Chorus intensity modulation driven by time-varying field-aligned low-energy plasma

Y. Nishimura*[(1)], J. Bortnik[(1)], W. Li[(1)], J. Liang[(2)], R. M. Thorne[(1)], L. R. Lyons[(1)], V. Angelopoulos[(3)]

(1) Department of Atmospheric and Oceanic Sciences, University of California, Los Angeles, California, USA. http://web.atmos.ucla.edu/~toshi/

(2) Department of Physics and Astronomy, University of Calgary, Alberta, Canada

(3) Department of Earth, Planetary and Space Sciences, University of California, Los Angeles, California, USA.

Recent studies have shown that chorus waves are responsible for scattering energetic electrons that drive the pulsating aurora with a few seconds to tens of seconds of intensity modulation. In spite of a long history of chorus and pulsating auroral studies, the cause of the intensity modulation has been a mystery in wave-particle and auroral physics. While some of the chorus intensity modulation events are correlated with <~100 eV electron density modulation, most of the chorus intensity modulation events in the post-midnight sector occur without apparent density changes. Although it is generally difficult to find evolution of low-energy (<~20 eV) electron fluxes due to constraints imposed by the spacecraft potential and ESA energy range limit, we identified using THEMIS satellite data that low-energy ions of ~100 eV show density modulation that is correlated with chorus intensity modulation. Those low-energy ions and electrons are field-aligned with major peaks in 0 (for northern hemisphere winter event) and 180 (for northern hemisphere summer event) deg pitch angle, indicating that outflowing plasma from the sunlit hemisphere is the source of the low-energy plasma density modulation near the equator. Plasma sheet plasma density and ambient electric and magnetic fields do not show modulations that are correlated with the chorus intensity modulation. Assuming charge neutrality, the low-energy ions can be used to represent cold plasma density in wave growth rate calculations, and the enhancements of the low-energy plasma density are found to contribute most effectively to chorus linear growth rates. These results suggest that chorus intensity modulation is driven by a feedback process where outflowing plasma due to energetic electron precipitation increases the equatorial density that drives further electron precipitation.