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Geoscientific Model Development Discussions

Interactive comment on "δ^{18}O water isotope in the *i*LOVECLIM model (version 1.0) – Part 1: Implementation and verification" *by* D. M. Roche

Anonymous Referee #2

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General Comments

The author describes the implementation of a scheme for representing O-18/O-16 water isotope ratios (delta O-18) in the LOVECLIM Earth system Model of Intermediate Complexity (EMIC). Such ratios have been simulated in higher and lower complexity climate models in various studies over the last 20 years or so (as cited in the manuscript), but this is perhaps the most comprehensive attempt to date to represent delta O-18 in an EMIC. The only other such attempt of which I know is an implementation in the UVic model (Brennan et al. 2012), and this paper should perhaps be cited, in either/both Introduction and/or Conclusions. To the extent that they are reliably able to reproduce most of the present-day links between delta O-18 and temperature/precipitation/salinity (as tested here), EMICs are ideally suited (rather than slower GCMs) for exploring past

climate changes in ocean circulation and climate that are typically inferred from proxies, but often poorly understood or only hypothetically explained. iLOVECLIM is therefore an important addition to this developing model family. As a model description, the manuscript should be suitable for publication in GMD, subject to minor and technical revisions in response to the comments below.

Reference: Brennan, C.E., Weaver, A.J., Eby, M. and K.J. Meissner, 2012: Modelling oxygen isotopes in the University of Victoria Earth System Climate Model for Pre-industrial and Last Glacial Maximum Conditions, Atmosphere-Ocean, DOI:10.1080/07055900.2012.707611.

Specific Comments

1. Section 2.1.1 – I think it would be helpful to specify units for the "quantity of precipitable water for the whole atmospheric column" – this seems clearly a depth (m), assuming mks

2. p.5, l.11: specify "surface area of the cell"

3. p.5, eqn. (3): define Rˆ18

4. p.6, l.2: define upper-case lambda

5. p.6, l.3: clarify "surface specific humidity immediately above the ocean" (if that is what you mean); clarify "humidity of atmospheric layer 1"

6. p.6, eqn (5): Is Rˆi_E equivalent here to Rˆ18_E?

7. p.8, eqns. (11)-(13): define the alphas – I assume these are fractionation coefficients?

8. P.9, l.3: lower-case lambda is noted as a tunable parameter – what value was used to obtain the verification results? How sensitive might these results be to lambda?

9. Section 3.1.1, eqns. (19)-(30), seems like standard theory – is this all necessary

here? It may be OK to keep this in the paper, but which of the equations are actually implemented and used in iLOVECLIM?

10. Fig. 2: Perhaps zoom-in on the erroneous decrease of delta O-18 with increasing humidity (highlighted in the text), in the ranges 0.000 to 0.001 m and -20 to -40 per mil, and show it in an insert to Fig. 2?

Technical Corrections

1. p.3, l.15: “resources”

2. p.6, l.19: “that exchanges”

3. p.8, l.14: Clarify “Thus our fractionation scheme for large-scale or convective precipitation, and snow, may be summarized as”

4. p.8,9, eqns. (15), (16): Choose a symbol other than S, as this was previously used for surface area in eqn. (1) – alternatively use A for area in Eqn. (1)

5. p.10, l.22: “fractionation”

6. p.11, l.10-11: Improve clarity as “In order to assess implementation of all above fractionation factors, we now . . .”

7. p.11, l.12-13: “. . . and selected simulated . . .”

8. p.11, l.16: “as follows”

9. p.11, l.17: “loses”

10. p.12, l.3: “yields”

11. p.13, l.5: “recharged”

12. p.13, l.14: “Another”

13. p.16, l.22-23: “. . . yields a very positive result, enabling detection of some defects . . .”

14. p.17. l.21: “captures”

15. p.18, l.11: “Figure 5 presents . . .”

16. p.19, l.5: “a non-conservation”

17. p.19, l15: “adequately”

18. p.24, Fig. 1 caption: “as follows”

19. p.26, Fig. 3 caption (near end): “the GNIP”

20. p.27, Fig. 4 caption: why does m appear twice in both max and min?

Interactive comment on Geosci. Model Dev. Discuss., 6, 1467, 2013.