

## ***Interactive comment on* “Two new sources of reactive gaseous mercury in the free troposphere” by H. Timonen et al.**

### **Anonymous Referee #1**

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The authors present an analysis of long range transport events: 3 events with anthropogenic plumes and 4 events with transport of clean air originating from Pacific marine boundary layer. They found enhanced RGM concentrations in the anthropogenic plumes (type 2 events) and claim that they originate from in-situ formation during the transport. Very high RGM concentrations in clean air masses originating from Pacific marine boundary layer (MBL, type 3 events) are attributed to chemistry within BL and possible evaporation of reactive mercury from particles during the long range transport to Mt. Bachelor.

The paper is well organized and lucidly written. But the authors tend to sweeping statements which are not borne by their data in several instances detailed below. I believe that they have a good case for the type 3 events (transport from MBL) but

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the presentation of the type 2 events would perhaps become more convincing if the contradictions in the data were addressed.

Page 29205, line 18: "Oxidation of GEM in the stratosphere (...) is the only known source of RGM above BL." This statement would imply that reactions producing RGM in the stratosphere do not occur in the troposphere. Obviously this cannot be true since all the suspected oxidants (O<sub>3</sub>, OH, Br, Cl, etc) also exist in the troposphere above the BL. Please reword. Dtto page 29208, line 17.

Page 29209, line 21: "We present three clear ALRT events (Fig. 2, Table 1)..” but in Fig. 2 only one event is shown. Similarly for type 3 events on page 29211, line 5.

Page 29209, last paragraph and Fig.4: Based on the combination of data from 3 events in Fig.4 the authors claim here that the overall THg/CO slope is consistent with Asian plumes. However, when looking at individual events this statement appears too sweeping as e.g. the slope for the event in April 2008 is probably only half of the "on average" slope. What do the authors mean with "on average": average of three slopes or a slope of all points in Fig.4? The latter is of course no average slope whatsoever.

Page 29210, lines 8-9: Does the negative RGM/CO correlation for the April 2008 event really imply a "common origin"? In addition, Table 1 shows also that the correlations RGM vs GEM for May 2006,  $\sigma_{sp}$  vs RGM for April 2007, RGM vs CO for April 2008 and May 2006, and  $\sigma_{sp}$  vs CO for April 2008 and May 2006, are not significant, i.e. 6 of 12 correlations.

Page 29213, line 18-19: Holmes et al. (2010) makes a good case for Br chemistry but conclude that the comparison of model data with measurements is inconclusive, i.e. does not preclude the possibility of O<sub>3</sub>/OH chemistry. This should be mentioned also at the end of the chapter 3.4.1.

Page 29213, paragraph starting at line 20: See the above comment about page 29210.

Page 29214, 1st paragraph: The authors discuss only the O<sub>3</sub> and Br mechanisms,

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neglecting the possibility of OH mechanism. Fig. 3 in Holmes et al. (2010) shows high oxidation rates by O<sub>3</sub>/OH chemistry in latitudinal band between 30°S and 30°N, i.e. in region where most of the backward trajectories in Fig. 6 of this paper originate.

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