Solar activity and dynamics of the mesosphere and lower thermosphere

The mesosphere and lower thermosphere (MLT) region extends from 50 to 150 km in the atmosphere. It is affected from above by solar UV/ EUV irradiances and precipitating energetic particles, as well as by atmospheric waves from below. So, the MLT region is an interface to couple solar energy into the atmosphere and the energy transported by atmospheric waves and tides into the thermosphere/ionosphere.
Upward propagating gravity waves eventually break and dissipate there. In this way, their momentum flux divergence in the MLT drives the mean meridional circulation but also impacts the thermal structure. In turn, this dynamical feedback affects the zonal wind structure of the MLT and influences the filtering conditions for upward propagating waves generated in the lower part of the atmosphere. The energy budget of the MLT region is complex, being comprised of solar radiative heating by N2, O2, O, and O3 in the UV/EUV spectral range and IR radiative cooling by CO2 and NO, chemical heating by exothermic chemical reactions, and Joule heating of the ionospheric currents, as well as dynamical drivers. Most of these terms are affected by short-term solar variability, either directly or through chemical-dynamical feedbacks. In the proposed project, we will analyze the influence of short-term solar variability – solar EUV flares, geomagnetic storms and solar proton events – on the composition, energy budget, gravity wave propagation and dissipation, temperature, and circulation of the MLT region based on dedicated model experiments with the high-resolution high-top chemistry-climate model UA-ICON-MECCA. With this detailed analysis, we will help fill in a missing piece in understanding the energy budget of the transition region between our atmosphere and space.