The Formation Process of 3D normal-mode Energy Spectra using Numerical Simulation of Rossby Wave Breaking

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Energy spectra represented by a three-dimentional normal mode expantion follow the slope of $E = (p_s / g) c^2$. Rossby wave breaking plays an important role in making energy spectra. Tanaka and Watarai (1999) said wave breaking is caused by increasing the energy of noise waves. $E = (p_s / g) c^2$ is derived from the Garcia (1991)'s criterion $(dq/dy) < 0$, representing the local meridional gradient of potential vorticity becomes negative, in Tanaka et al. (2004).
In this study, we verified the criterions of saturation and breaking through time. First, we watched how the energy is transfered by each factors. The wave-wave interactions begin with the saturation of transportation from wavemaker to its harmonics. Second, the energetic relation among waves is reseached. The local meridional gradient of potential vorticity becomes negative in PV contours as the energy becomes $E = (p_s / g) c^2$, but wave breaking isn't neccesary occured. The transportation to noise waves is excited by the saturation of wavemaker and harmonics. Wave breaking occurs when the energy of noise wave becomes comparable with the total energy of harmonics. The results agree with the Tanaka and Watarai (1999)'s criterion of wave breaking and the Tanaka et al. (2004)'s saturation criterion.
Third, the baroclinic instability was injected under the fixed ratio. Transfering energy to the noise waves sets up the Rossby wave breaking and the structure of baroclinic instability defines the transportation of wave-wave interaction.

Keywords: Normal-mode energetics , Energy spectrum, Rossby wave breaking

