Biogeosciences Discuss.,
doi:10.5194/bg-2016-118-AC1, 2016


Biogeosciences Discussions

# *Interactive comment on* "Depth-averaged instantaneous currents in a tidally dominated shelf sea from glider observations" *by* L. Merckelbach

**L. Merckelbach**

lucas.merckelbach@hzg.de

Received and published: 7 November 2016

Response to Interactive comment on "Depth-averaged instantaneous currents in a tidally dominated shelf sea from glider observations" by Anonmous Referee #3.

I thank the Referee for his time and sharing his thoughts and comments on the manuscript "Depth-averaged instantaneous currents in a tidally dominated shelf sea from glider observations". I agree with the Referee that at face value the choice of the journal seems ill-chosen. As also noted by the Referee, the manuscript, however, is meant to be part of a special issue on Cosyna, a coastal observatory in the framework of which this work was carried out.

The Referee asks wether there are any studies published that might use this type of data (instantaneous currents observed from gliders), as the introduction only points out



the possibility of using this type of data. In fact, the incentive for this study was two-fold. First, the operation of gliders in the German Bight is controlled by the German shipping authorities, who require 12-hour position forecasts during glider operations. The methodology described herein has been used in this context for recent glider deployments. Second, in the German bight sediment resuspension events are mainly driven by (tidal) currents and wind waves. Current and yet unpublished research looks at resuspension rates and their relation with the tidal currents. I made a small change to the discussion (now page 16, line 31) where I come back to the issue for which studies this method could be applicable. Here I name a few studies that could use this type of data, if the would have been done in a tidal setting.

Specific comments:

page 4, line 9. Indeed a great deal of the tidal variance is accounted for by the M2 tide. Although not so essential in this context, I supplied the numbers 80% and 65% for the eastward and northward currents, respectively.

Page 4. line 16 (I think meant is page 6). Technically adding more tidal frequencies is trivial. The phase information is found by the Kalman filter (by means of the amplitudes a cosine and sine component). The linear model (eq 9) serves as a model to be used in the Kalman filter. The nonlinear terms ommited, notably friction, would, when included in the modelling, lead to interaction of signals with different frequencies and generate higher harmonics. The time scale at which this evolves is deemed longer than a tidal cycle. For the predictive capability of the method, adding nonlinear terms unnecessisarily increases the complexibility. For the reconstruction of the instantaneous currents, the Kalman filter is set flexible enough to allow for the tidal components to change slowly over time (through the modelling uncertainty). Since gliders can move (slowly) in space, it is to be expected that tidal components can change slowly in time, so that also in this case the added complexity of nonlinear terms, leaing to a nonlinear Kalman filter, brings no real benefits. Good point, though.

Page 8, line 23: It is true that there is also an error associated with the ADCP readings. Also that these errors might not have a zero mean. In order to test the algorithm per se, I make use of syntethetic currents, derived directly from the ADCP data in order to be realistic. Before adding the Gaussion noise the synthetic data are assumed to be the true observations. What the glider observes is computed from the synthetic data. The reason for this is that then the effect of different subsurface times can be estimated, but also the uncertainty in the ADCP measurements can be ignored. See also the first paragraph of section 4.2.

Page 8, line 29. I totally agree with the Referee. What was meant here is that buoancy driven currents on large scales, because of the fresh water influx of the River Elbe for example, would have a non-tidal, but barotropic character (far enough away from the river mouth). To remove any ground for confusion I changed the text to refer to "tidal currents and mesoscale circulation"

page 11, line 1. "The error seem Gaussion". This has been tested using a standard chi-squared based test, which does make me believe the hypothesis that the errors are Gaussion, using a level of significance of 5%.

page 16. I believe I have confused the author to how the calculated instantaneous currents could contribute to the analysis of glider data in terms of mixing. I have rephrased that in the discussion so that it should be clear as what is meant. (second paragraph of section 7)

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