Implications of Tropical Mesopause at ~100 Km to the MLT Region

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Recent satellite observations reveal that the altitude and temperature of mesopause over tropical region lie at ~100 km and 180 K, respectively, with little seasonal variation [1]. A secondary minimum in temperature occurs at 75-85 km. The secondary minimum shows semi annual variation with maximum altitude in solstices. The mesopause temperature shows a decreasing trend of 0.72 K/year while its altitude shows no noticeable trend. We have examined in this presentation the implications of temperature structures in the mesopause region to the various physical processes to the MLT specifically turbulence, turbopause altitude, molecular diffusion and collision frequencies.

Positive temperature lapse rates up to 100 km mean that the region of potential static instability extends up to ~100 km. Available wind profiles in mesopause region reveal strong vertical shears. The positive temperature lapse rates coupled with strong wind shears make the altitude region up to 100 km potentially unstable and conducive for turbulence. Using the SABER/TIMED temperature profiles, the minimum wind shear required to yield Richardson number of 0.25 (criterion for turbulence) has been calculated. In two altitude regions, 70-80 km and 90-100 km, the minimum wind shear required is quite low and is about 0.01m/s/m. It is found from literature [2] that such wind shears are of common occurrence in the mesosphere. These two altitude regions can thus be considered as conductive for turbulence. MST radar observations at Gadanki reveal that mesospheric echoes occur more frequently in the altitude region of 70-80 km [3], supporting the above contention that the region 70-80 km is favorable for neutral turbulence. Further, evidence from the temperature profiles from Rayleigh Lidar from Gadanki corroborates the existence of turbulence in this region. Radar echoes from Field Aligned Irregularities (FAI) in the altitude region 88 to 97 km can be attributed to neutral turbulence in that region. Extension of positive temperature lapse rate up to 100 km will also have bearing on the altitude of turbopause and implies mixing of constituents up to 100 km.

Keywords: Tropical mesopause; Turbuelnce; Turbopause; Molecular diffusion; VHF radar, Rayeligh Lidar.

References

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