Hydrology and Earth System Sciences Discussions

Interactive comment on "Regional-scale identification of groundwater-surface water interaction using hydrochemistry and multivariate statistical methods, Wairarapa Valley, New Zealand" *by* M. R. Guggenmos et al.

Anonymous Referee #3

Received and published: 8 September 2011

Overall this is an interesting and well written paper. The use of mulitvariate statistical analysis of hydrochemical data is an established technique applied here to identifying surface water - groundwater interactions, which is novel. The authors conclude that the methodology offers a way to rapidly evaluate hydrochemical data on a basin scale. They compare their conclusions about surface water - groundwater connectivity with previous work based on other types of data (isotopes, excess air and river gaging) and show the results are consistent.

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Comments:

1 - The exclusion of outliers (section 3.2) is justified since the aim is to look at the broad scale, however, it should be noted that those samples contain significant information. For instance, excluding S26/0442 (section 4.1) is useful in maintaining a more homogenous dataset, but the presence of extremely evolved groundwater at this site does reveal significant information about flowpaths.

2 - Eight parameters were used in the HCA, but four additional parameters were added for the PCA. Most examples to date where authors have used both techniques in conjunction have used the same parameters. Since the point of the PCA is to explain the source of variability in the dataset used in the HCA, this may be over-reaching.

3 - The authors interpret TDS increases as representing age of water. The assumption that more TDS represents more water-rock interaction, thus longer flow time is not always valid. For instance, groundwater flowing through highly soluble lithologies may exhibit higher TDS than older water flowing through low solubility rocks. Perhaps the addition of some inverse geochemical modeling to support the proposed hydrochemical evolution would strengthen the argument.

4 – The authors note the principle differentiators between clusters of samples are TDS, redox and major ion ratios. What is unclear is the redox metric. Is it actual measurements of Eh, or the amount of SO_4 (4.2, line 19)? There are a number of redox indicators available such as Fe, Mn and NO_3/NH_4. Are those also being used to support the interpretations?

5- Inclusion of filtered and unfiltered samples in the dataset is problematic without further justification. Unfiltered samples will often produce higher solute values due to dissolution of particulates when acidified. Since the TDS was generally calculated, this could be a problem since charge balance does not address this issue.

6 – Finally, there is an apparent contradiction between the conclusions where specific

areas are identified as locations of groundwater-surface water interaction and the absence of seasonal variability at sample sites with seasonal samples (pg 6453, line 4-6). The authors note 25% of sites had "significant parameter-specific temporal trends", but state the rates of change were less than 2% a year. This line of argument was used to justify using median values for parameters for sites with multiple samples. However, lack of temporal variation is evidence for little or no groundwater-surface water interaction. Perhaps the authors can clarify the apparent contradiction.

Interactive comment on Hydrol. Earth Syst. Sci. Discuss., 8, 6443, 2011.

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