Contribution of whistler-mode chorus to the loss of plasma sheet electrons: THEMIS observations

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A dominant loss process of electrons in the inner magnetosphere is thought to be the pitch angle scattering by plasma waves. Electrons scattered into the loss cone precipitate into the atmosphere and contribute to aurora emissions. It is generally accepted that the dominant source of diffuse aurora is electrons scattered from the central plasma sheet. However, there is still much controversy on dominant scattering mechanism of plasma sheet electrons because electrons resonate with both electrostatic electron cyclotron harmonic (ECH) waves and/or whistler-mode waves. The purpose of this study is to investigate which wave is mainly responsible for the loss of the plasma sheet electrons. In the present study, we estimate lifetimes of the plasma sheet electrons from the THEMIS observations, and compare them with the theoretical loss timescales due to the pitch angle scattering by whistler-mode chorus. We have derived global distributions of the average phase space density in the first adiabatic invariants of 50 and 100 eV/nT, using the electron data obtained from the electrostatic analyzer (ESA) on board the THEMIS satellites for 2 years. The electron loss timescales are estimated from the decrease of the PSD along the drift paths, which are calculated from the UNH-IMEF electric field and TS04 magnetic field models. The loss timescales are theoretically evaluated from the pitch angle diffusion coefficients due to a typical whistler-mode chorus waves. The comparison suggests that the precipitation loss of the plasma sheet electrons is mainly caused by the chorus waves. We also estimated the required wave amplitudes that can explain the estimated loss timescales and compared them with the average chorus wave amplitudes from the THEMIS wave measurements. The result shows that the required wave amplitudes are roughly consistent with the observed chorus amplitudes. Therefore, we suggest that whistler-mode chorus is responsible for the loss of the plasma sheet electrons in the morning side, and contributes to the generation of diffuse auroras in the morning side. We will extend the estimation of the loss timescales to lower and higher first adiabatic invariants to investigate the energy dependence of the electron loss process.