Geophysical Research Abstracts
Vol. 20, EGU2018-13795, 2018
EGU General Assembly 2018

Polar cap patch climatology based on Swarm density data

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Polar cap patches are defined as ionospheric F region plasma density enhancements with density at least twice that of the background. They are regarded as one of the principal space weather issue in the polar cap as they are often spatially correlated with small-scale irregularities responsible for radio wave scintillation and radar backscatter. Due to their instrumentation and coverage over the Polar Regions, the Swarm satellites offer a powerful tool to survey polar cap patches. Based on the straightforward definition of patches, we thus developed a new algorithm that automatically identifies patches in the Swarm density data and computed the seasonal and spatial distributions of more than 20000 patches detected by each of the satellites [1]. The results show that both in the Northern Hemisphere (NH) and in the Southern Hemisphere (SH), the number of polar cap patches detected is larger during local winter than it is during local summer. In particular, patches are essentially winter phenomena in the NH, while they are also detected during local summer in the SH. Patches are distributed over the entire polar caps and their occurrence rate is higher in the SH. Furthermore, we investigated the spatial and temporal distributions of the density fluctuations associated with the patches identified. As the electron density gradients and irregularities associated with patches can degrade HF radio and Global Navigation Satellite System signals, this study may have important implications for space weather forecasts.

[1] Spicher, A., L. B. N. Clausen, W. J. Miloch, V. Lofstad, Y. Jin, and J. I. Moen (2017), Interhemispheric study of polar cap patch occurrence based on Swarm in situ data, J. Geophys. Res. Space Physics, 122, 3837–3851, doi:10.1002/2016JA023750.