Ocean Science Discussions

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Comment on os-2021-30

Anonymous Referee #2

Referee comment on "Flow separation, dipole formation, and water exchange through tidal straits" by Ole Anders Nøst and Eli Børve, Ocean Sci. Discuss., https://doi.org/10.5194/os-2021-30-RC2, 2021

General overview

This is an interesting contribution that is within the remit of the Ocean Science journal. The authors discuss the dynamics of vortex dipole formation due to tidal flow. In general, it is an ambitious contribution that touches on a range of physics expected through the flow separation effects triggered through tidal straits

Specific comments

- On the definition of the case study - An idealised setup is explored and yet some practical elements seem to unnecessarily be included. For example, why would Coriolis effects be included in this case? Elements such as symmetry are also not exploited which could be interesting.

- "The water column is divided into two layers in the vertical" - does this provide sufficient vertical resolution? The depth the authors use could be used to argue that frictional effects are not so significant , (which is still not fully accurate as indicated later), but surely the flow separation (particularly in constricted straits) will lead to upwelling that will affect the vortex evolution. How is vorticity calculated? is it averaged across the 2 layers or is the top layer considered in the analysis

- Mesh discretisation - The analysis is based on spatially defined metrics such as vorticity and circulation. These are extremely sensitive to the resolution of the model. The fine resolution close to the strait bounds can lead to higher vorticity peaks that will influence the conclusions of the study - while coarse resolution will dissipate the vortices. It is challenging to conduct this analysis using unstructured models, and some earlier studies

included a mesh sensitivity, and a normalisation based on the element length to check whether the key dynamics are accurately preserved independently of the mesh resolution (see e.g. Vouriot et al, Env. Fl. Mech., 19, 328-348 (2019)). It is understood that the same issue was indicated in an earlier submission of this manuscript so this must be addressed. For example, Eq. 12 seems heavily affected by the mesh resolution and must proven that it is mesh independent.

- Increasing length of the strait will increase the effects of friction, and thus influence u and Q through the strait. This seems to be the reason for the monopolo/dipole trends of Fig.3. However, this is the reason why I suspect that Section 8.1 is invalid as friction becomes more and more important as the strait length increases.

- How was Γ determined for each vortex? How was Ts estimated and is uθ the propagation velocity of the vortex?