

# Thermosphere-Ionosphere Observing System Simulation Experiments with multi-satellite constellations

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## Abstract

Space weather in the thermosphere-ionosphere has the potential to disrupt our technological systems, for example by affecting radio signals and satellite orbits. In some cases, system designers have implemented various adaptation and mitigation measures in these areas. In severe space weather conditions with heightened ionospheric variability, these measures may prove inadequate. The consequences can range from degraded or interrupted radio signal reception, resulting in user errors in communication, navigation, and timing, to extreme cases of intermittent loss of all operations. Multi-point and multi-instrument in-situ sampling provides crucial data sets to better understand and address the impact of space weather on the thermosphere-ionosphere system.

In this study, we conduct observing system simulation experiments (OSSEs) to evaluate a thermosphere-ionosphere data assimilation framework incorporating synthetic plasma and neutral measurements from Swarm and future geospace dynamics constellation (GDC) missions. These OSSEs are designed to assess the impact of realistic observing systems under geomagnetic storm conditions. We present the results of two case studies. We discuss the usefulness of assimilating multi-point Swarm- and GDC-like in-situ observations in thermosphere-ionosphere modelling, both in the context of reanalyses and forecasting.