Review of Dal Molin, Marco, Dmitri Kavetski, and Fabrizio Fenicia. 2020. “SuperflexPy 1.2.0: An Open Source Python Framework for Building, Testing and Improving Conceptual Hydrological Models.” *Geosci. Model Dev.* https://doi.org/10.5194/gmd-2020-409.

By Riccardo Rigon

The paper illustrates the new software superflexPy, a system for doing hydrological modelling at catchment scale, which originates from the previous Superflex adding to it a more appealing implementation and offering a easier access and improved usability within the Jupyter/Python interface.
I think it is built on solid scientific premises and well deployed, even if I believe that overall its engineering has not the quality of a System Product (Frederick and Frederick, 1995). However it will be useful for many researchers in Hydrology. Its relatively easiness of use, its being based on Open Source tools, its effort to be object oriented, and its use of Jupyter infrastructures for the documentation and dissemination will encounter the favor of many users and researchers. It comes as one Python infrastructures, in which Landlab (Hobley et al., 2017, and https://landlab.github.io/#/) is a mature example. From its pros is the freshness of the approach and its usability and the very flat learning curve (if we do not include the learning of all the tools for developing illustrated in Figure 12 of the paper).

The paper is well written, well organised and requires very minor modifications. The main concerns I have regard the Figures, in which many symbols are incorrect, as I list below.
Another concern has to do with the traditional representation that is given in the paper of the model M2 and M04. As proponent of a different way to represent the hydrological models I believe that some further effort can be made as I mention below, even if this is a side issue. Essentially I think that the representation used in the paper does not actually shows the mathematics behind the model. One part that does not work as it is, for instance is the "lag" item used in the paper. As shown in Bancheri et al., 2019, and Rigon and Bancheri (2020) the lag functions imply the existence of a reservoir which remains, in this case hidden because its functioning is assigned through a travel time distribution. Therefore, willing to preserve the same type of representation used in the paper, the lag item should be promoted at the same graphical level than the reservoirs of which is just a different expression. In our, Extended Petri Net representation, (Bancheri and Rigon, 2020) the M02 and M04 would be represented as shown in the attached pdf.
Having awareness of this is indeed important in this modelling because the strategy underneath SuperflexPy is the comparison of model structures for a better representation of catchment processes (Clark et al., 2011) and getting, for what is possible in lumped models, the "right answer for the right reasons" (Kirchner, 2006).

Though my point is marginal to the economy of this paper I want the Authors and the readers to consider that having a proper visualization of the models is deemed necessary in view of the selection tasks and of implementing those extensions to treat contaminants that the Authors envision in the final parts of the manuscript.

In synthesis, I believe that the paper can be published with very minor modifications, even if I would prefer, but I cannot require that much, that they change their model representation.

Detailed comments

Line 235 - As I mentioned in the main text, the lag function is nothing different from a reservoir from the point of view of the model structure. It is just that the reservoir dynamics is given a different way. E.g. Rigon and Bancheri, 2020

Line 3 - Is the node here what elsewhere is called "Hydrologic Response Unit" ?

Line 275 - Among the models that generate Level 4 predictions, I would cite Formetta et al., 2014

Line 440 - acyclic directional graph or directed acyclic graph ?

Figure 3 - The right reservoir should be renamed S_{FR}

Figure 4 - The Figure suggests me to ask if there is any method to have, inside SuperflexPy, the list of the available reservoirs.

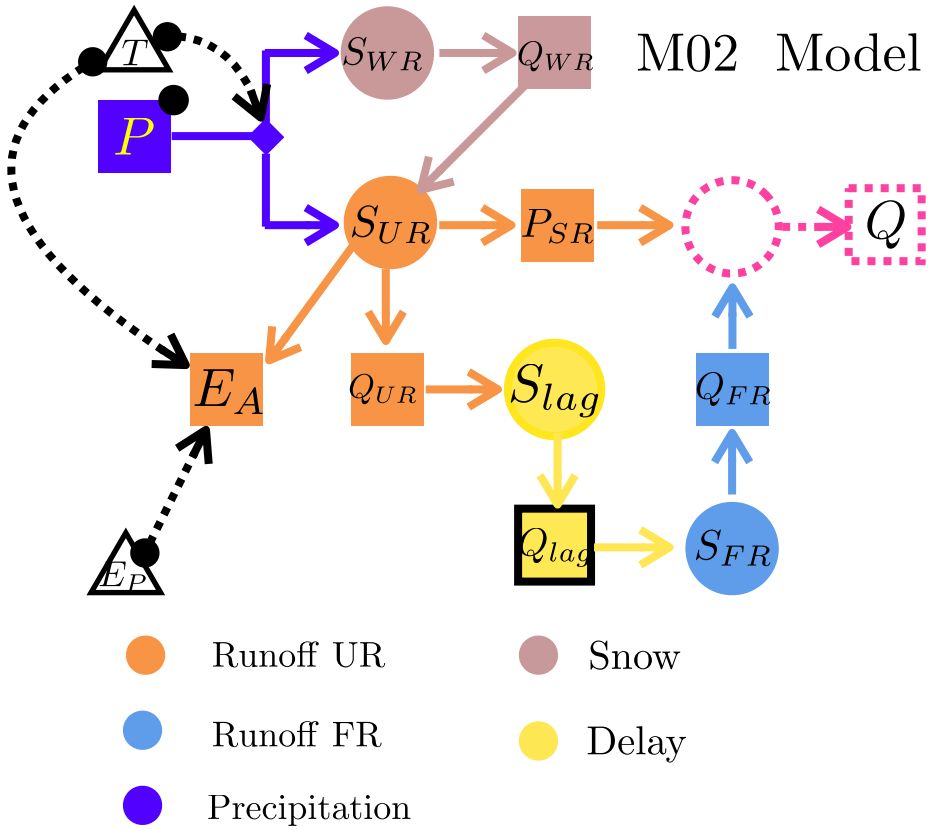
Figure 8 - The bottom reservoir should be renamed S_{SR}

Figure 9 - Why transparent layers are necessary ? Are not they a weakness in the software design ?

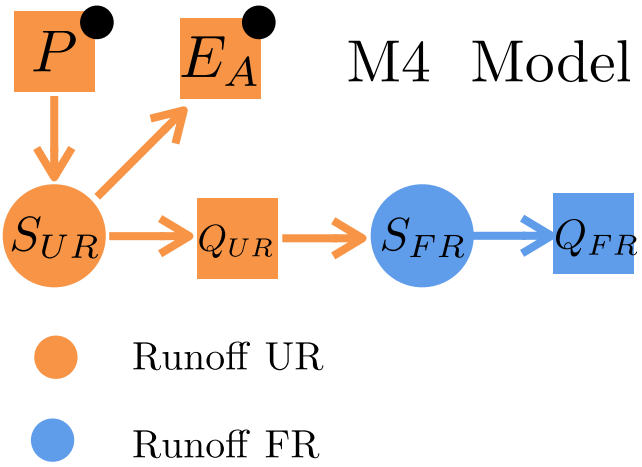
Figure 10 - A curiosity here: how can parameters of the consolidated and unconsolidated can be distinguished. Is there any problem with identifiability ?

Further comments on lumped models representation

As side issue, I show here below the representation of the Model M2 with the Extended Petri Net



This Figure is actually intended to clarify the fact that the delay introduced by the lag function assume the existence of a reservoir. It is the yellow circle in Figure and I stress that is important to account for properly when discussing of the models structure. The black frame on the flux is used to indicate that the budget of this reservoir is assigned through a travel time distribution (see also Rigon and Bancheri, 2020).



M4 model is much simpler though and possibly the EPN representation does not have any particular added value with respect to representation used in the reviewed paper. For a short introduction to the EPN, please see http://abouthydrology.blogspot.com/2020/10/introducing-extended-petri-net-by.html

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