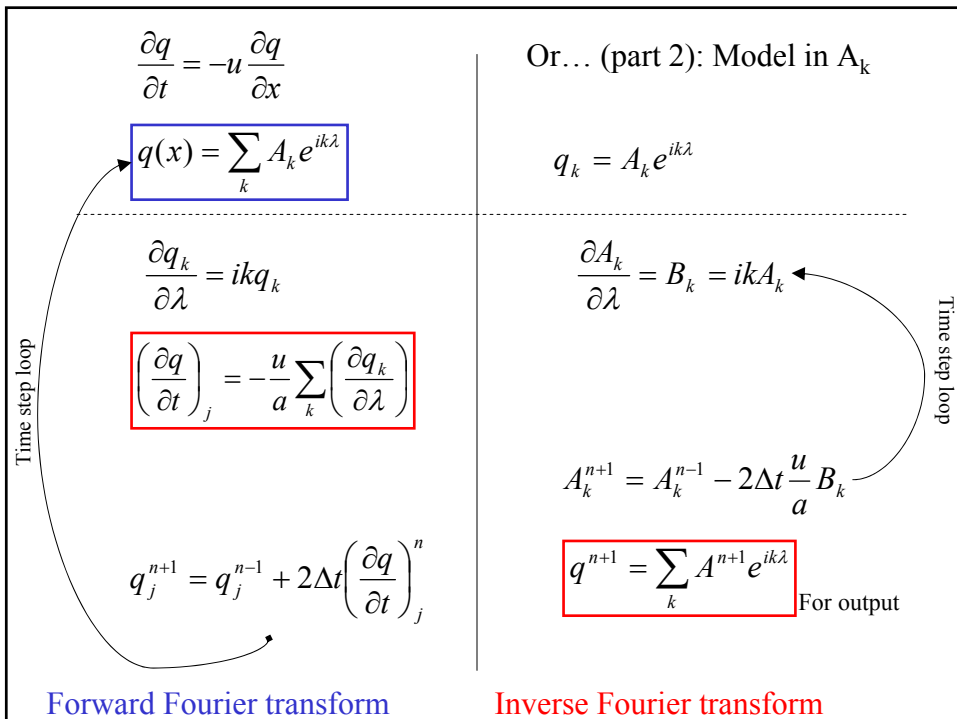


Spectral advection model



Tips for implementation

- Begin with the advection model from last week.
 - Use 32 points from west to east, and choose u to give one complete cycle every 20 days.
 - Set up a test to ensure that you can for the FFT for q . Confirm the inverse FFT should give you back q .
For the first step, find the derivative with Fourier coefficients (be careful with real and complex variables!)
[It might be useful to output and plot the dq/dx from both finite difference and spectral form to double check]
 - Increase the number of time steps
1. Part 2: Modify the time stepping to use Fourier coefficients rather than grid point form. Do the FFT for output.

Fast Fourier Transform

- Takes grid point $q(x)$ values and returns Fourier coefficients $A(k)$
- Takes Fourier coefficients $A(k)$ and returns grid point values $q(x)$
- Subroutines in `fft99.F`

<code>call setfft(...)</code>	Initializes transform (once)
<code>call fft991(..., -1)</code>	Forward transform
<code>call fft991(..., +1)</code>	Inverse transform
- `nlon` MUST be even, and best if it has prime factors of only 2 (i.e., 4, 8, 16, **32**, 64, 128...)
- The array of data going in and out of the subroutine must be `nlon+2` in length
- The input data is **OVERWRITTEN** with output

FFT example

- The subroutine is in the file
~dcn/ATOC7500/week05/fft99.F
- See the example in:
~dcn/ATOC7500/week05/fftstub.f90

(compile with: f90 fftstub.f90 fft99.F)

Also, ~dcn/ATOC7500/week05/plotq.pro
can be used to plot the example output.

Discussion and experiments:

- 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 (set coefficients of high wave number to zero), does the model still behave well?
- What have we gained from going to a spectral model?