

# SA43B-3196 - Multi-scale statistical analysis of Poynting flux using Swarm: Quantifying the Impact of Small- and Meso-scales in Electromagnetic MIT coupling



Thursday, 12 December 2019



13:40 - 18:00



Moscone South - Poster Hall

## ePoster

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## Swirl Topics

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## Abstract

In recent years it has become apparent that magnetosphere-ionosphere-thermosphere (M-I-T) energy coupling occurs at a range of scales, with smaller scales which had hitherto largely been ignored now being increasingly recognised as significant. This study quantifies the scale-dependence of the Poynting flux entering the ionosphere by utilizing the extensive high-resolution E- and B-field dataset from the ESA Swarm mission at 450 km altitude. We analyse the characteristics of the Poynting flux observed along the world line of the Swarm satellites, and calculate the Poynting flux values as a function of scale size using statistics derived from numerous auroral zone crossings. We use time domain band-pass filtering to statistically resolve the electromagnetic energy partition as a function of scalesize and as a function of season, hemisphere and geomagnetic conditions. We find that small scales ( $\sim$ 10-150 km) and mesoscales ( $\sim$ 150-250 km) are statistically energetically significant in the global field-aligned current (FAC) system with each carrying up to  $\sim$ 30% of total energy if a moving average filter is used. By using the dispersion relations for incident, reflecting, and interfering Alfvén waves, we demonstrate that much of the energy transport at these small- and meso-scales is associated with Alfvén waves. At smaller scales still, however, it appears that Alfvénic disturbances with sub-kilometer scales are not associated with a significant magnetosphere-ionosphere coupling (MIC) nor with a significant net Poynting flux energy fraction. As Swarm orbits are at altitudes below the auroral acceleration region, we discuss these findings in the global context in relation to a broader energy partition between electromagnetic waves and accelerated auroral electrons. This is important, not least because the electromagnetic energy observed at Swarm altitudes will be the residual remaining after the action of any auroral electron acceleration higher up the field line. Finally, we discuss the implications of our observations not only for identifying the dominant physical processes active in MIC, but also for assessing if these have implications for the scale-dependence of energy transport. In particular, we discuss the extent to which scale-dependent Alfvénic energy transport may play a key role in MIC.

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