Geophysical Research Abstracts
Vol. 15, EGU2013-136, 2013
EGU General Assembly 2013

Scaling law of the self-similar multiplicative model for turbulent convection and its numerical verification based on a shell model

Zong-Peng Song (1) and Fei Hu (2)

(1) Institute of Atmospheric Physics(IAP), Beijing, China (szp@mail.iap.ac.cn), (2) Institute of Atmospheric Physics(IAP), Beijing, China (hufei@mail.iap.ac.cn)

Turbulent convection is of tremendous importance to areas of atmosphere and ocean. In atmosphere, thermally driven turbulence influences weather and atmosphere circulation. In ocean, thermohaline convection drives the deep-ocean circulation. Turbulent convection is relevant both on small scales for weather and large scales for climate and ecology.
In fully developed turbulent convection, heat and kinetic energy is injected from the integral scale L and cascaded to smaller scale, then dissipated on the dissipation scale η. It is believed that in the inertial range(η«r«L) the cascade mechanics is universal. Put it another way, in inertial range, there exists definite scaling relation between the velocity(temperature) structure function and distance r.
However, the cascade mechanics, especially the thermal cascade mechanics has not been well understood. Many cascade models have been proposed to solve this problem. Here we introduce the self-similar multiplicative(SSM) model(Hu, 1995) for temperature field. The scaling law yielded by this model has been found(Hu et al,2005) has found rather consistent with the experimental data through 1$\sim$8 orders. The experiment data is obtained from urban canopy layer. And the Rayleigh number is about 10̂9.
Furthermore, we carried out a numerical work based on a new shell model(Rayleigh number is about 10̂10), which shows the SSM scaling law fits perfectly with the numerical result through 1$\sim$8 orders. Shell model is a useful tool to investigate the statistical property and cascade process for turbulence, especially the structure function. The new shell model we carried out contains Richardson number and Prandt number .It is well suited for atmosphere turbulent convection.

Key words: turbulent convection, structure function, scaling exponent, self-similar multiplicative model, shell model