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0^+ whistlers in the ELF band recorded by Swarm satellites used to reconstruct the ionosphere below the satellite height

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The Swarm satellites record the variations of the intensity of the Earth magnetic field using the Absolute Scalar Magnetometers. Beside their nominal operation sampling the magnetic field at 1 Hz, these instruments can be operated in burst-mode and produce data at 250 Hz, enabling the observation of whistlers signals in the frequency band between 20 and 120 Hz. Seven burst session were operated at the beginning of Swarm mission in 2014 and an additional one in July 2018, collecting a total of 500 hours of burst data, in which several thousands of whistlers were detected, particularly in low latitudes regions. These whistlers have been characterised in terms of dispersion and intensity of the recorded signal. To assess the capability of using these data for monitoring the ionosphere below Swarm satellites, forward modeling of the propagation of ELF signals between the lower boundary of the ionosphere up to Swarm satellite position have been developed using ray-tracing calculation of electromagnetic signals propagating through the ionospheric plasma provided by IRI 2016 model and the magnetic field by IGRF model. Additional in-situ electron density measurements of Swarm Electric Field Instrument (EFI) have been used to constrain the vertical profile of ionospheric electron density provided by the climatological model. The combined experimental information from in-situ measurements and whistler characteristics are investigated with the aim of provide new constrains for modelling the ionospheric plasma.