

Interactive comment on “The chemistry of daytime sprite streamers – a model study” by H. Winkler and J. Notholt

Anonymous Referee #1

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The manuscript on daytime sprite streamer chemistry by Winkler and Notholt for the first time discusses relevant chemistry aspects of the streamer of sprites during the day time. The authors use an ion-chemistry model that accounts for all relevant processes for this study, and find that the response of several neutral species, especially ozone, to sprite streamers is very different during the day than during night. The manuscript is suited well for publication in ACP after consideration of the following comments.

P 29523, I 7: From my understanding the downward propagation is followed by an upward propagation also, see e.g. Cummer et al. (2006)

P 29523, I 9: “conductivity of the middle atmosphere is higher than at night”: This is only true for the mesosphere, but not for the stratosphere, where cosmic rays are the only

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ionization source, ion-ion recombination and ion-aerosol attachment rates are also not day/night time dependent. See e.g. Tinsley and Zhou (Initial results of a global circuit model with variable stratospheric and tropospheric aerosols, JGR, 2006, 111, 16205). What altitude range is most important for the electric breakdown/sprite generation? In section 3 you state that this is likely to occur at 54 km, which is below the region of day/night time dependence of conductivity. Therefore, conductivity is unlikely to affect differences in nighttime vs daytime sprites.

P 29523, I 20: You might also want to mention the well-established NO_x formation by lightning in the troposphere

P 29525, section 3. While some parts of the model originate from previously published models, it seems like the model infrastructure used here is new. An evaluation and comparison against established models or measurements would have been desirable, and would have helped other scientist to reproduce or built upon this publication. However, I realize that such an evaluation would exceed the extent of the paper. If such a publication is in preparation, it would be good to indicate this here.

Results: For a discussion and to put the results into context, what is the diurnal cycle variability of ozone (i.e. related to solar zenith angle/ chemistry at the three different altitudes? See e.g. Studer, Å. S. et al. (A climatology of the diurnal variations of stratospheric and mesospheric ozone over Bern, Switzerland, ACPD, 13, 22445-22485, doi:10.5194/acpd-13-22445-2013, 2013.) Many ion-chemistry reactions have large error bars, is there any possibility to estimate or discuss their effect on your results?

Minor comments: Fig. 6. the bottom panel is labelled “NIGHT”, please add “DAY” to the top panel. I suggest to replace the word “plot” e.g. with “panel”.

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