Hydrol. Earth Syst. Sci. Discuss., 8, C3986–C3989, 2011
www.hydrol-earth-syst-sci-discuss.net/8/C3986/2011/

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 #4

Received and published: 12 September 2011

The authors of this paper present and demonstrate an effective approach for analyzing a watershed system using a large water-quality database to characterize and interpret surface water and groundwater quality and interactions. Faced with the daunting challenge of unifying water quality data from multiple sampling schemes and schedules, a systematic approach was developed based on median concentrations. This approach is reasonable for the first-cut analysis of the system and is successfully used to interpret the general characteristics of water quality in the watershed. As pointed out in the

discussion (end of page 6468), a logical future extension of this method would be to include the effect of seasonal variability on water quality and surface water-groundwater interactions.

The methods and results are generally well explained. Some specific comments are given below.

1. Discussion of the hydrochemical database on p. 6452-6453:

It would be helpful to include the range of groundwater sample depths in the description of the data.

The sites with multiple samples were analyzed for year-to-year temporal trends; were they also examined for the magnitude of seasonal trends? Did the character of surface-water quality change from low flow to high flow seasons?

Mn and Fe concentrations can be high in anoxic groundwater. Could their exclusion from the charge balance error (CBE) calculations have led to some of the high CBE values and exclusion of these types of samples from the analysis?

How many of the final 305 sites were surface water and how many were groundwater?

2. Section 4.2 Hydrochemical differences between clusters:

This section would benefit from subheadings because it covers four different topics: the results of the cluster analysis, the affect of the number of clusters on the analysis, the results of PCA analysis, and comparison of results to other indicators of water source and age.

On page 6460, line 27 the authors introduce the excess air measurement. They should indicate in the text (as is explained in the caption of Fig. 10) that this measurement is based on measured concentrations of dissolved nitrogen and argon. One concern regarding the use of large excess air values to indicate groundwater recharge from rainfall is that excess nitrogen can also be the result of denitrification in groundwater.

The high excess air samples from the B clusters shown in Fig. 10 may be influenced by denitrification.

3. Section 4.3 Identifying areas of groundwater-surface water interaction:

The cluster analysis is shown to be very effective at separating different types of groundwater, and the authors explain the relation of these groundwater types to sample depth. As one would expect, groundwater concentrations are more closely related to surface water concentrations in the shallow groundwater system. In the lower Wairarapa Valley the majority of groundwater samples come from the deep aquifer system that is isolated from the surface-water system by low permeability marine and lacustrine deposits. The authors correctly conclude that there is little interaction between this groundwater system and the surface water. However, this does not preclude all surface water – groundwater interactions: there may be connection to the river in the shallow system of Q1 deposits. In fact, the anomalous B5 cluster samples probably represent the shallow groundwater flow system that has been influenced by agricultural activity. This type of groundwater could be involved in surface water-groundwater interactions in the lower valley area.

4. Section 5 Conclusions and implications:

In the second paragraph of p. 6466 the authors explain that the surface and groundwater in the Whangaehu and Taueru Rivers are both in the B1 cluster. They indicate that this suggests recharge of the groundwater by B1 type surface water. Couldn't the opposite also be true? The surface water could be reflecting groundwater input of B1 type water.

Minor typographical comments:

p. 6452, line 15: delete the extra 'the remaining'

p. 6455, line 24: change 'end target of clusters' to 'end target of number of clusters'

p. 6456, line 24: the reference to Fig. 6 is out of order – it follows the reference to Fig.

3 on p. 6451 and comes before the reference to Fig. 4 on p. 6457

p. 6460, line 25: should 'more negative than 6.5' be 'more negative than -6.5'?

p. 6465, line 9: there is no 'Lake Ferry' on the map in Fig. 1, should this be Lake Onoke?

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