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Biogeosciences Discussions

Interactive comment on "Quantifying biologically and physically induced flow and tracer dynamics in permeable sediments" *by* F. J. R. Meysman et al.

F. J. R. Meysman et al.

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We thank the referee for his extensive, constructive and accurate comments and suggestions. These really have improved the manuscript.

Title. The manuscript deals both with modelling and the testing of the model output to data, so we think that 'quantifying' is appropriate.

P1811-L3. 'Rusch'; corrected

P1812-L5. Reimers et al is now included in ref list.

P1812-L26. Reference 'Cardenas and Wilson' corrected. I truly apologize to have misspelled the referee's name. I was confused by the affiliation in the AWR paper where it said 'M. Bayani Cardenas'.

P1813-L10. The last two paragraphs of the introduction are rewritten in response to the comments of the referees. This clarifies the focus and goals of the manuscript. The references to the (substantial) work of Packman and co-workers have now been included.

P1817-1818. We defined the dispersion coefficients as they are defined in Oelkers (1996). Both representations are entirely equivalent, and the selection of one over the other is mostly a matter of preference.

P1818-L8. The Peclet numbers differ spatially in each of the four case studies, obviously in relation to the associated velocity fields. For example, in the lugworm case high Peclet numbers (˜100) near the injection pocket, which then rapidly and radially diminish when moving away from the injection pocket. We do not think the reader would gain much be additional information by showing spatial plots of Peclet numbers (as these simply scale with the velocity field).

P1818-L 15. Sentence corrected.

P1821-L25. Good suggestion. We have reformulated the sentence.

P1824-L23. This was bad phrasing from our side. We meant 'possible' rather than 'applicable'. It's always possible to make a model (even when you get garbage output). We have altered the formulation to make this clear.

P1827-L25. We have now emphasized that a velocity of 10 cm s-1 and Re=2000 is the transition from laminar to turbulent conditions, and that under natural conditions, fully-developed turbulence is the most likely outcome.

P1830. We now properly discuss these results.

P1835-L15. 'small' has been deleted

P1836-L21. 'Huettel' corrected

P1837. We did not know of the work of Javandel and Tsang (very interesting and very

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similar indeed!). We have now inserted a short description of their work.

P1838. A sensitivity analysis of density-dependent flow would be very interesting suggestion. However, this would add substantially to the present paper (which is already quite long).

Section 5.4. We agree completely with the referee’s assessment of the importance of our results (and that section 5.4 was indeed the weakest part of the manuscript). As also noted below in response to referee B, we think that neither the laminar simulation, nor the k-epsilon model provides satisfying results. Our main objective was a demonstration of the problem (showing that pore flow is very sensitive to the model type chosen for the overlying water), rather than presenting a definitive solution. We do not have the ideal model yet, perhaps k-omega will work, but that is not available in the current version of COMSOL. We have now rewritten the section to clarify these issues, so our message gets across better.

P1840. The work of Rutherford et al is now acknowledged.

Section 6.1 . The exploration of the k-omega model has been added as a promising route for future research.

Section 6.2. We have added the reference to Cardenas and Wilson (2007)

Section 6.3. Column experiments are 1D, we referred to multidimensional models (2D are 3D). We have now made this explicit.

P1846-L25. Return is added

Interactive comment on Biogeosciences Discuss., 3, 1809, 2006.