

Interactive comment on “Mercury Methylation in paddy soil: Source and distribution of mercury species at a Hg mining area, Guizhou Province, China” by L. Zhao et al.

Anonymous Referee #1

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General comments

The study conducted by Zhao et al. takes on a challenging set of important questions regarding mercury in rice paddy soils. The study looks at two different systems, a point source polluted rice paddy at Gouxì, where artisanal mining of Hg occurs, and Wukeng, an abandoned mine with reduced atmospheric deposition of Hg. These two sites are commonly compared to Hauxi, a ‘control site’ of regional pollution. The design of the study is less-than ideal (see below in specific comments) but the temporal measurements of MeHg makes this study an asset for those interested in Hg in rice paddies.

The manuscript falls short in a few areas. First, the paper lacks a strong, clear state-

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ment of hypotheses and the biological/chemical mechanism. By clearly stating the hypotheses, this will greatly aid in organizing the discussion and determine which mechanisms need to be specifically addressed in greater detail in the discussion. From my understanding of the manuscript one hypothesis should be “We hypothesize that the Gouxi site will have greater MeHg than the Wukeng site because greater atmospheric deposition of ‘new Hg’ is more susceptible to methylation”. A second hypothesis could be “We expect greater MeHg in the upper mineral soil horizons at the Gouxi site than Wukeng site because ‘old Hg’ is less susceptible to methylation”. These are just suggestions but explicitly stating them is needed to guide the discussion. In addition to the missing hypotheses, the inclusion of the water-atmospheric model was unnecessary in lieu of a more simplistic comparison of fluxes. The modeling made many assumptions that also made it unreasonable to apply (see specific comments). Lastly, Hg in *Oryza sativa* data should be presented in this study. Since the uptake of MeHg and Hg by rice is central to this study, linking the belowground processes to the plant would be a great addition to the study.

Specific comments

The introduction lacks discussion of microbial and chemical mechanisms responsible for methylation. Even if you are not testing for methylating bacteria, the mechanisms of methylation should not be absent. In the experimental design, I understand the practicality of monitoring two, 10 X 10 meter rice paddies. However, sampling one plot multiple times to assess an treatment/affect is potentially pseudoreplication. For Section 3.3.2 on Soil Cores, the physical and chemical data of the soil cores should be included in the discussion. Was dissolved oxygen, sulfate, Fe or other important electron acceptors measured and comparable through time? Page 13 Line 1 – 9: The results should be better integrated with existing knowledge about the effect of microbial production of MeHg in flooded soils. The model is an interesting thought-experiment based on a number of assumptions such as negligible amounts of Hg volatilizing from the water surface and dynamic equilibrium of the aqueous solution. However, the as-

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sumption I find the hardest to justify is that the system is behaving as an unsaturated soil (as cited in Munthe and Hintelmann) and not behaving as a water-sediment system. I understand it simplifies the system to a traditional unsaturated agricultural system but the fact is the water and saturated soil (now behaving as a sediment) are exchanging with each other rather than acting as one system. Instead of the model in 3.4, is it possible to just compare the atmospheric Hg fluxes, irrigation Hg fluxes, and 'Old Hg' pools and find the same conclusion that Hg was primarily from atmospheric deposition and MeHg is produced in situ? Page 15 Line 25: Could you compare your data on estimated Hg methylation with other rice paddies in Asia to assess how alkaline conditions have slowed or retarded Hg methylation?

Technical comments Page 2 Line 10: a strong bioaccumulator? There is an adjective missing. I might suggest re-writing the sentence. Page 2 Line 15: In which part does the rice uptake Hg? Page 2 Line 27: Although its a common term in Hg literature, please define IHg. Page 3 Line 21 – 25: I feel these details should be in the methods since they describe your actions. Page 4: Is it possible to provide coarse latitude and longitude for the Wanshan mining district in the text? Page 7 Line 3: The phrase 'under argon' is in exact. Please re-phrase with details. Page 7 Line 10: Extra period at beginning of sentence. Page 8 Line 10: correct to EPA method 1630. Page 8 Line 12: Please define HgTunf and HgTf explicitly at first use. Page 8 Line 26-Page 9 Line 1: Please include "respectively" to indicate the relationship between the blank concentrations with THg and MeHg. Page 9 Line 13 – 15: Please mention these are non-parametric tests for those unfamiliar with those tests. Pages 9 – 15: It is conventional for this journal to include a space between numbers and symbols, particularly when expressing the mean and standard deviation. Page 15 Line 6: Was this model used for Hg and MeHg?

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