

Interactive comment on “Budget of N₂O emissions at the watershed scale: role of land cover and topography (the Orgeval basin, France)” by G. Vilain et al.

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Dear Referee#2, We thank you for taking the time and the effort to review our manuscript and for making constructive comments. We felt your comments very useful and took them on board and made changes accordingly.

*This paper describes an ambitious task to estimate river-basin scale emissions of nitrous oxide. Although this greenhouse gas contributes only a small fraction to global warming, it receives much research attention. A large number of papers has been published in the past 2-3 decades, representing an enormous amount of financial resources from research funds. Despite this enormous effort, the uncertainty in the es-

C5887

timates of N₂O emissions at the global scale has not been reduced. Now this paper describes an attempt to generate more reliable estimates for N₂O emissions at the scale of a landscape, including both the direct emissions to air, and the indirect emissions from nitrogen leached from soils or lost through surface runoff, and subsequent denitrification in groundwater and riparian zones, and surface water. The paper is well written, well structured and reads easily.

Author's response: thank you

*However, there are some major questions related to the approach, and to the uncertainties in the estimates. In section 3.5.2 the authors mention that they assumed that all N₂O in groundwater is released to the atmosphere from drains or by diffusion from the groundwater table to the unsaturated zone. This assumption at least merits some more discussion. This assumption implies that there is no denitrification in the groundwater in this river basin. The reasoning behind this assumption is missing.

Author's response: This assumption is based on previous researches (based on isotopic $\delta^{15}\text{N}-\text{NO}_3^-$ analysis) which showed a very limited denitrification capacity of the studied oxygenated limestone aquifer. A sentence has been added to the text for better understanding.

*Denitrification in the unsaturated zone will occur if there electron donors available, so apparently this is not the case. So some more explanation is needed. Similarly, the authors need to argue why N₂O moving through the unsaturated zone would not be prone to denitrification. It needs to pass through the soils, so could be reduced by denitrifiers.

Author's response: what we measured is the dissolved N₂O contained in the aquifer. Our estimation of groundwater-derived indirect emissions is then based on groundwater N₂O concentrations. Then, measured N₂O has already moved through the unsaturated zone and eventually reduced by denitrifiers.

C5888

*Similarly, readers may wonder if there are no riparian zones in this landscape, or is there no denitrification in such zones? Many literature studies indicate that riparian zones may be important sources of N₂O at the landscape scale. Or is the N₂O flux estimated for springs actually the site where riparian zones are expected. If so, is there no double counting of emissions, since all N₂O in groundwater is assumed to be released to the atmosphere?

Author's response: in our case, the riparian zone consists in a small vegetative buffer strip which leads to insignificant amounts of nitrous oxide emissions. We thus do not concentrate our attention on this buffer strip.

*This may, however, be totally unimportant, since the estimated contribution of direct emissions is 96%, but yet I think the assumptions need to be argued in more detail. The second comment relates to the uncertainty. The emission coefficients and estimates of total emissions are different for the various approaches, which stem from the same measurements. So an estimate of the uncertainty in the emission coefficient would be very helpful for readers to understand the differences between the methods for upscaling. These uncertainties may be far larger than the differences between the upscaling methods. Perhaps this has all been published in the previous papers by this group, but should at least be mentioned here.

Author's response: According to the similar comments of Reviewer#1 we performed an uncertainty analysis and added to the text the results. You can refer to the comments addressed to reviewer#1 and the revisions added to the manuscript.

Interactive comment on Biogeosciences Discuss., 8, 10823, 2011.