EPFL MIDDLE EAST

ÉCOLE POLYTECHNIQUE FÉDÉRALE DE LAUSANNE

ÉCOLE POLYTECHNIQUE FÉDÉRALE DE LAUSANNE

Innovation Program :	**Wind Engineering**
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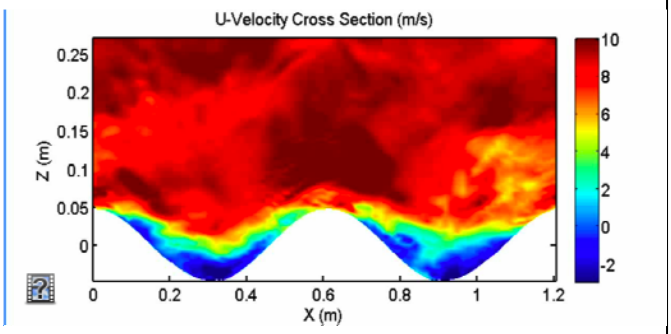
Main Laboratory:	Wind Engineering and Renewable Energy Laboratory (WIRE)
Project time line:	09.2010 – 09.2013
Research project:	**Modeling turbulent flow over complex terrain: surface heterogeneity and topography effects**

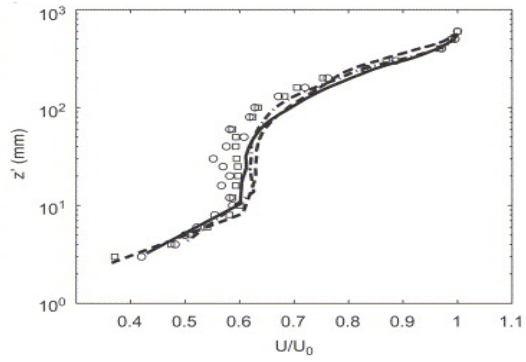
Abstract

Prediction of wind and turbulent transport of heat, water vapor and pollutants in the atmosphere is of great importance for wind engineering, wind energy and environmental applications. It requires numerical simulation of the highly turbulent airflow in the atmospheric boundary layer (ABL), the lowest part of the atmosphere, and its complex non-linear interactions with the land surface. These interactions are further complicated by the effects of surface heterogeneity and topography. Large-Eddy Simulation (LES) is the state-of-the-art technique used for simulation of three-dimensional unsteady turbulent flows. However, the accuracy of LES hinges on our ability to model physical processes that occur at resolutions smaller than the grid size (subgrid-scale processes).

The goal of our research is to develop and test improved numerical models (subgrid-scale parameterizations) for LES of atmospheric flow over heterogeneous terrain. To do that, we use a synergistic combination of theoretical work (for model development), experimental research (in the wind tunnel and in the field) and numerical simulations using supercomputers. Figures 1 and 2 show results from a numerical simulation of flow over an idealized sinusoidal terrain. These simulations are validated against wind-tunnel measurements.



Instantaneous velocity profile (m/s) of turbulent flow over idealized sinusoidal terrain



Simulated (lines) and measured (symbols) average velocity over the hill crest. Simulations were performed using the LES code developed in the WIRE Lab at EPFL