Project title

Physico-chemical Process Modeling of Biofiltration Systems

Project number: IMURA0154

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Research Academy theme/s
List only the research academy theme/s that is relevant to the project
1. Advanced computational engineering, simulation and manufacture
2. Infrastructure engineering
3. Clean energy
4. **Water**
5. Nanotechnology
6. Biotechnology and stem cell research

The research problem
The increase of impervious surfaces consequent to large urbanization rates enhances runoff volumes and peaks, thereby increasing the risk of flooding, and reduces runoff quality with detrimental effects on urban aquatic environments. Biofiltration systems (or bioretention system, biofilters, or rain garden) have been successfully adopted to reduce stormwater runoff and to improve water quality of urban water bodies (http://www.monash.edu.au/fawb/). Although a lot of research has been devoted to the experimental monitoring of the performance of such systems, less effort has been dedicated to the understanding and to the mathematical modelling of the complex physical and biochemical processes occurring within these systems.

Project aims
The project aims to develop a mathematical model to describe the physical and biochemical processes occurring in the different components of biofiltration systems (soil media, microbial community and vegetation) and the main interactions between these components.

Expected outcomes
The main outcome of the project is a mathematical model that describes soil water flow, carbon, nitrogen, and phosphorus cycles, including the key roles of the microbial community and vegetation within the system. Although the model is planned to be applied to biofiltration systems, it will be easily extendible to natural environments and/or for agricultural applications.

Which of the above Theme does this project address?
The project mainly deals with **water** related issues.

How will the project address the Goals of the above Themes?
The model purpose is manyfold: (i) it serves to understand the physical and chemical processes in the soil media and in the vegetation, (ii) it will be used to describe the outcome of existing experiments, and (iii), once calibrated, it can be used to predict the performance of the biofilter under a range of different applications not tested in the laboratory, but possibly occurring in real working conditions. As such, the outcome of this project will give a useful tool for institutions dedicated to water management and water resources planning, providing reliable estimates under different future climatic and social scenarios.