Statistics of Upper-Level Turbulence based on the Eddy Dissipation Rate using 1-Hz In-Situ Aircraft Data

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Statistics of upper-level turbulence is derived from the estimated Eddy Dissipation Rate (EDR) using 1-yr period of 1-Hz Quick Access Recorder (QAR) aircraft data in 2012. The EDR is a rate of turbulent kinetic energy cascading down from large-scale to smaller-scale, which is a standard for reporting turbulence by the International Civil Aviation Organization (ICAO). In this study, we first calculate a vertical velocity derived from several avionic parameters like inertial vertical velocity, pitch angle, and angle of attacks. Second, the Fast Fourier Transform (FFT) is applied to the derived 1-Hz vertical velocity data for every 1-minute segment. For each segment a value of EDR is derived by finding the best fit of the k-5/3 Kolmogorov scale within the inertial subrange. For three different types of aircraft (B737, B777-200, and B777-300), Statistics of the estimated EDR is constructed by using the Probability Density Function (PDF). This eventually provides us the average and standard deviation of the log-scale EDR estimates. This result suggests that the long-term archived in situ aircraft data can provide a climatology of upper-level turbulence as the EDR metric.

Key words: Statistics, Upper-level turbulence, Eddy Dissipation Rate, Kolmogorov scale

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