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Mesospheric aerosol particles studied with the European Incoherent SCATter (EISCAT) radars

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The polar mesopause region is a fascinating part of the atmosphere which is strongly influenced by energy input from below and from above. For example, gravity waves propagate upward from the troposphere and deposit their energy and momentum in the mesopause region whereby they give rise to a pronounced summer-winter pole circulation driving the polar mesopause $\sim$80 K away from radiative equilibrium. On the other hand, solar Ly-alpha radiation may penetrate down to altitudes of $\sim$70 km, thereby leading to the fact that the mesopause region coincides with the lowest part of the ionosphere, the D-region, where significant numbers of free electrons and ions exist. It is in this part of the atmosphere, in which ice particles may form, potentially by heterogeneous nucleation on meteor smoke particles, and give rise to phenomena known as noctilucent clouds and polar mesosphere summer echoes.

In this paper we describe efforts to characterize both mesospheric ice particles and meteoric smoke particles utilizing the European Incoherent SCATter radars. We discuss the general physical processes by which ice and meteoric smoke particles modify the ambient plasma of the D-region, and give rise to detectable signatures. For the case of ice particles, we present EISCAT VHF measurements of polar mesosphere summer echoes and discuss which information on the atmosphere may be obtained from these. Finally, for the case of meteor smoke particles we present some first measurements with the EISCAT UHF radar performed in January 2005 from which we try to infer information about the existence and concentration of meteor smoke particles.