R006-P31
ポスター１：11/4　PM1/PM2 （13:45-18:15）

#プテリ　デシプルナミシンギー [1), 笠原　禎也 [1), 松田　昇也 [1), 土屋　史紀 [2), 熊本　篤志 [2), 松岡　彩子 [3)
(1 金沢大学,(2 東北大学,(3 京都大学

Electron density profile approximation technique by using lightning whistler propagation characteristic

#Desy Purnami Singgih Putri[1)], Yoshiya Kasahara[1)], Shoya Matsuda[1)], Fuminori Tsuchiya[2)], Atsushi Kumamoto[2)], Ayako Matsuoka[3)]
(1Kanazawa University,(2Tohoku University,(3Kyoto University

A lightning whistler wave is an electromagnetic plasma wave originated by the lightning flush in the VLF. It propagates through the ionosphere into the Earth's magnetosphere as a whistler mode wave. It generally propagates from the southern hemisphere along the Earth's magnetic field lines to the northern hemisphere or vice-versa. At the source point, it is simultaneously emitted in a wide frequency range, but the propagation velocity is larger in the higher frequency range and becomes slower in the lower frequency resulting in a dispersive spectrum property. The propagation velocity depends on the electron density along the propagation path. Thus the dispersive property strongly depends on the length of the propagation path and the total electron content along the path. To obtain the lightning stroke location, we refer to the world wide lightning location network (WWLLN). It locates lightning globally using sparsely distributed VLF detection stations[1]. Due to the propagation characteristics of the lightning whistlers, it is possible to estimate a density profile along the propagation path. We further expect to derive a global density profile accumulating the lightning whistler events. In the present study, we propose a technique to reconstruct the global density profile using ray tracing by scrutinizing the dispersion analysis of a lightning whistler. Ray tracing program numerically calculates the propagation path of whistler mode waves calculating the refractive index referring to the background magnetic field vector and the electron density[2]. In other words, we expect a reliable propagation path that gives an appropriate magnetic field and electron density models in the ray tracing program.

The international geomagnetic reference filed (IGRF-12) model and the Tsyganenko (TS05) were used to approximate the background magnetic field. The global density profile was generated first separately from the main ray tracing program using the global core plasma model (GCPM), and the international reference ionosphere (IRI). GCPM provides derived core plasma density as a function of geomagnetic and solar conditions. Plasmasphere observed by Gallagher et al. only extends inward until ~2RE , then IRI can be used up to ~600 km[3]. The ray paths of whistler mode signals calculation in the frequency range 1-10 kHz initiating from a region near the candidate lightning stroke from the WWLLN database (around ~1000 km from the source) and try to reconstruct the spectrum shape of the lightning whistler detected by the spacecraft orbiting in the inner magnetosphere. Therefore, we also approximate the region of the lightning whistler source. In this work, we propose modifications in the generated density profile model that satisfies the lightning dispersion characteristics measured by the satellites in the magnetosphere, including delay time and dispersion direction. First, we showed the straightforward modification method by multiplying the global density profile with a constant. Then the modification uses a linear function: keep the density profile on the lower altitude and change the higher one.

We applied our method to a lightning whistler event on August 14, 2017, measured by PWE/WFC aboard the Arase satellite and analyzed the dispersion of the observed lightning whistler. We show how the density modification affects the ray path dispersion characteristics. The first modification can approach the appropriate dispersion, but the propagation time is slower than the observation. The second modification can better approximate the propagation time and get a good agreement in the direction. In the presentation, we will introduce our method and tentative results applied to the observation data.