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Ocean Science Discussions

Interactive comment on "Three-Dimensional Reconstruction of Ocean Circulation from Coastal Marine Observations: Challenges and Methods" *by* Ivan Manso-Narvarte et al.

Anonymous Referee #2

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I went through the manuscript with great interest as the data-driven reconstruction of subsurface velocity is a topic of grea interest and has some potential but I must admit I was disappointed when reading the body of the text. the title and the paper are misleading as they suggest that real data are used for the task, which unfortunately is not the case here. The manuscript indeed focuses on 'emulated' observations of currents provided through some 'supposedly' accurate and realistic model simulation. However, when it comes to the description of the model, the reader is pointed out to some references to other studies. If you have the model, why not compare that to the HFR data if you do not want to use the data itself for the task?

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Discussion paper

the literature review is lacking some important references. Development of subsurface current estimation procedures to complement surface currents started as soon as radar technologies were available. Some are given below, I leave the Authors to do a thoroughly review. Simple models dedicated to the prediction of current profiles have been developed (Prandle D., 1982. The vertical structure of tidal currents. Geophysical and Astrophysical Fluid Dynamics, 22, 29-49, 1982. Prandle D., 1987. The fine-structure of nearshore tidal and residual cirrculatins revealed by HF radar surface current measurements. Journal of Physical Oceanography, 17, 231-245, 1987. Prandle D., 1991. A view of near-shore dynamics based on observations from HF radar. Progress in Oceanography, 27, 403-438, 1991. ; Davies, 1982, 1983, 1985, 1992). Semi-empirical models, based on shallow-water hydrodynamics coupled to a modal representation of the current profiles, in which the modes have been estimated from local current profiles time series, have been used to estimate the 3-dimensional flow field from HF surface currents near the Rhine river outflow (de Valk C.F., 1999. Estimation of the 3-D current fields near the Rhine outflow from HF radar surface current data. Coastal Engineering, 37, 487-511, 1999.). A statistical method, based on vector correlation analysis between HF surface and ADCP subsurface currents and coupled with a modal representation in which modes were obtained from ADCP currents, was proposed in order to "project" surface currents along the water column. A different approach that infers the approximate shape of the current profiles from surface data without making use of local current profiles, has been introduced in 2001 for shallow-water coastal zone (Shen et Evans, 2001), subsequently extended to deep-water regions (Shen C.Y., Evans T., 2001. Surface-to-subsurface velocity projection for shallow water currents. Journal of Geophysical Research, 106, C4, 6973-6984, 2001. Shen C.Y., Evans T., 2002. Dynamically constrained projection for subsurface current velocity. Journal of Geophysical Research, 107, C11, 3203-3216, 2002. Doi: 10.1029/2001JC001036.), and is meant as an alternative to data assimilation into circulation models. The same approach has been recently applied to a shallow-water region in order to infer current profiles and to obtain maps of sea-surface slope from HF radar current estimates (Marmorino G.O.,

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Shen C.Y., Evans T., Lindemann G.J., Hallock Z.R., Shay L.K., 2004. Use of 'velocity projection' to estimate the variation of sea-surface height from HF Doppler radar current measurements. Continental Shelf Research, 24, 353-374, 2004.). More recently, coupled with a two-layer density plume model, this technique was applied to estimate current profiles and density structure in a coastal zone dominated by a plume (Gangopadhyay A., Shen C.Y., Marmorino G.O., Mied R.P., Lindeman G.J., 2005. An extended velocity projection method for estimating the subsurface current and density structure for coastal plume regions: an application to the Chesapeake Bay outflow). The so-called "Velocity Projection Technique" introduced in these papers, relies on the surface-to- subsurface viscous coupling and turbulent transfer of momentum and shear in order to infer the velocity distribution over depth from measured surface currents and wind stress. This method, applied in its original formulation to shallow coastal water, resolves the vertical structure of the currents in terms of a finite expansion of orthogonal modes spanning the water column. The modal weights are obtained by applying appropriate dynamical constraints to the inferred current profiles and their vertical derivatives at the boundaries.

Abstract / main body: define surface. HFR sense different 'depths' based on the working frequency. Define Long-Range and spell "ADCP'. Although I am puzzled by the fact that 'no real data is used for this paper' some details should be given on the HFR systems mentioned here.

two methods are introduced here and the abstract mentions that one seems to perform better than the other one - please provide quantitative information so to guide other users in their choice and critically assess the reasons why one method is performing better than the other.

Introduction. lines23-27: I don't understand this sentence. it seems to me that you are using horizontal interpolation (as described in the cited references) to reconstruct the vertical profile - which is not the case here. please rephrase this (and other sentences in the ms, possibly with the help of a native English speaking service- as most of the

sentences are long and convoluted and can be misinterpreted.

Section 2.2 Please provide quantitative figures of data reconstruction accuracy - even from different deployments as long as other readers have a clear idea of what we're aiming at here.

Skill assessment: this is done at a very basic level. there's plenty of good skill assessment approaches that would be more appropriate than what is used here.

Section 3.1. This needs to be rewritten in a more understandable way.

Section 3.2. define winter and summer seasons.

Overall, I think it has potential, but, I am puzzled and at this stage I am choosing to reconsidr after major revisions although I am leaning towards rejection. no real data is used -apart from the initialization of the covariance matrix, which should have been derived through HFR data instead. Using real data is complicated, fair enough, but this would guide users to a feasibility study in a more realistic scenario: what is the effect of data gaps, what is the data output rate that should be used (hourly-daily-weekly averaged HFR currents?). There is no discussion of the proposed approaches against data assimilation into the model, which has proven a very effective way of correcting a model's trajectory. there is no discussion of the computational requirements or efforts, again for instance against data assimilation into the models. If the proposed approaches are more effective (machine time - wise for instance) well that's would be beneficial indeed.

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