Review of hess-2020_34

'Drivers of nitrogen and phosphorus dynamics in a groundwater-fed urban catchment revealed by high frequency monitoring'

by Yu et al. (2020)

General comments

The topic of the paper in combination with the use of high-frequency nutrient concentration data in a complex hydrological system such as an urban low land polder is an interesting topic well in the scope of HESS. The scientific content could be an interesting addition to the current state of knowledge and is thus worth to be published. Nevertheless, the paper shows some formal and methodological weaknesses, which need to be improved or clarified before publication:

1. The language of the paper is often unprecise (expressions such as 'much higher') and there are many grammatical mistakes (see specific comments). The same expressions are often used shortly after each other, leading to repetitions of the same content (e.g. L 20, 22 and 24: mixing of groundwater and runoff governed water quality). This unnecessarily prolongs the text. A higher scientific precision, a better grammar and a consolidation of the text would add much to its readability and the scientific language.

2. Total phosphorus (TP) and ammonium (NH4) is analysed, but unlike nitrate (NO3) ammonium is not directly a driving factor for eutrophication. NO3 on the other hand is not included in the discussion, mainly because the planed NO3 measurements didn´t work in a proper way. This raises the question why NO3 wasn´t at least monitored by regular grab samples (low frequency). This would have also helped to confirm the conceptual model for nutrition dynamics in low land polders.

3. Though high frequency data were collected, they haven´t been really used in the analysis to precisely describe single events, except for the analysis of single pumping events. There would probably have been the same results when the data resolution would have been one day. Mostly concentrations are discussed in an annual or seasonal context. Please elaborate more on the added value of a 20 min sampling compared to a daily sampling in the discussion. Probably, the focus of the paper should not be too much on high-resolution sampling (e.g. in the title).

4. A statistical analysis of the data is completely missing. All processes seem to be deduced by just visually comparing the graphs, without calculating e.g. correlation coefficients.

5. The authors developed a mixing model to determine which amount of nutrients can be attributed to hydrological mixing and which to biological processes. Latter one is derived by the discrepancy between model results and measured concentration. Electrical conductivity (EC) acts as a conservative tracer in this case. However, the model failed to reproduce EC within the polder after November 2016. This raises the question whether the amount of biological processes for nitrogen and phosphorus can be determined on this basis. This uncertainty should be discussed in more detail.

5. The authors are classifying their study in the context of eutrophication: the findings of this study are meant to help water managers to mitigate eutrophication. However, there are no suggestions how the results of the study can be used to do so.

6. An aim of this study was to analyse and compare annual scale, precipitation events and pumping events (lines 88-90), but this scheme can´t be found in the discussion. The three scales are mixed up rather than to distinguish between the dynamics of the different time scales.

Specific comments

L22: *'through variation of the intensity and duration of the events'* I don't understand the meaning of this sentence.

L23: Is NH4 really the dominant form in surface waters? I know many examples from Europe where nitrate dominates. Furthermore, NH4 gets nitrified to NO3, leading to decrease in NH4 and increase in NO3 concentrations. Maybe the authors mean that NH4 is the dominant form in urban water bodies?

L 24, 25: *'low concentrations during the algae growing season, <u>while</u> concentrations were governed by mixing of groundwater and precipitation inputs in the late autumn and winter.'* This sentences only makes sense, when the authors mention the concentrations in autumn and winter as well.

L26 – 28: The two sentences have nearly the same content: release of reduced iron causes turbidity.

L29, 30: Was organic N measured? A denitrification needs anaerobic conditions, while in spring O2 concentrations were rather high, how does that fit together?

L 41: I would replace '*end up'* by *'reaching'* or something similar

L 45: This sentence belongs to the following paragraph.

L 47: it should be *'in <u>the</u> aquatic environment'* or *'in aquatic environments'*

L 48, 49: molecular nitrogen and phosphate was not mentioned until now, the authors should introduce N2 and PO4 first, like they have done it for nitrate and ammonium

L 49: *'NH4 is the preferred N-form by microbes'.* There are also other microbes which prefer different forms of Nitrogen (like the authors mentioned in the sentence before).

L 50, 51: The content of this sentence is obvious, when there is no NH4 and NO3 the uptake of the substances can´t reach a maximum.

L 53: *'Under aerobic conditions, NH_4 can be oxidized to NO_3 through nitrification by nitrifying microbes even under cold conditions (below 10 °C), which is an O_2 consuming, acid generating process'* Please revise the sentence structure. It sounds as if the nitrification under cold conditions is O2 consuming.

L 59: *'during events'* what kind of events? The authors should be more precise with their expressions *'during <u>hydrological/precipitation</u> events'*

L60: *'and chemical reactions….'* This part of the sentence doesn't fit substantively to the ones before, which were about transport processes not transformation processes. The latter aspect is discussed in the following paragraph.

L 74: *'N and P dynamics, for instance <u>its</u> response…'* Please replace 'its' by 'the' or 'their'

L 83. Please replace '…insight in…' by '…insight into…'

L 86 – 88: Please replace '*We conducted a one-year high frequency monitoring campaign in 2016-2017, measured parameters EC, NH4, TP, turbidity and water temperature. ' by* '*We conducted a one-year high frequency monitoring campaign in 2016-2017. Measured parameters were EC, NH4, TP, turbidity and water temperature.'*

L 97, 98: Do the authors mean that groundwater seeps into the catchment because the water level of the groundwater is higher than the sole of the channels and the drain system?

L 99: *'much higher'* How much is much higher?

L 102: NAP doesn´t need to be explained, naming the abbreviation should be enough.

L 117: The temporal resolution (20 min?) is missing in the description. I could only find it in the abstract.

L135: *'was calibrated'* instead of *'was calibrating'*

L153: What was monitored by Waternet? – '*Waternet has monitored the water quality'?*

L154: *'the frequency became twice…'* Frequency cannot increase by itself: '*frequency was increased….."*

L154: *'were measured in this dataset'* In a data set nothing can me measured. Please be more precise.

L 172: Potential evapotranspiration is a virtual measure derived from meteorological data. It doesn't give an actually evaporated water volume. How is the use of potential evapotranspiration justified? Actual evapotranspiration should rather be used in this case.

L 172: I suppose groundwater seepage S stems from outside of the polder. How are the values of this variable derived? Calibration? And why is it multiplied by the area of the polder? Please clarify these issues.

L 174: Naming the variables in the order of their occurrence in the formulas would be easier to follow.

L 182: *'d(VC)"* is not explained in the text, I guess it is the concentration of the ditch water?

L 185. Is the high salt concentration really the reason for EC being a conservative tracer? Or do you mean that the concentration difference between the two water sources renders EC a useful tracer?

L 193*: 'simulated concentrations … together with their high frequency…'* exchange *'their'* with *'the'*

L201: Rain events are very long (> 1 month), that seems to be more representative for a (sub-)season or similar. A rain event usually is shorter than a few days in central Europe.

L 207, 208: Four times *'and'* in one sentence. Please rephrase.

L 217: Why did the wet season start in October and end in February? Did the authors maybe calculate a cumulative water deficit? According to Figure 2 there has been quite a lot of rain up to the middle of March. Further, a dry and wet season usually refers to a semi-arid climate, which Amsterdam is far from being in. Please think about re-naming the compared time spans and give details on how they were separated from each other.

L222: Please change *'..period that the water temperature…'* to '…during which the water temperature….'

L228 – 229: *'In contrast to the constant water level ranges from surface water regulation regime'* I am not sure about what the authors want to say. Please clarify.

L237: Remove *'…if there was no rain'.*

L 237: *'this duration of the return'* Bad expression

L 241- 244: The authors mention twice, that NH4 deviated from slope of EC.

L 250: The authors refer to excessive precipitation, but unfortunately this is not shown in Figure 2.

L247 – 252: The description of turbidity is rather confusing: 'Turbidity was constantly below 100 FNU' is followed by a peak description of 500 FNU. The authors also miss out, that there are several EC peaks during October. They also repeat the same content *('turbidity stayed around 200 FNU'*) in lines 249 and 251.

L 259: Delete *'when'*

L265 – 274: The authors are writing that concentrations are captured well, but there are discrepancies of more than 50 %. Maybe the authors want to point out, that the dynamics are captured?

L265 – 274. Since water levels were measured: why were the model results of the water levels (L(t)) not compared to measurements?

L 277, 278: What is the criterion for a 'significant dilution event'?

L 287, 288: Why does event 2 follow EC but not event 3? According to figure 3 NH4 concentration seems to increase parallel to EC. The authors attribute the missing dilution only partly to the data gap. I don´t think a statement about the missing part can be made, when there are no data available. Further, the word *'partly'* implies that there was no strong dilution.

L 289: Can you be sure about the dilution? When you compare the high frequency measurements with grab samples (figure 2) 0.35 mg TP/l seems to lie within the uncertainty range of the high frequency measurements. Please discuss a potential sampling uncertainty.

L290: The authors forgot to mention, that TP was also falling again after reaching 0.8 mg/l

L292: There were more small rainfall events during recovery period of event 3 compared to event 4

L310: *'pumping has the least influence on NH4 in winter'* It is difficult for the reader to relate this to figure 5, because the scaling for NH4 concentrations is different for every event

L316: The authors suggest that turbidity is influenced by pre-event conditions, but the reader has no specific information about the pre-event conditions. This point is also not further discussed in the Discussion, where this sentence should be placed anyway.

L 329*: 'Runoff in Greuzenveld has waters with EC….'* – Please rephrase.

L332: *'…the mixing model…which revealed close similarity to the measurement'*. This statement is wrong. There is a big discrepancy between model and measurements in the second part.

L341 – 347: Only the discrepancies during winter are discussed, but measurements and the model reach into middle of June.

L 397: NH4 can be consumed by nitrifying bacteria (not by nitrification).

L398, 399: Denitrification and anammox are two different processes and the chemical equation doesn´t fit to neither of them. For anammox NO2 is needed, not NO3. I am also wondering why nitrification and denitrification are not discussed apart from this two sentences. Nitrification is also an oxygen consuming and NH4 reducing process. While denitrification can take place under anoxic conditions.

L 417 Turbidity only increased for a short period (end of October to middle of November)

L418: 'Iron-rich particles are the most likely source of turbidity in freshwater': Concentration of iron particles is high until February. If this is true, why is turbidity low in February? Please clarify.

L 433: *'…turbidity became high*' according to figure 2 turbidity wasn´t high in this time span.

L447: *'relatively low in oxygen (because of warming)'* Additionally, a reason for reduced oxygen might be an increase in O2 consumption by microorganisms.

L 523 – 664: The references are not completely in an alphabetical order and slightly different citation styles were used (e.g. sometimes DOI is written in capital letters, sometimes not)

Figure 1: Readers have to guess the channel after the pumping station is Boezem Haalemmerweg and whether the left drainage system is the secondary water channel which Greuzenveld is connected to. The map above the Google Maps Card with the location is too small and doesn´t help to understand the system. Please provide a better overview map of the study area.

Figure 2: The discrete sampling data points are hard to identify; adding precipitation would help for interpretation of data.

Figure 3: ‘measured’ and ‘modelled’ timeseries overlap in the same colour. It is not visible whether ‘TP modelled’ shows the same peaks like ‘TP measured’. Choose different colours.

Figure 4/5: A rearrangement of graphs and scales could add to a better understanding of the figures.

Figure 5: The reader can´t distinguish between day and night time, though the authors discuss this in chapter 3.3.2 based on this figure; while the first block only contains water temperature, the second block contains three measured parameters. There is room for improvement of visibility.