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Interactive comment on "The probabilistic hydrological model MARCS (MARkov Chain System): the theoretical basis for the core version 0.2" *by* Elena Shevnina and Andrey Silaev

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We noticed that it was not easy to find Referees for our manuscript. The discussion of the manuscript is started 18 April, 2018 and, since then, many Referee's nominations were rejected. Finally, the comments of two Anonymous Referees and A. Frolov result to the revised text of the manuscript. The following changes were implemented in the new text:

Title: In the new test, the name of the model is the MARCSHYDRO instead of MARCS. We realized that the model MARCS is already exists (http://marcs.astro.uu.se/index.php) with the official name the MARCS – atmospheres.

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Discussion paper

Then, the abstract was rewrote to stress that our paper introduces a new version of the model. In the revised Introduction, the last paragraph explains our motivations to include the theoretical basis of the model core 0.2 into the model description paper.

Structure: We moved the theoretical basis of the AFA to the Annex 1. On our opinion it allows to introduce the Section 1.1 to "a general audience" (see the Constructive suggestions by Anonymous Referee #1) and, at the same time, to keep the math "language" in description of the AFA method behind the new model MARCSHYDRO model. We supposed, that "general audience" are people working on development and evaluation of numerical models of hydrological system and its components.

Sections' content: To place better the MARCSHYDRO model core version 0.2 into the structure of the model we added the Fig. 1 into the Section 1. Then, we discussed the features of the current version of the MARCSHYDRO model such as the prediction on a climate scale, the low computational costs and the direction toward socio-economic applications in long-term risks assessment. Six blocks of the MARCSHYDRO model were breathy introduced in the revised Section 1. The last paragraph of this section is now discussed the limitations of the current core version of the MARCSHYDRO model according to the comments of two Anonymous Referees and A. Frolov. The specific comments by Anonymous Referee #1 in lines 90, 158, 273 were accounted in the text revision. Section 2 hasn't much changes, it describes details of the model set up, forcing and output for the case of the Iijoki River basin.

Discussion: The section of Discussions was extended, and now we have been trying to specify the model ability for an "express analysis" of water extremes in changing climate due to low computational costs and direct connection to social-economical applications. We stressed that the method behind the model is not a new (see the comment 1 the Anonymous Referee #2), but not well known outside the Russian hydrological community due to the lack of publications in international journals. In the revised Discussions we also focused on limitations of the method used as well as on the further development of the MARCSHYDRO model (according the comment 3 of the

Anonymous Referee #1).

Conclusion: We stressed the novelty of the core version 0.2 and gave final remarks about results obtained for the Ilijoki River.

Annexes: Recently, the Annex 1 provides the theory and limitations of the AFA for readers wanted for the details. Two tables with the notations used for the secondary parameters were also added into the Annex 1 according suggestion given by the Anonymous Referee #1

References: We have been trying to incorporate as much references as possible in the revised manuscript. However, some of them were not finally included to the revised manuscript to keep the section of References balanced 50/50 for Russian and English publications. In particular, we do not rise the discussion the comment 1 by A. Frolov (in the RC2) or the suggestions by the Anonymous Referee #2 since it needs to additional references to the regional studies or specific technical papers in Russian. However, three important references in Russian were added to the list of references to discuss the comment 3 of the Anonymous Referee #2.

The following references were added to the list:

1. Veijalainen, N., Korhonen, J., Vehviläinen, B. and Koivusalo, H.L Modelling and statistical analysis of catchment water balance and discharge in Finland in 1951–2099 using transient climate scenarios, Journal of Water and Climate Change, Vol. 3, 55–78, 2012.

2. Willmott, C. J. and Robeson S. M.: Climatologically aided interpolation (CAI) of terrestrial air temperature. International Journal of Climatology, 15(2), 221-229, 1995.

3. Yip, Q. K. Y., Burn, D. H., Seglenieks, F., Pietroniro, A. and Soulis, E. D.: Climate impacts on hydrological variables in the Mackenzie River basin, Canadian Water Resource Journal, 37(3), 209–230, 2012.

4. Kovalenko, V. V.: Partial infinite modelling and forecasting of the process of

river-runoff formation. St. Petersburg, RSHU Publishers, 2004. Available on-line: http://elib.rshu.ru/files_books/pdf/img-417153826.pdf

5. Sokolovskiy D.L.: River runoff (bases on a theory and methods of calculations). Leningrad, Hydrometeoidat, 540 p. 1968. (in Russian)

6. Shevnina, E.: Long-term assessment of the multi-year statistical characteristics of the maximal runoff under the climate change over the Russian Arctic, doctor of science thesis, Russian State Hydrometeorological University, Russia, 355 pp., 2015. (in Russian).

The following references were excluded from the list:

1. Serinaldi, F. and Kilsby, C. G.: Stationary is undead: Uncertainty dominates the distribution of extremes, Adv. Water Res., 77, 17–36, doi:10.1016/j.advwatres.2014.12.013, 2015.

2. Hamududu, B. and Killingtveit, A.: Assessing of Climate Change Impacts on Global Hydropower, Energies, 5(2), 305–322, doi:10.3390/en5020305, 2012.

3. Obrezkov, V.I. (Eds.): Hydroenergy: a handbook for engineers, Energoizdat, Moscow, 1988. (In Russian).

4. Salvosa, L. R.: Tables of Pearson's Type III Function. Ann. Math. Statist., 1, 191–198, 1930.

5. Shevnina, E.: Changes of maximal flow regime in Arctic, Construction of Unique Buildings and Structures, 7(22), 128–1412014, 2014. (in Russian).

6. Shevnina, E. and Krasikov, A.: The probabilistic hydrological model MARCS (MARkov Chain System): the core code (Version 1.0), doi:10.5281/zenodo.1220096, 2018.

We thank to two Anonymous Referees and A. Frolov for their comments to our manuscript. We hope, that the new text allows better understanding of the MARC-

SHYDRO model specifics as well as our motivations behind the submission this model description paper to GMD. The revised version of the manuscript is included as the Supplement.

with the best regards, Elena Shevnina and Andrey Silaev

Please also note the supplement to this comment:
https://www.geosci-model-dev-discuss.net/gmd-2018-108/gmd-2018-108-AC7-supplement.pdf

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