Contribution ID: **34** Type: **Talk**

Implementation and assessment of a flux-limiter based wetting and drying scheme

Thursday 30 January 2020 12:00 (30 minutes)

Wetting and drying processes in shallow water systems by surges, tides and seiches have important societal, physical and biological impacts. Operational regional models are now of sufficient resolution, O(1 km), that the processes of wetting and drying need to be included. Here we describe a flux limiter based approach that allows a numerical ocean model with a flux formulation of tracer advection to wet and dry. Following WarnerEtal13, the flux limiter approach limits the outflow from a cell whose depth is below a critical value defined by the user. The limiter can be a step function or a smooth function of the water depth flux limiter, the latter increases model stability and avoid rapid alternation between dry and wet states on long slopes as the critical depth is approached. Furthermore, the user may proportionally limit the baroclinic fluxes as a cell transitions from wet to dry over the course of the large baroclinic time step. The simplicity of the flux limiter approach lends itself to its application within existing numerical models without significant intrusion into the code base. Here we explore the scheme's effectiveness, sensitivities and limitations within the 3D NEMO ocean model by assessing it using test cases of increasing complexity. It is shown to perform well in classic channel test cases and 2D parabolic test cases with analytic solutions. Its performance against analytical 1D dam break experiments is explored and used to interpret its performance against laboratory measurements of a 2D dam break. The scheme is also shown to run stably for a realistic 3D regional domain of the North West European shelf and to improve some aspects of the model's performance against tide gauges.

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No

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Track Classification: COMMODORE conference