This manuscript uses chloride concentrations (and electrical conductivity data as a proxy for chloride concentrations) along with hydraulic head data to examine the relative importance of mountain-front recharge vs. mountain-block recharge in aquifers near the Mount Lofty Ranges in Australia. Overall I think that this manuscript is good, and the method they are using is something that can be applied in other basins in a relatively simple, cost-effective manner. However, there are some areas where I feel they need to strengthen some of the foundations—in some cases I am not able to see in the figures what they describe, and there are some alternative views I have expressed. I hope the authors are able to address these comments, as I think it would result in a very good paper.

'Scientific' comments:

p 2 L 3: you mention mountains receive higher rainfall, but another important consideration is that in many parts of the world, mountains are high enough in elevation that they receive snow when surrounding low-lying areas receive rain. Several studies (e.g., Earman et al., 2006; Simpson et al., 1972; and Winograd et al., 1998) have shown that snow can be a much more 'efficient' recharge agent than rain (e.g., the percentage of recharge derived from snowmelt exceeds the portion of precipitation that falls as snow). A quick web search appears to show that your study area receives snow at least in some years; even if it did not, if you wish your case study to have broad applicability, you should mention this issue.

p 2 L 28 (and numerous other instances): since you are referring to the chloride ion (not elemental chlorine [see comment p 5 L 5], you should use the symbol "Cl^-", not "Cl"

p 3 L 23-24: can you show a diagram of what these 'triangular facets' are? It is not clear to me from the text.

p 4 L 25: I'm not sure what is referred to by 'embedding materials'—do you mean the fault has the same K as the basement; the same K as the sediment; or that the upper half of the fault has the same K as the sediment, and the lower half of the fault has the same K as the basement?

p 5 L 5: this sentence needs to be rewritten to be chemically correct. *Chloride* is **not** an element—it is the monovalent anionic form of the element *chlorine*. Chlorine [the element] is quite highly reactive, not "relatively non-reactive compared to the other elements". The chloride ion is usually considered to be a 'conservative' tracer in groundwater systems, but you are confusing the issue by referring to chloride as an element.

p 5 L 8: here it is stated that Cl^- should remain equal to the concentration at the time of recharge if dispersion can be neglected. Dispersion is likely to be the only process that can reasonably be expected to *reduce* Cl^- concentration under most hydrogeologic conditions (precipitation of Cl^--bearing minerals will only take place at extremely high concentrations, typically after a significant [>50% of original water] evaporation). However, there are many factors that could *increase* Cl^- concentration (e.g., salting of roads in the area, mixing with brine, dissolution of evaporite minerals, impacts from fertilizer, influence of septic/sewage systems, irrigation). You may be able to rule those out in your study area, but those influences should at least be mentioned.

p 5 L 11: atmospheric deposition is often the main influence on groundwater chloride, but there are other natural and anthropogenic sources of chloride (see previous comment)

p 5 L 14: I understand that evaporation leaves residual water more concentrated in all ionic species, but the impact of ‘transpiration’ on groundwater ionic composition has me a bit puzzled. I have found many references that say ‘transpiration’ removes pure water (leaving the residual enriched in ions), but those references all seem to refer to ‘transpiration’ as evaporation from the stomata in plant leaves. So I am left wondering if the actual uptake of water by plants at the root actually removes pure water or water and ions. My guess is that the uptake of soil water or groundwater into a plant root is controlled simply by head gradient, in which case ions should move into the plant along with water. If that is correct, water in plant leaves may become enriched in ions, but the uptake of the water itself would not be enriching [I admit that this is completely outside my area of expertise, so this assumption could be dead wrong!].

p 5 L 27-29: you refer to the need for reducing potential misinterpretation due to spatial variability, but on lines 15-16, you said that chloride concentrations in mountains “can be expected to show significant spatio-temporal variability”, so shouldn’t you be concerned with temporal variability in addition to spatial variability?

p 6 L 19-p 7 L 11: is it possible to include at least a conceptual schematic diagram showing a typical cross section of these aquifers?

p 7 L 6: you mention that wells in the area are used for “irrigation and industrial activities”. Related to comment (p 5 L 8), I will point out that irrigation is often a driver of increased groundwater salinity, and industrial uses can also increase salinity; perhaps you should discuss potential impacts of these activities on the CMB method.

p 7 L 7: suggest replacing “permanent” with “long-term”. Perhaps I’m being overly pedantic, but these cones of depression are ‘permanent’ only as long as water use remains higher than recharge. I realize that you say water use is forecast to rise instead of drop, but it is still possible (although unlikely given societal constraints) to make the cones of depression go away.

p 8 L 32-p 9 L 1: I don’t think I agree with this statement. If you were discussing the rate of water chemistry change due to chemical reactions (e.g., weathering, dissolution, etc.), I would agree that chemical concentrations may often change relatively slowly compared to groundwater flow (even though groundwater flow can often be slow). However, pumping can induce chemical mixing by changing hydraulic gradient and bringing ‘new’ water into the pumping zone. For instance, some of the Cl^- values you report (Figure 5) are extremely high (since the dots overlap in Figure 5, it’s hard to estimate how many samples are there, but a decent chunk of your samples have Cl^- > 1,000 mg/L (topping out with a Cl^- value around 10^5 mg/L!), which is quite high (I'm guessing these might be paleowaters in the lower aquifer). If, for example, pumping caused increased interaquifer flow, the chemical change brought about by mixing would occur on the same time scale as the hydraulic mixing.

p 9 L 1: here, you state "Hence, as for hydraulic heads, all available Cl data were retained"; I'm having trouble resolving that with your explanation of your hydraulic head data set in section 3.2.1, especially p 7 L 26 where you state "the data were filtered out for unsuitable measurements…" and p 7 L 27 where you state "After filtering, 111,538 hydraulic head measurements from 9,561 wells were obtained."

Section 3.3.1: in this section, you discuss the relationship between head contours and streams, and use it to invoke flow into/out of the streams (e.g., streams are gaining in location *x*, but losing in zone *y*). One the scale of Figure 7, I can't really see that. Is it possible to show one or two 'details' of head contours near a stream, similar to Figure 8B and 9B in Winter et al. (1998)? If you could show something similar to those figures, I think it would greatly strengthen your argument.

p 10 L 5-8: You state that with the exception of the upper reaches of rivers, head contours indicate streams in the Mount Lofty Ranges are gaining (lines 5-6), yet on line 8, you state that "the infiltration capacity of the mountain block is limited". If the mountain block has such limited infiltration capacity, where is the water that causes the streams to be gaining coming from? If the streams are gaining, I assume it's because groundwater is flowing in, which would suggest the mountain block must be capable of receiving/transmitting water fairly well.
The root of your 'low infiltration capacity' hypothesis seems to be on lines 6-7, where you observe that the principal exception to the 'streams are typically gaining in the Mount Lofty Ranges' rule is "along the upper reaches of rivers, i.e. where the stream order is small". A few thoughts on the upper reaches of streams:

> 1. Are you sure the upper-reach sections of stream that you are discussing here are perennial? I have spent a lot of time in mountains, and a lot of that time has been spent sampling from springs. In my experience, virtually all perennial mountain streams in non-glaciated regions originate as groundwater outflow. If, for example, you are relying on a GIS data set for stream locations/origination points, your data set may have sections of stream channel that are ephemeral digitized in (e.g., from air photos) with no distinction from perennial reaches of stream. By definition, an ephemeral stream channel will be reliant on overland flow/interflow after precipitation instead of groundwater. Have you ground-truthed any of these upper reaches of stream to make sure they are perennial? If the upper reaches that don't appear to be gaining are ephemeral, it removes support for your 'limited infiltration capacity' hypothesis (although as already stated, the fact that the rest of the stream reaches are gaining already goes against that hypothesis).

2. Upper reaches of rivers in mountains tend to be in the highest-elevation areas, where wells (and thus head values) are typically the sparsest. Do you have the data density in the zones surrounding the upper reaches of rivers in the Mount Lofty Ranges to make the shapes/locations of your head contours definitive enough to truly tell whether the streams are gaining or losing? Looking at the head data points relative to stream headwaters in Figure 7, I'm not sure you have the data density to make this call. Also, looking at Figure 7, I'm not really able to see head contours 'veeing' (as Winter et al. (1998) show to indicate gaining or losing streams [depending on 'vee' direction relative to upstream/downstream]) to/from streams in most instances. If you have the data density to make plots as suggested in my comment on Section 3.3.1 and actually show the 'veeing', that would be much stronger support of your case.

3. As mentioned in (2), upper reaches of rivers in mountains tend to be in the highest-elevation areas, which means they would tend to be recharge zones, not discharge zones. Your Figure 1 suggests that mountaintops are recharge zones, and that it is necessary to get some distance downslope before you reach a groundwater discharge zone. This is a potential argument against the idea that "the infiltration capacity of the mountain block is limited". Recharge zones can have very high infiltration capacity, but because they are recharge zones, we don't expect discharge to occur. As a result, I don't believe that lack of discharge alone can be used as a test for low infiltration capacity. The upper stream reaches may be getting no groundwater inflow because they are in recharge zones instead of discharge zones.

To sum up, I'm not sure the infiltration capacity of the mountain block is limited, but if you can present evidence more likely to convince me, I'd be willing to reconsider!

p 12 L 7-8: see my earlier comment (p 10 L 5-8) that I think it is likely perennial streamflow in your system is generated by groundwater inflow, not by overland flow/interflow (also see your statement on line 19 of this page)

p 13 L 11-13: see comment p 8 L 32-p 9 L 1; if pumping induces mixing between waters with different chloride concentrations, the chemical change should occur at the same rate as the hydraulic change

p 14 L 11: this could probably use some clarification—I think you are describing using an airlift pump at the same pressure in multiple wells and assigning higher T values to wells that yield a relatively high amount of water and lower T values to wells that yield a relatively low amount of water. Please note that many readers might be unfamiliar with airlift pumps, so this could merit a bit more explanation than you currently give.

p 11 L 19: what are you defining as "the front line"? Is it the fault that mostly runs along the eastern boundary of the NAP (but continues on through the CAP), is it the fault that mostly runs along the eastern boundary of the CAP, is it somewhere else? This should be clarified.

p 14 L 30-33: at the end of this sentence, you refer only to ‘water found in streams running down the mountain’ to contrast to water that recharges diffusively, but I think the important concept here is that [some/much of] the water flowing in the streams will become focused recharge in contrast to the diffuse recharge found outside stream zones. I think you need to make clear to the reader that the important concept here is diffuse vs. focused recharge.

Conclusions: I will have an easier time agreeing with all the conclusions if you can address some of the earlier comments I made (e.g., if you can make figures as suggested in my comment on Section 3.3.1, I can better believe that analysis of head contour shape adjacent to surface features allows you to distinguish gaining/losing reaches of streams).

Grammar/spelling/etc. comments & comments on figures/tables:

Title: should read “electrical-conductivity data”

p 2 L 16 (and numerous other instances): not sure of journal style, but typically “e.g.” is followed by a comma, e.g., “e.g., Hely et al., 1971…”

p 3 L 4: you make reference to a geographic location here, so you should ‘call’ a figure that shows that location. Your Figure 3 shows this area, but you need to move the call to this first mention of the area in the text (which will cause it to become Figure 2)

p 3 L 23 (and any other instances): not sure of journal style, but typically “i.e.” is followed by a comma, e.g., “i.e., the in-between-streams zones…”

p 4 L 1: Winter et al., 1998 is cited here (and on line 8), but does not appear in the reference list, need to add a reference.

p 5 L 32: change “increasing” to “increase”

p 7 L 27: change “aquifer test or drilling” to either “aquifer tests or drilling” or “aquifer testing or drilling”

p 8 L 4: sentence is unclear—I’m not sure what is meant by the statement that the aquifer “was informed in the database for about two thirds of the wells”.

p 8 L 27: change “less restrictive filtering” to “less-restrictive filtering”

Figure 6: two issues with this figure:

1. many of the contour labels are very difficult to read (too small); especially the red/pink labels for topography (and those are even worse over some of the areas with dark red-brown fill in the southeastern edge of the map).
2. you do not show a key for the contour fill colors that you use, if you provided one, that might help with problem (1)

p 10 L 15: change “by” to “minus”

Figure 10: the faults are often difficult to see (especially since one is nearly the same color as the CAP boundary (but a thinner line than the CAP boundary), and runs on/very near the CAP boundary for a good distance. Could the faults be some other color on this figure (the green of the Australian ‘green and gold’ color scheme might be one choice that would stand out a bit better)?

p 11 L 20: change “occur” to “occurs”

p 11 L 25: cut the first instance of “salinity” on this line

p 11 L 28: change “do not contribute either” to “also do not contribute”

Figure 11/Table 1:

1. In Figure 11, you plot flow rate using the units ML/d, but in Table 1, you report mean flow rates in GL/y, which makes comparing the two difficult. Please pick one consistent set of units for flow rate/mean flow rate and use it in both Figure 11 and Table 1.

2. At first glance, there appear to be two sets of ‘paired’ streams (e.g., the symbols used for South Para River and First Creek are identical to my eye, as are the symbols for Brownhill Creek and Gawler River). On closer examination, I can see a slight difference between the Grawler/Brownhill point colors, but it is tough to tell which is which (I think Brownhill is the lower-concentration data set on the plot); I can’t make any difference out for the other ‘pair’). Can you do something to make each data set more distinct? One suggestion: there are only so many colors you can use that work well unoutlined, but if your graphing software is able to outline points, they can become much more ‘readable’ (e.g., yellow circles on their own can be hard to see on a white background, but a yellow circle with a black border shows up well on a white background). Using outlined shapes might let you add a couple of distinct colors that would make it much easier to tell the data sets apart on the figure.

3. In Table 1, change two instances of “uS/cm” to “µS/cm”

p 13 L 1: change “great” to something along the lines of “useful”, “effective”, etc.

p 14 L 15: cut “based on”

p 14 L 23: cut “only”

p 14 L 25: add comma after ‘contrast’

p 14 L 28: cut “yet”

p 15 L 1-2: change “this study proposes” to “we propose” [or if the journal style does not allow that, the more stilted “the authors propose”]. Your study can’t propose anything, but you can!

References:

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Simpson, E. S., Thorud, D. B., and Friedman, I., 1972. Distinguishing seasonal recharge to groundwater by deuterium analysis in southern Arizona. In: *World Water Balance. Proceeding of the Reading Symposium, July 1970*, Volume 3, International Association of Scientific Hydrology-UNESCO-WMO Studies and Reports in Hydrology, vol.11; Gentbrugge, Belgium, Publication No 94 of the International Association of Scientific Hydrology, pp 623–633

Winograd, I. J., Riggs, A. C.. and Coplen, T. B., 1998. The relative contributions of summer and cool-season precipitation to groundwater recharge, Spring Mountains, Nevada, USA, *Hydrogeology Journal* (6) 77– 93.

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