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Interactive Comment

# *Interactive comment on* "RRAWFLOW: Rainfall-Response Aquifer and Watershed Flow Model (v1.11)" *by* A. J. Long

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Author responses to Anonymous Referee #2 Referee comments are shown, followed by Author's responses.

Also, please see Author's additional comment with attached pdf showing actual changes made to the manuscript.

The present manuscript (MS) introduces a conceptual rainfall-runoff model and deÂňscribes basic functionalities. The model runs in open source language "R", the source code is provided and as such has a high potential to be used by the community either for research, for applied science or for education purposes. RRAFLOW is flexible reÂňgarding input, is simple and parsimonious and ready to use with a sample

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Interactive Discussion

Discussion Paper

data set. This is highly acknowledged and principally deserves publication in GMD. Here, I am fully in line with referee #1. BUT: A high level of redundancy exists to a published paper in HESS by the same author (Long and Mahler 2013). While the exact wording has been changed in the present manuscript, most of the equations and also the data used to test RRAFLOW have been published before (Long and Mahler 2013). Therefore, I propose that the model should be generalized and tested with new data to show its general value. Moreover, the manuscript should significantly be shortened. I detail my concerns down below.

—Author's response: The author thanks the referee this thoughtful review. Examples with new model data have been added, and the manuscript (MS) elsewhere has been shortened, except where other referees requested additions. The MS did not make it very clear that this is the first release of the RRAWFLOW code to the scientific and public communities. Long and Mahler (2013) presented it as a research model with no code or user's manual. The revised MS now clearly states in the abstract and introduction that the purpose of this paper is to present a new version of RRAWFLOW with added versatility, to make the code publicly available, and to guide users in its operation.

A) Redundancy with Long and Mahler 2013 In (Long and Mahler, HESS 2013) all main components of the RRAFLOW have been described in great detail: The majority of the equations (1,2,3,5,6) and also the text paragraphs in between are included there. Wording is a little different but the meaning is more or less equivalent. As a difference, a more general parametric IRF (gamma function) is introduced in the present manuscript (MS) instead of concentrating on exÂňponential or lognormal IRFs in (Long and Mahler 2013). Also time-variant IRFs are not a new feature here, also those have been discussed and tested in depth in the precedÂňing paper. Most strikingly, also the data set used to test the model has been published before, Figure 6 in the present MS is equivalent to Figure 3 in (Long and Mahler 2013). I recommend to refer to the published material and strictly remove redundant data, paragraphs, equations and text passages.

—Author's response: Equations 1-5 have been moved to an appendix. This was necessary because specific variables in Eqs. 1-5 are referred to throughout the MS and are included in RRAWFLOW outputs, and the RRAWFLOW download contains a user's manual that cites all equations in this manuscript. To avoid confusion for the user, I feel it will be most helpful if all equations are contained in the body or appendix. Eq. 6 (now Eq. 1) is left in the main body because (1) I added one term to show how the equilibrium datum is applied in groundwater models, and (2) it pertains to Fig. 1, which is new in this MS to help explain convolution conceptually, which people seem to have trouble with. The related text has been shortened.

—Time-variance options, although some were presented previously, need to be discussed briefly for the purpose of explaining the different RRAWFLOW settings and options referred to in Table 1. The new continually changing IRF scale function needs to be presented also. An additional feature that I have included since submitting the MS is the option to have RRAWFLOW calculate the wet and dry periods on the basis of the precipitation record, which includes options for two different methods. Previously, the user had to supply the wet and dry periods. Therefore, a short section (section 2.6) was added to describe how these options work and the associated RRAWFLOW settings.

B) Applicability of RRAFLOW outside karst For me it is not stated clear enough, if RRAFLOW is a model exclusively for karst systems or for other catchments/aquifers as well. This needs to be clearly clarified at the beginning of the MS. But here I see also a great chance for improvement: I propose to apply the model also to non-karst systems. If RRAFLOW can be used (and I am pretty sure that this is possible, because the structure is highly flexible), then this should be shown by new data. Differences in model performance, parameters, etc. should be highlighted in the discussion. This would add a large value to the manuscript and lower the problem of redundant information (see A above).

—Author's response: This is an excellent point. The introduction (section 1.2) now states much more clearly that RRAWFLOW is suitable for hydrologic systems of any type, not just karst. Five example simulations for a non-karst watershed have been added, which are compared to the karst simulations, and the discussion highlights the differences and additional challenges when modeling karst. Then, in the Discussion and Conclusions, a comparison is made to another non-karst watershed simulated by Long and Mahler (2013). Because it is easier to simulate non-karst systems in RRAWFLOW, the karst examples are useful to show how the different RRAWFLOW functions can be used effectively to simulate more complex hydrologic systems.

C) Lengthy discussions on IRFs and tests with the same data set Eleven of thirteen Figures show IRFs, theoretic or generated by modelling the Barton Springs or a well in the Madison Aquifer. This section needs to be condensed, particÂňularly because the IRF-discussion is not new (again see A above). Again, I propose to apply RRAFLOW to other systems as well, if possible outside karst, if not possible to a system with a different karstification level. Finally, the IRFs received can be compared in order to show if system properties can be deducted from different IRF-shapes.

—Author's response: The figures related to Barton Springs and the well have been reduced to 5 figures. Four of these figures are used to demonstrate the new control-points IRF option. The related discussion also has been condensed, as suggested. A discussion of the different system properties related to the different IRFs was added to the Discussion and Conclusions section, as suggested.

D) Subdaily timestep In l15-16 p5923 it is mentioned that sub-daily time steps can be used. This requires discussion and needs to be justified, because most model parameters and concepts are daily (soil moisture index, evapotranspiration, recharge, snowmelt etc.).

—Author's response: The equations are not specific to any particular time-step. Therefore, all references in the MS to daily time steps (except in examples) were deleted and



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are now referred to in general terms. A discussion was added at the beginning of the section 2 (The model) that explains that the time-step length is selected by the user and defined by the time step of the input record. A discussion of choosing an appropriate time step also was added. I also revised the RRAWFLOW code and input-file format to make it easier to use time steps that are shorter or longer than one day.

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