Advection Equation

- If we have a flow of the background fluid, mobile things can be transported

J: amount of some stuff (heat, chemicals, biology, etc.)

chain rule!

$$\frac{dJ}{dt} = \frac{\partial J}{\partial t} + \frac{\partial J}{\partial x}\boxed{\frac{\partial x}{\partial t}}$$

→ velocity of frame of reference (i.e. fluid flow)

$$\boxed{\frac{\partial J}{\partial t} + u\frac{\partial J}{\partial x} = S(x,t)}$$

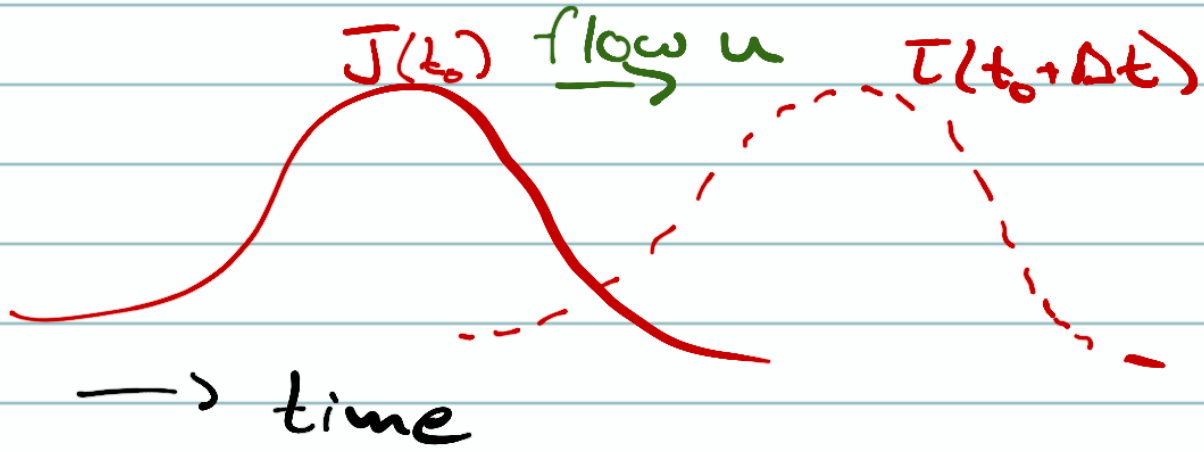
Advection Equation!

u: fluid velocity

S: source of stuff

This form assumes u is constant, but it can also be written in more general flux form

$$\boxed{\frac{\partial J}{\partial t} + \frac{\partial}{\partial x}(uJ) = S(x,t)}$$



Advection equation describes how things are transported by advection of background flow

Discretizing the advection equation

Consider $J_i^k = J(x_i, t_k)$ (k ← time index, i ← space index)

$i \in [1, \ldots, n]$

$k \in [1, \ldots, m]$