



Local grid refinement within ICON based Earth System Model at DWD

The project “Earth System Modelling at the Weather scale” (ESM-W) by DWD in cooperation with GeoInfoDienst BW aims to develop a coupled ocean-atmosphere forecasting system based on ICON-O for the ocean model and ICON-NWP for the atmosphere.

As part of this project, in an effort to improve the prediction capability of the ocean model without significant increase in computational resources required, the coastal grid refinement algorithm (by Logemann) is adapted and tested on arbitrary regions (not just coastal) as a way to locally increase resolution. Compared to Limited Area Mode (LAM), this approach preserves the globality of the model and requires only a single model run.

A region of interest inside the global ocean grid is defined, and then the grid generator modifies the grid topology by filling the predefined region with more cells, thereby increasing the resolution. The transitional zone between coarse and high-resolution regions is filled with gradually finer triangles, creating a gradual resolution transition. The algorithm accepts several refinement criteria at once meaning several regions can be refined at once, while also having the possibility of refining the coasts.

One of the main challenges comes from the gradient of the grid resolution which is never assumed when deriving the governing equations. This can easily destroy flow features and has to be properly tested and rectified. Our goal is to find a good solution to make this type of approach work in practical applications.

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