Small-scale dynamics in the MLT: Causes of layering and local structure and implications for large-scale dynamics and measurements

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Small-scale dynamics arise in the mesosphere and lower thermosphere (MLT) as a result of the refraction of gravity waves (GWs) to small vertical scales in shear flows, and of instability and turbulence dynamics, and their associated transport and mixing, accompanying GW breaking and shear flow instability of larger-scale motions. Here we illustrate the dominant processes leading to these small-scale MLT dynamics, the consequences of these dynamics for transport, mixing, and spectral evolution, and the implications of these dynamics for measurement and interpretation of these processes. Among the interesting results are 1) the inefficiency of heat and constituent mixing accompanying GW breaking, 2) the occurrence of turbulence accompanying small-amplitude GWs, 3) the excitation of other GW motions due to wave breaking, 4) the layering of wind, temperature, and constituent gradients due to localized mixing, and 5) the radar signatures anticipated from these various instability processes.