Howard et al. Response to Reviewer 2.

We are grateful to the anonymous reviewer for their thoughtful comments and for their positive comments regarding the manuscript. These comments have helped to sharpen a number of points within. Please find below the comments and responses, numbered by individual comment. Within each entry we provide a) the reviewer comment, b) our response, and c) changes made to the manuscript.

1. a. Introduction, first paragraph: it should be made clear that the mercury emissions here refer to those emitted into the atmosphere
   b. This has been fixed accordingly.
   c. Page 2, Line 5: Inserted: “to the atmosphere”

2. a. Introduction: Soerensen et al. 2014 ES&T Elemental Mercury Concentrations and Fluxes in the Tropical Atmosphere and Ocean analyzed GEM fluxes in the tropical ocean and is a relevant reference for the third paragraph
   b. Included this reference in the introduction and in Section 3.1 (see 5c).
   c. Page 3, Line 8: Inserted “Soerensen at al., 2014.”

3. a. Page 4, line 10: “relative” humidity
   b. This has been changed.
   c. Page 4, Line 11: Inserted “relative”.

4. a. Page 6, Section 3.1: Slemr et al. 2015 ACP Comparison of mercury concentrations measured at several sites in the Southern Hemisphere suggested that the systematic uncertainty among the GEM measurements at different stations is about 0.1 ng/m3. I am not sure whether the 9% difference between the ATARS station and Cape Grim really indicates a l latitudinal gradient.
   b. This is an important point raised by the reviewer. Although the values are statistically different, there are other uncertainties that bring into question this significance, including the systematic instrumental uncertainty raised by the reviewer. We have altered the text to highlight these uncertainties.
   c. Page 7, Line 10: Added “These differences are statistically significant (Student's t-test, $p < 0.0001$), though differences in the sampling periods introduces additional uncertainty due to seasonal variation at the sites. Further, an analysis of systematic instrument uncertainty for the Tekran 2537 by Slemr et al. (2015) showed this to be ~10 %.”

5. a. Page 8, lines 22-24: The Ocean is commonly a sink of total atmospheric mercury, but is commonly a net source of GEM (the measured mercury species).
   b. We thank the reviewer for pointing out this distinction and have adjusted the text accordingly.
   c. Page 8, Line 23: Removed "Air-sea exchange of GEM … from soil and vegetation."
   Page 9, Line 11: Inserted "Air-sea exchange of mercury is complex, with the ocean generally considered a net sink for atmospheric mercury (Mason and Sheu, 2002; Song et al., 2015). Reduction of mercury within the photolytic zone can give rise to increased concentrations of elemental mercury and hence evasion of GEM to the atmosphere (Soerensen et al., 2014). Terrestrial surfaces are also commonly sources of GEM; Nelson et al. (2012) modelled terrestrial mercury emission fluxes over Australia that were generally between 8 and 44 μg m^{-2} a^{-1} from soil and vegetation. Figure 3 does not show a strong difference in concentration distributions between the two source regions."

6. a. Page 9, line 23, "Howard et al." typo
   b. The typo has been edited.
   c. Page 10, Line 4: Changed "Howard et al." to "Howard and Edwards (2017)".

7. a. As this station also has data of other chemical species such as aerosol and ozone, including these data would highly facilitate the data analysis (for example on the effect of biomass burning on GEM).
   b. The inclusion of such data would quite likely facilitate additional analyses, however they are not currently evaluated to the standard required for publication. When these data become available, future analyses will be undertaken.
   c. No changes made.