Japan Geoscience Union Meeting 2013
(May 19-24 2013 at Makuhari, Chiba, Japan)

AGE04-09 Room:102B Time:May 20 17:00-17:15

Surface heterogeneity and flux measurement height in large eddy simulations

Sofia Tu[1*], Annika.Nordbo[1], Antti Hellsten[2], Tiina Markkanen[2], Janne Rinne[1], Timo Vesala[1]

[1]University of Helsinki, Finland, [2]Finnish Meteorological Institute, Finland

Source/sink heterogeneity of a surface is a critical issue for micrometeological measurement methods of turbulent surface fluxes because the surface is heterogeneous in nature which is different from the assumption of horizontal homogeneity by most methods. This affects methods such as the eddy-covariance technique where fluxes are measured in situ from a mast and the source area (i.e. footprint) of the measurements lies upwind from the mast. If the horizontal scale of the heterogeneity is very small compared to the measurement height, effects of surface heterogeneity will be averaged out above a blending height, which would be below the measurement height. Moreover, if the spatial scale of the surface patches is so large compared to the measurement height that the turbulent flux footprint of the measurements will cover only one patch, the area within the footprint will be homogeneous. Hence, we will evaluate the impact of the scale of horizontal homogeneity on the turbulent flux for varying measurement heights. To obtain detailed turbulence information in the atmospheric boundary layer, large eddy simulations (LES) are applied. In addition, a Lagrangian stochastic (LS) model is applied for particle simulations in order to interpret source areas. Neutral and cyclic boundary conditions are set for LES model. Simulations are based on an ideal chess board surface with alternating surface exchange: particles are released from alternating squares and the source height is on the surface (0 m). Each simulated surface has a different, but homogeneous, roughness. This study reveals important information on the relationship between measurement height and horizontal homogeneity of the surface as well as the effects of surface roughness to the blending height. The results of the study can be used in the design of future flux measurement systems, and in the interpretation of results from the existing systems.

Keywords: Large eddy simulation, Lagrangian stochastic model, Blending height