NLC, POTASSIUM DENSITIES AND TEMPERATURES BY LIDAR AND FALLING SPHERE AT SPITSBERGEN, 78°N

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Temperatures, potassium densities and NLC at mesopause altitudes were observed by a potassium lidar at 78°N (Spitsbergen) in 2001-2003. Almost all measurements were taken under full daylight condition. At the same location a set of temperature profiles were obtained by rocket borne techniques (`falling spheres') within the ROMA campaign (Rocket borne Observations in the Middle Atmosphere) from mid July to mid September 2001. In this paper we demonstrate for a simultaneous observation on August 28 that the temperatures of both methods are in good agreement. Similar good agreement exists for the seasonal variation of temperatures throughout the entire ROMA campaign. Lidar measurements before the ROMA campaign show that the lowest temperatures of ~120 K occur at the beginning of July at 89 km.

Comparison of the seasonal and height variation of K number densities with similar measurements at mid latitudes (54° N) shows a remarkable reduction in the lower part of the layer during the summer months. This reduction strongly correlates with the appearance of ice particles detected as noctilucent clouds (NLC) and polar mesosphere summer echoes (PMSE) by the same lidar and by a VHF radar, respectively. In a total of 226 hours of simultaneous K and NLC observations, the upper edge of the NLC layer was always detected below the lower edge of the K layer (i.e., no overlap), even when both edges vary substantially with height and time. The ice particle effect on potassium seems to correlate with the ice particle size: 'large' particles (>10–20 nm, detectable as NLC) completely remove all available K atoms, whereas smaller particles (but still large enough to create PMSE) gradually reduce the number of K atoms. Our observations suggest that the loss of K atoms on ice is just in the right order of magnitude to compete with the major production and loss terms.