Climate Modeling

Homework 4 due 04-29-2013

1. Test the properties of the leap frog and upwind schemes of the advection equation numerically. Construct a grid with M=50 (+2) grid points in the spatial (x) direction and use cyclic boundary conditions ($C_0=C_M$, $C_{M+1}=C_1$). Use $\Delta x=1$ and u=1. Initialize the model with a half sine wave of wave length $\lambda=20\Delta x$ in the first 10 grid points and zero elsewhere. Now integrate the model forward. Due to the cyclic boundary conditions your signal should return to its initial position after some time. To initialize the leap frog scheme use for the first time step an Euler time step. Plot the original (initial conditions) signal and the signal after it has propagated once through the grid. Experiment with different time steps. (7)
2. Test the conservation properties of the schemes and plot the average tracer concentration as a function of time. (2)