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Mesosphere Summer Echoes observed at polar and mid latitudes

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The summer polar mesospheric region is characterized by the lowest temperatures in the Earth's atmosphere. During the summer months so-called polar mesosphere summer echoes (PMSE) are observed by VHF radars from heights between about 80 and 90 km at polar latitudes. These unexpected strong radar returns are, to a lesser extent, also observable at mid latitudes and known as mesospheric summer echoes (MSE). The phenomenon is related to charged ice particles which can only exist if temperatures are below about 140 K.

(P)MSE have been observed with VHF radars around 50 MHz at various locations for more than two decades. Often these investigations were however restricted to special research campaigns. Continuous measurements have been carried out at Svalbard (78°N), Andenes (69°N) and Kühlungsborn (54°N) from the mid/late 1990s until now. Here we present results obtained from observations at these sites during various summer seasons.

Generally (P)MSE were observed from mid of May to end of August. However their special occurrence characteristics depend on latitude. At 54°N mesosphere summer echoes occur not daily within this period and normally only during daytime for some minutes or hours with a occurrence maximum at 85 km. At 69°N the seasonal variation of PMSE is characterized by a strong increase during end of May, a quite stable level in June/July and a more gradual decrease during August. At very-high latitudes PMSE occur nearly permanent during about 12 weeks. Here are multiple layers a regular feature during the main season and the height distribution of PMSE is not symmetrically around its maximum occurrence height.

Furthermore we show diurnal variations, the strong aspect sensitivity, scattering and turbulence characteristics of (P)MSE and their height dependency.