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Geoscientific Model Development Discussions

Interactive comment on "Anoxic iron and sulphur cycling in the cGENIE.muffin Earth system model (v0.9.16)" *by* Sebastiaan J. van de Velde et al.

Anonymous Referee #3

Received and published: 14 December 2020

General comments:

This paper is a nice clear introduction to the anoxic iron and sulfur cycling scheme which has been introduced into the cGENIE model. The limitations of the approach are well stated and the results and uncertainties are clearly displayed. I have a few minor comments below but overall the paper needs little modification in my opinion, given that it is very much a technical document.

Specific comments:

-page 5 line 25: a lot of the ideas the model is aimed towards involve biogeochemical cycling on the marine shelf and slope, but the model ocean is entirely abyssal. It would be worth noting this and giving some background here.

-Page 9. Why do you ignore nitrate reduction? What will you miss by ignoring this?

-Page 11: Table 2: the kinetic formulations are "based on standard kinetic formulations in biogeochemical models (see text for details)". Can you include the relevant references in the table alongside each expression? I am not sure I can see them all in the text.

-Figure 4: perhaps I am misreading this (?) but given that panel a has H2S at 100uM and panel b has Fe2 at 100um, then shouldn't the fractional values be the same for each plot when we look at 100uM on the x axis? E.g. Fe2(free) is 40% in panel a but only 20% in panel b under what appear to be the exact same conditions?

-Page 18 line 15: might note recent work that proposes an important role for gypsum in Precambrian oxygenation e.g. Shields et al (2019) nature geosci.

-Page 22: "Since the aim of this manuscript is to describe the newly developed Fe-S chemistry, and not ocean circulation in real or fake worlds, we will not further discuss the emerging patterns of ocean circulation." Yet they are discussed in the next section as they are fundamental for driving redox variability. There should be a brief summary of the circulation here.

Figure 9 b, should say "S mass balance" as the title

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