Passive Scalar Transport in Peripheral Regions of Random Flows

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We investigate statistical properties of the passive scalar near boundaries (walls) in random (turbulent) flows assuming weakness of its diffusion. Then at advanced stages of the passive scalar mixing its unmixed residue is concentrated in a narrow diffusive layer near the wall and its transport to bulk goes through the peripheral region (laminar sublayer). We conducted Lagrangian numerical simulations of the process for different space dimensions and revealed structures responsible for the transport that are passive scalar tongues pulled from the diffusive boundary layer to bulk. We investigated statistical properties of the passive scalar and of the passive scalar integrated along the wall. Moments of both objects demonstrate scaling behavior outside the diffusive boundary layer. We propose an analytical scheme for explanation scaling of the passive scalar, the obtained exponents agree reasonably with numerics in 3d.