Dear Reviewer,

We highly appreciate your time and effort spent on reviewing our manuscript. We have prepared a new version of the manuscript with your comments taken into account. Below we include a point-by-point reply to each comment.

Comment:

Page 2, line 12. Many references are missing for stable water isotopes in oceanic models: for instance, Delaygue et al, 2000, Roche et al, 2004, etc.

Response:

Done.

Comment:

Page2, Line 23. Please define "checkpoint 64w"

Response:

Done.

Comment:

Page 3 and 4, section 2.2: This section describes the methodology used for implementing the water isotopes in the MITgcm model. The simulation is forced with isotopic quantities derived from the NCAR IsoCam model, isotopic composition in precipitation and water vapor for evaporation. These quantities should be presented and discussed at least briefly in the manuscript, in order to allow further discussing the impact on oceanic model performance. Furthermore, it is also useful as the same isotopic oceanic MITgcm model could further be used with other atmospheric model forcing, it will offer the possibility to compare with the results from this study.

Response:

We included a comparison of $\delta^{18}O_w$ in P in the section 4.2 and added the global distribution as well as model-data fit as an additional figure to the manuscript (Fig. 11). Unfortunately, we do not know of any comprehensive compilation of the isotopic composition in water vapor over the ocean and thus cannot present this field.

Comment:

Page 4, Line 24: value of Ce is not specified.

Response:

C_E is specified as transfer coefficient for evaporation on page 4, line 30. For the exact definition, we added Large and Yeager (2004) as a reference, since the calculation of evaporation follows the bulk forcing approach by them.

Comment:

Page 5; line 3: the presentation of the architecture of the code should be more explicit: Apparently, gchem represent the “source and sinks” module and “ptracers” the transport module.

Response:

To clarify the purposes of the respective packages involved in the simulation of the stable water isotopes, we added an additional Table (Table 1) as an overview and rephrased the respective sentence in section 2.2.

Comment:

Page 5, line 7: Fw should be explicitly defined as Evap – precip – Runoff.

Response:

Done.

Comment:

Page 5 line 17. The freshwater flux is balanced by adjusting the precipitation field (page 3 line 14). The adjustment applied to water isotopes simulation must be described and a discussion on how it can potentially affect 180-Salinity relation is necessary.

Response:

We added the description of the calculation of the tracer specific correction factor to Appendix A and also modified Fig. A1. Due to the correction factors both the global salinity and $\delta^{18}O_w$ remains constant. Thus, any artificial drifts are prevented, which would otherwise lead to inexplicable changes in the y-intercept and slope of the $\delta^{18}O_w$-salinity relationship.

Comment:

Page 5: what is the duration of the spin-up of the simulation?

Response:

The duration of spin-up was 3000 model years (cf. section 2.1, page 3, line 20).

Comment:

Page 6 – results Section 3.1 presents model performance for temperature and salinity. Salinity anomaly should be analyzed considering the characteristics of Evaporation and Precipitation forcing fields used in this study. This will also be useful for next analyzing the water isotopes simulations.

Response:

For the presentation of the general model performance, we added zonally-averaged cross sections of temperature and salinity through the Atlantic Ocean and compared them to the GISS data. Regarding the salinity, we present precipitation and evaporation anomalies in section 4.1.

Comment:

Page 6: figure 3 : color scale is not adapted. Range (-1, 1 ‰) is too narrow to represent the more elevated values of the observations.

Response:

Done. (now Fig. 4)

Comment:

Page 6and 7 and discussion: discussion of water isotope distribution in ocean water: the discussion is too superficial. Shortcomings in water mass isotopic composition is described but the causes are never analyzed in function of model dynamical performances (AABW, NADW, AAIW formation) or surface boundary conditions (precipitation, evaporation, isotopic composition in precipitation and water vapor). A minimum more detailed analysis of the simulation is required to assess this modelling approach.

Response:

As described above, we added zonally-averaged cross sections of temperature and salinity through the Atlantic Ocean and compared them to the GISS data. Further we present precipitation and evaporation anomalies in section 4.1. The general model performance is shortly discussed in section 4.1, while the isotopic composition in precipitation is presented and discussed in section 4.2.

Comment:

Pages 9-10: discussion - the discussion of the sources of errors are mainly focuses on rivers input and sea-ice melting for the Arctic Ocean. The discussion must also consider more quantitatively the shortcomings associated to surface boundary conditions (for instance, an analysis of the realism of the isotopic composition in precipitation of the forcing has to be presented and considered, see previous comment).

Response:

We expanded the discussion on the sources of error by e.g. considering the surface boundary conditions.

Comment:

Page 11- discussion Planktonic Foraminiferal: Observation is a compilation of isotopic measurements derived on different species. The isotopic signal they register is then not obvious since the different species are living at different depth and differently affected by the seasonal cycle. A more sophisticated approach, taking into account the characteristics of some species would be more appropriate.

Response:

We changed our comparison of modeled $\delta^{18}O_c$ with measurements by using only plankton-tow data. Since the isotopic composition of the foraminiferal shell may be altered by mechanisms such as vital effects, vertical migration and modifications after death, a comparison with living foraminifera, where the depth and month of sampling in known, seemed to be more appropriate for testing the capability of the model on reconstructing $\delta^{18}O_c$. This way different depth habitats for the different species as well as seasonal peaks should be overcome. Further, we also performed a model-data comparison for each species separately to get a better idea on sources of error for the $\delta^{18}O_c$.