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Parameterization of Blue Jets in Global Circulation Models: Global occurrence rate and chemical influence in the stratosphere

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In this work [1] we present the first parameterizations of the global occurrence rate and chemical influence of Blue Jets, a type of Transient Luminous Event (TLE) taking place in the stratospheric region above thunderclouds. These parameterizations are directly coupled with five different lightning parameterizations implemented in the Whole Atmosphere Community Climate Model (WACCM4). We have obtained a Blue Jet global occurrence rate of about 0.9 BJ per minute. The geographical occurrence of Blue Jets is closely related to the chosen lightning parameterization. Some previously developed local chemical models of Blue Jets predicted an important influence onto the stratospheric concentration of N_2O, NO_x and O_3 [2]. We have used these results together with our global implementations of Blue Jets in WACCM4 to estimate their global chemical influence in the atmosphere. According to our results, Blue Jets can inject about 3.8 Tg N_2O N yr^{-1} and 0.07 Tg NO-N yr^{-1} near the stratosphere, where N_2O -N and NO-N stand for the mass of nitrogen atoms in N_2O and NO molecules, respectively. These production rates of N2O and NO_x could have a direct impact on, for example, the acidity of rainwater or the greenhouse effect. We have found that Blue Jets could also slightly contribute to the depletion of stratospheric ozone. In particular, we have estimated that the difference in the concentration of O_3 at 30 km of altitude between simulations with and without Blue Jets can be about -5% in Equatorial and Polar regions.

References:

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[2] H. Winkler, and J. Notholt. "A model study of the plasma chemistry of stratospheric Blue Jets." Journal of Atmospheric and Solar-Terrestrial Physics 122 (2015): 75-85.