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Two-way nesting ocean models with different vertical coordinates

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The NEMO platform possesses a versatile block-structured refinement capacity thanks to the AGRIF library. It is however restricted up to versions 4.0x, to the horizontal direction only. In the present work, we explain how we extended the nesting capabilities to the vertical direction, a feature which can appear, in some circumstances, as beneficial as refining the horizontal grid.

Doing so is not a new concept per se, except that we consider here the general case of child and parent grids with possibly different vertical coordinate systems, hence not logically defined from each other as in previous works. This enables connecting together for instance z (geopotential), s (terrain following) or eventually ALE (Arbitrary Lagrangian Eulerian) coordinate systems. In any cases, two-way exchanges are enabled, which is the other novel aspect tackled here.

Considering the vertical nesting procedure itself, we describe the use of high order conservative and monotone polynomial reconstruction operators to remap from parent to child grids and vice versa. Test cases showing the feasibility of the approach are presented, with particular attention on the connection of s and z grids in the context of gravity flow modelling. This work can be considered as a preliminary step towards the application of the vertical nesting concept over major overflow regions in global realistic configurations. The numerical representation of these areas is indeed known to be particularly sensitive to the vertical coordinate formulation. More generally, this work illustrates the typical methodology from the development to the validation of a new feature in the NEMO model.