Magnetospheric Signatures of STEVE: Implications for the Magnetospheric Energy Source and Interhemispheric Conjugacy

Y. Nishimura, B. Gallardo-Lacourt, Y. Zou … See all authors

First published: 16 April 2019

https://doi.org/10.1029/2019GL082460

Citations: 8

Abstract

We present three STEVE (strong thermal emission velocity enhancement) events in conjunction with Time History of Events and Macroscale Interactions (THEMIS) in the magnetosphere and Defense Meteorological Satellite Program (DMSP) and Swarm in the ionosphere, for determining equatorial and interhemispheric signatures of the STEVE purple/mauve arc and picket fence. Both types of STEVE emissions are associated with subauroral ion drifts (SAID), electron heating, and plasma waves. The magnetosphere observations show structured electrons and flows and waves (likely kinetic Alfven, magnetosonic, or lower-hybrid waves) just outside the plasmasphere. Interestingly, the event with the picket fence had a $\gtrsim$1 keV electron structure detached from the electron plasma sheet, upward field-aligned currents (FACs), and ultraviolet emissions in the conjugate hemisphere, while the event with only the mauve arc did not have precipitation or ultraviolet emission. We suggest that the electron precipitation drives the picket fence, and heating drives the mauve as thermal emission.
Plain Language Summary

STEVE (strong thermal emission velocity enhancement) has become increasingly popular among citizen scientists due to its distinct colors and structures of emission in the night sky and its occurrence over more populated areas than for typical aurora in the auroral oval. This study addresses two major questions of STEVE: What is the energy source of the STEVE purple or mauve colored arc and green picket fence up in space? and Does STEVE occur in the Northern and Southern Hemispheres at the same time? Using a set of imaging and satellite observations, this study found that STEVE is connected to fast plasma flows, sharp plasma boundaries, and intense waves 25,000 km (15,000 miles) up in space. Photographs taken by citizen scientists have played a key role in finding STEVE and its morphology. Plasma heating due to the fast flows and waves is suggested to drive the mauve colored arc. But this mechanism does not explain the picket fence. We found that energetic particle precipitation drives the picket fence. The picket fence is found to occur in both hemispheres at the same time, supporting that the energy source far up in space feeds energy to both hemispheres.

Citing Literature

Back to Top