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Discussions

Interactive comment on "Shelf sea tidal currents and mixing fronts determined from ocean glider observations" *by* Peter M. F. Sheehan et al.

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Review by D.G.Bowers

This paper is about using a glider to study the position and movement of a front at the north-west entrance to the North Sea. The front is a boundary between mixed and stratified water and seems to have a mixture of causes: tides are important in creating the mixed water; the stratification is produced by a combination of surface heating, freshwater input and currents from the Atlantic.

The authors will likely disagree with me, but it seems to me that gliders are a solution still looking for a meaty problem to get their fins into, at least in shelf sea oceanography. Fronts could be just what they are looking for. Fronts are not always straightforward to

find and so moorings, if misplaced by a few kilometres, might miss them altogether. Ships, for reasons of cost, are limited and satellites can only see the surface. Programming a glider to make repeated transits of a front (with a generous allowance for frontal movement), as has been done in this work, can lead to useful new knowledge. It's some years since I've worried about these problems but the observations presented here, are among the best set of observations of the autumn retreat of a front that I have seen for a while.

There are a few things I would invite the authors to comment on. One of the most important things which moves a front in a shelf sea is the tide itself. The front will be in a different place at low water slack, say, than high water slack. The difference can be a dozen kilometres or so. I don't think the authors have corrected their observations to allow for this. Is that right? If so, it's not a big issue: it will introduce noise into their observations rather than bias, but it would be interesting to know how easy it would be to do this with glider measurements.

The appropriateness of the h/u3 criterion for a front which may have other causes than heating and stirring has been commented on by another reviewer and I won't dwell on that. The results shown in figure 5a are impressive, I think. It's a very nice set of observations of the autumn retreat of the front compared to a simple theoretical prediction. One thing I don't understand about this figure is why there are several yellow spots on each crossing. Where there several fronts? Of course, in the autumn, heating is no longer important: the tide and wind together are eating away at the buoyancy stored over the summer. The cooling of the surface in the autumn is helping and there may be an influence from the Atlantic. The authors might like to construct their own model with these processes in (not now, but for a future paper) and see if this fits the observations better?

This is as much a methods paper as anything and I have a couple of questions about that. First, the authors have used u from the glider and h from a data bank to test front position as measured by surface-to-bottom temperature difference, also measured by

the glider. Why those choices of data sources, I wonder. Could everything be determined from the glider? Does it know how deep the water is that it is gliding through? Or would it be better to use current velocities from a model? We all do this –select data from wherever we think is best, but maybe in this case some justification of the choice would be good. Finally, I'm a little surprised that the water velocity is so close to the glider velocity that the glider velocity can be used to give the depth-averaged current. Does the glider not move relative to the water to glide through it?

I think this is an interesting paper using new methods to tackle an old problem. Thank you for letting me read it.

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