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GPS scintillation effects associated with polar cap patches, auroral arcs and blobs in European Arctic sector

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Both polar cap patches and auroral arcs are associated with irregularities that can affect the propagation of radio waves and thus disrupt the navigation system in the high latitudes. But which is the worst case remains unanswered. This study focuses on the direct comparison of the relative scintillation effects associated with different phenomena in high latitudes. The All Sky Camera located at Ny-Alesund, Svalbard observed six polar cap patches on January 13, 2013. The patches exited into the nightside auroral region in response to the ongoing substorms and then they are termed blobs. The collocated GPS scintillation monitor is used to study the scintillations produced by these different phenomena which are frequently observed at high latitudes. The amplitude scintillation index (S_4) was very low during this period, while the phase scintillation index (sigma_phi) indicated a disturbed ionospheric condition but responded differently to these three types of phenomena. Comparisons of the associated scintillation effects indicate that the blobs are the most violent scintillation source. Moreover, polar cap patches produce scintillation more effectively than auroral arcs do. Five of the six polar cap patches were observed to produce significant scintillations either on the edges or on the center of the patches, which imply most of the polar cap patches are associated with strong small scale irregularities. All of the scintillations produced by the pure auroral arcs were below 0.2 rad in this period. This study highlights the compound effects of the particle precipitations (auroral arcs) and high density plasma islands (patches) in developing the small scale irregularities. From the space weather forecasting perspective, particular attention is to be paid to polar cap patches exiting the polar cap at night in the European sector.