Reviewer 2

We are grateful for the reviewer's deeply informed and insightful comments. We have addressed the detailed comments that were made on the PDF copy of the earlier version of the manuscript. Please find our replies to your comments and suggestions below.

Line 23, you can change "." to ",".

Reply: *We agree with this suggestion.The clarified text (Page 2, Line23) reads as follows "Plant foliage plays an essential role in accumulating mercury (Hg) from the atmosphere and transferring it to soils in terrestrial ecosystems, while many studies have focused on forested ecosystems.".*

Line 34: where these Hg accumulated in plants come from?

Reply: *Thank you for the reviewer's question. Vegetation is generally considered a sink for atmospheric Hg, with the majority of Hg in vegetation leaves accumulated from the atmosphere (Jiskra et al., 2018; Obrist et al., 2017). Previous studies showed that plant roots acted as a barrier of Hg transport from soils to shoots (Wang et al., 2015), and less than 10% of Hg in roots was transported to the aboveground portion of plants (Ericksen et al., 2003; Mao et al., 2013).We have incorporated additional content in Page 3 (Line 56-65). The clarified text (Page 3, Line 56-65) reads as follows "Vegetation is generally considered a sink for atmospheric Hg, with the majority of Hg in vegetation leaves accumulated from the atmosphere (Jiskra et al., 2018; Obrist et al., 2017). Plant leaves accumulate Hg from the atmosphere mainly through stomatal uptake (Lindberg et al., 1992). Stamenkovic and Gustin (2009) suggested that the non-stomatal pathway of Hg deposition to the leaf cuticle and subsequently retention and incorporation into leaf tissue also plays an important role in accumulating atmospheric Hg. Plant roots generally acted as a barrier of Hg transport from soils to shoots (Wang et al., 2015), and less than 10% of Hg in roots was transported to the aboveground portion of plants (Ericksen et al., 2003; Mao et al., 2013). Some studies also found that a great proportion of foliar Hg in Halophytes in salt marshes was translocated from the root (Canário et al., 2017; Cabrita et al., 2019; Weis and Weis 2004). The plausible reason is that plants in the hydroponic growth system have fewer apoplastic barriers (i.e. Casparian bands and suberin lamellae) in root architecture than plants grown in contaminated soils (Redjala et al., 2011)".*

Line 65 Here are more Hg accumulated studies in the peatland"

Grigal, D., Kolka, R., Fleck, J. & Nater, E. Mercury budget of an upland- peatland watershed. Biogeochemistry 50, 95–109 (2000).

Grigal, D. F. Mercury sequestration in forests and peatlands: A review. J. Environ. Qual. 32, 393–405 (2003)

Osterwalder, S. et al. Mercury evasion from a boreal peatland shortens the timeline for recovery from legacy pollution. Sci. Rep. 7, 16022 (2017).

Woerndle, G. E. et al. New insights on ecosystem mercury cycling revealed by stable isotopes of mercury in water flowing from a headwater peatland catchment. Environ. Sci. Technol. 52, 1854–1861 (2018).

Reply:*We agree with this suggestion. We have incorporated additional content in this section and cited more recent references. The clarified text (Page 4, Line 75-77) reads as follows "Previous studies have found that the majority of Hg in plant leaves in wetlands was from the atmosphere (Brahmstedt et al., 2021; Enrico et al., 2016; Fay and Gustin 2007) and nonvascular plants (e.g., fungi, lichens, and mosses) had higher foliar Hg concentrations than vascular plants (Moore et al., 1995; Pech et al., 2022).".*

Line 118. Plot size sampling in 2018? Is that the same size with samples collected in 2019?

Reply:*Thanks for the reviewer's question. Actually, the "plot" in 2018 should be "location". In 2018, five locations several hundred meters apart were selected in the sedge-dominated fen to serve as within-site replicates to account for potential local-scale variability. In 2019, seven 0.25 m2 (0.5 m × 0.5 m) plots several hundred meters apart were selected at the end of August 2019 during senescence and before leaf off to estimate the annual biomass of senesced leaf. The revised text (Page 6, Line 129) reads as follows "Leaves of each species that were collected from each location in October 2018 were divided for foliar total Hg (THg) analyses and a foliar Hg leaching experiment.".*

Line 121. For annual biomass, there is always variation between different years, depends on weather conditions, such wet or drought, warm or cool, etc.

Reply:*We agree with this suggestion. However, based on the weather data, the mean air temperature in the growing season in 2018 and 2019 was 15.82 ± 3.50 °C and 15.16 ± 3.38 °C, respectively. The total precipitation in the growing season in 2018 and 2019 was 243.9 mm and 189.3 mm, respectively. The mean water table levels in the growing season in 2018 and 2019 were –6.3 ± 1.0 cm, and –7.5 ± 3.9 cm, respectively. There were no significant differences in air temperature and precipitation between the growing season in 2018 and 2019 (temperature: $F_{(1,182)} = 1.74$, $p > 0.05$; precipitation: $F_{(1,182)} = 0.48$, $p > 0.05$). Therefore, we think the annual plant biomass may not change significantly between 2018 and 2019.*

We have incorporated additional content in the Supporting Information (Page 1, Line 7-13) and the clarified text reads as follows "The mean annual air temperature and precipitation from 2012 to 2018 were 1.7 °C and 721 mm, respectively. The mean air temperature in the growing season in 2018 and 2019 was 15.82 ± 3.50 °C and 15.16 ± 3.38 °C, respectively. The total precipitation in the growing season in 2018 and 2019 was 243.9 mm and 189.3 mm, respectively. The mean water table levels in the growing season in 2018 and 2019 were –6.3 ± 1.0 cm, and –7.5 ± 3.9 cm, respectively. There were no significant differences in air temperature and precipitation between *the growing season in 2018 and 2019 (temperature: $F_{(1,182)} = 1.74$, $p > 0.05$; precipitation: $F_{(1,182)} = 0.48$, $p > 0.05$).".*

Line 183. Meaning of F(1.73,24.26)and F(1.23,23.38)?

Reply:*Thank you for the reviewer's question. For the repeated-measures ANOVA, we get the results F(x,y) and p. F is the statistics of the repeated-measures ANOVA, p-value indicates that if the mean difference among all groups was statistically significant. x and y is calculated based on the degree of freedom between subjects and the degree of freedom within subjects. Based on Mauchly's Test of Sphericity, if the results did not follow Mauchly's Test of Sphericity, the results needed to be modified with epsilon (e). We double-checked our analysis throughout the manuscript and made the necessary corrections in the manuscript. The revised text (Page 8, Line 192) reads as follows "Foliar THg concentrations were related to time/leaf age ($F_{(3,36)} = 108.86$, $p < 0.001$) and plant species ($F_{(2,12)} = 51.85$, $p < 0.001$) (Fig. 1)".*

Line 189. I think it is valuable to also quantify Hg mass, biomass times with Hg conc., not only with Hg concentrations, due to biomass also accumulate across the growing season.

Reply:*We agree with this suggestion. The main reason that we only valued the foliar Hg concentrations is to compare with the previous results of Hg concentrations in leaves (Laacouri et al., 2013; Moore et al., 1995; Obrist et al., 2021; Poissant et al., 2008; Wang et al., 2016; Zhang et al., 2009). We will consider valuing Hg mass in future research.*

Line 193. Due to different plants structure, perhaps Hg accumulated in foliage is not dominantly from atmospheric uptake as forests did, some foliage Hg may also from root uptake. At least some salt marsh studies have shown that Hg from roots can transport to marsh vegetation leaves due to higher Hg concentration contained in their roots (list as following). More studies are needed to demonstrate your conclusion here, such as belowground roots and rhizomes, and soils samples collect associate with Hg analysis.

such as studies from Cabrita et al., 2019 (Mercury mobility and effects in the salt-marsh plant Halimione portulacoides: Uptake, transport, and toxicity and tolerance mechanisms);

Weis and Weis, 2004 (Metal uptake, transport and release by wetland plants: implications for phytoremediation and restoration)).

Reply:*We agree with this suggestion. We have incorporated additional content in Page 3 (Line 56-65). The clarified text (Page 3, Line 56-65) reads as follows "Vegetation is generally considered a sink for atmospheric Hg, with the majority of Hg in vegetation leaves accumulated from the atmosphere (Jiskra et al., 2018; Obrist et al., 2017). Plant leaves accumulate Hg from the atmosphere mainly through stomatal uptake (Lindberg et al., 1992). Stamenkovic and Gustin (2009) suggested that the non-stomatal pathway of Hg deposition to the leaf cuticle and* *subsequently retention and incorporation into leaf tissue also plays an important role in accumulating atmospheric Hg. Plant roots generally acted as a barrier of Hg transport from soils to shoots (Wang et al., 2015), and less than 10% of Hg in roots was transported to the aboveground portion of plants (Ericksen et al., 2003; Mao et al., 2013). Some studies also found that a great proportion of foliar Hg in Halophytes in salt marshes was translocated from the root (Canário et al., 2017; Cabrita et al., 2019; Weis and Weis 2004). The plausible reason is that plants in the hydroponic growth system have fewer apoplastic barriers (i.e. Casparian bands and suberin lamellae) in root architecture than plants grown in contaminated soils (Redjala et al., 2011)".*

We also revised this sentence in the manuscript (Page 9, Line201-204) as follows "This result showed a clear pattern of continuous THg accumulation in foliage in boreal peatland plant species over time as has been shown for forests (Laacouri et al., 2013; Millhollen et al., 2006b; Rea et al., 2002), which can be attributed to foliar Hg accumulation from the air, given that plant roots act as a barrier of Hg transport from soils to shoots (Wang et al., 2015).".

Line 211 Hg may also mobilize between plants, roots, rhizomes. Also other Hg sources perhaps, i.e. Hg conc in soils, uptake through roots, and then transport to the leaf may also contribute Hg conc increase.

Reply:*We agree with this suggestion. The revised text (Page 10; Line 220-222) reads as follows "Although foliar Hg can transport to other plant organs, such as tree rings (Arnold et al., 2018; McLagan et al., 2022), and/or can be re-emitted into the atmosphere (Zheng et al., 2016; Yu et al., 2016; Yuan et al., 2019), the majority of foliar Hg by mass is generally incorporated into leaf tissue (Laacouri et al., 2013; Lodenius et al., 2003; Stamenkovic and Gustin, 2009). In addition, it is likely that less than 10% of Hg in roots was transported to the leaves (Ericksen et al., 2003; Mao et al., 2013).".*