

EGU21-10818

<https://doi.org/10.5194/egusphere-egu21-10818>

EGU General Assembly 2021

© Author(s) 2022. This work is distributed under the Creative Commons Attribution 4.0 License.



sensitivity of middle atmospheric ozone to solar proton events: comparison between climate model and satellites

Kenneth Nilsen¹, Antti Kero¹, Pekka Verronen^{1,2}, Monika Szlag², Niilo Kalakoski², and Jia Jia¹

¹University of Oulu, Sodankylä Geophysical Observatory, Finland (kenneth.nilsen@oulu.fi)

²Space and Earth Observation centre, Finnish Meteorological Institute, Finland

Energetic particle precipitation (EPP) impact on the middle atmospheric ozone chemistry plays potentially an important role in the connection between space weather and Earth's climate system. A variant of the Whole Atmosphere Community Climate Model (WACCM-D) implements a detailed set of ionospheric D-region chemistry instead of a simple parameterization used in the earlier WACCM versions, allowing to capture the impact of EPP in more detail, thus improving the model for long-term climate studies. Here, we verify experimentally the ion chemistry of the WACCM-D by analysing the middle atmospheric ozone response to the EPP forcing during well-known solar proton events (SPEs). We use a multi-satellite approach to derive the middle atmospheric sensitivity for the SPE forcing as a statistical relation between the solar proton flux and the consequent ozone change. An identical sensitivity analysis is carried out for the WACCM-D model results, enabling one-to-one comparison with the results derived from the satellite observations. Our results show a good agreement in the sensitivity between satellites and the WACCM-D for nighttime conditions. For daytime conditions, we find a good agreement for the satellite data sets that include the largest SPEs (max proton flux $>10^4$ pfu). However, for those satellite data-sets with only minor and moderate SPEs, WACCM-D tends to underestimate the sensitivity in daytime conditions. In summary, the comparisons WACCM-D ion chemistry, combined with the transportation, demonstrates a realistic representation of the SPE sensitivity of ozone, and thus provides a conservative platform for long-term EPP impact studies.