

Computational Astrophysics

Problem 05. 2-Dimensional Advection

2 Dimensional Advection Equation

The two-dimensional linear advection equation is

$$\partial_t a + u \partial_x a + v \partial_y a = 0 \quad (1)$$

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

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

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 :) !