Parallel Simulation of Particles in an Advection Field Applied to Volcanic Tephra Transport

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Abstract

Numerical simulations of volcanic tephra transport are of great practical interest. Indeed, hazard assessments are necessary for example in cases such as ground threats caused by tephra deposition or disruption of airline transport due to volcanic clouds.

Moreover, the physics of volcanic phenomena still requires a better understanding. Towards this end, having a flexible and efficient simulation tool could prove very useful. Eruption models usually describe particle motion via turbulent velocity fields. As turbulent transport can be modeled by a diffusion process, we consider here an approach capable of simulating the advection-diffusion of point particles in a given field.

We consider a hybrid Eulerian-Lagrangian model for which particles remain linked to a site with their exact position being kept track of. This allows one to deal with diffusion in an accurate way while maintaining a known maximum spatial integration step. The associated data structure facilitates a parallel implementation as well as the addition of a phenomenon like aggregation.

This work presents an MPI-based implementation of a parallel simulator of particles in an advection field with an application to the simulation of tephra transport in a strong plume eruption[1].

[1]Based on work by Kae Tsunematsu *New numerical solutions for the description of volcanic particle dispersal, PhD thesis Sc.4521, 2012, University of Geneva* `http://archive-ouverte.unige.ch/unige:26675`