Computational Astrophysics

2019

Exercises 15. 2 Dimensional Advection

2 Dimensional Advection Equation

The two-dimensional linear advection equation is

$$\partial_t a + u\partial_x a + v\partial_y a = 0 \tag{1}$$

where u is the velocity in the x-direction and v is the velocity in the y-direction.

As a first example in solving a 2 dimensional partial differential equation, you will advect a Gaussian profile

$$\Psi_0 = \Psi(x, y, t = 0) = e^{-\frac{(x-x_0)^2+(y-y_0)^2}{(2\sigma^2)}}, \tag{2}$$

with $x_0 = y_0 = 30$, $\sigma = \sqrt{15}$, with positive velocities $u = v = 0.8$ in a $[0, 100] \times [0, 100]$ domain.
In order to handle the boundaries, we will choose "outflow" boundary conditions, that simply copy the data of the last interior grid point into the boundary points.

Happy Coding :) !