A major risk to helicopters is the unexpected encounter of degraded visual environments in close-to-ground operations, where a loss of visibility often is caused by clouds of dust (brownout) or snow (whiteout) stirred up by intense downwash. The understanding of the phenomenon is limited, and there is a need for instruments that can measure flow fields on scales larger than a few meters with good resolution. This paper reports on the use of synchronized continuous-wave Doppler lidars for rotorcraft downwash flow field studies. Built from a modified ZephIR wind lidar and a double-prism arrangement for agile beam steering, a wind scanner—WindScanner—has been developed at the Department of Wind Energy at the Technical University of Denmark (DTU) Risø campus. The WindScanner measures the line-of-sight component of the airflow remotely and by rapid steering, the line-of-sight direction and the focus position; all points in space within a cone with a full opening angle of 1208 can be reached from about 8 m out to some hundred meters depending on the range resolution required.

The first two-dimensional mean wind fields measured in a horizontal plane and in a vertical plane below a hovering search and rescue helicopter are presented. Since the line-of-sight directions of the two synchronized WindScanners were scanned within the plane of interest, the influence of the wind component perpendicular to the plane was avoided. The results also demonstrate the possibilities within less demanding flows encountered within complex terrain and wind-energy-related research for which the WindScanner technology primarily has been developed.

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