EMS Annual Meeting Abstracts
Vol. 10, EMS2013-125, 2013
13th EMS / 11th ECAM

Turbulence detection using radiosondes: plugging the gaps in the observation of turbulence

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Turbulence costs the airline industry tens of millions of dollars each year, through damage to aircraft and injury to passengers. Clear-air turbulence (CAT) is particularly problematic, as it cannot be detected using remote sensing methods and we lack consistent observations to validate forecast models. Here we describe a specially adapted meteorological Radiosonde that is used to measure turbulence. The turbulence sensor consists of a Hall-effect magnetometer, which uses the Earth's magnetic field as a reference point, allowing the motion of the sonde to be measured. The standard deviation of the data from the Hall sensor over a given time provides a way of quantifying the turbulence encountered, defined here as the Magnetic Variance Unit (MVU). A solar radiation sensor is mounted at the top of the package, to determine whether the sonde is in cloud. The turbulence sensor has been calibrated against a nearby Doppler lidar, allowing the MVU to be compared with the standard deviation of the vertical wind in boundary layer turbulence. Results from multiple balloon ascents over Reading, UK in different conditions between October 2012 and March 2013 have found turbulent regions near the boundaries of the jet stream and above cloud tops. The use of these results will allow better validation of turbulence models and increase our understanding of CAT.