

Interactive comment on “A generic system dynamics model for simulating and evaluating the hydrological performance of reconstructed watersheds” by N. Keshta et al.

Anonymous Referee #2

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GENERAL COMMENTS The paper evaluates the performance of a model used in the hydrological modelling of a land restoration project. The primary contribution is the performance of the upgraded model called GSDW. Its predecessor SDW did not include canopy interception. The authors quote the primary advantage of the GSDW model as its capability for handling a large number of soil layer stratifications. This is important as the land reclamation project involves laying down different layers of soil types.

SPECIFIC COMMENTS 1. Conclusions reached are that the model simulates ET and soil moisture "reasonably well" although this isn't necessarily substantiated by the fig-

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ures or even the stats. Modelling is a very difficult process and thus, admitting that the modelling is not done all that well does not diminish the utility of this work. But modelling papers should in general show that the incorporation of concepts and upgrades to equations, etc., do or do not improve the representation of hydrological processes. While the simulation of ET and soil moisture were pushed to the forefront, the concepts involved in those parts of the model output are the same in both GSDW and its predecessor SDW. Thus, because this is a modelling paper, it should show how the "upgrade" between SDW and GSDW improved the simulations. Thus, the authors must include the simulations by SDW and show an improvement by GSDW.

2. Not only should the SDW simulations be conducted and the validation statistics compared to GSDW, but water balance components for each model in the simulations should be provided. Especially the canopy interception model which the authors claim is the primary upgrade. Once these are included, the paper will be an excellent contribution.

3. The literature review is fair but leaves something to be desired. On page 1445 the authors describe what Yanful and Aube (1993) did in their lab tests including a "comparison of results"; however, they neglect to state what the results were and how they contributed to the development of the current study research objectives (as all literature reviews should). With regard to the paragraph starting on line 10, page 1445, it is noted that Elshorbagy et al applied SDW to "inclined" reconstructed watersheds. It would be useful if the authors detailed the significance of terrain in their model, or perhaps the need to refer to the watershed as "inclined" at this stage and how SDW was extended to simulate "other inclined watersheds". From examining equation 11, it seems to be an empirically based expression and not a physically-based one or even a conceptual one similar to that in TOPMODEL.

4. It would be useful if the authors could connect all the model equations to the loops described in figure 2.

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5. With regard to the natural watershed description, what is the size of the area and the resolution of the digital terrain model used to obtain the slopes? How was information obtained at the sub-daily time step used in the modelling process which seems to be at a daily time step? What were the saturated hydraulic conductivities and pore-size distributions? Since the AET model is an important part of this paper, the primary equation showing the lambda terms should be provided somewhere on page 1454.
6. While the calibration coefficients are listed, it would be useful to list other non-calibration parameters that were implemented in the model and affect soil moisture distribution and AET.
7. The authors speak of "depth-averaging" at the top of page 1461. Please elaborate.
8. If SM is as important as AET, why not report AET as daily values like they do with soil moisture. Can they show the daily graphs as opposed to the cumulative graphs?
9. Why aren't the same statistics used to validate the models for soil moisture used to validate the models in terms of AET outside of rain events?
10. The authors should consider using more than equations 13, 14 and 15. While the authors recognize that certain equations are more affected by peaks than others, they should also include stats that only focus on peaks as long extended drying periods will often improve the values of statistics that simulate the entire time period. The authors should also make a comparison of extreme/peak values or values immediately after rain events.
11. Can the authors please show which years used in the calibration/validation are wet or dry years.
12. The title does reflect the contents of the paper but the abstract is neither concise nor complete. The abstract does not include any of the results of the model performance. It sounds like an introductory paragraph followed by a paragraph from the conclusions section. Please revise the abstract.

Semantics/Philosophy Issues:

Consider the statement made on page 1443 starting with line 15 which reads: "This key role, of both processes, is pronounced in the evolving hydrological behaviour of reconstructed watersheds resulting from the mining industry." While the reconstructed watershed may evolve in terms of the spatial and temporal distribution of AET and SM, I don't believe it is "pronounced" as compared to the processes in any other type of watershed. The authors should eliminate this word or describe how it is pronounced.

How is depression storage incorporated?

Page 1444 line 1 states that "...tool that facilitates the assessment of the sustainability of various reconstructed watersheds." The word "sustainability" has multiple meanings both in the public sector and within the scientific community. The authors need to define what they mean by a sustainable watershed in this context.

The authors continue on Page 1444 (line 6) with statements such as "complex hydrological processes of the reconstructed watersheds". The impression conveyed is that these reconstructed watersheds are somehow more complex than any other watershed. The authors need to describe what is complex about them in relation to any other watershed more specifically, they should detail why reconstructed watersheds in the Alberta Oil Sands have mostly failed and what success, sustainability and failure mean.

On page 1464 the authors state on line 8: "As expected in....the GSDW model shows that the AET process and soil moisture content play the dominant role in the hydrological processes of the watersheds" Dominant over what other processes? If canopy interception was the primary upgrade to GSDW, what recommendations would the authors make regarding the role of canopy interception?

TECHNICAL COMMENTS There are numerous typographical errors detailed below.

Page 1442 Line 1: use "salvaging" not "salvage"; at the end of this line.

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Page 1443 Line 1: replace "has" with "have" Line 2: remove "different" Line 23: remove the second "process" Line 25: "accurate" should be "accurately"

Page 1444 Line 21: insert "the" before "HELP" Line 21: remove "in the evolution stage" and replace with "evolving" Line 25: insert "the" before "SoilCover model"

Page 1445 Line 2: put "used" before "extensively" not after

Page 1447 Line 17: switch "underneath" with "layers"

Page 1448 Line 13: remove "in the meanwhile"

Page 1450 Line 5: insert an apostrophe at the end of "leaves" and place in units of $Cc(t)$

Page 1452 Equation 9: Should the sign before the fraction term of equation (9) be positive instead of negative?

Page 1454 Line 17: replace "it has to be mentioned that C_i is" with "which is also"

Page 1455 and Page 1456, when describing the three watersheds, don't use (i), (ii) and (iii) in your paragraphs within section 4.1 because it's confusing and they are inappropriate ways to start a sentence. Instead simply state "The first reconstructed watershed" and "The Second is" etc.

Page 1456 There is no reference to Figure 3. Line 27: Insert "an" before "hourly basis"

Page 1457 Line 4: Replace "if" with "of" Line 15: Insert "a"; before "well drained loam"

Page 1459 Line 5: remove initial "was" Line 15: remove the semi-colon after "namely"

Page 1464 Line 1: replace "it" with "and" Line 1: remove the "s" on the end of "years" Figure 2 seems to be missing the sign on the Evapotranspiration to Layer 1 Storage connection in (c).

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