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Are statistics on vorticity about a horizontal axis useful for characterising turbulence as experienced by aircraft?

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The severity of an aircraft encounter with turbulence is most commonly quantified by reference to the aircraft normal acceleration. For an encounter between an idealised aircraft and an idealised vortex, the acceleration vector is equal to the cross product of half the vorticity vector with air velocity vector. More realistic expressions for the aircraft acceleration have been derived in the context of aircraft encounters with wake vortices, and, although the scale of wake vortices is smaller than that of naturally occurring vortices, the broad methodology is broadly applicable. For the normal (near vertical) component of aircraft acceleration, vortices with a horizontal axis of rotation are relevant, but vertical vortices will cause horizontal accelerations.

Predicting the normal acceleration for a real aircraft is beyond the scope of meteorology. However, it may well be useful for meteorologists to predict turbulence characteristics in terms of statistics pertaining to vorticity about a horizontal axis.

Currently it is the practice for World Area Forecast Centres for aviation to provide information on Clear Air Turbulence for a dissemination grid box, which is currently 1.25^o * 1.25^o * 4000 feet. It is proposed that in future, information on the statistical distribution of the vorticity vector within the dissemination grid box would be provided. The information would pertain to both the strength and direction of the vorticity vector. The direction information is potentially very valuable given that, as discussed earlier, the aircraft response depends on the vector product of the vorticity and the air velocity. Although current model resolutions are in general insufficient to resolve vortices of the scale relevant to commercial aviation, current models can predict the processes which give rise to increasing strength of vortices with a particular orientation.