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The Nastrom-Gage spectrum — a review

The kinetic wavenumber energy spectrum of atmospheric motions at scales of the order of a few km up to several thousands of km was first measured in the landmark study by Nastrom & Gage (1983).

It was found that the spectrum can be divided into two ranges, a rather narrow synoptic scale range were the spectrum scales as k^(-3) and a broad mesoscale range (2-500 km) where the spectrum scales as k^(-5/3).

Ever since the measurement was made, there has been a lively debate on the dynamical origin of the spectrum, in particular the mesoscale part of the spectrum. It has been suggested that the dynamical origin of the mesoscale spectrum is 2D turbulence with an associated inverse energy cascade, downscale cascading gravity waves, downscaling cascading stratified turbulence or Surface Quasi Geostrophic turbulence.

In this talk I will review the observational findings as well as the different hypotheses. Based on recent observational evidence and numerical simulations I will discuss the various explanations and point out what extra pieces of knowledge we would need in order to reach a full explanation of the spectrum. Finally, I will discuss recent progress of GCM:s to simulate the spectrum, and possible modifications that are needed to make further progress.