Biogeosciences Discuss., 9, C2198–C2206, 2012
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Biogeosciences Discussions

Interactive comment on "Regional analysis of groundwater nitrate concentrations and trends in Denmark in regard to agricultural influence" *by* B. Hansen et al.

B. Hansen et al.

bgh@geus.dk

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Author response to Anonymous Referee #2

Firstly, we want to thank for the positive and very useful comments for improvements of our paper.

Here come responses to specific section and figures:

Nitrate conservative compound? The argumentation for focusing on nitrate in oxic groundwater is "hopefully" improved by changing the sentence to: " In oxic Danish groundwater it can been assumed that nitrate leached to groundwater acts as a con-

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servative compound under the presence of oxygen and the generally low reactivity of organic matter below the root zone."

Temporal effects in map (special distribution)? The purpose of using all available nitrate data in constructing figure 2 is to show that nitrate has been found in groundwater almost everywhere in Denmark. Most of the data is based on groundwater sampling after 1990, so the geographic distribution is believed to be due to mainly spacial and not sampling time differences across the country. The different types of data used for constructing the figures were not clear in the first submission of the paper. The different groundwater nitrate data used in the statistical analyses of nitrate in Danish groundwater are now been elaborated by including a table (table 1) and some text corrections has also been made in order to make the data analyses more clear.

N surplus We are only comparing N surplus and nitrate in oxic groundwater on a general macro-level. On the annual national level the N surplus is calculated as the difference between inputs (synthetic fertilizer, import of animal feed, organic waste products, net atmospheric deposition and fixation) and outputs (export of plant and animal products) based on information from Statistics Denmark (2010) on these entries in the budget. This is now elaborated in the text. The 10 regional N surpluses are estimated according to the number of livestock units in each geo-region by using the linear relationship between livestock units and N surplus former identified by Dalgaard et al. (2011b) for Danish conditions.

Effect of N surplus on leaching In the beginning of section "2.6 Nitrogen surpluses in agriculture" the estimation of the annual national surplus of N is now explained more detailed: "The annual national surplus of N in agriculture is estimated as the difference between inputs (synthetic fertilizer, import of animal feed, organic waste products, net atmospheric deposition and fixation) and outputs (export of plant and animal products). The annual national N surplus presented in this paper is estimated based on information from Statistics Denmark (2010) on these entries in the budget." Thus, data on the reduction of the N deposition in Denmark is included in the calculation of the annual

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national N surplus. However the term “Nemission” in equation 1 is misleading and is now corrected to Nemission+Ndenitrification, and explained in more details in the text.

At page 5331, line 20-22 we are describing the results which shows a comparable pattern between surplus and nitrate concentrations. There are many reasons for the geographic distribution of nitrate in oxic groundwater where the N surplus might be one of them but other reasons might be the geographic distribution of soil types, land use, nitrate-reduction-capacity of the sediments, precipitation and groundwater recharge in Denmark. This formulation is now included in the text.

Conclusion section The last two sections have been renamed is order to match the contents with the titles. The “Results and discussion” section is now called “Results” and the “Conclusions” section is now called “Discussion and conclusions”.

Number of analyses in different sections of the paper As already described the different types of data used for constructing the figures were not clear in the first submission of the paper. The different groundwater nitrate data used in the statistical analyses of nitrate in Danish groundwater has now been elaborated by including a table (table 1) and some text corrections has also been made in order to make the data analyses more clear.

Question 1: There are totally 162.144 (1890-2011) nitrate analyses where 46.800 (1973-2011) are coming from the National Groundwater monitoring Programme. Totally there are 3757 (1967-2011) oxic monitoring points where 194 (1988-2009) are CFC dated monitoring points in the National Groundwater monitoring Programme. Of the 194 CFC dated oxic monitoring point 152 have sufficient long time series to make individual trend analyses.

Question 2: We have decided to use the word “monitoring point” for a screen in a well. “Sampling point” has been corrected to “monitoring point”.

Figure 2 a-c: The 3 figures in Fig.2 a-c has been enlarged og are now in colours in

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order to make them more readable.

Figure 3: We think it is important to show all the lines in Fig. 3. Therefore the figure is now in colours in order to be able to recognize all the lines.

Page 3731, line 8: “high nitrate leaching from land use” is changed to “high nitrate leaching from agricultural land”.

Page 3731, line 11: “Denmark can be divided. . .” is changed to “Denmark is divided into ten geo-regions as in Kronvang et al. (2008)”

Page 3732, line 7-8: “Mowing” has been corrected to “moving”.

All the changes are included in the revised version of the manuscript shown in “Figures” and “Supplement”.

Please also note the supplement to this comment:
http://www.biogeosciences-discuss.net/9/C2198/2012/bgd-9-C2198-2012-supplement.pdf

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Interactive comment on Biogeosciences Discuss., 9, 5321, 2012.

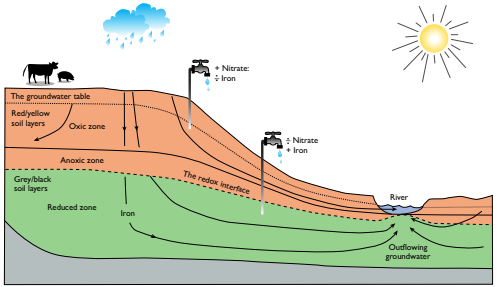

Fig. 1.

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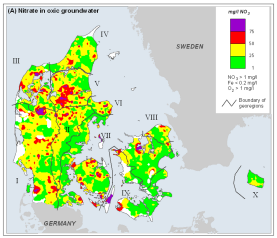

Fig. 2.

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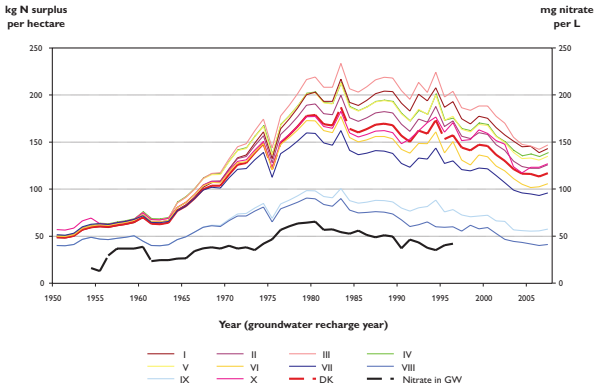

Fig. 3.

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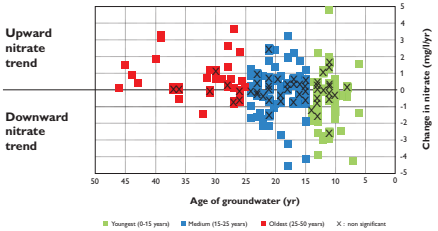

Fig. 4.

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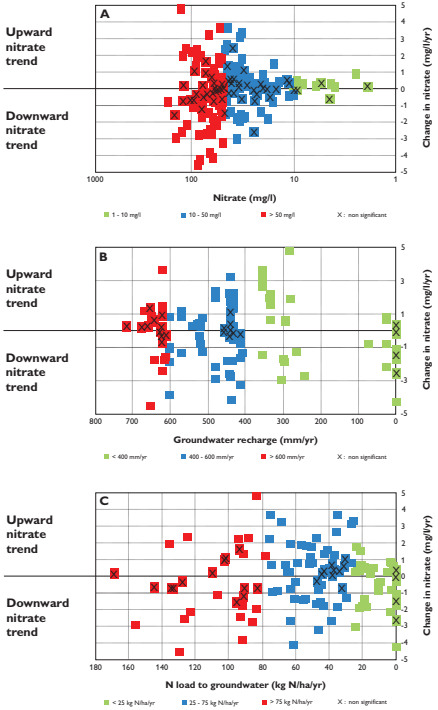

Fig. 5.

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