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Understanding turbulent entrainment using direct numerical simulations

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ABSTRACT

Turbulent entrainment (TE) is a key mechanism occurring in a variety of industrial and environmental flows such as jets and boundary layers. TE governs important aspects of these flows, such as the exchanges of mass, momentum and scalars (e.g. heat) and the growth of shear layers (e.g. jet spreading).

Recent experimental and numerical works have shown that the classical assumptions used to model the turbulent entrainment, which have been used over the last 40 years, turn out to be too simplistic. In short, the smallest scales of motion, which are inaccessible to engineering and environmental simulations, play a major role in the dynamics of the turbulent entrainment. This raises new challenges for modeling.

This lecture focuses on our current understanding of the TE mechanism based on recent direct numerical simulations (DNS) of turbulent flows. The implications for large-eddy simulations (LES) of environmental and engineering flows are also addressed.