

## ***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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Dear Colleagues, My main remarks on the article by E. Shevnina and A. Silaev are as follows. 1. The equation describing the river runoff must not contain noise  $c$ , which is generated by measurement errors. The physical reason for this removal is that measurement errors cannot in any way form the river runoff. Therefore, multiplicative noise should be excluded from equation (4-Shev.-Sil.). 2. The approximate method for solving the FPK equation proposed by V. Kovalenko cannot be considered correct until confirmed by professional mathematicians working in the field of Markov processes. In my humble opinion, it is better to use the proven recommendations contained in the

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classic monographs, for example, V.I. Tikhonov and M.A. Mironov “Markov processes” (1977). 3. Paying tribute to the studies obtained by experts from Colombia, Côte d’Ivoire, Mali etc., I dare to draw the attention of E. Shevnina and A. Silaev to my some results published in 2006 and 2011. I used the stochastic differential equation describing river runoff long-term fluctuations in the form  $(dq(t))/dt = -kq(t) + k[R(t) - E(t)]$ , (1) where  $q(t)$  is the river runoff,  $k$  is the coefficient in the dependence between the  $q(t)$  and the total water reserves  $w(t)$  in the catchment area,  $q(t) = kw(t)$ . The solution for (1) was obtained within the framework of the correlation theory of non-Gaussian random processes. On the basis of this solution, exact analytical dependences between the main statistical characteristics of the river runoff and the corresponding precipitation and evaporation parameters were obtained. Namely, the variance and autocorrelation function, the coefficient of variation, the coefficients of mutual correlation between river runoff and precipitation and the one for the river runoff and evaporation. These formulas can be used to estimate the response of statistical characteristics of runoff to changes in precipitation and evaporation, for example, caused by climate change. Details can be found in the (Frolov, 2006). The discrete modification of model (1) was considered in (Frolov, 2011). I hope that references mention above will help E. Shevnina and A. Silaev to point out the advantages of their model of river runoff in comparison with the results obtained by me about 10 years ago. Respectfully, A. Frolov  
References  
Frolov F.V. Dynamic-stochastic modeling of long-term fluctuations in river runoff // Water resources. 2006. Vol.33. âĎŮ5, ÑĀÑĀ. 483-493.  
Frolov F.V. Discrete dynamic-stochastic model of long-term fluctuations in river runoff // Water Resources. 2011. Vol.38. âĎŮ5, ÑĀÑĀ. 583-592.

Please also note the supplement to this comment:

<https://www.geosci-model-dev-discuss.net/gmd-2018-108/gmd-2018-108-SC2-supplement.pdf>

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