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4.4A RELATIONSHIP OF ISOLATED TURBULENT REGIONS TO THE GENERAL TURBULENT BACKGROUND

R. G. Roper

School of Geophysical Sciences
Georgia Institute of Technology
Atlanta, GA 30332

The atmosphere below 100 km is often referred to as the homosphere; the region above, the heterosphere. In the homosphere, constituents are mixed, and average molecular weight is constant. In the heterosphere, diffusive separation occurs, and species tend to fractionate; average molecular weight decreases with height. Mixing in the homosphere has as its source dynamical (wind) energy.

Against this background turbulence, intermittent enhancements of turbulent intensity are observed. Some of these enhancements are long lived -- for example, a turbulent layer at approximately 86 km altitude seems to be almost a permanent feature of the (global?) daytime D region, as observed by partial reflection and MST radars. This may well be a delineation of the mesopause level, since long-term radio meteor studies have shown ∿ 85 km to be the break-point between thermospheric circulation above, and mesospheric circulation below. Rocket-released chemical trails are also characterized by turbulent sheets interleaved by laminar layers in which the diffusion coefficient is not much larger than molecular. (The prevalent practice of plotting vertical diffusion coefficients which are less than molecular does not really make much sense -- one of the basic definitions of turbulence is that it is characterized by a diffusion coefficient much larger than molecular.) If the observed turbulent layers remain at constant height, then vertical mixing is severely inhibited. Most models propose an eddy diffusion profile which varies smoothly with height -- such a profile is observed for about one in ten chemical trail releases in the mesopause and lower thermosphere.

In terms of long-term monitoring, the best estimates of height/time profiles of turbulent intensity come from the height/time profiles of signal strengths from ST radars in the lower atmosphere, and MST and partial-reflection radars in the mesosphere. In the stratosphere, Fresnel reflection is observed from stable refractivity structures whose "tilt" is related to baroclinic disturbances.

Correlations between vertical shear in the horizontal wind, presumably the source of turbulent energy, and the existence of turbulent layers have not proved conclusive. However, once a turbulent sheet is formed (perhaps by the breaking or nonlinear interaction of gravity waves), the hysterisis inherent in the formation and dissipation of turbulent structures could mean that the sheet is advected a considerable distance from its source before dissipating. Such a mechanism should be observable from the Colorado Wind Profile Network.