

## ***Interactive comment on “Virtual laboratories: new opportunities for collaborative water science” by S. Ceola et al.***

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Received and published: 13 January 2015

In this paper, a much-needed proposition for development of virtual laboratories for collaborative research in hydrology, ensuring reproducibility and repeatability of experiments, is made. The paper's focus seems rather trivial, but I agree with the authors that it is not! In fact many hydrological studies to date lack reproducibility due to lack of data sharing, limited metadata, poorly shared and documented experiment protocols and experiment outputs.

I do have a number of comments of which the last one is the most important. I hope the authors find them useful for improving the manuscript. The most important comments are given below. I have also provided an annotated manuscript with some smaller

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remarks that should be treated.

No reference is made to past or ongoing global model intercomparison studies (some also including social interaction with the natural system) that may also benefit from the methods presented, e.g. ISLSCP, ISIMIP, EU-WATCH. I suggest to add some of these including references. The fact that these studies are global scale rather than local definitely sets this study apart from them as many of the issues raised by the authors (e.g. differences in preprocessing procedures, parameter selection, state handling) are difficult to resolve or less important at global scale, but can be tackled more appropriately at local scales.

The 7 stages mentioned do not seem to be very specific for hydrology (although their implementation in the virtual laboratory of course is hydrology specific) but instead could be applied on any scientific model intercomparison experiment. This raises the question if you are here proposing a general framework for virtual laboratories, showing an application in hydrology, or that you are proposing a hydrology-specific framework. From the remainder of the paper, we can conclude that it is probably the latter. It would be stronger if you can emphasize how these stages are specific to hydrology compared to other scientific fields or change them so that they are hydrology specific.

Stage 3: the reworking of data into model specific inputs. Stage 3 suggests that any modeller can do any preprocessing he/she deems fit. In this transformation process however, much of the intercomparability of the experiments may be polluted by the fact that one modeller does something else with the data than another. I would propose that the degree of freedom is controlled through the proposed protocols and that you clarify this in the description of stage 3.

An important comment is that the connection between the 7 steps and the description of the collaborative experiment, performed in the SWITCH-ON project is not very clear. Please refer to the steps in the description of the 2 experiments performed so that the reader can make this connection more easily. Moreover, in the experiment description,

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a lot of focus is on the protocol design (which I agree is very important) while the protocol design receives very limited attention in the general 7-step description. It is somewhere hidden in step 4. I would emphasize more on the protocol design and describe in the 7-steps more accurately what the protocols should embody. In fact, you could argue that the protocol design should be a concrete separate step. Please consider this option.

In page 13463, l. 24-25, the authors state that “with different model implementations, the main purpose of the modelling exercise needs to be clearly defined”. Whilst I fully agree with this, strictly speaking, the second experiment design did not adhere fully to this statement. The authors indicate this also in page 13462 l. 17 “we did not specify what model improvement meant a priori”. I can imagine that this observation in fact led to the statement above, however this is not clear from the discussion. Please add a sentence that explains whether the lack of specification of the meaning of model improvement indeed led to the conclusion that the purpose of the experiment needs to be very clearly defined.

My most important comment: the experiments performed are rather simple (same model structure, same spatial representation, same data, data handling) and perhaps not very representative for the type of collaborative model experiments that the hydrological community would like to perform in the forthcoming decade. Whilst including a more complex experiment is perhaps beyond the scope of this paper, it would make the paper a lot stronger, if the authors can demonstrate that the suggested procedure for protocol establishment indeed applies even when a completely different (more complex) experiment would be performed. For instance, the suggested protocols for the experiments performed amongst the research groups would not yield a satisfactory intercomparability when the science question would be related to differences between model structures, where all groups would use different hydrological models and/or different levels of process or input distribution in their models throughout the 15 catchments, or when e.g. different ways to include man-made interactions in models would

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be studied. In these examples, models may have very different states and fluxes, and may even have different spatial representations of states and fluxes making their intercomparison a lot more difficult. It would make the framework a lot more convincing if the authors can perform a thought experiment in the discussion that demonstrates the validity of the proposed framework, even in more complex cases that will become important in this decade of Panta Rhei such as mentioned above.

I hope these comments prove useful and I am looking very much forward to an improved manuscript.

Please also note the supplement to this comment:  
<http://www.hydrol-earth-syst-sci-discuss.net/11/C6069/2015/hessd-11-C6069-2015-supplement.pdf>

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Interactive comment on Hydrol. Earth Syst. Sci. Discuss., 11, 13443, 2014.

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