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# Seasonal and Solar Cycle Variations of Polar Cap Patches in the Terrestrial High-Latitude Nightside Ionosphere

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## Abstract

The influence of the season and solar cycle on the occurrence of polar cap patches in the nightside ionosphere was observed and simulated above northern Scandinavia close to solar maximum (1999 – 2001) and solar minimum (2007 – 2008). The observations were conducted under conditions which were predicted to be favourable for observing patches using the EISCAT Svalbard Radar (ESR) with the requirements based upon the convection pattern, the IMF and an absence of in situ precipitation. In each set of observations the patch-to-background ratio was calculated. This ratio showed a clear seasonal difference, with values of up to 9.4 ± 2.9 in winter and 1.9 ± 0.2 in summer, however there was no significant difference between solar maximum and solar minimum.

The PLASLIFE computer simulation was used to model the observed trends in the patch-to-background ratio and establish reasons for the variation. The seasonal difference was primarily attributed to changes in the chemical composition of the atmosphere which altered both the plasma densities drawn into the polar cap and the rate of plasma loss by recombination. A secondary factor in the seasonal trend was the maintenance of the background ionosphere by photoionisation in summer throughout the polar cap. At solar maximum plasma production by photoionisation was greater than at solar minimum, however changes in the composition of the thermosphere meant that this plasma decayed faster at solar maximum. These effects largely cancelled, resulting in no significant change in the patch-to-background ratio for polar cap patches in the nightside ionosphere between solar maximum and solar minimum.