PhD position in Atmospheric chemistry/Environmental toxicology (2019-2022) at INERIS (France).

BBSOAT: Understanding of the biomass burning secondary organic aerosol (SOA) formation and toxicity.

Keywords
Atmospheric chemistry, Air quality, Aerosol, Biomass burning, Reactivity, Toxicity, Bioassays, Effect directed analysis (EDA)

Context and objectives

The knowledge of aerosols (particulate matter, PM) in ambient air is essential to assess health and climate impacts of air pollution. Their sources, formation processes and chemical composition are still poorly known. Biomass burning accounts for a significant part of the primary emissions of fine PM notably in winter period due to wood combustion for residential heating purposes (50% in France). This source also emits large quantities of volatile and semi-volatile organic species leading to the formation, via photochemical processes, of secondary organic aerosols (SOA) accounting for a significant part of fine PM concentrations. However, SOA formation yields from this source, or from the corresponding SOA precursors emitted, are still poorly documented in the literature especially during night-time chemistry (with nitrate radical). The species contributing to the toxicity of these primary or secondary PM are also relatively unknown. If the toxicity of the polycyclic aromatic hydrocarbons (PAHs) and their derivatives (nitro- and oxy-PAHs) associated to the emitted PM is largely recognized, their quantification is rather limited and often not representative of the whole mixture toxicity. In this context, the use of more integrative metrics seems relevant to better understand and identify the chemical species responsible of the primary or secondary biomass burning PM health impacts. Thus, in addition to the chemical characterization, the use of methods based on a biological response (e.g. in vitro bioassays) should be used to evaluate biomass burning PM toxicity.
The main objectives of this PhD work are first, to study and characterize the SOA formation from residential wood stove emissions (SOA biomass burning) and from typically emitted SOA precursors but poorly document in the literature such as furans (2,4- et 2,5-dimethylfurans; SOA furans). To do so, wood combustion emissions, or pure precursors, will be aged using an oxidant flow reactor. Both, night-time (nitrate radical) and day-time chemistries (hydroxyl radical) will be studied and compared. Second, the toxicity of the primary emitted (biomass burning) and secondary formed PM (SOA biomass burning and SOA furans) will be assessed and compared using in vitro bioassays. The biological response due to the presence of dioxin-like and PAH-like compounds will be specially addressed (aryl hydrocarbon receptor (AhR). Tests will be performed on different human cells (HepG2 et A549) and biological responses will be compared to the chemical characterisation (PAHs, nitro-PAHs, oxy-PAHs). Finally, an effect directed analysis (EDA) approach will be applied on selected PM samples to identify the species involved in the observed biological response using bioassays. Selected samples will be fractioned by liquid chromatography and then, individual fractions tested in vitro. Fractions showing a biological activity will be analysed using non-target screening methods (LC and GC coupled to high resolution mass spectrometry) in order to identify the dioxin- or PAH-like molecules responsible for the observed biological activity.

Candidate profile

- Degree in Environmental Sciences or Environmental Chemistry or Analytical Chemistry or Environmental toxicology or Ecotoxicology will be considered
- Strong lab and field work interest.
- Knowledge in environmental (atmospheric) chemistry and/or analytical chemistry (GC-MS, LC/MS) and/ or environmental toxicology
- Computer knowledge and data analysis
- Autonomy, scientific rigour, adaptability, communication and writing abilities.
- Good English level.

Useful information

Place of PhD work: INERIS (Verneuil en Halatte, France) = 100 %

PhD in co-supervision: with University of Aix-Marseille (Barbara D'Anna).

PhD start: November - December 2019

To apply: Send CV, cover letter and any recommendation letter before 30/09/2019.

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