The Cryosphere Discuss., 6, C768–C770, 2012
www.the-cryosphere-discuss.net/6/C768/2012/

The Cryosphere Discussions

Interactive comment on "Limitations of a coupled regional climate model in the reproduction of the observed Arctic sea-ice retreat" *by* W. Dorn et al.

Anonymous Referee #1

Received and published: 14 June 2012

The paper addresses an important question in climate research: limitations of coupled climate models to simulate the Arctic sea-ice retreat. Based on a seven-member ensemble with a coupled regional climate model the effects of internal model variability are discussed. It is concluded that maximum internal variability in summer reduces the ability to simulate atmospheric summer circulation realistically which is essential for simulating the sea ice volume of the following years.

The paper is well written and presents interesting and important results. However, some of the conclusions are arguable and to some extent misleading. More information about the initial state and the impact of the Arctic Ocean (not only the sea ice) would be helpful.

Specific comments:

1. Sea ice initial conditions are discussed in detail, but information about ocean initial condition is missing. It is stated that “the present ensemble simulations can be used to estimate the impact of the Arctic Ocean’s initial state on the variability of the Arctic climate system” (page 1274, lines 17-18). Later on it is concluded that “realistic ocean and sea-ice states . . . might therefore be an essential condition for more realistic simulations of the total volume of Arctic sea ice” (page 1269, lines 2-4) and in the last paragraph that “. . . the initial state need[s] to be close to reality in order to have a reasonable chance of a realistic sea-ice simulation” (page 1289, lines 24-26). By focusing on the sea ice and not providing any information about the ocean state the impression is given that the sea ice state is crucial for realistic simulations. This is in contrast to previous GCM studies which show a sea ice recovery from a complete removal within a few years only [Schroeder and Connolley, 2007; Tietsche et al., 2011]. It is possible that the impact of the sea ice state is much stronger in your model setup, but therefore more information about the ocean initial state and its variability is needed. An additional simulation would be desirable in which the initial sea-ice state only is modified to be able to separate between the impact of the sea ice state and the ocean state.

2. “Despite almost identical climatological patterns of ice thickness and extent, there are large deviations in the temporal trend of these variables among the ensemble members.” (page 1276, lines 20-22) This statement seems to be wrong for ice thickness. Figure 2 shows that the ice volume in run G is constantly larger by several Thousands of km3 than the ensemble mean in March and September for the period 1960 to 1995. Although there are no strong differences from 1950 to 1960 and from 1995 to 2008, the climate means must differ significantly between run G and the ensemble mean.

3. Section 4: Correlation between sea ice and atmospheric circulation patterns: I recommend to add a discussion of the impact of the atmospherically driven sea ice drift on summer sea ice extent.

4. I recommend to include the study of Perovich and Menge (2009) for explaining the sea ice loss in the Arctic.

TCD
6, C768–C770, 2012

5. Typing error: most of the members do not show (page 1286, line 6).

References:

Perovich, D. K., and J. A. Richter-Menge (2009), Loss of sea ice in the Arctic, Ann. Rev. Marine Science, 1:417-441. Schröder, D., and W. M. Connolley (2007), Impact of instantaneous sea ice removal in a coupled general circulation model, Geophys. Res. Lett., 34, L14502, doi:10.1029/2007GL030253. Tietsche, S., Notz, D., Jungclaus, J. H., and Marotzke, J. (2011), Recovery mechanisms of Arctic summer sea ice, Geophys. Res. Lett., 38, L02707, doi:10.1029/2010GL045698.

Interactive comment on The Cryosphere Discuss., 6, 1269, 2012.