EMS7/ECAM8 Abstracts,
Vol. 4, EMS2007-A-00041, 2007
7th EMS Annual Meeting / 8th ECAM

Analysis of turbulence in fog episodes

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Many processes interact in a complex and highly non-linear way during the life cycle of fog, the turbulent transport being among them. Observations and analysis of turbulence are, then, fundamental to our understanding of the physical processes involved with fog formation, evolution and dissipation. In the first stage, suppression of turbulence by a strong static stability inhibits mixing and, thus, creates favourable conditions for the fog formation. After the onset of fog, the radiative cooling at the top of the fog layer and the slow-down of the cooling at surface lead to a less stable surface layer, increased turbulence and vertical build-up of the fog. During the mature phase, fog top condensation balances evaporation and droplet settling processes to maintain the depth of the fog. Entrainment of dry air and consequent evaporation of droplets via turbulent mixing is enhanced by the presence of vertical wind shear at and above the top of the fog layer. Finally, increasing shear caused by increasing wind above the fog may raise the entrainment rate of warm and dry air and accelerate the dissipation. Data gathered by fast-response sonic anemometers are processed using wavelet methods with the aim to estimate turbulence parameters such as kinetic energy or fluxes during the successive stages of the fog evolution. The differential behaviour of these magnitudes compared to that observed in a dry atmosphere is highlighted. The filtering skill of the wavelet transform allows effective separation of the different spectral ranges that are relevant in the data time-series. Therefore, wavelet methods constitute an ideal tool to identify and separately analyse phenomena belonging to many different space and time scales.