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Atmospheric Chemistry and Physics Discussions

Interactive comment on "Global impact of nitrate photolysis in sea-salt aerosol on NO_x, OH, and O_3 in the marine boundary layer" *by* Prasad Kasibhatla et al.

Anonymous Referee #1

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In this manuscript, the authors have developed a sea-salt aerosol particulate nitrate photolysis module and incorporate it into the GEOS-Chem global model to evaluate the impact of this photochemical process on NOx, OH and O3 in the marine boundary layer (MBL). The modeling results indicate that while the impacts on global NOx, ozone and OH mass burdens are small (∼1-3 %), it could be significant on a regional scale in the tropical and subtropical marine boundary layer, with peak local enhancements ranging from factors of 5-20 for NOx, 1.2-1.6 for OH, and 1.1-1.3 for O3. The parameterizations appear to be appropriate for the stage of our current understanding (see below for the specific comments below). The manuscript is well organized and written, and is suitable for publication in Atmospheric Chemistry and Physics.

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Specific comments:

1. The model appears to capture most of the variation features and the levels of NOx, HONO and particulate nitrate measured at the Cape Verde Atmospheric Observatory (CVAO) when appropriate ratios of NITs:HNO3 photolysis coefficients are used. However, it should be cautioned that the photolysis rate constant can be highly variable, by 2-3 orders of magnitude, for inorganic nitrate associated with aerosol particles in different regions (Ye et al., 2016, 2017a). Aerosol acidity and organic matrix are probably the two major factors in determining the NITs photolysis rate constant. While the authors have attempted to examine the effect of varying NITs photolysis rate constant by using different J(scale) values in the model, the validation through comparison with measurements from only one location at the CVAO is not sufficient. The authors should state explicitly the limitation of this modeling effort and the uncertainty in the global scale extrapolation. To truly understand the global impact of nitrate photolysis in sea-salt aerosol on NOx, OH, and O3 in the MBL, much more field studies in different marine environments are needed.

2. Is there a depositional term in the model for HONO, O3 and NO2? The authors did not give any explicit description on deposition parameterization; the answer to the question is probably yes, judging from significant diurnal variations in the modeled HONO concentration. Seawater is a slightly basic solution and is an effective sink for HONO and O3. Since measurements at the Cape Verde Atmospheric Observatory were made only a few meters above the sea level, the depositional loss can significantly affect the observed concentrations near the sea surface, for example, resulting in strong diurnal variations. The depositional loss may explain in part the lower HONO concentrations (Reed et al., 2017; Ye et al., 2017b) at the CVAO than those measured on board the C-130 aircraft (100 – 1000 m above sea level) (Ye et al., 2016). The depositional loss mechanism should be included in the model if it has not been yet.

References

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