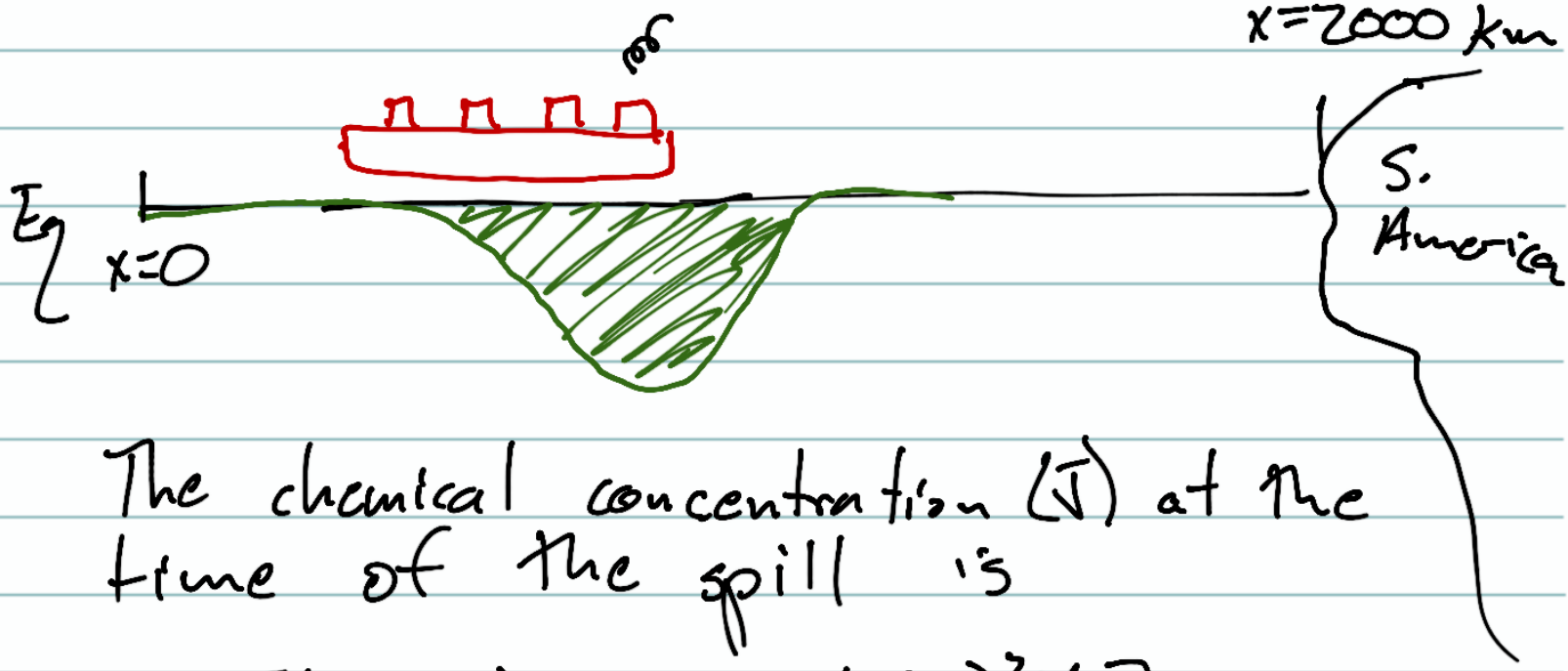
Advection Example - chemical spill in the ocean

A tanker in the Western equatorial Pacific unknowingly spills a chemical as it is steaming Eds



The chemical concentration (J) at the time of the spill is

$$J(x, t=0) = \exp\left[-(x-300)^2/10\right]$$

where x=0 km is Indonesia

Assume there is an equatorial current transporting material to the East at $u = 1$ m/s

Assume also that there is no flux of out each boundary ($x = 0, 2000$ km).

$$\frac{\partial}{\partial x}(u\vec{J})\Big|_{x=0,2000} = 0$$

Step 1] Write down all the necessary ingredients: ① continuous model eqns, ② initial conditions, ③ boundary conditions
(5 mins)

Step 2] Write down discretized equation in terms of time steps t_i and spatial grid points x_j
(10 mins)

Step 3] Write the discretized eqcations w/ boundary conditions in the form of a matrix equation for each time step
(10 mins)

Step 4 | Write some code with calculates the matrix M in the time