Muttama paper review comments

Reviewer 1:

This study presents a comprehensive dataset for a catchment with significant ground salinity issue. This data contains long term observation of water flow, ground water and salinity levels, which is very useful for further research. Therefore, I recommend a major revision of the manuscript before it can be accepted for publication.

General comments:

There are so many figures in the main-text. Some of the figures need to be moved to supplementary information.

Based on both reviewers' comments, we agree that we can rationalise and combine some of the figures and reduce the number of figures in the paper.

The authors need to state something about the representativeness of the watershed in the discussion. Otherwise, this is a local dataset. Can you write something about how this dataset can be useful for the study for other regions of the world with similarity in hydrological or geological conditions.

We will expand the introduction to highlight this point better.

The watershed is representative for semi-arid watersheds globally, but typical for Australia where a significant amount of research has taken place at the watershed scale (e.g. Crosbie et al. 2007; Hughes et al. 2007; Hughes et al. 2008; Summerell et al. 2006). Unfortunately, a lot of the older data is not easily accessible and extractable. This paper attempts to correct this by providing an open dataset, which hopefully will also encourage older research to summarise and report open data.

As all watersheds are unique in some way, it is hard to identify more exact matches to the watershed. However, we believe that the data would be relevant for areas in the US, Canada, Asia and South America (Thorslund and van Vliet, 2020; Stavi et al. 2021).

Dryland salinity also remains a global problem (Thorslund and van Vliet, 2020; Stavi et al. 2021; McFarlane et al, 2016). In particular the impact of salinity on freshwater systems such as wetlands is recognised as a serious threat (Cañedo-Argüelles et al. 2016). More importantly, in this case it is recognised that not only the EC (such as in the global database from Thorslund and van Vliet (2020)) is of importance, but the actual different chemicals, as they have different impacts on ecology (Cañedo-Argüelles et al. 2016). Our dataset addresses this by providing a long-term database of all major ions as well as salinity values. To strengthen this point, we will add a correlation plot of the EC and the major anions to the paper.

Finally, there are very few, long term, watershed datasets that include salinity, major ions and cover groundwater and surface water. We hope this data set can help improve our understanding of salinity processes which can then support studies and management of watersheds globally.

The changed text in the introduction now reads:

L24:

Dryland salinity also remains a global problem (Thorslund and van Vliet, 2020; Stavi et al., 2021; McFarlane et al., 2016). In particular, the impact of salinity on freshwater systems such as wetlands is recognised as a serious threat (Canedo-Arguelles et al., 2016). More importantly, in this case it is recognised that not only total salt concentration, using the often reported electrical conductivity (EC, such as in the global database from Thorslund and van Vliet (2020)), is of importance, but the actual different chemical species, such as types of cations, as they have different impacts on ecology (Canedo-Arguelles et al., 2016).

And

L61

The Muttama catchment is representative of flat semi-arid catchments globally, but especially of Australian catchments where a significant amount of research has taken place at the catchment scale (e.g. Crosbie et al., 2007; Hughes et al., 2007, 2008; Summerell et al., 2006). Unfortunately, a lot of the older data is not easily accessible and extractable. This paper attempts to correct this by providing an open dataset, which hopefully will also encourage other research teams to summarise and report open data. As all watersheds are unique in some way, it is hard to identify more exact matches to the watershed. However, we believe that the data would be relevant for semi-arid areas in the US, Canada, Asia and South America (Thorslund and van Vliet, 2020; Stavi et al., 2021).

References

Cañedo-Argüelles, M. et al., 2016. Saving freshwater from salts. Science, 351(6276): 914-916. DOI:doi:10.1126/science.aad3488

Crosbie, R.S., Hughes, J.D., Friend, J., Baldwin, B.J., 2007. Monitoring the hydrological impact of land use change in a small agricultural catchment affected by dryland salinity in central NSW, Australia. Agricultural Water Management, 88(1–3): 43-53. DOI:http://dx.doi.org/10.1016/j.agwat.2006.08.009

Hughes, J.D., Crosbie, R.S., van de Ven, R.J., 2008. Salt mobilisation processes from a salinised catchment featuring a perennial stream. Journal of Hydrology, 362(3-4): 308-319.

Hughes, J.D., Khan, S., Crosbie, R.S., Helliwell, S., Michalk, D.L., 2007. Runoff and solute mobilization processes in a semiarid headwater catchment. Water Resour. Res., 43: W09402. DOI:doi:10.1029/2006WR005465

McFarlane, D.J., George, R.J., Barrett-Lennard, E.G., Gilfedder, M., 2016. Salinity in Dryland Agricultural Systems: Challenges and Opportunities. In: Farooq, M., Siddique, K.H.M. (Eds.), Innovations in Dryland Agriculture. Springer International Publishing, Cham, pp. 521-547. DOI:10.1007/978-3-319-47928-6_19

Stavi, I., Thevs, N., Priori, S., 2021. Soil Salinity and Sodicity in Drylands: A Review of Causes, Effects, Monitoring, and Restoration Measures. Frontiers in Environmental Science, Volume 9 - 2021. DOI:10.3389/fenvs.2021.712831

Summerell, G.K., Tuteja, N.K., Grayson, R.B., Hairsine, P.B., Leaney, F., 2006. Contrasting mechanisms of salt delivery to the stream from three different landforms in South Eastern Australia. Journal of Hydrology, 330(3-4): 681-697.

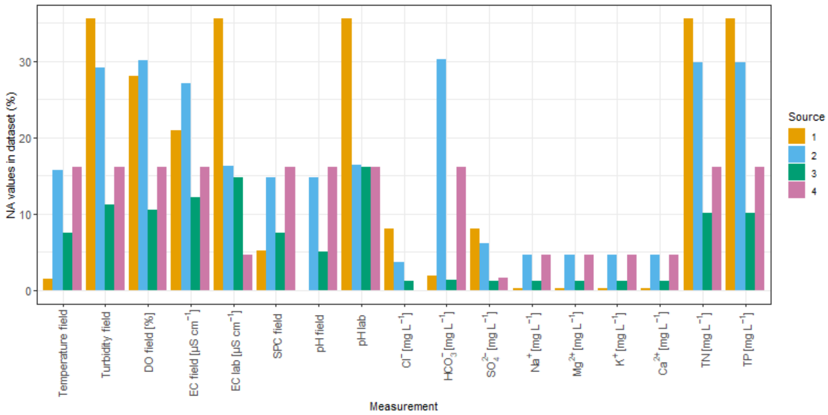
Thorslund, J., van Vliet, M.T.H., 2020. A global dataset of surface water and groundwater salinity measurements from 1980–2019. Scientific Data, 7(1): 231. DOI:10.1038/s41597-020-0562-z

Line-to-line comments:

Figure 4 are not very important; can you move it to supplementary information. I think you only need to present the figures relate to the results.

We think highlighting the temporal gaps in the data is important. However, we agree that the current figure is not very informative. We will redo this figure to highlight the data gaps by month and by location and merge with Figure 3.

Figure 3 and 4 now combined:



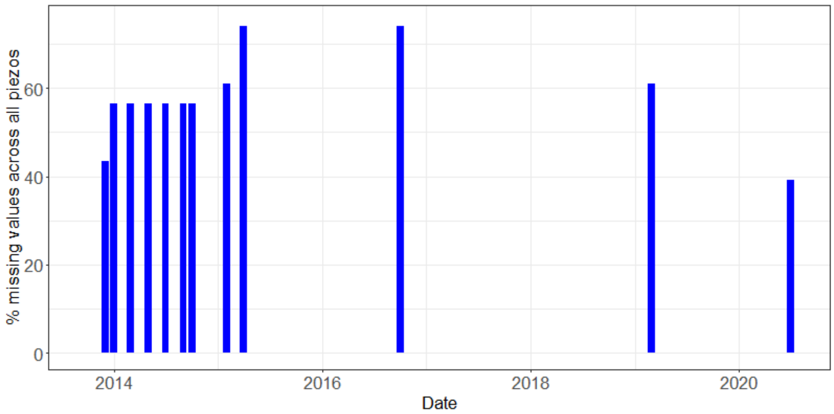
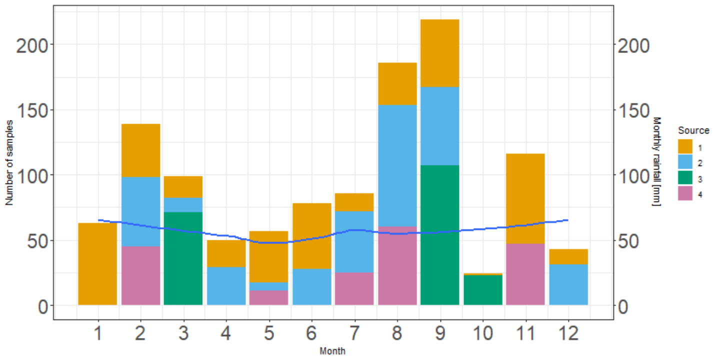
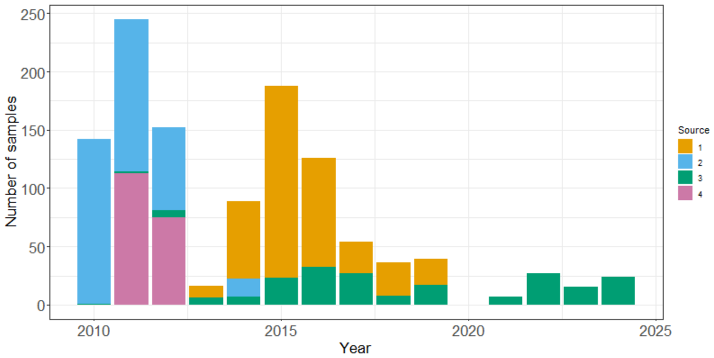


Figure 5 and 6 can be put together.

Agreed, we will combine figure 5 and 6:





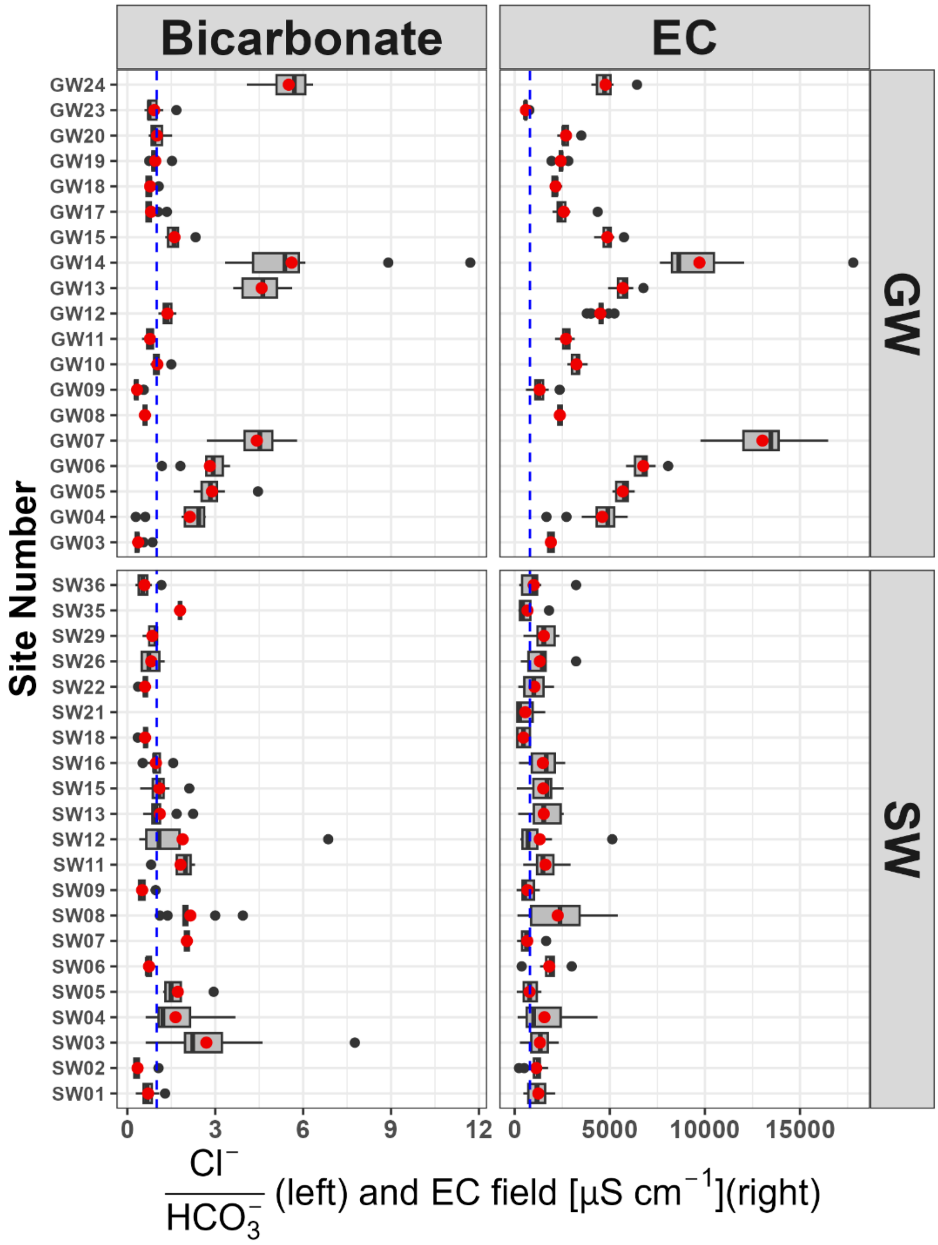
Page 8: can you move the Pseudo code to supplementary information

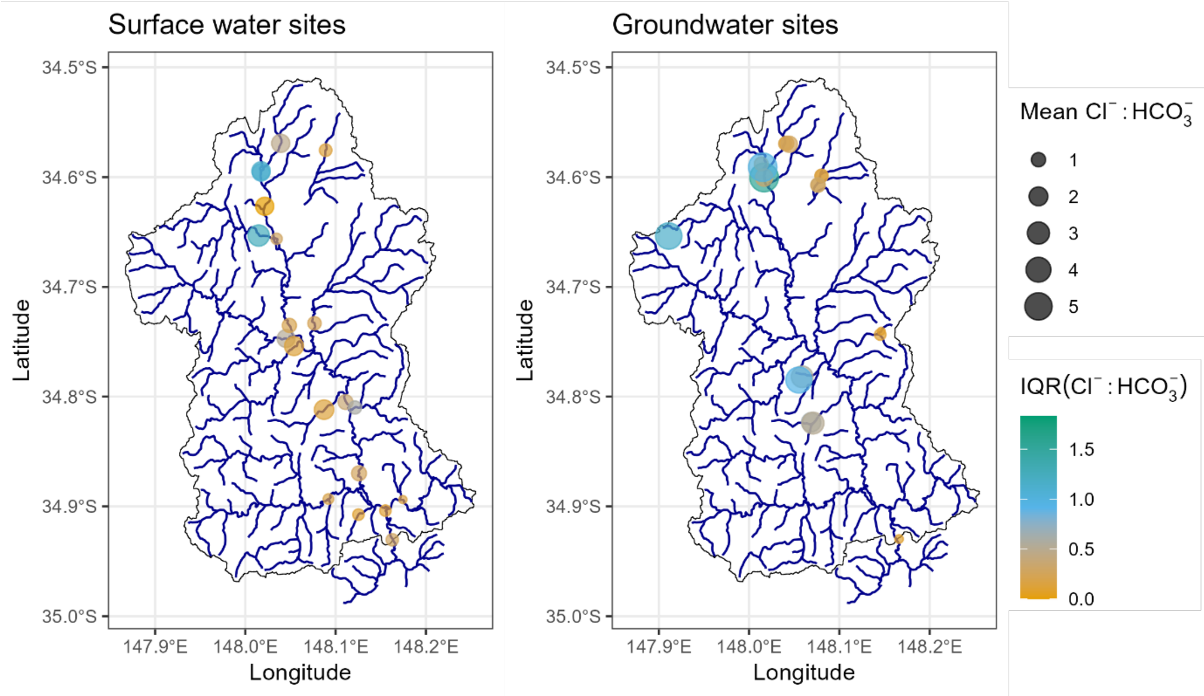
Agreed, will move this to the supplementary information

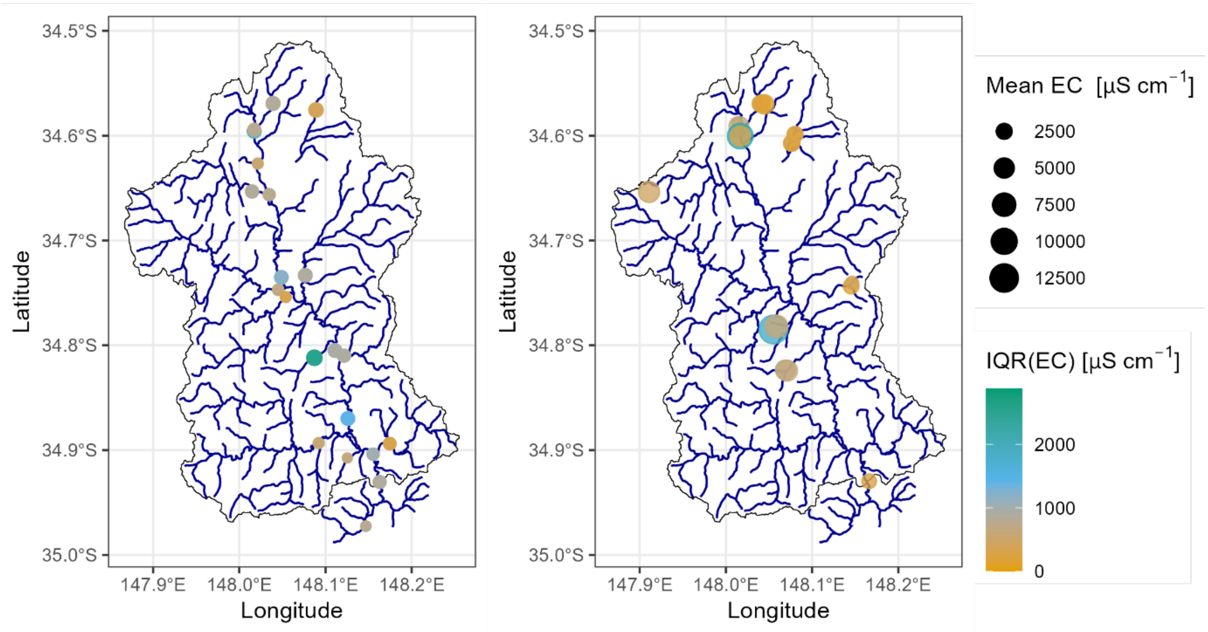
Can you compile figure 10 and 12 together? Also, for Figure 11 and 13.

We can try to combine Figure 10 & 12, which we originally did, but worried that the maps would become too small. However, we will attempt this again and landscaping the figure. Combining Fig 11 & 13 would probably make the figures too small and the labels very difficult to read. We believe it is therefore better to keep them as separate figures.

We have managed to combine both figures in the way the reviewer requested







Line 240: can you compare the items in other national datasets?

Only limited comparisons can be made with existing national datasets. Almost none of the national datasets include sufficient detail in hydrogeochemistry to provide comparison. A lot of the Australian work has concentrated on deep aquifers and the connections with the Murray river and larger regional scales across Australia, which provides limited comparison for catchment level studies of both surface water and groundwater.

Some comparisons we can be made with the work by Hughes et al. (2007 & 2008) who provides some level of hydrogeochemistry detail for studies in NSW. This suggests that the results in our dataset are similar.

We will include a comparison to the Australian data in the global dataset from Thorslund and van Vliet (2020) focusing on shallow groundwater and the surface water data in this dataset. However, this dataset only covers EC

And there is some smaller watershed scale work in the state of Victoria in Australia, but more focussed on groundwater (e.g. Cartwright et al. 2004; Bennetts et al. 2006). Also no detailed data is provided in these papers.

We have added text and a new figure to the discussion

L272 (tracked) and L 258 (revised):

As a baseline comparison, we compared the EC data from the catchment samples with data from the database from Thorslund and van Vliet (2020). We subset the global database by Australia, and restricted the groundwater data to shallow groundwater 260 < 20m from the surface (Figure 11). The data from this figure are not included in the github due to the size of the global data set and because the original data is readily available. The figure clearly shows that the data collected in the Muttama catchment fall well within the overall distribution of comparable observed salinity values in Australia for both surface water and groundwater.

In addition, comparison with Table 3 and Figure 5 in Hughes et al. (2007) clearly highlights the value of the Cl/HCO3 ratio in comparing values of EC, Cl, and HCO3. For example, in a catchment about 100 km north of Muttama catchment, Hughes et al. (2007) found a much lower mean of 77 mg L-1 for CaCO3 in runoff. This study found a higher mean of 334 mg L-1 (Table 3). However, Hughes et al. (2007) found a mean of 1056 mg L-1 for Cl, while this study found a much lower mean of 294 mg L-1, suggesting quite different ratios. Finally, Hughes et al. (2007) reported a mean EC of 3717 μ S/cm in runoff, while our data has mean of 1246 μ S/cm (Using the temperature corrected value). In other words, the EC values in the Muttama Creek catchment are more dominated by the alkalinity, resulting in lower EC values. However, similar to Muttama Creek catchment, Figure 5 in Hughes et al. (2007) also indicates much higher alkalinity in the groundwater.

References

Bennetts, D.A., Webb, J.A., Stone, D.J.M., Hill, D.M., 2006. Understanding the salinisation process for groundwater in an area of south-eastern Australia, using hydrochemical and isotopic evidence. Journal of Hydrology, 323(1): 178-192. DOI:https://doi.org/10.1016/j.jhydrol.2005.08.023

Cartwright, I. et al., 2004. Hydrogeochemical and isotopic constraints on the origins of dryland salinity, Murray Basin, Victoria, Australia. Applied Geochemistry, 19(8): 1233-1254. DOI:https://doi.org/10.1016/j.apgeochem.2003.12.006

Hughes, J.D., Crosbie, R.S., van de Ven, R.J., 2008. Salt mobilisation processes from a salinised catchment featuring a perennial stream. Journal of Hydrology, 362(3-4): 308-319.

Hughes, J.D., Khan, S., Crosbie, R.S., Helliwell, S., Michalk, D.L., 2007. Runoff and solute mobilization processes in a semiarid headwater catchment. Water Resour. Res., 43: W09402. DOI:doi:10.1029/2006WR005465

Thorslund, J., van Vliet, M.T.H., 2020. A global dataset of surface water and groundwater salinity measurements from 1980–2019. Scientific Data, 7(1): 231. DOI:10.1038/s41597-020-0562-z

Reviewer 2:

General Comments

This article offers a brief yet intriguing description of a hydrogeochemical dataset. This dataset comprises 1,160 water samples gathered over a span of 14 years at 62 different sites. Both the dataset and this article hold important value for the community interested in dryland and irrigation salinity. Nevertheless, the article may require substantial revisions prior to publication.

My primary concern lies in the further value of this dataset, considering that the data were collected through inconsistent methods. The authors do provide a comprehensive description of the dataset regarding its collection process, quality, and known and unknown biases. However, the potential of the data set for further use is not adequately emphasized. A concrete example of this critique is Section 3.3.

In this section, Table 2 and Figures 8 - 13 present some instances of what this dataset can reveal, but the analysis is rather weak. If six figures and one table only warrant two general paragraphs of explanation, then the necessity of presenting these items might be called into question. Moreover, Figures 10 and 11 are not mentioned at all throughout the article, and Figures 7, 8, and 9 are in different sections from their corresponding references/explanations, indicating that the organization of the content needs considerable improvement.

We specifically removed analysis of the dataset as this is a "data paper" and we wanted to leave the specific analysis to the users of the datasets. However, given the concerns of the reviewer we can expand section 3.3 to provide a more detailed description of the data and the spatial variation in the data set and how this links to the local geology. In addition, we will include a correlation diagram between the EC and the major ions to highlight the relationships eluded to in the introduction, and we will do a comparison with the Australian EC data for surface water and shallow groundwater from Thorslund and van Vliet (2020).

We will also check that we describe all the figures in the section in more detail and outline the specific characteristics of the dataset in these figures.

Please see revised text with reviewer 1. We also included this figure:

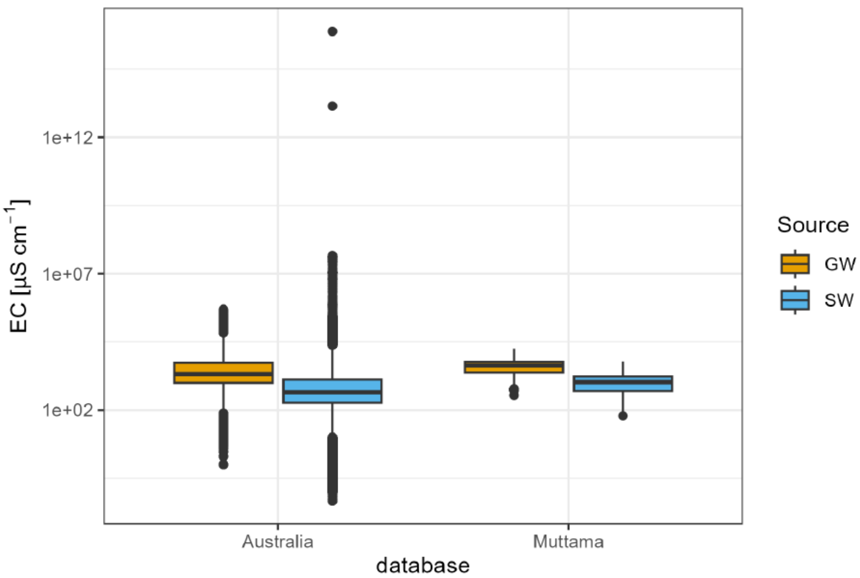


Figure 11. Boxplots comparing the electrical conductivity for samples of the Australian database extracted from Thorslund and van Vliet (2020) and the database of samples from Muttama Catchment.

For a data - description paper, it is preferable to offer readers information beyond just the appearance of the dataset. More importantly, it should inspire others regarding its greater potential. Specific scientific questions that the dataset can contribute to may be helpful.

See our last comment, we did not want to provide a full analysis of the dataset, as this paper is focussed on simply describing the data and making it available for other researchers. We will also expand the discussion to provide a number of questions that can potentially be answered with the data, some of which are part of our current research:

- Long term trends in the data given climate variation
- Spatial and temporal variation in groundwater and surface water interactions
- Testing different hydrological and hydro chemical models

We have expanded the discussion with the following text

L292

The presented dataset provides significant opportunities for further research, particularly because of the length of the time series. For example, there is the opportunity to examine trends in salinity due to changes in climate. There are few datasets that cover shallow groundwater and concurrent surface water across a similar wide range of hydrogeochemistry. This opens up the opportunity to look at temporal variability in groundwater surface water connections, particularly for flat semi-arid systems similar to Muttama Catchment, as in Akter (2018). The comprehensive nature of the data also creates opportunities for testing more complex hydrological and hydrogeological models. An example could be to extend the work by Deb et al. (2019) to look at variations in rainfall-runoff response during wet and dry periods, which for Muttama catchment was linked to groundwater surface water connections. Finally, given our intention to continue collecting data in the catchment, there is an opportunity to look at shifts in the hydrogeochemistry as a result of wet and dry periods.

Details

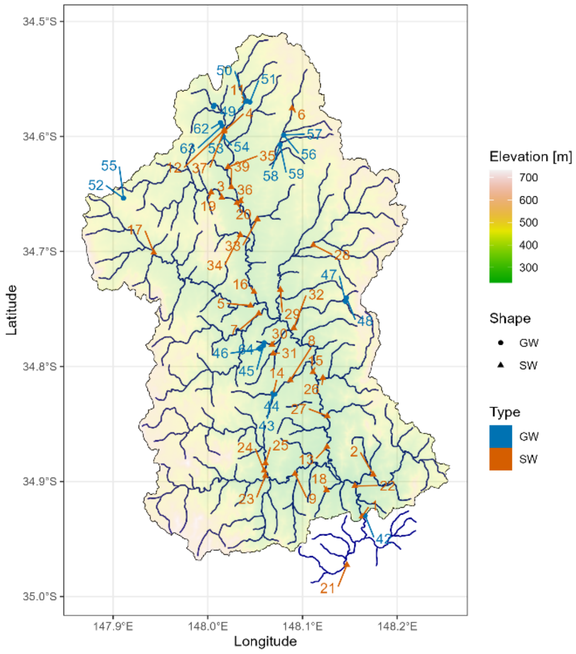
Line 98 mentions "62 sample locations," which does not align with the sites marked and numbered in Figure 2. Additionally, as the authors have clarified that "not all sites were sampled at all times," I suggest incorporating an extra color bar in Figure 2 for location markers to denote the specific number of samples through different colors. In this case, the previous "GW/SW" color bar could be removed, and the information it conveys could instead be represented by varying shapes of the location markers. Regarding the caption of Figure 2, the mention of "Brown/Orange" seems inaccurate. Isn't the color for "GW" coral red?

Ther are 23 groundwater samples and 39 surface water samples, which equals a total of 62 samples. The numbers are 1 – 23 for the groundwater samples and 1 – 39 for the surface water samples in the data set.

We agree that the caption of the figure will be corrected and updated to reflect information suggested by this reviewer

We originally had varying shapes but removed these as the figure became too busy. However, we will now improve the figure by increasing the transparency of the background, and inserting different shapes for groundwater and surface water.

The new figure is below



Line 109 – 112: The description of Table 1 as well as Table 1 itself is not very clear. Readers cannot tell from Table 1 which locations consist of 6/5/4... variables or at least the numbers of locations that include specific numbers of variables.

We will update the table to provide clearer information about how often and what at each location was sampled.

The new table is below:

Table 1. Variables measured in the field and laboratory.

Field measurements	Records Field	Lab repeat	Records Lab	Anions	Records Anions	Cations	Records Cations	Other	Records other
pH	742	pH	182	Cl^-	1010	Na^+	1035	Total Nitrogen	96
EC (Electrical conductivity)	274	EC	332	HCO_3^-	583	Mg^{2+}	1035	Total Phosphorus	96
SPC (temperature corrected EC)	653			SO_4^{2-}	961	K^+	1035		
Temperature	684					Ca^{2+}	1035		
Dissolved Oxygen (DO)	174								
Turbidity	90								

L119-L120: The exact instrument information with the data is crucial for others to do research based on data sets not collected by themselves. Could the authors make more effort to supplement the instruments and their configuration information?

Page 6 of the paper already includes the specifics of the instruments, but we will expand this by inserting a table that outlines more specific detail of the probes and the sensors installed on the instruments.

The new table is below:

Table 2. Different instruments used in the sampling.

Instrument	Purpose	Date	Sensors
YSI6600	Surface water	up to November 2014	pH: 6561 pH probe
			Temperature/EC: 6560 Conductivity/Temperature
			Turbidity: 6136 Turbidity Probe, Wiping
			DO: 6562 Dissolved oxygen probe
YSI600	Ground water		pH: 6561 pH probe
			Temperature/EC: 6560 Conductivity/Temperature probe
YSI ProDSS multiparameter sampling		November 2014 - mid 2019	pH: ProDSS pH Sensor with Module
			Temperature/EC: ProDSS Conductivity and Temperature Sensor
			DO: ProDSS ODO Optical Dissolved Oxygen Sensor
YSI EXO2 multiparameter sonde	Surface water	After November 2014 - end 2023	pH:EXO pH Smart Sensor
			Temperature/EC: EXO Conductivity and Temperature Smart Sensor
			Turbidity: EXO Turbidity Smart Sensor
			DO: EXO Optical Dissolved Oxygen Smart Sensor
YSI EXO1 multiparameter sonde	Ground water	After Mid 2019 to current	pH: EXO pH Smart Sensor
			Temperature/EC: EXO Conductivity and Temperature Smart Sensor
YSI ProDSS multiparameter sampling	Surface water	Start 2024 to current	pH: ProDSS pH Sensor with Module
			Temperature/EC: ProDSS Conductivity and Temperature Sensor
			Turbidity: ProDSS Turbidity Sensor
			DO: ProDSS ODO Optical Dissolved Oxygen Sensor

L146: 'pseudocode below', The comparison operator in the conditional statement of the pseudocode is missing.

Corrected and moved to supplementary material as suggested by the first reviewer

L151: 'due to the a lack of...'

corrected

Figures

Some captions of tables/figures, have a comma at the end while others do not, please unify them.

corrected

Figure 4: This figure is poorly presented. I cannot distinguish thicker lines from these sparse, thin lines.

Agreed, we will redo figure 4 to make it clearer. We will group the data by month to make the figure more interpretable and still convey the same information. Figure 4 has also been merged with Fig 3

See reply to reviewer 1, which highlights the figure

Figure 6: Why not use the same visualization method as Figure 5? (with intervals between adjacent bars)

Agreed, we will redo figure 6

See Reviewer 1 for the new figure