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Ocean Science Discussions

Interactive comment on "Circulation of the European Northwest Shelf: A Lagrangian perspective" *by* Marcel Ricker and Emil V. Stanev

Anonymous Referee #1

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Review of 'Circulation of the European Northwest Shelf: A Lagrangian perspective' by Marcel Ricker and Emil Stanev.

Summary

The manuscript describes a series of Lagrangian particle tracking experiments carried out to characterise the water circulation and the accumulation of hypothetical particles on the northwest European continental shelf. Particles were released at the surface and the bottom at the start of monthly runs for six different scenarios, mostly uniformly distributed over the area. Some scenarios were carried out over one year, others only for January. A property called 'density trend' is defined to analyse the resulting particle movements. The analysis consists mainly of differences of this 'density trend' between the model scenarios.

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Discussion paper

General comments

This is an interesting manuscript, with powerful visualisations, supported to a large extent by the newly introduced 'density trend'. However, after reading it, I am left mostly confused, because important information is not supplied (or has escaped my attention), and choices are not motivated (while some of these choices are bound to affect the results). Moreover, the results and discussion section is rather long-winded, depends on visual comparison between figures (which will end up on different pages), and seems to jump unpredictably between figures in quite a few places. It is not clear to me how the particles (are allowed to) move in the vertical (vertical mixing seems to be absent or under-represented). For a number of figures, it is not clear if surface, bottom or e.g. depth-averaged values are presented. Also, I have doubts about the January temperature fields presented/used: the temperatures seem too high, and I am surprised by the magnitude of the spatial gradients in the North Sea. Validation of these is absent. Overall, I would recommend major revisions. I will provide more detailed comments below.

Vertical particle motion

Under well-mixed conditions, as may be expected in most of the North Sea in winter, I would expect neutrally buoyant particles (as simulated here?) to be mixed quickly in the vertical by turbulent mixing processes. That means that there should be little difference in the overall dispersal of surface and bottom-released particles; yet, these differences are so substantial in the simulation results that it seems that most particles did not leave the surface or bottom model layer. Were the particles tied to the surface or bottom layer (i.e. vertical velocities set to zero)? It does not seem so, because at some point in the manuscript up- and down-welling are addressed. Was the effect of turbulent mixing omitted? Why? If so, I'm not sure what the presented results mean/represent. If the effects of (vertical) turbulent mixing were included, checks need to be made to see if this was done correctly. This needs to be resolved and/or absolutely clear, otherwise this work cannot be published.

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Missing information (main points)

-It is not clearly explained a priory (section 2.4) why each experiment was carried out, and with which objective (what do you expect to learn and how will these experiments provide that knowledge)?

-There is no validation of the temperature and salinity fields. The salinity fields correspond to what I would expect, but the temperature fields don't.

-l. 54-62. Also discuss seasonal stratification and subsurface jets (eg. Hill ea 2008).

-Different, and offline model for backtracking: a forward run of this model for the control run should be compared with CR to identify/quantify differences in results resulting from the model/method differences.

-Markings in the figures (plusses, minuses, stars, arrows): It is not clear what the criteria were to place these where they were put (often other locations seem equally justifiable), or for which areas they hold. Please remove and find a different/better/more quantitative way to quantify/visualise/discuss this.

-There is repeated mentioning of 'westerlies' as an explanation in the discussion/conclusions, but no detail about the wind forcing is presented (e.g. to show that this was the dominant wind direction during the simulations), nor short-term simulations (e.g. to show what happens when the wind is from the west).

-Section 3.4. Why were 80m intervals chosen? Why at these depths? Why allow gaps in the vertical in this analysis? What happens in the gaps? It would help if the initial positions were shown?

-Figure 2: for which depths are these data presented? Surface, bottom, depth-averaged?

-Monthly runs were done to depict DT. How dependent is the result on this monthly interval? For instance, what happens to the visualised results if 2 weeks or 2 months

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are used as interval?

Structure

-Section 2.2 contains results, please separate methods and results.

-Section 2.3 contains (many) results, please separate methods and results.

-Results and discussion: there does not seem to be much system in the order in which the various release experiments (as in Table 2) are presented/discussed, with quite a few jumps between experiments. There also does not seem to be much balance in the amount of attention given to these various experiments. This makes it difficult for the reader to keep track of the narrative. This should be tidied up; one way of doing that would be to split the section into two separate Results and Discussion sections. Linking back to the objectives of each experiment (see also Missing information above) will also help here.

Density Trend

I don't think that this term describes the quantity properly. For instance, 'trend' typically indicates a change in time, which is not the case here. Please find a better descriptor. I would suggest 'Normalised Cumulative (Particle) Density'?

Detailed comments

l. 29. bracket missing

l. 29. '..achieved with substantial contributions from Eulerian numerical...'

l. 31-33. I don't understand why this remark is made, see l. 64-69.

l. 41. or around S/W Ireland.

l. 44. Baltic, subsequently those

l. 96. value horizontal eddy viscosity: please check value. It seems odd that it is negative, and to the power of 10?

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l. 98. Drag coefficient: units?

l. 99. output: and vertical velocity?

l. 105. spinup period: is this enough? The North Sea has a residence time of several years.

l. 109-110. Really? Please check: I don't think hourly data are available.

l. 112. operational FOAM-AMM7.

l. 155. The residual velocities and the velocity amplitudes... Please use the term 'residual velocities' throughout for this element (I will not indicate all occurrances).

l. 158. low residual velocities

l. 159. surely not only in the English Channel?

l. 160. It is not clear to me how this is defined/quantified?

l. 163. 'sea level oscillations': these are not presented: velocity oscillations?

l. 174. Why winter? How is 'winter' defined?

l. 177. The East Anglia plume is not defined by temperature, but by turbidity (and lies somewhat south of the location suggested here).

l. 178. Frisian front: is a summer feature separating temperature-stratified from well-mixed conditions.

l. 182. 'a number of mesoscale features': it is not clear to me what is meant here.

l. 183. '...compare with...': it is not clear to me what should be compared.

l. 184. Fig S2a: why is this fig in the supplementary material?

l. 188. NTE: why does the narrative jump to this here? What about stratification?

l. 189. 'much of what is known': please specify.

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l. 192-205: please better specify/explain variables.

l. 206. Why 25 h average (I can guess, but not everyone might). On which day? Why this day? Why one day?

l. 212. difference: which was subtacted from which?

l. 213. 'despite': replace by 'In addition to'

l. 212-214: what do positive/negative values mean?

l. 216. 'significant importance': what does it do to them?

l. 217. this is not presented?

l. 218. I don't understand this sentence/reasoning.

l. 229. This is a conclusion. Also: how can you tell, as the experiments were not set up in the same way?

l. 236. ARIANE user manual: please provide reference.

l. 237-239. Then how, exactly, does the horizontal particle diffusion work? Is the 7 km grid really sufficient to explicitly resolve all horizontal turbulent diffusion processes as eddies?

l. 245: stripe: strip. Along the shelf edge? A figure may help here.

l. 248. Why use a different model?

l. 250. Why at a constant depth, i.e. different (?) from the forward experiments? How can you then compare? Why at 1 m, and not at the surface as in the other experiments?

l. 285. 6 months? Why?

l. 259. only january: why?

l. 260. NTE also July: why?

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Table 2. Please complete with release time. Backtracking: 1 m, not surface.

l. 305. Why 12 h? The tidal period is (roughly) 12.5 h, so the difference between start and end point of the depicted loops are not the residual (or net transport), but still contain a tidal contribution.

l. 318. Refer to fig 4 after 'different'.

Figure 4. After introducing DT, it is not clear to me why the plots of particle positions were included? If it is to point out that DT is a better way to visualise, one simple comparison figure should suffice.

l. 324. It is not clear to me what the authors aim to point out here?

l. 331. breaking internal waves: the hydrostatic NEMO model cannot represent these.

l. 333. I don't see the causal relationship here?

l. 342. flown: been transported? They don't have wings...

l. 355. ambiguous: what is meant with this? If you mean that the accumulation patterns have high spatial variability (or something like that), then say that? Please also change other occurrences?

l. 366. off-shore

l. 372. reduced: smaller than for surface particles

l. 382. I'm not sure what exactly you're indicating here.

l. 397. Irish Sea. Why mention this specifically: there are other places, too.

l. 412. 'possibly indicating': can you quantify the scales to make this a firm statement?

l. 418. the front: which front? Also I'm not sure if there is a front in winter?

l. 421. suggests: how?

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l. 427. variability: of what?

l. 429. FEW: FWE?

l. 435. 'smoothing': please be consistent (with the abbreviation), and use 'filtering' throughout.

l. 440. 'that disappears': one can't see this in difference plots?

l. 442. this contradicts the previous sentence.

l. 445. Remove of substantiate.

l. 453. 'differences': please specify.

l. 469. 'side of particle supply': what exactly do you mean?

l. 470. 'the particle supply is hampered by the front': what exactly do you mean?

l. 468-470. So backtracking experiments do not produce realistic results, as interactions with frontal dynamics are non-reversible?

l. 483-487. Please demonstrate this by providing wind data.

l. 491. How could this work? Most fronts are absent in January.

l. 512. I don't understand this sentence.

l. 528. So what is causing the up/downwelling there, then?

l. 548. So what does this experiment add?

l. 578. 'thalweg': This is German, please find English equivalent. Also occurs elsewere.

l. 587. 'floating marine debris': only floating?

l. 589 etc.: Please provide links/references to data sources.

Figure captions: please put graph labels before the descriptors, not after.

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Figure 3, caption: what are the isobaths in a) and b)?

Figure 5, 7 caption: southern bight, not German Bight, please check throughout.

Figure 5: 'annual mean' is depicted, not 'monthly average'?

Figure 7: distance: along transect?

Figure 8, caption: I'm not sure what's meant with the last sentence.

Figure 9. It is not clear to me why a portion of the particles is purple? Surely they have all potentially changed depth?

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