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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 two specially adapted meteorological radiosondes that are used to measure turbulence. The first 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 second consists of an accelerometer that measures the accelerations the balloon encounters. A solar radiation sensor is mounted at the top of the package, to determine whether the sonde is in cloud. Results from multiple flights over Reading, UK in different conditions, show both sensors detecting turbulent regions near jet boundaries and above cloud tops, with the accelerometer recording values in excess of 6g in these regions. Case studies will show how these observations can be used to test the performance of a selection of empirical turbulence diagnostics initialised from ERA-interim data.