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Generalized higher order two-point moments in turbulent boundary layers. XIANG YANG, The Johns Hopkins University, IVAN MARUSIC, The University of Melbourne, CHARLES MENEVEAU, The Johns Hopkins University — Generalized higher order two-point moments such as $\langle {u'_z}^m(x){u'_z}^n(x+r)\rangle^{2/(m+n)}$ and $\langle[{u'_z}^2(x)-{u'_z}^2(x+r)]^n\rangle^{1/n}$ (where z is the distance from the wall, r is the distance in the flow direction, and m and n are arbitrary integers) are examined using high Reynolds number experimental data in turbulent boundary layer flow. Logarithmic behaviors with respect to both s and z in such statistics are observed. Certain predictions for such generalized log laws can be made in the context of the attached eddy hypothesis. Particularly simple results can be obtained for the scaling if one considers the velocity fluctuations at some point x and height z being the outcome of a random additive process, e.g. $u'_N = \sum_{i=1}^{N} a_i$, where Ndepends on the wall normal distance $z$as $N \sim \log(\delta/z)$, and the a_i's are identical independent random additives. Predictions can be made of the slopes in the generalized log laws and these can be compared to the experimental data. For instance, already for single point higher-order moments it was known that the model overpredicts some slopes, indicating a sub-Gaussian behavior in the statistics. Gaussian behavior is rooted in the assumption of independency in a_i's. We discuss some variants that introduce correlations, and provide evidence that the generalized higher order two-point moments can help discriminate among various possible models.

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