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EDITORIAL

Chemical, microbiological, and spatial characteristics and impacts of contaminants from urban catchments: CABRRES project

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Chemical and microbial contaminations of urban waters including stormwater runoff, wastewaters, and combined sewer overflow waters have been shown for a number of years. It is clearly demonstrated, for example, that metallic ions, polycyclic aromatic hydrocarbons (PAH), pesticides, and microbial pathogens can be conveyed by such waters, and they have been found strongly associated with suspended matters. The "Water Framework Directive" (WFD) led to the launching of several research initiatives toward the "Best Management Practices – BMP," through novel or improved technologies aiming at reducing the ecotoxicological impacts and health risks associated with these waters. Some of these techniques consist at keeping these waters for a certain amount of time in a confined system in order to favor settling of their suspended particles and lead, in part, to the natural biological degradation of their contaminants. These systems are typically impervious basins that can receive stormwaters, e.g. detention basins, biofilters, artificial wetlands, or combined sewer overflows, e.g. stabilization ponds of wastewater treatment lagoons. Several key mechanisms occur in these systems (Fig. 1). The deposits formed constitute areas of high levels of contamination.

These structures (basins) are ecosystems with an important biological diversity. They can represent a high risk of contamination of the connected surfaces, streams, or groundwater environments into which they are discharged. Investigations regarding their efficiency at retaining and transforming pollutants and killing undesirable microbes are thus required. When landscaped, these structures may lead to the development of urban public spaces. In this context, they are subjected to social practices generally associated with public gardens, practices which accidentally or regularly expose the public to their contaminants. In addition, these structures require maintenance and specific management, exposing workers to their contaminants. It is therefore essential that the chemical and microbiological contaminants present in these systems are accurately characterized and measured (i.e. which chemical forms and microbial species and genotypes, and how much?), and their health hazards and risks be inferred or estimated. In this context, several biofilters, detention basins, and stabilization ponds have been monitored and investigated around the world.

The CABRRES project (Chemical, microbiological, spatial characteristics and impacts of contaminants from urban stormwater detention basins: Assessment and Management of Environmental and Human Health Risks, http://www.graie.org/cabrres), funded by the French National Research Agency (ANR), is one of these research initiatives. It is an interdisciplinary research project (Fig. 2) aiming at better defining the interactions between chemical pollutants (including toxic

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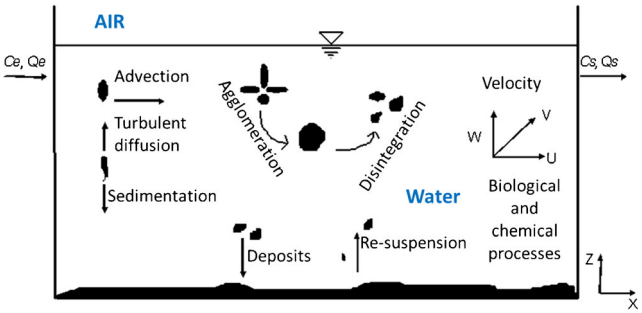


Fig. 1 Hydrodynamic parameters and biophysico-chemical processes in detention-settling basins (*Qe* and *Qs* represent respectively the inlet and outlet flow-rates, while *Ce* and *Cs* represent respectively the inlet and outlet concentrations of particles)

agents), microbiological agents (including pathogens), and hydrodynamic parameters of detention basins. The working packages include state-of-the-art investigations of each, the chemical and microbiological contaminants, and the hydrodynamics. They also include innovative statistical computing and modeling attempting at defining reproducible trends among the data sets and at identifying particular "indicators" of the "sanitary" status of such basins. These tasks could lead to predictive tools that could be used on a routine basis. Sources of the chemical and microbiological contaminants present in the basin are investigated by means of socio-technical approaches and microbiological surveys. The detention basin investigated in this CABRRES project is part of the field observatory for urban water management (http://www.graie.org/othu/) and named the Django Reinhardt detention-settling basin of Chassieu (east Lyon, France). It is connected to an infiltration basin.

The first analyses conducted in the frame of the CABRRES project regarding the microbiological characterization of the sediments of the detention basin are presented in this special issue (see Sebastian et al. paper). These data highlighted a relationship between PAH distribution and microbiological indicators, i.e. *Escherichia coli*, intestinal Enterococci, and *Nocardia*, used to predict contamination by pathogenic microorganisms. The detention basin was considered to be contaminated by fecal contaminants, but their origin remains to be investigated. Metagenomic surveys of the bacterial diversity of the sediments have been done, and statistical tests are now being performed to define the dominating taxonomic groups and the incidence of the hydrodynamics and physicochemical forces on their repartition and survival.

The results deriving from CABRRES project will (a) increase knowledge on the interactions between chemical, physical, and microbiological components of detention basins; (b) improve the understanding of the socio-technical processes generating and disseminating contaminants among urban waters; (c) define key indicators for assessing the sanitary status and ecological hazards of these systems; and (d) propose protocols for monitoring

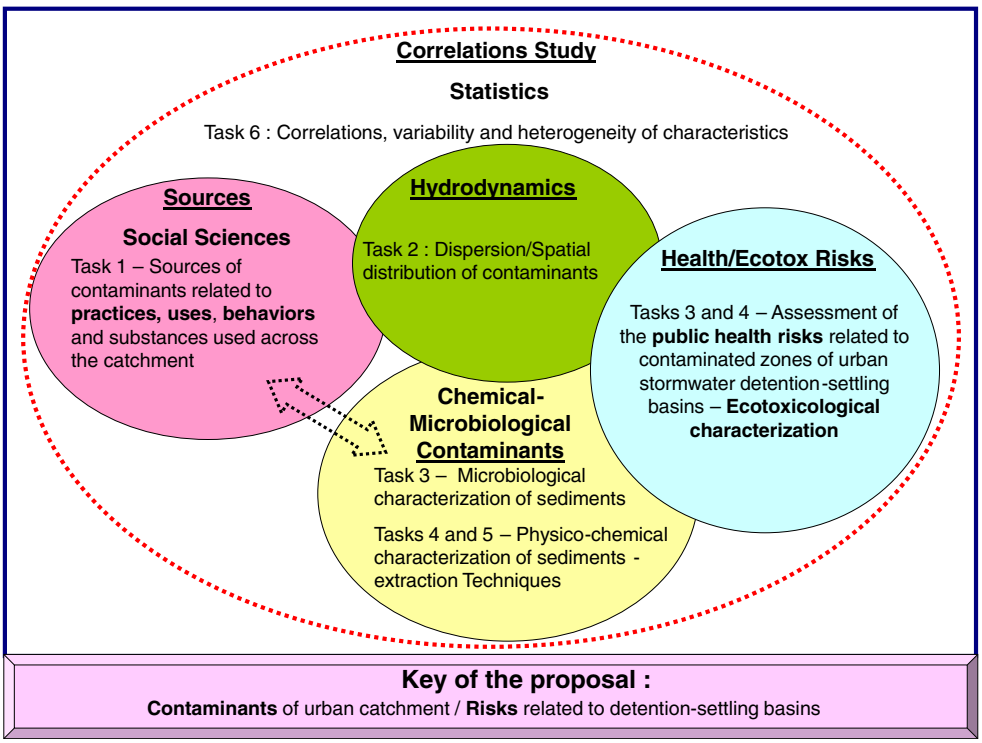


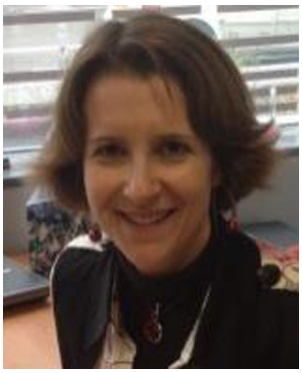
Fig. 2 Connections between the tasks and the related CABRRES disciplines

these structures. CABRRES is also financially supported by "IMU" Labex ("Intelligence des Mondes Urbains" national excellence laboratory) and OTHU.

Other papers selected for this special issue are on topics related to the CABRRES project. These papers present original observations regarding dissolved or particulate urban contaminants (chemical or microbiological ones) and their dissemination through the water cycle across urban areas. They describe (a) chemical contaminants among the total atmospheric fallout (Gasperi et al.); (b) the sources of contaminants, their accumulation on and their mobilization from, urban surfaces (Shorshani et al.; Kaaniche et al.); (c) the transport and the variability of contaminants in sewer system (Hannouche et al.; Lucas et al.); as well as (d) their key characteristics (El-Mufleh et al.), their trapping, and their transformation in sewer or stormwater-specific structures such as biofilters (Chandrasena et al.; Mailler et al.), lagoons (Lavenir et al.), settling basins (Yan et al.; Sebastian et al.; Gonzalez-Merchan et al.), and infiltration basins (Gonzalez-Merchan et al.).

Authors and reviewers are greatly acknowledged for their contributions. Several contributions come from the French observatories for urban water monitoring and management (ONEVU-Nantes, OPUR-Paris, and OTHU - Lyon), which are gathered into the same inter-observatory structure called SOERE URBIS (http://www.graie.org/urbis-soere/spip/?lang=en) and give an overview of the French initiatives in this field. Dr. Philippe Garrigues, Editor-in-Chief of *Environmental Science and Pollution Research*, and his Editorial team are warmly thanked for their interest on this topic and handling of the review process.

Gislain Lipeme Kouyi is Senior lecturer since 2007 at the LGCIE (Laboratory of environmental and civil engineering) hosted by National Institute of Applied Sciences of Lyon (INSA Lyon) and the University Lyon 1. **Gislain Lipeme Kouyi** defended a PhD thesis on three-dimensional modeling of hydrodynamic behavior and particles separation in combined sewer overflow structures – CSOs in 2004 at the University of Strasbourg (France). He acts as a lecturer at the Urbanism and Civil Engineering department of INSA Lyon (corresponding to around 230 hours of teaching per year) in the following fields: urban hydrology, hydraulics, numerical methods and modelling, decision making methods and fluid mechanics. His main research areas of expertise are the modeling of hydrodynamics and multiphase flows transport in specific structures of urban drainage systems (CSOs, detention-settling basins, aerated tank, junctions, etc.), metrology, particularly the instrumentation of CSOs, and the use of CFD (Computational fluid dynamics) modeling to improve metrological systems and practices, as well as the design and sizing of vertical flow constructed wetlands and detention-settling stormwater basins. He won first prize for best oral presentation at the national urban hydrology doctoral conference in 2004. He has been involved in 10 national (5)/ international (3)/ local (2) scientific programs as coordinator/scientific leader for LGCIE since 2009. He has received ADEME/POLLUTEC HORIZON 2013 award for the novel hydraulic structure design (DSM: **D**ispositif de Surveillance et de **M**aîtrise de la qualité des rejets des déversoirs d'orage) improving quantitative and qualitative monitoring of sewer systems. During the ten last years, he has published 22 scientific papers in both national (9) and international (13) journals. He has been involved in the supervision and the co-supervision of 4 PhD students, 5 post-doc and 11 Master students between 2007 and 2013. He acted as a scientific member and/or sessions chairman during the 12th International Conference on Urban Drainage at Porto Alegre (Brazil) and during NOVATECH 2013 in Lyon, which are probably the two main international conferences related to the understanding and the management of the urban water cycle and its interactions with multiphase urban contaminants/pollutants.



Cécile Cren-Olivé is a CNRS researcher specialized in the field of analysis of complex environmental and biological matrices at the Institute of Analytical Sciences (UMR 5280) hosted by CNRS, University Lyon 1 and ENS Lyon (Ecole Normale Supérieure de Lyon). Graduated from the ENS-Ecole Normale Supérieure (Ulm, Paris), she obtained a master in analytical chemistry (University Paris VI) and her PhD degree in synthesis, physico-chemistry and analysis of polyphenols from the University of Lille. She joined the CNRS as researcher in 2002 first with a specialization in proteomics. In 2006, she created a research group "Technology and Research in Analytical Chemistry for Environment, Health and their interactionS" (TRACES) at the Institute of Analytical Sciences in the Lyon area. Her research interests include the understanding of interactions "Environment and Health" by the search of analytical strategies based on chromatography and mass spectrometry, and the study of the fate of chemicals in environment as well as in human. Her research activity includes the development of an original and systemic approach integrating all the key elements of the analytical chain from sampling, sample preparation, the development of effective strategies coupling chromatography and mass spectrometry to statistical analysis. The developed approach enables significant progress in understanding the metabolism of chemicals, including endocrine disruptors in sentinel environmental organism. These new strategies are also applied to a field often cited but little explored: the contribution of degradation products to the overall environmental exposure. Finally, the team has recently initiated pioneering studies on environmental human exposure. She has published more than 50 articles and book chapter in the last 12 years (hindex of 16). She organized many national conferences related to biochromatography either in Lille (2006) or in Lyon (2014) and will be the organizer of the 2014 JFSM conference (Journées Françaises de Spectrométrie de Masse) in Lyon.

Benoit Cournoyer is a CNRS research director at the Microbial Ecology Research Unit (UMR5557) which is hosted by University Lyon 1 and VetAgro Sup veterinary school in the Lyon area. He has been hired by the CNRS in 1995. His undergraduate and postgraduate studies were carried out in the fields of environmental and applied microbiology at McGill University (Canada), Laval University (Canada), and University Lyon 1 (France). He created in 2003 a research group aiming at developing interdisciplinary approaches for a better understanding of the ecology and evolution of bacterial opportunistic pathogens. His research interests cover all issues regarding the cycle of these opportunistic pathogens going from their colonisation of outdoor environments to the exposure of human populations and colonization of the human host. His research activities include the use of integrative approaches considering natural field situations (e. g. the Chaudanne experimental river of the Lyon "Field Observatory for Urban Water Management") and molecular microbiology advances to better understand evolutionary trends among populations of bacterial pathogens. These activities are mainly dedicated to water environments but studies on bacterial genetic variants observed among major crops are also performed. These works concern the notions of balance between bacterial populations, of bacterial invasions of natural habitats, functional redundancy, competition, but also the effects of environmental forces and pollution on the genomic evolution of bacterial pathogens. Parts of these research activities concern the identification of the main factors/conditions that can favour the passage of microbial pathogens from natural environments to man. Benoit Cournoyer published more than 90 scientific papers and book chapters. He is also the head of a biological resource center in microbiology of the French bio-banking network offering tools for the identification of microbes, and favoring the conservation and distribution of bacterial strains for research purposes.