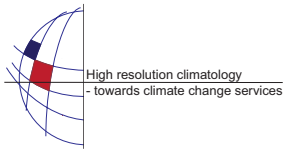
EMS Annual Meeting Abstracts
Vol. 7, EMS2010-702, 2010
10th EMS / 8th ECAC



A Non-Linear Mixed Spectral Finite-Difference 3-D Model of Planetary Boundary-Layer Flow over Complex Terrain and Its Application

W. Weng and P.A. Taylor

York University, Earth & Space Science & Engineering, Toronto, Ontario M3J 1P3, Canada (wweng@yorku.ca, +1 416 736-5817)

Based on the early linear and Non-Linear Mixed Spectral Finite-Difference (MSFD and NLMSFD) models, a 3-D non-linear model of planetary boundary-layer flow (NLMSFD-PBL) was developed to study neutral PBL flow over complex terrain. The model assumes upwind or zero-order profiles of mean and turbulence variables about which perturbation quantities are calculated due to the effects of the terrain. In early models, the mean zero-order wind profile was assumed to be a simple logarithmic surface-layer profile and Reynolds stresses were constant throughout the depth of the model domain. This formally limits the applications of model to the surface-layer flow. The new model utilizes the results of early 1-D planetary boundary layer model of Weng and Taylor as the zero-order or upstream profiles of mean and turbulent quantities. The limitations associated with the original MSFD/NLMSFD model (e.g. logarithmic wind profile and constant shear stress layer) are relaxed. The effect of earth's rotation is also included in the model.

Model results for planetary boundary-layer flow over complex terrain are discussed, particularly, the flow over Askervein hill – the site of a detailed and much referenced field study of flow over hills in the 1980s. This type of modelling of flow over complex terrain has important applications for wind energy resource assessment and wind farm design.