Review of: Quantitative Sub-Ice and Marine Tracing of Antarctic Sediment Provenance (TASP v0.1) by Marschalek *et al*

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Marschalek *et al.* present a tracer program using Matlab, called TASP, that determines the trajectory of ice rafted debris in the ocean based on the the results of ice sheet model simulations. They specifically are interested in neodymium isotopes, but such a module could likely be applied to any sediment proxy. They start by introducing a reconstruction of neodymium isotopes for Western Antarctica, based on geological and geophysical inferences. The next section describes how the program determines the transport of sediment by the ice sheets. The third section describes how sediment is redistributed in the ocean by icebergs, gravitational flows and currents, and how the program can discriminate between the mechanisms to determine the relative amount that is due to ice rafted debris. The final section describes the application of the model with the neodymium map, and demonstrates some model-data discrepancies, especially with respect to unincorporated features like Quaternary volcanoes. This kind of tracer modelling is important as there are few direct ways to determine past ice sheet configuration, so using offshore proxies is the only way to make inferences.

Overall, there are a lot of interesting things presented in this paper and am supportive of what the authors are trying to achieve. However, I agree with the other reviewer that this paper is lacking in focus. This paper has been submitted as a model description paper, yet nearly 1/3 of the paper is dedicated to the description of the construction of the neodymium map. The algorithm used to determine the trajectory of the ice rafted debris is inadequate to allow someone to reproduce the model (which is likely desirable for people like myself who do not have Matlab access). There are a lot of assumptions made in the parameters used in the model (for instance, lines 567–572, 627–628, 636–637, 667, 680, 689 and 737), with no tests to show what the impact of these assumptions are on the results. The reported effectiveness of the model (section 5) is hampered by the usage of the estimated real-world neodymium distribution.

I think the way forward here is to split the paper into two – one paper where the TASP model is described in greater detail, making use of artificially constructed neodymium concentration maps to test the sensitivity of the model to different parameters, and a second paper to describe the case study of the realistic distribution of neodymium described in section 2. The model description paper should have information like the types of input needed for the model (including a table of the parameters found in the User Guide in the source code package would be ideal). With idealized maps of the neodymium concentrations, you could then truly test if the model is capable to achieve the stated goal of determining past ice sheet configuration. You could, for instance, assign a single neodymium value to a single ice sheet sector and another value for the rest of the model domain, and trace how that affects the concentrations in the offshore region (in essence, testing if the signature of that sector can be detected). There should also be a description of the computational overhead. The second paper would be a case study that could be expanded to use TASP to, for instance, test the difference between present day and LGM ice configurations. This paper could then demonstrate whether or not sediment tracers can be used to determine past ice sheet configuration, a result that would be very useful for paleo ice sheet modellers.

Other comments

Streamline function

In terms of generating reproduce-ability, a lot of riding on the Matlab "streamline" function. The details of this function are not described. I assume that it creates a vector map of the trajectory of the parameter (*e.g.* ice and water velocity), and traces the material along those lines. However, this is going to have some time dependence, and it is not stated how this is applied. At the very least, there should be some reference to what this function is.

Wind blown dust

Another factor that could influence the geochemistry of the ocean bottom sediments is wind blown dust. There are large dust sources in Patagonia, southern Africa and Australia that may be important, especially as you get further from the edge of the ice sheet. A cursory glance at Southern Ocean neodymium isotope research indicates that these dust sources influence the concentrations in the water (though I do not know the follow-on in terms of sediment concentration). The melting ice could also include dust from these sources, which may become important as the bottom of the iceberg melts away and it loses the sediment directly scraped from the ice-bed interface. I realize that separating these two factors would likely be impossible, but it probably should be commented on in the manuscript about the possibility that dust could influence the results.

Details on the ice sheet modelling

The description of the ice sheet model used to test TASP is limited. Is it a modern day simulation? How was it run? Does it replicate modern day ice flow observations? There should be some more details so that we know whether the results will be reasonable given the geological data.

Colours on the plots

I found the colours used in figures 8 and 12 made it difficult to make out the values, especially with the yellows. I suggest improving the contrast.

Best Regards,
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