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# The application of ICOM, a non-hydrostatic, fully unstructured mesh model in large scale ocean domains

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There are many apparent advantages of the application of unstructured meshes in ocean modelling: a much better representation of the coastal boundaries, the ability to focus resolution in areas of interest, or areas of intensified flow, such as boundary currents, etc. In particular with adaptive mesh technology, where the mesh is adapted during the simulation as the flow evolves, one is able to resolve much smaller features in the often turbulent ocean flow, than would be possible with fixed, structured mesh models. The Imperial College Ocean Model[1], is a non-hydrostatic ocean model that employs fully unstructured adaptive meshes, that allow focussing of resolution not only in the horizontal but also in the vertical. This enables the modelling of physical processes, such as open ocean deep convection, density driven flows on a steep bottom topography, etc. that are very important for the global ocean circulation.

The Imperial College Ocean Model has been applied succesfully in the modelling of many of these processes. On the other hand hydrostatic, layered ocean models have a significant advantage in large areas of the oceans where the hydrostatic assumption is valid. The fact that with fully unstructured meshes it is no longer straightforward to separate horizontal, baroptropic modes and vertical, baroclinic dynamics, has consequences for both numerical accuracy and the efficiency of the linear solvers. It has therefore been a challenge for ICOM to remain competitive in these areas with layered mesh models. These problems have been overcome by, amongst others, the development of a new mesh adaptation technique that maintains a columnar structure of the mesh in such areas. The application of multigrid techniques has improved the effiency of the non-hydrostatic pressure solve[2] in such a way that convergence is now independent of aspect ratio, which makes the pressure solve competitive with that of a hydrostatic model.

In this contribution an overview will be given of some of the difficulties that were encountered in the application of ICOM in large scale, high aspect ratio ocean domains and how they have been overcome. A large scale application in the form of a baroclinic, wind-driven double gyre will be presented and the results are compared to two other models, the MIT general circulation model (MITgcm, [3]) and NEMO (Nucleus for European Modelling of the Ocean, [4]). Also a comparison of the performance and parallel scaling of the models on a supercomputing platform will be made.

## References

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