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Biogeosciences Discussions

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

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The manuscript provides a back-of-the-envelope estimate of the mixing potential of the population of sperm whales in the vicinity of Hawaii. Like many such estimates, there are many points where inconsistencies can be missed. This appears to be a case in point here. The premise of the authors' argument is to calculate the area covered by the whales' each year and calculate the enhanced diffusivity created by their turbulent wake while ascending and descending. The authors offer a formulation to estimate diffusivity with no reference or justifying argument. This is a serious concern in itself, but assuming for the moment this formulation can be substantiated, the subsequent diffusivity estimate of 10ˆ-6 mˆ2/s is moderately high (3 orders of magnitude greater than molecular) but still 1 to 2 orders of magnitude less than physical mixing (winds, tides, internal waves, bottom currents). The whale mixing estimate however, is calculated on their annual swimming track area, estimated to be 1.3 x 10ˆ10 mˆ2. It may

sound a lot, but it is actually less than 50% of the land area of the Hawaiian Islands. In other words, the comparison offered by the authors is only valid if the entire population of whales confine themselves to a (circa) 100 km square box of habitat, concentrating their mixing influence there.

I offer a sketch (Figure 1) to give an idea of the scale of the area (the red box) over which the authors assume whale mixing to be concentrated, and within which the comparison to physical mixing is made.

A more reasonable estimate of the areal range of whales range (erring on the conservative side) would be 2 orders of magnitude greater. Physical mixing after all acts over a much greater areal extent than the annual swimming track of 80 whales. Specifically, in order to be consistent, the number density of whales should be calculated over the same spatial area as the mixing processes it is to be compared to. Based on this, a more reasonable estimate of the whale enhanced diffusivity (contingent on the validity authors' formulation (eq. 1)) is 10ˆ-8 mˆ2/s, a value that is only slightly greater than molecular diffusivity.

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

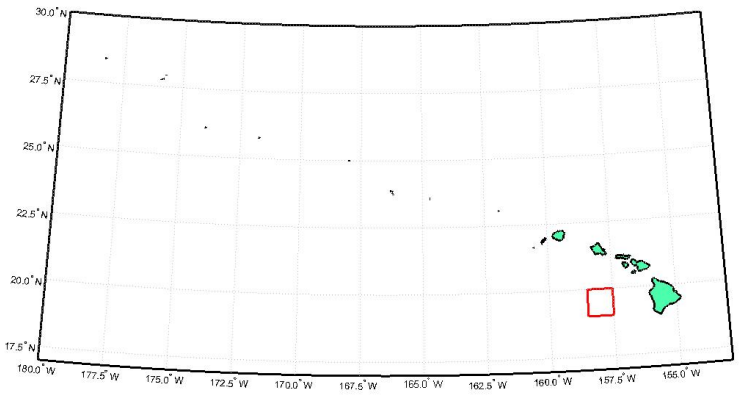

Fig. 1. Assumed area over which whale mixing is concentrated.