

## Review of cp-2022-8

### Glacial state of the global carbon cycle: time-slice simulations for the last glacial maximum with an Earth-system model

by T. Kurahashi-Nakamura, A. Paul, U. Merkel, and M. Schulz

The authors nicely improved the manuscript in this revised version. I confirmed that the points raised in the previous review round have been improved and well discussed. In particular, the comparison between models and data using various tracers for the LGM time slice is valuable. Some minor points are noted below.

#### General comments:

This study conducted a two-step spin-up to establish values of DIC and alkalinity that are compatible with glacial ocean restoration. Additional charts or more detailed explanations would make it easier to understand the intent of the method.

Would you evaluate how much atmospheric pCO<sub>2</sub> would be obtained in each LGM experiment if there were no additional increments in DIC and alkalinity, which may come from changes in shallow water deposition of CaCO<sub>3</sub>? It may support the significance of continental shelf processes.

#### Specific comments:

P5/L27: It may be helpful to clarify the additional increase of 100  $\mu\text{mol kg}^{-1}$  in this sentence.

P8/L16: Is AOU calculated explicitly in the model? If not, would you indicate how it is calculated?

P8/L21: What caused the positive anomaly of  $\delta^{13}\text{C}$  in the North Pacific in expLGMws. From Fig 7e, it is assumed that this is due to stronger volume transport from the Southern Ocean, which results in a smaller effect of remineralization.

P10/L15: Is the small MAR of CaCO<sub>3</sub> in all experiments in the Southern Ocean due to the dominance of other particle fluxes such as opal?

P10/L21 In Discussion section 4.1, the authors provided changes in the budget of oceanic DIC and alkalinity between the LGM and modern. It would be easier to understand if the estimated fluxes shown here could be visualized.

Figures: There are abbreviations in the title of figures that are not explicitly stated (e.g. IFRAC). Also, it would be better to correct 330E and 210E in the title of the figure to 30W and 150W, respectively.