UNIVERSIDAD TECNICA
FEDERICO SANTA MARIA

DEPARTAMENTO DE INGENIERÍA MECÁNICA

CHARLA

En el marco de la asignatura Seminario de Ingeniería Mecánica, se invita a la Comunidad Universitaria a participar de la Charla:

"Numerical enhancement of a mesoscale model for large-eddy simulation of the wind over steep terrain"

Expositor: Dr. Alex Flores Maradiaga

FECHA : Jueves 11 de abril de 2019.

Hora : 11:30 hrs.

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Numerical enhancement of a mesoscale model for large-eddy simulation of the wind over steep terrain

Presented by: Dr. Alex Flores Maradiaga

Abstract

The Mesoscale Compressible Community (MC2) model, devoted for weather forecasting and used in the Wind Energy Simulation Toolkit (WEST), performs well for simulations over flat, gentle and moderate terrain slopes but it is subject to numerical instability and strong spurious flows in presence of steep topography. To remove its inherent computational mode and reduce the wind overestimation due to terrain-induced numerical noise, a new semi-implicit (N-SI) scheme was implemented to discretize and linearize the non-hydrostatic Euler equations with respect the mean values of pressure and temperature instead of arbitrary reference state values, redefining as well the buoyancy to use it as the thermodynamic prognostic variable. Additionally, the climate-state classification of the statistical-dynamical downscaling (SDD) method is upgraded by including the Brunt-Väisälä frequency that accounts for the atmospheric thermal stratification effect on wind flow over topography. This study provides a real orographic flow validation of these numerical enhancements in MC2, assessing their individual and combined contribution for an improved initialization and calculation of the surface wind in presence of high-impact terrain. By statistically comparing the wind simulations with met-mast data, obtained within the Whitehorse area of the Canadian Rocky Mountains, it is confirmed the numerical enhancements may reduce over 40 percent of the wind overestimation, thus, attaining more accurate results that ensure reliable wind resource assessments over complex terrain.

Profile Summary

Alex Flores has more than 10 years of experience in wind engineering, and is currently working as a full-time professor and researcher at the Department of Mechanical Engineering of the Federico Santa María Technical University (UTFSM). He has been lecturer of undergraduate and graduate courses, and is currently in charge of the Hirschmann Renewable Energy Laboratory at the UTFSM. He obtained his undergraduate degrees in Industrial Engineering and Mechanical Engineering, as well as a Master of Economics from the National University of Honduras. Then, he obtained a Master of Science in Mechanical Engineering from the Federico Santa María Technical University (Chile) and, finally, a Ph.D. in Mechanical Engineering from the University of Quebec (Canada).

He has led six research projects on wind engineering related topics, four of which were funded by the UTFSM, one FONDEF project funded by CONICYT and one Innova project funded by CORFO. His main research work is related to wind energy and geophysical fluid flow, with applications on the development of numerical and experimental methods for solving engineering problems. His interest is mainly focused on desinging innovative wind turbines, implementing novel wind resource assessment methods and applying advanced computational fluid dynamics to accurately predict the wind over complex terrain.