

Dependence of substorm energy storage and release as a function of the position and the substorm magnitude

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The purpose of this paper is to investigate in a model-independent manner the energy storage and release process of substorms as a function of both the position and the substorm magnitude. As an index of the substorm magnitude, we use the amplitude of the positive bay observed at mid and low latitudes. As an index of the energy storage and release in the magnetotail, we use the total pressure obtained by GEOTAIL. In an attempt to establish the analysis procedures, we have preliminarily analyzed three years' worth of data. As a result we have identified more than 100 substorms, and performed the superposed epoch analysis of the total pressure at GEOTAIL for all the substorms. The result is the pressure increase before the onset and recovery after the onset, consistent with former studies.

How substorm onsets occur and what controls their occurrence are basic and important questions in the study of substorms. The two popular models to answer the questions are the near-Earth neutral line model and the current disruption model, and many studies have been made based on each model. The purpose of this paper is to investigate in a model-independent manner the energy storage and release process of substorms as a function of both the position and the substorm magnitude. For example, we study whether the substorm activity is more closely correlated with the energy storage and release near $X = -20R_E$ or that in the region closer to the Earth. We also study if the answer is the same or not for large substorms and for small substorms. Via these analyses we would be able to address the validity of the two models in an objective manner.

To perform a statistical analysis, we identify substorm onsets on condition that the $Pi2$ is simultaneously observed at three mid- to low-latitude ground stations in the 210MM network when they are located near the midnight sector. In order to enable a clear recognition of the energy storage and release process, we choose substorm onsets with no other onsets in the preceding 30-min interval. As an index of the substorm magnitude, we use the amplitude of the positive bay observed at mid and low latitudes; because the positive bay is the remote effect of the substorm wedge current system at the auroral latitudes, local perturbations of the current density in the wedge current system are smoothed out and thus the amplitude of the positive bay is regarded as a good indicator of the total magnitude of the wedge current. As an index of the energy storage and release in the magnetotail, we use the total pressure obtained by GEOTAIL.

In an attempt to establish the analysis procedures, we have preliminarily analyzed three years' worth of data. As a result we have identified more than 100 substorms, and performed the superposed epoch analysis of the total pressure at GEOTAIL for all the substorms. The result is the pressure increase before the onset and recovery after the onset, consistent with former studies.