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Time evolution of Thorpe profiles corresponding to atmospheric soundings

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The interplay of phenomena on a wide variety of space and time scales makes the parameterization of unresolved processes in atmospheric models complicated. The interpretation of atmospheric turbulence data requires a way to assess the evolutionary stage at which a given turbulent event is sampled. With this aim, our focus is on characterising the small scale turbulence, and its evolutionary stage, in the planetary boundary layer (PBL) by means of the identification of its turbulent patches –vertical overturns-. Based on PBL profiles from several balloon soundings, the authors investigate the time behavior of overturns and their overturning length scales which are identified based on potential temperature measurements.

Our focus is on characterising the small scale turbulence –generated by overturns- and its evolution. This small scale turbulence could be identifyed by Thorpe displacements, d_T. Thorpe profiles are found by comparing the observed potential temperature profile $\theta(z)$and the monotonic potential temperature profile $\theta_m(z)$ which is constructed by reordering $\theta(z)$ to make it gravitationally stable.

Vertical overturns, produced by turbulence in stratified fluids – as the atmosphere and the ocean-, are often quantified by the Thorpe scale, L_T. This scale is deduced of Thorpe displacements profiles which are calculated by reordering the PBL potential temperature profiles.

The time evolution of overturns is studied from the up and down Thorpe profiles and they give us an approximate evolution of overturns which it has been measured di-

rectly. The down Thorpe profile at a fixed height compared with the up Thorpe profile at the same height provide a real idea of the turbulent stage of overturns and it also provides an approximation to the evolutionary stage at which the atmosphere was sampled. The authors also make other studies on time evolution of Thorpe profiles during a daytime with different stratification conditions.

The authors not only quantify PBL Thorpe's scale, they also investigate the maximum displacement length scale, L_{max}, and they study the ratio between these two scales which depends on the rate of turbulent kinetic energy dissipation. One of the aims is to clarify if L_{max} is a more appropriate length scale than L_T for the study of atmospheric turbulence based on displacements in potential temperature profiles. Another aim is to evaluate the time evolution of these scales ($L_T$andL_{max}).

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