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Hydrology and Earth System Sciences
Discussions

Interactive comment on "Spatially-distributed influence of agro-environmental factors governing nitrate fate and transport in an irrigated stream-aquifer system" *by* R. T. Bailey et al.

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Note: Line numbers listed in the response correspond to the submitted Word document containing the revised manuscript. The revised manuscript is posted as "Supplement."

Reviewer #1 Nitrate contamination in irrigated stream-aquifer systems is a serious problem in agricultural watershed. Numerical modelling and relevant sensitivity analysis are important methods for understanding of nitrogen fate and transport, as well as making remediation strategies. This study used a nitrogen fate and transport groundwater model and the revised Morris sensitivity analysis method to identify the spatially-

varying influence of system factors on nitrate fate and transport in a regional-scale irrigated hydro-agricultural system. Some results were valuable for future data collection and remediation strategies in the study area. On the whole, the paper was well written. Some minor improvements and corrections are needed.

1. According to the title, the spatially-distributed influences should be the emphasis in this paper. But in the abstract there are no such descriptions or conclusions. some important conclusions should be added in the abstract. Response: The abstract has been modified to include more details regarding the spatial variability of factor dominance. The modified text read:

Lines 31-38: "Results suggest that fertilizer loading, crop uptake, and heterotrophic denitrification govern NO3 fate and transport for the majority of the study area, although their order of influence on NO3 groundwater concentration and mass leaching varies according to crop type and command area. Canal NO3 concentration and rates of autotrophic denitrification, nitrification, and humus decomposition also dominate or partially dominate in other locations. Each factor, with the exception of O2 reduction rate, is the dominating influence on NO3 groundwater concentration at one or more locations within the study area."

2. In your model, there are 7 vertical layers. Each layer has the same depth for each grid cell, which means you don't consider the topography? Is the groundwater table keeping constant or can be changed in different seasons? Response: Only the top 3 layers have the same thickness across the model domain. Layers 4-6 vary according to the saturated thickness of the aquifer. This is now described in the text:

Lines 277-278: "Thickness of layers 4, 5, and 6 varies according to saturated thickness, with layer thickness ranging from 2.8 m to 12.6 m."

The groundwater hydraulic head changes from week to week (the MODFLOW model uses weekly time steps) according to changes in infiltrating rainfall, irrigation water, pumping, and groundwater-surface interactions. The MODFLOW model used in this

study is described on Lines 266-273.

3. There should be many input parameters in the UZF-RT3D model, why you chose such 9 factors as the target to analyze? Please give the explanation. Response: Based on literature, the parameters selected represent the main fate and transport processes for Nitrogen species. Also, they were found to be the most dominant when 13 parameters were assessed in a previous study [Bailey, R.T., T.K. Gates, and M. Ahmadi (2014), Simulating reactive transport of selenium coupled with nitrogen in a regional-scale irrigated groundwater system. J. Hydrol. 515: 29-46], as referenced in the manuscript. This is now mentioned in the text:

Lines 150-152: "Nine model factors are included in the assessment, with their overall influence on NO3 fate and transport evidenced in a previous study in the region [Bailey et al., 2014]."

4. E is an environmental reduction factor that accounts for θ and T and acts to temper the reaction rates based on microbial activity, âĂŤâĂŤâĂŤdo θ and T have the same effects on microbial activities in different processes (i.e. nitrification, volatilization and denitrification)? Response: All microbial processes are affected equally by soil temperature. However, water content affects nitrification, mineralization, and denitrification differently (this is based on Birkinshaw and Ewen, 2000, reference in the manuscript; also, more description is found in Bailey et al., 2013b, also referenced in the manuscript). This is now stated in the text:

Lines 262-265: "...and E [-] is an environmental reduction factor that accounts for θ and T and acts to temper microbial activity rates [Birkinshaw and Ewen, 2000; Bailey et al., 2013b]. Nitrification, mineralization, and denitrification each have uniquely specified relationships between θ and microbial activity."

5. In page 14, formula (5) , the left should be rfvol Response: Thank you. This has been corrected.

6. in line 5 of page 24,it seems to have some words lost after 'and.'. The term did not appear in the typeset PDF. We will ensure that is correct in the revised Response: submission.

7. In line 10, line 17 of page 24, 'CO2' and 'NO3' should be 'CO2 ' and 'NO3'? Response: This again seems to be an issue with the typesetting. It appears as in the submitted document.

8. In line 18 of page 24, 'andshould' should be 'should'? or some words after 'and' are lost? Response: The term did not appear in the typeset PDF.

9. In line 19 of page 24, 'withmonitored' should be 'with monitored'? Response: The term did not appear in the typeset PDF.

We thank Reviewer #1 for the helpful comments and suggestions.

Please also note the supplement to this comment:
http://www.hydrol-earth-syst-sci-discuss.net/12/C3402/2015/hessd-12-C3402-2015-supplement.pdf

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Interactive comment on Hydrol. Earth Syst. Sci. Discuss., 12, 1653, 2015.