R006-37
A 会場 ：9/27　 AM2 （10:45-12:30）
11:30～11:45

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A drift kinetic simulation of ULF wave excitation based on multi-point spacecraft observations

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In the terrestrial magnetosphere, ultra-low frequency (ULF) waves are excited by a variety of external and internal energy sources. High-speed solar wind and perturbation of the solar wind dynamic pressure are external drivers of ULF waves (e.g., Kepko et al., 2002; Zhang et al., 2010). The ULF waves driven by the external sources can accelerate energetic ions (Zong et al., 2012; Oimatsu et al., 2020) and relativistic electrons (Elkington et al., 1999) through the drift/drift-bounce resonance (Southwood et al., 1969). Therefore, these ULF waves are important for the energy dynamics in the magnetosphere. Because solar wind parameters can show dramatic variations at the same time, these external drivers of ULF waves can coexist. This makes it difficult to distinguish the excitation mechanism(s) of ULF waves for a particular event. Using a global ring current model, we discuss the possible excitation mechanisms of the ULF waves observed on 29 October 2013.

We conducted a global drift-kinetic simulation of the ring current (Amano et al., 2011) coupled with an ionospheric potential solver (Nakamizo et al., 2012). During the event, the solar wind dynamic pressure showed a step-like variation, and a moderate substorm (AL ~-470 nT) was triggered. Both toroidal and poloidal ULF waves were detected by Van Allen Probes on the duskside. From the observations of Iridium satellites, we found that the Region-1 field aligned current (R1FAC) gradually reached greater than 1.0 uA/m^2 in the expansion phase. The spatiotemporal variations of R1FAC were fitted with the Gaussian function to calculate the electric field potential in the ionosphere. With the fitted R1FAC distributions, we obtained a simulation result in which toroidal ULF oscillations of the electromagnetic fields were continuously excited. Their Poynting flux along a field line indicates that electromagnetic field perturbation propagates from the southern ionosphere to the magnetic equator in all MLT sectors except for the noon sector. This result suggests that the energy source of the toroidal oscillations is in the southern ionosphere on the nightside. To identify the cause of the toroidal waves, we changed the input parameters of R1FAC and the ionospheric conductivity. First, we fixed the location of a current sheet of R1FAC and only the current density was changeable. With this setting, we found that the toroidal oscillations still existed. If we fixed the all parameters of R1FAC, the toroidal oscillation disappeared. Next, we mirrored the background ionospheric height integrated conductivity in the southern ionosphere to the northern ionosphere. In addition, we used the background conductivity not on 29 October 2013 but on the autumnal equinox day (23 September 2013) to weaken the north-south asymmetry of the conductivity. As a result, the toroidal oscillations were still generated. We concluded that the temporal variation of R1FAC directly/indirectly drives the toroidal oscillations even if there is no north-south asymmetry of the ionosphere. If the toroidal oscillation we found is not an artificial signal, the temporal variation of the intensity of field aligned currents is a new driver of ULF waves which has been overlooked in previous studies.