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Ocean Science
Discussions

Interactive comment on "Can seafloor voltage cables be used to study large-scale circulation? An investigation in the Pacific Ocean" *by* Neesha R. Schnepf et al.

Anonymous Referee #2

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The authors go through the commendable and accurate process of estimating oceanic electric fields from models, to compare with data from 4 submarine cables. The primary results presented are correlations between the observed and modelled electric fields, which are used to infer the suitability of using submarine cables for oceanic velocity. The statistical interpretation of these correlations does not seem methodical enough to be believable in its current state. The conclusions presented are not detailed, and do not advance the field beyond earlier papers on the topic. Even their recommendations for placing cables in strategic points - an easy thing to propose but much harder to actually implement, see the SMART cable effort - does not include the specificity needed to ensure that such cables can provide useful results for inferring ocean circu-

lation, such as resolving meanders, variables subsurface sediment thickness, or flow acceleration/deceleration. This article focuses on just the first step of getting useful cable voltage measurements, obtaining a high correlation between observations and models, but the second step of interpreting why the cable voltages change is just as important and even harder.

Technical comments:

Intro

lines 41-43: Another confouncing factor is that, because longer cables integrate over longer distances, it becomes harder to assign transport or velocity to any single section of the cable.

lines 44-45: This question has already been addressed in the literature.

Data and Data processing

line 65: Also look at Luther publications from BEMPEX for an interpretation of the oceanic EF response at periods from hours to days.

Section 3

lines 86-93: Does elmgTD also include mildly conductive subsurface sediment layers, which varying significantly across ocean basins? Theses are important for interpreting oceanic EM signals.

Figure 3: What date/time are the ECCO velocities shown for?

Figure 4: Why is this shown globally, when the focus is on the North Pacific? It would be more instructive to show the signed electric field across the cables, as the fact of taking the absolute magnitude hides the important fact of current reversals across the cables? What time point do these figures apply to? The two pairs of plots (a and b; c and d) are slightly redundant: it doesn't matter what the surface or bottom fields/forcing are, but rather what their depth-integrated quantities are. Suggest reducing this figure

to 2 plots showing the depth-averaged quantities.

Section 4, Results and Discussion

line 119: I am highly surprised that "all of the p-values were equal to 0". Given that a p-value is positive definite by definition, I expect this to be impossible, certainly with real-world noisy data. This statistical significance testing needs to be redone more accurately. You need to also account for the degrees of freedom of a low-frequency signal.

For interpreting the HAW1N, HAW1S, and HAW3 voltages, it would be instructive to do statistical tests (see earlier comments) to see if the correlations of these cables with the model data are statistically distinguishable from each other. I am doubtful that they are.

lines 153-156: This is the crux of successfully using submarine cable voltages: placing it in a region that is conducive to interpreting such measurements. Note also that substantial effort is put into calibrating the Florida Current voltage time-series, see more recent publications by Meinen.

lines 157-163: Yes, most scientists who work with submarine cables could confirm that these are useful requirements for using such signals to interpret voltages. This point is not, however, substantiated in detail by this paper.

Nowhere do the authors note that their correlations are subject to an important additional source of noise: that the ECCO model might not accurately reflect the actual monthly averaged oceanic velocity field. To my knowledge nobody is able to evaluate ocean models based on their velocity field (for many practical and technical reasons). In light of this, a better approach, see Flosadottir et al 1997, would be to use a "perfect model" approach, so that you don't have to worry about the mismatch between ocean models and actual ocean circulation.

Also, for understanding the Florida Cable results, important details are presented in

Spain and Sanford, J Mar Research, 1987.

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