Referees comments are in italics, reply from author is in plain text

This paper uses high-frequency nutrient monitoring data to characterise responses to a major rainfall event across 3 contrasting catchments. I really like the concept of examining hysteresis behaviour to the same storm event across the UK, and it is a really novel use of the detailed data generated by the DTC catchments. This paper is original, of interest to an international audience, and generally well written. However, it would require some corrections and restructuring before I could recommend publication.

The authors thank the reviewer for this comment, we are pleased that you liked the concept of the paper and found the hysteresis comparison to be novel.

General comments

1) *The paper is very overlong and contains much repetition. It needs to be much more focussed and more clearly structured. The introduction in particular needs to be greatly reduced and refocused. Much of the text is justifying the DTC project. This has probably been presented elsewhere in other papers, and should be kept to a minimum here.*

In fact, at present background information on the DTC project hasn't been published elsewhere, hence the overlong description here. Other reviewers made the same comment and so this section has been reduced.

2) *A large section of the introduction describes the storm event from a meteorological perspective, which is not needed to support this study. Much of this is repeated in the Methods anyway, and the text in the Introduction should be removed. The intro contains other descriptions of methodology and site descriptions that should also be omitted. Once the above items have been removed, the remaining Introduction is very weak, and there is a real need to put this study into context. This should be done by including a brief review of similar hysteresis studies. The authors state (probably correctly) that no previous studies have captured hysteresis patterns at high frequency in catchments across the UK. However, there are lots of studies that have captured storms at multiple sites across catchments, and also studies that have studied hysteresis at single sites at high monitoring frequencies. Suggested references include –*

Bowes, M.J., Smith, J.T., Neal, C., 2009. The value of high-resolution nutrient monitoring: A case study of the River Frome, Dorset, UK. J. Hydrol. 378, 82-96.

House, W.A., Warwick, M.S., 1998. Hysteresis of the solute concentration/discharge relationship in rivers during storms. Water Research 32, 2279-2290.

Ide, J., Haga, H., Chiwa, M., Otsuki, K., 2008. Effects of antecedent rain history on particulate phosphorus loss from a small forested watershed of Japanese cypress (Chamaecyparis obtusa). J. Hydrol. 352, 322-335.

McKee, L., Eyre, B., Hossain, S., 2000. Intra- and interannual export of nitrogen and phosphorus in the subtropical Richmond River catchment, Australia. Hydrol. Process. 14, 1787-1809.

Siwek, J., Siwek, J.P., Å˙zelazny, M., 2013. Environmental and land use factors affecting phosphate hysteresis patterns of stream water during flood events (Carpathian Foothills, Poland). Hydrol. Process. 27, 3674-3684.

Stutter, M.I., Langan, S.J., Cooper, R.J., 2008. Spatial contributions of diffuse inputs and within-channel processes to the form of stream water phosphorus over storm events. J. Hydrol. 350, 203-214.

The authors thank the reviewer for this comment. We have now added a paragraph into the Introduction about the value of hysteresis studies (page 3 line 23 – page 4 line 9). The meteorological information has been removed.

2) There is no mention of how the Hach phosphate chemistry and probe data was quality checked. As the study is wholly reliant on this time-series data, its quality is vital. Were these automated data corrected using analysis data from spot samples? How were the probes calibrated? How often?

We have now included a section on QA/QC procedures which we agree are essential for validating the high resolution data (section 2.3). We have included a comparison table between data collected using bankside analysers and grab samples analysed using standard laboratory procedures which show the measurements are in good agreement (Table 2).

3) The paper structure is very confusing. There is lots of discussion within the Results section, but then many observations are left unexplored. I think the readers (and the authors) would benefit from having a combined results and discussion section, if that is allowed within the format of this journal.

This comment has been taken on board and the interpretive elements have been moved from the Results to the Discussion section.

The conclusion is really just another summary of the manuscript, and adds nothing to the paper. The conclusion should state why this work is worthy of publication.

The conclusion has been edited to reflect the unique contribution of this work.

Specific comments
Title: (and throughout). High resolution could refer to either spatial or temporal resolution. Replace with high temporal resolution or high frequency.

This has been done.

Demonstration Test Catchments should be capitalised.

This was a typesetting error and has been corrected for.

Abstract Page 15122, line 9. Studying one extreme storm event after a prolonged drought does not indicate the size of the nutrient pools in the catchments (unless they became exhausted). The study would need to extend across multiple events for an extended time period to quantify this pool (i.e. until exhaustion was actually observed). Please remove this statement.

This has been done.

Line 26. How are point sources "increasingly controlled"? Replace with "Improved nutrient removal at WWTPs are reducing point source inputs".

This has been done.

Page 15123, line 24 to 15124, line 28. Delete paragraphs.

This has been done.

15125. Line 5 (and throughout) Change resolution to frequency

This has been done.

Line 6 – 16. Delete (Repeated in Methods)

This has been edited to lead onto the aims of the paper.

Line 19 – 26. Delete (should be in methods)

This briefly outlines the aim of the paper so has not been removed.

Section 2.2. Give brief method descriptions for the nitrate and phosphate analysis. How was the data quality controlled? Is this data raw, or is it corrected against spot sample analysis?

See comment above.

Section 2.3. Greatly reduce word count or delete. The study only requires data on the timing and quantity of rainfall to each catchment, which is given in Figure 3.

This paragraph has been deleted.

Results.
There is lots of discussion of (some of) the results here, and I think a combined Result and Discussion section would be most appropriate.

See comment above.

Section 3.1, line 16. Not true. The Eden responded to the rainfall event on the 12th April.

This sentence has been removed.

Line 23-25. Delete the meteorological causes of the rainfall events.

This has been done.

Page 15129, line 21. Doesn't the dilution of the nitrate concentration imply that there is little diffuse nitrate input to the Avon either from throughflow and overland flow? This result suggests groundwater input domination.

This is discussed in depth in the Results section (page 9 line 8 – 9) and then in the Discussion section (page 13 line 11 – 16; page15 line 29 – page 16 line 14).

line 26. There is no evidence that the nitrate input to the river is by throughflow (although I agree it might be). The authors need to add lots of caveats with their speculations on nutrient sources.

This has been removed from the results and discussed in depth in the discussion (see above comment).

15130, line 2. Delete "during this event".

This has been done.

Line 17. There are 2 major sources that seem to be ignored within this paper; groundwater inputs (for the Avon and Wensum) and storage of phosphate within the bed sediments. These major inputs would explain why nitrate is diluted during storm events i.e. the loops have a negative gradient, and why P and ammonium respond so quickly to produce clockwise hysteresis.

The authors would like to point out that groundwater contribution was already included in the Discussion but has been further discussed with the inclusion of borehole concentration data to strengthen arguments (see comment above for Avon, page 13 line 23 – page 14 line 9 for Wensum). The storage of P within the bed sediments has been added as a potential source in the Avon (page 17 line 18-19) but was already included in the discussion for the Wensum interpretation (page 18 line 6).

15131 line 17. See comments above.

See our response above.

Line 25. To interpret this observation correctly, the reader (and author) needs to know the nitrate concentration of the ground water. Please provide for the Wensum and Avon.

This has been done (page 9 line 9 for the Avon, page 13, line 24 for the Wensum).

15135, line 20. Should it be left of the plot?

Yes! Thank you for this observation!

15137. Line 6. Are there any sewage treatment works in the catchments? If so, please give details in the study area descriptions. If so, how does this change your interpretation of the results?

There are no sewage treatment works as these are headwater streams, however, there are a number of septic tanks in the area which could influence the water quality which were already included in the discussion for the Avon where they are thought to have most impact (page 17 lines 25-28).

15141, line 9-21. Repetition. Delete.

This has been done.

15143. Line 25-26. What ongoing research? Is there a reference? Is it future work within DTC?

Has been edited to make clear this is referring to the wider scientific community.

Line 27. Delete temporal.

This has been done.

Section 5. Delete summary of findings within this section. These are already given previously and in the abstract.

This has been done.

Figure 1. Remove shading for London. It looks like one of the study catchments.

This has been done.

Figure 2. Delete. This meteorological data is not required.

This has been done.