A self similar subgrid parameterisation is presented for the Large Eddy Simulation (LES) of atmospheric flows. In LES the large scales of motion are resolved by the computational grid, and the subgrid scales are parameterised. In this study we adopt a stochastic model to represent the subgrid scales via a drain eddy viscosity and a stochastic backscatter noise term. Both these terms are calculated from the statistics of a higher resolution reference Direct Numerical Simulation (DNS).

The subgrid parameterisation is developed for typical atmospheric flows simulated by the two-level quasi-geostrophic spectral equations. A reference DNS is generated, with 504 total and zonal wavenumbers, which is equivalent to a grid point approximately every 0.25 degrees. This data set is then truncated back to various smaller LES truncation wavenumbers, with the associated wavenumber dependent drain eddy viscosity and stochastic backscatter terms calculated. Using this subgrid parameterisation the LES is shown to replicate the energy spectra of the reference DNS.

It is also shown that when non-dimensionalised by the LES truncation wavenumber, the eddy viscosity (and backscatter) profiles form a family of self similar functions. A universal scaling law is developed, which approximates how the eddy viscosity and backscatter terms change with resolution. Using this scaling law, one can undertake a LES without the need to provide a reference DNS data set.