Post-doctoral fellowship in atmospheric transport modelling of radioactive isotopes

Employer: École Normale Supérieure

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Project: Modelling of long-distance atmospheric transport: comparison of Eulerian and Lagrangian approaches for the interpretation of radionuclide detection (aerosol and trace gas) from the International Monitoring System (IMS) of the Comprehensive Nuclear-Test-Ban Treaty Organization (CTBTO)

Background: The position is located at Laboratoire de Météorologie Dynamique (LMD) as part of LRC Yves Rocard, which promotes collaborations between CEA-DASE and the Department of Geosciences of ENS. The main workplace will be École Polytechnique to enable optimal collaboration with the CHIMERE model development team based on this site (researchers participating in the project: Laurent Menut, Sylvain Mailler, Solène Turquety). Visits or working days on the site of the CEA in Bruyères-le-Châtel (91) will be considered (participating in the project: Pascal Achim, Sylvia Generoso).

Duration: 1 year, renewable according to project needs

Position Description: The objective of the project is to improve the representation of atmospheric transport and physico-chemical properties of some radioactive isotopes of interest for environmental monitoring. For this purpose, it is proposed to compare the Eulerian approach of the CHIMERE model, developed at LMD, with the Lagrangian approach of the FLEXPART model used at DASE for operational simulations. Innovative results are expected in two ways. On the one hand, the radionuclides that will be studied are poorly documented in the literature, yet they offer an opportunity to evaluate atmospheric transport models through the availability of a unique measurement network. On the other hand, the contribution of CHIMERE type models to the study of these radionuclides remains to be documented.

It is proposed to use the monitoring of radionuclides by the International Monitoring System (IMS), a measurement network of the Comprehensive Nuclear-Test-Ban Treaty Organization (CTBTO), as a framework for the proposed studies on numerical transport. Indeed, this network provides daily continuous measurements of several atmospheric tracers relevant to the evaluation of transport codes. Case studies of interest concern gases and aerosols and correspond to episodes of atmospheric dispersion of radionuclides that last over several days, and affected several stations of the network (e.g., radionuclide detections linked to Fukushima (2011), the presence of ruthenium 106 in Europe (2017), industrial radioxenon background, forest fires in the Chernobyl region and potentially associated particulate emissions).

Some of the trace gases measured are inert (case of radioactive xenon isotopes). Therefore, they provide privileged case studies for the understanding of large-scale transport. Other compounds such as Iodine 131 are on the contrary chemically active and likely to be transferred between a gas

phase and a liquid aerosol phase depending on weather conditions. The study of aerosol cases will also allow to assess the representation of dry and wet deposition processes in models.

The scientific and technical issues addressed during the project are: the ability of a Eulerian model to replicate the capabilities of a Lagrangian model in terms of transporting isotopes in the gas phase, and the possible added value of the Eulerian formulation in terms of the representation of processes representation for the particulate phase (phase changes, deposition process for the particulate phase, radioactive filiation). The successful candidate will carry out the CHIMERE and FLEXPART simulations necessary for the project, develop and implement the methods and tools for comparing the two simulation approaches, the objective being twofold:

- clarify the potential of the Eulerian simulation for the interpretation of ISS measurements
- Valorize the results through scientific publications

Profile:

- Ph.D. in Atmospheric Sciences or Applied Mathematics
- Knowledge of Fortran language and HPC computational techniques
- Experience in numerical modelling
- Programming skills (R or Python)
- Ability to work independently, at the interface between two teams, and to communicate in a pedagogical and synthetic way

Desired start date: As soon as possible