We thank the reviewer for taking the time to review our manuscript and for providing very constructive comments. Below, we give a response (in blue in 'normal' font) to the reviewer comments (included in italic for general, major and minor comments).

General comments

The manuscript is a model description paper that presents the Wflow_sbm v0.6.1 hydrological model developed by Deltares. The model structure and equations are presented in detail followed by case studies of its application in various catchments across the world. The presented model has a great potential in contributing to large scale and high resolution hydrological modelling. Overall, the paper is well written, the model is presented in detail and the applications demonstrate the capability of the model to simulate major hydrological processes in different regions. I appreciate the effort of the authors to make it public and provide transparency in the model functioning. I have enjoyed the paper, but I am missing a key component when it comes to "spatially fully distributed" hydrological models, which concerns the Wflow_sbm ability to be spatially calibrated and evaluated with gridded data (not catchment average) and its performance in representing the spatial patterns, which is the major feature of grid-based models, as compared to lumped or semi-distributed models. Therefore, I urge the authors to demonstrate the performance of their model in reproducing the spatial patterns of major hydrological processes like actual evapotranspiration, soil moisture, and terrestrial water storage and snow accumulation as global data exist to do so.

Yes, we agree that a comparison with gridded data is missing in the manuscript, while representing spatial patterns is a major feature of wflow_sbm. In the revised version of the manuscript we propose to extend the Moselle case (4.2.4) to demonstrate the ability of wflow_sbm to represent the spatial distribution of at least two major hydrological processes like actual evapotranspiration, soil moisture and snow.

Specific comments

Major Comments

The key strength for spatially distributed hydrological models is the ability to simulate hydrological processes in space and provide their spatial variations. I strongly recommend demonstrating that your model can be calibrated and evaluated on spatial patterns as it is becoming the state-of-the-art in this field (e.g. Dembele et al. 2020, Demirel et al. 2018, Zink et al 2018).

Demonstrating that wflow_sbm can be calibrated and evaluated on spatial patterns is indeed missing in the manuscript. We propose to extend the Moselle case (4.2.4) to demonstrate this in the revised version of the manuscript. Since the focus of the manuscript is on a-priori model parameter estimates in combination with a manual adjustment of the multiplication factor applied to vertical saturated hydraulic conductivity, and not on fully calibrating a hydrological model, we propose to follow the same approach for demonstrating the ability of wflow_sbm to represent the spatial distribution of at least two major hydrological processes like actual evapotranspiration, soil moisture and snow.

L672-674: Why the use of ERA5 for Europe and other products for other regions (e.g. CHIRPS for Oueme in Africa)? Were these datasets evaluated or previously found suitable for hydrological modelling in these regions?

CHIRPS rainfall is based on merge of satellite and gauge observations. ERA5 is reanalysis data and in general performance less good where convection is important. See also Figure 6 from Beck et al. (2017), where you see that satellite information gets much higher weight than reanalysis above the tropics/ Africa. We could also have used MSWEP, but we preferred CHIRPS (Africa, 0.05 degree) as it is readily available like ERA5 reanalysis. All our other examples are outside of the tropics.

Minor comments

What are the available objective functions for model calibration? Is multivariate calibration supported by the model?

The focus of the wflow_sbm model as part of the Wflow.jl hydrological modelling framework is on the computations (computational engine), see also L.154-156. Therefore, we do not provide objective functions for model calibration as part of Wflow.jl. However, the Wflow.run function can be easily extendend/changed for custom use (custom model run function), for calibration purposes or for example to run wflow_sbm in ensemble mode.

Be consistent with the use of the term "hydrological" or "hydrologic" (see e.g. lines 1 and 783). Choose one and keep it throughout the paper.

Good point about using the term "hydrological" or "hydrologic" consistent, we will make this consistent (using the term "hydrological") in the revised version of the manuscript.

L10-11: Mention clearly that this is the model performance for discharge.

We will change line 10-11 in the revised version of the manuscript and mention clearly that this is model performance for discharge.

L511: A variable name should not have several meanings. Here P is defined as the wetted perimeter while it refers to precipitation in Table A1. Please correct this.

Thanks for noticing this about the variable names, we will correct the variable name to P_W for wetted perimeter in the revised version of the manuscript.

L382: is f_canopygap time dependent? There is no exponent t in the name in Table A2.

f_canopygap is indeed time dependent, and for Table A2 this is also true for a couple of other variables like for example precipitation (P) and leaf area index (LAI). For Table A2 (and A1) the focus is on the variable (Symbol) used (without exponent t, as for the equations in the manuscript) in the manuscript and the corresponding Wflow.jl name (including description, unit and default value).

Technical corrections

Many thanks for providing these technical corrections, we will include these corrections in the revised version of the manuscript.

References

Beck, H. E., van Dijk, A. I. J. M., Levizzani, V., Schellekens, J., Miralles, D. G., Martens, B., and de Roo, A.: MSWEP: 3-hourly 0.25° global gridded precipitation (1979–2015) by merging gauge, satellite, and reanalysis data, Hydrol. Earth Syst. Sci., 21, 589–615, https://doi.org/10.5194/hess-21-589-2017, 2017.