Young scientist position in environmental modelling

Atmospheric monitoring of the global NO_x, SO_2 and NH_3 emissions using satellite observations

## LSCE: Laboratoire des Sciences du Climat et de l'Environnement
Gif-sur-Yvette, France

ESA - World Emission project

Context

The European Space Agency (ESA) World Emission project (https://www.world-emission.com, https://app.world-emission.com) aims to provide a service for enhanced global monitoring of the emissions of pollutant and greenhouse gases based on satellite observations of the atmospheric concentrations. The project partners, among which LSCE, develop atmospheric inverse modelling systems (data assimilation systems with atmospheric chemistry and transport models) for the production and distribution of estimates and maps of emissions at global to local scales. End users, such as inventory agencies, are engaged in the assessment of the emission estimates, and in the definition of requirements and specifications for the service.

Nitrogen and sulfur dioxide (NO_x and SO_2) are primary pollutants emitted by the combustion of fossil fuels and wildfires, which impact climate, air quality and atmospheric chemistry. Ammonia (NH_3) is mainly emitted by agricultural activities, as well as industrial processes and wildfires. These species have a short lifetime in the atmosphere and produce nitrate and sulfate aerosols. Satellite instruments like IASI/MetOp, OMI/Aura and TROPOMI/Sentinel-5P measure the column concentrations of these species over the entire globe on a daily basis.

During the first phases of World Emission, LSCE has developed atmospheric inverse modelling frameworks to derive global time-varying maps the NO_x, SO_2 and NH_3 emissions, assimilating these satellite observations into the global atmospheric chemistry transport model LMDZ INCA at a resolution of 1° globally. The production of such emission maps must be resumed, strengthened and exploited in the next phase of project, over the next two years.
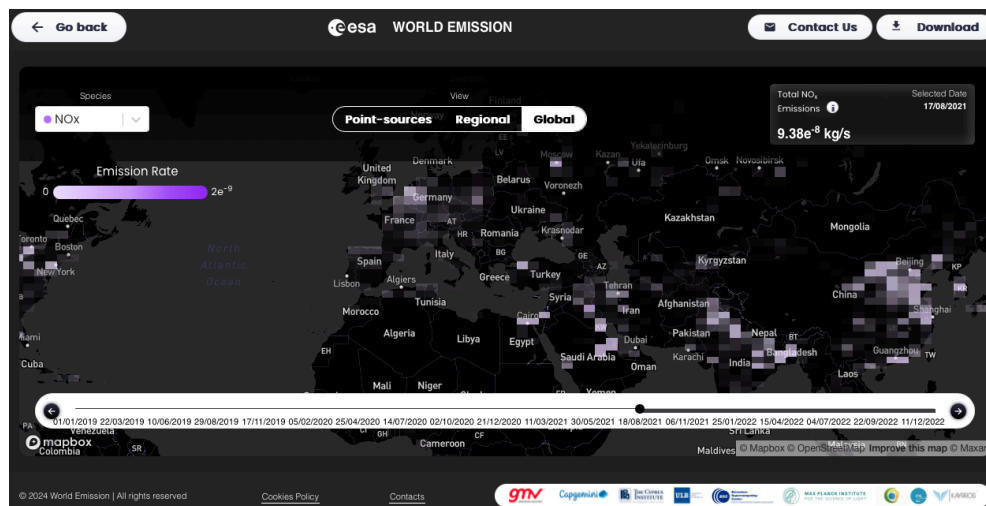
Visualization of the NO_x global emission maps from LSCE in the World Emission web interface

Research objectives and job description

During this next phase of World Emission, we aim to upgrade the global NO_x, SO_2 and NH_3 inversion framework through modeling and methodological improvements, to conduct series of validations in close collaboration with the inventory agencies participating to the project, and to interpret and exploit scientifically the global picture of the emission spatial and temporal trends and variations given by the satellite observations, and the results obtained in regions where these observations shed the light on specific emission processes.

The candidate would be hired at LSCE in the frame of World Emission to fulfil these objectives. More specifically, with the support of the inverse modelling team at LSCE, he/she is expected to

-   resume the regular estimate of the global NO_x, SO_2 and NH_3 emission maps based on updates of the satellite observation products, potentially including observations from new satellite missions
-   upgrade the inverse modelling framework to improve the account for the non-linearities of the relationships between the emissions and the observed concentrations due to the atmospheric chemistry
-   evaluate the emission estimates with comparisons to local and regional scale estimates derived at LSCE or by the partners of the project, and to inventories of the emissions based on process models and statistics on the underlying activities, in collaboration with inventory agencies.
-   analyse the emissions maps and such comparisons with a view to interpret the trends and variations in terms of processes.
-   Interact regularly with the different partners of the project and with ESA.
-   Promote his/her results through presentations during international conferences and scientific publications

Requirements

-   PhD in atmospheric sciences (or more generally: in geosciences) and/or in applied mathematics.
-   Programming skills, preferably in python and Fortran.
-   Interest for satellite data analysis and numerical modelling
-   Autonomy, dynamism, spirit of curiosity and initiative, ability to work in a team, to interact and communicate with different types of collaborators, and time management skills.

Work place: LSCE (Gif-sur-Yvette, France)

LSCE (https://www.lsce.ipsl.fr) is a world-class research laboratory established as a collaboration between the Commissariat à l'Énergie Atomique et aux Énergies Alternatives (CEA), the Centre National de la Recherche Scientifique (CNRS) and the University of Versailles Saint-Quentin-en-Yvelines (UVSQ). It is part of the Institute Pierre Simon Laplace (IPSL). LSCE hosts more than 350 researchers, engineers and administrative staff including many PhD and master's students. LSCE has developed strong resources and expertise for the measurement and modelling of the atmospheric pollutant and greenhouse gases at the global to the local scales.

LSCE is located about 20 km from the heart of Paris in the Orme des Merisiers green area (https://www.lsce.ipsl.fr/Phocea/Page/index.php?id=1).

Duration: 2 years (renewable)

Starting date: the position is available from Oct 2024, and will remain open until filled

Salary: competitive with full social and health benefits, accounting for work experience

How to apply: please send an application package with (1) curriculum vitae including the most important recent publications, (2) a covering letter with a statement of motivation and explaining the suitability for the profile sought (4) names, addresses, phone numbers, and email of at least two references, to Grégoire Broquet (gregoire.broquet@lsce.ipsl.fr), Philippe Ciais (philippe.ciais@lsce.ipsl.fr) and Didier Hauglustaine (didier.hauglustaine@lsce.ipsl.fr).

LMDZ-INCA NO_2 - Annual - Column
NO_2 column [10^{15} molec./cm^2]
Max= 21.6 Min= 0.05

LMDZ-INCA SO_2 - Annual - Column
SO_2 column [10^{15} molec./cm^2]
Max= 36.46 Min= 0.16

LMDZ-INCA NH_3 - Annual - Column
NH_3 column [10^{15} molec./cm^2]
Max= 52.97 Min= 0.0