The probabilistic hydrological model MARCS (MARkov Chain System): the theoretical basis for the core version 0.2 (Shevnina and Silaev, 2018)

General comments

At a first glance, the paper show how competent the authors are in probabilistic hydrological models. Reviewer thinks that key aspects of this research are to provide the theoretical background of Markov Chain System. The manuscript is well written and logically structured. The extensive literature review is much appreciated as well.

Even though the goal of the paper relies on the scope of GMD, the intuition of the approach is not clearly stated. Since the approach uses Markov chain system, for the recent scientific community, it may not be new. So, the reviewer suggests laying the objective of the paper in different way. Indeed, the authors showed much effort on the topic but there is not much about the model use and its description. The manuscript mentions the version of model is 2. Reviewer does not see properly how they are different. The assumptions of the model are not clearly stated. The paper is mathematically enriched. Sometimes, reader may lose the concentration due to inappropriate description of the technical jargons.

The conclusion made in this manuscript seems to be the summary of the whole content. It may need revision posing future research and recommendation of this research. Right now the direction of this research is not clear. The reviewer suggests including some potential application beyond the water engineering even though the method is similar to Pearson type distribution. The extension of the paper will be better if the idea of posing such approach in space. Such statement shall be made clearly.

At this moment, the effort of authors is appreciated but still needs further improvement as described below prior to acceptance.

Constructive suggestions

- Author mentioned three statistical moments in line 79. But these are not listed here. For general audience, reviewer suggests to list them.
- Section 1.1 is very rich in mathematical expression. Only audience or practitioner with sound mathematical background easily understands. But for general audience, this section shall be revised in a simpler way...
- Please briefly mention what kind of parameters are lumped one and why such is called.
- The reviewer wants to have implicit explanation of the secondary parameters like a, b, c and c, Gs. It is not clear how such empirical equations are related with either data or physics.
- Are the time-series data are daily or monthly or yearly as mentioned in line 227? It would be better to define the time scale.
- In order to make the paper strong, reviewer suggests having some key statistics pictorially. This means how the observed set and models are correlated. What is the degree of performance?
- Reviewer feels the paper is somewhat incomplete as in the several statements; the authors did not mention how future works will be proceed. They just envisioned about the future paper.

Specific comments

- In line 90, comma is needed between features and which.
- The authors mentioned in parenthesis ("the reference"). What does it mean? It seems the authors forgot to have proper citation. In line 158.
- There are three graphs in the paper however, they are not proper captions. In line 273 has Figure 2, but where is Figure 2?