Lightning influence on tropospheric ozone over North America using TES, IONS, NLDN and LRLDN data and the GEOS-Chem model

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The Tropospheric Emission Spectrometer (TES) performed extensive observations of the North American and North Atlantic regions during summer 2006. In this study, we use the TES dataset in conjunction with the lightning flashes observed by the National Lightning Detection Network (NLDN) and the Long-Range Lightning Detection Network (LRLDN) to investigate the lightning influence on ozone over the US during July-August 2006. First, TES ozone profiles are compared to the ozonesonde measurements from the IONS (INTEX Ozonesonde Network Study) 2006 campaign to provide validation specific to the North American summer conditions. Then, the lightning influence on the air parcels sampled by TES is investigated by computing forward trajectories initialized at the times and locations of each cloud-to-ground flash observed by the lightning detection networks. Several cases are identified where distinct enhanced ozone layers observed by TES could be related back to lightning events. For these cases, we study the differences between the ozone observed by TES and simulated by GEOS-Chem to infer deficiencies in the lightning NOx parameterization in the model. A different parameterization using recently updated estimate of the NO production by flash is tested in the GEOS-Chem model and resulting predictions compared to the TES data.