Dynamics of greenhouse gases in the aquifers of two agricultural catchments of Belgium

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Greenhouse gases (GHGs) are an environmental problem because their concentrations in the atmosphere are continuously increasing. Agricultural practices represented up to one third of anthropogenic emissions of GHGs such as nitrous oxide (N_2O), methane (CH_4) and carbon dioxide (CO_2), which all contribute to climate change and N_2O to stratospheric ozone destruction. This study presents recent case studies in two different agricultural areas of the Walloon Region (Belgium). To this end, the dynamics of CO_2, CH_4 and N_2O were studied in the aquifers of the Triffoy and Geer catchments. In order to get an insight into GHGs production/consumption processes, the results of the stable isotope analyses of NO_3^-, N_2O, SO_4^{2-}, B, DOC and ^3H along with the hydrogeochemical data were used. Our study attempts to acquire additional evidence about (1) the processes that consume and produce GHGs in groundwater in these two catchments (2) the spatial variability of N_2O along the lateral and vertical dimensions of the Geer aquifers and (3) the dynamics of GHGs in the river-groundwater interface in the Triffoy catchment. Results indicate that groundwater is oversaturated in N_2O and CO_2 with respect to atmospheric equilibrium but only marginally for CH_4, suggesting that groundwater can be a source of these GHGs to the atmosphere. Nitrification and nitrifier-denitrification seems to be the main process for the accumulation of N_2O in groundwater of the two catchments and the oxic conditions prevailing in the aquifers are not prone to the accumulation of CH_4. Groundwater is probably an important source of N_2O and CO_2 into the river but when the measures are scaled at catchment scale, these fluxes are probably relatively modest. Nevertheless, their quantification would better constrain nitrogen and carbon budgets in natural systems.