Comprehensive Analysis of the Magnetic Signatures of Small-Scale Traveling Ionospheric Disturbances, as Observed by Swarm

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**Abstract**

Based on Swarm satellite data from 2015 through 2018, we present the mean characteristics of magnetic field fluctuations at midlatitudes and low latitudes. It is the first comprehensive study focusing on small-scale variations (<10 km). Events are observed on about 35% of the orbits. The highest occurrence rates are detected after sunset, in the East Asian/Australian sector, and during months around June solstice.

Low occurrence rates are found at low magnetic latitudes (below ±10° quasi-dipole latitude), in the region of the South Atlantic Anomaly, and during equinox seasons. All these occurrence features compare well with those of medium-scale traveling ionospheric disturbances. We therefore term our small-scale events small-scale traveling ionospheric disturbances (SSTIDs). SSTIDs exhibit high field-aligned current (FAC) densities connected to narrow current sheets with meridional width of typically 4 km. The intense FACs flow typically between the hemispheres. Return currents are distributed over larger scales.
and thus have smaller amplitudes. Peak current densities get larger toward lower latitudes. There are two groups of events, around morning-noontime and evening-night, which are separated by demarcation lines near 04 and 15 magnetic local time. The magnetic amplitudes of the small-scale fluctuations are larger in sunlight than in darkness, indicating larger total currents in the loops. But the FAC peak current densities are larger in darkness, inferring a stronger squeezing of the current sheet under low-conductivity conditions.

We suggest that our SSTIDs are an evolutinal state of medium-scale traveling ionospheric disturbances.

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