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Advisors:

We are looking for a highly motivated PhD candidate to study the contribution of shipping emissions mixing with urban air pollution in Marseille.

Description of the work topic:

"Evaluation of the contribution of shipping emissions to the urban background of Marseille based on PM$_1$ chemical composition and oxidative potential (OP) from particulate and gaseous pollutants"

1/ Scientific context. Marseille is a highly urbanized area exposed to a variety of anthropogenic (traffic, residential heating, cooking, shipping, industries) and biogenic (terrestrial vegetation, marine aerosols) sources of pollutants. High levels of fine particles have often been observed in Marseille, where mortality rate and cardiovascular hospital admissions are high, even higher than in Paris.

Shipping and industrial emissions can significantly affect air quality in nearby cities and are characterized by high levels of gas (SO$_2$, NO$_x$, CO$_2$), ultrafine particles and metals. High temporal resolution is a key factor in determining transient emissions as is the case for shipping/industry plumes. The new atmospheric urban background supersite Marseille-Longchamp (Atmosud/LCE, https://www.hermes-aq.com/) is dedicated to the long-term and near-real time chemical and physical characterization of submicron aerosol (PM$_1$). Furthermore, LCE recently participated in developing the so-called "rolling Positive Matrix Factorization" (PMF) method applied to the dataset from the supersite for the identification of industrial and shipping emissions (COST Action COLOSSAL; https://www.cost.eu/actions/CA16109/).

IGE improves the current state-of-the-art in terms of source attribution of Oxidative Potential (OP), a relevant proxy for the health impact of the aerosol. As of now, no online short time device existed to

perform this task for OP. IGE patented a prototype ("Reactive Oxygen Species"; ROS online) for OP DTT (Dithiothreitol) and OP AA (Ascorbic Acid) with 20 min time resolution that will be engaged in this project.

2/ Participation to a field campaign. The 1-year campaign (summer 2022 - summer 2023) in Marseille-Longchamp supersite will represent the central element of the PhD. A large array of instruments will be deployed including both online real-time measurements and sampling for off-line analyses. On-line instrumentation includes: SMPS (number and size distribution of particles), ACSM (for ions and organic fraction), Xact (for trace metal fraction), and aethalometer (AE33) to gain further insights into the Black Carbon (BC) sources (biomass burning vs fossil fuel emissions). During the whole year PM_1 filters will be daily collected to conduct offline measurements of the chemical composition of PM_1 and the oxidative potential. OP will be also measured with an on-line automatic instrument (ROS online with 20 min resolution) for a period of 3 to 4 months (intensive campaign) during the spring/summer season when shipping activity is at its highest.

3/ Methodology/Data analysis. The candidate will participate to the field campaign in Marseille by collecting, treating and validating the produced data. The data will be analyzed to resolve the PM_1 chemical composition and OP. Using short term measurements of OP with ROS Online may be an efficient way to access the plume contribution to average OP. At first, the sequences with shipping emissions plumes will be identified with their chemical fingerprints during the intensive campaign. The PM_1 source contribution of the shipping/industrial plumes vs other sources will be determined using the rolling PMF approach. This first step will also deliver an evaluation of the intrinsic OP from shipping and industrial emissions in the urban area after short-term aging and dilution. Second, the overall 1-year series of offline filters will be processed in the same way, the intrinsic OP obtained above eventually used as a constraint in the inversion process for the calculation of the contributions. For both methods OP will be measured with 2 assays (DTT and AA).

PhD context:

- *Location*: The PhD student will be hosted at LCE in Marseille (France), in the St Charles University campus (lce.univ-amu.fr). Stays at IGE in the main campus of Grenoble-Alpes University (France) will be intended (ige-grenoble.fr)
- *Funding program*: The research activities will be funded by the SHIPAIR project (ANR)
- *Requirements/Skills*: The candidate must have a master's degree in atmospheric sciences or a related discipline. An interest for research work (experimental/field work, curiosity, ability to synthetize, write and communicate research results in English) and solid knowledge of air pollution, atmospheric chemistry and physics are required. Experience in scientific programming and data analysis (Igor Pro, R, Python…) would be appreciated.
- *Salary*: Around/between 2590€ gross per month.

To apply, please send an email Barbara.danna@univ-amu.fr, Benjamin.chazeau@univ-amu.fr and gaelle.uzu@ird.fr containing a cover letter, a CV and a list of references.