



## **Global chemical influence of lightning with CAM5: Comparison of lightning schemes with observations**

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Thunderstorm lightning has a significant annual global contribution to the production of nitrogen oxide ( $\text{NO}_x$ , that is,  $\text{NO}$  (nitric oxide) +  $\text{NO}_2$  (nitrogen dioxide)). In this work we present simulations performed with six different lightning parameterizations implemented in the Community Atmosphere Model (CAM5). Our calculations with CAM5 can help to constrain the amount of lightning-produced nitrogen oxides ( $\text{LNO}_x$ ) by the various lightning parameterizations considered and to provide some insight on how the lightning  $\text{NO}$  injected in the atmosphere can influence the global concentrations of key chemical species such as  $\text{OH}$ ,  $\text{HO}_2$ ,  $\text{H}_2\text{O}_2$ ,  $\text{NO}_x$ ,  $\text{O}_3$ ,  $\text{SO}_2$  and  $\text{HNO}_3$ .

In particular, our results indicate that the lightning schemes based on, respectively, the upward ice flux at 440 hPa (ICEFLUX) and the cloud top height (CTH), exhibit the highest global spatial correlation (0.73 for ICEFLUX and 0.72 for CTH) with respect to global flash rate observations from OTD (Optical Transient Detector) and LIS (Lightning Imaging Sensor). The global annual lightning- $\text{NO}_x$  production rates based on predictions of the ICEFLUX and CTH lightning schemes yield 6.8 and 6.5 Tg N  $\text{y}^{-1}$ , respectively, and 337 and 328 mol  $\text{NO}$  / flash, values well located within the latest consensus estimate of  $5 \pm 3$  Tg N  $\text{y}^{-1}$ . We found that the CTH and ICEFLUX schemes predict maxima enhancements of, respectively,  $\sim 38\%$  and  $\sim 44\%$  in the concentration of tropospheric ozone ( $\text{O}_3$ ) with respect to background values with no lightning.