INTRODUCTION

Leaching of nitrate-N from grazed pastoral systems and other intensive land uses, is a key water contaminant of surface and groundwater quality in New Zealand’s agricultural catchments. Currently, water quality is monitored by taking monthly grab samples. Although high-resolution monitoring of nitrate is commonly used in drinking and wastewater plants in New Zealand, their broader use for surface water quality monitoring in agricultural catchments in this country, is rare.

As a case study for high-resolution monitoring strategies in low nitrate-N concentration ranges, a UV/VIS nitrate sensor was installed at an established monitoring site (Teachers College) on the Manawatu River (total catchment 5,900km² Fig. 1) in Palmerston North. The catchment above the monitoring site (3,914km²) is dominated by sheep and beef land use (62%), forest (24%) and dairy (13%).

METHODS

A NITRATAX (Hach Lange GmbH, Germany) sensor was installed for a period of 1 year, to monitor nitrate-N concentrations on a 15 minute interval. The sensor’s accuracy was checked routinely against calibration standards and against manual samples analysed in a laboratory, using standard methods.

Flow rate was collected at the same site and calibrated using regular river gauging. A pump malfunction resulted in the loss of sensor data for 1 month in July. The standard monthly grab sample data were used to compare nitrate-N loads with the high frequency sensor data. Loads were calculated using the flow weighed method.

RESULTS AND DISCUSSION

The standard solution calibrations and manual laboratory checks indicated that the NITRATAX sensor concentrations were slightly negatively biased at the low concentration range monitored (Fig. 2a). However, intensive 24hr manual sampling showed that the sensor was precisely monitoring small diurnal changes in nitrate-N concentrations over time (Fig. 2b). Therefore, a small positive correction factor could be applied to the NITRATAX data (Fig. 3).

The high frequency data indicated higher nitrate-N concentrations at the start of the runoff season, when river flow rate increased. However, concentrations decreased later in the season and remained low (<0.6 mg/L), as nitrate-N was likely flushed through the soil profile, despite high flow events over summer (Fig. 3). These results confirm findings from plot scale leaching studies, but these processes have rarely been studied at a catchment scale in New Zealand.

There was an 14.9 % difference in nitrate-N loads between the NITRATAX data and the monthly grab samples, when calculated using the flow weighed method (Table 1).

The grab sample method was unable to capture all of the flow rates, particularly the highest flows and emphasises the value of using higher resolution sensor data to monitor nutrient flows in streams and rivers.

SUMMARY

The NITRATAX provided robust nitrate-N measurements, which coupled with calibration and correction, could reliably be used in New Zealand’s low nitrate-N rivers. The high frequency data provided powerful information on the seasonal and diurnal fluctuations of nitrate-N in this river, that were previously not possible or observed. These data also allowed the calculation of more accurate nitrate-N loads, which is critical to catchment nutrient management and planning.

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