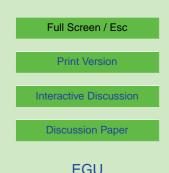**Hydrology and Earth System Sciences Discussions**

Interactive comment on "A daily salt balance model for representing stream salinity generation process following land use change" *by* M. A. Bari and K. R. J. Smettem

M. A. Bari and K. R. J. Smettem

1. General comments:

Referee Comments: The authors present a new and innovative model approach for simulation of salt balance/stream salinity. This conceptual approach is a component of a coupled salt and water balance model to represent stream salinity generation. They discuss the influence of forest clearing on the stream salinity of two Australian test sites. After an introduction a surprisingly short presentation of the research area is given. In a third chapter processes of salinity generation are discussed, partially in general and partially in context to the research area. Also some additional information about the experimental set up and the changing conditions due to the specific land use change are discussed here. In a fourth chapter the architecture of the model approach

Full Screen / Esc

Print Version

Interactive Discussion

Discussion Paper

EGU

as well as the basic equations are presented, followed by some short information about the model calibration and model parameter requirementsinchapter5. In chapter 6 the application of the model for daily, monthly and annually simulations were presented and partially discussed. Finally in chapter 7 a summary and conclusion should be given. This chapter contains more information about the model approach which are partially redundant to the abstract and not many conclusions can be found in this part.

Generally this manuscript is an interesting and innovative contribution to the journal. The authors present a novel and substantial method of analysing salt balance processes and its influences on stream salinity also in a quantitative way. The scientific questions discussed in the manuscript are in the scope of the journal.

However, the manuscript needs some substantial improvements in its structure but also additional information/ discussion is needed at some chapters to ensure its definite comprehensibility. The overall presentation of the assumptions and scientific results is partially rather confusing. The manuscript lacks from a clearer structure beginning with the discussion of the considered scientific problem or question (as partially done in the introduction but some of these information are spread al over the manuscript), the state of the art, open questions and research needs to highlight the motivation, methods, results and discussion. Especially the discussion of the miscellaneous results and what we can learn (for instance if the prediction of your model over/under estimates the reality) is mostly to short and not sufficient.

Author Response: The structure of the paper has been modified substantially in line with the general comments. In the introduction, the problem and objective of the paper is now well defined. The description of the experimental catchments is elaborated (Section 2). The ‘Salinity generation process’ section (Section 3) is now elaborated, restructured and gives better description of how salinity happens in Western Australia. The water balance model was described in detail in Section 4. Testing of model performance is now elaborated in Section 6. The prospect of the coupled model and how it was used to develop a basin scale operational model is now

discussed in Section 7.

Referee Comments: Other important information are totally missed. The introduction of the research area as well as of the experimental set up is insufficient. It is necessary to specify some of the main characteristics of the research area, give more detailed information about parameters which have been observed (why, where, how), about the spatial and temporal characteristics of the experimental investigations (especially because the model was calibrated against these observed data one has to know about their quality). Some insufficient information about experimental set up are contained in chapter3-these parts have to be revised/restructured.

Author Response: The description of the two experimental catchments (Section 2) is now elaborated. Section 3 of the paper is now restructured to better reflect streamflow and salinity generation processes. A table (Table 1) with different flow components and storage contents are now added and described in Section 3.3. Observed and predicted stream salt loads from both the catchments are now presented in Fig. 3. Table 1 presents the sources of flow and salt components of two catchments.

Referee Comments: Furthermore there is additional information needed about the water balance simulation part of the model and its assumptions and processes. Although this information might be given in a previous submitted paper ‖A daily water balance model for representing streamflow generation process following land use changes, Hydrol. Earth Sys. Sci. Discus., 2, 821-861, 2005‗ this manuscript should be understandable as stand alone and these information are substantial to understand the salt balance simulation approach presented in this manuscript. There is a significant lack of information regarding the model characteristics in terms of spatial resolution, consideration of spatial heterogeneities etc. Furthermore it is not completely clear how the coupling of the salt and water balance parts of the model work.

Author Response: The description of the water balance model has now been elaborated (Section 4). How the stores are connected and fluxes between them are now

Full Screen / Esc

Print Version

Interactive Discussion

Discussion Paper

EGU

described in detail. How the model handles subcatchment heterogeneity – particularly land use – is described in the calibration section (Section 5). How the salt and water balance model coupled together is now explained in Section 4.

Referee Comments: A discussion of the transferability as well as of the model limitations is missed. I would expect a sensitivity analysis of the two model parameters, which control the salt balance at least. In chapter 6 the model has been applied and tested. I am not sure if the data are valid enough for the assumptions made in this chapter. On the other side a lot of effects as systematically over / underestimations have not been discussed for their reasons - there might be also a potential for a better understanding of the simulated processes due to analyses of the model failures. Also the overall salt balances (simulated) might be discussed in more detail - do they fit? I would advice to analyse model efficiency more detailed, for instance sequentially (precutting, post cutting, wet, dry).

Author Response: The transferability and sensitivity analysis of the key parameters of the model are now discussed in Section 7 (General discussion). Assumptions made in Section 6 were based on observed data and were also compered with the observed data from similar experimental catchments in Western Australia. Overall salt balance is discussed in detail in Section 6.2.3 (Annual salinity and load). Model efficiency on daily time step is now analysed in detail (Section 6.2.1) and presented in a new table (Table 2).

Referee Comments: Additionally the title of the manuscript promises the analyses of changing conditions due to land use changes but only one alteration of land use, deforestation, has been considered. Thus, the title has to be changed to be less general. Otherwise a discussion/declaration is needed to proof how this single land use change do reflect all possible/characteristic changes of this typical landscape - but again, also in this case a specification of the title would be required. More detailed information need to be provided about vegetation influences in the model concept. How is vegetation reflected, parameterised, which parameters are effected and in which direction?

Author Response: The title of the manuscript is now changed to reflect clearing of native forest for pasture development. The vegetation is represented by Leaf Area Index and relative rooting depth and volume in different stores of the model.

Referee Comments: I would expect a more detailed discussion about the variable simulation goodness. Additionally the NSE or R2 alone might not be enough in some cases to evaluate the goodness of model fit.

Author Response: The performance of the model on daily time step is now elaborated in Section 6.2.1 NSE and correlation coefficients between the observed and predicted daily streamflow for both the catchments are included in a new table (Table 2) and discussed in Section 6.2.1.

2. Specific comments:

Referee Comments: p1148/22: R2 for annual stream salt load is only partially presented in the text, also for other results (monthly) R2 is presented sometimes, sometimes not - please consequently -give always at least the NSE.

Author Response: The NSE for the daily stream salt load is given in a separate table (Table 2) and discussed in section 6.3.1.

Referee Comments: p1149/13 ‘new hydrological equilibrium’ is rather unspecific- please specify.

Author Response: The text is modified to clarify hydrological equilibrium.

Referee Comments: p1149/15/29 is confusing due to disordered arguments- better structuring needed, for instance bring 17 - 29 before ‘For example in Queensland’. So you reach a line of arguments 1. Western Australia is different, 2. Characterisation of West Australian conditions, 3. Comparison to ‘rest of the world’

Author Response: Text modified as suggested.

Referee Comments: p1550/1551 chapter 2 ‘The study catchments’ is much to sketchy - please revise this part and improve/provide also information concerning the physical/natural characteristics of your test sites (including soils, land use etc), hydrological characteristics, runoff components, experimental set up.

Author Response: The description of the study catchments is now elaborated as suggested.

Referee Comments: p1551/9 again -how was salt fall measured and where?

Author Response: Salt fall was measured at five sites, now explained in the ‘The study catchments’ section.

Referee Comments: p1551/17-18 regarding shallow interflow - what is the origin and background of this information -do you know it from experimental investigations, previous studies- where does this information come from?

Author Response: It is well established from previous studies. Accordingly two relevant references are included into the paper.

Referee Comments: p1552/10 this is much to vague and needs to be specified.

Author Response: Section 3.3 is reorganised and rewritten.

Referee Comments: p1153 as mentioned above - before giving a description of the salinity component please give a brief but sufficiently detailed introduction into the water balance part of your model

Author Response: Description of the water balance model is now elaborated.

Referee Comments: p1153 an additional figure would help to better understand the processes presented by the storages of the model and its adjacent transfers between storages – this could be presented in chapter3 in order to give also a better presentation of the actual processes described there.

Author Response: Instead of giving a new figure we have elaborated the description of the water balance model. In chapter 3 we have introduced a new table (Table 1) and elaborated how different storage components have changed following clearing.

Referee Comments: p1154/13 the use of one single lumped parameter for all of these processes needs to be discussed and justified.

Author Response: Using a minimal number of parameters is the fundamental philosophy of this model development. The benefit of using a single parameter is now discussed in the calibration section.

Referee Comments: p1155/1156 again it would help if abbreviations used in the equations are given for the parameters used in the text additionally.

Author Response: Done as suggested.

Referee Comments: p1156/19 the initial estimation of salt in SG is not understandable at this stage: how observed, how many boreholes, how variable (spatially/temporally), has it been interpolated and if yes- how?

Author Response: Initial estimate of the salt content of different stores is now elaborated in the calibration section.

Referee Comments: p1558 this chapter seems to be a little bit sloppy, significant results are lacking, please rewrite and give more detailed information about: i) the definition of your initial conditions, ii) eventually warm up periods iii) what criteria/parameter have been compared for calibration, iv) what is the extend of the parameters you calibrated by ‘trial and error’, v) sensitivity analysis of your parameters?

Author Response: The calibration section of the paper is now reorganised and elaborated. The sensitivity analyses are discussed in the ‘General Discussion’ section.

Referee Comments: p1160/8 what is observed, what predicted, fig. 5a shows the dry

Full Screen / Esc

Print Version

Interactive Discussion

Discussion Paper

EGU

store content only!

Author Response: Figure 5(a) is to show how the store contents vary with time. Salt contents were measured at five observation holes only.

Referee Comments: p1160/10 observed and predicted data are of the range but seem to be not similar!

Author Response: The text is modified as suggested.

Referee Comments: p1161/3 there is the reference to a figure lost?

Referee Comments: p1661/8 'hydrographs were very similar……..' - this statement, and also in the following is unspecific.

Author Response: Typo error, fixed.

Referee Comments: p1163/4 what is the NSE for Fig. 12a - in general I would advice to include the NSE also in your figures (there is enough space left) or at least in the figure captions.

Author Response: NSE for the calibration and verification periods is provided in a separate table (Table 2).

Referee Comments: General discussion: again, also this part needs to be improved significantly - I miss a general discussion of the result (see annotation made above).

Author Response: This section is now elaborated as suggested.

Referee Comments: p1164/16-19 this reference/information does not belong into this chapter –or you have to bring it better into a context of your results.

Author Response: Text modified, elaborated and reorganised.

Referee Comments: p1164/23 '15-20 m below' does this mean the groundwater table increase until 1987 was 20 m?!

Author Response: Yes, a figure is provided in the daily water balance paper.

Referee Comments: in regard to technical comments made for figure1 -how has the watershed delineation been carried out (also for the groundwater) and how similar are surface and subsurface (groundwater) watersheds?

Author Response: A new figure (Figure 2) is provided which shows the details of each of the catchments.

3. Technical corrections:

Referee Comments: p1553 generally for the model description it would be easier for the reader to follow when you always give also the abbreviation of the parameters in the text. This is done sometimes but not always.

Author Response: Done as suggested.

Referee Comments: Generally, the figure captions are rather short and need to be improved, especially when the Figure contains different parts (a, b, c)

Author Response: Elaborated as suggested.

Referee Comments: Figure1: is of a too bad quality, captions are partially not readable due to overlap with the scheme.

Author Response: Original copy of Figure 1 appears to be OK.

Referee Comments: Is it right that the Ernie catchment covers only one side of the river? How can the salinity status of the river than be brought into context of the Ernie catchment only -what's about the influences of the catchment/landscape on the other (southern) river side -can these be neglected?

Author Response: A new figure (Figure 2) is provided which shows the details of each of the catchments.

Referee Comments: Figure2: please shift the lower caption, there is an overlap with

the lower scale.

Author Response: Done as suggested.

Referee Comments: Figure 5a please adapt the scale at salt storage axis (values vary between 3.36 and 3.4 only). Figure 5b why do you present stream zone salinity data for the last 2/3 - generally: please include also information about modelled and observed character of the data presented.

Author Response: Done as suggested.

Referee Comments: Figure 7 - 9 observed graph might be to weak - the figures could additionally be improved due to modification of the time scale (half of the axis presents not simulated time periods)

Author Response: Done as suggested.

Interactive comment on Hydrology and Earth System Sciences Discussions, 2, 1147, 2005.

Full Screen / Esc

Print Version

Interactive Discussion

Discussion Paper