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Modelling the effects of solar particle events on vibrationally excited hydroxyl

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The main source of vibrationally excited hydroxyl molecules in the Earth's mesosphere is the reaction H + O_3 $\rightarrow$ OH(v) + O_2. The exothermicity of this process leads to excitations of hydroxyl up to the 9th vibrational state. During solar particle events (SPEs), energetic protons and electrons can enter the polar atmosphere and cause ion-chemical perturbations. It is well established that both ozone and hydrogen are affected by SPEs. As a result, the production rate of OH(v) changes. Additionally, the quenching rates of OH(v) change due to increasing concentrations of atomic oxygen. Furthermore, SPE induced temperature changes influence the chemistry of OH(v).
We use a one-dimensional atmospheric chemistry model in combination with the University of Bremen Ion Chemistry (UBIC) model to simulate the impact of major SPEs on mesospheric OH($v = 0 \ldots 9$). For this purpose, SPE ionisation rates from AIMOS (Atmospheric Ionization Module Osnabrück) are used. Temperature changes are considered by predictions of the MSIS-E-90 atmosphere model as well as by data from the SABER (Sounding of the Atmosphere using Broadband Emission Radiometry) satellite instrument. The modelled radiative emissions of OH(v) are compared to satellite observations (SABER and SCIAMACHY = Scanning Imaging Absorption Spectrometer for Atmospheric CHartographY).