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Hydrology and Earth System Sciences
Discussions

Interactive comment on "A Bayesian Approach to Infer Nitrogen Loading Rates from Crop and Landuse Types Surrounding Private Wells in the Central Valley, California" *by* Katherine M. Ransom et al.

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We appreciate the review from referee #1 and the constructive comments, all of which we would be able to address in a revised manuscript, as proposed here:

Point 1). The model indeed requires linearity in the transport process and this is a good point to clarify in the methodology. Uncertainties about nitrogen transformations in the vadose zone are implicitly embedded in the statistical approach, being one source of uncertainty. We propose a) to clarify that "recharge" is indeed the point in time when

nitrate mass enters the groundwater (not when it enters or leaves the root zone); b) to emphasize after equation (2) that the model implicitly assumes linearity in the transport processes between the points of recharge and pumping. c) add a specific point about uncertainty in nitrate fate and transport in soils and the deep vadose zone at the end of the paragraph on p5 line 14.

We also want to clarify that the results are not soil-specific in the sense that soil type surrounding a well with a nitrate sample plays an explicit role. The PDFs of loading rates implicitly reflect, among others, the variability in soils found in the Central Valley. The PDFs are specific only to the range and spatial patterns of soils found across the Central Valley. They are also specific to the crop distribution and land management practices found in the Central Valley.

Our approach in fact distinguishes two groups of environmental conditions that also account for the thickness of the vadose zone and for soil type: The choice of Groundwater Protection Zones as a spatial zonation to distinguished between two vulnerability levels is embedded in the model through the indicator I_i in equation 4. We believe this point is well explained in the manuscript (last paragraph on page 6).

Point 2). The travel time in equation (1) is the travel time in groundwater. This will be addressed with the changes to improve definitions of recharge and loading suggested for Point 1).

Regarding both Points 1) and 2): The discussion section of the paper contains extensive treatment of the model limitations and interpretation of results arising from denitrification and travel time, in the vadose zone and in groundwater (see pages 15 and 16).

Point 3). We propose to add a sentence to the Project Area description that clarifies the negligible slope (<0.2%) and relatively small amount of runoff to streams in most areas of the Central Valley. Irrigation water runoff is typically reused on the same or neighboring field. Since runoff to streams is small relative to recharge into groundwater,

the effect of runoff cannot be estimated.

We agree to address both minor points in a revision.

We appreciate the reviewer's efforts.

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