Large-eddy simulations for the local log-law-of-the-wall in neutrally-stratified turbulent boundary-layer flows

M. Burlando (1), A. Mazzino (1), A. S. Lopes (2), C. F. Ratto (1)

(1) Department of Physics, University of Genoa, Genoa, Italy, (2) Faculdade de Engenharia da Universidade do Porto, Departamento de Engenharia Mecânica e Gestão Industrial, Porto, Portugal (burlando@fisica.unige.it / Phone: +39-010-353-6425)

In 2003, Besio et al. found that, in the presence of complex topography, the mean velocity profiles show a logarithmic behaviour with effective parameters locally depending on the position along the hill. They called this behaviour local logarithmic law-of-the-wall. To achieve a deeper understanding of this topic, the velocity fields over bi-dimensional sinusoidal topographies obtained by large-eddy simulation of neutrally-stratified flow have been analysed. By these analyses, the proof of the local validity of the logarithmic law-of-the-wall is provided for the first time exploiting this numerical strategy. The simulations recover the local log-law-of-the-wall involving effective parameters smoothly depending on the position along the underlying topography, and this dependence looks related to curvature effects of the streamlines rather than to the shape of the topography, as originally supposed. The genuine nature of the local log-law-of-the-wall is then investigated through both the evaluation of Reynolds stresses and vertical momentum fluxes, and the comparison with the undisturbed values over flat terrain. The results provide a physically consistent interpretation of the local log-law-of-the-wall over complex topography.