We thank the reviewer for his comment on the paper.

In the following the reviewer's comments (in italic font) are followed by our detailed answer.

Two basics: 1. The reaction Hg◦ + NO3 –> HgO + NO2 is endothermic by 190 KJ/mol 2. The bonding energy of HgO is a mere 4 Kcal/mol (Shepler & Peterson, 2003, JPC) dismissed the validity of this study. There is no point to go further with a study that calculates HgO as a product of GEM oxidation by NO3. Peleg et al. (2015), the paper preceding the present one, should not have been published in the first place.

We agree that the direct oxidation of GEM by NO_3 probably does not occur in the atmosphere. However, we assume in our study an indirect oxidation of GEM by NO_3. We think that our statement in the abstract: "We assumed a second-order reaction for the NO_3 induced nighttime oxidation of GEM." may be misleading. In the methods section it is mentioned that: "The possibility of direct oxidation of GEM by NO_3, however, is in contrast to recent computational results presented by Dibble et al. (2012)… as a first approximation we incorporated the nighttime oxidation of GEM by NO_3 as a second-order rate according to the reaction ..." (see pages 10-11, lines 206-215).

NO_3 can be involved in GEM oxidation in two basic chemical pathways: NO_3 may play a secondary role in GEM oxidation through addition to an unstable Hg(I) radical species. NO_3 might be involved in GEM oxidation initiation, based on 1) the studies of Sommar et al. (1997) and Yarwood and Niki (1990) which support the oxidation of GEM by NO_3 (assuming a negative enthalpy of -12+/-33 kJ/mole) and 2) recent unpublished updates on the binding of the Hg-NO3 complex. We therefore believe that at present when the related mechanisms are not resolved, including GEM oxidation by NO_3 as a second order rate is good as a first approximation. This enables us to estimate its potential oxidation efficiency, considering that results from two recent field studies point out to a significant nighttime GEM oxidation: Mao and Talbot (2012) and Peleg et al. (2015) pointed out a significant nighttime oxidation of GEM in the MBL. Measurements performed by Peleg et al. (2015) under high NO_3 concentrations and dry conditions further indicated robust correlation of NO_3 with RGM.

In order to emphasize that we do not necessarily base our study on direct oxidation of GEM by NO_3 we now state in the abstract: “Considering current uncertainties regarding GEM oxidation by NO_3 we assumed a second-order reaction for the NO_3 induced nighttime oxidation of GEM as a first approximation”. We also significantly expanded the discussion on NO_3 chemistry and involvement in GEM oxidation (pages 5-6, lines 101-127).

References

Dibble, T., Zelie, M. and Mao, H.: Thermodynamics of reactions of ClHg and BrHg radicals with atmospherically abundant free radicals, Atmos. Chem. Phys., 12, 10271-10279, 2012.

Mao, H. and Talbot, R.: Speciated mercury at marine, coastal, and inland sites in New England – Part 1: Temporal variability, Atmos. Chem. Phys., 12, 5099–5112, doi:10.5194/acp-12-5099-2012, 2012.

Peleg M, Tas E, Obrist D, Matveev V, Moore C, Gabay M, Luria M.:
Observational Evidence for Involvement of Nitrate Radicals in Nighttime Oxidation of Mercury, Environmental Science & Technology, 2015.

Sommar, J., Hallquist, M., Ljungström, E. and Lindqvist, O.: On the gas phase reactions between volatile biogenic mercury species and the nitrate radical, J. Atmos. Chem., 27, 233-247, 1997.

Yarwood, G. and Niki, H.: A critical review of available information on transformation pathways for the mercury species in the atmospheric environment, Report prepared for Atmospheric Environment Service, Environment Canada, Downsview, Ontario, Canada and references therein, 1990.