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An improved parameterization of lightning NOx production in the TM5 global chemistry transport model

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The global production of lightning NOx (= NO + NO2) is uncertain by an order of magnitude. Since lightning-produced NOx is an important driver for the formation of tropospheric ozone, a key greenhouse gas, this uncertainty stands in the way of an accurate assessment of the radiative forcing of tropospheric ozone. Satellite retrievals of tropospheric NO2 concentrations (such as from GOME and SCIAMACHY) have proven to be of great use in providing global, top-down constraints on the production of NOx by lightning. To interpret satellite observations of lightning-produced NO2 by the Ozone Monitoring Instrument (OMI) and the Global Ozone Monitoring Experiment-2 (GOME-2), we use a three dimensional global chemistry transport model, TM5, that simulates the locations and times of lightning flashes based on meteorological information from the ECMWF model. Using satellite measurements from the Lightning Imaging Sensor (LIS), four parameterizations based on ECMWF parameters were tested: convective precipitation, cloud top height, ice water content and updraft mass flux. We find that updraft mass flux is the most useful parameter in determining the lightning distribution in the 35S - 35N region. We discuss the implementation of a state-of-science scheme for the vertical distribution of lightning NOx that is based on a cloud resolving model, and test this scheme against aircraft observations.