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The ultimate ionospheric scintillation climatology over Svalbard

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The interest about the impact of the ionosphere on the propagation of GNSS signals is continuously increasing, mainly because of the high demand of precise positioning (with positioning error below 1 meter). The ionosphere induces scintillations on GNSS signals when passing through an uneven distribution of the electron density. The high degree of unpredictability of the polar and auroral scintillations and the paucity of the long (at least one solar cycle) data series make the climatological description of the ionosphere at L-band very challenging. In addition, the global models show significant limitations when applied to the polar and auroral ionosphere. In this frame, the availability of a continuous and systematic monitoring of the high latitude scintillations is essential.
The paper presents an unprecedented description of the climatology of Total Electron Content (TEC) gradients and ionospheric scintillations over the Arctic derived from the longest GNSS (Global Navigation Satellite Systems) data series ever collected for this specific aim. A TEC and scintillation monitor receiver is working at Ny Ålesund since September 2003, sampling the L1 and L2 signals at 50 Hz from all the GPS satellites in view. The receiver monitors an area of about 600 km radius that includes the auroral and the cap regions. The exceptional length of the data series and the privileged site of observation allows describing the Arctic ionosphere along two solar cycles. Our analysis results into a detailed assessment of the long-term behaviour of the ionosphere under solar maximum and solar minimum conditions, including several periods of perturbed ionospheric weather caused by geomagnetic storms. Since November 2015, the station is equipped also with a multi-constellation GNSS receiver providing the opportunity to perform the ionospheric climatology from Galileo signals. The results offer a unique realistic picture of the ionosphere that cannot be derived from TEC and scintillations models, which generally fail when applied to the quite unpredictable high latitude ionosphere.

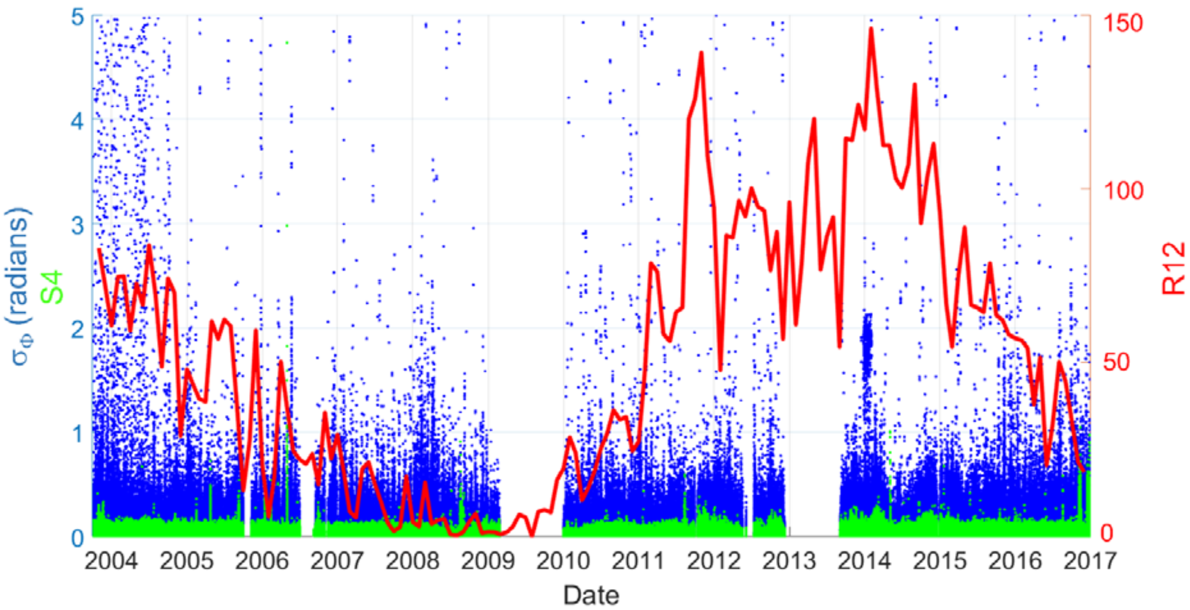

Figure 1. Time profiles of σ_Φ (blue) and S4 (green) of the considered dataset. Red curve is the twelve-month smoothed relative sunspot number R12.