

Graduate School of Oceanography - OCG 695

Apr. 21, 2008, 3:30 PM, Corless Auditorium

Seminar Abstract

Zhitao Yu

Numerical Simulation of Roll Vortices under High Wind Conditions

Roll vortices, also known as large eddies, are common in the atmospheric planetary boundary layer (PBL). They contribute significantly to the vertical transfer of momentum and heat. Roll vortices have been observed by satellites, radars, and aircrafts in cold-air outbreaks over the ocean. Recent observations have shown roll vortices in the boundary layer of tropical cyclones. Yet very little is known about their formation, temporary and spatial scales and the impact on the momentum and heat fluxes under extremely high wind conditions.

High-resolution, 3-D large eddy simulation (LES) models can be used to simulate roll vortices. But 3-D LES models require significant computer resources and thus have limited utility. Observations have shown that the along-roll scale of roll vortices (~ 100 km) is much longer than the cross-roll scale and vertical height ($\sim 2-4$ km). Therefore roll vortices can be approximately treated as 2-D features. We have developed a 2-D model for simulating convective motions (roll vortices) in the boundary layer coupled with a larger scale model for the background flow. Our approach follows the idea of superparameterization which was introduced recently for explicit simulation of clouds in atmospheric general circulation models. The model explicitly calculates a two-way interaction of the background flow and the convective motions. The results of numerical experiments show that roll vortices obtained in our 2-D model have similar characteristic as those obtained in 3-D LES models and have similar momentum and heat flux vertical profiles. The existence of roll vortices enhances vertical mixing throughout the boundary layer and increases the surface wind speed. The sub-grid scale turbulence is only important near the sea surface and the top of the boundary layer where the vertical wind shear is significant.

Zhitao Yu received a B.S in Oceanography from Ocean University of Qingdao in 1994 and an M.S. from University of New Hampshire in 2001. He entered GSO as a Ph.D. candidate in the fall of 2006. His major professor is Isaac Ginis. Other members of his core committee are Georgi Sutyrin, Alexander Meyerovich, Tetsu Hara, and Malcolm Spaulding.

Please rank the abstract and presentation in areas A-G using the scale below:

0=Decline to Evaluate
1=Outstanding

2=Above Expected Standard
3=Acceptable

4=Below Expected Standard
5=Poor

A. Quality of Abstract _____
B. Preparation of Material _____
C. Timing _____
D. Scientific Content _____

E. Quality of Verbal Communications _____
F. Adequacy of Visual Aids _____
G. Ability to Handle Questions During Discussion _____

Comments and Suggestions

Evaluator: _____ . Please return to Academic Affairs Office, Box 43.