L'ÉCOLE NORMALE SUPÉRIEURE-PSL

Créée en 1794, l'École normale supérieure, membre de l'Université PSL, est un établissement d'enseignement supérieur et de recherche qui recrute sur concours les étudiants les plus talentueux en France et à l'étranger. Établissement d'élite, dont l'activité recouvre l'essentiel des disciplines scientifiques et littéraires, l'ENS-PSL jouit d'un grand prestige international par la qualité de ses étudiants mais aussi par la réputation de ses centres de recherche dont 30 unités mixtes de recherche.

Située au cœur de Paris et classée parmi les 50 premières universités mondiales, l'ENS-PSL fait dialoguer tous les domaines du savoir, de l'innovation et de la création en formant au plus près de la recherche des chercheurs, ingénieurs, artistes, entrepreneurs ou dirigeants conscients de leur responsabilité sociale, individuelle et collective.

L'ENS-PSL mène une politique dynamique en matière de qualité de vie au travail et d'égalité professionnelle, offrant ainsi un cadre de travail enrichissant et propice au développement et à l'épanouissement professionnel.

Recrute un / une

RADIODINA project Post-doc position (F/H)

Département ou service de la structure : Département de Géosciences

Catégorie/Corps : Post-doc

ENVIRONNEMENT DE TRAVAIL (structure d'accueil du poste)

The RADIODINA project will be carried out within the "LRC Yves Rocard", a research program involving teams from the CEA's Department of environmental assessment and monitoring (DASE at CEA/DAM Île de France) and the Geosciences Department at ENS-PSL. Its aim is to develop research actions that meet the objectives of the DASE, drawing on the expertise of the teams in the Geosciences Department at ENS-PSL, and in particular the ENS Laboratoire de météorologie dynamique, into which the candidate will be integrated.

Specifically this project combines ENS expertise on numerical modeling of the atmospheric chemistry and environmental fate of halogens, specifically iodine, with DASE expertise on monitoring radioactive nucleides and impact evaluation. The project will be hosted at the Geosciences Department of ENS-PSL in central Paris, with regular visits to researchers at DASE and LMD in the wider Paris region, and in close collaboration with international partners.

RADIODINA Project : RADIOactive IODINe nucleides in the Atmosphere

The RADIODINA project seeks to quantify the atmospheric processing and fate of radioactive iodine, enabling to better assess impacts on health and the environment following nuclear accidents or past nuclear tests.

The project involves numerical modeling to investigate the physico-chemical processing of radioactive iodine emissions as they disperse in the atmosphere. Understanding these processes, and especially the atmospheric chemistry that controls partitioning of Iodine between gas and aerosol is essential to quantify impacts of radioactive iodine on human health and the environment, as, for example, I-131 in aerosol form is more easily deposited to surfaces (including lungs, and fixation on thyroid and thus more strongly affects human health).

Iodine-131 can be released into the atmosphere during nuclear accidents. For example, tsunami damage to nuclear reactors in Fukushima Japan in 2011 led to a radioactive cloud that dispersed I-131 across the northern hemisphere. Iodine was also released during past nuclear tests in the Pacific. The I-131 can be emitted in a variety of forms (e.g. inorganic, organic and particulate), e.g. Fortin et al. (2019), and is also produced within radioactive clouds, via the decay of parent nucleides as the cloud disperses.

Iodine is highly reactive in the atmosphere and undergoes gas-phase, aerosol-phase and photochemical reactions through chemical cycles closely coupled to other halogens like bromine and chlorine. The half-life of Iodine I-131 is 8 days, allowing for an extensive chemistry to occur as the radioactive cloud is transported and disperses in the atmosphere. The location and severity of human and environmental impacts of I-131 releases depends critically on the form (aerosol or gas-phase) and thus the physico-chemical processing of iodine in the dispersing radioactive cloud.

In recent years the atmospheric modeling community achieved major advances in its capability to numerically simulate iodine chemistry in the atmosphere. This project will take advantage of the 1D chemistry and dispersion model (PACT-1D) that was recently developed to include state-of-the-art iodine chemistry alongside bromine and chlorine (collaboration : Stutz group, UCLA, see Fritzmann et al. 2023). The model will be adapted to include radioactive iodine, and applied across a range of I-131 emissions and environmental conditions. The project will thereby characterize and quantify the environmental fate and impacts of Iodine-131 releases, based on detailed knowledge of its physico-chemical processing in the atmosphere including the important inter-halogen reactions. Model findings will be cross-compared to observations of I-131 radioactivity provided by the DASE. As the project progresses, the model may also be used to develop and test simplified parameterisations of the iodine chemistry. This will allow to advance towards implementing simplified representations of the atmospheric physico-chemical processing of Iodine into the larger-scale model CHIMERE, which has been developed jointly by LMD and DASE researchers for tracing the 3D dispersion of radioactive clouds over regional to hemispheric scales (Adenis et al. 2024).

Adenis L., Mailler S., Menut L., Achim P., Generoso S., Lagrangian and Eulerian modelling of 106Ru atmospheric transport in 2017 over northern hemisphere, Journal of Environmental Radioactivity, Volume 275, 2024, 107416, ISSN 0265-931X, https://doi.org/10.1016/j.jenvrad.2024.107416

Fortin C., Fèvre-Nollet V., Cousin F., Lebègue P., Louis F., Box modelling of gas-phase atmospheric iodine chemical reactivity in case of a nuclear accident, Atmospheric Environment, 214, 2019, 116838, https://doi.org/10.1016/j.atmosenv.2019.116838

Fritzmann A., Stutz J. et al. Reactive Halogen Species in Bermuda: Results from a 1D Box Model With Observational Constraints from UCLA's Long-Path Differential Optical Absorption Spectroscopy (LP-DOAS) instrument during the BLEACH Experiment. AGU Fall Meeting 2023, held in San Francisco, CA, 11-15 December 2023, Session: Atmospheric Sciences / Chemistry in the Marine Atmosphere II Poster, Poster No. 2978, id. A43P-2978.

MISSION PRINCIPALE

The postdoctoral researcher will apply the atmospheric chemistry model (PACT-1D) for the study of iodine radioactive nucleide releases. The main goal is to understand the atmospheric chemical processing of radioactive iodine.

The PACT-1D model is a comprehensive atmospheric chemistry model operating as a 1D advected column including vertical dispersion and deposition to the surface. A new version of PACT-1D has recently been developed with state-of-the-art iodine chemistry (gas-phase, photolytic and aerosol-phase reactions for iodine, with coupling to bromine, chlorine chemistry), in the context of a tropical marine boundary layer field-campaign (Fritzmann et al. 2023, Stutz group). This observation-validated version of PACT-1D will now be adapted to trace the physico-chemical processing of radioactive I alongside the usual stable iodine.

Model case studies will allow to investigate how atmospheric chemistry controls the fate of iodine, including its partitioning between gasesous and aerosol forms, that is a key factor for the health and environmental impacts of radioactive iodine releases. The model is computationally fast, allowing to explore a wide parameter space i.e. to investigate various emission release compositions and fluxes, plume evolution with distance over hours and days downwind, and the interaction with other halogens (e.g. from sea-salt aerosol).

Example case studies include radioactive nucleide releases following the tsunami damage to Fukushima nuclear power plant in 2011, and I releases from past nuclear bomb tests in the Pacific (including mixing with halogen-rich marine aerosol). Model simulations will be compared to observations from DASE researchers who undertake I-131 radioactivity monitoring at sites globally. In a second stage, the PACT-1D model results will be used to identify key chemical reactions and develop and test simplified parameterisations for inclusion in the regional-scale 3D CHIMERE model for nucleide dispersion (Adenis et al. 2024).

ACTIVITES PRINCIPALES

- Application of PACT-1D model using matlab, and further development to introduce I-131 species with 8-day lifetime, following the same mechanism as the existing iodine-bromine-chlorine chemistry.
- Undertaking model case studies across a wide range of parameter space, and synthesizing results on I-131 chemistry and fate
- Analysis of model output in comparison to field observation datasets of radioactivity following radioactive nucleide releases, or speciated iodine observations from atmospheric chemistry field experiments
- Development and testing of new model parameterisations e.g. for gas-aerosol reactions
- Reading and summarizing relevant interdisciplinary academic literature (e.g. across: atmospheric chemistry and physics, reaction kinetics, nuclear reactor emissions, radioactivity observations)
- Lead-author writing of manuscripts for academic peer-reviewed journals, and presenting findings at international conferences

SPECIFICITES DU POSTE (conduite de projet, encadrement, sujétions particulières…..)

The research will be undertaken at ENS/LMD (Paris and Palaiseau) in close collaboration with research scientists at DASE (Paris region), and internationally (Stutz group, UCLA & Kuhn, Heidelberg Univ.).

CHAMPS DES RELATIONS

Internes : Laboratoire de météorologie dynamique
Externes : Département Analyse, Surveillance, Environnement (DASE) du CEA/DAM Ile de France)

COMPETENCES ATTENDUES

Diplôme : PhD

Expérience professionnelle : The position is advertised at the post-doctoral level for 12/24 months (with possibility for renewal). Applications might also be considered from excellent PhD candidate (3-year) with strong research capabilities and motivation for the topic.

Connaissances :

- Experience and interest in atmospheric chemistry, pollution, plume dispersion
- Experience in halogen chemistry, or a strong motivation to develop this understanding and expertise
- Numerical modeling (and/or measurements) in atmospheric science and their data analysis

Compétences techniques :

- Programming skills (model code is in matlab) in matlab or similar e.g. Python
- Organised approach to model application/development, tracking versions as code evolves
- Ability to carefully analyse complex model data involving multiple chemical species and reactions

Compétences comportementales :

- The candidate will work as part of a wider team in the Paris laboratories
- Strong organization and motivation for the interdisciplinary research topic
- Travel between research laboratories in Paris region as well as to international conferences and zoom meetings with international (US) partners

AUTRES INFORMATIONS

Poste à pourvoir le : Dès que possible
Lieu de travail : Laboratoire de météorologie dynamique à l'ENS, 24 rue Lhomond, 75005 Paris
Quotité de travail (50% ou +) : 100 %
Poste ouvert : aux contractuels (CDD de 2 ans – Rémunération selon grille et expérience)
L'ENS-PSL est un établissement handi-accueillant et attaché à la mixité et à la diversité

Contact for further information : Tjarda.Roberts@lmd.ipsl.fr

MODALITES DES CANDIDATURES

Merci d'envoyer votre dossier complet (CV, lettre de motivation)
par mail : Tjarda.Roberts@lmd.ipsl.fr
Please send your complete dossier (CV, letter of motivation) to Tjarda.Roberts@lmd.ipsl.fr

Non-discrimination, ouverture et transparence

Les établissements membres de l'Université PSL s'engagent à soutenir et promouvoir l'égalité, la diversité et l'inclusion au sein de ses communautés. Nous encourageons les candidatures issues de profils variés, que nous veillerons à sélectionner via un processus de recrutement ouvert et transparent.