM4 has carried out a sensitivity experiment for the Bering Strait (Otto-Bliesner et al., 2017). The closed Bering Strait leads to an AMOC strengthened by ∼2.5 Sv (∼10%).

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Discussion paper

Based on the PlioMIP1 boundary conditions, COSMOS simulates that the closed Bering Strait makes the AMOC increased by ∼1.8 Sv (∼11%).

MIROC4m has done a sensitivity experiment for the Bering Strait, but based on the pre-industrial boundary conditions. With an open and closed Bering Strait, the AMOC maximum is 19.6 and 21.65 Sv, respectively. Thus, closing the strait in the pre-industrial increases the AMOC by ∼2.0 Sv (∼10%).

In addition to the Eoi400 experiment, CCSM-UoT has done a sensitivity simulation with the Bering Strait opened. Model results show that the closed strait causes the AMOC enhanced by ∼4.2 Sv (∼25%).

2) Sensitivity experiments to the Arctic gateways (the Bering Strait and the Canadian Arctic Archipelago)

With the PlioMIP1 boundary conditions, CCSM4 has done a sensitivity experiment with the Bering Strait and the Canadian Arctic Archipelago closed. The model responds with an even greater strengthening of the AMOC (∼4.5 Sv or ∼18%), approximately doubling the response with only the Bering Strait closed (Otto-Bliesner et al., 2017).

Based on the PlioMIP2 boundary conditions, COSMOS has run a sensitivity experiment with the Bering Strait, the Hudson Bay and the Canadian Arctic Archipelago opened. The comparison between the Eoi400 and this experiment shows that the closing of the gateways only leads to an enhancement in AMOC of 1.68 Sv (∼9%).

These results show the model-spread in simulating AMOC responses to the modification of the Arctic gateways. Although CCSM-UoT shares many similarities with CCSM4, CCSM-UoT produces a much large response in AMOC than CCSM4. Moreover, CCSM4 suggests that the Canadian Arctic Archipelago is also an important factor that influences the intensity of AMOC, whereas COSMOS shows that its impact seems small.

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