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Interactive comment on "FORTE 2.0: a fast, parallel and flexible coupled climate model" *by* Adam T. Blaker et al.

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The paper describes and evaluates a fast, parallel and flexible coupled climate model (FORTE2.0) which due to its simplicity but still retaining the realistic physics of the fluid flow, can be run with a noticeable throughput of ∼100 model years per day on on 28 cores. Possibility of running FORTE2.0 on a desktop computer makes it an ideal model for the academic studies and climate research. The paper demonstrates that FORTE2.0 produces a stable climate and in terms of certain performances is not worse than most of high resolution CMIP models. The description paper for FORTE 2.0 is certainly needed and the GMD is the proper journal for this.

The paper is good written optimally organized, explains what FORTE 2.0 is about and

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Discussion paper

is ready for publishing after minor corrections. I have several comments which the authors may wish to elaborate on in the revised version of the paper.

A general question before downloading the code: in which programming language is FORTE written?

Page 3, lines 2 and 3: It sounds like two different grids are being used in the atmosphere. I would therefore rephrase to something like "A longitudinally regular and Gaussian in latitude grid with a grid spacing of $\sim 2.8^{\circ}$ is used for advection and diabatic processes."

Page 3, line 31 and below: "FORTE 2.0 does not include dynamic sea-ice representation. Instead, sea ice is represented by a barrier. . ." Do I understand this correctly that there is no dynamic sea ice nor the sea ice itself but the flux barrier? I am curious about the process of flux computation in this place. How the values for temperatures and albedo to parameterize the presence of sea ice were chosen? At the end of the page the authors say "...until the ice has melted". Considering what is said above, is it the same as ... until the atmospheric temperature becomes $> 271^{\circ}$K?

I assume the restoring of SST below the sea ice a part of the ocean component? Maybe it is worth mentioning this since this chapter describes the atmospheric component.

Page 4, line 13: How the topography was interpolated? Was it smoothed in between or not? conservatively?

Page 4, lines 18 to 20: Considering the model "biases" which are shown below in the paper I wonder whether the geometrical scaling of GM could improve the solution? Was there a run made without GM? Does it improve the SPG in the NA?

Page 5, lines 2 to 3: in the Table 1 the background vertical diffusivity is defined as a constant value but it is stability dependent here. Which mixing scheme is used above the background?

Page 5, section 3: it is worth repeating that the pre-industrial atmospheric concentrations of CO2 were used.

Page 5, line 16: should there be the minus sign? The ocean warms initially but cools towards the end of the control run. Actually most of models simulate higher than observed ocean temperatures even under pre-industrial forcing (e.g. Griffies et al. 2011, doi:10.1175/2011JCLI3964.1; Lucarini and Ragone 2011).

Page 5, line 17: is the salinity trend caused by the use of the linear free surface (W_surf * SSS)?

Page 6 line 8: the drop in AMOC happens abruptly. Do you have any idea of what has happened?

Page 8 line 5: Is there a link between low ACC and GM (or is it because of winds)?

Page 8 line 9: I wonder why only 25 years? Do you expect any change in results if a longer period is considered?

Page 10: A pre-industrial run is compared with the present day climatology. Bias seems to be not the proper word then. Maybe it is also worth mentioning that the Levitus climatology is being used as a metric only.

Page 11, line 13: the commonly observed "cold bias" around Newfoundland is replaced by a warm anomaly instead. Something very different from most of the climate models is happening there. Same in SSH (page 13, line 5). Is it because of the winds? Does FORTE depict any MLD in the Labrador Sea or it is fully shifted towards high latitudes? Which role you expect GM to play in improving the NA SPG?

Page 13, line 17: Was the OHT computed through the meridional velocities or the atmospheric heat flux?

Section5: were the EOFs computed for global fields or only for shown areas?

Page 17, line 19 (Summary): naming is incorrect: control simulation is only 25 years

long and 2000 years simulation is attributed to as spin up throughout the text.

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