

Simultaneous observation of auroral substorm onset in Polar satellite global images and ground-based all-sky images

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Substorm onsets have originally been defined as longitudinally extended sudden auroral brightening ("Akasofu initial brightening") followed a few minutes later by auroral poleward expansion in ground-based all-sky images. In satellite global images, in contrast, such a clearly marked two-stage development has not been observed, and instead substorms have often appeared to start in a localized area. To resolve these differences, optical substorm onset signatures in global images and all-sky images were compared for a substorm that occurred on 7 December 1999. We have used the Polar satellite ultraviolet global images with a fixed filter (170 nm), enabling a high time resolution (37 s), and have used the 20 s resolution green line (557.7 nm) all-sky images at Muonio in Finland for comparison.

We first identified the substorm onset brightening at 2127:49 UT in the global images and then searched for corresponding signatures in the all-sky images. The Akasofu initial brightening (2124:50 UT) and the poleward expansion (2127:50 UT) were observed in the all-sky images, indicating that the onset in global images was not simultaneous with the actual onset but rather with the poleward expansion in the all-sky images. The Akasofu initial brightening was not observed in the global images, which may possibly be attributed to the limited sensitivity of global images for thin auroral arc brightenings. This result suggests that substorm onset identified in global images does not necessarily represent the Akasofu substorm onset, but rather corresponds to the poleward expansion a few minutes later.

Keywords: substorm, auroral breakup, aurora, global image, all-sky image