Reference: hess-2020-501

"Aquifer recharge in the Piedmont Alpine zone: Historical trends and future scenarios"

Reviewer #1

1) *The manuscript sent by Brussolo et al. provides a study and information of water potential for drinking water supply in the catchment area that belongs nearly 2.3 million inhabitants. The past, present and future state of the water potential is studied. Brussolo et al. provides a methodology that accounts for precipitation, temperature, snow melt and actual evapotranspiration. Climate change scenarios are predicted by RCM (RCA4). I think this study serves the local policy very well and will benefits the local measurements of future usage of water consumption as they also mention in conclusions "This study constitutes a knowledge basis which helps for a better informed management, infrastructural and supply decisions for the study area considered…" Brussolo et al concluded that "…our methodology could be extended also to other regions".*

We thank the reviewer for this positive feedback.

2) *The methodology presented here is not very novel and I encourage the authors to look much more detail in the scientific literature about the models that have been used in the prediction of water potential in local, regional and even continental scale. Authors do not provide any background about previous studies of methods that have been used in the past 20 years. For example page 2, 30, they list impacts of CC impacts on hydrological cycle but do not provide any references of previous studies.*

We revised the Introduction to include more references providing a background about previous studies (Smerdon 2017; Epting et al., 2021; Li et al., 2015, Taylor et al. 2013) which justify the use of precipitation as the largest source of recharge variability, the importance of the spatial and temporal variability in recharge-related studies and illustrate how groundwater recharge projections are related to projections of precipitation, irrigation and snowpack reduction.

3) *The main objective of the paper is to estimate future change and variability of precipitation, AET and drainage (recharge) locally. This kind of assessment is more or less day-to-day job nowadays which means that novelty with respect to scientific research should be emphasis more clearly in this study. If they like to present a novel method or approach, and use this region as an example, they need to clearly state how this method/approach improves the previous ones that have been used. If the goal is to assess water potential of this region, then they need to come up with the outcome that is not noted in previous studies (in similar environment) and clearly emphasis this outcome. Unfortunately I did not recognize this. I encourage authors to get back on board, and revise the paper in the sense that it could focus more on the methodology and clearly state the novelty of it, or if the focus is more on the region itself, the novelty of simulations results need clearly state and what are new findings that could attract readers, not only from this region but also elsewhere.*

We thank the reviewer for this comment that allows us to better explain the focus of the paper.
In fact, in our opinion this paper can be considered as a case-study of an interdisciplinary research approach, where scientists in atmospheric/climate research and hydrologists work together with agricultural and soil scientists and experts from a water utility to quantify the role of groundwater in providing water for society. A local water utility (to which the first author is affiliated) provided funding for this study and participated in defining the goals of the research and in the development of the analysis. This paper shows the results of an approach really tailored to stakeholder needs, and the outcomes will drive local policies, helping to assess the water potential of the study area. This study provides the knowledge basis for the definition and refinement of the study-area long-term guidelines and strategic development for groundwater resources protection and infrastructural provision and planning.

In such a context, it is important to highlight that no similar "stakeholder-driven" research studies were already carried out in that area and this approach anticipates the recent EU Sustainable Taxonomy (REGULATION (EU) 2020/852) that clearly states that all the mitigation and adaptation measures undertaken by the different stakeholders should be quantified and driven by state-of-the art climate information and projections.

The estimation of future change and variability of precipitation and other water balance terms are currently provided by different climate services already developed by the scientific community, however these services require an appropriate engagement with users which is still lacking to a large part. Often the stakeholders are not considered as proactive actors but only as final users who download pre-computed decision-relevant scientific information in order to develop and apply adaptation or mitigation strategies. In such a framework, this paper provides an example of a shared and sinergical work. We think that this study is totally in-line with the official aim and scope of HESS, to serve both the hydrological science community as well as water engineers and water managers.

Moreover, the characteristics of spatial and temporal variability of aquifer recharge found in this paper can be of interest for other European areas, particularly in the Mediterranean area and in the Alps. The paper not only relies on future climate simulations to provide estimates of future aquifer recharge, but also analyses about 60 years of historical data related to the water balance terms. The dry east-west valley shows significant negative drainage trends both yearly and in the spring quarter, confirming the seasonal variations found by Epting et al. (2021), and giving interesting hints for many other similar valleys in the Alps. Actual evapotranspiration is shown to generally increase both in historical data and in future simulations, despite the role of regulation given by soil drying. Finally, as suggested by Taylor et al. (2013), the role of irrigated agriculture is considered. In such a context, irrigation, that significantly contributes in increasing actual evapotranspiration as a consequence of the air temperature increase, is simulated in a novel way. More specifically, the results of field studies with both surface and sprinkler irrigation methods were used, combining them with crop and irrigation regional databases (as described in the Sections "Study area and methodology" and "Input data of the soil water model" of the manuscript.)

All these considerations have been included in the revised paper extending the abstract, introduction, methodology and conclusions.

4) *The results need (in both cases) to discuss in depth and compare with previous findings.*

Actually, our manuscript already discusses and compares exhaustively the results to previous findings, as also demonstrated by our extensive bibliography (which has been further extended following our reply #2 to this reviewer). If there are specific points which the reviewer thinks should be discussed in more depth, we will be glad to address them.