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Swarm-SWITCH: A new tool for monitoring the weather in the thermosphere-ionosphere using in-situ satellite observations and models

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Abstract

The thermosphere-ionosphere can have a variety of adverse effects on technological systems, for example by affecting radio signals and satellite orbits. Space weather service providers typically use a combination of observations and models to keep track of the behaviour of this highly dynamic environment, with the aim to provide timely and accurate alerts to users. However, model data and observations must be obtained from a variety of repositories for operational and scientific data with varying latency and data formats. This makes this a difficult and time consuming effort.

In the Swarm-SWITCH project, we are starting to address these issues in three steps: 1) further development of our interactive space weather timeline viewer tool in combination with our HAPI (Heliophysics API) server for space weather data, 2) incorporating Swarm in-situ observations in the tool, now available with a much-reduced latency of the level 1b products and 3) including selected output from thermosphere-ionosphere models, such as NOAA's operational WAM-IPE, sampled and graphically presented for regions of interest as well as along the satellite trajectories for direct comparison and verification. We will demonstrate the tool for a variety of use cases, including the sampling during geomagnetic storms and ionospheric irregularities. Through the use of open source software and open standards, such as HAPI, we hope to encourage wider adoption of this approach, by both users and data providers.

In addition to data from the 3-satellite Swarm mission, we have simulated data for the 6 satellites from the future NASA Geospace Dynamics Constellation (GDC). This allows us to assess the pros and cons for space weather service providers of the variety of in-situ sampling geometries represented by such multi-satellite missions. These developments will provide valuable input, not only for space weather operation centers, but also for model developers and for the implementation of future operational and scientific thermosphere-ionosphere monitoring missions.

Annexes

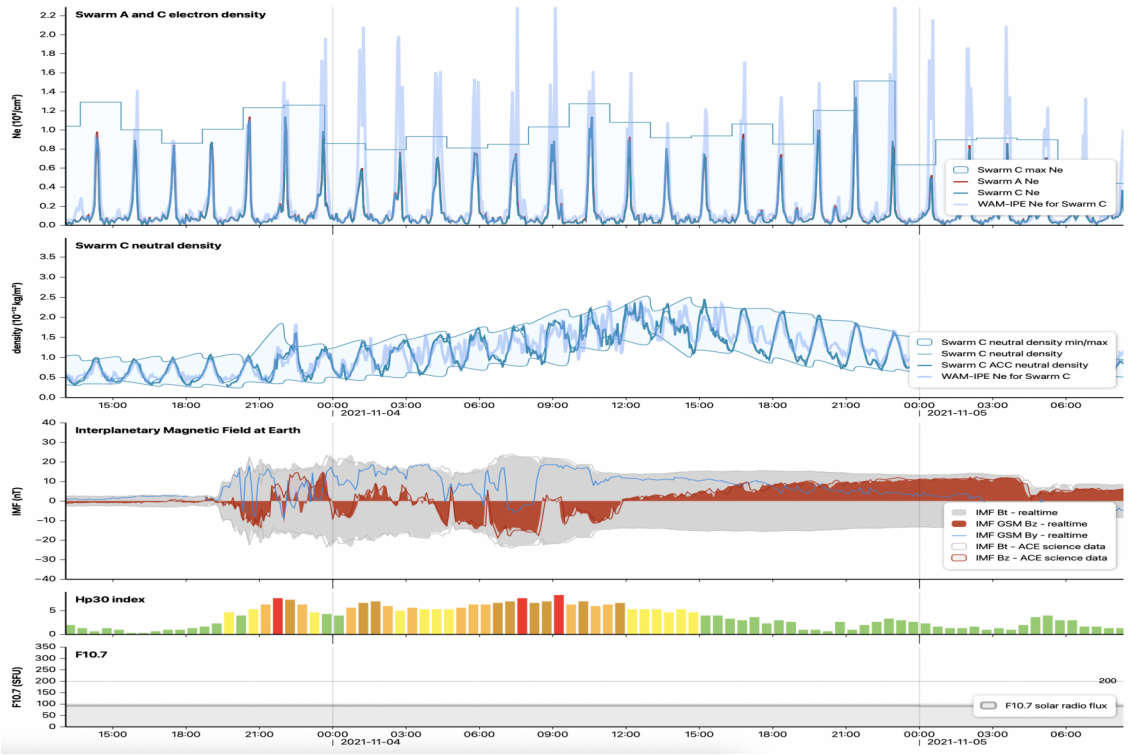

Figure 1: Comparison of Swarm and WAM-IPE data, combined with basic space weather data during a geomagnetic storm. Users can smoothly zoom in and out of such events to view context and details.

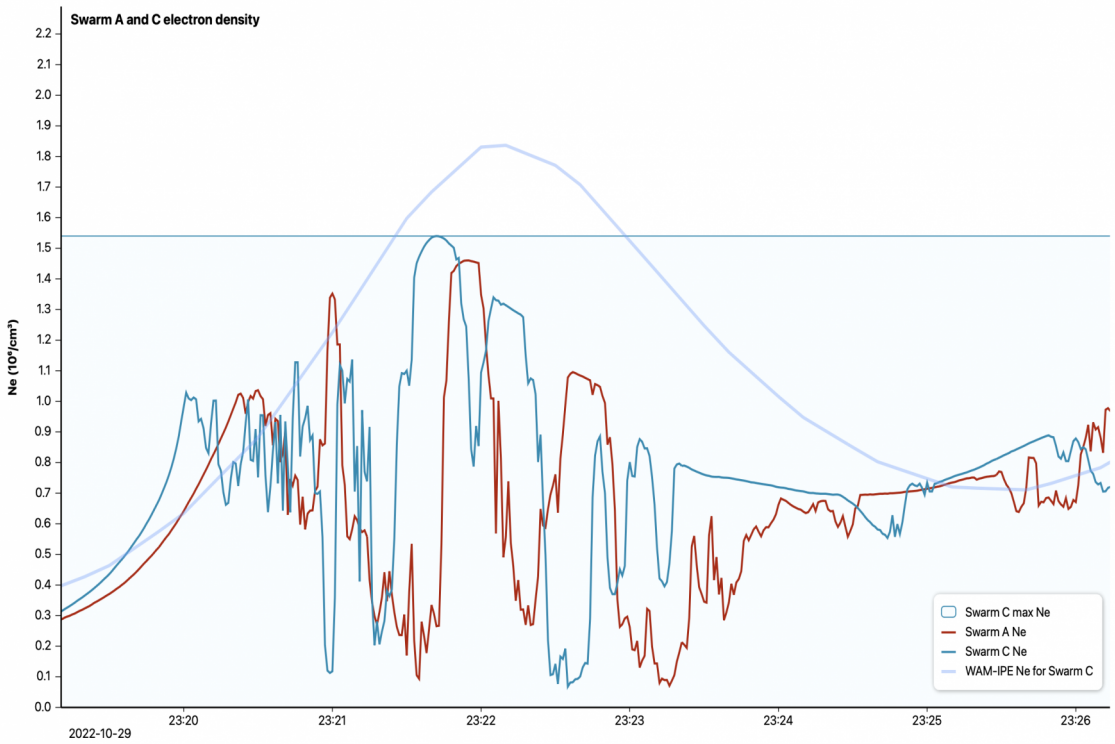

Figure 2: A zoomed in view on Swarm A and C plasma data, showing the occurrence of ionospheric irregularities. The WAM-IPE model shows the regular features of the equatorial ionosphere, as it is not able to simulate such small scale irregularity features.