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Small scale density variations of electrons and charged particles in the vicinity of polar mesosphere summer echoes

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Abstract. We present small scale variations of electron number densities and particle charge number densities measured in situ in the presence of polar mesosphere summer echoes. It turns out that the small scale fluctuations of electrons and negatively charged particles show a strong anticorrelation down to the smallest scales observed. Comparing these small scale structures with the simultaneously measured radar signal to noise profile, we find that the radar profile is well described by the power spectral density of both electrons and charged particles at the radar half wavelength (=the Bragg scale). Finally, we consider the shape of the power spectra of the observed plasma fluctuations and find that both charged particles and electrons show spectra that can be explained in terms of either neutral air turbulence acting on the distribution of a low diffusivity tracer or the fossil remnants of a formerly active turbulent region. All these results are consistent with the theoretical ideas by Rapp and Lübken (2003) suggesting that PMSE can be explained by a combination of active and fossil neutral air turbulence acting on the large and heavy charged aerosol particles which are subsequently mirrored in the electron number density distribution that becomes visible to a VHF radar when small scale fluctuations are present.

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