
# Research results of a new governance method in climate adaptation; the international City Climate Scan

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**Summary**
Cities are becoming increasingly vulnerable to climate change and there is an urgent need to become more resilient. This research involves the development of the City Climate Scan methodology to measure, map, scan and assess different parameters that provide insight into the vulnerability of urban areas and neighborhoods. The research involved the development of a set of measurement tools that can be applied in different urban neighborhoods in a low-cost low-tech approach with teams of stakeholders and practitioners. The City Climate Scan method was tested in different cities around the globe with groups of young professionals and stakeholders in rapid urban appraisals.
For the Rotterdam City Climate Scan (September 2017), the following challenges were selected: risk of flooding, heat stress, water quality (micro-pollutants and plastic waste) and air quality. The Rotterdam climate scan is evaluated with their triple helix partners (public, private and academic partners). The conclusion is that the City Climate Scan approach helps policy makers and practitioners to gather valuable data for decision makers in a rapid appraisal at the neighborhood and city level. The results of the City Climate Scan method provides insights, creates awareness and brings together stakeholders. The most valuable deliverable is the concrete and tangible results. The participatory approach brings residents and practitioners together and provides insight into local problems, while at the same time the method facilitates the collection of valuable data about the robustness of neighborhoods. As a result of this positive evaluation, the City Climate Scan will be up scaled to a number of cities in Europe and Asia in the upcoming months.

**Introduction**
The changing climate has an effect on the quality of life in our cities. A well-known example is rainfall with a high intensity, resulting in flooding. It is less known that climate change also has an effect on our air and water quality and will warm up parts of our city (heat stress). Awareness among various stakeholders about these changes is of great importance. In the Netherlands, the 3 step adaptation strategy 'analyze, ambition, act' is often applied. All municipalities in the Netherlands must conduct a stress test in the coming two years to identify bottlenecks in areas such as flooding and heat stress. This is stated in the 'Delta Plan for Spatial Adaptation', which was presented in The Hague at the end of 2017 [1]. In order to take the steps from 'analyze' to 'action', a new method was introduced at the end of 2017: the international City Climate Scan. During the scan, an international team cooperates in a 'triple helix' composition (governments, companies and knowledge and educational institutions including young professionals and students) during a short period of time. The climate adaptation status or level in a city is evaluated with various stakeholders, using concrete measurements and results.

The first idea was presented during a meeting of COST-sub-urban in March 2017 in Bucharest [2] during the presentation 'The need for Innovations for extreme climatic events' [3]. The City Climate Scan methodology for climate adaptation was received with great interest by various international knowledge institutions, especially because of the focus on measurements and the collection of data which provide tangible results. Partly due to the arrival of the Global Center of Excellence on Climate Adaptation (GCECA), which will be based in Groningen and Rotterdam, the existing collaboration on climate adaptation between various knowledge institutions in both cities has been further expanded. The applied universities of Rotterdam and Groningen have been working together for years on (inter) national climate adaptation in the Netherlands, Europe and Asia (with an initial focus on Indonesia and the Philippines). In September 2017 the first international City Climate Scan was organized in Rotterdam with universities from Gdansk (Poland) and Groningen & Rotterdam applied universities. The cities of Gdansk and Groningen maintain close ties as Hanseatic cities and Gdansk relates to Rotterdam being a sister (harbor) city. Rotterdam is also a partner in the Connecting Delta Cities [4] and 100 Resilient Cities [5] networks.

**History**

The international concept of City Climate Scan was tested in Thailand, Taiwan and finally on bigger scale in Metro Manila where Dutch and Filipino students measured the water quality with a free downloadable Akvo app [6] in Pasig and Pateros river in April and December 2016. The results of the water quality measurements were plotted on the climate scan website and presented to Filipino decision makers, such as the Secretary of Public works and Highways, the secretary of Environment and Natural Resources and the Dutch ambassador. The challenge regarding plastic waste was introduced in the second try out of the City Climate Scan in December 2016. The Villar CIPAG foundation, founded by the Villar family, initiated a project on plastic waste collection in the Paranaque river in Las Pinas City where the problem of plastic waste and solid waste collection has extreme proportions. The villar Sipag Foundation makes various products as plastic school chairs from the recycled plastic [7]**.** One of the concrete results of the City climate Scan in April 2016 was the design of a 'Longanissa', which means sausage in Tagalog and is in fact a litter trap. The litter trap was designed in April 2016 and was constructed at the Villar Sipag compound in December 2016 and promoted with a video [8].

When more practitioners became interested in the method, the city development department of city of Rotterdam invited Rotterdam and Groningen University of Applied Sciences to organize a City Climate Scan in Rotterdam. 37 Dutch students from Rotterdam and Groningen University of Applied Sciences, 20 Polish students from Gdansk Technical University and three French students from Ecole Centrale de Nantes participated in the City Climate Scan Rotterdam in September 2017. Infiltration capacity and actual measurement of plastic waste along Maas river was added to the measurements. The City Scan method was captured at this City Climate Scan Rotterdam [9].

Plastic was also measured during the City Climate Scan Challenge Cebu City (Philippines) in October 2017. 7 Dutch students worked together with 12 Filipino students from the University of San Carlos in Cebu City in close collaboration with the City of Cebu, city of Mandaue and Ramon Aboitiz Foundation Inc. The city scan was captured and promoted with a video [10] and new city scans were planned for September 2018 in Semarang (Indonesia)

and November 2018 in Cebu (Philippines) with a follow up in 2019 in other Asian and European cities.

**METHOD**

The City Climate Scan method gathers essential data in a short period of time (1-2 weeks) with young professionals and practitioners that enable them to assess the 'level of resilience' of a specific neighborhood or city. The City Climate Scan method aims to use low-cost and low-tech tools and instruments that stimulate interaction with stakeholders. Relatively little is known about resilience at street and neighborhood level. With the City Climate Scan method it is possible to collect relevant information in a short time about the level of resilience in streets and neighborhoods. The objective of the scan is to develop a set of cost-effective measuring methods that can be used worldwide to gain insight into the degree of resilience in a neighborhood. The measurement results of the selected parameters provide insight into the degree of resilience of a particular street, neighborhood or city. This knowledge will raise awareness among citizens and other stakeholders about vulnerability, and will thus contribute to capacity building among stakeholders and will increase support for the implementation of climate adaptive measures at the local level. A very important aspect of the method is the selection of 'the wicked problems' or challenges in the city where the City Climate Scan will take place.

Challenges Rotterdam

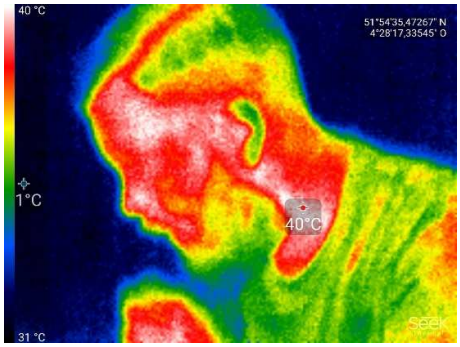
The City Climate Scan methodology provides insight into certain predetermined parameters in a short time. These parameters can vary per neighborhood or city. The decision to pick or focus on a certain set of parameters can be tailored to the wishes of the user in a particular country or neighborhood. After consulting various partners in the city of Rotterdam, various challenges were selected for the City Climate Scan in Rotterdam: flood risk, heat stress, water quality (surface water and plastic waste) and air quality.

Results City Climate Scan Rotterdam

The objective of collecting a lot of data and interpreting climate adaptation in a short period of time during the City Climate Scan Rotterdam has been achieved. During the data collection with students and practitioners awareness was raised among the participants. The interaction between various stakeholders resulted in the collection of valuable data. The method and research results are stated in table 1.

Parameters that were assessed in Rotterdam are: urban heat (temperature), urban water quality (several parameters such as: nutrients, ph, conductivity, temperature, turbidity, oxygen), urban air quality (several parameters), urban floods (infiltration capacity) and waste pollution (plastic waste).

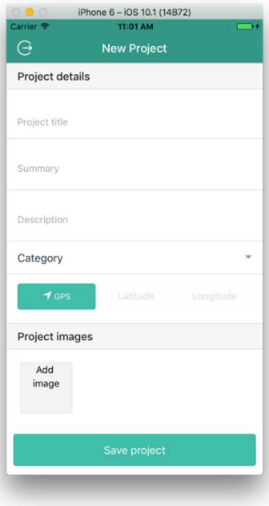
*Table 1 challenges and results of the City Climate Scan Rotterdam.*

| Challenge | Method | Results |
|---|---|---|
| Urban floods  | • Mapping floodings and infiltration capacity measurements with infiltrometertest | • Measurements on infiltration capacity (see next paragraph<br>• map with measurements www.climatescan.nl, figure 1 and 2 |
| Hittestress   | • Dynamic and static measurements of temperature on several surfaces in the urban dense area with heatcameras and sensors | • Map with heatstress in the urban dense and green areas in the city |
| urban waterquality mirco polutants  | • apps and teststrips and underwaterdrones with camera's and sensors | • maps with results of grab samples of nutrients in urban water<br>• 3D-scans of waterquality with continuous sensors with indication of pollutant sources |
| urban waterquality marco polutants; plastic waste  | • 'square method' the type and amount of plastic waste is determeined at 1m² | • detailed insight in waste per m²<br>• optimized method to be used at projects in Ambon (Indonesia) and Cebu City (Philippines) |

The various experiences gained during the measurements have contributed to a stronger development of the city climatic scans methodology. The results on data collection, governance and the various forms of international knowledge exchange are used in the international projects WaterCoG [12] and INXCES [13].

**FINDINGS**

The first results from the City Climate Scan Rotterdam show that the method gathers valuable multidisciplinary data that is currently not collected. The method is currently being developed and number of parameters is being expanded. The parameter Water Quality was measured and mapped using free apps that give insight in the water quality at street or neighborhood level. The parameter Urban Heat was measured at the street level and gave new insights in how heat differs in different neighborhoods and streets. The parameter Plastic Waste was measured at the riverbanks of Maas river and can now be systematically measured. The data gives detailed insight and awareness in the contribution of Plastic waste pollution in our river systems. The parameter Infiltration Capacity of open spaces and the contribution to reduce floods was measured at multiple locations in the city. The open green spaces show a 3-6 higher infiltration rate that paved areas. From detailed flood maps and flood models, locations have been selected to implement green and blue measures.
More than 25 Best management practices (BMPs) in climate adaptation are mapped on an open source web based international knowledge exchange tool www.climatescan.nl. Some of the BMP's have been tested during the City Climate Scan: e.g. the infiltration rates of permeable pavements have been considered very low after being in service a couple of years. The discussion of this and other results in the triple helix consortium has led to a detailed strategy for the city to be more resilient.



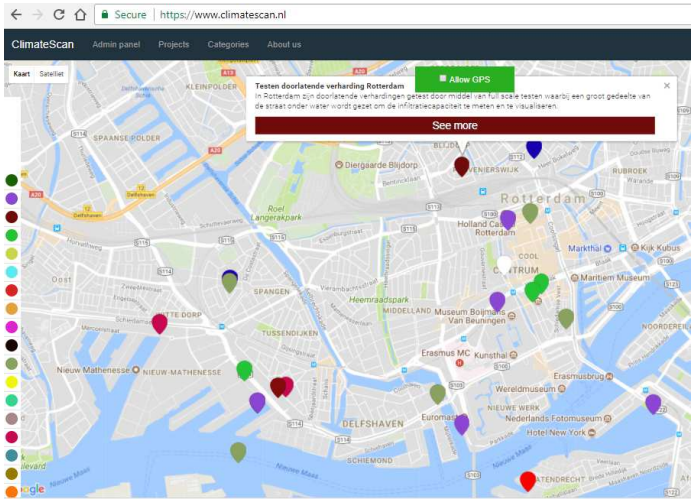




*Figure 1. Web-based mapping climate adaptive examples with app from www.climatescan.nl*
*Figure 2. Result of mapping climate adaptive measures in Rotterdam www.climatescan.nl [14]*

Infiltration tests City Climate Scan

The infiltration rate was measured with an infiltration test. This gives an indication of the amount of water that can infiltrate in a certain time in the urban area (see table 1). These tests raise awareness among the participants on the fact that that greening of the city is positive for climate adaptation and provide a higher infiltration capacity. The experiments show that the infiltration capacity of green is a factor 3-6 higher than that of hardened surface.

There is a large variation in the conducted measurements, but the measurements on permeable pavement (results vary in the range of 70 to 150 mm/h) indicated a high rate of clogging of these pavement in the first years. Doubts have been raised on the effectiveness of this climate adaptation measure by several studies [15] and by the municipality of Rotterdam [16].

**Conclusions City climate Scan method**

The City Climate Scan method was evaluated with stakeholders and practitioners in order to identify the relevance and significance of the method for policymakers and stakeholders. The conclusion was that the City Climate Scan method is a low-cost, low-tech methodology that can easily be applied in cities around the world. The approach helps policy makers and practitioners to gather valuable data for decision makers in a rapid appraisal at the neighborhood and city level. The results of the City Climate Scan method gives insights and creates awareness and brings together triple helix partners (public, private and academic partners).

The delivery of tangible concrete final results is highly appreciated by stakeholders. For Rotterdam the tangible result was, among other things, an open source interactive map with climate adaptive measures (Figure 2, [16]). The City Climate Scan measurements that were conducted in other cities yielded data and insights about (plastic) waste and pollution levels in rivers and pilots about increasing the survival levels of mangrove seedlings using floating islands (Figure 3). Groningen and Rotterdam University of Applied Sciences will implement the City Climate Scans in other cities to collect data on the level of resilience and increase (international) awareness among various parties. Several City Climate Scan events are planned with cities in Indonesia (Semarang) and Philippines (Manila, Cebu), but also with various European cities.


*Figure 3. tangible results of international city climatescans at the Philippines. Left: the wastetrap 'longganisa' in Manila [17, 18]. Right: bio-based floating islands for water quality improvement in Cebu [19].*

**Acknowledgements**

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