

Titre du projet : ISONITRATE, Traçage isotopique des nitrates atmosphériques de l'atmosphère aux exutoires des bassins versants

Volet : Recherche

Porteur du projet : JC Clément

Laboratoires impliqués : LECA, IGE, SAJF

Bilan du projet pour l'année/la période

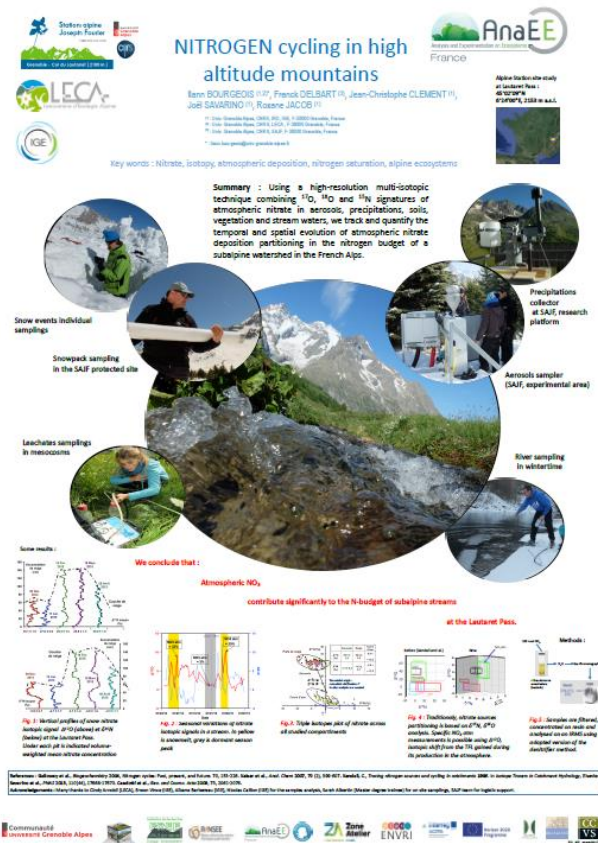
Bilan d'activité (1 page max)

In 2016, using the 7 000€ grant from the LabexOSUG@2020, we were able to run aerosol, snow, soil, stream and plant samples to characterize their atmospheric nitrate content and isotopic signature. The gathered data enabled us to present preliminary results in 3 international conferences and to prepare 2 articles for international scientific journals, one of them being under revisions. Here, we briefly summarize the main outputs of our research.

Understanding nitrogen dynamics (i.e., imports and exports) is essential to evaluate prospective decay of the ecosystem services that subalpine headwater catchments provide, especially as these ecosystems experience increased anthropogenic nitrogen deposition. We used a multi-isotopic tracer ($\Delta^{17}\text{O}$, $\delta^{15}\text{N}$ and $\delta^{18}\text{O}$) of nitrate in aerosols, snow and streams to assess the fate of atmospherically deposited nitrate in the subalpine watershed of the Lautaret Pass (French Alps). We show that **atmospheric deposition contributes significantly to streams nitrate pool year-round**, either by direct inputs (up to 35 %) or by in situ nitrification of atmospheric ammonium (up to 35 %). Snowmelt in particular leads to high exports of anthropogenic nitrate, most likely fast enough to impede assimilation by surrounding ecosystems. Yet, in a context of climate change, with shorter snow seasons, and increasing nitrogen emissions, **our results hint at possibly stronger ecological consequences of nitrogen atmospheric deposition in the close future.**

Despite decades of studies on nitrogen (N) cycling perturbations caused by anthropogenic activities, several caveats remain before fully understanding the fate of deposited N. Subalpine meadows, for long overlooked by environmental studies, are especially relevant in that concern as N is a key-limiting nutrient fostering the dominance of specific plants communities, thereby providing potentially impacting essential ecosystems services. **We found isotopic evidence ($\Delta^{17}\text{O}$, $\delta^{18}\text{O}$ and $\delta^{15}\text{N}$ of nitrate (NO_3^-)) from two different endemic plants species at the Lautaret Pass, French Alps, indicating a direct contribution of atmospherically deposited NO_3^- up to 33% of plants NO_3^- pool, punctually.** Differences between leaves and roots show that plants strategies for N uptake reflect on their NO_3^- isotopic composition, and evidence direct foliar uptake of atmospheric nitrate as a non-negligible, yet overlooked, pathway for nutrients entry in grasses under natural conditions. These findings point at the need for immediate mitigation efforts by diminishing ambient N levels. Further, we demonstrate that this multi-isotopic approach has a unique potential to further unravel the global functioning of ecosystems with changing N supplies.

Illustrations - avec légende et crédit (à envoyer également séparément)



Production scientifique (articles scientifiques, actes de congrès...)

Actes de congrès

- Bourgeois I., J. Savarino & Clement J.C. Response of subalpine watershed to atmospheric NO₃⁻ deposits using $\Delta^{17}O$. **Goldschmidt 2017**. Paris, FR. 13- 18 Aug. 2017. Talk
- Bourgeois I., J. Savarino & Clement J.C. MIF from an ecological point of view: insights on the synergy between nitrogen deposition and past land-use in mountainous basins **Goldschmidt 2016**. Yokohama, JP. 26 June-1 July. 2016. Talk
- Bourgeois I., J. Savarino & Clement J.-C. Response of subalpine vegetation to N deposition and land-use changes from a new isotopic perspective. **Joint European Stable Isotopes User Meeting (JESIUM)**. Ghent University, Belgium, 4-9 Sept. 2016. Talk
- Bourgeois I., Savarino J. & Clement J.C. Export of atmospheric NO₃⁻ in streams along an elevation gradient in the French Alps. **The 8th International Symposium on Isotopomers**. Nantes, FR, 3-6 Oct. 2016. Talk.
- Bourgeois I., Delbart F., Clément J.C. & J. Savarino. NITROGEN cycling in high altitude mountains. **AnaEE Congress**, Montpellier, FR, 28-31 March, CNRS, DOI: 10.13140/RG.2.2.21550.82247.

Articles scientifiques

- Bourgeois I., J. Savarino, N. Caillon, H. Angot, A. Barbero, F. Delbart, D. Voisin & J.C. Clement. *Tracing the fate of atmospheric nitrate in a subalpine watershed using $\Delta 17O$* . **Environmental Science and Technology**. Under revisions
- Bourgeois I., J. Savarino, N. Caillon, C. Nesti, N. Deschamps & J.C. Clement *Fertilization of subalpine plants by atmospheric nitrate*. **PNAS**. In prep

Bilan financier succinct (avec suivant les cas : co-financements éventuels, équipements achetés, missions, recrutements divers, fonctionnements divers...)

Date	Supplier	Items	Cost
mai-16	CHROMOPTIC	Consommables	1124,25
mai-16	GILSON	logiciel	4588,5
mai-16	Conférence Japon - complément		320
mai-16	Agilent	consommables	409,34
mai-16	Sigma	consommables	295,7
juin-16	Fisher	consommables	262,21€
TOTAL			7 000€

Annexes si besoin ou lien sur des sites existants et pérennes jusqu'à la fin du Labex (2020).

For more details and links to research outputs see :

<https://www.researchgate.net/project/DEPONIT-NATEAU-ISONITRATE>

Ilann Bourgeois presented new results at the Goldschmidt Conference in Yokohama, Japan, in June 2016: <https://goldschmidt.info/2016/uploads/abstracts/finalPDFs/284.pdf>

Ilann Bourgeois gave a talk on his PhD work at the JOINT EUROPEAN STABLE ISOTOPES USER group MEETING in Ghent, Belgium, in October 2016 : http://www.jesium2016.eu/assets/bookabstracts_jesium2016_3108.pdf