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The spectrum of waves and turbulence at the tropopause

T. Duck (1), and J. Whiteway (2)

(1) Department of Physics and Atmospheric Science, Dalhousie University, Halifax, Nova Scotia, Canada, (2) Department of Earth and Space Science & Engineering, York University, Toronto, Canada (tom.duck@dal.ca / Fax: 902-494-5191 / Phone: 902-494-1456)

The Egrett aircraft was applied to investigate the dynamics of mixing in the tropopause region above the UK during May and June 2000. This involved measurements of waves, turbulence, and composition. Case studies are presented here that show turbulence generation by breaking gravity waves and by wind shear. A small-scale wave of length 500 m was found within regions of instability associated with larger-scale gravity waves having wavelengths longer than 10 km. The horizontal kinetic energy spectra determined from the measurements extend to minimum scales of 3 m. A sharp knee in the turbulence spectrum at a scale of 100 m is associated with the equipartition of kinetic energy in three dimensions; at other scales the vertical motions are relatively suppressed. It was found that the combination of waves and turbulence of different kinetic energies could produce a variety of power law slopes in horizontally measured fluctuation spectra and average log-log slopes of -5/3 result only after considerable averaging. Wavelet spectra have been applied to investigate the time evolution of the wave-turbulence interaction.