

Interactive comment on “On the modulation of the periodicity of the Faroe Bank Channel overflow instabilities” by E. Darelius et al.

Anonymous Referee #2

Received and published: 10 July 2015

1) General scientific comments

The article combines observations - a set of one year-long moorings and SLA from AVISO - with results from a regional high-resolution model to describe the variability at the FBC sill and downstream of it. The observations reveal oscillations with variable strength and periodicity, which are consistent with changes in the outflow transport across the FBC sill. An increase in the outflow transport leads to downstream oscillations that are more intense and with a shorter period, and this is confirmed by the results from the numerical model and by the baroclinic instability theory. This is clearly presented and it is also consistent with a previous study by Guo et al., 2014. The article also explores how changes in the barotropic background flow and upper layer currents can partially help to explain the changes in oscillation period; this is also consistent

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with previous studies. However, a clear connection between the different parts of the paper, including the potential role of TRWs, is not provided. It is not clear to me how important the numerical model results are in this study, since the main conclusions are mostly drawn from the set of moorings, the AVISO data and previous studies. It would be useful to know how well the model represents the real world; I understand that the model was run for a different period than the observations, but some kind of model vs. observation comparison would be useful in identifying why the model fails to capture some of the processes discussed in the paper, including the inflow events discussed in the last paragraph of page 838. The manuscript is overall well written. Once the different components and the general picture are clearly presented, it will provide valuable information to the community and, therefore, it will be suitable for publication.

2) Editorial comments

page 824, line 18: “for decreased plume thickness” I think it should be “for increased plume thickness”.

page 824, lines 22-24: This is an important statement. However, it is not clear in the text (see comment below about page 835, lines 7-8) how this was estimated.

page 825, lines 3,9: “outflow” and “overflow”. What’s the difference between overflow and outflow? If there is no difference between them, I suggest using just one term throughout the paper for consistency.

page 826, lines 6-8: This sentence is not clear, please rephrase it. Also, please clearly state that the goal of this study is to investigate “the modulation of the oscillations and ...” (lines 9-11), and I suggest that you include a quick description of your findings at the end of this paragraph.

page 827, lines 9-11: Any specific reason for choosing a Morlet mother function? Are the results sensitive to this choice? Please state that in the text.

page 827, lines 21-23: This sentence is not clear, please improve it. Some explanation

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on the effect (if any) of the artificially elevated EKE values on the results would be useful.

page 828, lines 3-11: Some comments on the sensitivity of the results to the choice of $T = 6\text{ C}$ would be good. For example, how would the results change (roughly) if $T = 5\text{ C}$?

page 829, line 2: Please define DMI.

page 829, line 19: Please state which Coast Guard.

page 833, lines 4-5: "Fig. 3c" => "Fig. 5c"; "Fig. 3b" => "Fig. 5b".

page 833, line 17: Please reference Figs. 7b and c at the end of the sentence.

page 833, line 22: "Faroe Shetland Channel" => "Faroe Shetland Channel (FSC)", since FSC is used throughout the text (e.g., page 834, line 27). Also, please include the location of the FSC in Fig. 1.

page 834, lines 15-20: Please reformulate this sentence. After reading it for a few times I could understand what you mean, but perhaps breaking it into two sentences would help the reader.

page 835, lines 7-8: Please explain how a correlation of 0.71 indicates that about 50% of the variance can be explained by the local barotropic force. It is not clear how this is done, so please include some explanation to help the reader.

page 835, lines 19-22: Where is the time series showing the thickness of the outflow across the sill? After a quick check, I could not find that in Hansen and Osterhus, 2007. A wavelet analysis of this time series could be extremely helpful.

page 836, lines 26-29: In the model, the oscillations (downstream of the sill) follow the outflow transport and the velocity of the upper layer (at the sill). However, there is not a connection between the outflow transport and the plume thickness at the sill. Is that right? if so, it needs to be presented in a clearer way (perhaps some additional

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plots would help).

page 838, first paragraph: Are these evidences that TRWs also play a role in the observed variability? If so, please make this clear. How about the numerical mode, does it also show the presence of these waves? I don't understand what is meant by "to changes in the intrinsic period", please clarify.

page 839, lines 1-4: Why does the model fail to capture inflow events? Please comment more on that.

page 840, lines 11-15: Have you explored the possibility of having TRWs generated by the outflow passing through the sill? Marques et al., (2014) GRL have shown that such waves can be generated by the outflow of Antarctic dense water through troughs. Depending on the ambient characteristics (i.e., ambient stratification, shelf slope, along-slope background flow), the energy of these waves may propagate in the opposite direction (or even be trapped) as the phase velocity/outflow. This could explain why the signal is not observed downstream. It is possible that neither the Nordic WOCE dataset nor the numerical model (HYCOM) captured these waves.

page 841, lines 2-4: Please reformulate this sentence. If possible, I also recommend including a final comment on the broader implications of your findings. For example, how can future observational programs or climate models benefit from these findings?

page 848, Fig.1: This figure needs to be improved. I think you should combine the upper and lower insets into one (i.e., show the study region and model domain in the same plot). It is hard to see which area is covered by the numerical model; maybe by showing a few isobaths in the inset this would be clearer. On the main plot: a schematic showing the main path of the outflow would help the reader.

page 849, Figure 2: If possible, please make these panels slightly larger and include the location of at least a few mooring that are shown in Fig. 1 in one of the panels.

page 852, Figure 5: In the top panel the x and y values are not shown, please fix that.

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Also, please make the panels slightly larger if possible; line 4: “and at the sill from FB at the sill”, this is confusing, please rephrase it; panel c: is that averaged velocity? if so, please specify in the text.

page 854, Figure 7: If possible, please include the location of at least a few mooring that are shown in Fig. 1 in one of the panels. Is panel d important? I do not recall any reference to it on the text. If this panel is not important, I recommend removing it from Fig. 7. Otherwise, please change some of the colors (the red-ish and black-ish) since it is hard to differentiate them.

page 855, Figure 8: Again, please use a different color for either T1 or T5.

page 857, Figure 10: It is hard to differentiate the blue and green plots in a and b. Please change the colors or make the lines thicker. What are the different curves in c? please explain that in the caption.

page 861, Figure 14: “EKE” => “EKE in the 2-6 days band”.

3) Typos

page 824, line 6: “is” => “are”

page 824/826, line 13/10: “high resolution” => “high-resolution”

page 825, line 3: “≡” => “=”

page 826/827, line 24/17: please add a comma before “respectively”

page 827, line 12: please remove the comma after “highest”

page 829, line 11: “z level” => “z-level”

page 830, line 4: “is” => “are” (I think)

page 830, line 19: “heatflux” => “heat flux”

page 836, lines 15,19: Please remove the commas before “highly” and “that”

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page 836, line 2: “linke” => “linked”

page 842, line 24: “deep water” => “Deep Water”

page 843, line 24: “Faeroe” => “Faroe”

page 848, line 2: “black, labeled” => “black-labeled”

Interactive comment on Ocean Sci. Discuss., 12, 823, 2015.

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