Whole Atmosphere Modeling Intercomparison (WAMI)

This project aims to support the analysis of the Cross-scale cOUpling pRocesses in the Solar–tErrestrial system (COURSE) project, part of SCOSTEP's 2026–2030 scientific program. We specifically address Focus Area 3: External impacts and internal dynamics of the Earth's atmosphere. This initiative provides a platform to evaluate how different whole-atmosphere models treat coupling between the lower atmosphere and the mesosphere and lower thermosphere (MLT). The primary focus of the model intercomparison is to understand gravity-wave and tidal variability in the MLT by comparing multiple state-of-the-art whole-atmosphere models, including KMCM, WACCM-X, TIE-GCM, HAMMONIA, WAM, and the upper-atmosphere extension of ICON (UA-ICON). Comparisons between whole-atmosphere models and thermosphere–ionosphere models highlight the critical role of interactive lower-upper atmosphere processes, as well as the trade-offs between physical complexity, computational cost, and model skill.

This study may also shed light on the model configurations and parameterizations needed to accurately capture key coupling mechanisms, focusing on atmospheric waves from planetary to mesoscales and their effects on the middle and upper atmosphere. In addition, extreme space weather and meteorological events—namely, sudden stratospheric warmings (SSWs) and geomagnetic storms—will serve as natural test cases. Tidal amplitudes and phases in the lower thermosphere will be evaluated using ICON/MIGHTI neutral wind and temperature measurements. Concurrently, MLT wind and temperature structures will be assessed using satellite data from TIMED/SABER. Additionally, we will validate the models against an extensive observational dataset from IAP stations in Norway using ground-based meteor radars and lidar collected during the NASA VortEx sounding rocket campaign in March 2023.