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Interactive comment on "Prospects for improving the representation of coastal and shelf seas in global ocean models" *by* Jason Holt et al.

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The paper examines the state of the art in the representation of shelf seas in global models and explores options for their better representation in future in terms of resolution, processes and numerical schematisation mapped against potential increases in compute resource.

The paper provides a background context by considering the interaction between shelf seas and the ocean in terms of impacts, i.e. upscaling and downscaling, and in terms of process representation. The bulk of the paper considers physical process resolution in terms of a set of characteristic length scales and assesses the relative 'cost' of refining processes to capture coastal and shelf sea scales in global models. The final section considers the cost benefit of three different numerical schematisations for capturing

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Discussion paper

coastal and shelf scales in global models – quasi-uniform structured meshes, unstructured meshes, multi-blocking refinement – against projected computer resource.

The 'standard' model against which the various options are considered is the 1/12 degree NEMO global model. The scale considered acceptable for coastal and shelf processes is a few metres in the vertical and 1.5km in the horizontal, leading to the requirement of at least 1/72 degree resolution in coastal and shelf sea regions and some form of hybrid coordinate in the vertical. It is suggested that such a requirement could be met in 6-10 years depending on the numerical schematisation employed.

Three points for me make revisions to the paper necessary:

1) Most of the introductory theory is well-known to modellers in both ocean and shelf communities, and could be truncated, keeping the informative figure 1 and reducing figures 2 and 3 since there is no discussion of 1/24 and 1/48 degree resolution, i.e. they are unnecessarily complicated. The same can be said for figure 7 as 1/36 degree resolution is only briefly discussed. I also feel that figures 4,5 and 6 contribute little enhancement over the given text and can easily be omitted.

2) It is understood that most of the authors are practised users of quasi-uniform structured grids, and, understandably, take one of their models as the benchmark. However the treatment of other numerical schematisations is given only cursory consideration and selects, what seems to me, to be a totally arbitrary scaling factor (5) for the performance of unstructured models (in this case FVCOM is chosen) against NEMO in a limited shelf region (without any detail of these simulations), which is then applied on a global scale. A more considered view of alternative numerical representations is warranted, and the authors are aware of some of these (e.g. FESOM, MPAS) and there are others (e.g. SELFE, SCHISM), and what about adaptive grid schemas? Also, there is no discussion of the efficiency of NEMO against other comparable models which are global (e.g. MOM, HYCOM, ROMS).

3) It is probable that, if aiming for a coastal-ocean resolving global model (i.e. 1/72

degree), then some of the processes discussed e.g. tides, sea ice, etc. will need to be included to properly represent the physical processes in these regions at this scale, so some estimates of their inclusion ought to form part of the discussion.

A few minor points, but ones that need attention:

Page 2, line 23. Liu et al reference missing

Page 5, line 14. Robinson & Brink reference missing

Page 5, line 17 "...tides are ubiquitous in the coastal-ocean". Well, no they are not an important process to resolve everywhere, some coastal ocean regions have extremely small tides.

Page 6, line 34. Please better explain the factor E

Page 7, line 35. Madec reference missing

Page 8, line 29. St. Laurent reference missing

Page 9, line 20+. Worth adding further detail regarding the sophistication of the hpg calculation and explanation of its impact on the energy cascade

Page 10, line 12. "... but is not generally used ..." is it 'used' or 'required'?

Page 12, line 5. States Figure 9, should be Figure 10

Page 12, line 8. Need a reference for the statement "serious numerical issues"

Page 12, lines 13-16. Sentence badly constructed

Page 13, line 30. What are the implications of this energy figure?

Page 13, line 31. The projections of compute power in Figure 9 appear to be based on extrapolations of existing architecture, how realistic is this assumption?

Page 14, line 38. Spelling ... ocean.

Page 17, line 9. Bryan reference incomplete.

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