Study on the control mechanism of seasonal variation of AKR based on the Doppler mode conversion process.

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For the mechanisms of seasonal variation of AKR the blocking of AKR's due to the upwelling plasma from the ionosphere has been proposes based on the cyclotron maser instability (CMI) which is not in favor in high plasma density region. However, based on the Akebono satellite data, the present study has indicated intense AKR can be generated even in high plasma density region where fp/fc>0.5. It has been also revealed that the upward-flowing ion events show similar seasonal variation to the case of AKR. Therefore, we inferred that AKR's are not controlled by the condition of CMI process, but by the formation condition of acceleration regions. The formation mechanism of AKR sources at the locations of the acceleration region is also proposed based on the Doppler mode conversion process.

[Introduction] In the recent studies, the seasonal variation phenomena of AKR have been revealed based on the long term observations by the GEOTAIL and the Akebono satellite [1,2]. The investigation of the control mechanism of these phenomena becomes, then, significant subjects being related to the origin of AKR. Based on the analyses of emission frequency range and intensity of AKR, seasonal dependence is suggested to be clearer for AKR's from low altitude sources than those from high altitude sources. Focusing on this feature, it is proposed that AKR's are directly blocked by increasing plasma density due to the upwelling plasma from the ionosphere; i.e. cyclotron maser instability (CMI) can not work in high plasma density condition [1]. In the present study, we have reconsidered the proposed mechanism based on the observation data by the Akebono satellite.

[AKR sources in high density plasma regions] As has been reported in our previous study, AKR can be generated even in high density plasma region where fp/fc>0.5 [3]. These results suggests that there exists generation mechanism of AKR being different from CMI mechanism; due to this mechanism AKR can be generated even in high density plasma region. As the generation mechanism under the condition of high fp/fc, then, applicability of Doppler mode conversion (DMC) process has been investigated. By the numerical calculations of total gain of UHR waves and energy conversion rate from UHR waves to R-X mode waves, it has been shown that intense AKR can be generated via the DMC process even in high plasma density region where fp/fc>0.5.

[Seasonal variation of UFI] In order to clarify the relations between the formation of potential drops along the magnetic field and the vertical distribution of AKR sources, the occurrence frequency of upward-flowing ion (UFI) events has been statistically analyzed based on the data of LEP on board the Akebono satellite. That is, UFI events indicate the existence of acceleration regions below the satellite. The results show that the lower limit altitude of the occurrence of UFI event is shifted up to 5000 km in the summer polar region, while that is shifted down to 3000 km in the winter polar region. These seasonal variations of vertical distributions of UFI events show distinct coincidence with those of AKR sources, which have been reported in the previous study [4]

[Discussion] The similarity of seasonal variations between the lower limit altitude of AKR sources and that of UFI events suggests that AKR sources are controlled by the formation conditions of acceleration regions. The present study has also indicated that the seasonal variation of vertical distribution of AKR sources is not the result of the formation conditions of CMI. In the present study, further consideration has been made for the relation between AKR sources by the DMC process and the acceleration regions. We can assume the series of the cascade-like electric fields in the acceleration region in which fast flowing electrons and slow moving electrons coexist. Because of the Cerenkov type interactions with fast flowing electrons, the UHR waves are generated in slow moving electrons, and then, efficiently converted to the R-X mode waves in the neighboring plasma as the results of DMC process. Because movements of slow electrons show one to one correspondence between local electric field, the distribution of intense AKR sources indicate good coincidence with that of potentials along the magnetic field. For the seasonal variation of the formation region of acceleration regions, it is generally considered that high density plasma from the ionosphere has tendency to prevent the formation of electric potential structures. Precise investigations with quantitative analyses are, however, deferred to the future works.

[1] Kasaba et al.,GRL,24,2483,1997.
[2] Kumamoto and Oya, GRL,25,2369,1998.
[3] Kumamoto et al., SGEPSS Meeting,B41-04,1999.
[4] Kumamoto et al., SGEPSS Meeting,C42-04,1998.