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Hydrology and Earth System Sciences Discussions

Interactive comment on "Can the dataset of field based recharge estimates in Australia be used to predict recharge in data-poor areas?" *by* R. S. Crosbie et al.

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General Comments

This is a generally well written paper that provides a platform with which to extend the spatially-restricted studies of recharge to broader areas. As such it will be of use to both researchers and land/water managers, and is certainly worth publishing. My main comments largely relate to the start of the paper that I found very general – there are several places where mention of studies and approaches are touched on without being specific; most of those issues are dealt with later, but it takes a bit of time to get

into the details of what is being done. In the same vein, some more specifics in the abstract would have helped. I would also like to see the study put into a more global context – some comparison in the conclusions with the results of other national studies or general methodological comments that would help a similar study be carried out elsewhere would give the paper a bigger impact.

I hope that the comments are useful for what is a good attempt to distil such a broad array of data into a nice succinct study.

Specific Comments

Abstract: The abstract is a clear indication of the subject matter of the paper and the main findings. However, it would be improved by some specific details. For example the term "field-based studies" cover a wide range of possibilities – some details of the type of studies used to make the conclusions would be helpful here. Similarly, on lines 10-11 (pg 5648), the strength of the correlations or the weight that each factor has could be mentioned.

Introduction: The start of the Introduction is a clear statement of the aims of the paper and the rationale for carrying the work out. It would be good if reference were made to one or two specific instances where decisions on resources were made using such unconstrained data. If there are any publically available reports / technical documents that can be cited then that would also be useful. Without trying to apportion blame to under-resourced water managers, an example where the approach was seriously flawed would be interesting.

Pg 5649, lines 15-20. This just says that there have been several studies done – try to outline why these are of significance (i.e., why you are referencing them in this paper).

Pg 5649, lines 21 onward. Are all of these studies reviews or are some generating primary data? It might be more appropriate to give an overview of the types of recharge studies that have been carried out in Australia rather than the reviews of the studies.

Pg. 5650, lines 9-17. It would help if the methodology were briefly mentioned here. This would give the paper more of a global focus – as it is I might read the paper if I were interested in southeast Australia, but if the methodology looked interesting, it might read it if I were addressing similar problems elsewhere.

Pg. 5651, lines 16-18. Some of this repeats material in the previous section. In what is a recurring theme, this section also needs a few more details. I had to open the supplemental spreadsheet to find out what types of studies were included – a statement here in the text that the data included water table fluctuations, Cl mass balances, and radiogenic isotopes would be useful to better understand the context of the paper.

Pg. 5651, lines 16 onwards. One issue that it would be useful to mention here is that notwithstanding that all the studies are from dryland areas, the different techniques applied (14C, 3H, Cl mass balance water-table fluctuations etc) will characterise recharge over different timescales. In the study that I am most familiar with (Cartwright et al., 2007) that was partially the aim. It is discussed later, but would be useful here when setting the scene. The review paper by Scanlon et al. (2002) also makes this point and also discussed difference in area scales, which also would be worth a mention.

Pg. 5652, Section 2.1.1. This is a better level of detail and answers many issues that I had above. This section would be better as part of the introduction (section 1) as it is not a "factor effecting [sic] recharge as such". There are two forms of 14C dating: firstly the one that is applied to relatively old waters (a14C < 100) that dates longer-term recharge; and secondly the one that uses the "bomb-pulse" C to date recent recharge (a14C > 100). A similar distinction can be made for 36Cl. Are both types grouped or separated in the table?

Pg. 5653, line 8. Are both Annuals and Perennials non-native vegetation?

Pg. 5653, lines 2-7. It would be worth stressing the Australian context here – Australian native vegetation seems to be amongst the most water efficient globally so that the replacement produced extreme changes to recharge.

Pg. 5653, line 20. Cartwright & Simmons said "could" not "would" and it was only for the case where vegetation cover was lost due to increasing aridity. I agree it was very speculative.

Pg. 5654, line 22. "Australia" rather than "the nation" would be better.

Pg. 5655, line 1. Not sure that karst is a problem – there are some areas of karst in Australia but in many areas they are not extensive. Could you comment on this?

Pg. 5656, section 3.1. In addition to the change in land use is there an issue of changing climate. Leaney et al. (2003. Salinization of a fresh palaeo-ground water resource by enhanced recharge. Ground Water 41, 84-92) make this point nicely for the SW Murray Basin – recharge rates there were higher during past periods of wetter climate. Correlation of the longer-term recharge tracers will be with longer-term average climate, whereas some of the very short-term measurements (e.g. WTF or lysimeters) might reflect anomalously low recharge in the recent drought.

Pg. 5656, lines 17-21. Without looking at the two references, I can't judge what the difference between these two methods is. Can you explain it in a sentence or two – and more particularly does it produce different results?

Pg. 5657. As noted above, there are two different types of 14C recharge estimates. The vast majority represented in this study are probably the more "traditional" type where 14C has been used to date relatively old groundwater; however, there are a few instances of very recent recharge rates being addressed using 14C (often in conjunction with 3H); in these cases one might expect estimates from 14C to agree more with those from WTF than say Cl.

Pg. 5659, lines 6 to 21. It is also worth noting that the impact of the water-efficient native vegetation also shows up in the very high groundwater salinities. In the Murray Basin, evapotranspiration is the dominant hydrochemical process and has produced of the most saline groundwater basins globally (much of the groundwater basin has

salinities of >14,000 mg/L). The stable isotope data imply a major role for transpiration rather than just surface evaporation (e.g., Herczeg et al., 2001. Origin of dissolved salts in a large, semi-arid groundwater system: Murray Basin, Australia. Marine and Freshwater Resources 52, 41-52).

Pg. 5660, section 3.3. Not sure whether there is any data to test this, but is there an impact in storm frequency and durations. I would imagine that another "confounding factor" is whether the winter rainfall is delivered in a set of heavy storms over a short period rather than as steady rain events with some separation.

Pg. 5662, lines 20-24. Is there any chance that many of the recharge estimates are impacted in this way (and the authors have failed to take the evapotranspiration from the saturated zone into account)? From the point of view of trying to understand deep groundwater, I never sought to distinguish between gross and net recharge. Is ET from the water table likely to be significant?

Pg. 5666, Conclusions. A paragraph here comparing the results of this study to others carried out elsewhere in the world (or a statement to say that this is a first) would give the paper better global impact. This is a valuable study and it should have impact outside Australia. Perhaps some comments on the potential pitfalls / lessons in doing this type of work would also be useful

Technical Comments (mostly minor)

Pg 5648, line 6: "database" should be single word (and elsewhere in the paper)

Pg 5648, lines 18-20: The sentence "The 95 percent confidence limits about the recharge predicted using these relationships is generally greater than an order of magnitude either side of the relationship developed" is not clear.

Pg 5650, lines 9-17: These two paragraphs essentially say the same thing and could be combined.

Pg5652, line 14: order of references (should be chronological?)

Pg 5652, line 1: "affecting" not "effecting" I think (effecting is a verb)

Pg 5653, line 5: should be "by up to..."

Pg 5653, line 8: errant "," in "and, Trees

Pg 5658, lines 20-21: "we can see that recharge under annuals is greater" would be better as just "recharge under annuals is greater"

Fig. 1. Strictly the state abbreviations should be defined in caption.

Fig. 2. The surface geology discussed in the text was simplified. Is this what is shown on Fig. 2 – it would be most useful if that were the case.

Figs 1 & 3. This might be too difficult with such a large database but is there any way that the specific studies can be tied to the maps (if you already have a key map, perhaps it can be provided in the supplementary data).

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