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Geoscientific
Model Development
Discussions

Interactive comment on "The efficient global primitive equation climate model SPEEDO" *by* C. A. Severijns and W. Hazeleger

Anonymous Referee #1

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General Comments

This manuscript describes a new coupled ocean-atmosphere model based on the primitive dynamical equations that, due to its resolution and physical parameterisations, is nevertheless able to conduct centennial->millennial scale climate simulations with very modest computational resources. As such, the paper fits perfectly within the scope of GMD. One or two such models have recently been published, and another one adds welcome diversity to the field. The paper is generally clearly written and easy to understand, so I only have pretty minor comments. I look forward to seeing more experiments using SPEEDO.

Specific Comments

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Interactive Discussion

Discussion Paper

Title: Assuming there is to be some ongoing development of the SPEEDO model, would it be possible/appropriate to specify a version number/name for the precise version described here?

pg1116, line 3 and elsewhere: The term "intermediate complexity" (or the acronym "EMIC"), is used to describe SPEEDO, as well as the models presented in Smith08 and Farneti09, and the models listed in Claussen02. The appellation originated with the Claussen02 list, and, whilst it's a pretty vague term, I personally wouldn't class SPEEDO, FAMOUS or ICCM as EMICS. All of the Claussen02 models simplify at least one of the major components dramatically, usually by reducing them to 1 or 2D systems. If a model is fully 3D, based on the primitive equations and not tied to prescribing major variables (eg winds, clouds), I think it's basically out of the EMIC box and is justly classifiable as a coupled GCM - compare the complexity of something like Manabe and Stouffer (JClim 1, 1988) - albeit with the caveat of "coarse resolution" or something similar.

p1116,8 and elsewhere: "long" isn't a very precise description of the timescales of which the model is capable of simulating - a more specific timescale would be helpful

Section 2 and elsewhere: I'm not totally happy with the use of references in the paper. In general it feels a little under-referenced (specifics below in technical corrections), but I felt that the model description section was rather light on actually describing the model, in favour of simply citing previous papers. Given that this is a model description paper and, as it stands, it's not too long, I think it would be useful to the reader to see some of the more pertinent details of the simplified atmospheric parameterisations and the ocean/sea-ice model.

p1119,22: How well does the model scale? 72 years per day on a desktop machine sounds pretty good for any kind of OAGCM - could you get $\sim$250 years from 4 processors, or 500 from 8? Many readers will have access to clusters and might think of trying multi-millennial runs with something like SPEEDO, so it would be useful information.

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Section 3.2.1 The description of the 20/21st century runs doesn't say how volcanic or aerosol forcings were dealt with, or greenhouse gases other than CO2. These are particularly relevant factors when then comparing with observations, or other model runs that may or may not have included these factors, or dealt with them differently. The information given later (p1126) about aerosols would be better put up front in the model description.

p1222,4: does the atmosphere have any kind of representation of ozone? - with only 8 layers, that would be a good candidate for lack of SW absorption. What's the vertical temperature structure in the atmosphere like - do you get any kind of tropopause?

p1126,21 a timeseries of surface temperature isn't a very good way of demonstrating that a climate is in equilibrium - a top-of-atmosphere energy budget is a much better measure.

p1126,22 the description of the spatial structure of the T2m response after CO2-doubling as "very similar to the CMIP3 models" isn't really demonstrated by fig16, apart from in the very general sense of reproducing polar amplification of warming from the sea-ice response. I'd like to see more detail, which would then justify the comparison.

Technical Corrections

throughout: Units of 10ˆ6mˆ3sˆ-1 are often used - "Sv" (Svedrups) is a commonly used shorthand.

p1117,9-13: could do with some references to actual experiments using EMICS at the end - the Claussen ref should be put earlier when introducing EMICS.

p1118,13: "The parameterizations are simplified and described by Molteni" - does this reference only refer to the atmosphere model, or ocean as well?

p1118,22: it would be clearer if the model name "Speedy" were used earlier in the aragraph, not introduced half-way through as though it were a new model.

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p1119,17: "the pole problem" - could do with clarification

p1119,19-20: this sentence is basically a repeat of line 8?

p1120,16: tense inconsistent "is in equilibrium"...."we performed a 1000yr"

p1123,9: "These are typical features ..." could do with some references to other, similarly afflicted models

p1123,24: reference - what is the value of the AABW in obs/other models?

p1124,13: for reference, PNA and NAO patterns from observations would be useful

p1124,19-26: references for observations of the NAO, ENSO and AMO required.

p1124,27: it should be clarified that fig10 shows the AMO in SPEEDO, not observations

p1125,7: "dominant ocean variability is found" - unclear sentence

p1129,11: "have been used extensively in climate variability studies" - references?

figs3,5,16,17,18 have no colour scale

fig15 - the caption refers to a thick black line, the figure shows black crosses?

figs10,11,13 - confidence intervals are good to have on power spectrum plots to show where peaks are significant.

Interactive comment on Geosci. Model Dev. Discuss., 2, 1115, 2009.