Climate Adaptation monitor using the ClimateScan toolbox: Adaptation-DNA of cities and national contribution of nature-based solutions to urban water storage.

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Highlights

- Biggest global database on climate adaptation with over 14.000 uploaded projects on private and public property
- Visualisation of Climate Adaptation DNA of several cities for international knowledge exchange
- First calculations on (national) distribution of urban storage volumes: case study The Netherlands with high potential for international upscaling

Introduction

As presented at ICUD 2017 in Prague, over 2000 climate adaption projects where uploaded on the open-source database ClimateScan in the period of 2014-2017 (Boogaard et al 2017). Since then, 12.000 additional projects have been mapped on ClimateScan by professional submissions and 'citizen science'. This paper describes potential calculations and visualisation of this database to get basic insights in (inter-)national climate adaptation. Municipalities and water authorities require basic insight in:

1. Climate Adaptation DNA of cities: what is the distribution of climate adaptation measures in a certain region or city? Background: a total overview of sustainable urban drainage systems (SuDS) or nature-based solutions (NBS) on private and public ground in a city or on national level is often not available. Often several types of NBS are implemented and for maintaining the long-term efficiency of these NBS several methods are required. Knowledge on the distribution of these NBS with high scoring numbers of a certain type or 'DNA' of NBS (and their efficiency) can stimulate knowledge exchange between cities and will help urban planning and maintenance to plan their activities.
2. Insights of water storage volumes of nature-based solutions: most NBS are implemented on street or house level without knowledge of their contribution (amount and volume) on the total climate adaptation ambition or demand of a city or a country.

Methodology

To answer the 2 research questions a large dataset is required of sustainable urban drainage systems (SuDS) or nature-based solutions (NBS). The open-source citizen science platform ClimateScan mapped over 14.000 projects related to climate adaptation around the globe in 10 years with an average of more than 2000 registered users uploading projects thanks to the openness of the website and active online and offline promotion. The platform is the biggest inventory of nature-based solutions projects around the globe for international knowledge exchange (Restemeyer & Boogaard 2021).

Climate scan collects climate adaptation locations from all over the world (figure 1). The global platform can be used as a first step to collect data and share the knowledge on realized climate adaption measures of a certain city or region and compare this to other parts of the world. The tool ClimateScan focuses mainly on the topics surrounding the areas of urban resilience and climate proofing and climate adaptation. The main objective of this interactive international open access platform is knowledge exchange on climate adaptation projects through the platform itself and the connected social media channels as twitter, Instagram and Facebook. The Online citizen science knowledge-sharing platform ClimateScan.org contributes to an accelerated climate adaptation by promoting more green and blue spaces in urban areas. Basic insights can be made from the projects that contain information on the category and location and additional info (if available: photos, videos, research papers and data). Currently, all the data points are categorized into 7 sub-groups (Water, People, Nature, Heat, Energy, Urban Agriculture and Air quality) holding over 20 categories, which are each assigned a different colour as shown in the legend to the left of the webpage (Figure 1).

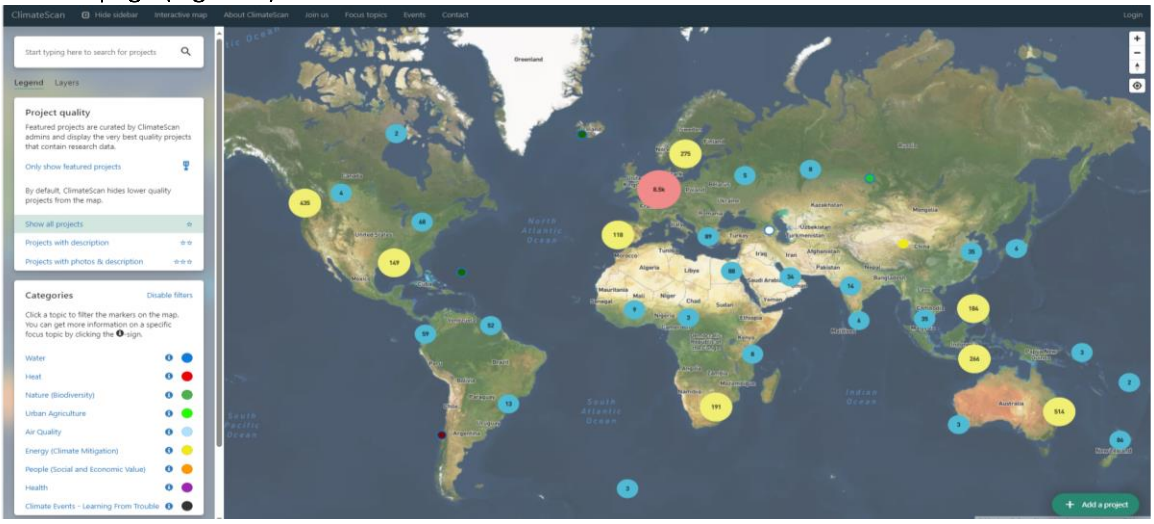


Figure 1 climatescan.org platform with over 14.000 projects around the world

Most of the uploaded projects belong to categories related to NBS, SuDS, WSUD and BMPs that are designed to reduce the rate and quantity of surface water runoff from developed areas and to improve runoff water quality. Uploads on ClimateScan include constructed wetlands, bio swales, green roofs and walls, permeable pavements, rainwater gardens, and floating structures on public and private property (Table 1). For this paper the number of projects in categories are analysed, and the distribution of the projects by 2 cities: early adaptor of green infrastructure Amsterdam and starting on this green infrastructure transformation in Riga in 2020. Calculations are made with GIS of the majority of the measures implemented in the Netherlands for a first indication of the volumes of urban NBS on national level.

Results and discussion

For this paper the number of projects in categories with more than 100 implementations are analysed and visualised in figure 2.

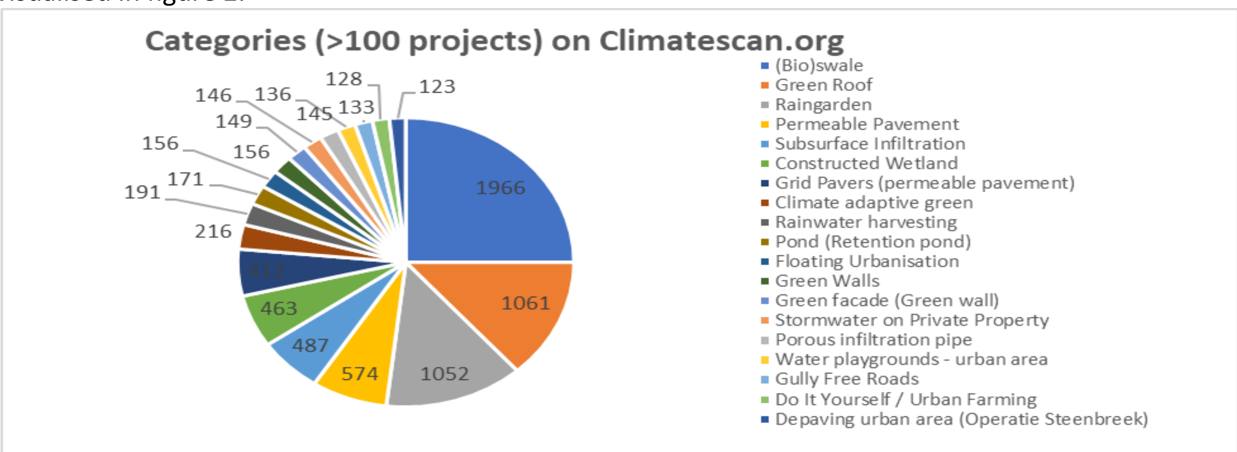


Figure 2 Categories with highest project numbers in categories mostly referring to small scale urban nature-based solutions (status December 2023)

Bio swales and raingardens (bio-filtration) and green roofs are dominant in de database with over 4000 international projects (figure 2). The quality control on this data is high since these categories are visual on the surface and are checked with arial photos. The first 3 categories (as number 6 and 7 on the top 20: constructed wetlands and grass filled grid pavers) have a higher accuracy than: subsurface infiltration and permeable pavement (number 4 and 5) since from photos the dimensions of these measures are not always visual and easy to be estimated.

Calculation water storage volume distribution of NBS

To determine the dimensions of the green infrastructure there are 2 types of input from ClimateScan:

1. The surface (length and width) is determined from polygon of ClimateScan projects (figure 4). Large surfaces of >10.000m2 (unlikely in urban dense area) are checked or removed.
2. If no polygon is available (a point) the average is taken of all points in that category.

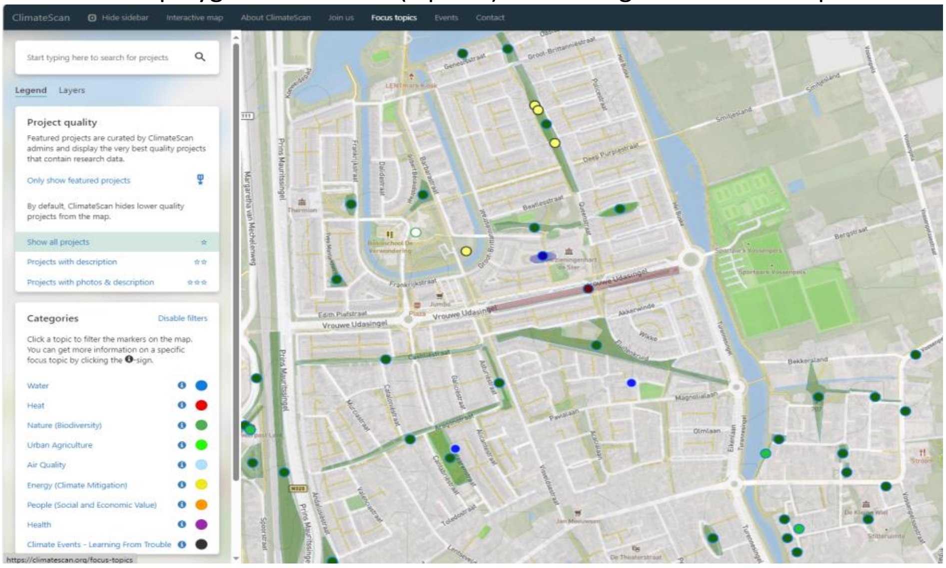
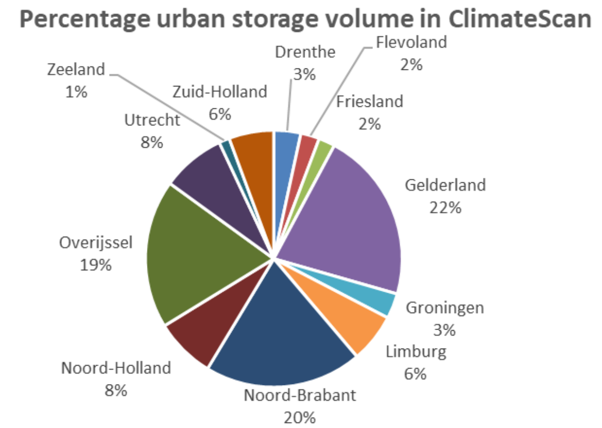


Figure 1 large quantity of projects in ClimateScan are polygon allowing to determine the shape and contour of the climate adaptation measures for calculations.

The depth is estimated according to guidelines in table 1. Note that the presence of green infrastructure doesn't mean that its effective so conservative depths are used for this first calculation.

Table 1 Estimation of depth of the green infrastructure in calculations.

category	dimensions	Depth [m]
(Bio)Swale	According to guidelines swales have an average slope of 1:3. Depth average 0.3 and maximum 0.5 m.	0.2
Green_roof	Most green roofs are flat allowing more than 0.1 m water height as storage but there is also a high amount of green roofs with a slope. 'Blue roofs' allow a water depth up to 0.5	0.1
Permeable_Pavement	4 types of pavements with different constructions. Most will allow a water depth higher than 0.1 and have storage underneath. Since clogging and low permeable infiltration rates are determined a water depth of 0.05 m is used in the first calculations.	0.05
Constructed Wetland	Constructed wetlands allow 0.3-0.5 water depth as storage	0.3
Raingarden	Raingardens (often without slopes as the bio-swales) are 0.3-0.5m deep.	0.3
Watersquare	Watersquare allow almost in every case a water depth of >0.5 m as storage volume.	0.5



First calculations show that over 25.000.000 m^3 of storage volume is created in the last 20 years in the Netherlands for climate adaptation. Large cities score well in volume and number but related to the population small villages score often higher. The first results are checked in detail with (regrettably only limited) municipalities that have their own calculations on water storage of public and private properties available. Figure 5 shows the distribution of urban storage volumes in different regions in The Netherlands. The results show that some regions have more urban storage (mapped on ClimateScan) than others in numbers and volumes.

Figure 2 distribution of urban storage volumes in different regions in The Netherlands

Climate DNA of cities

From cities where multiple uploads are available (figure 1) an overview can be created of what kind of categories are uploaded in numbers giving an indication what can be found in that city with proven implementation in practice (photos etc) and location. For this paper 2 cities are chosen that have over 40 uploads from several users with different background given a multidisciplinary overview of solutions related to climate adaptation in that city. Figure 3 gives the climate DNA of 2 cities in 2 different ways (percentages and total amount):

1. Riga: city with low amount of green infrastructure (started in around 2020)
2. Amsterdam: city with high amount of green infrastructure (started around 2002)

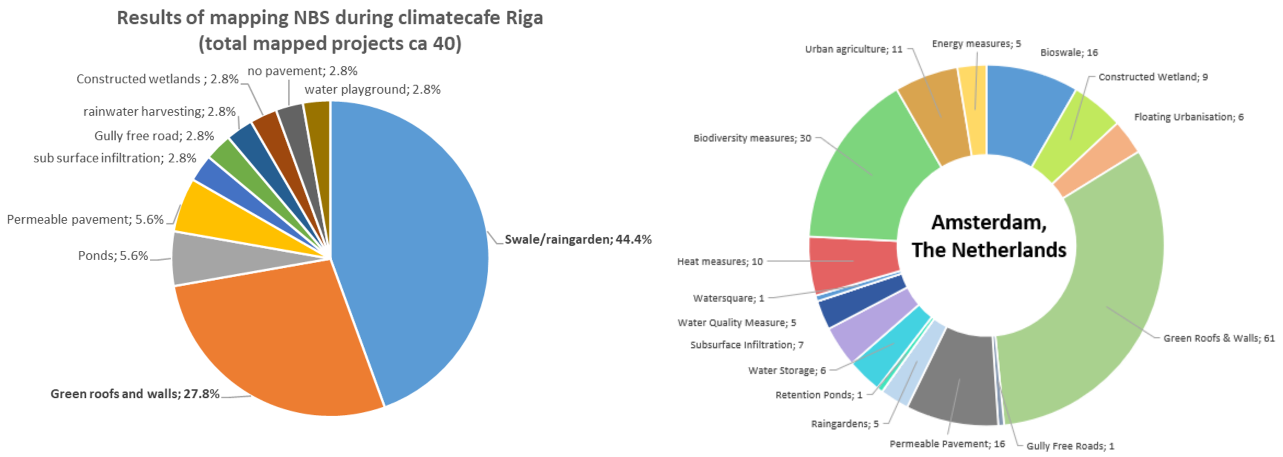


Figure 3 Climate DNA of Riga (left) and Amsterdam (right)

From figure 2 can be arrived that bio filtration such as swales and raingardens dominate the NBS structure in Riga (based on 40 data points). Amsterdam with over 500 climate adaptation measures shows large quantities of green roofs (subsidised program), bio-swales and permeable pavement.

Conclusions

This paper shows 2 examples of analysing and visualisations of ClimateScan platform data. Analysing the open-source Change Adaptation Platform ClimateScan shows that surface bio filtration is the category with most uploads, which is the case in Riga (started green infrastructure around 2020) in contrast to early adaptor (since around 2002) Amsterdam with large quantity of green roofs (as result of a subsidy program).

First national calculations of all Dutch NBS show that over 25.000.000 m^3 of storage volume is created in the last 20 years in the Netherlands for climate adaptation. Large cities score well in volume and number but related to the population small villages score often higher.

Because of the open-source character of the tool, every city can use ClimateScan to engage partners to upload climate adaptation measures and analyse and make their own 'climate adaptation DNA'.

In the process of calculations and visualisations we came across some basic improvements to have more accurate outcomes which we will discuss with frequent users of ClimateScan:

- use polygon to sketch the shape of the project for more accurate calculations.
- Evaluating the platform with an increasing number of expert users since the platform is under constant change.
- Detailed check on outcomes of the data with stakeholders from municipalities and water authorities
- Follow up stakeholder meetings to verify the potential of further calculations and visualisations.

References

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