International knowledge exchange Nature Based Solution with the ClimateScan adaptation platform. Lessons learnt from Australia and Europe

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Highlights

- Over 6000 NBS locations mapped around the world by citizen science
- Category with most uploads: bio-filtration with over 2000 projects in Europe and Australia
- Analysing results leads to cross continents recommendations for NBS

Introduction

There is a clear demand for a collaborative knowledge-sharing on climate adaptation and mitigation. As a consequence of urban expansion, green spaces are lost and the available areas for pervious green areas are decreasing. Many cities will experience greater impacts from flooding and heatstress due to climate change. Blue-green and small scale Nature-based solutions (NBS) such as bio swales, raingardens and wetlands offer opportunities to adapt urban areas to the impacts of climate change, but their multiple benefits are often unknown to the wider public.

Research suggests that effective management of mitigate flood events and heat stress will be achieved by applying a range of NBS measures at different locations in cities [Majidi et al 2019]. Mapping of these (potential) locations for NBS will raise awareness and contribute to capacity building on climate adaptation.

Some open source Climate Change Adaptation Platforms (CCAPs) allow mapping of NBS by citizen science and can help to inform and inspire different stakeholders on the topic of climate adaptation in respective region. The aim of most CCAPs is to facilitate an open and free exchange of knowledge on an international scale. Raising awareness about climate adaptation in urban areas and promoting NBS are also key aims. Figure 1 shows several CCAPs that are available around the world [Climate Ireland, 2019].

Figure 1 global Climate Change Adaptation Platforms as presented during 2nd international climate change adaptation platform workshop in Dublin October 2019 [Climate Ireland, 2019].

As presented in Figure 1, there are a number of CCAPs around the world offering information to different target groups. One of the three global platforms, ClimateScan.org, started as a Google-based project map and through iterative processes, shifted into its own website, serving as an international knowledge exchange tool on urban resilience [Tipping, 2015]. Global platforms can be used to exchange knowledge on NBS in different continents in the world and was used as open source database for this paper.

Methodology

Registered users of ClimateScan are able to log NBS projects quickly and efficiently. These data are then uploaded to the platform to facilitate free and open exchange of the information (Figure 2).

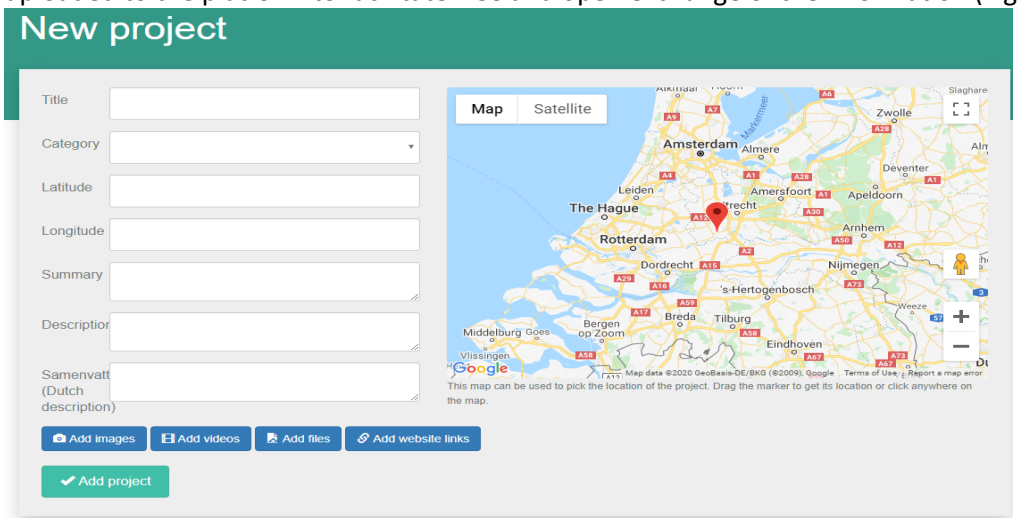

Figure 2 - Project logging site on Climatescan.

Most of the uploaded projects relate to the NBS, Sustainable Urban Drainage Systems (SuDS) or Water Sensitive Urban Design (WSUD) and Best Management Practice (BMP) categories. These systems 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 bio filtration, constructed wetlands, floating gardens, swales, green roofs, permeable pavements, rainwater gardens, and floating structures on public and private property (see Table 1).

Using the project logging method described, ClimateScan now has thousands viewers a month that spend more than 5 min on the website viewing different climate adaptation projects around the world. The simplicity of the project logging method has resonated with users and now as a consequence, ClimateScan has over 2,000 registered users that are uploading projects around the world. More than 60% of the users are younger than 34 and 51% of users are female (Boogaard et al, 2018).

With over 14,000 uploaded projects, the platform is considered to be one of the biggest inventories of 'blue-green' projects around the globe for international knowledge exchange. Currently, all the data points are categorised 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 3). Users of Climatescan can create their own climate adaptation categories and upload projects.

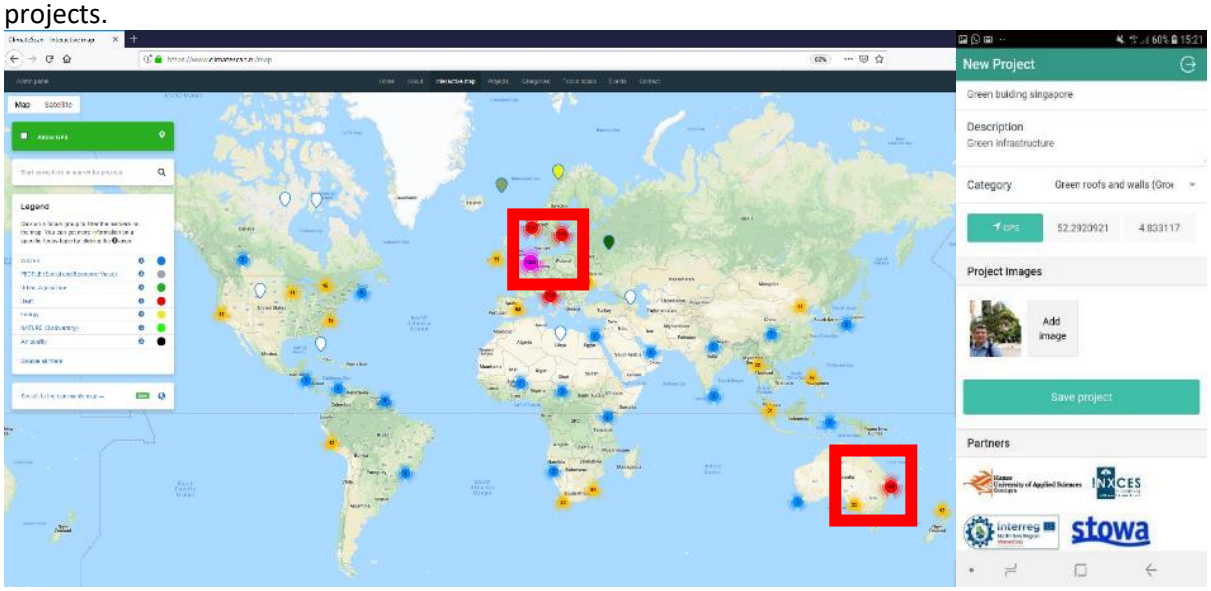

Figure 3 ClimateScan platform with over 14000 projects around the world and app for uploads of climate adaptation projects (right). In red square locations discussed in this paper are indicated

Results and discussion

Over the past several years over 6000 international NBS locations (green subsurface bio filtration systems) have been mapped on ClimateScan by professional submissions and via 'citizen science'. The top 5 of most uploaded projects (with detailed info and examples on these categories in) are summarized in table 1.

Tabel 1 details of the top 5 uploads in categories (selection of projects in The Netherlands and Australia).

No	Category projects [n]	Definition [Susdrain[1]]	Example Visual (source: climatescan.org)
1	(bio) swale, (bioretention, raingarden) [1181]	Bio swale: A shallow vegetated channel designed to conduct and retain water but may also permit infiltration. The vegetation filters particulate matter. Rain garden: A planted basin design to collect and clean runoff (normally from a roof, or hardstanding with low risk of pollution).	 Raingarden in Amsterdam (in top 3 of most viewed projects on climatescan). This is a regular sight in Australia but only a few can be found in The Netherlands. https://www.climatescan.nl/projects/921/detail
2	Green roofs and walls [530]	A roof with plants growing on its surface. The vegetated surface provides a degree of retention, attenuation, and treatment of rainwater, contributes to local biodiversity and promotes evapotranspiration.	 Green wall municipality Building of Venlo, The Netherlands: https://www.climatescan.nl/projects/1154/detail
3	Constructed wetland (incl waterharmonica) [454]	Wetland: flooded area in which the water is shallow enough to enable the growth of bottom-rooted plants. Wetlands are constructed in urban areas to store water after stormwater events and improve water quality. The Waterharmonica (Ecological engineering treating waste water into usable surface water) focuses on integrated ecological engineering processes, by optimising multifunctional constructed wetland processes.	 Multifunctional wetland constructed for the purpose of filtration, phytoremediation, sediment trapping and flood attenuation but is also accessible for recreation (benches and walking path). Amsterdam: https://www.climatescan.nl/projects/122/detail
5	Permeable pavement [218]	A permeable surface that is paved and drains through voids between solid parts of the pavement. A permeable surface is made up of material that is itself impervious to water but, by virtue of voids formed in the surface, it allows infiltration of water to the sub-base through the pattern of voids.	 Permeable pavement during a Full scale test: a monitoring method co designed by Australian and Dutch scientist and applied at more than 100 locations in The Netherlands with stakeholders. Meppel, The Netherlands: https://www.climatescan.nl/projects/328/detail
5	Floating urbanisation (including floating green) [126]	Constructed floating wetlands (CFWs) are a relatively novel approach to water treatment. Macrophytes are planted into a buoyant structure to enable them to float on top of surface waters. The high root mass increases the available surface area for microbial biofilm that trap fine particles, transform nutrients for plant uptake and for volatilization (nitrogen). CFWs can be used for many purposes, including: Stormwater and wastewater treatment; Habitat creation/enhancement; coastal and river bank erosion protection; and remediation of eutrophic water bodies.	 floating wetlands enhance the existing pollutant removal performance of sewage treatment infrastructure. By adopting an efficient, low maintenance approach, it is anticipated that such green infrastructure can boost the performance of existing systems, thus offsetting the immediate need to update large scale and costly wastewater treatment plants.

[1] https://www.susdrain.org/resources/glossary.html

Global lessons from ClimateScan: bio filtration Europe and Australia

Most ClimateScan users are in Europe where the platform was set up with the help of EU funded projects such as WaterCoG and INXCES. But the relevance and usage in other continents has become more evident over time. For example, projects in Africa, Asia [Adi et al 2020] and North America such as Canada have uploaded over 30 'depavement' projects. The 'depave' approach recognises the fact that impervious surfaces reduce infiltration and increase pollutant loading to sensitive environments. By removing, or 'decoupling' existing impermeable areas and replacing them with pervious areas (e.g. lawns, parks, trees) infiltration is increased, pollutant loads are reduced, and neighbourhood beautification occurs.

In terms of international knowledge exchange, The Netherlands and Australia are two countries separated by significant geographical distance. Despite this, both countries have contributed to the highest number of projects in the (bio) swale (bio retention, raingarden) category. Cross collaboration between the countries has seen the open and detailed exchange of knowledge regarding the implementation, maintenance and design of such systems.

The high numbers of projects where gathered by a small group of enthusiastic mappers such as Jack Mullaly from Ideanthro (Australia). He started his google based site Ideanthro since *'he firmly believes that the best way to learn about WSUD is in the field with the main question: how do I know where systems are to (digitally) visit hem?'* As an employee at Logan City Council he started visiting systems on his way home from work. His inspiration for the map was to keep details low *so people could just take a glance at the map when going out and pick some stuff on their route to go and see.* On the other side at the world Floris Boogaard and other Dutch researchers had the same idea, mapping and exchanging research locations which now is the highest dense inventory of NBS with over 2000 NBS in The Netherlands. Both websites had a surprisingly large number of people contributing to the sites and now joined forces what grew into a global Climate Change Adaptation Platforms (CCAPs) with almost 1000 registered enthusiastic 'citizen scientists'.

Highlights:

- Exchanging and merging bio filtration examples from 2 locally orientated platforms (ideanthro.com and climatescan.nl) into 1 interactive international open-source platform climatescan.org
- Field visits to innovating locations where the long-term efficiency is discussed with interviews that have been shared on social media
- New monitoring methods have been co-designed for permeable pavement and bio-swales and research results have been published[2].
- Research on Australian concept of floating wetlands with Dutch monitoring techniques as underwater drones

Conclusions and future work

Over 6000 small scale urban NBS locations are mapped around the world by citizen science making it the biggest database of climate adaptation locations in the world. Analysing the open source Change Adaptation Platform ClimateScan shows that bio filtration is the category with most uploads (1181 projects) with the highest contributions from The Netherlands and Australia. Despite that these two countries are separated by significant geographical distance, climate and geohydrological circumstances, cross collaboration between the countries has seen the open and detailed exchange of knowledge regarding the implementation, maintenance and design of NBS by the means of ClimateScan. Even new monitoring methods are developed and active international knowledge exchange on innovations in NBS started years ago and is still active.

New knowledge exchange in the next year will focus on floating infrastructure (5th highest category on ClimateScan with 126 projects uploaded). Floating infrastructure is of interest in areas as The Netherlands where the urban dense area is situated under sea-level and 17% of the total surface of the mainland consists of water. The majority of work in the Netherlands has been on monitoring ecosystems established under floating structures. Conversely, in Australia the majority of work is on vegetated floating structures and how they improve water quality, but little consideration has been given to the ecosystem provision. Through the Platform ClimateScan the value is seen of both approaches and aim to integrate them into future, collaborative research which will benefit all countries working on floating urbanisation.

More knowledge will be exchanged in place in the near future during new international projects on climate adaptation where mapping of NBS will take place. Climate Change Adaptation Platforms such as Climatescan are an inspiration to stakeholders to make their cities more resilient to climate change. Potential upgrades of these platforms have been identified with stakeholders.

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