

Interactive comment on “Sources and fate of nitrate in groundwater at agricultural operations overlying glacial sediments” by Sarah A. Bourke et al.

Anonymous Referee #2

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This paper presents a study of using isotope (N^{15} and O^{18}) to study the nitrate mixing and transport. Denitrification of nitrate was considered in this study. The authors argued that their study used isotope in a quantitative way, different from the qualitative way of previous study. This however seems an overstatement to me, because they only used the isotope data to calculate the mixing ratios and denitrification coefficients. This is not very quantitative. I also have a few questions, listed below, related to their calculation of the mixing ratios and denitrification coefficients.

The authors used in equation (4) of the two-member mixing method to calculate the nitrate mixing ratio. This does not seem right to me, because there should be more than

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two nitrate sources, such as the background ambient groundwater, the direct infiltration from fertilizer, the manure source, and the transformation from ammonium to nitrate. I doubt that the two end-member method is adequate to consider the multiple sources.

To account for the denitrification, the authors used a denitrification coefficient in equation (4). While this is conceptually OK, it does not consider that denitrification is a kinetic process (zeroth-order or first order). In other words, the denitrification coefficient used in the paper cannot reflect the kinetics of denitrification.

As to denitrification, it is unclear to what extent denitrification occurs in the aquifer. The plots in Figure 2 do not support the conclusion on denitrification, because the slopes shown in Figure 2(a) are not 0.5. For well CFO4, the slope of 0.42 is close to 0.5, and the data listed in Table 2 and the well locations shown in Figure 1 indeed support the conclusion of denitrification. But what about well CFO1?

The authors said somewhere in the manuscript that the initial nitrate concentration can be neglected. I do not think that it is a reasonable assumption for agricultural areas.

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