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Interactive comment on "Wave induced mixing and transport of buoyant particles: application to the Statfjord A oil spill" *by* M. Drivdal et al.

Anonymous Referee #2

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I have read with interest the paper in Subject. Indeed, there is the need to further investigate the effect of wave breaking and Stokes drift on near-surface mixing situations. The fact of intersecting this with the oil issues is an interesting idea. Unfortunately, the authors do not succeed in making the fundamental of these processes clear and their assumptions and conclusions are heavily questionable. As it looks now, the paper is not acceptable and should be very revised or rejected. I encourage a resubmission after a very deep revision that is taking intop consideration state-of-the-art and fundamental papers on these topics.

Page 1268: The authors appear to ignore earlier pioneering literature on various topics. For example, McWilliams et al. (JFM 1997) were the first to talk about "Langmuir turbulence" and the influence of Coriolis-Stokes term. However, this reference is miss-

ing and instead the credit seems to be given to Rohrs et al. (2012). In the same way, Kantha and Clayson (2004) were the first ones to include Stokes shear production in mixing models. Yet Eq. (9) is referenced to Grant and Belcher (2009) which appeared five years later with the same equations as in Kantha and Clayson. In any case, contrary to assertion by the authors, Kantha and Clayson (2004) and Kantha et al. (2010) do not use the vortex force term per se, but includes Stokes production term in both the TKE and turbulence length scale equations.

The authors appear not to be well focused about Langmuir turbulence. They should refer to McWilliams et al. (1997) and Kantha (2012) review. Huang and Qiao (2010) formulation is questionable, as recently shown by Kantha et al. (JGR, 2014) and so the authors' citing the reference as proof of how the dissipation rate behaves is not a strong subject. They have to get to Kantha et al. 2014 paper and either rebut to those findings, or change your current statements.

Last, it is hard to believe that the law of the wall scaling prevails when waves are breaking strongly. Further support should be given to this discussion.

Page 1269: It is more justifiable to calculate wave-related quantities such as Stokes drift from the wave spectrum; here the authors seem to be on the right track. If the oil stays on the surface, then it is the surface current that determines its drift and so the 3% rule and 15o angle are plausible. But when the oil is mixed down into the mixed layer by very strong mixing as in Statfjord 2007 spill, it is not surprising that its drift speed comes down and the angle is closer to the classical Ekman transport at right angles to the wind.

Page 1271: Mention McWilliams et al. (1997) in addition to Polton et al. (2005)

Page 1272: Mention Kantha and Clayson (2004) in addition to Grant and Belcher (2009)

Page 1273: Mention Kantha and Clayson (2004) in addition to Umlauf and Burchard

OSD
11, C538–C540, 2014

(2003) since they also presented length scale equation that included Stokes production term.

Page 1279: See comments on page 1269. Nice analysis in Sections 3.1 and 3.2 Page 1285: When there is strong wave breaking, it is hard to expect law of the wall near the surface. Law of the wall may prevail deeper below the wave breaking zone.

Fig 2: Best plotted to the same scale

Fig 10: I would show the wind direction

Symbols are sometimes undefined (eq. 4-5), sometimes used twice for different quantities (eq. 9) . Please go through the turbulence notation more carefully!

Suggested references

Carniel S., Sclavo M., Kantha L.H. and C.A. Clayson, 2005. Langmuir cells and mixing in the upper ocean. Il Nuovo Cimento, 28C(1), 33-54. DOI: 10.1393/ncc/2005-10022-8

Harcourt R.R., 2013. J. Phys. Oceanogr. 43, 673-697

Huang, C. J., and F. Qiao (2010), Wave-turbulence interaction and its induced mixing in the upper ocean, J. Geophys. Res., 115, C04026, doi: 10.1029/2009JC005853.

Kantha, L., H. Tamura, and Y. Miyazawa (2014), Comment on “Wave-turbulence interaction and its induced mixing in the upper ocean” by Huang and Qiao, J. Geophys. Res. Oceans, 119, doi:10.1002/2013JC009318.

Interactive comment on Ocean Sci. Discuss., 11, 1265, 2014.