

Dear Dr. Yaling Liu,

While this work has merit of enhancing the understanding of driving forces for desalination expansion, it needs substantial improvement to provide solid contribution to the community.

Thank you for taking time to read our discussion paper and provide valuable comments. Our response to your questions and comments are shown below.

1. The methodology part is very vague, no model representations or equations are documented, and it is not clearly explicit so that the study can be reproduced.

Thank you. Although we still believe all the necessary information is described in the discussion paper to reproduce our results, we further elaborated the details of methodology in the Method Section for broad readership. In short, our model overlays several gridded global maps of hydrological and socio-economic factors, and extract the grid cells that meets the conditions. Such fundamental concept has been now clearly shown in line 148-157 of the revised manuscript.

2. The assumption of "All the municipal and industrial water withdrawal in Area Utilizing Seawater Desalination (AUSD) is supplied by seawater desalination" is unrealistic. Take the current biggest desalination country Saudi Arabia as an example, the surface freshwater withdrawal, groundwater withdrawal and desalinated water in 2005 is 1.1, 21.5 and 1.0 km<sup>3</sup>, respectively (AQUASTAT).

Thank you for giving us an opportunity to clarify some important points. The large volume of groundwater you pointed out is used for agriculture which is excluded from this study (we are focusing on only industrial and municipal water). In fact, AQUASTAT reports that as much as 88% (20.83 km<sup>3</sup> yr<sup>-1</sup>) of total water withdrawal was used for agriculture in Saudi Arabia. Siebert et al. (2010) showed that 88.4% of irrigation water is supplied from groundwater in Arabian Peninsula. Hence the results shown in our discussion paper and the data provided by AQUASTAT are consistent.

3. Only global total desalination amount for 2025 and 2055 is presented, the part that would be valuable to the community – the spatial and temporal changes of desalination amount – is missing.

Thank you for this comment. In the revised manuscript, we have provided spatially and temporary detailed results. Spatially detailed results are now shown in newly added Table 5

(production of seawater desalination) and Tables S3-S4 (cost and its GDP percentage) and discussed in lines 310-330. Temporally (Historically) detailed results are shown in newly added Figure 5 and lines 281-294.

#### References

Siebert, S., Burke, J., Faures, J. M., Frenken, K., Hoogeveen, J., Döll, P., and Portmann, F. T.: Groundwater use for irrigation – a global inventory, *Hydrol. Earth Syst. Sci.*, 14, 1863-1880, 10.5194/hess-14-1863-2010, 2010.