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Impacts of a new analytical stretching function for terrain following vertical coordinates

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Terrain following vertical coordinates are commonly used in coastal ocean models as they allow an accurate representation of the bottom boundary layer. However, the depth dependence of these coordinates results in horizontal variation in grid cell heights, with these variations becoming large in model domains which span large depth ranges. In the surface layer in particular this causes problems. Inconsistencies in the depth of the surface layer results in non physically-justifiable differences in the way atmospheric fluxes are applied to the ocean model. Also, when coupling to atmospheric models the depth variation of the surface grid cell leads to discrepancy in what is meant by 'sea surface values' meaning the boundary conditions provided to the atmospheric model are inconsistent.
Stretching functions are commonly used to limit the horizontal variation of vertical resolution in parts of the water column. However in models spanning large depth ranges, such as the Met Office's Forecasting Ocean Assimilation Model (FOAM) Atlantic Margin Model (AMM7), commonly used stretching functions cannot suitably limit this variation near the surface without causing unacceptable loss of resolution in other parts of the water column.
A new stretching function for terrain following coordinates is presented. The new stretching function allows a user-prescribed, constant surface (and bottom) cell height whilst maintaining resolution throughout the water column, and allowing increased resolution at the surface or sea bed as required. The impact of this is tested on simulations of FOAM AMM7 and results presented.