



## **Swarm Utilisation Analysis: LEO satellite observations for the ESA's SSA Space Weather network**

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ESA's (European Space Agency) constellation mission Swarm was successfully launched on 22 November 2013. The three satellites achieved their final constellation on 17 April 2014 and since then Swarm-A and Swarm-C orbiting the Earth at about 470 km (flying side-by-side) and Swarm-B at about 520 km altitude. Each of Swarm satellite carries instruments with high precision to measure magnetic and electric fields, neutral and plasma densities, and TEC (Total Electron Content) for which a dual frequency GPS receiver is used.

SUA (Swarm Utilisation Analysis) is a project of the ESA's SSA (Space Situational Awareness) SWE (Space Weather) program. Within this framework GFZ (German Research Centre for Geosciences, Potsdam, Germany) and DTU (National Space Institute, Kongens Lyngby, Denmark) have developed two new Swarm products ROT (Rate Of change of TEC) and PEJ (Location and intensity level of Polar Electrojets), respectively. ROT is derived as the first time derivative from the Swarm measurements of TEC at 1 Hz sampling. ROT is highly relevant for users in navigation and communications: strong plasma gradients cause GPS signal degradation or even loss of GPS signal. Also, ROT is a relevant space weather asset irrespective of geomagnetic activity, e.g., high amplitude values of ROT occur during all geomagnetic conditions. PEJ is derived from the Swarm measurements of the magnetic field strength at 1 Hz sampling. PEJ has a high-level importance for power grid companies since the polar electrojet is a major cause for ground-induced currents.

ROT and PEJ together with five existing Swarm products TEC, electron density, IBI (Ionospheric Bubble Index), FAC (Field-Aligned Current), and vector magnetic field build the SUA service prototype. This prototype will be integrated into ESA's SSA Space Weather network as a federated service and will be available soon from ESA's SSA SWE Ionospheric Weather and Geomagnetic Conditions Expert Service Centres (ESCs).