CREW Center for Research and Education in Wind

CREW Seminar Series: Fall 2012

Toward Multiscale Simulations of Flows in Atmospheric Boundary Layers for Wind Energy Applications

Abstract

Large-eddy simulation (LES) methodology was first developed to study turbulent flows in the atmosphere by Lilly (1967) and Deardorff, (1970). Through four decades LES has been extensively used to study flows over flat plate atmospheric boundary layers under the assumption of horizontal homogeneity. Carefully designed LES have contributed significantly to development of better understanding of canonical atmospheric boundary layers and their parameterizations in large scale models. LES were often carried out using research codes specifically designed and developed for horizontally homogeneous flows.

Simulations of flows in heterogeneous boundary layers are of great importance for a wide range of applications including wind energy. Recent developments in numerical weather prediction codes enable their nearly seamless use across a wide range of atmospheric scales from synoptic to turbulent scales in atmospheric boundary layers. To develop a comprehensive multiscale simulation capability we are utilizing nesting capability in the Weather Research and Forecasting (WRF) model. Achieving accurate multiscale simulations requires extensive code validation under a range of atmospheric conditions as well as addressing the question of turbulence modeling in the range of scales between mesoscales and boundary layer scales (Wyngaard, 2004). We first focus on validation of WRF-LES for simulations of flows over complex terrain using data from Askervein Hill (Taylor and Teunissen, 1985, 1987). Toward a goal of developing capability for multiscale simulations for wind energy applications, we have implemented a generalized actuator disk model in WRF. The generalized actuator disk model implemented in WRF-LES is capable of representing the drag and torque effects distributed over the turbine rotor disk. We demonstrated the use of WRF-LES to simulate flow through an array of wind turbines under neutrally stratified conditions. Our simulations show that WRF-LES with a generalized actuator disk model is capable of capturing the characteristics of wind turbine wakes and their interactions with consecutive rows of wind turbines.

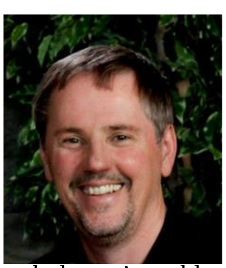
By **Branko Kosovic** from **NCAR**

On **Friday, October 19, 2012, at 11:00am**

In **Bechtel Collaboratory (room 1B50), Discovery Learning Center**
University of Colorado at Boulder

Refreshments will be available at 10:50am

To attend the live broadcast (using Adobe Connect):
https://meeting.colorado.edu/seminarseries-2012fall-brankokosovic/



Dr. Kosovic earned his B. S. degree in Mechanical Engineering at the University of Rijeka (Croatia), M. S. degree in Aerospace Engineering at the Penn State University and Ph. D. in Aerospace Engineering at the University of Colorado. Dr. Kosovic has worked at the California Institute of Technology, University of California at Davis, University of Colorado, and Lawrence Livermore National Laboratory before joining the National Center for Atmospheric Research (NCAR). His research focuses on studies of flow, transport, and dispersion in atmospheric boundary layers using large-eddy simulations. He specializes in subgrid modeling of turbulence in stably-stratified flows. He also worked on inverse problems using nonlinear optimization and Bayesian inference with stochastic sampling. He is currently working on extending multiscale modeling capabilities in the Weather Research and Forecasting model for wind energy applications. Dr. Kosovic is the Program Manager for Renewable Energy at the Research Applications Laboratory (RAL) of NCAR.

How to get to the CU-Boulder Discovery Learning Center

From 28th Street (Hwy 36), go west on Colorado Ave., which leads into the University. Take the next left (going south) onto Regent Drive. The Discovery Learning Center (DLC; highlighted in green below) is located on the west side of Regent Drive. Parking is available at visitor parking lots and nearby meters.
The seminar takes place in the Bechtel Collaboratory room (1B50), which is located in the 1st basement (ground level), on the east side of the building (right side of the building when you come in through the south entrance).