Proceedings

A. Gelabert, J. Lukovic, M. Robischon and M. Vanclooster (eds.)

Preamble

The overall objective of the HHE is to strengthen the partnership between Circle U units within the "Climate Change Knowledge Hub". We believe that this needs a better understanding of the partners' different thematic research fields and available specific expertise.

The Circle U, Climate Knowledge Hub, Happy Hour Events (HHE) are organized to reach this objective. An HHE is a short scientific event (typically lasting no more than 3 hours), consisting in two keynote lectures (one from the natural sciences and one from the human science domain), followed by a debate, a set of small pitch presentations and a final debate. The HHE is targeted to young researchers and doctoral students of the different partners. The participation in an HHE is certified by the organisers and can be included in the participants' portfolio of research training.

The current proceedings summarize the results of the a Circle U knowledge hub Happy Hour Event that deals with the theme "Increasing climate resilience of our cities through sustainable urban water management". The scope and objectives of the HHE is important since the current projected climate change for western Europe suggests an acceleration of the hydrological cycle, and hence predicts for the coming decades an increase of exceptional meteorological events such as heat waves, droughts, or catastrophic rainfall and flooding events. Such speeding up of the hydrological cycle adds considerable burden on the quality of life, in particular in urban environments, and calls for additional urgent measures to make European cities climate resilient. The adaptation of urban water infrastructure and water management is often considered as a key to face this challenge and to make cities more resilient to climate change. Yet, designing climate resilient water infrastructure for urban environments should be based on a thorough understanding of the hydrological processes in urban settings.

In this happy hour, scientific advances supporting climate resilient water management for urban environments have been discussed. Contributions were made of PhD students and researchers of Circle U related to urban water management and infrastructure adaptation to face the challenges of climate change in urban environments. Contributions dealt with the following topics extreme hydroclimatic observations in urban environments; water management infrastructure to reduce flooding and extreme drought impacts; restoration of natural watersystems in urban environments ; Nature based solutions for making cities blue and green; and people engagement to contribute to blue resilient water cities.

The happy hour was very interactive and catchy, and we hope that the contributions will allow strengthening collaboration between early career scientists working in this domain of research in the realm of Circle U.

The organising team

Prof. A. Gelabert U. Paris	Prof. J. Lukovic U. Belgrade	Prof. M. Robischon Humboldt U, Berlin	Prof. M. Vanclooster UCLouvain

Programme

13h00-13h30	Keynote lecture: "How does Paris impact heavy metal transfer in the Seine river?". Prof. Alexandre Gelabert, U Paris.
13h30-14h00	Keynote lecture: “Flooding in Walloon Brabant: from a transdisciplinary diagnosis to transdisciplinary actions?.” Prof. Jean Philippe de Visscher, LAB, UCLouvain.
14h00-16h00	Pitch presentation
	• Evelien Vandenbruel (UCLouvain): Mapping changes: on the territory of urban drainage services conducted by their users. Co-production of wastewater and stormwater systems in transition. • Thais Delafortrie (UCLouvain): Along runoff water. Spatializing the runoff water capacity across Belgian territories: building a common asset. • Matteo Roggero and Klaus Eisenak (Humboldt University): Flash floods in Berlin. Policy upscaling and governance issues • Ivan Fiaccadori and L. Cotrozzi (U Pisa) : Evaluating ornamental shrubs for resistance to drought conditions using hyperspectral assessment of leaf traits to avoid potential ecosystem services failures due to Climate Change • Branislava Lekic (U Belgrade): Zero waste concept for flood resilient cities. • Ermes Lo Piccolo (U Pisa) : Biochar as soil amendment for urban trees: What are the consequences for tree physiology, water management and soil quality?

Book of abstracts

Floods in Brabant Wallon: from a transdisciplinary diagnosis to transdisciplinary actions?

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The floods in Brabant Wallon of July 2021 illustrated the vulnerability of local territories to the effects of climate change. In order to cope with the pressures exerted by climate change on local territories, literature [Lettre 18/20, Plateforme wallonne pour le GIEC, 20/21], as well as field experience, reveals the need for:

- a multi-scale approach, considering flood isssues from the main watershed to the multiple local runoff axes, from the plateaus to the valley bottoms;
- a multi-disciplinary approach, involving climate sciences, agronomy, engineering, urban planning, architecture, social and political sciences, etc.; and
- a multi-stakeholder approach, involving political representatives, administrations, citizens, associations and socio-cultural actors, academic experts, innovative entrepreneurs.

In this context the interdisciplinary research platform Louvain4Water of UCLouvain, and the Maison de l'Urbanisme du Brabant Wallon, with the support of the Province du Brabant Wallon, organized a series of meetings dedicated to the co-construction of a diagnosis of the causes of the floods in this region and to the co-design of possible solutions to mitigate and adapt to floods. From september to december 2021, a first cycle of cross-teaching activities (AGRO, EPL, LOCI) between the members of Louvain4Water laid the foundations for a round table event. This event took place in february 2022 and brought together more than hundred people from the public sector (provincial deputies; mayors and aldermen; urbanists; urban planners, environmental and municipal public works departments; environmental advisors; agents from the regional GISER service), actors of the civil society (Fédération Wallonne de l'Agriculture, Contrat de rivière Dyle-Gette) and actors of the academic sector. Louvain4Water then drew up a summary of the diagnosis and solutions proposed by the participants. From april to june, several meetings with the cabinet of the Provincial Deputy in charge of flood risk management led to the official approval of the report. At the request of the SPW Territoire, the Maison de l'Urbanisme du Brabant Wallon is currently planning a series of events called 'Les Arènes du Territoire' dedicated to territorial adaptability, with a special focus on water managementand where the Louvain4Water report will be discussed.

A retrospective analysis of this experience reveals a strong contrast between the ease with which a transdisciplinary diagnosis could be established and the difficulty of initiating concrete transdisciplinary actions in the field. The interest of collaboration between academic and non-academic experts from different domains was obvious to all participants. Thanks to a didactic presentation of the different aspects of floods and flood management, and thanks to several case studies discussions, it was relatively simple to identify a common reading of the events and of the potential levers to be activated.

Conversely, the subsequent discussions with the provincial services did not lead to any path for a concrete transdisciplinary action. The first reason is a lack of funding prospects for joint projects. Most stakeholders ask for more recognition and funding to make these projects a priority and not a side task to busy schedules. A second reason is a lack of disentangling

practices. Without any clear joint perspective, everybody seeks to improve what is already ongoing in each department: the planners ask for better rules, the technicians ask for more data, the politicians ask for better governance etc. It must be noted that, so far, our research platform has been unable to be a game changer. This fact highlights the need for further research on disentangling methodologies and the necessity to provide better support for stakeholders in implementing the recommendations resulting from transdisciplinary diagnoses.

Zero waste concept for flood resilient cities

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Urban development is usually coupled with a rapid increase in imperious surface area and a correlated reduction of rainfall infiltration and an increase in stormwater runoff. Traditional urban drainage (UD) practice in Serbia that is focused primarily on conveyance and partial detention of stormwater combined with the climate change effects and an increasing occurrence of heavy rainfall events, results in urban flooding in many cities in Serbia on almost annual basis. Limitations of the existing UD systems have raised interest in green infrastructure (GI) that can mitigate urban flooding effects. Permeable/pervious paving (PePav) is an essential sustainable urban drainage (SUDS) technique that uses Low Impact Development (LID) strategies to recover pre-urbanization hydrology and manage urban stormwater in a distributed manner at the source. Smart SUDS solutions reduce the runoff volumes/rates and simultaneously improve the stormwater quality. Waste and recycled materials (WRM) have recently been used for PePav construction, however, current PePav SUDS are still weakly correlated to the science of the water purification mechanisms involved and its relation to the WRM structural and chemical properties. This project is focused on: a) valorization of WRM (steel/copper slag, recycled concrete, solidified hazardous waste and WWTP sludge, cathode ray tube glass, fly ash) suitable for PePav construction, based on contemporary structural science, CE and environmental protection principles; b) WRM-PePav design development, custom tailored for improved hydrological/purification performance, c) identification of value–action gaps in the use of WRM in construction in Serbia and formulation of strategies to overcome key issues, d) market analyses for large scale WRM-PePav implementation and a road map for industrial stakeholders, e) information base for decision makers to strengthen the guidelines and policies related to GI and flood resilience of modern cities, addressing all relevant (scientific, technical, environmental, market, educational, psychological) issues. Expected impacts: reduction of pluvial flood risks, reduced health hazards and benefits for public health, improved traffic safety, reduced environmental pollution, benefits for local economy.

Biochar as soil amendment for urban trees: What are the consequences for tree physiology, water management and soil quality?

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Trees play a pivotal role in the urban environment alleviating the negative impacts of urbanization, and for this reason, local governments have promoted strongly tree planting practices. However, poor soil quality and scarce attention to tree maintenance (e.g., irrigation and fertilization) can seriously mine the plant health status during the tree establishment phase. The use of biochar to provide long-lasting C to the soil and, at the same time, improving soil properties (e.g., improved water holding capacity), soil enzyme activities and NPK availability, is a promising research field. Therefore, with a two-step experiment, the study aimed to assay the physiological responses of a commonly used urban tree species (Tilia × europaea L.) to 1.5% (w/w) biochar amendment (B), and secondly, to assess the ability of trees, grown in biochar-amended soil, to tolerate a period of drought. Biochar amendment increased P and K availability in the soil, resulting in higher P and K concentrations in B than in control leaves, according to the leaf stage. The improved macronutrient availability induced B trees, higher values in both total biomass than controls (+22 %) in well-watered plants. Moreover, the higher water availability in soil amended with biochar helped B trees to tolerate water stress, accounting for higher photosynthetic performances and a faster recovery than stressed controls after re-watering. This study highlights the dual function of biochar, improving CO2 sequestration and soil properties, and at the same time, enhancing plant physiological responses to environmental constraints. The use of biochar at the tree planting stage, especially in an urban environment, is a feasible and environmentally sustainable strategy to improve the success during the tree establishment phase.

Evaluating ornamental shrubs for resistance to drought using hyperspectral data to avoid potential ecosystem services failures

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Urban vegetation mitigates elevated temperatures and may also provide at the same time resilient supply of flood protection in cities, if properly designed. Yet urban green spaces are increasingly threatened by climate change stressors like drought, resulting in potential deprivation of ecosystem services. Therefore, advancements in techniques for assessing plant status are needed for urban vegetation planning and management. Hyperspectral data have great potential to rapidly and non-destructively monitor plant stress. While this method has been exclusively developed on green leaf species, ornamental plants with variegated foliage have not been studied using this approach, even though they are widely used in urban landscape design. This study examined the capability of full range reflectance spectroscopy (400-2400 nm) to characterize responses to water stress in three varieties of Aucuba japonica (an ornamental shrub) with no, mild and high leaf variegation. Partial least squares regression models were built to predict from spectra an array of leaf photosynthetic, water, and morphological traits related with drought. While none of predictive models for photosynthetic traits was particularly accurate (R2: 0.10-0.58), those for water and leaf morphology showed excellent prediction accuracy (R2: 0.65-0.94), this because only these latter models did not include the visible spectral region (400-700 nm) which is highly susceptible to leaf variegation. Variations of spectral indices and spectra-derived traits confirmed A. japonica as drought tolerant shrub, especially the not variegated variety. In addition, results suggest that A. japonica is a suitable choice for designers to use as groundcover shrub especially in dry-shaded locations.

Mapping changes: the territory of urban drainage services conducted by their users through time

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Throughout time, the urban landscape has been shaped by its ever-renewing infrastructures that facilitate the daily lives of its inhabitants. Watercourses are manipulated in response to changing and growing societal needs. With this transformation, wastewater and stormwater drainage services are put under pressure, which is framed within a growing urgency of finding a response to environmental challenges like flooding, drought, and pollution. Although institutionalized systems are pushing the hand of these changes, 'water sensitivity' becomes perceptible in movements in which different alternative actors participate.

In this research, a historical tracing of hidden layers of the urbanized area reveals that non-institutionalized production services have played their role through time in water management. A better understanding of these services (their appearance, disappearance, or persistence) is explored to tackle the current challenges urban drainage systems face. By looking for turning points in history and examining the role of their users, the meaning, strengths, and limitations of co-production are unraveled. These changes are framed within the transition theory, focused on the asset of place-specificity. The territorial analyses are conducted through two case studies (Brussels and Dakar). The research seeks to better understand in which way the spatial configurations of the city influence the changes in wastewater and stormwater drainage services. A reflection on the territory is done while mapping the spatial impact of these changes on the respective territory. Meanwhile, the assets and limits of using mapping as a tool to visualize these changes through time are set out in an atlas of change.

Along runoff water. Spatializing the runoff water capacity across Belgian territories: building a common asset.

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This research aims at visualising runoff water geographies to foster integrated water management as a necessary practice for spatial planning. The project grounds on the hypothesis that a simultaneous visualisation of urban and water spaces entails the integration of otherwise sectorialised knowledges. Such sectorialisation and the complexity of the water system leads to the loss of an overview and asks for a systemic visualisation of the water system as a whole. To address this necessity a new narrative is proposed by considering runoff water as a proper and separate water system that runs into a dedicated infrastructure. If all water systems are operated by a dedicated manager (drinking-, surface-, sewage- and ground water), runoff water seems to not have been recognised as a separate system. The aim is to identify the infrastructures it intertwines in the public domain before it enters any of the other managed water systems. To do so this research argues the necessity of applying a systemic approach between different disciplines, from the technical to the socials sciences, in order to inform spatial policies and runoff water practices.