

# ***Interactive comment on “Integrated water system simulation by considering hydrological and biogeochemical processes: model development, parameter sensitivity and autocalibration” by Y. Y. Zhang et al.***

## **Anonymous Referee #1**

Received and published: 11 August 2015

GENERAL COMMENTS Thank you for the opportunity to read an interesting paper about a new integrated water and water quality model. Although this type of model is not entirely new, it adds an alternative to existing model formulations, particularly the inclusion of carbon and crop growth modules, and has indeed a number of novel process considerations. In particular, it is interesting to see the simulation of regulation in a water quality context. I do, however, have concerns with how the model calibration was performed and how the model evaluation is presented. The paper goes to great lengths to explain the model setup and which processes are described, but given the

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manner in which the automated calibration was used, can you really ensure that processes are reproduced in the correct balance? I also miss a scientific question that the paper addresses, a discussion of whether the study achieves these aims and a clear conclusion regarding this. The lack of discussion makes we wonder if the authors have considered any of the limitations in their approach or compared their approach to existing studies so that the reader might conclude whether this new approach provides any added value. Could the model be applied in ungauged catchments, other regions easily? What scales is the model suitable for? I commend the authors in testing the model in such a heavily polluted and regulated area for which it was probably difficult to describe inputs for; however limitations, such as accurately describing input data, are not mentioned at all in the paper.

SPECIFIC COMMENTS 1. I have many technical comments regarding the use of citations in the paper (see below). Please consider carefully whether or not a citation is needed and please don't cite recent papers for old, accepted knowledge.

2. Introduction: The paper lacks a scientific question. I deduce from the introduction that you would like to say that integrated models can improve simulation of the integrated factors, but do you actually show this? Have others shown this?

3. On pp 5001, lines 2-10, you mention a number of relevant theories, but can you show that including more and more processes actually improves model results? I'm not sure it does. Given the concerns I have about the calibration process, isn't it likely you end up with an overparameterised model with insufficient data to drive and test such a model? Please discuss.

4. pp5001: What about DAISY, SOILNP, ICECREAM models? It should also be mentioned that there is a tradition of coupling traditional rainfall-runoff models with field scale nutrient models, e.g.Arheimer and Brandt 2000 and 1998

5. pp5002: What about SWIM and HYPE which are also integrated WQ/Q models?

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6. pp5011: Regarding dams: Maybe you could mention the different functionality of dams and note that methods you try to reproduce are those common for flood control or water supply dams? Hydropower dams are likely to show completely different behavior.

7. pp5012, Lines 3-5 ‘...usually considered to take place at daily scale’ – You use the term ‘usually’, yet you refer to only 1 study to demonstrate that things are usually done this way? Actually, erosion, overland flow and phosphorous processes could very much be improved with subdaily time-scales. Lake turnover processes would be sufficient at coarser time-scales. Why do you really use a daily time-scale? Is it actually because this has traditionally been considered sufficient for rainfall-runoff modeling and consistent with data availability? I would write instead that it is practical to use a daily time-step as this is consistent with the underlying rainfall-runoff module. You should also discuss at what timescale you believe the results are realistic!

8. Calibration: I am concerned that the calibration may in fact just be model tuning and not take into account the correct balance between processes and landuse types. Given the very large number of parameters, and the fact that some processes occur in the soil and some processes occur in surface water resulting in the same downstream concentration, how do you ensure calibrated parameters don't compensate for each other and you don't get the right answer for the wrong reasons? For example, is it possible that you overestimate retention in groundwater and underestimate retention in surface water? Are the relative contributions of different processes realistic (for example surface runoff, overland flow etc.)? This topic requires more explanation and discussion

9. Table 6: It would be worth mentioning in the text the large change in bias for Nitrogen concentrations between calibration and validation at Fuyang and Yinshang. Why do you think this occurs? Could this be related to the limitations in calibration mentioned above?

10. How well is the input data described and how do uncertainties in the input data

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affect the calibration and evaluation of the model?

TECHNICAL COMMENTS Please do a more thorough English language check of the paper. There are many smaller grammatical errors which occasionally make reading difficult. (I have not listed all of these as I believe a language edit is required)

pp5000, Lines 1-5 It seems unfair to attribute knowledge of flooding, water shortages and ecological degradation to a few recent papers. I recommend removing these citations as these are commonly known facts.

pp5000, Lines 13-16. Again you are referring to recent papers for a longstanding conclusion

pp5000, Line 20 Also availability of open data contributes

pp5001, Line5, Spelling: Darcy's law

pp5001, Line 12 "Several models. . ." – Here you give no examples and quote a single paper –does this paper summarise all these models?

pp5004, Line 7 "Non-point pollution" is also commonly referred to as "diffuse pollution"

pp5004, Line 21 What is meant by dry land? I presume you mean dryland agriculture however this is not clear

pp5005, Lines 14-15 This sentence doesn't make sense. Please reword.

pp5009, Line 21 This sentence is more complex than it needs to be. What about "Point sources of pollutants are directly added to surface water in the model. Common point sources are urban water treatment plants or industrial plants.

P5013, Line 10 What is PAT?

P5017, Line 28 "little worse", This should probably be "a little worse", otherwise you are in fact saying that the results are not very different.

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