IMPLEMENTATION OF THE PIECEWISE PARABOLIC METHOD (PPM) FOR ADVECTION OF A PASSIVE SUBSTANCE IN POM

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Abstract
A Piecewise Parabolic Method (PPM) advection type scheme for a variable grid size has been implemented in the Princeton Ocean Model (POM). Preliminary tests for a tracer dispersion in the Adriatic Sea are presented.
Keywords : Adriatic Sea, Air-sea Interactions, Models.

An advection scheme for the Princeton Ocean Model (POM) was constructed based on the papers by van Leer [1] and Colella and Woodward [2]. Such numerical scheme is conservative and keeps sharp gradients, two requirements that is quite difficult to meet with the existing POM advection schemes. Since POM's grid spacing in vertical is nonuniform we had to use a slightly more complicated variant of PPM designed for the case.

In the first figure we present simple examples of the scheme behavior in advecting a Gaussian shaped concentration with constant speed, and a variable velocity case (sinusoidal shape) advecting an initially constant concentration.

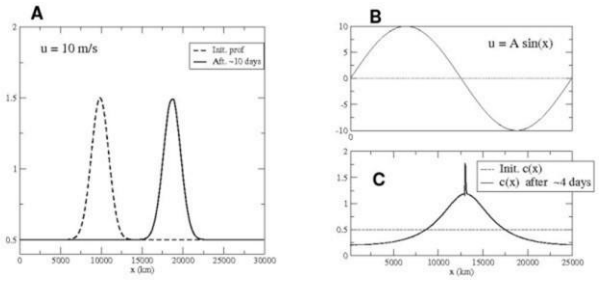

Fig. 1. The initial distribution of a passive substance with Gaussian shape, and its position after about 10 days of integration (A), velocity variation in space (B), concentration distribution after 4 days of integration (C).

The first experiment concludes that sharp gradients, if exist, will be preserved during the integration. The second experiment shows that very sharp gradients will be created if such situation arises. Once we were convinced that the scheme works as expected, we have implemented it in a fully coupled atmosphere-ocean model EBU-POM [3] (NCEPS' Eta is the atmospheric component, [4-7] while POM [8- 9] is the ocean component). The model was integrated for 17 days, staring from the 11th of February, 2003. That particular situation was characterized by strong bora, a cold wind that blows down the Dianaridis mountains from land to sea.

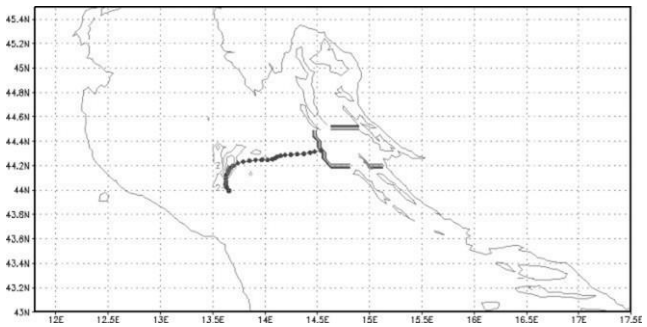

Fig. 2. Initial position of the patch and it's final position after 12 days of simulation. The dotted line is a 12 days trajectory of a point originating on the edge of the initial patch.

The second figure shows a snapshot of the tracer field from the 12th day of integration. A black line near the Croatian coast designates the initial position of the patch. Denoted by a dotted line, we show the trajectory of a point positioned at the edge of the initial concentration. This serves as a verification of the advection scheme.

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