PO.110

CFD-based corrections of LiDAR measurements at several complex terrain sites

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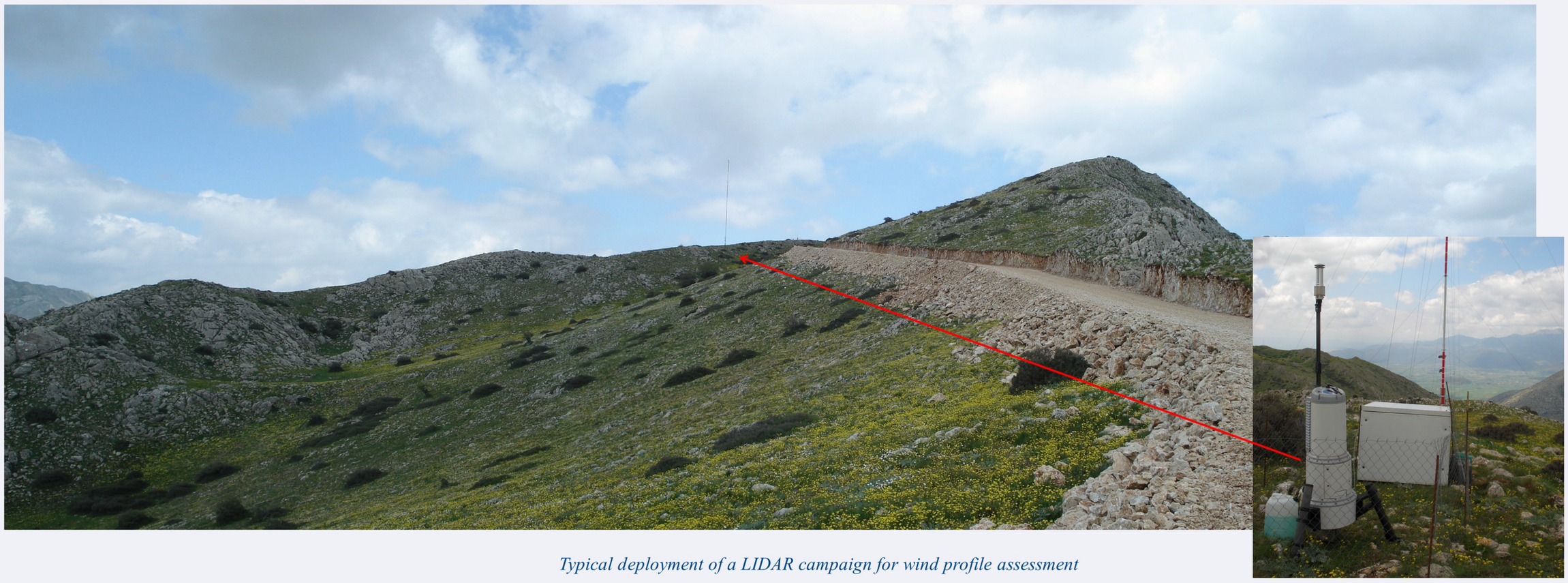
КАПЕ CRES



Typical deployment of a LIDAR campaign for wind profile assessment

Introduction

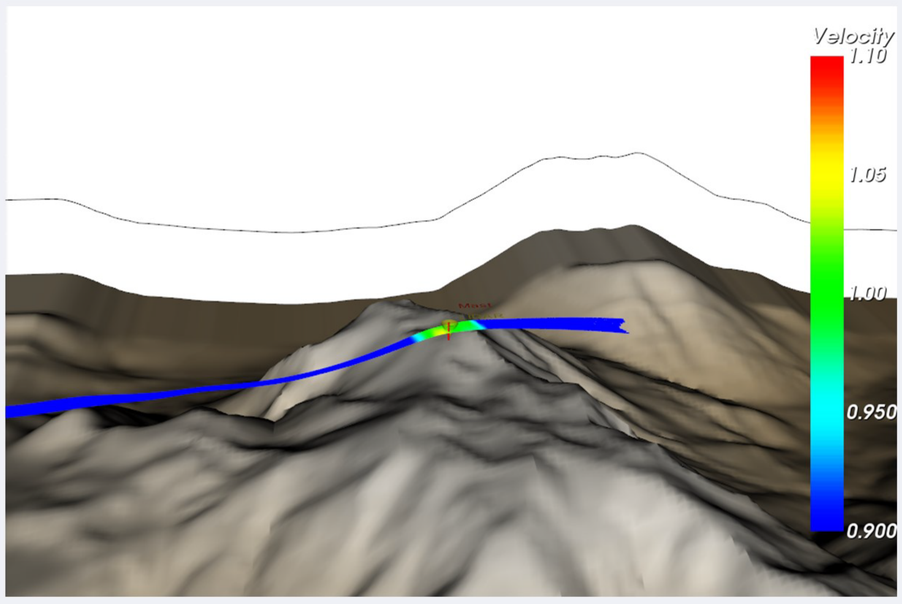
Recent experiments[1] have shown that in complex terrain sites, measurements of the horizontal wind speed from mast-mounted cup anemometers and ground-based LiDARs, present deviations that usually reach the range of 4-8%. These deviations are due to the different principles of measurements (point vs large volume) combined with the unavoidable wind flow inhomogeneity occurring at complex topographies. Therefore, a conversion of the results is necessary for the two measurements to be comparable. The present work describes the assessment of these deviations for several complex terrain sites, using a home-made CFD numerical tool, validated already in several round-robins and blind-test runs.

Approach

The present work presents results from several measurement campaigns, performed at various types of complex terrains, in Greece. These short-term LiDAR measurement campaigns (2-4 months), aimed to reveal the detailed wind shear and veer at the mast location. All datasets include the concurrent wind data from the top cup anemometer, mounted on an adjacent IEC-compliant (usually 40m high) meteorological mast. The numerical tool employed to assess the wind flow over the sites is "CRES-Flow", a CFD code that uses Reynolds averaged Navier-Stokes (RaNS) equations and the k-ω turbulence model [2].

Results

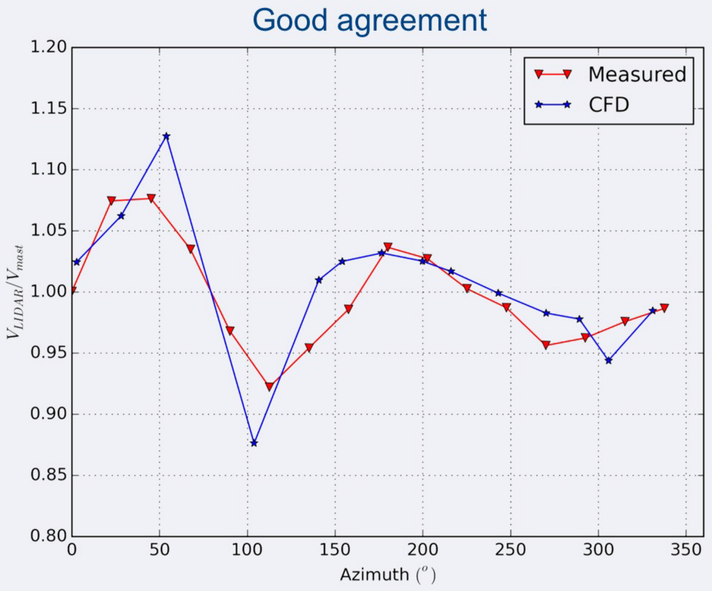
Iso-velocities variation within the LIDAR measurement cone



Polar variation of the LIDAR bias error (U_{LIDAR} / U_{CUP})

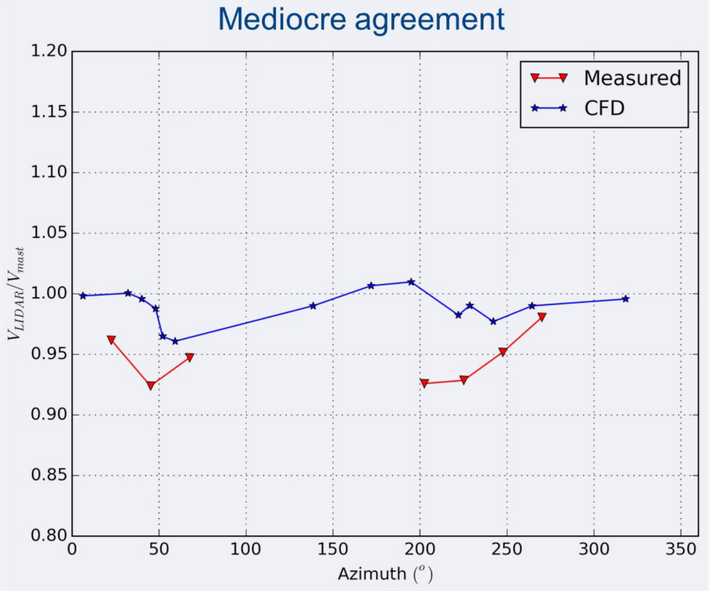
Case A

Good agreement



Case B

Mediocre agreement



Conclusions

Results confirm that the variation of the vertical wind speed component, within the scan code, is the main source of deviation of the horizontal wind speed between Mast and LiDAR measurements[3].

The described methodology reduces the observed deviations, by applying direction-dependent conversion factors to the LiDAR measurements and, if applied prior the LiDAR (or even the met. mast) installation, can provide indication for the best measurement location and device orientation.

References

[1] D. Foussekis, P. Gomez, M. Courtney "*Lidars deployment in Complex Terrain*", European Wind Energy Conference, Warsaw, April 2010.
[2] P. Chaviaropoulos D. Douvikas "*Mean Flow Field Simulations over Complex Terrain using a 3D Reynolds Averaged Navier-Stokes Solver*", Proceedings of ECCOMAS, 1998, vol. I, pp. 842–848
[3] F. Bingol, J. Mann, D. Foussekis "*Conically scanning lidar error in complex terrain*", Meteorologische Zeitschrift, Vol. 18, No. 2, 189-195, April 2009.