

# ***Interactive comment on “Surface deposition of oxidized mercury dominated by production in the upper and middle troposphere” by Viral Shah and Lyatt Jaeglé***

## **Anonymous Referee #2**

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Review of “Surface deposition of oxidized mercury dominated by production in the upper and middle troposphere” by Shah and Jaeglé.

The manuscript provides a thorough diagnosis of Hg chemical processing in the lower, middle, and upper troposphere within the GEOS-Chem model. The results are an incremental advance over past work in establishing the important role of oxidation in the middle and upper troposphere. The main advance over past work is in diagnosing the subtropical anticyclones as conduits for supplying Hg(II) to the lower troposphere.

I concur with the other reviewer who commented on the lack of model comparisons to aircraft data and observations in the subtropics, since that is where much of the action in the model is happening. The authors’ earlier work with aircraft could be in-

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cluded in discussion (Shah et al., 2016). It would also be very helpful to compare the model to surface observations in the subtropics, where they are available (e.g. Sheu et al., 2010). Likewise, I agree with the reviewer who pointed out that simulations for 2013-2014 are compared with AMNet observations for 2009-2012 without discussion of interannual variability.

The title is too sweeping. It implies that Hg(II) emissions and Hg(II) produced in the lower troposphere are minor sources of Hg(II) deposition. While that may be true on a global average basis (Table 1), Figure 5 shows that Hg(II) emissions contribute more than 50% of deposition in major industrial regions and lower troposphere Hg(II) dominates in polar regions. The 2x2.5 degree resolution of the model also likely dilutes the importance of Hg(II) emissions near large sources. These caveats are critical for policymakers, but are not reflected in the title or mentioned in the abstract.

My remaining comments are minor.

Please specify the version of the GEOS-Chem model used in this work.

Eq. R1 has a typo “15” in it.

The rate coefficient  $k_{1f}$  appears to be missing an exponent. Please check all rate expressions

P11, L1: typo: “tmodeled”

Table 1 and P12 report a 45 day lifetime for STRAT Hg(II). That seems surprisingly short considering that nearly zero reduction should happen in the stratosphere, based on the model assumption that reduction requires liquid water clouds. Based on context, I think the authors mean that the lifetime of Hg(II) produced in the stratosphere is 45 days once it enters the troposphere, but this is not clear.

Section 5 addresses the contribution of upper tropospheric Hg(II) to surface deposition across the US. Other recent papers on this topic are Weiss-Penzias et al., (2015); Shanley et al., (2015); Coburn et al., (2016); Kaulfus et al., (2017).

P18L6. The regression equation is not adequately explained. The units of each variable and coefficient must be provided. Is the regression equation fitted to the observed or modeled Hg fluxes?

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