# REALCOOL ‘Really cooling water bodies in cities’

## Summary

The ‘Really cooling water bodies in cities’ (REALCOOL) was a Research Through Design (RTD) project exploring the most effective combinations of shading, water vaporisation and natural ventilation around small urban water bodies. Small urban water bodies, such as ponds or canals, were commonly believed to solve urban heat problems but recent research showed that this might be a misconception. At the same time, there were indications that shading, vaporising water and ventilation can help to keep urban water bodies and their surroundings cooler. Yet, it was necessary to explore combinations of these strategies in urban designs and how to communicate the resulting design guidelines to design professionals. The REALCOOL project catered for this demand by designing virtual prototypes of the most cooling combinations of shading, water vaporisation and ventilation around small urban water bodies. We tested the designs on their microclimate effects with simulations, on their applicability with a broad triple helix stakeholder group and aesthetical perception with the public. Our extensive urban climate simulation studies showed that small urban water bodies do not have a relevant cooling effect. The prototypes we developed proved to be useful in practice as conceptual design guidelines. A final evaluation of REALCOOL’s advanced RTD methodology with the stakeholder group indicated that RTD is a reliable method to combine scientific knowledge and design knowledge into robust and widely applicable new spatial design guidelines.

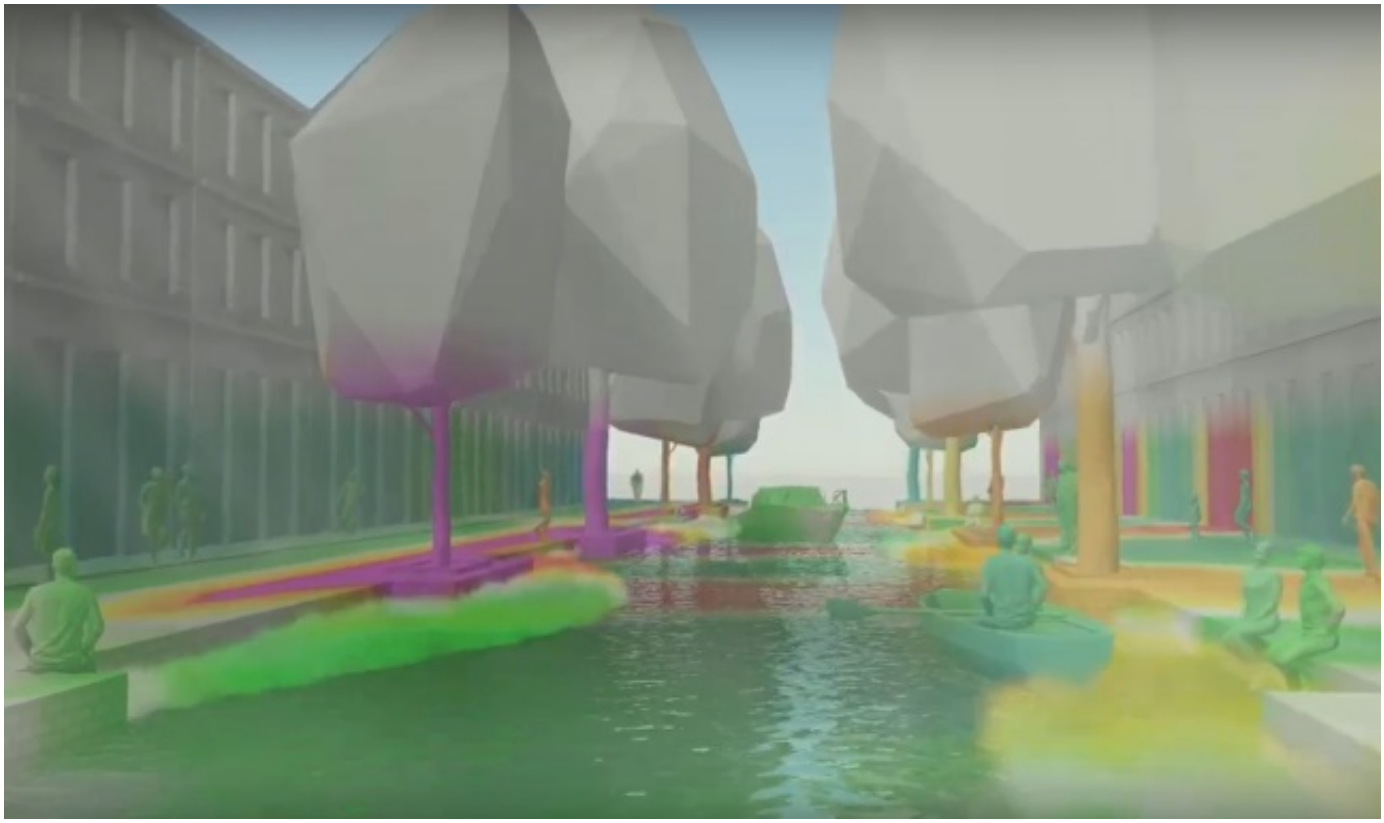

Figure 1: Still from the final animations that depict the spatial prototypes of the new water environments

# Case Description

## Background

Many assertions could be found in the urban design literature about urban water bodies having a cooling effect on their surroundings. However, recent research on larger water bodies showed that these may be quite limited over day and may lead to a night time warming. So the question arose if smaller urban water would show similar effects. At the same time, there are indications that shading water, vaporising water and proper ventilation might help to keep urban water bodies and their surroundings cooler. Yet, it was unknown how these strategies can be optimally combined in urban design and also effectively communicated to design professionals.

## Research objectives

The REALCOOL project aimed at understanding the micrometeorological effects of smaller urban water bodies and accordingly designing prototypical solutions combining cooling strategies like shading, water vaporisation and ventilation around small urban water bodies. The prototypes to be developed were virtual 3D scenes depicting the spatial layout and biometeorological effects of these combinations, that design professionals can use as design guidelines. These design guidelines were to convey the information about the spatial configurations and their biometeorological effects in an understandable way for urban design practitioners.

## Research approach

To answer understand the micrometeorological effects of small urban water bodies, simulations in the micrometeorology simulation software Envi-met with a new plug-in for water evaporation, were employed. We found that the cooling effect of such smaller water bodies is rather limited as well and that they cannot be used to effectively cool the environment. Based on this finding we started with the main part of the project: developing the design guidelines.

This main part was based on a 'Research through Design' (RTD), methodology, introducing an approach in which design and testing designs with scientifically robust methods was implemented (See Fig. 2). The project team consisted of experts in the areas of bio-climatological urban design, urban meteorology, water-atmosphere interactions, and 3D-visualisations from Wageningen University and the Amsterdam University of Applied Sciences. The project team closely cooperated with an advisory team from engineering consultancies, the national health institute, municipalities, water boards and design offices that assessed the design solutions we developed.

The RTD started with defining the environments into which the different design experiments could be projected: 'testbeds'. They are 3D spatial representations of typical Dutch urban water bodies such as different types of canals, ditches and ponds. After this preparatory work, the REALCOOL RTD process started, where each iteration had designing and testing components. The designing involved experimenting with different combinations of shading, vaporisation and ventilation strategies around water to reduce people's thermal load, but also took into account practical criteria.

Testing was done on different kinds of expected performance of the design solutions: biometeorological effects, through Envi-met simulations, hydrological functionality, combination with other urban functions (e.g. boat and road traffic), costs of implementation, maintenance requirements, and public health effects by evaluations of the advisory board. Design refinement principles for each subsequent iteration were directly retrieved from these assessments. Testing also included an online visual inquiry aimed at knowing how the general public would perceive hypothetical environments resulting from the application of the prototypes (photorealistic images). More than 1200 persons participated in the online questionnaire.

After this iteration, a set of final prototypes could be developed for each testbed. These were now tested in a 'reality check' where they were got applied by practitioners in 'real-world' projects. As the prototypes were evaluated positively by the practitioners we were able to finalize the RTD process. Subsequently we generated animated design guidelines, based on our prototypes, that visually communicate the 3D settings of the prototypes and the invisible microclimate science behind the designs

The last part of the project dealt with the visualization strategy to bring the new information across to the target group, being urban design professionals, in an understandable and inspiring way. The team's visualization specialist developed

different types of visualisations and tested these with the project and the advisory team. These animations can be found via: http://climatelier.net/projects/research/realcool-really-cooling-water-bodies-in-cities/.

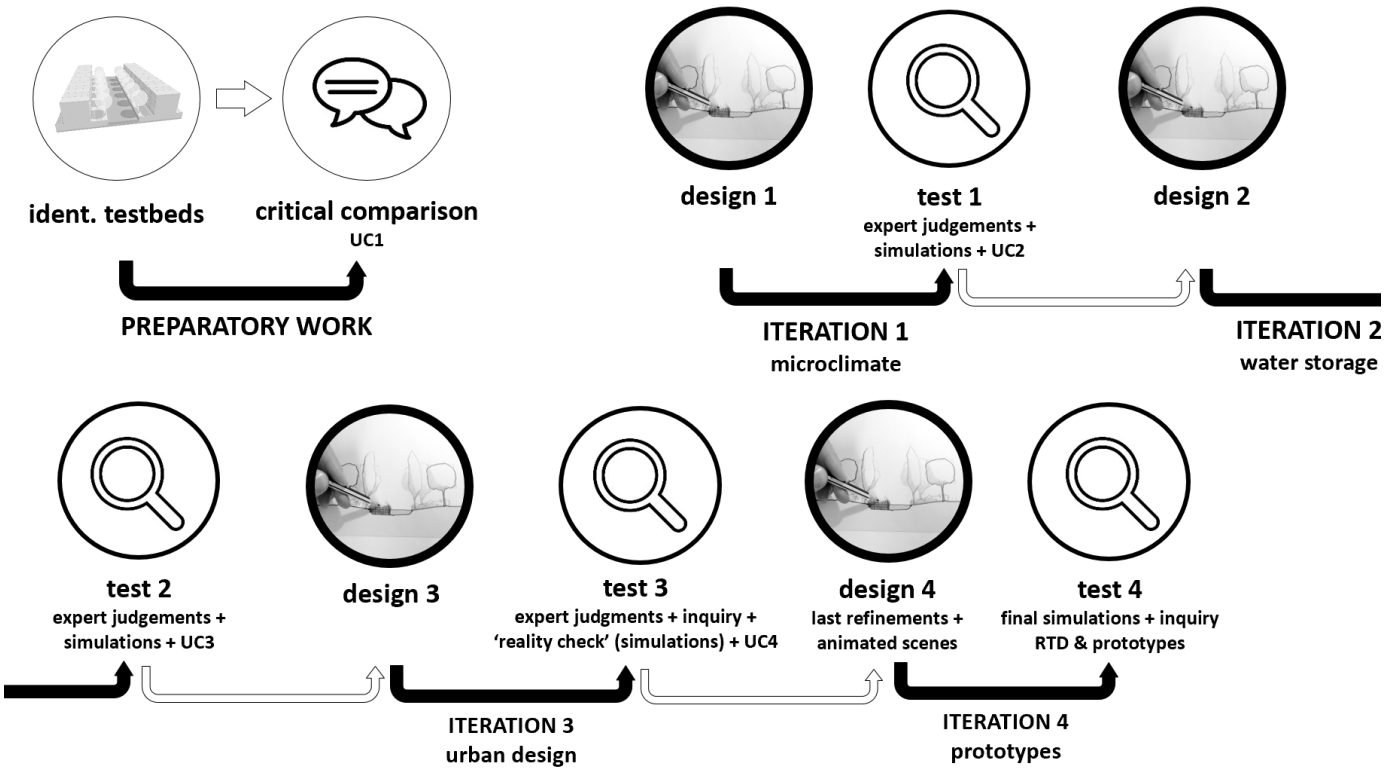


Figure 2: The method of Research Through Design in REALCOOL

## Main findings

*Biometeorology and hydrology*
According to the micrometeorological simulations the cooling (and also warming) effects of small urban water bodies on air temperature are quite small and often negligible — about 0.8 °C or less in air temperature and 2 °C or less in PET at 1.5 m above the water surface. In adjacent pedestrian areas, like quays, cooling effects were found to be even smaller, in particular during the night. Warming effects during the night were also very small and it appeared that little can be done through urban design to cool down water and to make it cool its surroundings.

Hence, the focus of the cooling water environments lies on implementing cooling strategies that cool people near the water but not the water body itself. The combination of these strategies across the different prototypes led to very significant local reductions in thermal sensation levels.

The prototypes increased rainwater storage capacity of current situations from 15% (meaning an increase of around 275 $m^3$ per 50 m) to 160% (meaning an increase of around 160 $m^3$ per 50 m).

The results from the online visual inquiry show that the majority of new water environments we had designed were perceived as more attractive than the current situations.

*Applicability in practice*
The interim consultations with the practitioner's advisory team, as well the 'reality check' showed that it was possible to easily and quickly apply the REALCOOL designs into site-specific projects; and there were no concerns about the relevance and usefulness of the conveyed principles.

*Aesthetical appeal of prototypes*
The results from the online visual inquiry show that the majority of depicted environments (12) were perceived as more attractive than the current situations. The remaining designs (4) were perceived as attractive as the current situations. Beauty, harmony and excitement were the main reasons for the perceived attractiveness of the designs.

*Visual communication of prototypes*
The consultations with the practitioner's advisory team, indicated that the visualisation of the prototypes as 3D animations worked well and that crucial criteria for effective visual communication of climate knowledge, being visual clarity, trustworthiness and raising interest, were met.

### Stakeholder involvement
REALCOOL had an intensive cooperation with the advisory team with which we met at least twice a year to discuss the outcomes of the different design iterations and asked them for their assessments of the designs. This helped us to generate results that are well-applicable in practice. The involvement of the broad public through the online inquiry about of the new urban environments was valuable to understand the future effects on citizen's perceptions.

Without the involvement of the entire quadruple helix, the REALCOOL project would not have been as successful and without such impact.

## Research Highlights

One of the main findings relevant for both urban climatology as well as urban design is the finding that smaller urban water bodies are not really cooling, proving earlier conceptions being incorrect. The recent paper about this finding is already cited quite frequently and researchers have been invited to give lectures about these results. (LIT nog invoegen!).

REALCOOL also brought about an extension of the Envi-met simulation software that was supplemented with input from the 'cool-water-tool' to predict evaporation processes more precisely.

Furthermore, REALCOOL brought about a methodological shift in landscape architectural RTD approaches as it employed more rigid testing of design proposals than other design-related research did. It was a 'proof of concept' of earlier, rather theoretical work on this matter that has now been employed in a research project successfully. The success of this project has led to many invitations for invited talks and keynote lectures.

### Impact
The REALCOOL project had impact at an early stage already as it actively engaged with the professional community and later also with a broad societal public, which increased the visibility of the project and led to many invitations to present the project, amongst the urban design community in design offices and municipalities but also at the TTW applied science festival and the Dutch Design week. The REALCOOL team was also invited to present the project in professional magazines and online outlets. The project also was mentioned in a state secretrary's letter to the parliament (kamerbrief).

The main outcomes of the project: the design prototypes are much valued in urban design practice and have already led to follow-up projects in which parts of the REALCOOL team work on implementing the knowledge from REALCOOL in other projects where urban water bodies are (re-)designed and get built (Nieuwe Mark Breda and GreenQuays).