Solar Cycle Dependence of Auroral Kilometric Radiation

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The solar cycle dependence of auroral kilometric radiation (AKR) has been investigated based on the 11-years data observed by the Akebono satellite. In the summer polar region, the occurrence probabilities of intense AKR become larger in the solar minimum than in the solar maximum. The ratio of average intensities of AKR is up to 10 dB. In the winter polar region, however, the solar cycle dependence of AKR is not distinct. The solar cycle dependence of AKR suggests that the variations in the ionosphere control the activity of AKR, as also suggested by the seasonal variations of AKR. In the solar maximum, large solar fluxes are expected to cause the increase of the ionization in the ionosphere, which are inferred to block the generation of intense AKR.

[Introduction]

Based on the close correlation between auroral phenomena and auroral kilometric radiation (AKR) [1,2], AKR has been generally considered to be active in the solar maximum period. However, based on the seasonal variation of AKR revealed by the recent studies [3,4], AKR in the solar maximum period is also expected to become quiet because the ionization in the ionosphere increases as in the summer polar region where AKR becomes weak with respect to that in the winter polar region. In order to solve the problem, we have carried out the statistical analyses by using the 11-years data observed by the Akebono satellite.

[Analyses]

The plasma wave data observed by the Akebono satellite from 1989 to 1999 have been used for the statistical analyses of solar cycle dependence of AKR. The occurrence probabilities of AKR in intensity range from -180 to -150 dBW/(m^2 Hz) have been calculated for 4 months around the solstice in the solar maximum (1989-1992) and minimum (1994-1997) periods.

[Solar cycle dependence of AKR]

The analyses have revealed the clear solar cycle dependence of AKR activities in the summer polar region. The occurrence probabilities of intense AKR become larger in the solar minimum period than in the solar maximum period. The ratio of average intensity of AKR is up to 10 dB. In the winter polar region, however, the solar cycle dependence of AKR is not so distinct as in the summer polar region.

[Discussion]

The solar cycle dependence of AKR, revealed by the long term observations by the Akebono satellite, suggests that the variations in the ionosphere control the activity of AKR, as also suggested by the seasonal variations of AKR. In the solar maximum period, large solar fluxes are expected to cause the increase of the ionization in the ionosphere, which are inferred to block the generation of intense AKR. As the reason why the solar cycle dependence of AKR is unclear in the winter polar region, it is possible that the solar cycle variations of AKR are masked because occurrence probability of intense AKR over the saturation level becomes large in the winter polar region. However, based on the inference that variations of the solar flux have little effects in the dark ionosphere, it is also possible that there is little dependence on the solar cycle in the winter polar region. In the present study, based on the scatter plot of average intensity of AKR versus the parameter of F10.7*sin(tilt angle), the empirical formula of the average intensity of AKR have been determined as P[dBW/(m^2 Hz)]<-150-0.12*F10.7*sin(|tilt angle|) for the summer polar region. This result shows the maximum level of AKR activities in long time scale, and provides a cue to investigate the blocking mechanism of AKR generation by the effects of the ionosphere.

[References]

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