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Climate of the Past Discussions

Interactive comment on "Low-frequency oscillations of the Atlantic Ocean meridional overturning circulation in a coupled climate model" *by* M. Schulz et al.

M. Schulz et al.

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General Comments:

1. The phrase "present-day boundary conditions" can indeed be misleading. We replaced it everywhere by "modern" and stated in sect. 2 more explicitly the settings for the pre-industrial boundary conditions being employed. We stated clearly in the original ms. that we perturbed the steady-state control (i.e., pre-industrial) experiment. We agree with the referee that the perturbation is not weak at a local scale. Accordingly, we removed "weak" whenever addressing the perturbation. However, we do not concur with the referee's view that the ms. implied that we analyzed present-day conditions. Indeed, we stated several times that we analyzed the perturbed control experiment.

Hence, we did not change the corresponding statements.

2. We added a section on "Comparison with oscillations found in other model experiments" to the discussion (sect. 4.4). However, we limited the discussion of decadal-scale variations since it would warrant a study on its own to analyze and discuss how decadal modes project onto lower-frequency modes and vice versa. We do not refer to the Hall and Stouffer (2001) paper, because their model shows a single event rather than an oscillatory behavior.

3. The focus of the ms. is on the unforced AMOC oscillations. The main role of the atmosphere in the oscillations is through the provision of random variability at short timescales. Although the atmosphere shows variations that might be of interest, we think that showing these results would blur the focus on the oceanic mechanism behind the oscillations. Hence, we do not follow the suggestion to include more atmospheric results. However, we added wind anomalies to Fig. 3 to provide more insights into the origin of the temperature anomalies.

Specific comments:

1. From the wind-field anomaly (added to new Fig. 3) it is obvious that the cooling over Siberia is associated with the advection of cold polar air masses. We don't discuss this in the text, because a focus on e.g. Siberia would be unwarranted within the scope of the ms.

2. Agreed. We rephrased all corresponding statements.

3. As can be expected, the correlation should increase if smoothed data are analyzed. For example, the max. correlation increases to 0.36 if the data are smoothed with a 101-year wide Hanning window (due to the smoothing that max. is also shifted towards a lag of -17 years). Since the usually employed t-test saturates for large N (here N=8000), essentially all estimated cross-correlation coefficients appear significant.

4. Indeed, ECBilt-CLIO has a built-in random generator to simulate weather. By default

CPD
2, S789–S791, 2007

EGU

this feature is switched off. To avoid any confusion, we removed this sentence and added a statement regarding the explicit generation of synoptic variability to the model description (sect. 2).

5. Yes, it is possible to induce state transitions in the case without Greenland-Sea inflow when using a higher value of sigma. However, in this situation the period of the oscillations in the standard case (all inflows included) becomes shorter (actually, the high-frequency noise masks the oscillations). The value of sigma = 0.2 Sv was chosen to reproduce the behavior of the 3D model, that is, to capture the multicentennial-to-millennial timescales of the oscillations. The take-home message of the conceptual model is to demonstrate that the inflow from the Greenland Sea via Denmark Strait favors stochastic switches from one mode to the other. A corresponding clarification was added to section 4.3.

Interactive comment on Clim. Past Discuss., 2, 801, 2006.