

Project A2025-16

Expected EMF from satellite-based communication systems

The rapid deployment of Low Earth Orbit (LEO) satellite constellations (altitudes of less than 1000 km), exemplified by Starlink, OneWeb, Kuiper, Quianfan, etc. represents a transformative development in global communication infrastructure. These systems employ high-frequency electromagnetic fields (HF-EMF) to provide broadband connectivity to end-user terminals and mobile devices, as well as to establish high-capacity links between satellites and ground stations that may serve as critical supplements to submarine cables. These technologies promise substantial societal benefits but also introduce novel HF-EMF exposure scenarios that are not yet well-characterized.



left: Visualization of active satellite constellations (satellitemap.space). As of Q4/2025, more than 14000 active satellites are in orbit, most of them being communication satellites in Low Earth Orbit (LEO); right: Starlink user terminal for satellite-based broadband internet access (starlink.com)

In this project we assess both the contribution to environmental HF-EMF exposure at ground level from the downlink activity of various satellite systems as well as the uplink emissions from available and representative user equipment. The latter include user terminals for broadband internet access, mobile phones, smart watches, emergency messengers and other devices supporting direct access to satellite networks.

Repeated measurement campaigns will be carried out in Switzerland to characterize and evaluate the contribution of satellite communication systems to the levels and spectral components of the environmental HF-EMF and its evolution over time. At least one measurement campaign will also take place near a satellite ground station facility to address the question whether such sites exhibit higher environmental HF-EMF exposure levels. These measurements will be used to validate exposure field strength calculations based on link budget models and to establish a worst-case estimation framework.

In the last part of the study, satellite-based telecommunication systems are compared to terrestrial wireless telecommunication systems in terms of EMF exposure as well as technical, economic, and environmental aspects. The expected outcome is a framework that highlights trade-offs in performance, efficiency, and exposure, contributing to informed decisions for future network design and policy development.