

Interactive comment on “The NUIST Earth System Model (NESM) version 3: Description and preliminary evaluation” by Jian Cao et al.

Anonymous Referee #2

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Review of "The NUIST Earth System Model (NESM) version 3: Description and preliminary evaluation" by J. Cao et al.

This study describes the basic features of the new Earth System Model, NESM v3, and evaluates the pre-industrial climate simulation against observation. The study aims at demonstrating the model's fidelity and suitability to address the global climate variability and change issues.

Documenting the characteristics of the NESM v3 is very important, because the model participates in the CMIP6 and the simulation data will be made publicly available. There are many potential users of the simulated results. The users would be interested in the model's fidelity in simulating the present-day or pre-industrial climate.

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The study nicely illustrates that the model can reproduce some aspects of the observed climate with stability. It also describes climate change due to CO₂ increase simulated by the model.

However, the study does not show some basic features of the simulated climate, in which potential users of the model output would be interested. Therefore I suggest that the authors add the following figures and table to make the study more comprehensive and informative to the readers.

Major comments:

1) I suggest adding figures for annual mean geographical distribution of TOA shortwave, TOA shortwave cloud radiative effect, TOA longwave cloud radiative effect, and surface air temperature over land. Readers would be interested in observation, model results, and model biases for these variables.

2) I suggest adding figures for geographical distribution of sea ice extent in March and September. Readers would be interested in observation and model results.

3) I suggest adding figures for zonal annual mean, latitude-pressure cross section of zonal wind, temperature, and specific humidity.

4) I suggest adding a table that summarizes global annual mean values for TOA radiation (net, shortwave, longwave, cloud radiative effect), SAT, and precipitation with respect to the model and observation.

I recommend a minor/moderate revision regarding the above issues, 1)-4), before the paper can be accepted for publication.

Minor comments:

5) P.3 L.55 "Project" Programme?

6) P.6 L.127 "pseudo wavelengths" Please explain the definition of the pseudo wavelengths.

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- 7) P.6 L.128 "time step for radiation scheme" "Frequency of radiation calculation" may be a more appropriate expression, because the word "time step" has a different meaning.
- 8) P.7 L.129 "kinetic energy scheme" Reference to the paper describing the turbulence scheme would be helpful.
- 9) P.7 L.134 "stratiform cloud scheme" Reference to the paper describing the cloud scheme would be helpful.
- 10) P.7 L.137 "Lott and Miller 1997" I cannot find the paper in the reference list.
- 11) P.9 L.174 "Hunck and Dukowicz 2002" I think the correct spelling is "Hunke". I cannot find the paper in the reference list.
- 12) P.10 L.195 "longitudinal" Horizontal?
- 13) P.10 L.206 "Clouds and the Earth's ... and Filled" Please explain what variables in this data set are used for the model evaluation (TOA radiation).
- 14) P.10 L.208 "World Ocean Atlas 2009" Please explain what variables in this data set are used for the model evaluation.
- 15) P.17 L.352 "14.2C" Fig.3 shows that the mean surface air temperature is 14.9C.
- 16) P.17 L.353 "-0.0021 C(100yr)⁻¹" Fig.3 shows that the linear trend of TAS is +0.00214 C(100yr)⁻¹.
- 17) P.17 L.355 "-0.016 C(100yr)⁻¹" Fig.3 shows that the linear trend of land surface temperature is -0.00984 C(100yr)⁻¹.
- 18) P.17 L.357 "-0.0073 C(100yr)⁻¹" Fig.3 shows that the linear trend of SST is +0.00731 C(100yr)⁻¹.
- 19) P.18 L.379 "the modern observational value" Readers would be interested in how large is the observational value.

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20) P.18 L.395 "recent decade's observation" Readers would be interested in how large is the recent decade's observation.

21) P.19 L.410 "within the range of uncertainty among different observations" Readers would be interested in what observations are used to estimate the uncertainty range.

22) P.22 L.478 "quadrupling atmospheric carbon dioxide" Doubling?

23) P.22 L.479 "product of the radiative forcing and the climate feedback parameter" Ratio of the radiative forcing to the climate feedback parameter?

24) P.23 L.494 "climate feedback parameter is considered as a constant" There are increasing number of evidence that climate feedback changes according to the surface temperature pattern (e.g., Andrews et al. 2015, J.Climate). Therefore, the sentence here could be refrased as "if we approximate the climate feedback parameter as a constant".

25) P.40 Figure 1 "JSBACH Dyn. Veg." The main text (L.114) explains that the JSBACH is a land surface model which is not equivalent to the parameterization for the dynamic vegetation.

26) P.41 Figure 2 The legend refers to the labels (a) and (b), which are not shown in the figure.

27) P.43 Figure 4 "sea water salinity", "sea water temperature" Are these volume-mean values for the full-depth global ocean?

28) P.45 Figure 6 "CERES" Which edition of the CERES data is used?

29) P.51 Figure 12 It is difficult to read the numbers and characters in the figure because they are small.

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