# Master's Student Project Advertisement

**Study title:** Local scale atmospheric transport inversion to quantify $CH_4$ emissions from industrial sites

**Level required:** M2 internship or engineers

**Forecast calendar: Ideally for 5-6 months starting April 2020**

***Opportunity to pursue thesis: Yes***

**Knowledge/skills needed or to be acquired during the course:** Local scale atmospheric dispersion modelling, CFD, Computer programming (python/fortran/R), atmospheric sciences, data analysis, written and oral presentation skills

**Expected human qualities:** Scientific curiosity, initiative, teamwork

**Workplace:** Laboratoires des Sciences du Climat et de l'Environnement (LSCE), Saint-Aubin

**Name of the supervisors:** Pramod Kumar (pramod.kumar@lsce.ipsl.fr), Grégoire Broquet (gregoire.broquet@lsce.ipsl.fr), and TRACE team

**Description of the Topic:**

Comprehensive information about greenhouse gas (GHG) emissions is essential for decision makers to track the effectiveness of emission control policies in the context of the Paris Agreement on Climate. To answer this need, LSCE launched a research program known as TRAcking Carbon Emissions (TRACE; http://trace.lsce.ipsl.fr) funded for four years by the French National Research agency and corporate partners THALES ALENIA SPACE, SUEZ and TOTAL. The TRACE program has been developing new GHG emissions measurement methods, going from the scale of industrial sites up to national and global $CO_2$ and $CH_4$ budgets, using satellite-mounted infrared spectrometers instruments, as well as high precision gas analyzers and arrays of low-cost sensors deployed in situ, on the surface, around emitting industrial sites.

A growing body of evidence points to the importance of methane ($CH_4$) in industrial emissions. These emissions are usually unintended and so called "fugitive" (leaks). They are difficult to identify and quantify, as they do not relate to easily measurable processes, unlike the combustion of fossil fuels for $CO_2$. The uncertainty in $CH_4$ emission inventories for fugitive sources, such as waste (landfills), and gas extraction (shale gas) reaches 50-100%. Research groups have developed emission quantification methods using atmospheric measurements of $CH_4$ concentrations, local dispersion models linking the emission rate to the $CH_4$ concentrations, and so-called "atmospheric inversion" approaches. These studies demonstrated that it is possible to identify, characterize and verify $CH_4$ emissions for different industrial sites, helping the site operators to control their emissions. Targeted measurement campaigns during the lifetime of a facility and for different

modes of operation thus allow an accurate assessment of the impact of on-site management and industrial processes on emissions.

In the frame of TRACE, researchers at LSCE have conducted targeted mobile measurement campaigns at different sites emitting $CH_4$ to quantify their $CH_4$ emissions and to track their changes over time. They have also conducted several controlled releases experiments to develop and evaluate the atmospheric inversion techniques for localization and quantification of $CH_4$ emissions sources. The role of the intern will be to:

1. Contribute to data analysis and interpretation of the results from these campaigns using scientific computer programming in languages such as R, Python and/or Fortran
2. Apply local scale atmospheric dispersion models to simulate the transport and to quantify $CH_4$ emissions of industrial facilities such as landfills and oil and gas infrastructure,
3. Apply and/or contribute to the development of the atmospheric inversion methods

To achieve this, the intern will be trained to apply the data analysis, atmospheric modeling and potentially inversion to quantify the emissions. He/she will regularly interact with both the TRACE science team (and more generally with the GHG measurement and modeling teams at LSCE), with scientific collaborators from other institutions, and the industrial partners of TRACE, which will provide him/her with a great opportunity to expand his/her professional network. He/she will be able to develop their written and oral presentation skills in a relaxed environment supported by colleagues at LSCE.