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Statistical Investigation of Turbulent Mixing by Means of Turbulent Line Segments MICHAEL GAUDING, NORBERT PETERS, RWTH Aachen University, INSTITUT FUER TECHNISCHE VERBRENNUNG, JARA-HPC TEAM — We examine the turbulent mixing of a passive scalar with imposed mean gradient. The Taylor microscale based Reynolds number varies between 85 and 530. A straight line through the turbulent field of a passive scalar ϕ is decomposed into piece-wise monotonously increasing or decreasing segments. These so called turbulent line segments (TLS) start at a local minimum point and end at a local maximum point or vice versa and are parameterized by the distance ℓ between the extreme points and by the corresponding scalar difference $\Delta\phi$. The implication is that TLS, whose mean length is about ten times the Kolmogorov length, characterize the dynamic process of scalar-energy dissipation. Firstly, we examine the joint distribution function of $\Delta\phi$ and ℓ and define the gradient $\Delta\phi/\ell$ of TLS. This helps to understand cliff-ramp structures as we can show at which length scale large gradients arise. Based on a statistical approach we can further relate the mean gradient to the local gradient and can examine the scaling of the kurtosis of the local gradient with the Reynolds number. Secondly, we define a structure function based on TLS, that relates the extreme points and calculate the scaling exponents. The result is compared with the KOC-theory.

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