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Towards a comprehensive Global Electric Circuit model: Conductivity and its variability in WACCM model simulations

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As an important step for increasing our understanding of the global electric circuit, the AC-GCM (atmospheric chemistry general circulation model) WACCM has been extended to provide a calculation of atmospheric conductivity. This is the first time an AC-GCM is used for this purpose. Such model simulations are ideally suited for conductivity calculations and are a significant improvement to previous studies. The advancements are based on the given model data consistency as well as the possibility for controlled experiments to study factors of variability in conductvity. Most importantly, the model considers ionization from galactic cosmic rays, solar proton events and radon, and loss processes from aerosols and clouds. The aerosol representation through CARMA (a sectional aerosol microphysical model available within WACCM) provides a realistic computation of aerosol effects for the first time. A flexible module implementation allows for the use of different parameterizations and external datasets. The module can be used online or offline (1-D or 3-D) using existing model output. We present and evaluate the modelled global maps of conductivity and its variability due to the sources and sinks of ionization. This first of a kind modeling shows that aerosols can have a strong impact on conductivity especially at low latitudes.