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Interactive comment on "Emission-dominated gas exchange of elemental mercury vapor over natural surfaces in China" *by* Xun Wang et al.

Anonymous Referee #2

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This paper provides an updated model of estimating the exchange of gaseous elemental mercury between the atmosphere and underlying surfaces in China. This topic is relevant to the scope of ACP and of great importance as very high uncertainty still exists in its estimate and it is closely related to Hg input into the ecosystem in China and Hg export to downwind regions. In general, the manuscript is very well written. I suggest the acceptance of this paper after the authors addressing the following general and specific comments. The manuscript also needs a careful proofread to correct many grammatical errors. General Comments: 1. In this paper, the "natural" emission refers to the sum of the primary natural activities (i.e. geogenic) and the re-emission of legacy Hg stored in the terrestrial and water surfaces. However, in some other papers, the "natural" emission only refers to geogenic activities. This may cause some confusion. I suggest a clear definition of the "natural" emission be given in the introduction

section. 2. There is a logical question. It is mentioned in the paper that "the feedback of the air-surface exchange to the air concentration does not significantly modify the atmospheric Hg0 concentration" (Lines 226-229), and thus I think that a different air-surface exchange mechanism may not significantly affect the outflow of Hg from China. But the authors do argue in the paper that the effect may be large. 3. The updated soil Hg concentration dataset is based on the NMPRGS survey. What is the depth of soil sampling, 0-10 cm? 0-20 cm? It seems that most of HgII reduction occurs within the very top soil layer. What is the vertical profile of Hg concentration? 4. It may be beyond the scope of this specific paper, but I wonder is it possible to calculate an uncertainty range of natural Hg emission? Specific Comments: Lines 51-52: The trend of future anthropogenic Hg emission depends on many factors and the Minamata Convention does not necessarily lead to a decrease. Also, the reference De Simone et al. 2015 is not relevant here. Lines 195-197: Is the value of the parameter of soil interfaces compensation point (3 ng/m3) only based on the measurements at air-snow interface? What about other types of underlying surfaces? Lines 224-226: Are the CMAQ modeled atmospheric Hg0 concentrations validated against real world observations in China? Lines 248-251: Do the measurements in the surface forest floor have similar environmental conditions with the modeling? In addition, the average measured concentration of 4.1 ng/m3 seems to be very high, if we consider vegetation serves as a large sink. Lines 257: What does the 1-2 ng/m3 refer to? Is it the difference between soil and air Hg concentrations? Technical Corrections: Line 64: "may be appropriate"; Line 69: "estimate"; Line 96: "at a resolution of"; Line 98: "a recent database"; Line 199: "at a 36-km"; Line 286: "can improve"; Line 402: "are more comprehensive"; Line 481: "to earlier estimates"; Line 487: "also enhances"; Figure 9.4: missing legend;

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