**Response to Reviewer Comments – Reviewer 2**

We thank the editor and the three reviewers for their constructive comments and suggestions. We thank all three reviewers' comments that the text is well written and for their recognition of our study as a valuable resource for groundwater practitioners. We believe that in addressing their comments, the manuscript will be considerably improved and be ready for publication.

Most questions were about minor text updates and queries. Two reviewers asked for further comparisons between our outputs and previous investigations. We present a suggested approach to address these comments, including new figures for both the manuscript and the supporting information.

We believe that these additions directly address reviewer concerns, clearly showing the impact of the distribution of our estimates as a primary control on the differences in recharge estimates between our study and previous studies.

Our responses to the reviewer's comments (**RC**) are provided below as author's comments (**AC**). To help with the assessment of our responses, we colour coded our responses into agreement (green), partial agreement (yellow) and disagreement (red). When referring to text excerpts in our manuscript, we have provided the line number and whether ~~text has been removed~~, or if new text is added.

**RC1:** I found the manuscript to be very interesting and, as a groundwater modelling practitioner, I expect it to be a valuable resource if published. I expect to use it as a source for initial model parameterisation of diffuse, rainfall derived-recharge fluxes and for providing a point of comparison and reference for groundwater models in Australia.

The document is well written and provides an excellent description of the methods used, the main findings and discusses interesting outcomes including the limitations in the approach.

> **AC:** Thanks for your interest, positive feedback and helpful comments on our manuscript that intend to improve our work.

**RC2:** I understand that point estimates of groundwater recharge have been obtained from chloride measured in groundwater bores by the Chloride Mass Balance method using gridded chloride deposition, runoff, and precipitation datasets. The point estimates have been integrated through a Random Forest analysis to produce a recharge model for the entire continent.

Although I have no experience or understanding of the Random Forest method, I assume that the R5, R50 and R95 distributions illustrated in Figure 6 illustrate the uncertainty associated of the Random Forest analysis and do not include the additional uncertainty of the Chloride Mass Balance estimates used to obtain the point estimates. In my opinion the text would be improved by a clarification of this point.

> **AC: We partially agree (minor change to manuscript suggested).** The reviewer's general understanding of how the point estimates of recharge have been obtained is correct. However, it appears that the reviewer has mistaken the $R_5$, $R_{50}$ and $R_{95}$ gridded maps shown in Figure 6 to represent the uncertainty associated with the Random Forest analysis. Rather, these are the outputs of the three separate random forest models and represent the uncertainty in the application of the CMB methodology (i.e., including uncertainty of groundwater chloride concentration, chloride deposition and runoff coefficient). To make this point clearer we suggest making the following addition.

**Suggested text changes in manuscript**

Suggested revision at line 183: A probability distribution was created for each bore by calculating recharge (R) 1,000 times using the 1,000 sampled replicates from the distributions of $Cl_{gw}$, D and α. To quantify the uncertainty in recharge estimates, the ~~The~~ median recharge ($R_{50}$), 95$^{th}$ percentile recharge ($R_{95}$) and 5$^{th}$ percentile recharge ($R_5$) values were calculated from each probability distribution and provided as outputs for each bore.

**RC3:** I found the comparison to similar published studies in Section 4.2 to be of particular interest. I was surprised at the apparent discrepancy between the average point recharge estimates from the current study and those collated from other recharge studies in Australia (specifically Crosbie et al. (2010a) and Moeck et al. (2020)). The current study provides average point recharge estimates that are about 5 times lower than those obtained from the other studies. The text suggests that different distributions of data used to derive the recharge estimates and the different methods used to calculate recharge (including watertable fluctuation, catchment scale water budgets and other environmental tracers) may be the factors that explain these discrepancies. Without further discussion and examples, I find it difficult to accept that these issues can explain the magnitude of the discrepancy. For example, I find it unlikely that the spatial distribution of data used for the current and previous studies will be significantly different. I assume they all rely on measurements made in groundwater bores, the total population of which being the same for all studies. The discussion also calls into question the reliability of the Chloride Mass Balance method when compared to other recharge estimation techniques.

**AC: We partially agree (minor changes to the manuscript and supporting information suggested).** To address this point, we will provide updates to the text and present a new figure in the manuscript and another in the supporting information to make this point more definitively.

The question from this reviewer is highly similar to a question from Reviewer 1. See response to RC2 from Reviewer 1, as the suggested changes directly address this question from Reviewer 2.

**RC4:** While not suggesting that significant revisions to the manuscript are necessary, I believe the paper would benefit from a more focussed, qualitative assessment of uncertainties included in the recharge distributions presented in Figure 6. This should not only address the uncertainty in the Random Forest model but also in the uncertainty associated with Chloride Mass Balance estimates themselves including the reliability of the datasets used to obtain the point estimates.

**AC: No (additional) change suggested.** We have addressed this comment in the previous two responses above.