Using multivariate statistical analysis to assess changes in water chemistry in sections of the Vaal Dam catchment between 1991 and 2008

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Abstract

Multivariate statistical analysis was used to investigate changes in water chemistry at 5 river sites in the Vaal Dam catchment, draining the Highveld grasslands. These grasslands receive more than 8 kg sulphur (S) ha^{-1}·year^{1} and 6 kg nitrogen (N) ha^{-1}·year^{1} via atmospheric deposition. It was hypothesised that between 1991 and 2008 concentrations of dissolved mineral salts, sulphate, nitrate and ammonium would increase as a result of the S and N deposition received. Significant spatial differences were found, by analysis of covariance, between sites within the catchment. Canonical correspondence analysis (CCA) showed that the environmental variables used in the analysis, discharge and month of sampling, explained a small proportion of the total variance in the data set – less than 10% at each site. However, the total data set variance, explained by the 4 hypothetical axes generated by the CCA was >93% for all 5 sites. Sulphate, nitrate-plus-nitrite, ammonium and phosphate concentrations increased at 1 site each, between 1991 and 2008. Over the same time frame, acid-neutralising capacity was decreased significantly at 1 of the 5 river sites. The concentrations of the ions analysed, with rare exception, were within the limits set by the national drinking water guidelines, between 1991 and 2008. Nitrogen and sulphur concentrations at the five selected river sites within the Vaal Dam catchment did not show a statistically significant increase between 1995 and 2008.

Keywords: Highveld grasslands, atmospheric sulphur and nitrogen deposition, sulphate, nitrate-plus-nitrite, acid neutralising capacity, dissolved major salts, multivariate statistics