# THE GENERATION OF POLAR MESOSPHERE SUMMER ECHOES (PMSE)

Hoppe, U.-P.[1], Blix, T.A.[1], Brattli, A.[1]
, Lie-Svendsen, O.[1], Rapp, M.[2]
[1]Norwegian Defence Research Establishment (FFI), N-2027 Kjeller, Norway
[2]Leibniz-Institute of Atmospheric Physics, D-18225, Kuehlungsborn, Germany

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We have found that six ingredients are necessary to create PMSE: (1) sufficiently cold temperatures, (2) water vapor, and (3) suitable condensation nuclei to create aerosol particles; (4) a pre-existing gradient in aerosol particle number density and (5) episodes of turbulence to create small-scale fluctuation structures in the aerosol; and finally (6) a sufficient density of free electrons to (a) charge the aerosol particles at least partially and (b) a sufficient number of remaining free electrons to "mediate" the charged aerosol fluctuating structure to the electromagnetic wave of the (VHF) radar. At times and places where any of these six conditions is lacking, no PMSE are observed.

We will refer to existing work regarding the first two conditions, and briefly discuss why we consider "smoke particles" (Hunten et al., 1980) to be better candidates for the condensation nuclei than cluster ions. The process of turbulent episodes acting upon a pre-existing gradient of aerosol particle number density to create small-scale structures in the aerosol will be treated in greater detail. We hope to quantify the necessary minimum for the pre-existing gradient as well as why turbulence creates fine-scale structures instead of erasing them. We will use radar and rocket observations as well as simulations to shed light on this process. Observed relationships between PMSE spectral width and PMSE power and the degree of specularity (aspect sensitivity) or isotropy of the radar echoes are interpreted in relation to the generation and removal of the fluctuations.

These authors and others have modelled or simulated by slightly different methods and with slightly differing boundary conditions how observed (by rocket) or assumed charged aerosol number density fluctuations create the electron density fluctuations necessary for PMSE, when and where there are free electrons. The fact that all these simulations give similar results indicates that our present understanding is robust. The physics of the different boundary conditions and modelling methods will be explained and compared.

1. (a)
Ulf-Peter Hoppe
Norwegian Defence Research Establishment (FFI)
P.O. Box 25
Kjeller, NO
N-2027 Norway
uph@ffi.no
   (b) +47-63 80 72 87
   (c) +47-63 80 72 12
2. G - Ionospheric Radio and Propagation
3. (a)
4. I - Invited Paper, Program chair: Mihaly Horanyi
5. I must leave from Denver on 8 January in the morning at the latest.