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Drone Based Experimental Investigation of Wind Turbine Wake Evolution DR. BALAJI SUBRAMANIAN, Fluid Energy Science Laboratory, University of California Santa Barbara, DR. NDAONA CHOKANI, PROF. DR. REZA ABHARI, Institut fr Energietechnik, LEC, ETH Zrich, Switzerland. — The characteristics of the wake downstream of a wind turbine has an important bearing on the optimized micrositing of wind turbines in a given land area, as well as on the loads seen by downstream turbines. We use a novel measurement system to measure the flow field upstream and in the wake of a full-scale wind turbine. The system consists of a fast response aerodynamic probe, mounted on an autonomous drone that is equipped with a suite of sensors. These measurements detail, for the first time at full-scale Reynolds number conditions, the evolution and breakdown of tip vortices that are characteristic of the near wake, as well as the turbulent mixing and entrainment of more energised flow, which are distinctive in the far wake. A short-time Fourier transform (STFT) analysis method is used to derive time-localized TKE along the drone's trajectory. Detailed upstream and wake measurements are needed to understand the flow behavior, as it helps in developing and validating simplified wake models that can approximate the wake qualities. Comparisons of these measurements to recently developed wake prediction models highlights how these measurements can support further model development.

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