Effects of the hydrogeochemical stratification on the distribution of GHGs concentrations

and their production/consumption processes in groundwater

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Groundwater under agricultural areas has been considered as a potential indirect source of GHGs to the atmosphere (Anderson et al., 2014; Jahangir et al., 2012; Minamikawa et al., 2011)



Source: Jurado et al., 2017

Fig.1. Types of GHGs emissions from agricultural areas

2 Regional studies



Peculiarities of the studied area:

- area: 480 km²;
- 65% of agricultural activities;
- high fracturing of chalk aquifer;
- unconfined the South;

semi-confined – near the Geer river;

confined - the North-West

3 Regional studies



Group 1 – dark blue, group 2 – green, group 3 – blue and group 4 – yellow.



Group	N ₂ O (μg N/L)	SP (‰)	DO (mg/L)	NO ₃ ⁻ (mg/L)	Processes
Group 1	3.4 ± 1.2	11.2 ± 1.6	8.2 ± 1.9	28.7 ± 3.8	nitrification and incomplete denitrification
Group 2	13.6 ± 6.3	26.1 ± 3.4	5.7 ± 2.4	48.7 ± 18.7	nitrification and complete denitrification
Group 3	6.7 ± 3.4	19.1 ± 6.7	7.2 ± 2.6	39.6 ± 16.2	nitrification and incomplete denitrification
Group 4	0.1 ± 0.1	not available	1.5 ± 2.1	0.2 ± 0.4	complete denitrification

Bovenistier

SGB





- 1. Low flow sampling using packer system
- 2. NO_3^{-1} and N_2O isotope and isotopomer analyses.

Isotopomers are molecules having the same number of each isotopic atom but differing in their positions.



6 Local studies: SGB





Local studies: Bovenistier

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8 Conclusions

- distribution of ¹⁵N between the central and peripheral positions helps in distinguishing the processes which control N₂O dynamics;
 - it is important to study the effect of microbiological consortia in situ to understand its impact on the isotopic signature of N species;
- 2. production of N_2O dominates over its consumption, which increases the role of aquifers in contribution to the total N_2O emissions to the atmosphere;
- 3. Occurrence and intensity of GHGs production/consumption processes is highly spatially variable even on the local scale.

Insitu Push-Pull tracer test

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- estimation of the incubation time:
- ✓ FVPDM tests to estimate groundwater flow rates (Jamin & Brouyère, 2018);

 Push-Pull pretest using Br as a conservative tracer.

Results: groundwater flow rates are to high and the incubation time is too short for the insitu Push-Pull tests.





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10 Isotopomer mapping



Fig. 5. $\Delta \delta^{15} N NO_3^{-}$ - N₂O versus SP (‰) isotopomer map

Push-pull pretest at the Bovenistier site

Location	Incubation time	Characteristics solu	s of the injected Ition	Background	Recovery of the tracer (%)
Location	(hour)	Volume (L)	Concentration of Br (mg/L)	Br (mg/L)	
Pz12 top	1	300	78.38	2.63	14.15
Pz12 bottom	3	300	71.87	0.22	89.03
PzCs	3	500	70.89	0.21	26.69
Pz13 bottom	3	300	66.62	0.20	65.59



Cumulative pulled volume/ Total pushed volume









Cumulative pulled volume/ Total pushed volume

12 FVPDM

estimation of groundwater flow rates at the SGB site

