Response to Reviewer #1's Comments

This paper explored the impacts of wildfire smoke on environmental variables and terrestrial productivity using long-term observations from both forest and wetland sites, and found moderate smoke promotes plant productivity via diffuse fertilization effects (DFE) but negative effects under dense-smoke conditions. Overall, this work is interesting and shows the significant impacts of diffuse radiation on ecosystem productivity. However, there are some important limitations need to be overcome before the publication in *ACP*.

[Major comments]

1. First, this paper neglected necessary comparisons of DFE with other studies. Smoke aerosols can increase diffuse radiation and enhance gross primary productivity (GPP). The magnitude of such DFE should be compared with previous studies, such as Hemes et al. (2020) or Zhou et al. (2021). Such quantification can help explore the contributions of DFE to site-level GPP under different smoke episodes and for varied vegetation types.

We appreciate the recent references and have integrated them into the revised manuscript. First, we note that we deliberately kept the literature review brief as much of this was included in our earlier *ACP* paper (McKendry, I. G., et al. Impacts of an intense wildfire smoke episode on surface radiation, energy and carbon fluxes in southwestern British Columbia, Canada, *Atmos. Chem. Phys.*, 19(2), 835–846, 2019.) Second, we have compared our results of diffuse fraction fertilization with previous studies. Our relationship between PARg and diffuse fraction was compared with Ezhova et al. (2018) at Line 601–616. We discussed different slopes in the relationship of LUE to diffuse fraction found by different studies at Line 617–639. The included studies are Cheng et al. (2016), Ezhova et al. (2018), and Hemes et al. (2020). Third, at the end of Section 4.3, we also further compared our estimated GPP increase due to diffuse fraction to the above mentioned studies and Lee et al. (2018).

Fourth, the results from Zhou et al. (2021) were published after our submission. As the reviewer suggests, we have now compared our results with theirs at Line 644–646 as follows: "… at five forest sites. Increases of 3–4.1% and 1.6–2.4% in GPP due to a 1% increase in DF were found for tree species and non-tree species, respectively, using 200 FLUXNET sites by Zhou et al. (2021). Hemes et al. (2020) found that the GPP enhancement was between 0.71%, and 1.16% at four sites for every 1% increase in diffuse fraction when absorbed PAR_g was held constant. Lee et al. (2018) also showed a comparable GPP enhancement at 0.94% GPP using a process-based sun-shade canopy model with observations from a broadleaf forest in the eastern USA."

2. Second, this paper had explored the changes of temperature, relative humidity, and other environmental factors caused by smoke aerosols, but did not consider the impacts of these changes of meteorology on GPP. I suggest that the authors consider impacts of other factors besides diffuse radiation using some statistical methods (e.g., simple linear regression used in Cheng et al. (2015)). The explorations of other environmental factors are important especially for temperature and humidity, because smoke aerosols can largely influence them as shown in Figure 3.

This is a good suggestion. We have now used a multiple linear regression approach to assess the effects of air temperature and vapor pressure deficit on GPP along with diffuse fraction. The follow paragraphs describe what we have done.

First, we have added few sentences at the end of Section 2.3 (Line 294–303) to briefly describe the method as follows:
"Besides diffuse fraction, air temperature (T_a) and VPD are two additional environmental factors that can influence stomatal conductance and photosynthesis, and thus affect GPP (Cheng et al., 2015). To assess the impacts of changes in T_a and VPD on GPP in addition to diffuse fraction, we first followed Cheng et al. (2015) to obtain GPP residuals (i.e., GPP changes caused by factors other than direct PAR). The coefficients used in the Michaelis–Menten light response function (rectangular hyperbola) were from Lee et al. (2017) and Lee et al. (2020) for the wetland and forest sites, respectively. After obtaining GPP residuals, we used Equation 3 and 4 in Cheng et al. (2015) to estimate the proportions of variation in GPP residuals explained by diffuse fraction, T_a, and VPD."

Second, we have now presented our findings in Section 3.2.3 (Line 501–511) and added a new table to our Supplementary material as Table S2 as follows:
"By conducting the simple and multiple linear regressions, we investigated the amount of variance in GPP residuals attributable to the three environmental variables (i.e., DF, T_a and VPD). When including the effects of T_a and VPD on GPP residuals with DF, the amount of variation in GPP residuals explained increased by up to an additional 38% (at the forest site) with an average of 24% and 9% at the forest and wetland sites, respectively (Table S2). A combination of three variables explained more than 90% of the variation in GPP residuals when the smoke arrived earlier in summer (i.e., July 2017) for both sites and for the forest site in August 2018. The only case for which T_a and VPD explained more of the variation in GPP residuals than DF was at the forest site during August 2017, which was the same month that the site experienced the greatest drop in *LE*."

Table S2. Proportions of variation in gross primary production (GPP) residuals explained by the three environmental variables. The proportions explained by diffuse fraction (DF) were obtained from the R^2 values from simple linear regressions that include only DF. The proportions explained by a combination of air temperature (T_a) and vapor pressure deficit (VPD) were obtained from the difference in R^2 values between the simple linear regressions and multiple linear regressions that include all three variables.

Buckley Bay forest site				
	2015	2017	2018	2020
DF	53%	19%	89%	41%
T_a & VPD	34%	38%	6%	19%
Burns Bog wetland site				
	2015	2017	2018	2020
DF	84%	44%	35%	55%
T_a & VPD	12%	8%	9%	6%

Finally, we have included the relevant discussion in Section 4.2 (Line 652–659) as follows:
"… in the eastern USA.

Our results also indicated that other environmental drivers that co-varied with DF can contribute to explaining GPP residuals under wildfire smoke events. Generally, T_a and VPD appeared to have small effects on GPP residuals at the two study sites (Table S2). In only one of the study events (Buckley Bay in 2017) did T_a and VPD account for more variation in GPP residuals than DF itself. Cheng et al. (2015) also observed this for mixed conifer forests, which implies radiation changes can be a less important role when T_a and VPD can greatly increase stomatal conductance under smoky conditions at conifer forests. We note that …"

3. Third, this study needed better explanations of their findings. For example, why the changes of PM2.5 and AOD in Figure 2 are not corresponding to each other. The high AOD in 2017 was associated with low PM2.5 while the high PM2.5 in 2020 was associated with low AOD. How such inconsistency affected the impacts of fire smoke on plant photosynthesis? Furthermore, there are some differences in the responses of meteorology as shown in Fig. 3. Why the RH was higher during smoke days for forest site in 2020 but was lower in other years? Also, section 3.1.2 discussed the changes in energy fluxes but did not explain why the responses of H and LE were different in different years.

We appreciate the suggestions and have attempted to clarify in the relevant sections. With respect to Figure 2, we did note in the caption that there are different numbers of AOD_{500} data points per day whereas there are 24 $PM_{2.5}$ data points per day. Therefore, there is no inconsistency between AOD_{500} and $PM_{2.5}$. In order to emphasize the difference in data points between the two measurements, we have now added a sentence at Line 152 and at Line 156, respectively, as follows:
"The monthly course of AOD_{500} for each of four episodes at Saturna Island is shown in Fig. 2a. Due to technical difficulties, numbers of AOD_{500} data points per day were inconsistent. For each event …"
"… concentrations at Vancouver International Airport is shown in Fig. 2b, and there were 24 $PM_{2.5}$ data points for each day. From Fig. 2, it is …"

With respect to RH, we refer the reviewer to our discussion of RH changes at Line 319–322 in the original submission. Furthermore, as described, this could be highly related to the wetness of two sites. We did also extensively explain possible mechanisms that caused different responses of *H* and *LE* during each event at Line 516–536 in the original submission. For example, we provided a possible reason explaining the reduction in *H* for the forest site at Line 520 in the original submission. We also pointed the roles of standing water caused by restoration and soil moisture at Line 523 and 526, respectively, in the original submission. In the end, we especially covered the special situation for the September 2020 case.

3. Finally, the authors needed to exclude other associated perturbations such as cloud and ozone. As shown in Figure S2, the site-level observations show large reductions in surface shortwave radiation during some non-smoke days. Such reductions are likely caused by cloud. Previous studies found that cloud could mask the positive effects of aerosol DFE (Yue and Unger, 2018). So it is not reasonable to compare the smoke and non-smoke days, which is defined as all the remaining days in the same month (Line 288), because the sky conditions between fire and non-fire days could be different. The authors need to redo their analyses based only on clear-sky days to exclude the cloud effects. Meanwhile, fires can cause large enhancement of ozone, which can decrease GPP. Such effects are not considered in this study and need to be discussed about their possible impacts on final conclusions.
We appreciate the reviewer's comment and acknowledge that disentangling the impact of smoke from myriad other environmental drivers such as cloud clover and ozone is challenging. In response, we have, for the most part, maintained our general approach which reflects and is consistent with the goals of the study i.e. to investigate biogeochemical and

biophysical responses to wildfire smoke episodes in natural ecosystems but *not* "isolating effects of diffuse radiation on biogeochemical and biophysical responses". In the second part of the study, we then tried to estimate the effects of changes in diffuse fraction induced by smoke on GPP.

However, we have incorporated the reviewer's recommendation by explicitly comparing cloudless/sunny days to smoky days when trying to quantify DRF (as in Hemes et al. 2020 and Park et al. 2015). This is described in Section 2.3. We also ran additional analyses to compare *H*, *LE*, and NEE between smoky and sunny days for the same months. The results are shown in Table 2 (for $K_{\downarrow}$) and Table S1 (shown below). The results from comparing with sunny days generally agreed with the original results. We have added a sentence at Line 389–392 (for *H* and *LE*) and Line 450–452 (for NEE) as follows:
"… of non-smoky mean daytime time values. We also compared *H* and *LE* between smoky and sunny days (Table S1). The results from the two comparisons (smoky vs. non-smoky days and smoky vs. sunny days) mostly agreed with each other, although greater differences were found when comparing smoky and sunny days."
" As was done for *H* and *LE*, we compared daily averages of NEE during smoky and sunny days (Table S1). Large differences between smoky and sunny days were also found in this case."

We have also added a sentence at Line 524–526 as follows:
"In order to compare to other studies, we also compared $K_{\downarrow}$ between smoky and sunny days (Table 2), as was done for *H*, *LE*, and NEE."

Table S1. The daily averages of sensible heat flux (*H*), latent heat flux (*LE*) and net ecosystem exchange (NEE) at the forest and wetland sites during the smoke events and sunny days, respectively, in 2015, 2017, 2018, and 2020.

Buckley Bay forest site								
	2015		2017		2018		2020	
	Smoky	Sunny	Smoky	Sunny	Smoky	Sunny	Smoky	Sunny
H	147.06	159.44	90.52	121.33	80.56	102.23	25.32	46.40
LE	56.40	49.76	43.97	29.47	20.19	24.26	30.44	49.94
NEE	-0.44	0.46	-1.53	0.80	-1.25	-0.82	-1.73	-1.90
Burns Bog wetland site								
	2015		2017		2018		2020	
	Smoky	Sunny	Smoky	Sunny	Smoky	Sunny	Smoky	Sunny
H	64.16	41.70	35.60	56.48	39.43	66.05	27.64	43.80
LE	97.42	72.15	68.69	84.77	61.56	87.59	24.35	36.01
NEE	-2.89	-1.59	-2.38	-1.09	-1.15	-1.23	-0.43	-0.76

With respect to the effects of ozone, we added ozone observations at Line 169–173 as follows:
"… the main event. The impact of smoke events on ground level ozone concentrations (O_3) at Vancouver International Airport and Nanaimo Labieux Road Station on Vancouver Island is shown in Table 1. For all of the study periods, the maximum daily average O_3 was below 25 ppb. The averages of the four months in the four years were ~16 ppb."

We have also edited Line 192–193 and Table 1 as follows:
"The study periods during the four months with wildfire smoke and the respective maximum AOD_{500}, $PM_{2.5}$, and O_3 values are summarized in Table 1."

Table 1. Summaries for the four study periods.

Year	Study period	Maximum AOD_{500}	Maximum $PM_{2.5}$ (mg m^{-3})	Daily average O_3 (ppb)
2015	4–8 July	5.3	210	24[b], 24[c]
2017	1–11 August	3.9	53	15[b], 24[c]
2018	8–23 August	4.0	165	15[b], 23[c]
2020	8–18 September	3.7[a]	178	14[b], 20[c]

[a]There were no available observations during the 2020 smoke episode. The value shown here was observed on 6 September 2020.
[b]The measurements were collected at Vancouver International Airport Station. The monthly averages O_3 were 20, 16, 15, 15 ppb during July 2015, August 2017, August 2018, September 2020, respectively.
[c]The measurements were collected at Nanaimo Labieux Road Station. The monthly averages O_3 were 20, 22, 21, 18 ppb during July 2015, August 2017, August 2018, September 2020, respectively.

In Section 4.3, we have edited Line 685–693 as follows:
"Although increased O_3 and co-pollutants are often associated with wildfires (Jaffe & Wigder, 2012; Pfister et al., 2008; Yamasoe et al., 2006) and can have an indirect impact on ecosystem carbon budgets that is harder to quantify (Malavelle et al., 2019). We did not observe an appreciable increase in hourly ozone maxima, nor daily average O_3 during the four smoke episodes (Table 1). Maximum hourly values at both sites were generally below 60 ppb while daily average values during smoke events were within 2-3 ppb of overall monthly average values. On this basis and using the results of Hemes et. al. (2020), we estimated that O_3 enhancements in smoke would contribute to a ~ 1% GPP reduction at Buckley Bay and Burns Bog".

[Minor comments]
Abstract: This section needs to explain which processes in this study are biogeochemical and which are biophysical.
We appreciate the reviewer's comment and have edited Line 16–19 as follows:
"However, there are few observational studies measuring the ecosystem-scale biogeochemical (e.g., carbon-dioxide exchanges) and biophysical (e.g., energy partitioning) properties during smoke episodes, and hence accessing effects on gross primary production (GPP) of changes in incoming diffuse photosynthetically active radiation (PAR)."

Line 23: H and LE should be explained at the first appearance.
Thank you for noticing this, we have now corrected it as follows (Line 25):
"When the smoke arrived in the later stage of summer, impacts on sensible and latent heat fluxes were also greatest."

Line 267: Is this formula of diffuse fraction applicable for the two sites in this study?
We only used the formula to obtain diffuse fraction when the measurements were not available (e.g., for the Burns Bog site and for the Buckley Bay site during 2015). We have now further compared the estimated diffuse fraction with the measured data when data were available (e.g. 2017, 2018, and 2020 at the Buckley Bay site). The estimates obtained using the equation agreed well with the calculated values using measurements as shown in the figure below.

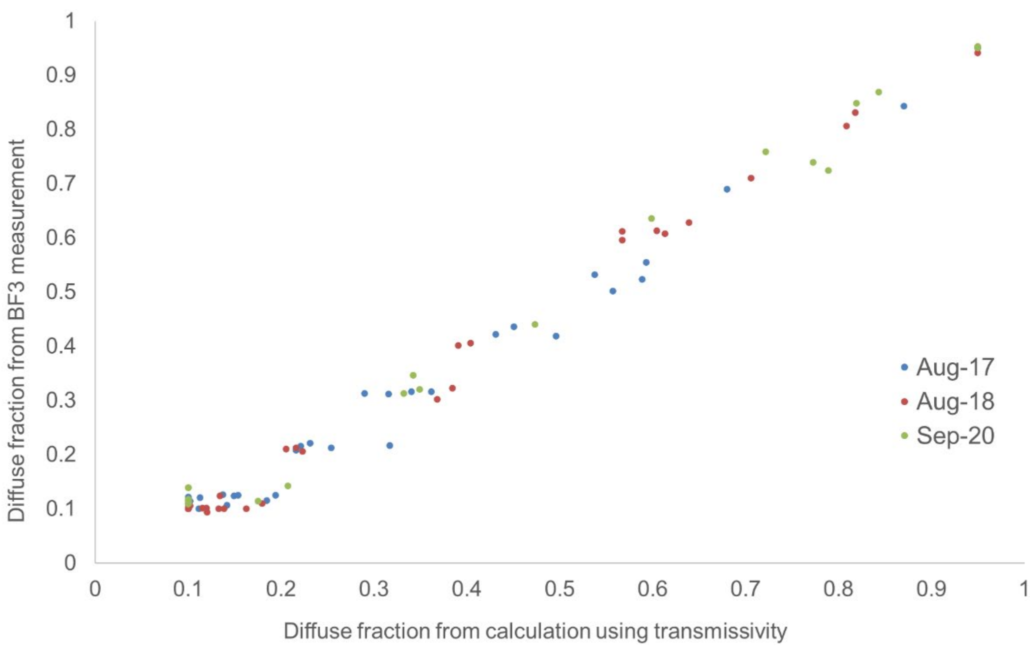


Figure 6: Although the relationships between LUE, PAR and diffuse fraction had been explored in this figure, I suggest that the relationships between GPP and diffuse fraction should be shown and compared with previous studies.
We appreciate the reviewer's comment. We did compare our results of diffuse fraction fertilization with previous studies including Cheng et al. (2016), Ezhova et al. (2018), Lee et al. (2018), and Hemes et al. (2020) (Line 601–651). As described in the response to the Major comment 1, we have now compared our results to those of

Zhou et al. (2021). However, in order to maintain the legibility of the figure, we decided not to include extra data in Figure 6.

Response to Reviewer #2's Comments

The paper by Lee et al., aims to characterize the biogeochemical and biophysical responses to wildfire smoke episodes from a forest and a wetland ecosystems by using eddy-covariance and meteorological datasets.

Although the paper addresses a relevant scientific question, in my opinion it lacks of substantial conclusions, and the reported ones are not sufficiently robust and supported by scientific evidence. The main limits of the current manuscript - as also stated by the authors – are all related.

[Major comments]
Few observations (in their current form): despite the wildfire episodes are sporadic and limited in time (there is not much to do for this) data can be treated and aggregated in a more sophisticated way than by the simple day-to-day comparison (e.g. creating layers of data using some representative ancillary variables). The attributions of ecosystem response: the very likely presence of confounding effects is not treated in an accurate way so that to exclude (or limit and identify) their effect on results. The selection of experimental and control datasets: the simple definition of "smoky" and "non-smoky" days, with the latter being the remaining day of the month, risk to confound the picture too much. This is a challenging task, but a more sophisticated method (e.g. a data driven approach) could be explored. Some of the literature cited in the paper could provide good methodological examples (e.g. Hemes et al., 2020; Park et al., 2018).
We appreciate the reviewer's comment and note that a similar suggestion was made by Reviewer #1. We have attempted, in response to both reviewers, to address these concerns around confounding effects (including ozone, see response to Reviewer #1). We have also addressed more specifically the effects of clouds by comparing smoke days with cloudless/sunny days.

Here is a response to Reviewer #1:
We appreciate the reviewer's comment and acknowledge that disentangling the impact of smoke from myriad other environmental drivers such as cloud cover and ozone is challenging. In response we have for the most part maintained our general approach which reflects and is consistent with the goals of the study i.e. to investigate biogeochemical and biophysical responses to wildfire smoke episodes in natural ecosystems. We then tried to estimate the effects of changes in diffuse fraction induced by smoke on GPP.

However, we have incorporated the reviewer's recommendation by explicitly comparing cloudless/sunny days to smoky days when trying to quantify DRF (as in Hemes et al. 2020 and Park et al. 2015). This is described in Section 2.3. We also ran additional analyses to compare *H*, *LE*, and NEE between smoky and sunny days for the same months. The results are shown in Table S1 and shown below. The results from the comparison with sunny days generally agreed with the original results. We have added a sentence at Line 389–392 (for *H* and *LE*) and Line 450–452 (for NEE) as follows:
"… of non-smoky mean daytime time values. We also compared *H* and *LE* between smoky and sunny days (Table S1). The results from the two comparisons (smoky vs.

non-smoky days and smoky vs. sunny days) mostly agreed with each other, although greater differences were found when comparing smoky and sunny days."

" As was done for *H* and *LE*, we compared daily averages of NEE during smoky and sunny days (Table S1). Large differences between smoky and sunny days were also found in this case."

[Minor comments]

It would be important to have a proxy variable to scale the AOD values to the measurement sites (e.g. PAR measured at the Saturna Island) and use this to select (or verify) the smoking days (or hours).

We don't disagree, but simply wish to emphasize that the AOD data is provided simply for context and as just one element of the data used to determine the study periods for our sites (i.e. a combination of AOD_{500} data, $PM_{2.5}$ measurements, and Hazard Mapping System Fire and Smoke Product).

Why did you use different partitioning methods for the two sites? This adds further uncertainty and makes respective estimates harder to compare.

The two sites were maintained by two different research groups, thus there are slightly different procedures on data collection and post processing. However, both methods are nighttime-based partitioning methods as described at Lines 217 and 241 in the original submitted version for the wetland and forest sites, respectively. Based on Lee et al. (2016) (https://dx.doi.org/10.14288/1.0308793), uncertainty introduced by differences between the REddyProc and FLUXNET Canada approaches on annual NEE, Re and GEP are small (~10%) (refer to the table below). Thus, the differences for solely partitioning are expected to be negligible.

CO_2 fluxes			
Annual Budget (June 16th 2015 to June 15th 2016)	NEE (g C m^{-2} yr^{-1})	R_e (g C m^{-2} yr^{-1})	GEP (g C m^{-2} yr^{-1})
1st run with input having two-year data	-163.43	216.95	380.38
2nd run with input having two-year data	-154.85	253.42	408.27
This study (FLUXNET Canada)	-178.97	235.61	414.58
Standard deviation of three results	12.23	18.23	18.20

Energy fluxes		
	H (GJ m^{-2} yr^{-1})	*LE* (GJ m^{-2} yr^{-1})
1st run with input having two-year data through online tool	656.54	1022.36
2nd run with input having two-year data through online tool	631.84	1000.86
3rd run with input having two-year data through online tool	674.36	1053.06
Standard deviation of three results	20.58	30.35

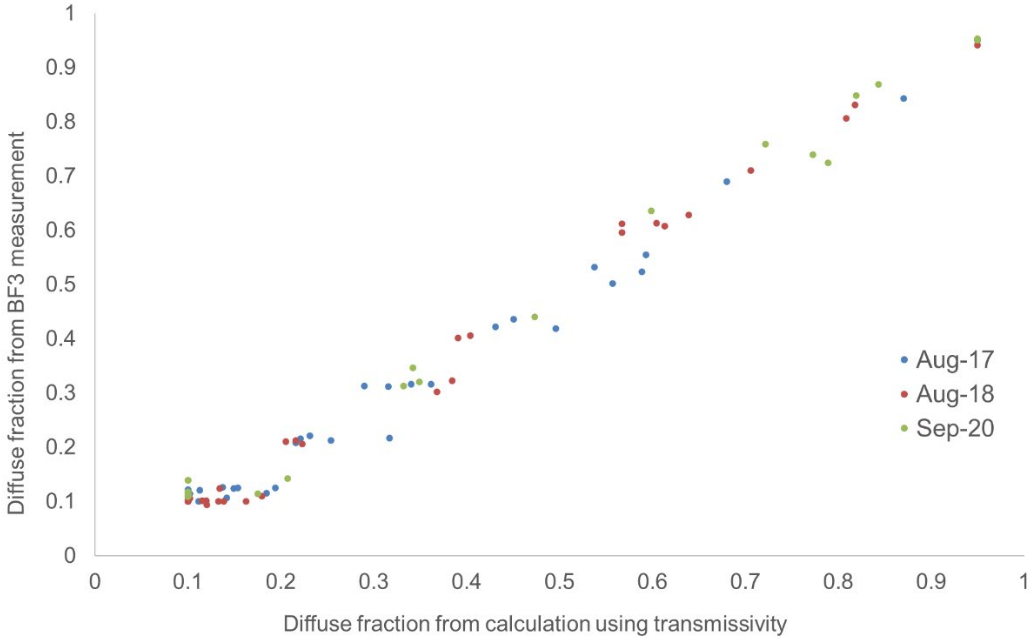
At line 284:285 you report, within brackets, that control days are "all the remaining days in the same month". This criteria must be better clarified and described reported in the method section.

As explained in our response to the reviewer's Major Comment, we have now added a sentence at the end of Section 2.1.3 (Line 194–196) to define our control days as follows:

"To assess how smoke altered biophysical and biogeochemical properties under representative environmental conditions in different months, we compared the study periods with the non-smoky days, which were the remaining days in the same month."

Line 263-270: did you compare the estimated diffuse PAR fraction with measured data when available? (e.g. from 2017 at the Buckley Bay site).

We appreciate the reviewer's comment and have now compared the estimated diffuse fraction with the measured data when data were available (e.g. 2017, 2018, and 2020 at the Buckley Bay site). The estimates obtained using the equation agreed well with the calculated values using measurements as shown in the figure below.



Given the small numbers of samples and their distributions, the differences between smoky and non-smoky days should be tested by non-parametric statistical methods..

We appreciate the reviewer's comment. We have run Mann–Whitney U test for the compared variables. We have now updated Figures 3 to 5 and all the relevant text.

Line 316: "Mean $K_{\downarrow}$ values were generally lower during the smoke events compared to the days that were not affected by smoke (Fig. 3), but these differences were not statistically significant with the exception of the August 2017 event at Burns Bog."

Line 373: "In 2017, *H* during the smoky days was ~85% of non-smoky mean daytime time value at the Buckley Bay site. However, *LE* increased significantly ($p < 0.05$) at Buckley Bay during the smoke period by ~60% of non-smoky mean daytime time values."

Line 407: "When the smoke arrived later in the season, as in September 2020, the diffuse fraction increased appreciably to almost 0.80."

Line 418: "These increases were statistically significant in the first two years with the exception of the July 2015 event at Buckley Bay."

Line 444: “Throughout the 2020 smoke period, when the diffuse fraction was the highest of all cases (0.30 to 0.80) appreciable impacts on NEE were observed at both sites.”

The updated results are summarized in the table below (next page).

The difference in PAR between smoky and non-smoky days seems to be never significant (except for August 2017 in the wetland site). The same holds for the diffuse radiation.
As in our response to the reviewer’s Major Comment, we believe comparing smoky days with non-smoky days suits our goal the best. That there was no significant difference in PAR_g and diffuse fraction between the averages we believe is an interesting result.

The Section 3.1.1 should be drastically reduced, moving all the text describing Fig. 3 in the supplement and keep the most relevant info.
We have now removed the following sentences:
Line 302-314 in the original submitted version: “In 2015, the most dramatic impact of the smoke plume on $K_{\downarrow}$ occurred on 5 July at Buckley Bay and 6 July at Burns Bog, respectively, during otherwise clear sky conditions (Fig. S2). The mean daily T dropped to ~35% and ~50% at Buckley Bay and at Burns Bog, respectively (Fig. S3). During the summer in 2017, the wetland site experienced the biggest impact of smoke on 4 August when T decreased to ~ 40% (Fig. S3). One day later, on 6 August, the forest site was most affected by the smoke with T reduced to ~ 50% (Fig. S3). The longest duration smoke episode of the four occurred in 2018, and reduced T much earlier at Buckley Bay (11 August) than at Burns Bog (19 August). The magnitudes of the decrease in T were similar at the two sites (dropped to ~35%) in 2018 (Fig. S3). The September 2020 case is notable for being the latest (season-wise) of the four cases, and the only case in which $K_{\downarrow}$ was reduced below 10 W m^{-2} at both sites (Fig. S2). Mean daily T values in September were about 70% at the two sites under sunny days (Fig. S3).”

Line 360: this is true for the smoke-free days too.
We agree with the reviewer and have now edited the sentence as follows (Line 381–382): “In September 2020, the latest of the four smoke episodes, H and LE dropped to low values at both sites for the smoky and non-smoky days (Fig. S4).”

Section 3.1.3: the described differences are never significant.
Yes. But this is not related to the part that quantified the maximum effect of smoke on GPP due to changes in the diffuse fraction. This part is to assess how diffuse fraction responded to wildfire smoke episodes in natural ecosystems.

Avoid basing discussion on single days. As you actually mention and as it is visible from Fig S4, heat fluxes are extremely variables. It's hard to draw robust conclusions here.
We believe those particular increases or decreases are worth mentioning and highlighting since those were the responses from the study ecosystems. And since the lifetime of wildfire smoke at a location is not long, dramatic changes on one to two days are critical.

	Forest	Wetland	Forest	Wetland	Forest	Wetland	Forest	Wetland
	July 2015	July 2015	August 2017	August 2017	August 2018	August 2018	September 2020	September 2020
$K_{\downarrow}$				**95%**				
PAR_g				**99%**				
T_a	**95%**		**99%**	**99%**	**95%**	**95%**	**90%**	
RH	**95%**		**90%**	**95%**	**95%**			
T_s	**90%**	**90%**	**99%**	**99%**	**90%**	**95%**	**99%**	
albedo	**99%**	**99%**		**99%**	**99%**	**99%**	**95%**	**95%**
T				**99%**		**90%**		
Diffuse fraction				**99%**		**90%**		
H		**95%**	**90%**	**99%**		**99%**		
LE	**95%**	**99%**	**95%**					
NEE		**99%**	**95%**	**99%**				
GPP	**95%**	**99%**	**99%**	**95%**		**95%**		
R_e	**99%**	**90%**	**99%**	**99%**	**99%**	**99%**		**99%**

Line 360-362: No need to compare flux absolute values between the two sites.
As the response to the previous comment, we have now edited the sentence as follows (Line 390–391):
"In September 2020, the latest of the four smoke episodes, *H* and *LE* dropped to low values at both sites for the smoky and non-smoky days (Fig. S4)."

Line 392-394: you report that "Both sites became a stronger CO2 sink ... These increases were statistically significant in the first two years." It is actually true that the significance (assuming its estimate is appropriate) is verified for the first two years in the bog and just for 2017 in the forest.
In response to the previous comment, we have run Mann–Whitney U test for the compared variables. We have now updated this sentence as follows (Line 419):
"These increases were statistically significant in the first two years with the exception of the July 2015 event at Buckley Bay."

I would not discuss single-day values (e.g. ll 403-406), or base a conclusion on 2 days (e.g. ll 430-421)
We believe those particular increases or decreases are worth mentioning and highlighting since those were the responses from the study ecosystems. Given that the lifetime of wildfire smoke at a location is not long, dramatic changes on one to two days are critical.

The same consideration as for NEE hold for GPP and Reco discussion.
As stated above, although the reviewer's point is well taken, we do feel that it is useful to still point to single day values if purely to highlight the complexity and variability of processes in play.

Section 3.2.3 Relationship between smoke and gross primary production. The title is not reflected the text. In addition, the relation between PARg and the diffuse fraction is not a result (and well known already) and should be moved in the supplement or in Methods.
We believe the title reflects the text. We showed how PARg and LUE responded to the changes in diffuse fraction and GPP is equal to PARg*LUE, which was described at Line 294. The negative relationship between PARg and the diffuse fraction is well known, but the rate of decrease can vary. We have compared the rates of decrease and intercepts from our study with others (Line 607–616).

R2s reported in Fig. 6(b) do not seem to reflect the scatter of respective points, please check (however, it is not necessary to report them here).
We have confirmed they are correct and have removed them as suggested.

Discussions: it is good to compare results with similar studies, but it is better to limit the use of conclusions from other works
We have properly cited all statements with relevant studies. We have now included the results from Zhou et al. (2021), published after our submission, as the Reviewer #1 suggested. This has been added at Line 644–646 as follows:
"… at five forest sites. Increases of 3–4.1% and 1.6–2.4% in GPP due to a 1% increase in DF were found for tree species and non-tree species, respectively, using 200 FLUXNET sites by Zhou et al. (2021). Hemes et al. (2020) found that the GPP enhancement was between 0.71%, and 1.16% at four sites for every 1% increase in

diffuse fraction when absorbed PAR_g was held constant. Lee et al. (2018) also showed a comparable GPP enhancement at 0.94% GPP using a process-based sun-shade canopy model with observations from a broadleaf forest in the eastern USA."

Fig. 1: please increase the quality, e.g., type of maps, distinguishing between EC sites and areas interested by fire..
We followed ACP guideline on figures and submitted Figure 1 as vector graphic in *.pdf format. The area shown was the area of interest, southeastern BC, and the measurements and sites were clearly described in the caption.

Line 143: insert AOD500 acronym after the word wavelength. Please recall why you select the 500 nm wavelength
We have added this as follows (Line 148):
"In this paper, we present the level 1.5 AOD data at the reference 500 nm wavelength (AOD_{500}) in order to compare both the magnitude and duration of the four smoke episodes." We use AOD500 as it is a commonly used wavelength in descriptions of aerosol radiative impacts due to the fact it is at the peak of the visible spectrum.

Line 145-147: please provide some reference examples for AOD value (e.g. during clear sky).
We have added this as follows (Line 150):
"… the four smoke episodes. The AOD_{500} ranged from 0 to 0.2 on the average cloudless summer days on Saturna Island."

Fig 2: please improve the axis labels, and align the two panel according to dates (days).
As noted in the caption of Figure 2, there are different numbers of AOD_{500} data points per day and 24 $PM_{2.5}$ data points per day. And we have now added a sentence at Line 1542 and Line 156 respectively, as follows:
"The monthly course of AOD_{500} for each of four episodes at Saturna Island is shown in Fig. 2a. Due to technical difficulties, numbers of AOD_{500} data points per day were inconsistent. For each event …"
"… concentrations at Vancouver International Airport is shown in Fig. 2b, and there were 24 $PM_{2.5}$ data points for each day. From Fig. 2, it is …"
So, it is impossible to align the two panel according to dates.

Line 240: inconsistent formula for albedo: should be switched, reflected/incident.
Thank you for noticing this error, we have now corrected it as follows (Line 261):
"α was calculated as $K_{\uparrow}/K_{\downarrow}$ at noon as for the wetland site."

Line 343: "Fig. S3" should be Fig. S4.
Thank you for noticing this error, we have now corrected it as follows (Line 367):
"Thus, the mean daytime values of *H* and *LE* are also shown in Fig. S4."

Line 412: add "g" to –5.40 C m-2 day-1.
Thank you for noticing this error, we have now corrected it as follows (Line 438):
"The biogeochemical impacts of smoke were a little different at Buckley Bay, where daily NEE showed little change until decreasing to –5.40 g C m^{-2} day^{-1} (stronger CO_2 sink) on the last day of the study period (Fig. S6)."

Fig S5 and S6: It would be better to move into the main text.
We appreciate the reviewer's comment. Currently, we already have 2 tables and 6 figures in the main text. In order to keep it within recommended length guidelines, we have chosen to keep Figures S5 and S6 in the supplementary materials.