Biogeosciences Discuss., 9, C2887–C2888, 2012
www.biogeosciences-discuss.net/9/C2887/2012/

Biogeosciences Discussions

Interactive comment on "Can whales mix the ocean?" *by* T. J. Lavery et al.

Anonymous Referee #1

Received and published: 1 August 2012

A review of Can whales mix the ocean? by Lavery, et al.

The authors estimate the impact of sperm whales on property transport. In particular, they consider the resident sperm whale population in the vicinity of the Hawaiian islands and attempt computations of their affect on the local diffusivity and transport of nitrogen. I interpret their conclusions to imply the impact of sperm whales on the physics of mixing is negligible and that the total sperm whale transport of nitrogen is also small. However, the authors make the point that the characteristics of the latter transport are quite distinct from those of other bio mechanisms, like migrating mats of plankton. The implications for ecosystem maintenance of sperm whale diving and foraging are thus held up as potentially significant.

This is an interesting paper attempting to quantitatively address the question of the biosphere on the transport of chemically important species, in addition to the impact

of the biosphere on the physical climate of mixing. The conclusions are suggestive. Having said that, I have a few questions about the substance of the paper.

First, I don't immediately understand the relevance of (1) to an effective diffusivity estimate. Certainly the formula returns a number with the proper units to be a diffusivity, but so do other combinations of parameters. The relevance of any one combination of parameters to diffusivity needs to be rationalized using a model that connects those parameters to mixing. How this is achieved for (1) is not clear to me. It will help the readers of this manuscript to understand it if the argument is provided here.

It might also help in the reading of (2) for the readers to be reminded what a Strouhal number is and how it is used here to compute the size of the tail stroke.

What does the estimate of sperm whale mixing (10ˆ-6 mˆ2/s) imply about the injection of kinetic energy by swimming whales into the environment? Does this compare to the energy estimates that have appeared elsewhere, in Huntley and Zhou and Dewar et al, for example?

The authors follow with a careful discussion of nitrogen transport and related primary production implications that seems solidly grounded in observations. They also include some viable estimates of the impact of sperm whale population reduction by fishing.

Regarding their conclusions, the suggestion of the constancy of the whale induced flux to the structure of the local ecosystem is interesting. However, it is important I think to compare this estimated flux not only to biologically mediated processes, but physical ones. In particular, a background diffusivity of a few times 10ˆ-5mˆ2/s, as is thought to be driven by the ubiquitous internal wave field, is similarly persistent in time (probably), yet appears to be at least 10 times larger than that due to the whale associated diffusivity of 10ˆ-6 mˆ2/s. Is there a reason that the role of whales stands out in spite of this comparison?

Interactive comment on Biogeosciences Discuss., 9, 8387, 2012.