

Interactive comment on “Eddy length scales and the Rossby radius in the Arctic Ocean” by A. J. G. Nurser and S. Bacon

Anonymous Referee #3

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Summary

This paper attempts to address an important topic for the dynamics of the Arctic Ocean, related to baroclinic deformation radii and scale of eddies involved in mass and property redistribution. However, it's lacking critical details on the model setup, assumptions used and actual simulation results, which are necessary in order to understand the presented results and properly review this paper. For example, there is no mention of model restoring, which I believe OCCAM has used in the past and which would affect its skill in representing upper ocean hydrography and density gradients. It is not clear from the paper, what a single value of a deformation radius at each model grid cell represent, as typical eddies in the ocean are of limited thickness hence their scale is a function of density over a specific depth range. Also, it is not clear from the paper

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how the authors interpret model estimates of deformation radii, which are at sub-grid scale. Finally, the authors should clearly state and justify what is a new science offered in this paper and how their findings are / are not a function of the model used. Other comments requiring further details, justification, or discussion are included below.

In summary, I recommend a major revision of this paper before it can be considered for publication.

Specific Comments

Abstract:

- clearly state what is the new science in this paper; in particular explain why estimate baroclinic radii of deformation from a model, which is not resolving such scales and does not realistically represent vertical distribution of T/S

Intro:

- provide a reference for or otherwise justify the following: “two gridpoints per eddy radius are necessary to adequately resolve the eddies, and one gridpoint per radius to “permit” them”; discuss if you expect to realistically represent the rotational velocity magnitudes of an eddy with 3-4 model grid points across?

Methods and Data:

- provide details of model horizontal resolution in the Arctic Ocean

- provide details on model surface salinity restoration and discuss its impact on vertical stratification

- assuming OCCAM uses hydrostatic assumption, discuss the horizontal scales involved in calculating model vertical velocity for calculations of deformation radius

- discuss the model ability, or limitations, in estimating deformation radii below its grid-cell size

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- vertical stratification and density gradients are varying with depth, which is why eddies are of limited thickness; explain how one should interpret model estimates of deformation radii calculated from the surface to the bottom

- provide details of model integration, including initial conditions, spinup time and its determination, the length of actual simulation, any model drift and methods used to determine it; in addition provide references and discuss the residence times of different water masses in the Arctic Ocean, which should help with determination of the required model spinup time

Results:

- provide uncertainty for model estimates of deformation radii and errors compared to observations

- discuss how the model can resolve very small deformation radii, which are sub-grid scale, especially those on the shelves and typical of mode 2 magnitudes

- discuss the criteria used/required to evaluate model skill in resolving / representing eddies

Interactive comment on Ocean Sci. Discuss., 10, 1807, 2013.