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The Cryosphere Discussions

Interactive comment on "Surface emergence of glacial plumes determined by fjord stratification" *by* Eva De Andrés et al.

Anonymous Referee #2

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Review of Surface emergence of glacial plumes determined by fjord Stratification by Andrés et al.

Andrés et al present oceanographic observations from two 1-2 week campaigns in July in 2012 and 2013 near a tidewater outlet glacier in SF. They include observations of temperature, salinity and ADCP-data near the terminus and apply a simple plume model to analyse the T/S-distributions in the two periods. They speculate that a larger stratification in the upper 10-20 m in 2012 explain why the plume was not observed at the surface in 2012. This is an interesting study and, in particular, the observations in front of the terminus are important for understanding the near-glacial dynamics. I find the application of a simple model justified for the analysis of the role of stratification and their results supports the hypothesis that increased stratification may prevent the

plume from surfacing. However, this mechanism is not a new finding and I find that the detailed discussion of Eq. 2, as it is presented, only explains a feature with this specific model setup and may not represent a general relationship. Model simulations are presented as "evidence", however they only support the hypothesis and the disregard the many assumptions about the real system in the model. More details about the initial conditions for the model simulations are required, and further information about the ADCP-data would be useful. I explain these comments further below. These comments need to be considered before I can recommend publication in Cryosphere.

Comments: Section 2.1 It is not clear whether data was obtained within the plumes from the XCTD's deployed by helicopter. Previous published studies have shown a significant difference between XCTD-profiles deployed in the center of the plumes and the near-by ambient water. Fig. 5 indicate that no profiles were obtained within the plumes. Please clarify whether data was obtained from within the plumes.

The model investigates the role of stratification and the relation between discharge rates and the neutral level. However, it applies the ambient stratification obtained from CTD-profiles. In relation to the comment above, it has been found that the stratification in the plume is significantly different from the ambient conditions. It is not clear how representative the applied stratification in this study is for the near-plume conditions. An analysis of horizontal gradients towards the plumes observed from the CTD-profiles is needed for assessing this important issue.

Eq 2 and Fig. 11: Fig. 2 implies a scaling depending on a and b. However, the found parameters of a and b does not result in a physical dimension of Eq 2 in accordance with the dimension of Z. Thus, the found relation does not represent a scale of the physical system but is related to the model-parameterisation and the applied parameters. It should be clarified to what extent this relation depends on the applied parameters in thid specific model setup.

Figure 7: This is a very interesting figure. However, information about the tides and

winds during the observational periods are missing.

L 360 “We have provided evidence that surface melting of a marine-terminating glacier, and the associated subglacial discharge, together with the fjord’s stratification exert a strong control on the dynamics of subglacial discharge plumes with implications for melting of the glacier face and export of meltwater”. I do not consider the model simulation as an “evidence”. The model results may support the hypothesis, but the applied model has not been validated against observations. The general model formulation is based on plume theory and it has been applied in several studies, but, as the authors point out, there are several assumptions in the choice of model parameters. Please modify the conclusions accordingly.

L 417: It is concluded: “We found that plume vertical extent is proportional to (ðİŚĄ2)−0.4ðİŚĎðİŚăðİŚŤ. While total submarine melting is proportional to (ðİŚĄ2)-0.43ðİŚĎ0.49ðİŚăðİŚŤ. These highlight the important role played by fjord stratification, and the subglacial discharge flux, in the dynamics and impacts of subglacial discharge plumes.” These findings are not based on observations, cf. my previous comment. It should be clarified that these relations are not constrained by data but related to the applied model parameters.

Minor comments: L 71: “No statistical differences were found between CTD/xCTD casts taken on different days . . .”. Statistical difference (?) has to be clarified.

L 73. “Temperature and conductivity values are converted to conservative temperature (Θ) and absolute salinity (SA) respectively (IOC, SCOR, and IAPSO 2010) using . . .”. The references in parenthesis are not included or explained.

L 231: replace sigma-theta with theta

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