

Abstract Submitted
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Very-large-scale coherent motions in open channel flows.¹ QIANG ZHONG, Tsinghua University, FAZLE HUSSAIN, Texas Tech University, DANXUN LI, Tsinghua University — Very-large-scale coherent structures (VLSSs) - whose characteristic length is of the order of $10h$ (h is the water depth) - are found to exist in the log and outer layers near the bed of open channel flows. For decades researchers have speculated that large coherent structures may exist in open channel flows. However, conclusive evidence is still lacking. The present study employed pre-multiplied velocity power spectral and co-spectral analyses of time-resolved PIV data obtained in open channel flows. In all cases, two modes - large-scale structures (of the order of h) and VLSSs - dominate the log and outer layers of the turbulent boundary layer. More than half of TKE and 40% of the Reynolds shear stress in the log and outer layers are contributed by VLSSs. The strength difference of VLSSs between open and closed channel flows leads to pronounced redistribution of TKE near the free surface of open channel flows, which is a unique phenomenon that sets the open channel flows apart from other wall-bounded turbulent flows.

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