Dear Reviewer 3,

Thank you very much for taking the time to review our manuscript. All your comments received were very helpful to improve the paper. We have responded to all the comments below. We believe that all your concerns have been now addressed.

Best regards,
Naota Hanasaki (on behalf of authors)

The authors present a study comparing the impact of global datasets vs. localized datasets when parameterizing hyper-resolution models for water resources applications. The paper is well written, and I appreciated the authors' efforts to obtain the best possible detailed localized data for their study site. Results show that, as expected, localized models performed better. While this is an interesting exercise, the paper would benefit from a better contextualization and insights on how we can leverage their work/their findings towards hyper-resolution modeling at the global scales, as the title suggests. Here are some major comments that should be addressed before publication:

Thank you for your positive evaluation to this paper.

L 131. "it was designed for applications to any spatial domain and resolution." One of my biggest concerns when applying large-scale designed hydrologic models to hyper-resolutions is the lack of or inappropriate processes representation at the fine scales. These large-scale models were often designed under the large grid cell assumption, in which local-scale and non-linear integrations between water and land and climate were negligible. However, when moving to fine scales, processes such as lateral water flow, the interaction between the river network and the land, and surface water pumping uphill, are no longer negligible. Rather than just increasing computational grid and parameter regionalization, hyper-resolution modeling also comes with the need to further understand and represent hydrologic processes at these scales. The authors do attempt to address the need for improving human activities representation at these scales with the implicit aqueduct estimation. It would be good to have a subsection where the authors describe the H08 efforts towards also improving hydrologic processes representation at the fine scales.

Thank you for this thoughtful comment. We agree with your point that hyper-resolution model require representation of region-specific hydrological processes not only on human activities but also on natural hydrological processes. Taking the comment of you and Reviewer 2, we have modified "4.3.4 Other factors" into "4.3.4 Natural hydrological processes" which now reads as follows.

While this study has mainly focused on the processes of water use and management, natural hydrological processes also need to be further improved. Snow falls only in limited mountainous areas of Kyushu Island and, therefore, the performance of snow process estimation was not evaluated in this study. Groundwater is expressed in highly conceptual way in H08 (treated as a hypothetical tank) which hampers the validation of groundwater simulation. As for the lateral flows of subsurface water, Ji et al. (2017) reported that they matter to the distribution of soil moisture and evapotranspiration at the spatial resolution of 1000m and finer. The inclusion of the process is crucial particularly in the regions where groundwater is the major water source. As such, the dominant hydrological processes differ region by region. Further application and investigation of the model under various environment is indispensable to fully realize globally applicable hyper-resolution modeling.

This modeling exercise demonstrated how models with localized inputs perform better than with global inputs. It would be great if the authors could provide a sensitivity analysis of the different input datasets to identify which are the most critical for improved performance. I propose a validation analysis using a leave one input out approach. In this way, besides just reporting what we know is already expected (localized models perform better), this paper has the potential to actually inform the scientific community of which of the inputs for hyper-resolution modeling we should be focusing on improving. Of course, all of them are important, but ranking them would greatly value future work in this field. Is that crop data? Precipitation? Water use and withdraws, etc.

Thank you for this comment. For hydrological simulation, we have newly conducted a sensitivity test. Please see our response to Dr. Luka Brocca for the results. In short, the results indicate that the usage of local meteorological observation dominantly contributed to improving the performance. Similar sensitivity simulations can be done for other components, including irrigation water requirement estimation and dam operation, but we omitted them because we can easily expect earning the same conclusions.

L 630. "it opens the door to applications of the model to hyper-resolution global hydrology." Not really, the results actually show the opposite: that without localized data global hyper-resolution modeling of water resources is inaccurate, and that perhaps we should be focusing on localized models. If the authors can demonstrate what are the large sources of uncertainties (e.g., which are the localized input variables that drive the uncertainties), then you could say that improving a given X input at global scales can enable more accurate hyper-resolution global hydrologic modeling.

> Thank you for your comment. We have now conducted sensitivity analysis and demonstrated that the key factor of improving the performance of hydrological simulation is the usage of daily local meteorological observation. This can be realized in two ways. One is to extensively collect daily local meteorological observation globally perhaps through international cooperation and latest information technologies. The other is to improve the reproducibility of reanalysis in particular the timing and extent of daily weather events (i.e. most of the sub-monthly scale global meteorological data are relying on reanalysis). These points and rationale are concisely summarized in newly added Appendix C (please see also our response to Dr. Luka Brocca).

Model calibration is an important aspect of the model validation performance, as such, the details should be moved from the supplemental material to the main text.

> Thank you. While we agree that model calibration played an important role in this study, we wish to keep placing the part in Supplemental Material because the method itself is very simple and the description of the related models overlaps with earlier papers (e.g. Hanasaki et al. 2008; 2018).

Section 3.1.4, in the implicit aqueduct scheme, does the water only moves downhill? How about water pumping schemes? While they are often negligible at the coarse scale they are very much relevant at the local scale.

> Thank you for this question. First, as shown in text (Line 205 of the original version), we assume the elevation of implicit aqueduct destinations (or the route of implicit aqueducts) must be always lower than the origins. This is an important assumption in the algorithm of implicit aqueduct estimation to express local water management

which sometimes dates back centuries ago when the gravity drainage is virtually the only option. We agree with you that pumps are implemented even if the aqueducts are basically drained by gravity, but these are not resolved in 1 arc minute of spatial resolution. Please note that explicit aqueducts transfer water irrelevant to elevation. Hence the aqueducts on the premise of considerable pumping can be expressed as explicit aqueducts. We have modified the following parts of "3.1.4 Implicit aqueduct estimation".

… the origins and destinations of known major water transfer facilities were prepared and implemented into the river network as explicit aqueducts. These explicit aqueducts transfer water irrelevant to elevation.

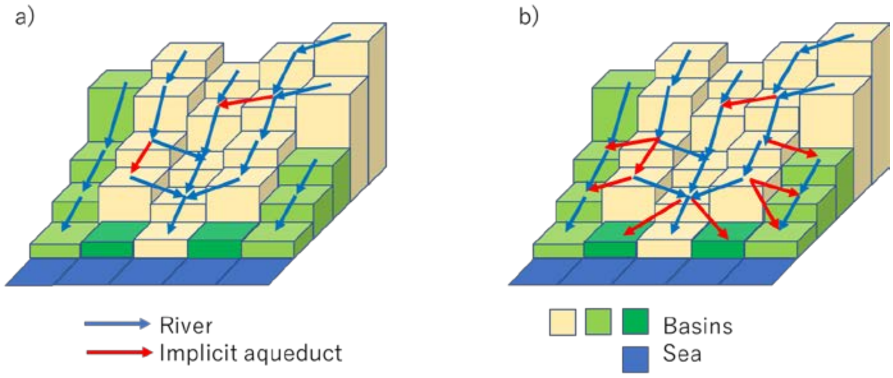
Moderate/Minor:

Section 4.3, as mentioned earlier, authors should also address hydrologic uncertainties in this section.

Thank you. We have now Section 4.3.4 "Natural hydrological processes" to discuss the hydrologic uncertainties.

Figure 3. This figure could be improved for clarity. Inter-basin transfer you mean between grid cells? Does the grid cell comprise a basin? Are the rives the blue arrows or the blue grids?

Thank you. Now we have modified the schematic for clarity (i.e. the original figure doesn't look like basins). The inter-basin transfer means water in one basin is transferred to another. The gird cells and flow directions comprise basins. As shown in the legend, the blue arrows are the rivers.



To make the point of our modeling clearer, we also modified the caption as follows.

Figure 3 Implicit aqueducts. a) The original scheme, which does not allow inter-basin transfer. Many coastal grid cells (shown in dark green) are prone to water scarcity because they have limited catchment area. b) The new scheme, which conditionally allows inter-basin transfer. Coastal grid cells receive inter basin water transfer from neighboring basins. Columns represent land grid cells. The height indicates each grid cells' mean elevation. Colors indicate different basins.

Table 5 would benefit from a more descriptive header.

Thank you. Now the caption reads "Table 5 Simulations. Key differences between the GLB and LOC simulations". To make the table consistent with the sensitivity simulation, the table has been slightly modified. That is, the original "meteorological data" are now subdivided into "spatial resolution of daily meteorological data" and "source of daily meteorological data".