Geosci. Model Dev. Discuss., 6, C699–C700, 2013
www.geosci-model-dev-discuss.net/6/C699/2013/


Geoscientific Model Development Discussions

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

**Anonymous Referee #1**

Received and published: 29 May 2013

This manuscript describes the implementation and basic verification of an 18O isotope scheme into the intermediate complexity Earth system model LOVECLIM. This is a very useful development, both for evaluation of the model's hydrological cycle and, given the model complexity, for use in long time-scale paleoclimate applications. Although the simplicity of the atmospheric model - in particular as the troposphere is modelled with a single layer - requires some significant simplifying assumptions, the resulting model is shown to behave well and reproduces most of the characteristics of the usual d18O-climate relationships. The major failing is in describing the isotopic composition of Antarctic precipitation. Given the importance of the Antarctic d18O ice core signal in paleoclimate, this failure should perhaps be mentioned in the abstract?

With one possible exception (1st para below) my comments are of a minor nature,



relating primarily to the description of the formulation.

It is not obvious to me why convective precipitation is assumed to be at the top-troposphere temperature. Although the convective precipitation is derived as the (would-be) moisture flux through the tropopause, this seems to be a clever modelling construct rather than a reflection of the true source of the precipitation? This assumption appears potentially very important, both for the global average d18O of pptn and for its latitudinal dependence (as the latitudinal temperature gradient is presumably less pronounced in the upper troposphere?). The assumption should be discussed and, if necessary, sensitivity analysis performed to consider the results under the assumption of, say, mid-troposphere temperature. Similarly, why is the tropopause temperature assumed for snow and what effect does this assumption have on, in particular, d18O of high latitude pptn?

A few minor points, primarily on the description of the scheme i) Please define R18 in equation 3. Is the approximate value of n18/n intended here, or the form implied by rearranging eqs 1 & 2? ii) Is the superscript "i" intended in equations 4 and 5, or should this be 18? Please define $\Pi$. iii) Please define D in equation 9 and provide a source for this relationship. What value is assumed for n and on what basis was this value chosen? iv) Please state the units of T and $\lambda$ (eqs 14 to 17). What value is taken for the tunable parameter $\lambda$? v) although it does no harm, I do not see much value in the two page description of the formulation of Rayleigh distillation. Does this differ from a textbook derivation? vi) Figure 4 and section 3.3 is included as a verification of the atmospheric component, but no observations are presented for comparison. Although the results appear quite plausible, this verification seems of limited value without such a comparison.

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