

Bi-modal log-normal distribution of substorm intensity: What does it mean?

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One of the essential issues in substorm study is how is the substorm intensity distributed and what determines the distribution. In this study, we made a data base of substorm onset and intensity for a long period from 2005 to 2014 by using Wp index provided by WDC for Geomag, Kyoto University and OMNI data base. Then, the substorm intensity (AL index) distribution is statistically studied using the data base. The obtained major results are,

- 1) Substorm intensity shows bi-modal log-normal distribution.
- 2) Its major peak is in small AL range around 100 nT and the secondary peak is around 300 nT.
- 3) The occurrence ratio between the major and second groups is 52%:48% (Number of small substorms is comparable with larger substorms).
- 4) The ratio of integrated AL value between the major and second groups is 32%:68% (One third of magnetospheric energy may be dissipated through small substorms).

The major and secondary groups are considered to be pseudobreakups and full substorms, respectively. The bi-modal distribution of substorm intensity means that substorm is not a continuum state between pseudo-substorms and full substorms as has been discussed, and may suggest that two different substorm processes are working. What are the two different substorm processes? Do they imply the different solar wind-magnetosphere interaction process, two types of loading-unloading process, or different substorm triggering?