

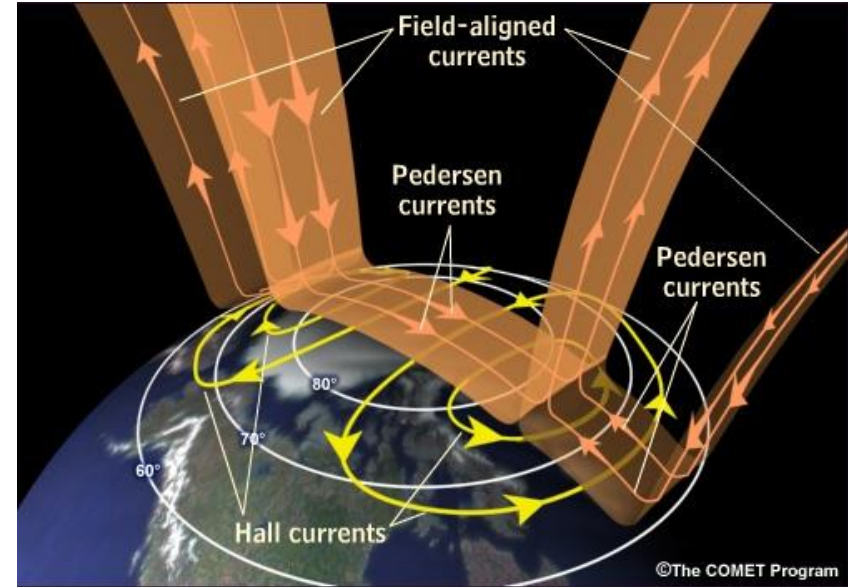
Recent results from scientific ESA Swarm projects

Lorenzo Trenchi, Jerome Bouffard, Anja Stromme, Octav Marghиту, Kirsti Kauristie, Adrian Blăgău, Joachim Vogt, Balázs Heilig, and Péter Kovács

The SIFACIT project

The Ionospheric current system, consisting of field aligned currents (FAC, parallel to the magnetic field) and Hall and Pedersen currents (perpendicular to it), establishes a link between the solar wind/magnetosphere with the Earth's ionosphere.

Swarm is the ideal mission to investigate ionospheric currents, with their precise multipoint measurements of magnetic and electric fields.



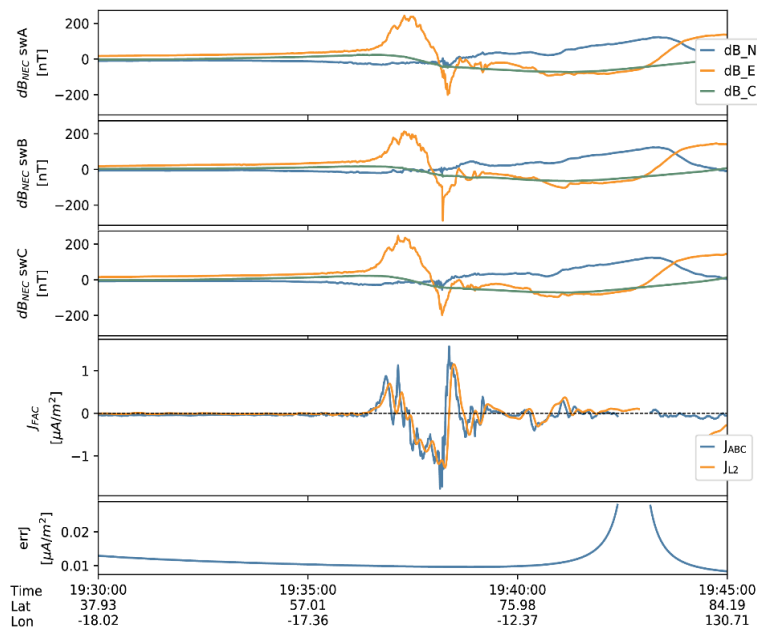
SIFACIT project is developing new methods to calculate FAC (Task1), and it is studying the Joule Heating resulting from Pedersen current using Swarm data (Task2).

The SIFACIT project: new methods to calculate FAC

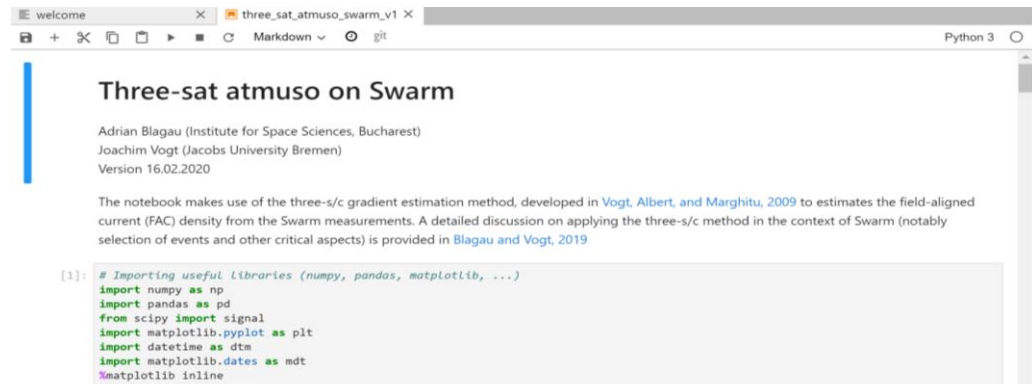


A new python FAC toolbox to compute FACs at different scales, using single- dual- and three spacecraft methods, and quality indicators to assess the stationarity of current layer.

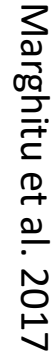
It runs in VRE (<http://vre.vires.services>) allowing to access Swarm data, process them, save the output.



3-s/c method already available: it computes FAC with data from all three Swarm s/c, during conjunctions: more spatial resolution with respect to 2-s/c L2 method, and no need for stationarity assumption (simultaneous measurements).



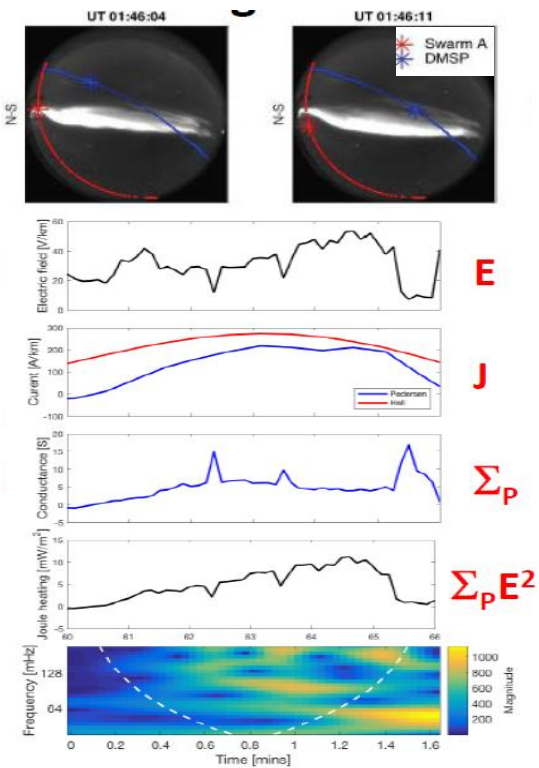
It changes atmospheric scale height and density => Significant impact on motion of satellites & space debris



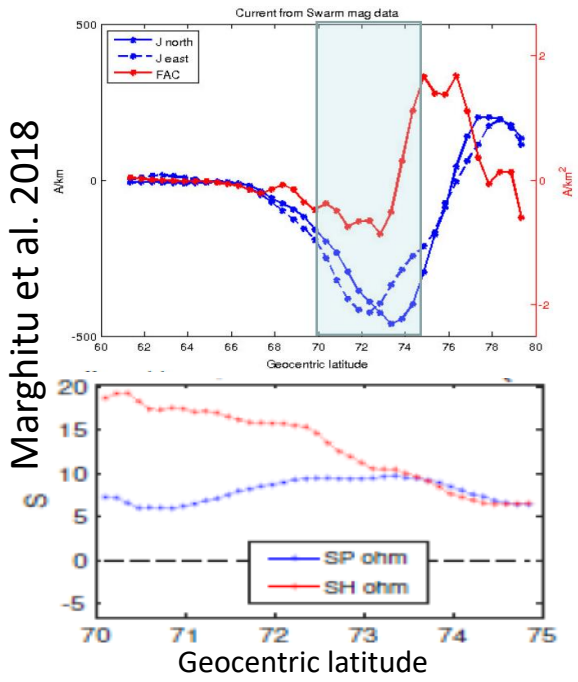
The SIFACIT project: Joule Heating at different spatial scales

Bunescu et al. 2018

ARC-scale: ALADYN technique

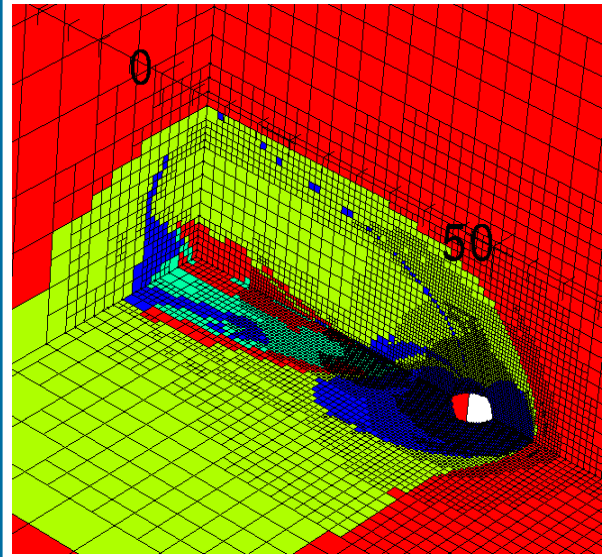


MESO-scale: SECS + E field optimization technique



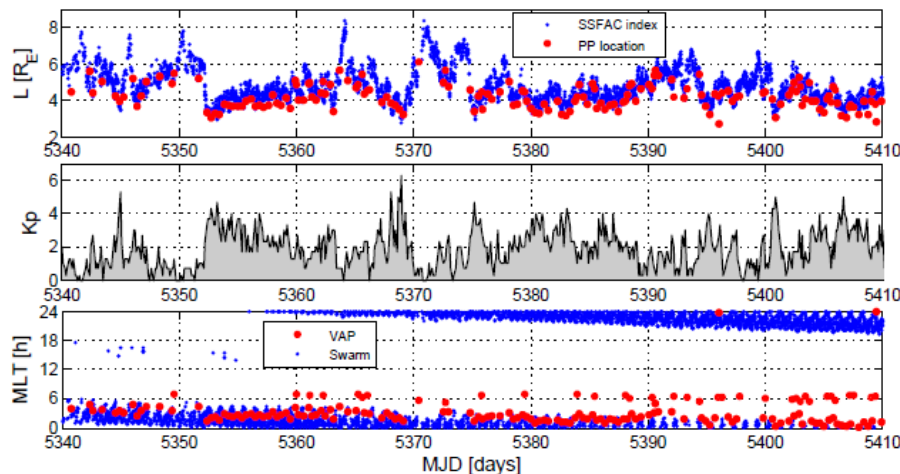
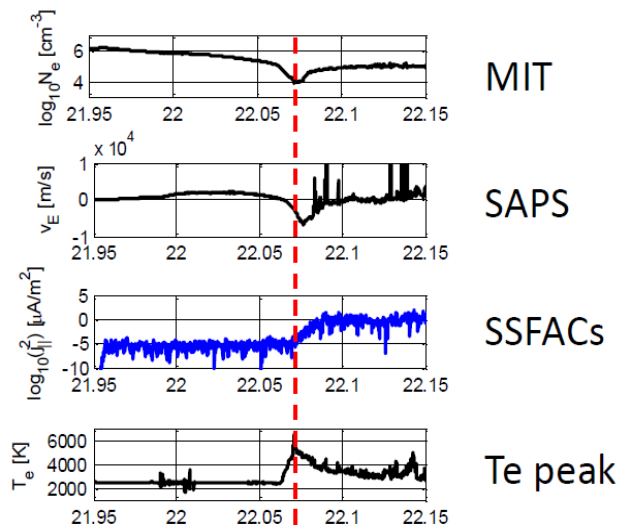
Marghitsu et al. 2018

Global-scale GUMICS5 simulation
Comparison with Swarm-based JH will allow to derive scaling coefficients and correct the GUMICS model.



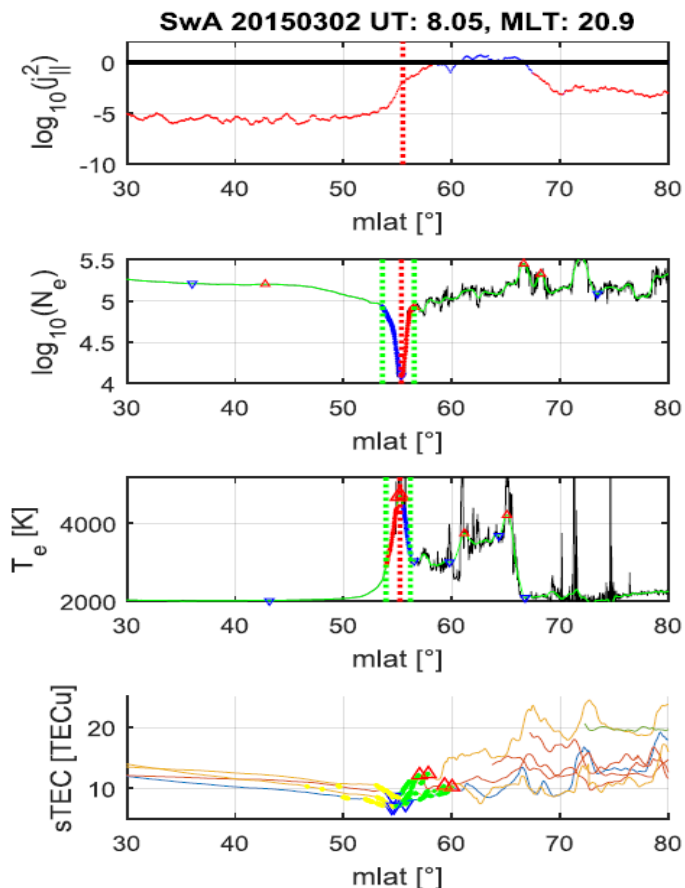
The EPHEMERIS project: MIT with Swarm data

The Midlatitude Ionospheric Through (MIT) is a clear depletion in the topside ionosphere where N_e drops by orders of magnitudes, often associated with peak in T_e , a signature in Small Scale FAC, and increase of drift velocity (red dashed line).



The position of PP can be inferred from Small-scales FAC from Swarm, demonstrated to be related to the PP position (in red the in situ detection of PP from Van-Allen probe, Heilig & Luhr 2013, 2018).

The EPHEMERIS project: MIT with Swarm data



This project is developing a new product to characterize the MIT from Swarm data, based on Langmuir Probes Ne, Te and a fully autonomous routine.

Validation will include a comparison with the location of MIT inferred from Swarm TEC, and with the independent dataset of PP crossings of NASA's Van-Allen Probes.

This will allow to verify the relation between the PP and the MIT for different Local Times and geomagnetic conditions.

The EPHEMERIS project: Intermittency index and GPS signal



Second part of this project is developing a new Swarm index for the detection of ionospheric irregularities based on Intermittent fluctuations in 50Hz VFM data measured by Swarm.

This index is very important for space weather, because intermittent high frequency fluctuations can cause a degradation of the GPS signals.

The investigation will include a comparison with the existing Swarm Plasma Bubble index, and with GPS signal loss events to assess the effect of Intermittent irregularities on GPS signals.

