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Discussions

Interactive comment on "Particle aggregation in anticyclonic eddies and implications for distribution of biomass" *by* A. Samuelsen et al.

Anonymous Referee #1

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I found this paper very good and enjoyable. The figures are clearly presented, the arguments are sound, and the caveats are mentioned. It contributes to our understanding of biological distributions in relation to mesoscale and submesoscale physics, and I could see myself referencing it sometime soon.

The paper has no major flaws. Here are a few suggestions for improvement:

The title is slightly misleading in that the aggregation is not in the center of the anticyclone, but at its edge. Perhaps it should read, "Particle aggregation at the edges of anticyclonic eddies..."

The last sentence of the Abstract is out of place, and unsupported, as a thorough analysis of the vertical velocity patterns is not presented. A complicating factor is that

their vertical velocity estimate is approximate (p 193 lines 8-9), as it neglects the effect of penetrative solar heating and diffusion on the isopycnals. Furthermore, although Fig. 3 shows spatial and temporal variability in 5-day averaged vertical velocity, the divergence of particles from the center and convergence at the eddy edge indicate structure in the temporal or azimuthal mean. The decay of the anticyclone (p 194 lines 23-27) is consistent with mean upwelling at the center and downwelling at the edge. A significant point is that the particles respond to the mean vertical velocity and divergence fields, which are difficult to estimate even in a model due to high variability.

p 195, line 8-9, "The highest particle concentration coincided with the vorticity patterns, but not the divergence field as one may have expected": Here again is missing the concept of correlation being a function of timescale. Because the divergence pattern has high frequency spatial and temporal variability, it is possible for particle concentration and divergence to be uncorrelated on short timescales but correlated on longer timescales or in the azimuthal average.

Section 3.3: Experiments MCD and M3D initialize particles below a significant pycnocline (Fig. 6). If this is the main pycnocline, then the pattern and magnitude of vertical velocities may be be different above and below it. It would have been interesting to try a layer of particles at 300 m, just above this pycnocline. But that is not necessary at this point.

p 199, bottom: Another "real life" complication is that different fish species exhibit different temperature, salinity and depth preferences. This may influence avoidance on short timescales, although acclimation can occur on longer timescales (weeks).

p 200, bottom: Another situation that happens in nature is higher biomass in an eddy or filament (e.g. wrapped around an eddy) coming from the coast due to the coast-open sea biomass gradient, not due to the physical dynamics or characteristics (e.g. salinity) of the eddy or filament itself. So correlation does not necessarily indicate causation.

p 202 line 7-8, "The evidence from these numerical experiments definitely points to-

wards the mechanism for aggregation at the surface being of physical origin.": This is stated too strongly. The simulations indicate physical aggregation could be the cause; but biological processes are not ruled out, because biological processes were not tested. For example, perhaps the zooplankton congregate (behavior) to where the phytoplankton aggregate.

Minor typos/suggestions:

p 188 l 5: "physical redistribution" > "redistribution"

p 190 l 8: "Sea, this" > "Sea. This"

p 197 l 20: "role, although" > "role; although"

Fig 4. Caption: "patters" > "patterns"

Interactive comment on Ocean Sci. Discuss., 9, 187, 2012.