Digital tools for sponge city governance in Berlin

Outils numériques pour la gouvernance de la ville éponge à Berlin

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RÉSUMÉ

SmartWater est une initiative berlinoise qui intègre des mesures d'infrastructure bleue et verte dans l'urbanisme à l'aide de trois outils numériques. Ces outils sont actuellement testés dans deux quartiers contrastés et comprennent un outil de planification, un jeu numérique et un portail d'information sur les inondations. Ces prototypes démontrent le potentiel des infrastructures bleues et vertes pour réduire les risques d'inondation, atténuer le stress thermique et améliorer la résilience climatique urbaine. Le processus de développement a été méticuleusement structuré afin de faciliter un processus de co-conception collaboratif impliquant les administrations, les services publics, les experts et les résidents. Cette approche a joué un rôle déterminant dans la clarification des besoins en matière de gouvernance, des exigences en matière de données et des voies de communication. Les résultats illustrent l'efficacité de la modélisation coordonnée et des infrastructures numériques partagées pour faciliter les processus décisionnels, améliorer la compréhension du public et fournir un cadre transférable aux zones urbaines qui aspirent à améliorer l'adaptation au climat grâce à des approches intégrées et pragmatiques.

ABSTRACT

SmartWater is a Berlin-wide initiative that integrates blue and green infrastructure measures into urban planning through three digital tools. The tools are being tested in two contrasting districts and comprise of a planning tool, a digital game and a flood information portal. These prototypes demonstrate the potential of blue-green infrastructure to reduce flood risk, mitigate heat stress and enhance urban climate resilience. The development process has been meticulously structured to facilitate a collaborative co-design process involving administrations, utilities, experts and residents. This approach has been instrumental in elucidating the governance needs, data requirements and communication pathways. The findings illustrate the efficacy of coordinated modelling and shared digital infrastructures in facilitating decision-making processes, enhancing public comprehension, and providing a transferable framework for urban areas aspiring to enhance climate adaptation through integrated and pragmatic approaches.

KEYWORDS

Blue green infrastructure, digital planning tools, sponge city, climate change, urban resilience

1 MOTIVATION

Urban areas are increasingly confronted with intense rainfall, heat stress and growing pressure on urban water systems. In Berlin, the SmartWater project aims to incorporate blue and green infrastructure measures into the planning process at an early stage, with the objective of ensuring that nature-based solutions become a visible and effective component in both existing districts and new neighbourhoods. The project also aims to support residents in understanding the effects that blue and green measures have on the local area and how precautionary action can reduce risks.

The Kompetenzzentrum Wasser Berlin is responsible for the coordination of the project, in collaboration with key actors from the domains of digital innovation and water management. The abstract under consideration herein presents SmartWater as a case study exemplifying the integration of digital infrastructure, stormwater management and governance, and identifies insights that can be transferable to other urban areas across Europe and beyond.

2 PILOT AREAS AND DIGITAL TOOLS

The project operates within two distinct urban settings, characterised by marked disparities in structural and planning contexts. In the densely populated district of Friedrichshain-Kreuzberg, the primary concern is the mitigation of flood risk, the prevention of combined sewer overflows, and the management of heat stress. In the new development area of Pankow, blue-green infrastructure is to be integrated from the outset, thus enabling the exploration of planning routines under favourable conditions. The contrast between these two environments is indicative of differing governance requirements and cooperation structures.

The two pilot areas function as living laboratories for the three digital prototypes that are being developed in SmartWater: a planning tool, a digital game and a flood information portal.

2.1 Planning tool for urban development projects

The planning tool is designed to support administrations and planners in the assessment of blue and green infrastructure measures. The model utilises modelling software to estimate flood hazards, combined sewer overflows, heat effects and deviations from the natural water balance in the two pilot areas. A map-based interface facilitates the comparison of scenarios, the identification of spatial potentials, and the evaluation of combinations of blue and green measures. These measures may include green roofs, infiltration zones, the removal of sealed surfaces, or storage solutions. The purpose of this analysis is to determine which measure or combination of measures is most effective in addressing the identified climate risk of a given area.

2.2 A digital game as a tool for visualisation and activation

The digital game is being developed as a means of engaging residents by illustrating the influence of blue and green infrastructure measures on heat, water quality and flood hazard. Players are tasked with modifying photo-realistic scenes depicting sealed Berlin neighbourhoods, observing the impact of their choices on local conditions. The game employs a puzzle format, utilising ‘before’ and ‘after’ images, and is designed to be straightforward to use while conveying scientific relations in a comprehensible manner.

2.3 Flood information portal for the public

The flood information portal will provide clear and accessible information on intense rainfall and river floods. It will be possible for users to assess their home or workplace in terms of exposure and vulnerability, and to receive guidance on the appropriate precautions and behaviours to take. The portal utilises established hazard maps and translates them into visual and textual formats intended to inform Berlin's broad public.

3 CO-DESIGN, GOVERNANCE AND LEARNING PROCESSES

SmartWater is an integral component of Berlin's Smart City strategy, which follows a systematic process design of preparation, exploration, testing, development and scaling. Through this alignment, SmartWater supports the strategy's priorities that aim to strengthen natural resources, encourage participatory governance and improve public administration. Figure 1 illustrates the process.

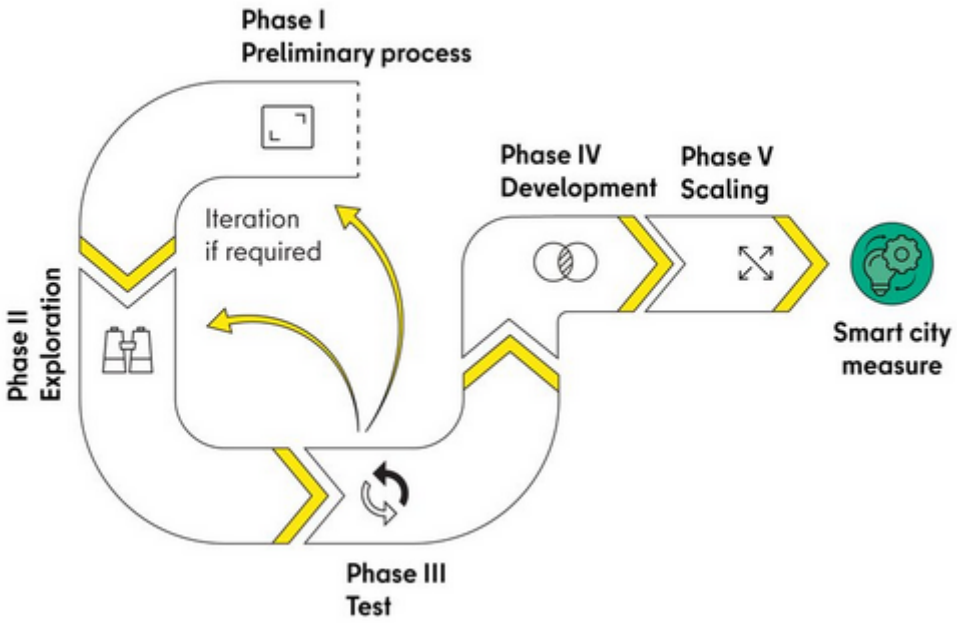

Figure1: Systematic process design for implementation by Berlin Senate Chancellery

The planning tool's development commenced with an extended phase zero. At this stage, project partners engaged in dialogue with district authorities, senate administrations and the water utility. In conjunction with the planning departments, the team conducted an examination of routine planning steps, extant instruments and customary decision processes. During these sessions, participants formulated expectations regarding the clarity of user guidance, the openness of model assumptions, the traceability of results, and the options to include local planning data. These insights subsequently informed the initial design concepts for the interface structure, spatial detail and result presentation. The subsequent development and testing of the tool is now overseen by these individuals.

The game's development was also informed by a collaborative design process. Project partner meetings and expert dialogues facilitated the identification of the intended audiences, the central messages and the structure of the game. The workshops focused on the exploration of diverse visual domains and the examination of game mechanics. Subsequently, the stakeholder jointly agreed on a concept that integrates playful elements with scientific reasoning, aiming to engage a broad public. Planned user tests with residents, schools and educational institutions will soon inform the refinement of difficulty levels, visual design and feedback systems.

Likewise, the preparatory work for the flood information portal commenced with the initiation of dialogue. A preliminary round of discourse on the subject of intense rainfall communication was convened with the objective of eliciting the expressed needs of prospective users. This was followed by a focused exchange with specialists in risk prevention, who discussed data, visualisation requirements and suitable wording. The results of this preliminary phase were used to establish a reference point for the structure.

In general, these participatory processes served to enhance the quality of digital tools and facilitated the establishment of spaces in which roles and cooperation structures are reflected and requirements and needs of the users are integrated. The discussions were therefore key regarding the distribution of responsibilities, the accessibility of data, the identification of appropriate communication channels, and the alignment with the city's existing strategies and programmes.

4 RESULTS

At the time of submission, the planning tool is halfway developed and rests on a stable technical foundation. A comprehensive conceptual framework for the digital game has been formulated, and its technical development is scheduled to commence in early 2026. The flood information portal has concluded its final consultation with administrations and subject experts, and is scheduled to be made available online early 2026.

The development of the planning tool proceeded along two distinct pathways, originating from the collaborative exploration undertaken in phase zero. One path concentrated on the configuration of the user interface, thereby instigating programming on the visual frontend and the technical backend. The other path involved the establishment of models that illustrate the effects of blue and green infrastructure measures in the two pilot areas. The models demonstrate the impact of blue and green infrastructure measures on stormwater runoff, local heat stress, combined sewer overflows and the deviation from the natural water balance. Consequently, the tool is now capable of comparing a range of measure combinations, including green roofs, infiltration areas, the removal of sealed ground and storage solutions. The objective is to ascertain which combination offers the strongest support for climate resilient development. Regular feedback sessions with potential users throughout the process ensured that expectations regarding clarity, usability and relevance were consistently integrated. A comprehensive user evaluation is scheduled for 2026, with the objective of effecting refinements to the tool's functionality and the overall experience for the user. The launch is scheduled for the end of 2026.

For the digital game, the agreed concept was passed to a game design agency which developed a coherent game logic, along with visual elements and sample animations. Concurrently, experts and stakeholders engaged in deliberations concerning a multitude of photographic scenes, with the objective of identifying locations in Berlin with which the local population is familiar and which hold significance. The selection process is approaching its conclusion, and the programming of the game is scheduled to commence in early 2026. The adoption of a participatory approach was instrumental in ensuring that the game's structure, visual language and interface not only provided a compelling and engaging experience for players but also facilitated effective learning.

The development of the flood information portal followed a collaborative path. Regular meetings with experts from several Senate administrations, combined with a click-based mock up, also called click-dummy, and early usability tests, helped refine the structure of the interface, the clarity of the language, the readability of the maps and the path through which users receive personalised information on flood risks. The discussions revealed that clear phrasing, address-based queries and the combination of short-term warnings with advice on structural and organisational preparedness are all of paramount importance. Following the completion of preparatory work, programming progressed expeditiously and is now approaching completion. The launch is scheduled to occur in early 2026.

5 CONCLUSION AND OUTLOOK

SmartWater links climate resilience strategies with coordinated modelling and scenario work across three complementary digital tools. This integration highlights the institutional conditions necessary for effective collaboration, including clear mandates, transparent responsibilities, and reliable data management. The project demonstrates how planning tools, communication formats and learning instruments can share a coherent technical foundation, establishing a common frame of reference for administrations, practitioners and residents.

SmartWater outlines a pathway for cities to move from isolated pilot activities towards integrated climate adaptation practices. The prototypes have the potential to inform planning routines, support decision-making processes, and strengthen public understanding of urban systems in the face of climate change. However, a sustained adoption will depend on stable agreements on data use, long-term operational arrangements, and continued investment in co-design and training. With these conditions in place, cities can develop digital support structures to help them create resilient, liveable urban spaces in the face of intensifying climate pressures.