Geophysical Research Abstracts
Vol. 18, EGU2016-12419, 2016
EGU General Assembly 2016

Relations between overturning length scales at the Spanish planetary boundary layer

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We analyze the behavior of the maximum Thorpe displacement $(d_T)_{max}$ and the Thorpe scale $L_T$at the atmospheric boundary layer (ABL), extending previous research with new data and improving our studies related to the novel use of the Thorpe method applied to ABL. The maximum Thorpe displacements vary between -900 m and 950 m for the different field campaigns. The maximum Thorpe displacement is always greater under convective conditions than under stable ones, independently of its sign. The Thorpe scale L_T ranges between 0.2 m and 680 m for the different data sets which cover different stratified mixing conditions (turbulence shear-driven and convective regions). The Thorpe scale does not exceed several tens of meters under stable and neutral stratification conditions related to instantaneous density gradients. In contrast, under convective conditions, Thorpe scales are relatively large, they exceed hundreds of meters which may be related to convective bursts.

We analyze the relation between $(d_T)_{max}$ and the Thorpe scale L_T and we deduce that they verify a power law. We also deduce that there is a difference in exponents of the power laws for convective conditions and shear-driven conditions. These different power laws could identify overturns created under different mechanisms.

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