MANIFESTATION OF SUBSTORMS AND STORM IN THE SAR ARC DYNAMICS STATISTICAL ANALYSIS

I.B. Ievenko and V.N. Alexeyev
Institute of Cosmophysical Research and Aeronomy, Yakutsk (ievenko@ikfia.ysn.ru)

It is known that mid-latitude red arcs (SAR arcs) are related to magnetic storms defined by variations of the Dst index. By using data of spectrophotometric observations at the Yakutsk meridian (Maimaga station, CGMC: 57° N; 200° E) we have shown that the occurrence and/or brightness of SAR arc take place during the substorm expansion phase (Geomagnetism and Aeronomy, V.39, N.6, P.697, 1999). Here we use of SAR arc 700 hours registration data in 1989-2000 and carry out the correlation coupling analysis of 630 nm emission intensity in an arc (Im) and the velocity of the arc equatorward movement (Vm) with magnetic indices AL, Dst and ASYH. The following peculiarities of influence of the substorm and storm to the SAR arc dynamics are revealed:

1) The SAR arc intensity during the weak magnetic storm of Dst≥-50 nT is defined by the auroral index AL with a correlation coefficient R=-0.45-0.55. The significant relation of arc intensity to Dst is not but it is essential with ASYH-index. It is assumed that the AL-dependence of Im is most likely caused by the considerable contribution of the asymmetric ring current arising during a substorm to the SAR arc generation.

2) In the samplings of data for the moderate storms of −50 ≥ Dst ≥-120 nT the statistically significant dependence (R=-0.5-0.7) of arc luminosity on the ring currrent intensity appears, that is in agreement with early results. In this case, the significant relation of Im to AL remains constant.

3) The velocity of SAR arc equatorward movement is of the significant dependence only on AL-index with R≈-0.5, that can be indicative of a conditionallity of this phenomenon by penetration of the non-stationary convection electric field to plasmasphere latitudes during a substorm.

4) The latitudinal distribution of SAR arc intensity maximum location by the number of observation hours at the Yakutsk meridian is close to the normal one with a median at Λc=55° N(L=3) and it is of a half-width 6°. It is supported that this latitude interval of SAR arc observation is the statistical mapping of a more dynamic region of outer plasmasphere L-shells into which the ring current in the stage of its development penetrates during substorms at Kp=3-6.

5) Most probable values of hourly average parameters of SAR arc and geomagnetic activity in used rows of data are: Im=140 R, Vm=20m/s, AL=-230 nT, Dst=-40 nT.