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VARIATIONAL MULTI-SCALE MODELLING OF ATMOSPHERIC FLOWS OVER COMPLEX TERRAIN USING ISOGEOMETRIC ANALYSIS.

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ABSTRACT

A computational fluid dynamics study of airflow over complex terrains is presented. In such terrain, the wind speed highly depends on location (i.e. ridge or valley) and stratification regime which possess significant challenges for the analysis. The objective of this work is to improve understanding of atmospheric flows over complex terrain through development of an efficient and robust numerical models.

The governing equations for flow over complex terrain are the incompressible Navier-Stokes equations for stratified flow. The variational multi-scale (VMS) framework is adopted to model turbulent stratified flows. The framework can handle different stratification regimes, e.g. atmospheric boundary layer flow with stable stratification [1] [2]. The computational domain is discretized using quadratic NURBS. The weakly enforced essential boundary condition is applied on the boundary representing the terrain surface.

Modeling techniques are first validated by comparing simulation results to experimental data for different terrain shapes, the Gaussian hill, RUSHIL experiment and Bolund hill. For further testing the airflow is modeled over complex terrain from the Perdigao project location. The Perdigao experiment is a part of the New European Wind Atlas campaign and has a focus on characterizing flow over complex terrain. The experimental region of interest, containing points of sampled data, is approximately 5700m x 2500m. The results are also compared with traditional finite element solution, showing good performance and accuracy.

REFERENCES

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