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Geoscientific Model Development Discussions

Interactive comment on "An integrated Dissolved Organic Carbon Dynamics Model (DOCDM 1.0): model development and a case study in the Alaskan Yukon River Basin" *by* X. Lu and Q. Zhuang

Anonymous Referee #1

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Review of "An integrated Dissolved Organic Carbon Dynamics Model (DOCDM 1.0): model development and a case study in the Alaskan Yukon River Basin", by Lu and Zhuang for GMDD This manuscript presents and tests a model of DOC dynamics with special emphasis on northern landscapes. The test case is in the Yukon River Basin. The model seems quite comprehensive and able to be inserted into a climate model. It could also be run as a standalone model on different scales.

The model and related science seems strong particularly as this is a model development paper. Most of my comments are about the writing structure and style, and I

suggest the authors significantly re-work the introduction and pay attention to whether the updated literature review necessitates any structural changes in the model, the presentation, or interpretation of its application in this case study.

First the introduction is rather dated with many references prior to 2010. Since that time there have been some strong papers on DOC transport and its related processes with a focus on the Arctic and subarctic. A few relevant works include (Loisel et al., 2014) for northern carbon stocks, (Mann et al., 2015, 2014) for riverine Arctic c transport, and (Laudon et al., 2013, 2011) for boreal region DOC fluxes. A stronger introduction in this sense would acknowledge more recent literature and be more specific in which processes are under-represented in the literature (and so more difficult to parameterize) and which ones are better known (and so easier to represent in a model).

Second, the choice of model years – 1976 and 2004 – is based on the historic cold and warm years. Please give some additional context for these choices – what is the long term mean, standard deviation, trend, etc. Why not also run the model for a more typical year? (or even for the whole range of the climate record)?

Third, in the model results – e.g., section 3.2 on watershed level results – I was hoping for something more quantitative. Has the water budget been closed? Is there any comparison against discharge data using something like a Nash-Sutcliff or bias metric?

Fourth, similar to point 1, more references in the discussion would be useful – e.g., page 10435 line 9 – is there any literature to support the notion that thawing soils result in more DOC accumulation in soils?

Specific comments: p. 10414, line 19, which kind of "DOC model"? I suggest "DOC export model" or "DOC dynamics model" p. 10417 – line 1, why not make the density of water and ice temperature sensitive? Especially as later parameters are sensitive to temperature I think including this relationship in these parameters would be more complete and not computationally expensive. p. 10424 –line 13, add "the" before "water surface" p. 10427 – line 5, "neighbor" is misspelled. p. 10429 – line 13 –

mention briefly how DOC concentration is determined by RS p 10429 – lines 21-29 seem more like results and discussion, and should be moved to a more appropriate section of the text. Also note line 26 you want “angle” and not “angel” p. 10430, line 24, after “air temperature” add “for these two years” p. 10431, line 7, reword “no-ice zone” – try “ice free region of the soil” or something like that p. 10432, line 2, use “generates” rather than the weaker “makes”; line 11, set “forest” to singular, line 29 “delivered” is misspelled Section 3.3 I found well put together with a nice comparison between years and nice use of these fraction-based metrics to understand the processes. p. 10436, line 2, say “valid” rather than “trustable”

It is very nice of the authors to make the code available and downloadable.

The table and figure captions should be spell-checked. Many words are misspelled here. For example: Table 1 – all of the last three words in the title; Table 2 (production), Figure 3 (aquifer, not acquifer), figure 5 (solid circle), figure 6b (precipitation), figure 9 (infiltration) The x-axis in Figure 7 should be converted into months and labeled from Jan to Dec, rather than in model hours. Figure 8 lacks labels for sub-plots e and f.

Works cited in review Laudon, H., Berggren, M., Ågren, A., Buffam, I., Bishop, K., Grabs, T., Jansson, M., Köhler, S., 2011. Patterns and Dynamics of Dissolved Organic Carbon (DOC) in Boreal Streams: The Role of Processes, Connectivity, and Scaling. Ecosystems 14, 880–893. doi:10.1007/s10021-011-9452-8 Laudon, H., Tetzlaff, D., Soulsby, C., Carey, S., Seibert, J., Buttle, J., Shanley, J., McDonnell, J.J., McGuire, K., 2013. Change in winter climate will affect dissolved organic carbon and water fluxes in mid-to-high latitude catchments. Hydrol. Process. 27, 700–709. doi:10.1002/hyp.9686 Loisel, J., Yu, Z., Beilman, D.W., Camill, P., Alm, J., Amesbury, M.J., Anderson, D., Andersson, S., Bochicchio, C., Barber, K., Belyea, L.R., Bunbury, J., Chambers, F.M., Charman, D.J., Vleeschouwer, F.D., Fiałkiewicz-Kozieł, B., Finkelstein, S.A., Gałka, M., Garneau, M., Hammarlund, D., Hinchcliffe, W., Holmquist, J., Hughes, P., Jones, M.C., Klein, E.S., Kokfelt, U., Korhola, A., Kuhry, P., Lamarre, A., Lamentowicz, M., Large, D., Lavoie, M., MacDonald, G., Magnan,

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