Geophysical Research Abstracts, Vol. 9, 09895, 2007
SRef-ID: 1607-7962/gra/EGU2007-A-09895

Lagrangian modelling of multi-dimensional advection-diffusion with space-varying diffusivities

D. Spivakovskaya (1), A.W. Heemink (1), E. Deleersnijder (2)

(1) Delft University of Technology (2) Université catholique de Louvain
(D.Spivakovskaya@ewi.tudelft.nl)

Large-scale diffusion processes in the ocean occur mostly along isopycnal surfaces, i.e. surfaces of equal density. There is also some diapycnal diffusion. The latter is associated with a diffusion flux orthogonal to isopycnal surfaces. The diapycnal and isopycnal diffusion fluxes are commonly parameterized *ă la Fourier-Fick*, a formulation involving a diffusion tensor that is not diagonal. Many Eulerian discretizations of the isopycnal diffusion term yield discrete operators that are not monotonic - a problem which is particularly annoying. The discrete version of the isopycnal mixing parameterization can produce spurious oscillations in the tracer fields, which disagrees with the well-known properties of diffusion operators.

Lagrangian approach follows particles through space at every time step. The movement of a particle is modeled with a stochastic differential equation, which is consistent with the advection-diffusion equation. By simulating the positions of many particles the advection-diffusion processes can be described. The solution obtained by random walk method is always mass conservative and non-negative. It makes this approach very attractive for a number of applications.

In the present work the random walk schemes associated with non-diagonal diffusivity tensors whose components vary in space are established for multi-dimensional cases. These methods are applied for simulating the transport of a passive tracer along isopycnal surface. The numerical solution is compared with the analytical solution for a linear problem. The developed stochastic algorithm is also tested for one-dimensional settling and diffusion model for which key properties of the solution can be derived. Results of testing show that Lagrangian approach provides accurate and effective solutions of advection-diffusion problems for general diffusivity tensor.