Numerical simulation of the windflow over complex topography: computational implementation and applications

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Abstract

The prediction of windfield over complex topography is of great value for several areas, such as the assessment of the eolic potential in a certain region, the evaluation of pollutant dispersion or the prediction of forest fires behaviour. The diagnostic model WindStation is a computer implementation of the Navier-Stokes solver CANYON [1], based on a graphical user interface. The original solver, written for a fully generalized coordinate system, was simplified to take advantage of the partial coordinate transformation in the two vertical coordinate planes, thus benefiting from improved run speed and lower memory storage requirements. The Reynolds-averaged Navier-Stokes equations are solved in their steady-state formulation, using a control volume approach. The SIMPLEC algorithm [2] is employed for the coupling of momentum and continuity equations, while turbulence effects upon the mean flow field are taken into account with the k-ε turbulence model [3]. Terrain roughness is modeled through a proper formulation of fluxes, adopting a logarithmic profile. Input data for the code consists on terrain elevation and terrain roughness description, stored in conventional ArcInfo ASCII grid files, and on wind data from meteorological stations. Alternatively, a wind profile may be specified. The software solves for wind speed and wind direction at the grid locations, along with turbulence quantities. Post-processing tools allow the visualization of the wind field at several elevations above ground level (cf. figure 1 and figure 2), statistical analysis and data export, among other features. Comparison of computed data with experimental measurements is also presented in this talk. The present code will be, in the near future, included in a larger package for the simulation of forest fires.

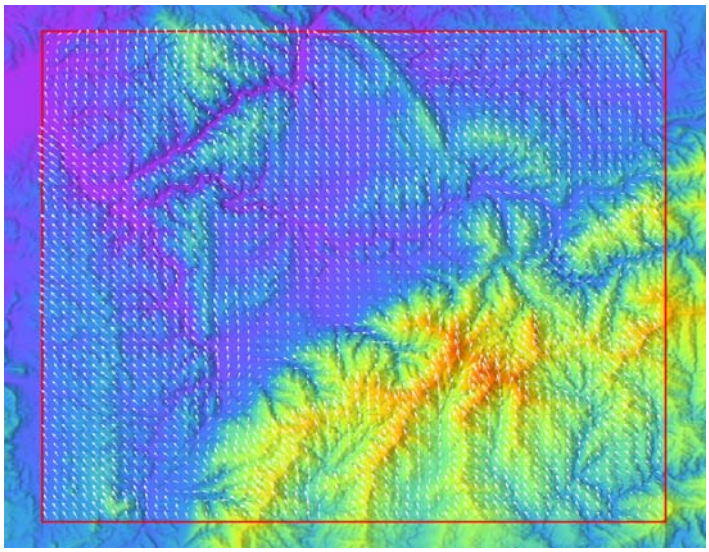

Fig. 1 - Vectorial representation of the wind field at a fixed distance above ground level.

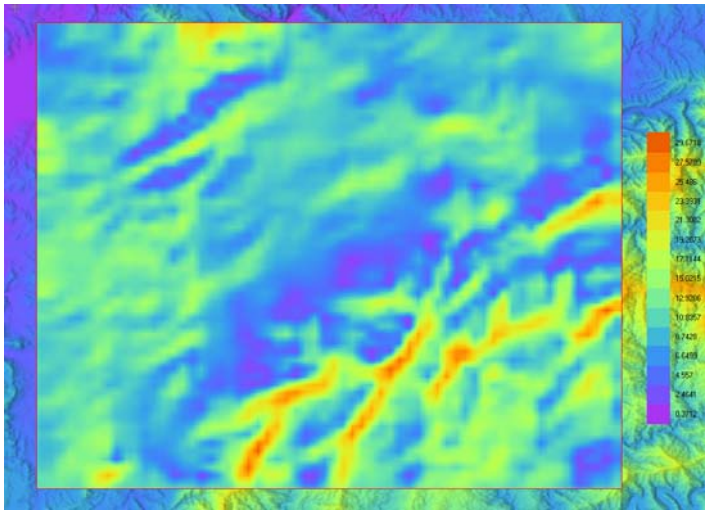

Fig. 2 - Colour-contour representation of the wind field at a fixed distance above ground level.

Keywords: Wind field, Complex topography, Navier-Stokes solver, Graphical interface

References

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