EUROMECH COLLOQUIUM 586
TURBULENT SUPERSTRUCTURES IN CLOSED AND OPEN FLOWS
JULY 12–14, 2017, ERFURT, GERMANY

External and internal shear layers in turbulent flows

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Most turbulent flows are inhomogeneous, where the statistical properties of the turbulence change as a function of position. This is particularly the case in the outer regions of jets, wakes, and boundary layers, where the turbulence propagates into the non-turbulent flow region and irrotational fluid is entrained into the turbulent flow region. Recent findings have confirmed that this process is dominated by viscous interactions in a thin interfacial shear layer [1]. Further observations revealed that similar shear layers also occur throughout the turbulent flow region that separate rather uniform flow regions [2]. It has been shown that these internal layers display the dynamics that are similar to those of the outer turbulent/non-turbulent interfacial layers [3]. When a dye was added to the turbulent flow region as a passive tracer, it was observed that the turbulent flow regions also contains uniform concentration regions that more or less overlap with the uniform momentum regions. (The non-perfect overlap can be understood in the different history of the momentum and concentration transport.) It thus appears that these shear layers are active features of the turbulent flow dynamics, which has consequences for the properties of transport processes in turbulent flows.

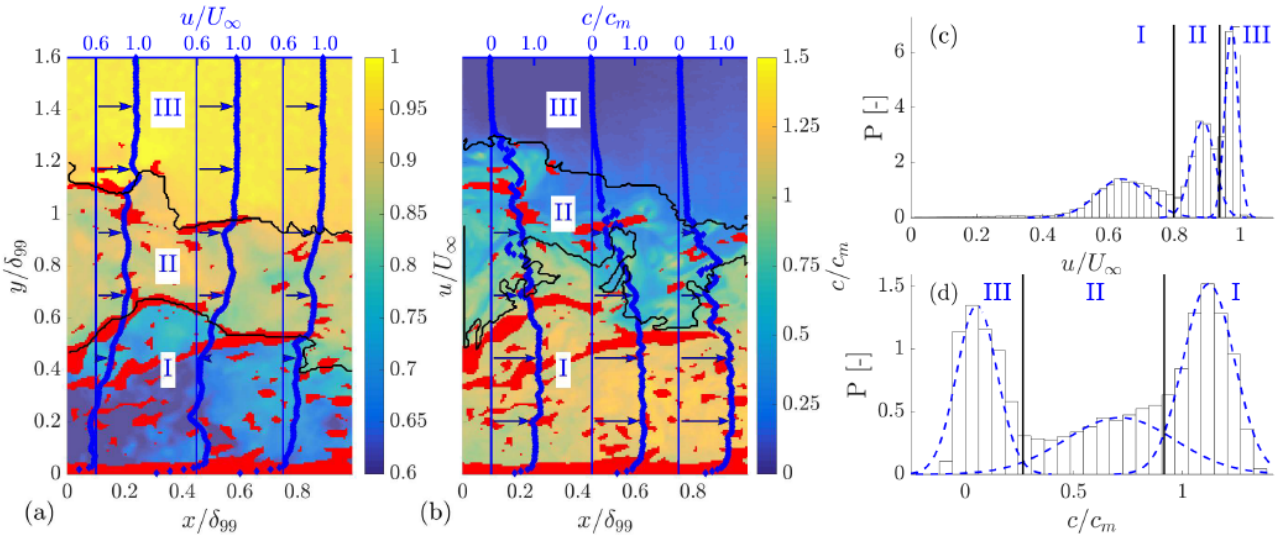

Figure 1: Uniform momentum (left) and concentration (right) zones (labeled I, II and III) in a turbulent boundary layer. Histograms on the right represent this instantaneous distributions for the velocity and concentration.

References

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