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Interactive comment on "Friction and mixing effects on potential vorticity for bottom current crossing a marine strait: an application to the Sicily Channel (central Mediterranean Sea)" *by* F. Falcini and E. Salusti

Anonymous Referee #1

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The paper "Friction and mixing effects on potential vorticity for bottom current crossing a marine strait: an application to the Sicily Channel (central Mediterranean Sea)", by Falcini and Salusti, derives a set of prognostic equations for the relative and potential vorticity (PV) of a bottom current when both bottom and entrainment stress are present. In a second part, the authors apply their formulation to study some aspects of the dynamics of the deep water mass overflowing the Sicily channel from the eastern Mediterranean; the methodology relies upon historical field measurements.

The manuscript is well written and organised and it is generally easy to follow, al-

though some figures could be definitely improved (especially Figures 3 and 4; see suggested technical corrections below). The formulation is well argued and provides expressions for vorticity and PV as a function of more easily observable properties of oceanic overflows. The approach is original and the results can be of interest for physical oceanographers interested in oceanic overflows. However, there are some aspects regarding the case study of the Sicily channel bottom flow that require better justification (see specific comments below). Overall, I would recommend the publication of the manuscript once these questions have been properly addressed.

1 Specific comments

1. Page 2511; line 1. "The lack of specific current-meter measurements does not allow for a realistic determination of vorticity and, in particular, for a validation of our model".
   I understand that measurements do not allow the determination of vorticity but you have model data to validate your results. This should not be difficult to do and would be a good test for your theoretical estimates. I do not necessarily expect a perfect matching between model and theory, but such comparison is of interest and would be an added value of the paper.

2. Page 2512. I might be missing something important, but I do not understand the analysis included herein. Why is not $\epsilon = 0$ (eq. 19) if the terms ϵ_1, ϵ_2 and ϵ_3 are derived from the solution to (16a)? Perhaps you used a different friction term in equation 16a (that is, something different to $-K^*\zeta u/h^2$, with $K^* = 2.6 \cdot 10^{-2}$)? Please clarify this.

3. Page 2514; line 4-6. "Knowledge of the downstream evolution of ξ allowed us (i) to infer the deep vein dynamics, in particular, around the sill region, where the flow is dramatically non-geostrophic".

Is the flow around the sill dramatically non-geostrophic? If this was the case you are violating your assumption $\xi << f$. An explanation is required.

2 Technical corrections

1. page 2505. "...an additional resistive force (Baringer and Price, 1997b; Gerdes et al., 2002) **that** should be ..."
2. page 2507, line 18; "...around the sill...". Please specify that your are referring to the west sill here.
3. page 2508, line 2-3; I suggest "banked against the Sicilian shelf break" instead of "flowing along the Sicilian shelf break".
4. page 2508, line 7-8; I suggest "banked against the Tunisian shelf break" instead of "flowing along the Tunisian shelf break" .
5. page 2510. "Velocity interpolations are also compared with PROTHEUS numerical data".
   Â£Why is not $\bar{h}$ derived from the numerical model as well?
6. page 2511. "The lack of specific current-meter measurements does not allow for a realistic determination of vorticity and, in particular, for a validation of our model."
   Again, it would be nice to validate your results with the outputs of the numerical model.
7. page 2511. "Our diagnosis, through use of the A01 experimental data set, confirms (i) ... and (ii) the inability of classical approaches (e.g., Gill's formulation as well as similar ones) to describe flow vorticity under the presence of a narrow

sill".
You did not confirmed (ii) explicitly. Please either provide an explanation for (ii) or remove the sentence.

8. Equation (18); last term. $-2K^*\zeta u/h^2$ or $-K^*\zeta u/h^2$?
9. Figures 3 and 4 look a bit fuzzy. Improvement of their quality would be appreciated.
10. Caption of table 1. "φ(EMDW) is the EMDW flux".
    I suggest "volume transport" rather than "flux".

Interactive comment on Ocean Sci. Discuss., 11, 2495, 2014.