

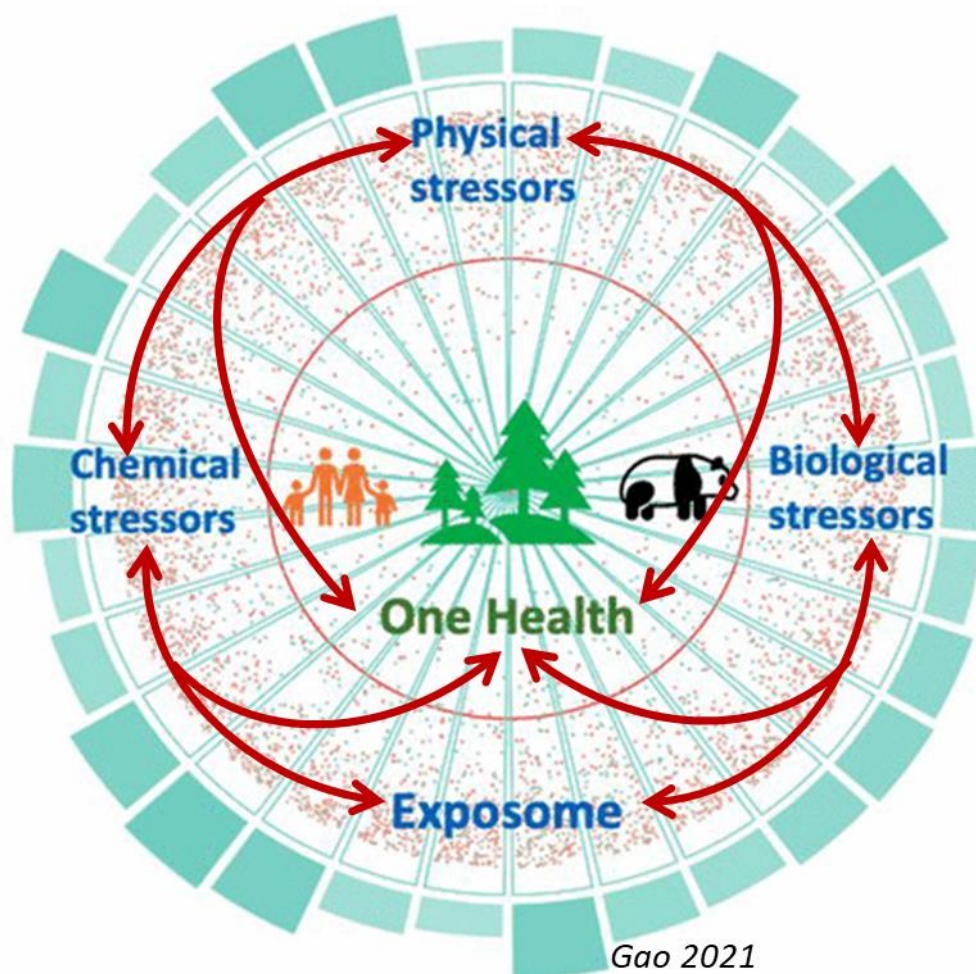
Observatoire des Sciences  
de l'Univers de Grenoble



# Ateliers transversaux

## Polluants

### Ecodynamique et écotoxicologie des xénobiotiques



**Séminaire** du 23 janvier 2023

*Animateurs de l'Atelier: Muriel Raveton, Emilie Lyautey, Stéphane Guédron, Christine Baduel*

*Comité scientifique: Jean Martins, Géraldine Sarret, Gaëlle Uzu*

## PROGRAMME

# 'Ecodynamique et écotoxicologie des xénobiotiques'

**8:30-9:00** : Accueil & Café

9:00-Présentation du thème de l'Atelier

9:15-*Keynote lecture*, **Marina COQUERY** (Riverly, INRAE, Lyon) 'New approaches to characterize contaminant sources and transfers in watersheds' - Visio

9:45 - **David GATEUILLE** 'Contribution of geotextiles to microplastic contamination'

10:00 -**Christine BADUEL** 'New strategies to assess the occurrence and impact of emerging contaminants in aquatic systems'

10:15 -**Céline DUWIG** 'ZAKABOL: The use of the critical zone concept for a better management and protection of the KAtari/Lago Menor Titicaca aquifer, Bolivia'

**10:30-11:00** : Echange autour du Café et des Posters

11:00 -**Magali ROSSI** 'Long-term inheritance of Pb in ancient mining sites: The Peisey-Nancroix Pb-Ag mine (1644-1866, Savoie)'

11:15 - *Keynote lecture*, **Benoit FERRARI** (Centre Ecotox, EPFL, Suisse) '*Behaviour and ecotoxicity of tire wear particles: Feedback*'

11:45 - **Emilie REALIS** 'Effects of parental PCB Contamination and climate change on a cold stenothermal Fish'

12:00 - *Keynote lecture*, **Sandrine CHARLES** (LBBE, Univ. Claude Bernard Lyon) 'Ecotoxicology 2.0 - Moving from the "one species-one compound" paradigm towards a systems-based approach in ERA'

**12:30-13:45** : Repas autour des Posters

13:45 - **Emilie LYAUTEY** 'Impact of contaminants on benthic microbial communities'

14:00 – **Jean MARTINS** 'Reactive transfer of pollutants in soil: experimental design and modelling'

14:15 - **Hester BLOMMAERT** 'From soil to bean: Unravelling the pathways of cadmium in cacao'

14:30 - **Muriel RAVETON** 'Plant plasticity/Adaptation to contamination resulting from past Mining activities in the Alps'

**15:15** –Clôture & Perspectives

**Inscription libre sur la liste de diffusion de l'Atelier-OSUG-Polluants**  
[osug-atelier-polluants@univ-grenoble-alpes.fr](mailto:osug-atelier-polluants@univ-grenoble-alpes.fr)

[https://listes.univ-grenoble-alpes.fr/sympa/subscribe/osug-atelier-polluants?previous\\_action=info](https://listes.univ-grenoble-alpes.fr/sympa/subscribe/osug-atelier-polluants?previous_action=info)

## Résumés des Conférences :

*Keynote lecture*, **Marina COQUERY** (Laboratoire de chimie des milieux aquatiques, Rivery, INRAE, Lyon)

*'New approaches to characterize contaminant sources and transfers in watersheds'*

*The presence of many contaminants in aquatic ecosystems can lead to a degradation of the ecological status of waters and increase exposure to these contaminants. The increasing artificialization of surfaces as well as climate change could lead to a critical degradation of water quality. In this context, our research aims to identify and quantify the transfer pathways of contaminants in dissolved and particulate phase. In addition, we seek to characterize the different types of contaminant sources: agricultural non-point sources, domestic discharges, storm water overflows,... For this, we rely on the development of original biogeochemical fingerprinting strategies based on trace elements, nutrients, organic matter and organic micropollutants (e.g. pesticides, pharmaceuticals). These approaches are applied at different scales: from small watersheds (e.g. Yzeron, Claduègne) to large hydrosystems (e.g. the Rhône and its tributaries).*

*In the framework of two ongoing projects (ZABR-IDESOC and ANR-CHYPSTER), we aim to define and test a new integrated methodology to identify and characterize (diffuse/point) sources of contaminants and ultimately predict stream contamination as a function of hydrological conditions, land use changes and climate change. This approach is applied to two instrumented mesoscale watersheds (Yzeron and Claduègne). Innovative tools (grab and integrative-passive sampling coupled with targeted and non-targeted, chemical and microbiological analyses) are deployed to characterize contaminant sources and define specific biogeochemical fingerprints. A particular effort is being made to evaluate non-point sources, whose contributions are still poorly documented in this type of mixed-use watershed (diversified agriculture, urbanization, tourism).*

*We are also studying the fluxes and sources of particulate contaminants at the scale of the entire Rhone River basin, based on the databases acquired in the framework of the monitoring network of the Rhone Sediments Observatory (OSR). In terms of future topics, our work also aims to identify all degradation products in small wine catchments of a few selected pesticides by developing a suspected HRMS analysis strategy. Finally, a new field of research is opening with the search for Technical Critical Elements (TCE) whose measurement in water and sediment is being validated and application in progress in suspended particulate matter of the Rhone River and various samples of alpine glaciers.*

**Christine BADUEL** (IGE)

*'New strategies to assess the occurrence and impact of emerging contaminants in aquatic systems'*

Thi Minh Tam Le, Truong An Nguyen, Romane Caracciolo, Tuyet Nguyen, Julien Némery, Phuoc Dan Nguyen / Beate I. Escher, Rita Schlichting / Foon Yin Lai, Rikard Tröger, Karin Wiberg  
Univ. Grenoble Alpes, CNRS, IRD, Grenoble-INP1, IGE, France / Asian Centre for Water Research (CARE)/HCMUT, Ho Chi Minh City, Viet Nam / Helmholtz Centre for Environmental Research-UFZ, Leipzig, Germany / Department of Aquatic Sciences and Assessment, Swedish University of Agricultural Sciences (SLU), SE-75007 Uppsala, Sweden

*The global population continues to grow at a rapid rate, the **expansion of urban areas continues to pose a significant threat to environmental quality** worldwide and particularly in the tropical zone. High population densities result in the spread of a broad range of organic pollutants including the **contaminants of emerging concern (CECs)**. Assessing water chemical contamination and associated hazards for human health and aquatic systems is extremely challenging as chemicals occur in unknown and complex mixture. This seminar presents the strategies that we have implemented to **characterize the impact of an important tropical megacity on the water quality**, regarding emerging contaminants, by combining **complementary integrative strategies** and state of this art analytical tools (passive sampling, grab sampling, **targeted and non-targeted analysis** as well as **in-vitro bioassays**). The seminar focuses on our on-going projects in Ho Chi Minh City (around 9 Million inhabitants) in Vietnam.*

These include **exhaustive assessments of drinking water quality and surface water quality along the full river-estuary-littoral continuum of the Saigon River.**

### **Céline DUWIG** (IGE)

'ZAKABOL: The use of the critical zone concept for a better management and protection of the KAtari/Lago Menor Titicaca aquifer, Bolivia'

Sébastien Hardy, Christine Baduel, Luis Hernandez, Yvan Rossier, Lorenzo Spadini, Jean Martins - IGE UMR 5001 (UGA, IRD, CNRS, G-INP, INRAE), Grenoble, France ; Alvaro Soruco, Oswaldo Ramos - UMSA, La Paz, Bolivia; Stéphane Guedron, Isterre UMR 5272 (UGA, IRD, CNRS, Univ Gustave Eiffel, UMSB), Grenoble, France; Gabriela Flores Aviles - Agencia Boliviana de Energia Nuclear, La Paz, Bolivia

*Sustainable management of the critical zone requires researchers from different scientific disciplines to work together (hydrology, meteorology, geochemistry, SHS) as well as stakeholders. Crossing disciplines allows us to understand and anticipate the feedback mechanisms between increasing anthropisation on the one hand, climate change on the other hand and the water cycle and its quality. It also allows the creation of scenarios that better reflect the reality of interactions between society and the environment, also known as the critical zone. In addition, the result of the cross-referencing of these data makes it possible to work with the stakeholders on proposals for more efficient and sustainable water resource management methods because they are better targeted. This targeting facilitates the path towards achieving a compromise between exploitation and preservation of the resource in the long term. The ZAKABOL project proposes to identify the links between human activities and water and contaminant flows in a major aquifer in the Northern Altiplano by involving scientists and stakeholders throughout the process. Previous results show that surface and groundwater as well as soils are contaminated by medicaments. On the other hand, a geo-referenced database (DB) was built in the framework of a previous research project with the municipality of La Paz, El Alto and the Universidad Mayor de San Andrés (UMSA) de la Paz, which locates certain activities classified as polluting. The aim is to construct a land use map based on archives (urban planning documents), statistical data produced (evolution of population densities, building permits) and evaluation of urbanization and informal activities, if any. The ultimate goal is the sustainable management of this aquifer, in agreement with the local populations and the stakeholders. This aquifer supports 10% of the Bolivian population.*

### **Magali ROSSI** (EDYTEM)

'Long-term inheritance in ancient mining sites: an interdisciplinary approach'

<sup>1</sup>M. ROSSI\*, F. GUILLEVIC, J. POULENARD, F. ARNAUD, P. SABATIER, D. GATEUILLE, E. NAFFRECHOUX, A.L. DEVELLE ;

<sup>2</sup>J. MARTINS, L. SPADINI ; <sup>3</sup>A. FOULQUIER ; <sup>4</sup>E. LYAUTEY, D. ETIENNE

<sup>1</sup>EDYTEM/CNRS/USMB/UGA, 73376 Le Bourget du Lac, France (\*correspondance : magali.rossi@univ-smb.fr)

<sup>2</sup>IGE/CNRS/UGA, 38000 Grenoble, France

<sup>3</sup>LECA/CNRS/UGA/USMB, 38000 Grenoble, France

<sup>4</sup>CARTEL/USMB/INRAE, 73376 Le Bourget du Lac, France

*The Pb-Ag district of Peisey-Nancroix (northern French Alps) is an excellent target to study the long-term environmental impacts (> 150 years) of former mining activity and inheritance of trace metal dispersal in the critical zone, considering that every steps of the mining cycle, from ore extraction to ore processing, were located on a 15 hectares site that has been unmodified since mine closure in 1866 (no reclamation, no major change in land use). The extraction of 22 000 t Pb and 53 t Ag produced significant amounts of waste deposits that have been abandoned to weathering for several hundred years.*

*A cross-disciplinary study has been conducted ore, slags, soils, stream and lake sediments and trees in order to (i) characterize present-day contamination on and around the mining site, (ii) determine the*

*speciation and bioavailability of lead in soils, and (iii) evaluate the effect of trace metals on microbial communities functioning.*

*Topsoils are significantly enriched to extremely enriched in Pb, and locally in As, Sb and Cu compared to the local geological background. Soils developed on top of abandoned slags contain up to 3.4% Pb, 1695 ppm Zn, 381 ppm Sb and 168 ppm Cu. Trace metal dispersal results from weathering of the abandoned Pb-rich sulphide ores and slags. Mineralogical observations highlight a changes in the Pb-bearing phases along the contamination gradient, from small particles of slags and galena weathered into cerussite, Pb-associated with manganese and iron (hydr)oxides. Stream sediments are enriched in Pb (galena) at by the dewatering galleries. Pb is then rapidly diluted into the stream sediments downwards. Lake sediments display Pb peaks during mining and smelting activity, providing evidence of deposition of the smelting Pb-rich fumes.*

*Batch leaching (48h) tests have been performed on selected topsoils. Apart from the metallurgical topsoils, the amount of leacheable lead is related to the soils lead content, whatever the reactant (EDTA, humic acids, water). The proportion of extractible Pb is related to the proportion of the various Pb-bearing phases in soils: the more Pb associated with Mn and Fe oxides, the less extractible Pb; the more Pb associated to ore and slags, the more extractible Pb.*

*Microbial activity (extracellular enzymes involved in organic matter decomposition and nutrient recycling) has been measured on a selection of topsoils along the Pb contamination gradient, on stream sediments and on lake sediments. The contamination doesn't affect microbial activity in stream sediments. In contrats, a reduction of nitrogen acquisition has been evidenced in the most contaminated topsoils, providing evidence that mining activity still impacts the ecosystem more than 150 years after mine closure. However, Pollution-Induced Community Tolerance experiments indicate that communities developed on the most contaminated soils have developed the greatest tolerance to Pb contamination. Data on lake sediments are not available yet.*

*Trunk sections in larch trees that have grown during smelting activity display Pb variations and depletions, which can be related to the end of smelting on site, suggesting that larch trees have also recorded Pb contamination.*

*The interdisciplinary and integrated (biotic vs abiotic, various compartments of the critical zone) approach developed allows assessing the long-term (> 150 years) heritage of mining activities in the critical zone and provides evidence of the long-term persistence and remobilization of Pb in the environment.*

### **Emilie REALIS (CARRTEL)**

*'Effects of parental PCB Contamination and climate change on a cold stenothermal Fish'*  
Romane Morati (1) ; Nathalie Cottin (2) ; Emmanuel Naffrechoux (2) ; Stéphane Reynaud (3) ; Jean Guillard (1) ;

(1) Univ. Savoie Mont Blanc, INRAE, CARRTEL, 74200 Thonon-les-Bains, France

(2) Univ. Savoie Mont Blanc, EDYTEM UMR CNRS-USMB 5204, Rue du lac majeur 73370 Le Bourget-du-Lac

3) Univ. Grenoble Alpes, LECA, UMR UGA-USMB-CNRS 5553, 621 Avenue Centrale, 38400 Saint-Martin-d'Hères (Contact e-mail : emilie.realis@inrae.fr)

*The end of the XXth century is characterized by rapidly changing aquatic ecosystems due to the effect of human activities via the increase of multiple stresses. Among these stresses, polychlorinated biphenyls (PCBs) are bioaccumulated by aquatic fauna, and particularly fish, as a result of their lipophilic nature and their low degradation. In addition, in the present context of climate change, temperature variations may have indirect abiotic consequences on PCBs, making them more bioavailable. Arctic char is a cold stenothermic salmonid whose population in Lac du Bourget has remained at a low level for the last decade.*

*Thus, the aim and originality of this project is to study the intergenerational effects of parental PCB contamination under the influence of small temperature increases via a multiparametric and multiscale*

*approach allowing the development of methods to investigate both omic and physiological mechanisms of action.*

*The results of our study show a population collapse due to maternal contamination coupled with an increase in temperature (12% survive maternal contamination Vs 50% survive paternal contamination). Parental transmission of PCBs affects the rhythm of life of larvae; the effects of maternal transmission being greater than the effects of paternal transmission. Indeed, synergistic effects (temperature and transmission of PCBs) have been shown on the same parameters for male and female, but additive effects of PCBs and temperature are more important, which could explain for women why the effect of maternal transmission coupled with an increase in temperature is more negative. In addition, PCBs are historical pollutants, they are POPs, so we can make the strong assumption that these results can be transposed to other POPs.*

**Keynote lecture, Sandrine CHARLES** (LBBE, Univ. Claude Bernard Lyon)

**'Ecotoxicology 2.0 - Moving from the "one species-one compound" paradigm towards a systems-based approach in ERA'**

*In this presentation, I will develop some arguments in favor of advanced modelling approaches to improve environmental risk assessment (ERA). Starting from the current practice of ERA as described in regulatory documents, I will illustrate why ERA now needs to embrace new systems-based methods and to be strongly supported in this process. Indeed, it is widely recognized that ERA needs to account for multiple routes of chemical exposure, different modes of internal contamination, mixtures of chemicals, multiple stressors, and ecological interactions. All these phenomena are known to cause multiple alterations in organisms, populations, and communities, so that for a better investigation, we need to merge them into an integrative modelling framework. Only with such a paradigm shift can ERA hope to achieve more informed, more realistic and more relevant environmental protection measures.*

**Jean MARTINS (IGE)**

**'Reactive transfer of pollutants in soil: experimental design and modelling'**

Jean M.F. MARTINS et Coll. Equipe HyDRIMZ-IGE.

*This seminar describes the reactive transfer of pollutants in porous media (soils), from a phenomenological description to theoretical and numerical modeling. The main mechanisms involved in the transport processes are described and identified experimentally. The modeling of water flow and solute transport in porous media is presented, including three fundamental problems: convection, diffusion, and dispersion. Reactive processes affecting pollutants during their transfer are also introduced, in particular retention processes leading to retarded pollutant transport and degradation processes leading to pollutant dissipation. The methodologies and the experimental and analytical tools implemented at the IGE are finally described along with some specific examples of the reactive transport of pesticides in soil.*

**Hester BLOMMAERT (ISTerre)**

**'From soil to bean: Unravelling the pathways of cadmium in cacao'**

*The accumulation of the potentially toxic metal cadmium (Cd) in cacao beans has recently become a subject of intense research after the European Union and the Codex Alimentarius lowered its legal limits in chocolate. The research on strategies to reduce Cd accumulation in cacao beans is currently limited by a lack of understanding of the Cd transfer pathways within the cacao tree. In this presentation, I will show a model of the Cd transfer from soil to cacao beans based on Cd stable isotope fractionation, X-Ray Absorption Spectroscopy and imaging techniques.*

**Muriel RAVETON (LECA)**

**'Plant plasticity/Adaptation to contamination resulting from past Mining activities in the Alps'**

Marion Deville-Cavellin, Florian Boucher, Stéphane Reynaud, Sylvie Veyrenc, Frédéric Laporte LECA UGA; Stéphane Guedron, Géraldine Sarret, Sylvain Campillo Isterre UMR 5272, UGA; Magali Rossi,

David Gateuille, Jérôme Poulenard EDYTEM, USMB; Maxime Rome, Rolland Douzet Jardin du Lautaret, UGA; Marie-Christine Bailly-Maitre LA3M, Aix-Marseille; Guillaume Marti MetaboHub, Toulouse

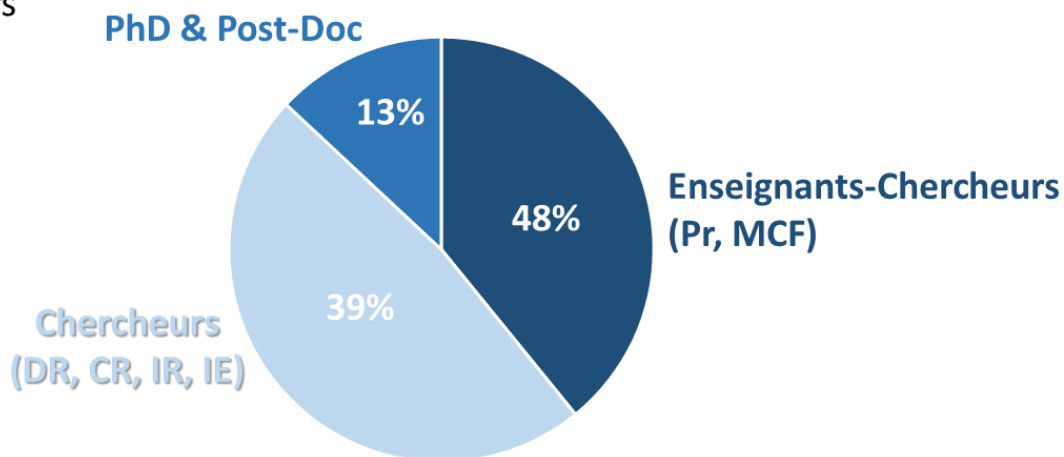
*Mine wastes contain significant amounts of trace metals and metalloids (TMM; eg, Pb, As, Sb, Cd, Cu, Hg) and Polycyclic Aromatic Hydrocarbons (PAH). In abandoned mines, dispersal of these contaminants into critical zone may allow them entering the trophic chain and threatening the ecosystems. Due to a favorable geological context, ores have been mined for millennia in mountain areas, leaving behind large volumes of wastes in an ecologically sensitive context. Even though hundreds of mines are abandoned in the French Alps, neither characterization of TMM and PAH in the mine wastes and their close environment nor the associated environmental risks have ever been established.*

*The LandMine project aims to study the impact of mine wastes on the plant cover of the alpine vegetation belt (>2100m a.s.l.) in particular by taking *C. resedifolia*, which is often found onto soils highly enriched in TMM and PAH, as a biological model. For this, the project will federate an interdisciplinary approach essential to i) characterize the exposome in relation with the history of past mining activities, ii) determine plant assemblages tolerant to mine wastes and their contamination in TMM and PAH, iii) study the ecophysiological responses of *C. resedifolia* under stress of mine exposomes, as well as iv) test the genetic adaptation of *C. resedifolia* populations to mine wastes. The innovative character of this project is to tackle the micro-evolutionary response of a plant species under contaminant stress and to select ecophysiological proxy to monitor plant tolerance in alpine mine wastes.*

# Synthèse du sondage

## Questionnaire

23 retours



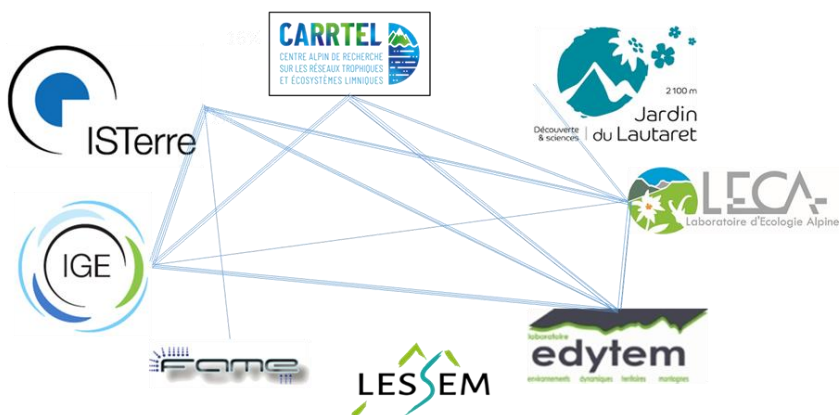
## Réseau actuel de collaboration

### Mots-clés:

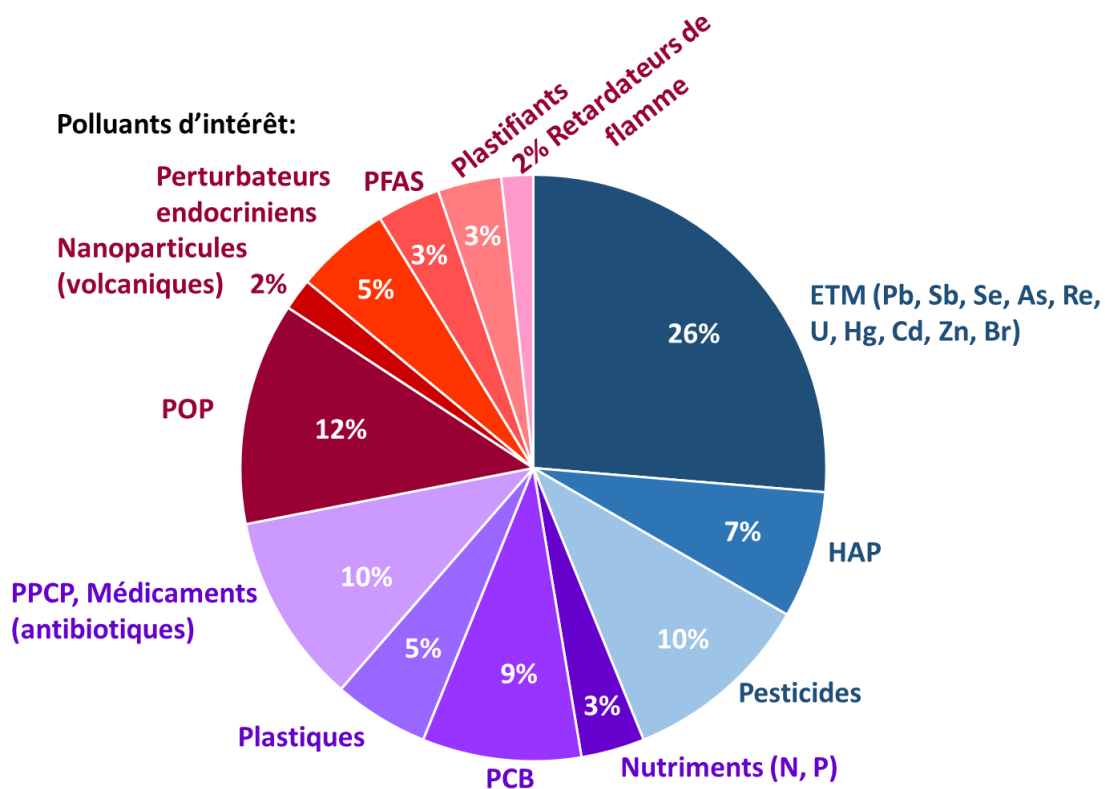
**'Thématiques':** Sol, Biogéochimie, Mines, Lacs

**Organismes :** Plantes, Microorganismes, Poissons, Batraciens

**Méthodes :** Transcriptomique, Analyse ciblée et non-ciblée, Approche populationnelle, Développement de Méthode analytique







**Thématiques scientifiques et transverses à développer :**

- Impact sur le fonctionnement des écosystèmes dans un contexte de changement global
- Impact du changement global sur le cycle des contaminants
- Qualité en analyse et développements analytiques
- Traçage isotopique
- Transferts atmosphériques
- Biodisponibilité, marqueurs d'exposition, évaluation des risques
- Impact / risque sur la santé humaine et la santé des écosystèmes
- Suivi des effets de restauration des milieux
  
- Approches « multi » : contaminants, compétences, échelles, écosystèmes
- Approches transverses : sources-puits, transferts, effets
- Approches interdisciplinaires autour du risque intégrant les SHS

## Outils à développer :

### Sites d'étude

Mésocosmes  
Site atelier

### Analytique

Chromatographie ionique  
Spéciation en phase aqueuse  
Analyses non ciblées  
Outils *low cost*

### Traitement des données

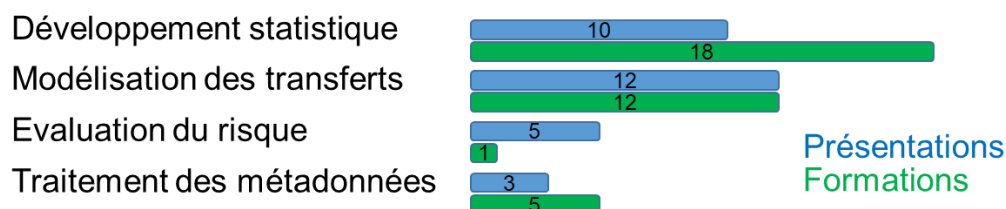
Bases de données partagées  
SIG avec couplage chimie des sols et transports atmosphériques  
Modélisation biogéochimique  
Modélisation des transferts

## Actions de communication d'intérêt:

### Communication



### Workshops



### Réunions



### Séminaires

Chimie, géochimie  
Géosciences, géologie  
Ecologie microbienne  
Sols, neige  
SHS

### Autres

Dispositifs et moyens techniques OSUG : laboratoire, mésocosmes, sites expérimentaux *in situ*

Plateforme d'entrepôt de données communes