Geophysical Research Abstracts
Vol. 17, EGU2015-13098, 2015
EGU General Assembly 2015

Wind profiling with LiDARs: detection of boundary layer inhomogeneity and uncertainty analysis

Fernando Carbajo Fuertes, Jaime Legerén Álvarez, and Fernando Porté-Agel
École Polytechnique Fédérale de Lausanne, ENAC, WIRE, Lausanne, Switzerland (fernando.carbajo@epfl.ch)

Wind LiDARs are nowadays a standard tool for the estimation of wind resource because of their ability to measure wind profiles, their reduced cost, the flexibility of their deployment and their ease of use. They allow the measurement of the horizontal wind speed up to several hundred meters with a high accuracy, but only under several assumptions. The horizontal homogeneity of the boundary layer is arguably the most limiting one. Therefore, measurements in complex terrain and in other conditions where one could expect inhomogeneities are to be treated very carefully.

The most common scanning strategies for pulsed wind LiDARs to reconstruct the horizontal wind speed make use of either a 3-shot scan (one vertical, one towards the North and the last towards the East), a 4-shot scan (N, E, S and W) or a 5-shot scan (vertical, N, E, S, and W). These strategies, however, do not provide any information regarding the homogeneity of the boundary layer.

The inhomogeneity of the boundary layer is difficult to assess a priori since there are many facts that could contribute to it, being complex terrain the most discussed one in research, but by no means the only one. This makes it difficult to know when to trust, and to which degree, the measurements taken with the strategies mentioned above.

Alternatively to common strategies, consecutive PPI (Plan Position Indicator) scans can be used to calculate wind speed and at the same time estimate the inhomogeneity of the boundary layer. Furthermore, a theoretical and statistical uncertainty analysis has been carried out, which relates the uncertainty in the measurement to a coefficient that represents inhomogeneity. This allows the measurement of wind speed profiles together with their uncertainty under any kind of circumstances (even highly complex terrain) and the rejection of only those wind vectors that do not have the required accuracy.