R006-30
A 会場 ：11/7　AM2 （10:45-12:30）
11:30〜11:45

沿磁力線電流とリングカレントの観測に基づく ULF 波動励起のドリフト運動論シミュレーション

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Drift-kinetic simulation study of ULF wave excitation based on the field-aligned current and ring current observations

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Ring current ions can excite poloidal (radial oscillation of a field line) ULF waves through drift-bounce instability (Southwood et al., 1969). The wave-particle interaction between poloidal waves and ring current ions has been focused on since the excited waves can also interact with radiation belt electrons (Ukhorskiy et al., 2009). One of the motivations of ULF wave modeling is assessment of its influence on space plasma environment because numerical simulation can provide spatial distributions of ULF waves, which is an important parameter for the total amount of the wave-particle interaction on the drift path of resonance particles. However, recent modeling of ULF waves excited by local plasma instability (Yamakawa et al., 2019, 2020, 2022[Revised]) assumed steady field-aligned currents in the ionosphere and symmetric distributions of injected ions with respect to the midnight in the magnetosphere. Therefore, the aim of this study is to clarify the ULF wave excitation with realistic simulation setting of the field-aligned current and injected ions for a specific date.

We used a coupling model of an ionospheric potential solver (GEMSIS-POT, Nakamizo et al,, 2012) and a drift-kinetic ring current model which solves Vlasov equation with 5D-phase space density f(x, v_{jj}, mu) (GEMSIS-RC, Amano et al., 2011). Field aligned current is an important input of this coupling model because it changes the ionospheric potential, convection E field in the magnetosphere, and hence the ExB drift of ions at $<\tilde{}$10 keV. The inputs of the Region 1 field aligned current (j_{R1FAC}) and injected ions are based on satellite observations in this study: the Iridium and LANL satellites, respectively. Van Allen Probes detected poloidal waves with a proton injection at 5.3-5.7 Re on the dusk side on 29th October 2013, thus we consider this event as a reference.

The energy spectra of ion dispersionless injection detected by three LANL satellites on the night side (19.6 MLT to 3.9 MLT) were used to determine the boundary condition of ion distribution at the geosynchronous orbit. We obtained three fitting parameters of the Kappa distribution (J = CW(1+W/(KW_0))-(K+1)), where J is the ion differential flux, W is energy, C is a scale factor, W_0 is the characteristic energy, and K is the kappa index. We set the phase space density of injected ions within 19.6 MLT to 3.9 MLT. K has a MLT dependence, thus we linearly interpolated $\log_{10}$K from K= 20 to 200 to obtain phase space density at each MLT of a simulation grid. As for C and W_0, we used their averaged values because they did not show a clear MLT dependence.

Current density of the Region 1 field-aligned current was fitted with Gaussian function in a latitude and longitude plane. The criteria of R1FAC detection are as follows: 1) current direction should be downward/upward at 00-12/12-24 MLT at its maximum (MLT_{max}), 2) the maximal current density j_{max} is >0.5 uA/m^2, and 3) the latitude of the maximal current density $MLAT_{max}$ is within 60-80 deg. We obtained five fitting parameters of R1FAC-like current: j_{max}, MLT_{max}, $MLAT_{max}$, Sg_{MLT}, and Sg_{MLAT}, where Sg is the standard deviation in the Gaussian function fitting. Using the fitted current density and auroral conductivity of Hardy et al. (1987), we set the auroral conductivity which is proportional to the current density. This is because the calculation of the ionospheric potential does not converge if the conductivity has a large gradient in the R1FAC.

Finally, we have successfully combined the fitting data with the GEMSIS-POT and GEMSIS-RC coupling model and made it possible to simulate the ring current development under realistic conditions based on the satellite observations. In this presentation, we will discuss the influence of a time-varying convectional field on the excitation of poloidal ULF waves.