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**Modelling wind turbine wakes using the turbulent entrainment hypothesis** PAOLO LUZZATTO-FEGIZ, UC Santa Barbara — Simple models for turbine wakes have been used extensively in the wind energy community, both as independent tools, as well as to complement more refined and computationally-intensive techniques. Jensen (1983; see also Katić *et al.* 1986) developed a model assuming that the wake radius grows linearly with distance $x$, approximating the velocity deficit with a top-hat profile. While this model has been widely implemented in the wind energy community, recently Bastankhah & Porté-Agel (2014) showed that it does not conserve momentum. They proposed a momentum-conserving theory, which assumed a Gaussian velocity deficit and retained the linear-spreading assumption, significantly improving agreement with experiments and LES. While the linear spreading assumption facilitates conceptual modeling, it requires empirical estimates of the spreading rate, and does not readily enable generalizations to other turbine designs. Furthermore, field measurements show sub-linear wake growth with $x$ in the far-wake, consistently with results from fundamental turbulence studies. We develop a model by relying on a simple and general turbulence parameterization, namely the entrainment hypothesis, which has been used extensively in other areas of geophysical fluid dynamics. Without assuming similarity, we derive an analytical solution for a circular turbine wake, which predicts a far-wake radius increasing with $x^{1/3}$, and is consistent with field measurements and fundamental turbulence studies. Finally, we discuss developments accounting for effects of stratification, as well as generalizations to other turbine designs.

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