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Climatology of Upper-level Turbulence Statistics Determined from Rawinsonde and ACARS/AMDAR Data

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The climatology of the spatial structure functions of velocity and temperature for various altitudes (pressure levels) and latitude bands is determined from the global rawinsonde network and ACARS/AMDAR aircraft data for the tropics and Northern hemisphere. This data is operationally available and does not require specially instrumented aircraft. The ACARS/AMDAR data provides very dense coverage of winds and temperature over common commercial aircraft flight tracks and allows computation of structure functions to scales approaching 1 km, while the inclusion of rawinsonde data provides information on scales approaching 10,000 km. Thus the combined measurement system extends the information about the spatial statistics of the atmosphere from previous results to include larger geographic regions, lower altitudes, and a wider range of spatial scales. Simple empirical fits are determined to approximate the structure function behavior as a function of altitude and latitude in the N. Hemisphere. The results produced for spatial scales less about 2000 km are consistent with previous studies using other non-operational data sources.

The resulting climatology is useful for better understanding turbulence aviation hazards, and can also be used with next-generation data assimilation techniques, and for forecast verification. These results can also be used to help evaluate various theoretical predictions for mesoscale turbulence.