GRAVITY WAVES AND THE MORPHOLOGY OF NOCTILUCENT CLOUDS AND POLAR MESOSPHERE SUMMER ECHOES

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The great majority of all Noctilucent Cloud (NLC) displays show propagating gravity waves (buoyancy waves) of long and medium horizontal wavelengths, but they resemble waves in very shallow water rather than deepwater waves, as one might have expected. Many Polar Mesosphere Summer Echo (PMSE) in VHF radar data show single, double or multiple layers of strong echo power which slowly descend and jump to a higher layer from time to time. The descent is in agreement with the assumption of a downward propagating gravity wave, and the jump appears to hop to the same phase one vertical wavelength higher up. Furthermore, precise radar observations of vertical velocity in the PMSE displays indicate significantly more vertical convergence than divergence as well as a slight majority of downward velocities in the volumes with strongest PMSE power. It is known that aerosol particles (ice particles) of typically 20 to 50 nm equivalent radius create the NLC visible by eye and by lidar as well as the Polar Mesosphere Clouds (PMC) observed from satellites. It is also known that the same particles, whether they are large enough to be visible or not, modify the spatial distribution of free electrons and positive ions to create PMSE, when the charge density is large enough. This presentation shows how the air parcel trajectories in a typical gravity wave field near the summer polar mesopause can explain the structure and morphology described above. The NLC and/or PMSE particles tend to collect at certain positions in the gravity field, moving with those positions as the wave propagates horizontally and downward.

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