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Interactive comment on "Resistance and resilience of stream metabolism to high flow disturbances" *by* Brynn O'Donnell and Erin R. Hotchkiss

Anonymous Referee #2

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General comments: The manuscript bg-2020-304 "Resistance and resilience of stream metabolism to high flow disturbances" by O'Donnel & Hotchkiss analyzes in a third-order stream the response of Gross Primary Production (GPP) and Ecosystem Respiration (ER) altered by disturbances such as isolated high flow events. The study is relevant as it is based on a long-term monitoring (5 years) of GPP and ER, which is critical to decipher seasonal and multiyear variability of stream ecology in the context of climate change. Overall, I found the approach of the study interesting but the authors should explore their dataset further, therefore I suggest major revisions.

Major comments: I was surprised that the authors did not discuss about in-stream net

ecosystem production (NEP). NEP is critical to decipher stream ecology as it does indicate whether an ecosystem is fixing more C than is respiring. The authors showed that ER has higher resistance and resilience in comparison to GPP, thereby should shifted NEP towards heterotrophy (decrease of the GPP:ER ratio). I believe it would be very interesting for the reader to understand/know how NEP is affected by high flow events. I suggest adding figures and discussion about NEP.

The dataset used by the authors is extended in time but the paper lacks of seasonal variability analysis. How GPP, ER and NEP, resistance and resilience are affected by seasons and by year-to-year variability. Indeed, temperature effect on stream metabolism is usually significant. The authors needs justify that the variability induced by the temperature does not overcome the variability induced by flow events. In the revised paper, I suggest the authors adding a figure such as GPP vs ER with points colored according to seasons or river flow.

In low order streams, GPP and ER are affected by groundwater inputs, as groundwater inputs are usually significant in such streams. Groundwater exhibit usually low oxygen concentration, which may be problematic when GPP and ER are based on oxygen monitoring. Inputs of low-O2 groundwater in stream can overestimate ER and underestimate GPP. However, the equation 1 does not take into account groundwater inputs. Why? Oxygen measurements during high flow, especially in low-order streams, can give erroneous values, so are the authors sure to measure appropriate values during the high flow events.

There is some variability in day-to-day metabolism rates; therefore, I do not understand why the authors took the maximum or minimum value of GPP (or ER) from the antecedent range to estimate the resistance. I believe that the median or the mean would be more appropriate. In addition, why the authors used 3 days as the antecedent range. Is it arbitrary?

I have concerns on how the isolated flow events are selected. Indeed, in the figure 2A, I observe that only few high flow events (15 events in 5 years) are actually selected by the authors. In the figure 2C, the authors did not provide statistical analysis on the difference of cumulative daily discharge between all days and isolated flow events. Is it statistically different? Visually, it seems not, considering the high range of cumulative daily discharge during "all days". If it is not statistically different, it means that the disturbance is the same in both groups. Is there a way for the authors to arbitrary select a greater number of high flow events? As examples, the authors could use maximum daily discharge vs cumulative daily discharge or the change in discharge from pre- to peak-storm flow. By the way, I do not understand why the authors wants to select isolated flow events rather than all high flow events. I believe that estimating resistance and resilience in each high flow events would be much more robust. In addition, the paper aims to study ecosystem response to high flow events, but the paper do not contain figures showing the relation of river flow versus stream metabolism. What is the relationship between river flow and GPP, ER, NEP, resistance and resilience? Resistance represents the change in GPP (or ER) during a change in river flow, so maybe it would be interesting to show ΔGPP (or ER) with ΔQ?

I the discussion section, I do not feel that the authors fully responds to their four hypotheses. How can the authors responds to H2 where they actually do not show carbon or nutrients measurements? H0 is strongly dependent on how you arbitrary selected the flow events. To my point of view, with their study design (unless the authors have measurements of carbon and nutrients) the authors can discuss only about H1 and H3. In addition, I also suggest rewriting the Discussion section in a more logical sense following the order of their hypotheses.

Minor Comments: L.1: Please, add somewhere in the abstract the ranges of ER, GPP, NEP, resistance and resilience. L.10-11: You defined the metabolic resistance as the magnitude of departure from the dynamic equilibrium during antecedent lower flows, so why using the words "ER magnitude of departure" to refer to resistance. Better used the word resistance and resilience throughout the text once you have defined those words.

Please add also in the abstract that more ER or GPP is resistant less the magnitude of departure is large. L. 69: It is strange to start with H1 and finish with H0 L.81: Usually precipitation is in mm L.90: How did you calibrate the different sensors, and how often did you check the calibration? L.93: can you add the weather station on the figure A1. The figure A1 needs a scale, a geographic footprint. L105: Please, specify that you works with gas exchange coefficient not gas exchange velocity L.110: How did you measure the PAR? How did you calculate the average depth? L.119: What are the values of K? L.133: Please define Qi L.167:169: For the different variables other than GPP and ER you used the medians from three days prior the flow event for correlations, but for resistance you used the maximum or minimum GPP or ER before the flow event. I believe it would be robust to use the same methods. L.180: Is the cumulative daily discharge statistically different between isolated events and other days? L.182-185: As mentioned in the major comments please showed how GPP, ER and NEP are affected by seasons and river flow. L219 Where can I see that ER was more resistant than GPP. It is on a daily basis? Yearly basis? Multi-year basis? Please give some details, some stats should be applied. Figure 1 do not show your results. L.228: Same comments 228-230: Can you show some results confirming what you stipulate? In the table 4 turbidity seems weakly correlated with resilience of ER and GPP. 254: The authors have a dataset representing 5 years of monitoring so why they cannot answer to this question, at least partly? Figure 5: I am not convinced by this figure. Figure 6: Same data as in the table 4, perhaps not relevant. Figure 8: Is there a better way to present these results? Table 4: Please indicate the p-values, Indeed, two parameters can have a correlation coefficient greater than 0.5 but they are still not correlated together if the p-value is greater than 0.05. Figure A4 to A18: In each isolated flow events: GPP, ER and Discharge can be combined in one figure with 3 axis Figure A20: To my point of view a figure such as this one showing the seasonal variability of the different parameters (GPP, ER, NEP, résistance and resilience) is important and must appear in the main text.

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