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Long-term study of coherent structures in the atmospheric surface layer

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In recent years, coherent structures have been an important subject in atmospheric turbulence research. Under convective conditions, the structures are evident in time traces of air temperature as ramp patterns in which a slow, nearly steady increase is followed by a relatively rapid change back to base-line level. Despite the observational efforts during the last years, the definitions of the temporal boundaries of the structures are still not established and discrepancies between the published results exist. Particularly, the mean contribution of the structures to the turbulent transport ranges from 40 to 90% in the open literature. The great discrepancies can be mainly attributed to the limitation on short data runs under particular meteorological conditions and to the different detection methods. In order to have reliable mean values concerning the statistical properties of coherent structures, a long-term study is indispensable. Since April 2005, consecutive turbulence measurements are conducted at the SIRTA observatory located at Palaiseau, 20 km south of Paris, France. A wavelet method is used to analyze the occurrence of ramplike coherent structures in the atmospheric surface layer using six months of turbulence data taken on a 30 m tower under varying meteorological conditions. The graduation of the time series with the wavelet coefficients into 2 time scales makes it possible not only to gain information about the mean time scales, but also to calculate their distributions, which depend on atmospheric stratification. It was observed that the structures occupied 35% of the total time with mean contributions ranging between 41% to 47% for momentum and heat. The calculation of a transport efficiency parameter indicates that coherent structures transport heat more efficiently than momentum. Furthermore, the transport efficiency increases with increasing contribution of the structures to the overall transport.