Thanks a lot to Anonymous Referee #3 for your questions and suggestions for our manuscript, which are all important in improving our manuscript.

Below are our responses to the anonymous Referee #3' comments.

Major comments:

-About the comment (1): I have serious concerns with the uncertainty of the ^{222}Rn concentrations in lake water. The water samples for ^{222}Rn analysis were collected into 40 ml sampling bottles. From my point of view, the water volume for ^{222}Rn analysis in surface water is usually > 1L. In this paper, the small volume of 40 ml may lead to large uncertainty (even up to 100%) of ^{222}Rn measurement by Water-40 with RAD7 in lake water and river water. I would recommend reporting the uncertainty for each ^{222}Rn data in Table S1. Was the uncertainty of LGD rate assessed by propagating radon measurement uncertainties throughout the entire calculation?

-Response: Thanks for your good suggestions. The samples we took were mostly collected in 250 mL glass bottles and measured using the WAT-250 protocol of RAD7. As the pore water samples obtained by push point were too small to fill the 250 ml glass bottles, they were collected in 40 mL glass bottles and measured using RAD7's WAT-40 protocol (only 2 samples). The uncertainty for each ^{222}Rn data were reported in Table S1. The uncertainty in the LGD rate is assessed by propagating the standard deviation of the radon concentration as an uncertainty throughout the calculation. The values of uncertainty for LGD are 52.16 mm d^{-1} in WEDL and 23.36 mm d^{-1} in EEDL. We have modified this section in the text.

Here is the revision for addressing this comment.

"Most of the lake water and groundwater samples for ^{222}Rn analysis were collected in 250-mL glass bottles. The volume of two pore water samples collected with push point was small, so they were collected in 40-mL glass bottles for ^{222}Rn measurement."

Table S1 The field parameters and ^{222}Rn concentrations of the lake water and groundwater samples.

Number	Tw (°C)	pH	Eh (mV)	EC (μS cm^{-1})	DO (mg L^{-1})	^{222}Rn (Bq m^{-3})	Sampling date	Site
S1	5.2	8.14	84.1	565	11.42	229.25 ± 104.58	2019	Lake shore
S2	5.3	7.74	167.3	359	11.54	226.12 ± 92.84	2020	Lake shore
S3	6.9	8.06	73.9	777	11.7	684.71 ± 152.04	2019	Lake shore
S4	6.5	7.88	152.5	557	11.33	700.72 ± 294.53	2019	Lake shore
S5	8.6	8.17	191.6	433	11.62	109.80 ± 69.30	2020	Lake shore
S6	5.5	7.86	115.2	449	10.32	257.42 ± 119.71	2019	Lake shore

S7	5.3	7.95	169.7	443	11.59	215.88 ± 112.28	2020	Lake center
S8	4.0	8.18	166.5	327	13.42	180.33 ± 101.77	2020	Lake center
S9	5.4	8.0	182.1	487	10.82	324.01 ± 78.55	2020	Lake center
S10	7.6	7.60	57.9	313	11.14	180.56 ± 128.61	2019	Lake center
S11	6.8	7.42	109.9	264	11.01	149.18 ± 105.22	2019	Lake shore
S12	5.3	7.71	75.1	278	11.31	148.32 ± 106.58	2019	Lake shore
S13	6.5	7.37	87.2	273	11.25	288.57 ± 116.59	2019	Lake shore
S14	9.0	8.01	188.5	298	10.82	149.27 ± 73.05	2020	Lake center
S15	8.9	8.18	237.7	313	11.22	110.05 ± 88.99	2020	Lake center
S16	8.8	8.12	280.0	300	11.15	99.44 ± 73.02	2020	Lake center
S17	10.2	8.00	154.3	295	10.98	113.02 ± 112.34	2020	Lake center
G1	15.3	6.96	-77.9	376	6.88	5191.34 ± 788.23	2019	
G2	/	7.89	-77.8	685	1.59	3234.86 ± 825.42	2020	
G3	/	7.71	-77.4	501	1.22	3598.82 ± 668.31	2020	
G4 (P)	16.8	7.13	-71.9	588	4.66	2149.87 ± 599.89	2019	
G5	14.0	7.01	-80.2	1182	1.64	2037.83 ± 650.34	2020	
G6	16.3	8.37	4	650	/	/	2019	
G7 (P)	/	/	/	/	/	6868.35 ± 1960.93	2019	
G8	15.6	7.19	201.1	553	4.07	12309.11 ± 1165.37	2020	
G9	16.0	6.98	201.2	282	5.92	2493.26 ± 365.45	2020	
G10	15.5	6.08	140.8	133	5.74	9337.33 ± 855.36	2019	
G11	/	/	/	/	/	5958.70 ± 3020.29	2019	
G12 (P)	16.4	7.04	-149.3	734	1.96	19821.17 ± 1587.35	2020	

*The dot beginning with "S" is surface water and the dot beginning with "G" is groundwater; the “(P)” means piezometer water.

“Using the standard deviation (SD) of ^{222}Rn concentration, wind speed and sediment diffusion flux as parameter errors, the error of LGD rate was calculated to be 52.16 mm d^{-1} in WEDL and 23.36 mm d^{-1} in EEDL based on the Gaussian error propagation principle.”

-About the comment (2):Lines 165-166, The groundwater and lake levels have been measured in this paper. I would recommend calculating the LGD rate using Darcy's law for comparison. Lines 238-239, The groundwater levels around the EDL ranged from 23.2 to 41.9 m, whereas the lake water levels varied from 21.2 to 22.4 m. Please mark the location of the groundwater monitoring station in Fig. 1. Also it would be better to show the groundwater levels and lake water levels in a figure. Did groundwater levels vary from 23.2 to 41.9 m only during the sampling period? Please clarify.

-Response: Thanks for your good suggestions.

1) We estimated the LGD rate using Darcy's law. In WEDL, the hydraulic conductivity was about 15–110 m d^{-1} and hydraulic gradient was about 0.0002–0.0015, the calculated average LGD rate is 53.13 mm d^{-1}. In EEDL, the hydraulic conductivity was about 2–5 m d^{-1} and hydraulic gradient was about 0.004–0.006, the calculated average LGD rate is 17.50 mm d^{-1}. The LGD rate of WEDL is also significantly greater than that of EEDL. In general, the estimated LGD rate using Darcy’s law can

be comparable to that from the ^{222}Rn mass balance model (WEDL, 71.47 mm d^{-1}; EEDL, 34.76 mm d^{-1}). The reason for the differences between the two methods may originate from the high spatial heterogeneity of hydraulic conductivity and hydraulic gradient.

Moreover, we used a water balance model to estimate LGD rates. The catchment area is approximately 8500 km^2, about 49 times the size of the WEDL. Groundwater recharge in the catchment mainly came from infiltration of atmospheric precipitation, infiltration of irrigation water from rice fields and recharge from surface water bodies (rivers and lakes). According to the local geological survey (HGSI, 2016), the groundwater is recharged from precipitation (~18.09 × 10^8 m^3 yr^{-1}), irrigation of rice fields (~3.45 × 10^8 m^3 yr^{-1}), rivers and lakes during the rainy season (10.36 × 10^8 m^3 yr^{-1}) and external margins of the catchment (~0.45 × 10^8 m^3 yr^{-1}). The total groundwater recharge was ~32.35 × 10^8 m^3/yr with a groundwater recharge rate of approximately ~380.57 mm yr^{-1}. The groundwater is discharged from evaporation (~17.22 × 10^8 m^3/yr), discharge to the river (~0.55 × 10^8 m^3 yr^{-1}) and the artificial extraction (~2.65 × 10^8 m^3 yr^{-1}), with little change in groundwater reserves on a multi-year average. According to the groundwater balance equation, the groundwater discharge to the WEDL was about 11.94 × 10^8 m^3 yr^{-1} and the groundwater discharge rate was about 68.90 mm d^{-1} (LGD only occurred in the dry season, December to early March of next year for approximately 100 days per year). This was very close to the LGD rate in the WEDL estimated by the ^{222}Rn mass balance model (we have optimized the parameters to obtain the updated LGD rate of 71.47 mm d^{-1}). The LGD rate of approximately 41.64 mm d^{-1} was calculated in EEDL from the water balance model. The slightly larger LGD rate for the EEDL estimated using the water balance compared to the ^{222}Rn mass balance model likely stems from the lack of monitoring accuracy of surface runoff flows to the lake (only one discharge measurement was made during the study period).

In a word, the differences among the calculations of the three methods can be compared (Table R1) and therefore the LGD results quantified by the radon mass balance model were acceptable and reasonable.

Table. R1 Comparison of average LGD rates estimated by different methods

	WEDL	EEDL
^{222}Rn mass balance model	71.47 mm d^{-1}	34.76 mm d^{-1}
Darcy's law	53.13 mm d^{-1}	17.50 mm d^{-1}

Water balance model	68.90 mm d^{-1}	41.64 mm d^{-1}

2) This refers to water levels in space (Fig. R1). The spatial distribution of groundwater levels and lake levels were plotted as follows:

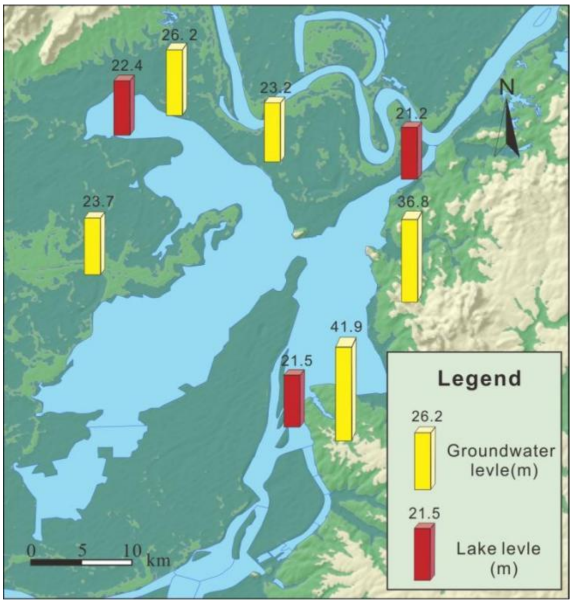

Figure R1. Comparison of groundwater levels and lake levels. The yellow bar represents the groundwater level, the red bar represents the lake level, the height of the bar indicates the water level, and the number is the water level elevation. The topographical information is from Geospatial data cloud (http://www.gscloud.cn/sources/index?pid=302).

-About the comment (3): The study indicated that the groundwater discharge transported large inputs of nutrients into WEDL. Unfortunately, there is little discussion on the significance of groundwater nutrient fluxes into the lake. I was hoping this would be further discussed (such as Zhang et al., 2020; Wang et al., 2018). Is LGD acting as a driver of lake water deterioration? Is there EDL water eutrophication due to the large inputs of nutrients from LGD?

Zhang, et al. Submarine groundwater discharge drives coastal water quality and nutrient budgets at small and large scales. Geochimica et Cosmochimica Acta, 2020, 290, 201-215.

Wang, et al. Submarine groundwater discharge as an important nutrient source influencing nutrient structure in coastal water of Daya Bay, China. Geochimica et Cosmochimica Acta, 2018, 225: 52-65

-Response: Thanks for your good suggestion. Your suggestions are very helpful for us. We have added the following text here, which are in the last part of section 4.3 in the revised manuscript.

Here is the revision for addressing this comment.

"Excessive nitrogen and phosphorus in lakes can lead to eutrophication of lakes. In addition to the LGD inputs, the sources of nutrients also include riverine input, diffusion from sediments and atmospheric deposition (Luo et al., 2018). In the area around the EDL, the NH_4-N load from atmospheric deposition input was about 1.3×10^{-2}g m^{-2} d^{-1}, the P load from atmospheric deposition input was about 1.22×10^{-4}g m^{-2} d^{-1} (Zhang et al., 2019); the NH_4-N and P load from sediment diffusion input was about 1.6×10^{-2}g m^{-2} d^{-1} (Gong et al., 2019) and 3.22×10^{-4}g m^{-2} d^{-1} (Gao et al., 2016), respectively. Of the NH_4-N sources in the WEDL, the contribution of atmospheric deposition, sediment diffusion and LGD were approximately 5.94%, 7.30% and 86.76%, respectively. Of the P sources in the WEDL, the contribution of atmospheric deposition, sediment diffusion and LGD were approximately 0.50%, 1.32% and 98.18%, respectively. Of the NH_4-N sources to the EEDL, the contribution of atmospheric deposition, sediment diffusion, LGD and lake flow input were approximately 1.21%, 1.49%, 6.90% and 90.40%, respectively. Of the P sources to the EEDL, the contribution of atmospheric deposition, sediment diffusion, LGD and lake flow input were approximately 0.09%, 0.24%, 0.88% and 98.78%, respectively.

LGD can not only input nutrients to the lake but also influence the nutrient structure of the lake. The ratio of N:P from different sources is a potential threat to disrupt the original nutrient structure of the lake. The N:P ratios from sediment diffusion and atmospheric deposition were 110.57 and 235.64, respectively. Despite significantly higher N:P rations, their influence on the N:P ratios of the lake should be weak due to the very low levels of nitrogen and phosphorus from atmospheric deposition and sediment diffusion. The ratios of N:P for WEDL lake water was 12.11 and for LGD was 17.50. The difference of the N:P ratios between lake water and groundwater discharge was large in WEDL, so N and P input from groundwater discharge to WEDL can therefore potentially influence the nutrient structure of the lake water. The ratios of N:P for EEDL lake water was 15.75 and for LGD was 141.07. However, due to the quite small contribution of LGD to N and P in the EEDL compared with the lake flow, the N and P input from groundwater discharge has little influence on the nutrient structure of the EEDL lake water."

Reference:

Gao, Y., Liang, T., Tian, S., Wang, L., Holm, P. E., & Hansen, H.C.B.: High-resolution imaging of labile phosphorus and its relationship with iron redox state in lake sediments, Environ Pollut, 219, 466-474, 2016.

Gong, L., Wang D., Qu, W., Qian, Z., Fan, Q., Yang, Y., and Tan, S.: Effects of dry excavation dredging on the nitrogen species and diffusion flux of ammonia nitrogen in the sediments of ditches in the Nanhan Embankment, China, Journal of Agro-Environment Science, 38(12): 2826-2834, 2019 (in Chinese).

Zhang, Y., Liu, C., Liu, X., Xu, W., & Wen, Z.: Atmospheric nitrogen deposition around the Dongting Lake, China, Atmos Environ, 207, 197-204, 2019.

-About the comment (4): This paper lacks comparison with LGD rates and nutrient inputs with previous study in EDL and similar lake systems worldwide. It would be better to include a table for comparison.

-Response: Thanks for your good suggestion. As there are fewer studies on LGD and associated nutrient inputs in similar large lakes located in the humid zone, it is difficult to make a systematic table for comparison. Therefore, we compared the LGD and associated nutrient loads of WEDL and EEDL with the whole Dongting Lake (Sun et al., 2020) and Poyang Lake (Liao et al., 2018), a large lake also located in the middle Yangtze Catchment.

We have added the following text here, which are in the section 4.3 in the revised manuscript.

"We compared the LGD rates and associated nutrient loads of WEDL and EEDL with the whole Dongting Lake (Sun et al., 2020), and Poyang Lake (Liao et al., 2018), a large lake also located in the center Yangtze catchment. The LGD rate in WEDL was comparable to the whole Dongting Lake (73.94 mm d^{-1}) and about 2.96 times that in the Poyang Lake (24.18 mm d^{-1}); the LGD rate in EEDL was about 0.47 times that in the whole Dongting Lake; and about 1.44 times that in Poyang Lake. The N input loads with LGD in WEDL is 4.75 times that in the whole Dongting Lake (0.04 g m^{-2} d^{-1}) and 1.72 times that in the Poyang Lake (0.11 g m^{-2} d^{-1}); the N load inputs with LGD in EEDL is 1.75 times that in the whole Dongting Lake and 0.64 times that in the Poyang Lake. The P input loads with LGD in WEDL is roughly of the same order of magnitude as both the whole Dongting Lake (1.18×10^{-2} g m^{-2} d^{-1}) and Poyang Lake (4.50×10^{-2} g m^{-2} d^{-1}), which are 2.03 times that in the whole Dongting Lake and 0.53 times that in Poyang Lake, respectively. The P load inputs with LGD in EEDL is 1 to 2 orders of magnitude smaller than the whole Dongting Lake and

Poyang Lake, which are 0.14 times that in the whole Dongting Lake and 0.04 times that in the Poyang Lake, respectively."

-About the comment (5): The lake water samples were collected only near the shore of the WEDL. Moreover, the distributions of groundwater and surface water sample locations were extremely uneven with low-resolution sampling. The high ^{222}Rn concentration near the shore would produce a considerable ^{222}Rn inventory, which may result in an overestimation of LGD in WEDL. Please clarify.

-Response: Thanks for your good suggestion. The uneven distribution of sampling points in the field work is a regret of this study. But we have done the best we can to complete the sampling of the lake water. During the dry season, the width of the exposed lake bed in the WEDL was 0.5–10 km due to the very low water level of the WEDL. The exposed lake bed had no road accessible for vehicles, and field sampling was very difficult as lake water could only be collected by walking slowly to the lake. Sampling sites on the western lakeshore of the WEDL were collected by walking approximately 2–3 km to the nearest lakefront. In fact, we also took samples in the lake center, which we did not state clearly in the method section. The site conditions for the lake center sampling are shown in Fig. R2. The sampling points marked with blue arrows and the sampling points in the blue boxes are located in the lake center. We searched for a small boat at a small fishing pier on the shore, drove it into the lake center and sampled the lake water. Due to the limited range of the small boat, we only collected samples from the lake within 5 km of the small fishing pier. The information on the location of the sampling points (lake shore or lake centre) has been added to Table S1. The method of collecting samples in the lake center has been added in the section 2.2.

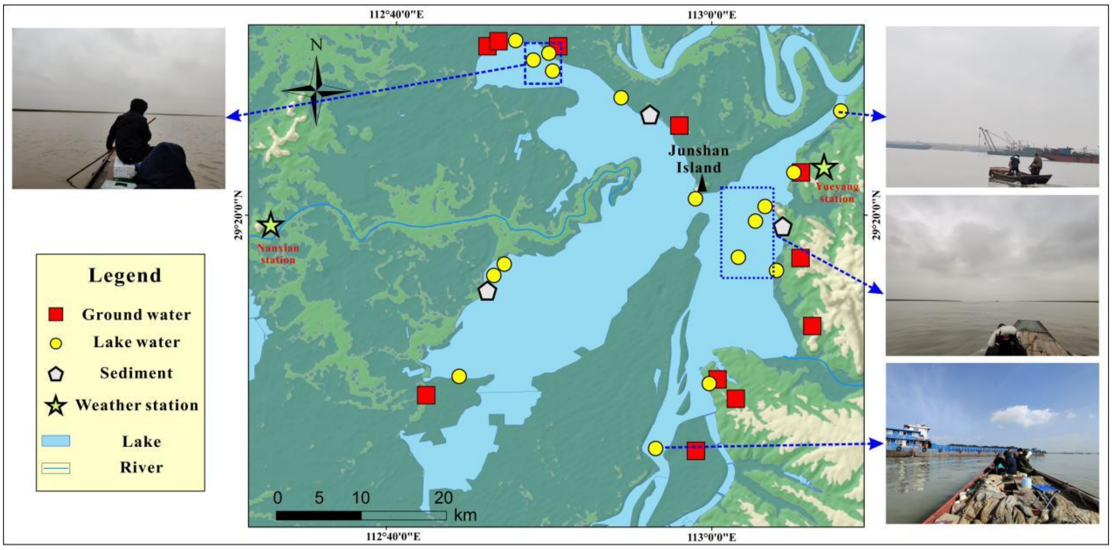

Fig R2. The distributions of sampling sites in EDL. The sampling points marked with blue arrows and the sampling points in the blue boxes are located in the lake center. The photo indicated by the blue arrow was a live view of the sampling in lake center.

Here is the revision for addressing this comment.

"9 lake water samples were collected at a depth of 0.5 m and as far as possible from the lake shore using surface water collection equipment. Moreover, 8 lake water samples were collected from lake center by a small fishing boat."

-About the comment (6): Minor comments

1) Lines 24, 466, 531: "On the contrast" should be "By contrast" or "On the contrary".

2) Line 9: please change "is" to "are".

-Uniform response 1)-2): Thanks for your good suggestion. These technical corrections have been corrected word by word.

3) Lines 34~37: "… groundwater is an important component of lake water and lake chemistry …" This is incorrect. Please modify.

-Response 3): Thanks for your remainder. Here is the revision for addressing this comment.

"Recent studies have shown that groundwater is an important contributing component in the budgets of water and chemicals of lakes."

4) Line 38: "impacts on" not "impacts to". In formal writing, it is forbidden to use *phrase abbreviations (like LGD here) as the beginning of a sentence. Please include the recent study such as Zhang et al. (2021) (Control factors on nutrient cycling in the lake water and groundwater of the Badain Jaran Desert, China. Journal of Hydrology 598, 126408)*

5) Lines 43, 54, 57, 81, 85, 102, 105, 512, etc.; "nutrients input" should be "nutrient inputs", keeping consistence with title.

-Uniform response 4)-5): Thanks for your good suggestion. These technical corrections have been corrected word by word.

6) Lines 52~53: "whereas small-scale patterns correlated with grain size distributions of the lake sediment." Please modify.

-Response 6): Thanks for your remainder. Here is the revision for addressing this comment.

"whereas small-scale patterns correlated with grain size of the lake sediment."

7) Line 55: "could be inter-played" . Please modify.

-Response 7): Thanks for your remainder. Here is the revision for addressing this comment.

"Moreover, the geological factor could be inter-played with hydrogeology, groundwater quality and even super-surface factors mentioned above, which may collaboratively lead to spatial variability in LGD and associated nutrient inputs"

8) Line 57: Please change "advancing" to "advancement".

9) Lines 66~67: It could be more concise, if change "the quality of this groundwater" into "the groundwater quality".

10) Line 72: Plus "been" after "yet".

-Uniform response 8)-10): Thanks for your good suggestion. These technical corrections have been corrected word by word.

11) Line 80: Please simplify this sentence "The ecological sensitivity and important ecological role of the EDL…".

-Response 11): Thanks for your remainder. Here is the revision for addressing this comment.

"The important ecological role of the EDL emphasizes the need for an evaluation of

LGD and associated nutrient inputs."

12) Line 104: Plus "a" before "new".

13) Line 114: Delete the second "annual average".

14) Lines 117 and 119: Change "originate" to "originating".

15) Lines 133~137: Modify "first", "second", "third" into "upper", "middle", "lower", respectively. Please simplify the description, like following, from "The ... aquifer is a phreatic/confined aquifer..." to "The ... aquifer is phreatic/confined ...".

16) Line 143: "... shores of both ..."

17) Line 152: Delete "from".

18) Line 157: Change "are" to "were".

19) Line 158: Change "in" to "at" before "the lake shore".

20) Line 161~162: Modify "... contained no captured air." to "captured no air bubble".

-Uniform response 12)-20): Thanks for your good suggestion. These technical corrections have been corrected word by word.

21) Lines 163~165: Modify "(GPS)" to "(DGPS)". The accuracy of DGPS is likely to be lower than the level differences between groundwater and lake water. So is it reliable to identify the exchange directions between groundwater and lake water?

-Response 21): Thanks for your reminder. The DGPS elevation data can be corrected against datum points in the study area and the elevations are within the error tolerance.

22) Line 171: Modify "were" to "was".

23) 23) Lines 176~177: The units should be given for λ and t.

24) Line 195: Simplify the sentence! "The following equation is used to estimate groundwater discharge rate ...".

25) Lines 207, 230: should be "Eqs. (...)".

26) Line 213: There is no need to repeat explaining $\lambda^{222}Rn$.

27) Lines 240~241: Don't repeat phrase abbreviations already explained above, such as Eh, DO.

28) 28) Line 253: Brackets should be half-width symbols.

29) Line 318: Change "both" to "by".

-Uniform response 22)-29): Thanks for your good suggestion. These technical corrections have been corrected word by word.

30) Lines 346-347, 409-411: Please rewrite.

-Response 30): Thanks for your remainder. Here is the revision for addressing this comment.

Lines 346-347: "In most cases, the amount of ^{222}Rn produced by the decay of the lake ^{226}Ra is so small that it can be ignored within the ^{222}Rn mass-balance model."

Lines 409-411: "The results of the ^{222}Rn mass-balance model showed that the LGD rate and flux in the WEDL were 71.47 ± 52.16 mm d^{-1} and 1.24 ± 0.90 $\times 10^7$ m^3 d^{-1}, respectively; the LGD rate and flux in the EEDL were 34.76 ± 23.36 mm d^{-1} and 3.08 ± 2.07 $\times 10^6$ m^3 d^{-1}, respectively."

31) Line 398 and similar problems above and below: Please uniform the expressions of "Figure/Fig.", "Equation/Eq." throughout the paper.

-Response 31): Thanks for your good suggestion. This is the HESS requirement for terminology in manuscript formatting, no abbreviation when Equation and Figure are used as sentence starters.

32) Line 478: Modify "makes" to "make".

-Response 32): Thanks for your good suggestion. The technical error has been corrected.