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ICOM going global: progress towards a new approach for tidal modelling

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Almost all of the current global ocean models use a fixed structured grid method and employ a spherical coordinate system. As the Earth has the shape of a nearly perfect sphere, this coordinate system seems to be the most natural option. However, this technique exhibits difficulties in dealing with the singularities at the South and North poles. In addition resolving local flow structures using a fixed structured grid can require a large number of grid cells. Given these issues with the current global ocean models, we are developing the Imperial College Ocean Model (ICOM) to run on the sphere.

ICOM uses an unstructured and adaptive mesh and is capable of simultaneously resolving flows on variety of scales. It is non-hydrostatic and employs an adjoint data assimilation method. To date ICOM has only been used on flat geographical projections. We report here a new approach to modeling flow on the globe. To avoid the problem of the polar singularities, the globe is represented in three dimensional Cartesian coordinates. A Jacobian mapping method is employed to transform the mesh on the surface of the Earth to a computational coordinate system. In this transformed coordinate space the elements have regular shape and solution accuracy is therefore preserved.

We detail the basic method of our approach and evaluate its performance focusing on tidal modeling.