

Geosci. Model Dev. Discuss., author comment AC3
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Reply on RC2

Vera Fofonova et al.

Author comment on "Plume spreading test case for coastal ocean models" by Vera Fofonova et al., Geosci. Model Dev. Discuss.,
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Dear Reviewer 2,

Thank you for your comments. This manuscript deals with a much more basic problem than assumed by the reviewer. It diagnoses numerical diffusion in coastal models, showing that it is related to advection schemes rather than to discretization or mesh type. There are many other important factors that influence plume propagation in realistic configurations, as explored in the papers cited by the reviewer, but all they work on the top of model numerical factors. We surely agree that the questions raised in the papers cited by the reviewer are important in real-world applications, that many important aspects of plume dynamics were carefully explored in the papers cited by the reviewer. However, the level of numerical diffusion is also important, which is sometimes not fully appreciated. The present manuscript is addressing this question using a specially designed plume configuration that does not characterize a particular river.

It is important to note that all simulations considered in the manuscript

- do not consider the wind, wave or tidal forcing as all of the listed by Reviewer 2 articles;
- are done without physical eddy diffusivity (except one to see the difference) to be able to trace the level of numerical mixing accurately;
- are performed by different models using different schemes.

So, we present a novel test case and diagnostic metrics by which the numerical mixing in ocean models can be quantified. Such a test case can be rather helpful for model developers, especially as it allows comparing models with very different numerical discretizations (in the present paper we consider finite volume C and quasi-B grid models on unstructured and structured meshes, as well as a discontinuous Galerkin finite element model on an unstructured mesh). We believe that the novel test case and metrics are of interest to the model development community.

The references proposed by the reviewer are all examples of excellent work, but they go beyond the present study as they deal with processes not considered by us (e.g. impact of winds, river discharge, or tides) or focus on model assessment in realistic river plume simulations. They do not focus on the systematic assessment of numerical mixing as the present work does. We also note that there are numerous regional studies (some of them are cited in the manuscript), which focus on plume behaviour under different conditions in

the different areas worldwide, and we are citing a few of them, including the work proposed by this reviewer.

We have revised the manuscript substantially, shortening and making it easier to read.