Comments to HESS-2018-31:

The paper by Bourke et al. was trying to use nitrogen isotope tracer to investigate the denitrification process in shallow aquifer at two feeding fields in Alberta, Canada. I recommend major revision on the present format. Hope these comments would be of use to you.

Abstract:

The abstract should provide a clear and concise summary of the aims of the paper together with the key results.

Page 1, Line 13: "Elevated NO_3^- concentrations in groundwater" please give specific data on this in the abstract.

Lines 16-17: it should be expanded to describe "the NO_3^- source and denitrification enrichment factors".

Lines 20-21: the range of NO_3^- concentrations can be shown here.

Could the authors keep consistent with using the NO_3-N concentration or the NO_3^- concentration in the whole paper? According to the description in the section RESULTS, you used "NO_3-N concentration in groundwater".

Introduction

The introduction provides good background to the study and places it in an international context. The specific aims of the study are reasonably clear.

Page 2: Lines 16-17: "Groundwater containing significant agriculturally derived NO_3^- also typically has elevated chloride (Cl^-) concentrations" could use a few more details. Specifically, it is not clear what is meant by "elevated chloride concentrations" and "the characteristic enrichment of ... (Line 34)" etc. Without a detailed knowledge of the area it is difficult to assess exactly the extent of the problem or what has been done to address it. If you provide a few more details, the context will be clearer.

Page 3: "the extent of agriculturally derived NO_3^- in groundwater" compared with "On-site denitrification reduced agriculturally derived NO_3^- concentrations by at least half" (in Abstract) did not show the variational concentrations. "sources and initial concentrations of NO_3^-" (Line 25, Page 3) was not clear in the text and abstract.

Materials and methods:

Page 4, Line 28: "slug or bail tests" could you expand them and give brief introduction to make the experiment clearer for readers.

Page 5, 2.3 section: where did you complete the measurements of groundwater and pore-water hydrochemical components?

Results:

Page 8, Lines 4-19: how to obtain some specific data (e.g. mean K, vertical gradient) in this part?

Lines 25-30: "The enrichment factor of $\delta^{15}NO_3$" can be replaced by "$\varepsilon^{15}N$".

Page 10, Lines 17-18: "The NO3-N in this core sample was most likely introduced into the groundwater system by vertical infiltration or diffusion from above." What's your evidence for this description?

Line 18: "much higher Cl- concentrations" please give a range of concentration levels with mean value.

Discussion:

This section needs in-depth analysis and focus on interpreting data combined with hydrogeological conditions, such as characteristics of glacial sediments, and agricultural operations.

The thrust of this paper should be distinguished into two or three aspects, explaining the main factors controlling the denitrification processes in the groundwater systems. You should try to keep this as the main focus of the paper. Additionally, how does the paper inform our understanding of nitrate fate in groundwater caused by agricultural activity in general?

It is mainly a case study and while these are important, you need to revisit those topics and explain in the conclusions the relevance to research elsewhere.

Conclusions:

There are very study specific. Please use the conclusions to look at the broader implications for regions outside this specific area. There must be a few things in here that will inform studies in other regions that will give the paper more impact.