Author's response

Bottom RedOx Model (BROM, v.1.1): a coupled benthic-pelagic model for simulation of water and sediment biogeochemistry. By E.V.Yakushev, E.A.Protsenko, J.Bruggeman, P.Wallhead, S.V.Pakhomova, S.Yakubov, R.G.J.Bellerby, R.-M. Couture

> *Topical Editor Decision: Reconsider after major revisions (26 Oct 2016) by Dr. Didier Roche*
> *Comments to the Author:*
> *Dear Dr. Yakushev and co-workers,*
>
> *We have received a new assessment of Dr. Guy Munhoven who recommends minor revisions with a list of comments to be implemented. I do not expect more comments on the current version of your manuscript.*
>
> *I thus recommend that you implement the changes suggested and send me a final version. At this stage, I have to request major revisions (only option in the system) but I follow the advice of minor revisions suggested.*
>
> *With best regards,*
> *Didier Roche*

Dear Didier Roche,

Thank you for your letter and decision. We implemented the changes suggested by the reviewer and uploaded the MS in the system.

These are the answers to 2 comments of Dr. Guy Munhoven, that he made for the text:

> *The model does not seem to include a diffusive boundary layer (which would be typically 1 mm thick in the deep sea), and which impedes the exchange of solutes between sediment porewaters and the overlying seawater. Is this not necessary in the setting chosen here?*

That is correct but we believe that the upper layer of the sediments should serve as an adequate barrier in this case (see text). The code does provide the possibility of an explicit DBL (see section 2.2.7). However, in our view, when considering layers on the scale of 1 mm or less, which is less than the roughness of a typical SWI, it seems somewhat arbitrary whether this barrier layer is modelled as strictly within the sediments or not. Also, note that the upper sediment layer (or DBL) will only be the limiting step if the fluff layer turbulent diffusivity is sufficiently large and the upper layer/DBL is sufficiently thick. In our example we have a fixed linear profile of D_{eBBL} with a value of 3e-7 m^2s^{-1} on the upper interface of the fluff layer. This implies of diffusive timescale or $(0.03)^2/3e\text{-}7 = 3000$ seconds. The diffusive timescale across the upper sediment layer (or DBL if we had one) is $(0.5e\text{-}3)^2/1e\text{-}9 = 250$ seconds, so in this example the limiting step for solute diffusion is in fact the fluff layer.

> *Eq. B2 is only correct if D_Bi^{intra} (please notice *intra*) is the same for all constituents of the solid phase, else D_Bi^{intra} does not cancel out.*

We believe that Eq. B2 is correct for any valid set of D_Bi^{intra} because intraphase mixing cannot *by definition* affect the total solid volume (see Meysman et al., 2005, section 5.1). Intraphase mixing merely exchanges equal volumes of sediment at different depth levels, resulting in net fluxes of individual components if there are gradients in individual

components, but no net flux of total solid volume (Meysman et al., 2005, Figure 1). In fact this definition can be considered to impose an additional constraint on the set of D_Bi^{intra} (Meysman et al., 2005, Eqn 55).

I recommend to put these sample brom.yaml and fabm.yaml files into supplementary material. Here, there are line-feed problems (lines are folded that should not, I suppose). T would be more helpful to have correctly formatted versions in separate files.

Done. These files are given as supplementary material.

p. 61 (figures): the top and bottom parts better had to have the same horizontal scales, else, they are really difficult to interpret

Our goal was to simulate the distributions of both in the water column and the sediments, but the typical concentrations change in orders of magnitude (i.e. for Mn or PO4). To demonstrate this we have to set different horizontal concentration scales for the water and the bottom parts of the figures.

Can you please inform us about the further steps of our paper progress.

Please not, that the paper's title and the list of the authors differ from the initial ones available at the web site. Can you please correct this!

On behalf the of the authors,

Evgeniy

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