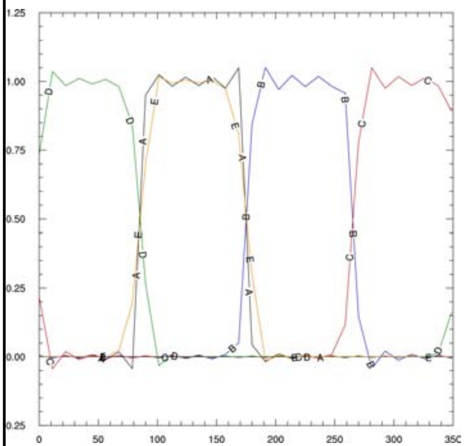
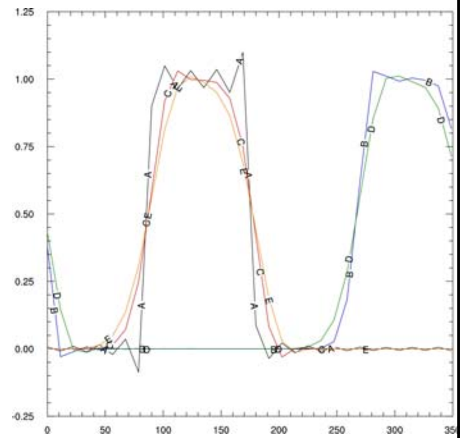
Diffusion and implicit solutions

Spectral advection

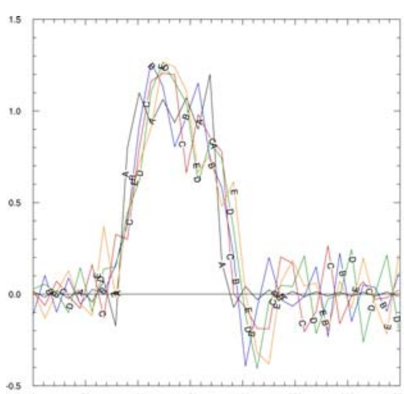
- Does the scheme conserve mass?
- Does the scheme conserve variance?
- Is the system positive definite?
- Are there errors in phase?
- Are there errors in amplitude? Are errors dependent on the shape you are advecting?
- Is the computational mode an issue in this model?
- If you truncate the solution does the model still behave well?



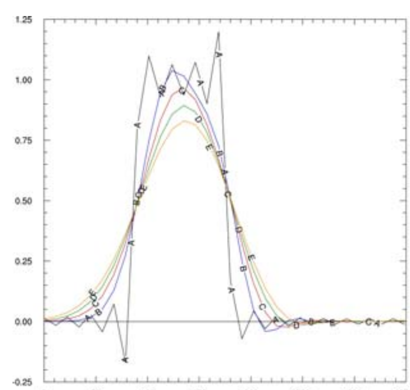
C = 0.13, vnu = 0



C = 0.27 vnu = 0.2

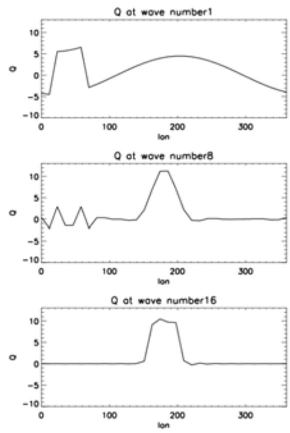


C = 0.53, vnu = 0



C = 0.53, vnu = 0.2

Truncation



$$q_k = \sum_k^N A_k e^{ikx}$$

$$A_k^{n+1} = A_k^{n-1} - 2u\frac{\Delta t}{\Delta x} B_k^n$$

Truncate A_k (state),
B_k will follow.

Assignment

- Remember to perform stability analysis of your models!
- (could present this as an appendix, etc)

Lab assignment

In Boulder the ground is frozen during winter, and plants can not grow in frozen soil. During spring, the soil thaws.

1. When should I plant tomatoes?
2. When will the tomatoes die (from the first frost)?

Build a model of the top meter of soil. Assume growing can start when the top 50 cm of soil thaws.

Heat flux through soil can be written proportional to the temperature gradient, such that local temperature change (convergence of flux is written:

$$\frac{\partial T}{\partial t} = K \frac{\partial^2 T}{\partial z^2}$$

Solve for T(t,z) with appropriate value of the diffusivity K, and a solution scheme.

The air temperature can be taken as mean of 280K of with an annual cycle of with an amplitude of 20 K