Non-linear filtering of numerical oscillations in two-dimensional unstructured grids

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Abstract

This paper presents two non-linear filters to reduce numerical oscillations in two-dimensional transport models using unstructured grids. The filters were designed to maintain mass and to eliminate only the local extrema, leaving the rest of the concentration field unchanged, and can be applied locally or to the whole domain. The filters were implemented in a 2D control-volume finite element Eulerian-Lagrangian model, and compared with two alternative ways to reduce oscillations: the use of numerical diffusion and a selective high-order/low-order integration. The behavior of the filters was evaluated in two numerical tests: a synthetic case and a complex estuary. Results show both filters introduce less damping than the artificial diffusion needed for a similar decrease in the oscillations, and peak reductions are marginal, in particular for the local application of the filters. Solutions using one of the filters were superior to results of the high-order/low-order method, in particular in mass conservation. Finally, the computational cost increase due to the filters is negligible.