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Hydrology and Earth System Sciences
Discussions



# *Interactive comment on* "Impacts of drought on the quality of surface water of the basin" *by* B. B. Huang et al.

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## General Comments

The proposed paper "Impacts of drought on the quality of surface water of the basin" deals with the impacts of the first rainfall after the periods of different drought severity on several parameters on water quality (nitrogen loss especially) in experimental conditions and conditions of the real basin. It brings some new interesting experimental results in the field of soil nitrogen loss dependent on drought severity and consequent rainfall intensity and duration. Unfortunately there are several significant limitations (see Specific Comments) that reduce the overall quality and usability of the acquired results. According to my opinion these limitations are of such a magnitude that the

present paper does not meet the criteria for publication in the Hydrology and Earth System Sciences Journal. I do recommend the authors to decide first whether they would like to continue in strictly non-point source pollution or not and upon the decision focus on more parameters of water quality (more important for water quality from ecological status aspect) and their verification in real but adequate conditions (accurately chosen basin related to the experimental conditions). They should also discuss their own results with other papers dealing with the topic.

Specific Comments

The title of the paper is not appropriate. You have studied the consequences of heavy rains (precipitation) following the droughts on water quality, not water quality during the (hydrological) drought itself. During the droughts, the concentration of NO3- ions usually decrease (there is no interflow or direct flow to the stream from non-point sources), and the concentration of NH4+ ions usually increase as a result of point source pollution predominance in catchment (municipal pollution) and because of the worsen dilution conditions (as you mentioned in page 14468/line 1). Also there should be "selected parameters of water quality" in the title, because you have studied only two basic parameters NO3- and NH4+ (with addition of BOD5 and COD in real catchment). You have not mentioned PO43-, Ptotal and chlorophyll-a that are far more important from the view of algae growth and shifts (ecological problems) in river ecosystems (see next paragraph).

In my opinion the omission of phosphorus forms behavior under the circumstances of drought and flood alternation is one of the weakest points of your research paper. In the paper you have mentioned several times that there could be a problem with worsening of ecological status of the river after the heavy rain following the drought period, which brings inorganic nitrogen into the water. But according to many references cited worldwide, a phosphorus (its PO43- form especially) is the crucial element for algae and plant growth in water environment. This is the limiting factor of algal bloom in the river, not a nitrogen itself, which is usually present in water in sufficient concentration



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every time. To sum up you should not mention loads of inorganic nitrogen as a trigger of algae boom and potential threat for an ecological status of the river without mentioning the more important phosphorus role!

There is an insufficient description of the Nenjiang River Basin. There is no situation map with highlighted position of the sites for water sampling. I was able to find only the Jianqiao site with Google Maps, but not the Kumotun and Fulaerji sites, so the map would be very useful for the reader. As I mentioned above, from the view of both point and non-point source pollution, there should be a Table with land-use (land-cover) structure of the basin as well as structure of associated population pattern – number of inhabitants, percentage of population connected to waste water treatment plants (WWTP), percentage of water volume from communal sources treated with WWTPs etc.

As a NH4+ form is predominantly connected with point source pollution (fresh sewage), there is no specification whether your three sampling sites in Nenjiang River Basin were not potentially influenced by outflows from WWTPs (e.g. sampling site under the bigger city, because usually not all the NH4+ is nitrified to NO3- form) or even by untreated outflows from sewage systems! Or by a dam outflow!

In your infiltration experiment (Fig. 1) there is no explanation how you have solved a direct surface runoff. When you operate with rainfall intensity of over 100 mm/hour, someone should suppose a direct surface runoff caused by an exceeding of soil infiltration capacity. Was there any spillway (overflow) on the side of your incubator for the excessive water amount? Or did you wait until the all (excessive) water infiltrates? This can influence the overall results easily! Please explain it.

If I focus on transition from your experimental results to the real conditions in the Nenjiang River Basin (for the verification of experimental results) I have to emphasize that these "sites" are almost incomparable. If you have an experimental incubator with one soil type, you should then choose a real basin covered predominantly with this soil type



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otherwise the results would by distorted (influenced by different soil permeability etc.). But what is more alarming if you study strictly non-point source pollution in your experimental incubator, you should choose a real basin with absent sources of point pollution (no cities, factories, dams, WWTPs, pipeline exhausts etc.). It is almost impossible to compare the results from the incubator (characterized by strictly limited conditions) with a real large basin (characterized by a complicated system of relations and linkages), of which the Nenjiang River Basin really is. This is surely the weakest point of your paper.

I have a problem with the structure of the paper that should follow the rules of a research paper structure – Introduction-Study Background/Study Site-Materials and Methods-Results and Discussion-Conclusions. In Chapter 2 (and its subchapters) you have mentioned some well-known mechanisms of drought/rainfall/pollution sources impacts on water quality and transformation of the pollution. This chapter should be strictly shortened (e.g. without/with less subchapters) and be either as a subchapter of Introduction or a part of "Study Background" chapter (again with reduced number of subchapters). The now presented Chapter 2 is inadequately long and diverted in comparison with your own results that should form a crucial part of your paper. Any way, the presented mechanisms should be cited appropriately (for example page 14467/line 14, 14467/26, 14468/13, 14469/2, 14469/9, 14470/5, 14470/18 14470/25...), the citations are missing!

In page 14467/line 25 you have mentioned that the point source pollution is being reduced gradually these days and the non-point source pollution has become the main factor of the surface water degradation (there is no appropriate reference considering it again). I do not have information about the city infrastructure in the Nenjiang River Basin (or in China itself), but in my country (Czech Republic) the pollution from point sources is still a big problem as the smaller towns (with less than 2000 inhabitants) still do not have WWTPs (even if it is strictly required by the European Union). I suppose that situation should be similar in China or not? You did not mention the basic parameters of the Nenjiang River Basin as written above (or the appropriate citation) so I do



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not know this I can only (as a reader) presume it.

In page 14470/line 1 you have mentioned that with the decreasing river flow (discharge) there is an increase in nitrogen!, phosphorus and so on. In fact there is usually a decrease in concentration of NO3- ions with decreasing river flow because there is no interflow (or direct flow) from non-point pollution sources, only NH4+ and phosphorus forms are usually rising.

In page 14470/line 14 you mentioned that coverage of the water surface with algae and plankton consume great amount of dissolved oxygen. This is the truth only in night, during the light day there is usually supersaturation with a dissolved oxygen due to photosynthesis! Surely there is a huge oxygen gradient towards the bottom of the river with prevailing degradation processes.

Page 14471/line 17 – Hydrogen is definitely not an "unpleasant" gas and you can hardly meet this gas in natural water environment. Did you mean hydrogen sulfide or methane?

Page 14470/line 22-24 – I do not understand this part of the text, what you meant with the vertical changes between the "metalimnion" (transitional layer in lake) and the "stratosphere" (layer above the troposphere)?

Page 14470/line 26 – Will the decrease in dissolved oxygen surely affect the phosphate concentration in a way that it will rise? I do not suppose this. What do you mean with the term "toxic organics" (which of them)?

Page 14470/line 30 – The eutrophication is a process of excessive loads of inorganic nitrogen and phosphorus forms into the water environment, not a multiplication of the algae (which is actually caused by eutrophication)!

Page 14471/line 10-12 – There is mentioned a mean "monthly" maximum temperature and a mean "yearly" relative humidity. Why not the same period of time?

Page 14472/line 8 – The soil type should be according the FAO soil classification.



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There should be also the basic chemical analysis of the soil sample (Table) used in incubator if you make the experiments with the loss of nitrogen.

Page 14471/line 22-23 – NS means the concentration of nitrogen forms in "soil" or "soil water"(moisture)? NL means "loss" or "concentration" of nitrogen forms in soil after the rainfall? If it means "loss" it should be the same amount as the "concentration" of nitrogen forms in leakage liquid because I suppose the experiment took place in the closed incubator.

Page 14473/line 12 – Higher soil moisture content and better soil ventilation are processes that go against each other, you should better formulate what you would like to express.

Page 14473/line 20 – Nitrate nitrogen IS definitely absorbed by plants as well as ammonium nitrogen although not so willingly. The statement in this form is not true!

Page 14473/line 21-25 – This is not a rule! It depends on soil type definitely. If you have arenosols (FAO), there is no problem with infiltration even after a severe drought and rainfall intensity (if you have less permeable soil but the rain is mild - and it can be quite long - the rain water infiltrates all finally). I know what you want to express but this way is rather misleading.

Page 14474/line 21-23 – I know what you mean but surface water quality (in rivers, lakes, reservoirs) can be affected (deteriorated) both by direct flow (interflow + surface runoff) and groundwater as well. From the text someone could assume that only surface runoff (actually very rare, rainfall intensity usually >100 mm/hour) can cause deterioration of surface water quality.

Page 14474/line 26 – The use of chemical pesticides is definitely not related to the nitrogen remained in soil. It is caused predominantly with the use of fertilizers.

Page 14475/line 2 – The "nitration" is not the appropriate term (there is no use of nitric acid).



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Page 14475/line 3 – An increase in nitrates itself does not intensify nitrogen leaching. This is caused by rain intensity, rain duration and drought severity.

Through the text as you present your own results (either from the experiment or Nenjiang River Basin) there are almost no other references (results from other studies) discussed. In the field of experimental or real nitrogen loss from soil (agricultural landscape) there are many available references that posses similar results – that rainfall intensity affects the ways of nitrogen leaching with increase of nitrate nitrogen during the increased flows (caused both surface and subsurface runoff). You should discuss your own results in a view of different rainfall intensities (especially effect of the intensities that cause direct surface runoff). You should also highlight your main contribution – the drought intensity (degree) effect on the loss of nitrogen during the upcoming first rainfall!

Page 14476/line 10 – Of course not, BOD5 does not usually relate to surface runoff issues, it measures a biodegradable organic pollution (sugars, proteins etc.) usually from big point sources (breweries, leather industry etc.). Moreover if you measure (in real conditions of the basin, see Fig. 4) concentration of NH4+ as a consequence of first rainfall after the drought period (it means as a form of non-point pollution), you should take into account also the concentration of NH4+ during the drought itself. Because NH4+ is predominantly released by non-point sources and if you compare the state before the rainfall itself, the concentration of NH4+ could be even higher than after the heavy rainfall following the severe drought because there is no dilution effect during the drought. The data on point pollution were not provided unfortunately (as well as the data on structure of the Basin and its population/infrastructure). This affects your results in the way that you consider NH4+ concentrations predominantly of non-point source origin (partly yes, but no at all) similarly to NO3- (typical non-point source pollutant). If you do the appropriate analysis you may not write "during the drought point source pollution dominates and the density of COD is significantly higher than of ammonium nitrogen" as in line 16-17. Moreover you can not say the concentration of



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COD is significantly higher than NH4+, these are very different things, though both are influenced primarily by the dilution.

You should also highlight/stress in the discussion that the measured concentration (Fig. 4) of nitrogen forms in Nenjiang River Basin are very low (close to limits for drinking water) and in this concentration they will not play an important role from ecological status point of view probably.

Page 14476/line 14 and Page 14477/line 25 – What does "self-purification of BOD5" mean? I have not yet heard about it. Please explain it.

Page 14476/line 16 – You mentioned "During the drought..." but in Fig. 4 there is a situation representing not the drought itself but the situation after first rainfall. Please explain it.

Page 14476/line 27-30 – Again you should first do the appropriate analysis of potential point pollution with NH4+ to be confident to write this statement!

Page 14477/line 1-2 – Please be aware that groundwater creates a substantial part of river water so you should not write "groundwater flows into the surface water along with river runoffs". Or did you mean surface runoff instead of river runoff?

Page 14477/line 8-9 and 12 – The paper provides no data on point source pollution during the drought itself, the conclusion is inadequate.

Page 14477/line 16-18 – The paper identifies only several mechanisms of pollutant generation, very important point source pollution effect on water quality is omitted.

Page 14477/line 22 – Actually if you make a chart of concentration of nitrate (ammonium) nitrogen on water temperature of the river, you will get a negative dependence. With increasing temperature there is usually a decrease in concentration of nitrogen forms because of their nitrification and assimilation. In this view a rise in temperature improves water quality (strictly chemically). The river discharge (especially low) has a much more pronounced effect on water quality than the temperature itself!



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Page 14477/line 25 – This is not true, as I wrote above, during drought itself there is usually a decrease in concentration of NO3- ions with decreasing river flow because there is no interflow (or direct flow) from non-point pollution sources. But there is surely a steep increase after the first rainfall (if you meant it).

Page 14477/line 26-27 – There was no direct dependence of BOD5 on discharge presented in Fig. 4. There is only a change in BOD5 after the first rainfall following the drought of different severity.

Page 14477/line 26-27 – I do not understand the sentence "When the rainfall duration is identical to the rainfall intensity...". Please explain it.

Technical Corrections

Page 14468/line 11 – It should be "o" in drought.

Page 14468/line 14 – It should be "is one of the most important natural processes...". It certainly is not the most important process.

Page 14468/line 20 – It should be without "amount".

Page 14468/line 25 (and several times through the text) – It should be "runoffs" without a dash.

Page 14469/line 9-11 and 14469/line 13-15 – There is a very similar formulation, should be omitted once.

Page 14469/line 16 (and several times through the text) – It should be "concentration" instead of density.

Page 14471/line 4 – It should be only "reduction of diversity" because it the same as a reduction of living species...

Page 14470/line 5-10 – I do not understand what you would like to express.

Page 14470/line 25 – It should be "oxidation" instead of "oxic reaction".



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Page 14470/line 20 – It should be gases, chemicals and reactions (plural).

Page 14470/line 30 – It should be rather "disturb" instead of "destroy".

Page 14471/line 10 – Please add the unit (Celsius?).

Page 14471/line 11 (and several times through the text) – There should be 69% (without space in front of %).

Page 14472/line 9-10 – These short sentences beginning with "See Table..." sound really odd.

Page 14472/line 22 – It should be "concentration" instead of "content".

Page 14474/line 12 (and several times through the text) – It should be "deteriorate" instead of "aggravate", sounds better.

Page 14474/line 12 – Did you mean really "infiltration of soil moisture"? Should be infiltration of rain water instead?

Page 14474/line 13 – should be either "absorbed in the particle" or "adsorbed on the particle".

Page 14475/line 4 – It should be Eq. (3).

Page 14475/line 19 – It should be "losses".

Page 14476/line 3 – It should be Table 9.

Page 14476/line 19 – There should be "The impact of drought on BOD5 is not significant".

Page 14476/line 10-11 and 19-20 – There are almost the same two sentences about BOD5 and water quality changes.

Page 14477/line 1 (and several times through the text) – A better term is "groundwater" than "underground water".



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Page 14478/line 9 – There should be "pollution-yield rate".

Table 2 and Fig. 2 – What the rainfall intensity was during the duration test?

Table 3 and Fig. 3 – What the duration of the rainfall was during the intensity test? Please switch the titles for rainfall duration and drought degree in Table 3.

Table 7 – It should be "Pollution-yield rate" in the Title.

Fig. 4 – In the Figure you compare influence of different drought degrees but there is no distinction in rainfall intensity/duration of the first rainfall, which is also important! In the legend there should be NH4-N for ammonium nitrogen and NO3-N for nitrate nitrogen.

When you cite the references in the text, you should sort them either from the year of publication (in increasing order) or alphabetically. There should be a clear system according to the particular journal.

You should let the paper check for English spelling by a native speaker. It is a common procedure that can improve the overall quality of the paper.

Please also note the supplement to this comment:
http://www.hydrol-earth-syst-sci-discuss.net/10/C6981/2013/hessd-10-C6981-2013-supplement.pdf

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