Towards Complete Gravity Wave Spectrum In The Earth's Middle Atmosphere Using Various Remote Sensing Techniques

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Earth's atmosphere is strongly perturbed by waves and oscillations of various temporal and spatial scales of which gravity waves are of utmost significance. Therefore it is important that we have a complete picture of spatial, temporal and altitudinal variability of gravity wave activity. Gravity waves fall in a wide spectrum of frequencies from Brunt-Vaisala to the Coriolis parameter. To introduce the effects of gravity waves in the middle atmosphere modeling studies, a complete understanding of the spectrum and the parts of the spectrum that each technique is able to capture is essential. In this study, we calculate the potential energy of gravity waves which serves as a proxy for wave activity using TIMED/SABER, a limb viewing satellite, COSMIC, a constellation of six satellites using occultation technique, and a ground based Lidar over Gadanki (13.5º N, 79.2º E). Global maps of potential energy derived using TIMED/SABER kinetic temperature data shows polar/midlatitudes high values with seasonal variation. It is also interesting to note that with increasing altitude the potential energy highs seem to shift equatorward and at the Mesosphere-Lower Thermosphere (MLT) region we find highest potential energies at the tropics in all seasons. Earlier studies using Radio occultation techniques and GPS-Met observations have shown that the high potential energy values are always seen around equator and never go beyond tropics. This is primarily because such techniques are capable of seeing another region of the gravity wave spectrum which a limb viewing satellite might not see. This will again be different for a ground based instrument when compared to a satellite whose horizontal resolution is poorer. Therefore, in this study we attempt to compare the potential energy profiles using different techniques and investigate to what extent each region of the gravity wave spectrum is captured by these techniques. The shift in the region of highest potential energy values with altitude also indicate that it might be due to wave-wave interactions that can cause refraction of waves to other regions of the spectrum. This aspect is also discussed in the present study.

Key words: Gravity waves; Potential energy; Remote sensing; Middle atmosphere; SABER