

***Interactive comment on “Analysis of the impact of climate change on groundwater related hydrological fluxes: a multi-model approach including different downscaling methods” by S. Stoll et al.***

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This manuscript provided insight of the effects of downscaling methods on the response of a hydrological system to climate change. The dynamic-multimodel analysis was rigorously performed for a small catchment in Switzerland. First, precipitation data from the general circulation model (GCM) was downscaled to local-scale precipitation that serves as the driving force of the ground water system. Then, the downscaled precipitation was applied to a 3-D integrated surface water-groundwater hydrological

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model to explore its impacts on the projected groundwater water response. Results of three different downscaling methods were compared. The authors concluded that the downscaling methods serve as the important source of uncertainty of the hydrological studies.

The most striking result of the manuscript is the increasing groundwater level predicted by the integrated model for the future using the downscaled precipitation. The result is very different from previous studies. Previous studies predict a reduction in overall precipitation, an increased frequency of both extreme precipitation events and severe droughts. All these lead to a possible decline of groundwater table. However, the net precipitation projected by three downscaled precipitation shows increasing in the future and leads to an increase of groundwater level. The difference of predictions for present and previous studies in groundwater table variation is very possibly caused by the downscaling methods (as shown in Figure 8). This raises important questions that which projected trend (with and without downscaling) of groundwater level is correct and whether new downscaling method is required. Since 2000-2010 precipitation data are well bounded by all projected envelopes with and without downscaling methods (Figure 9), the verification of the downscaling method becomes a challenge task.

The authors argued that the performance of downscaling methods should be evaluated by average values, the variability but also the intra-annual distribution (P. 7540, Line 26 – P. 7541, Line 2). Alternatives may be to recognize the capability of the downscaling method such that the downscaling results match the main concerned characteristics of precipitation for specific management purpose (for example, disaster prevention or drought adaptation). Analyzing historical data did help us to understand how the hydrological system has reacted under the significant historical changes in climate conditions. However, prediction work is for better adaptation in the future. Risk assessment is still the main tool. Historical variation may not repeat in the future. Therefore, the pursuit of appropriate downscaling method and its validation seems more urgent for the climate change study.

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More specific comments are as following. P. 7528, Line 20, “the eastern boundary is chosen parallel to groundwater flow line, . . .”. Does this mean a no flow boundary? With no flow boundaries around the numerical domain, the study area serves as isolated unit to response the climate change.

P. 7529, Line 4, Please explain why the SREE A1B emissions scenarios is chosen.

P. 7529, Line 27, Which weather station is used? Effretikon or Zurich-Kloten airport?

P. 7530, Lines 14-15, The monthly CDF correction downscaling method needs more detailed description. For example, how the previous methods were combined?

P. 7530, Lines 23-25. Uncertainty sources may also include the validity of the coupled surface water and groundwater water model since the available observation wells and piezometers are sparse in the study domain.

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