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Complex network-based Lagrangian analysis of turbulent mixing in channel flows at different Reynolds numbers GIOVANNI IACOBELLO, STEFANIA SCARSOGLIO, Department of Mechanical and Aerospace Engineering, Politecnico di Torino, Turin, Italy, HANS KUERTEN, Department of Mechanical Engineering, Eindhoven University of Technology, Eindhoven, The Netherlands, LUCA RIDOLFI, Department of Environmental, Land and Infrastructure Engineering, Politecnico di Torino, Turin, Italy — Turbulent mixing is a fundamental issue in many applications, from natural phenomena to industry. In the Lagrangian viewpoint, typical investigations involve the temporal evolution of pairwise mean-square separation or multi-particle shape evolution. In this work, recent advances in complex networks are exploited to study turbulent mixing in a Lagrangian framework. The dynamics of a set of fluid particles is geometrized in a time-dependent complex network, in which nodes correspond to groups of particles and link activation is based on particle spatial proximity. A turbulent channel flow setup is considered at different Reynolds numbers, with the aim to highlight the relative intensity of advection and mixing. Specifically, accurate direct numerical simulations of turbulent channel flows are performed, with Reynolds number between 180 and 950. By doing so, the network-based approach is able to capture the temporal development of particle dynamics due to the turbulent motion, as well as transient and long-term features of wall-normal turbulent mixing. Based on present findings, Lagrangian-based networks can pave the way for a systematic network-based investigation of turbulent mixing, thus extending the level of information of classical statistics.

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