Thursday, January 13, 2022
Hanyu Gao

Proposal 0

Topic: Interactive Parametric Digital tool for Sponge City Program (SCP) in Neighborhood scale

Motivation

As one of the biggest top-down national policy in China, Sponge City Practice has been initiated in over 30 citied and invested over billion of dollars. However, after over seven years of practice, many cities in China are still suffering from severe water logging. Especially Zhengzhou, Henan, who has spent more than $80 million in SCP since 2016, was overwhelmed by record-breaking flooding in July this year. It caused 53.2 billion yuan(about $8.38 billion) in economic losses and took 292 lives. The effectiveness and practice of SCP are facing unprecedented challenges and doubts. It is a wake-up call for us and an important question raised worth introspecting on —how can we improve the SCP in this situation and make it more effective?

My project aims to both answer questions and solve tasks —

- How to improve the SCP practice and bring the social factors to the system?
  1. Where should be prioritized to practice the SCP?
  2. Where is the most vulnerability community but with few funding plans?
- What is the appropriate SCP sizing and optimal combination of SCP facilities in the vulnerable spots? And what will the performance be to the vulnerable neighborhood?

Summary of Existing Relevant Research

According to overall **SCP** special planning, there are three key indicators:

1. **Volume capture ratio of annual rainfall (>75%)**
2. **Volume capture ratio of annual urban diffuse pollution (>50%)**
3. **The ratio of rainwater resource utilization (>5%)**

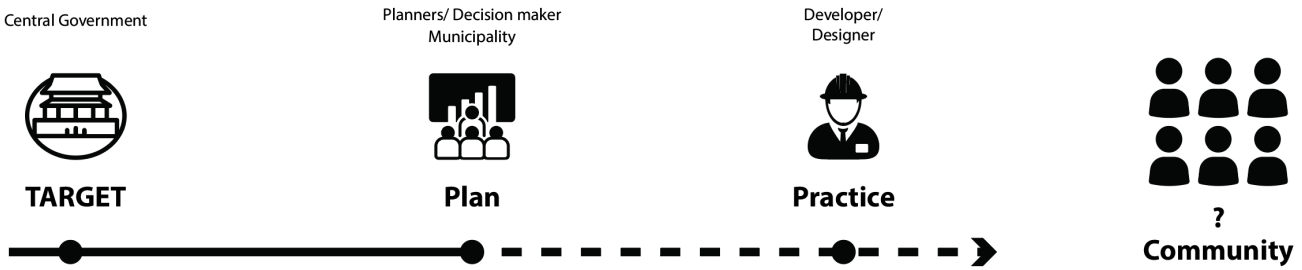
Under overall key indicators, there are four individual indicators for blocks in detailed planning:

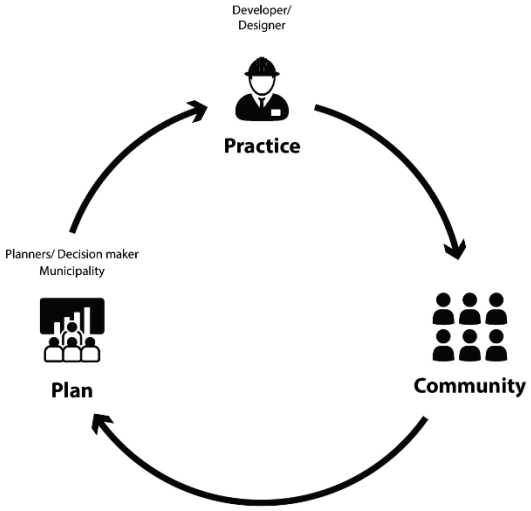
1. **Sunken green space rate and Sinking depth**
2. **Permeable pavement rate**
3. **Green roof rate**
4. **Other**

Dataset identified

- Census Data of China (6th)
- http://www.geodoi.ac.cn/webcn/doi.aspx?Id=131
- Sentinel 2
- Global landcover dataset (GlobeLand30)
- Rainfall map

Summary of Methods





As one of the biggest top-down national policy in China, current SCP program is a linear process led by central government and municipalities. The rainfall capture ratio target is leading the indicator decomposition and decide the funding plan. However, there is a huge gap between on-site practice and the community. Current plan is primarily based on hydrography and land use. The impact on community is not well evaluated and it is hard to effect decision.

I think it's import to use model to build a circular system, which brings communities voice into the SCP practice.

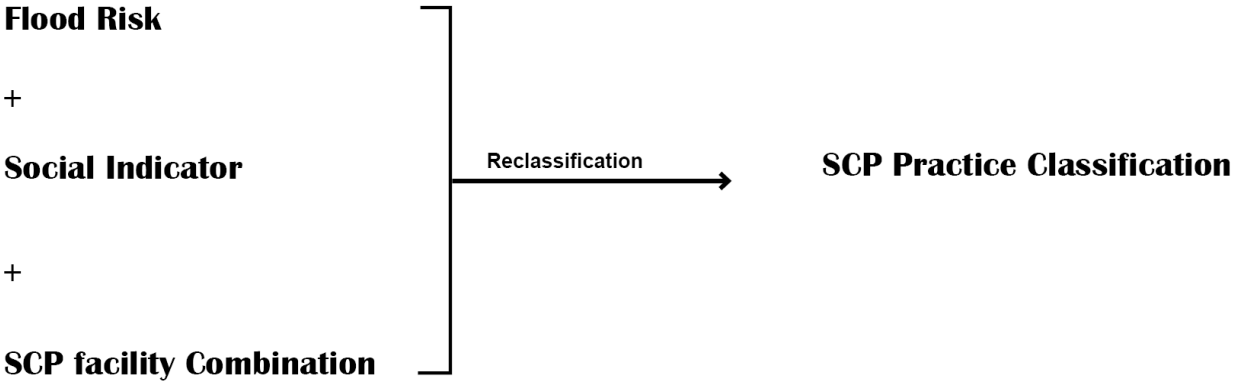
It is of the essence to explore how to understand overall key indicators and how to decompose them into individual indicators (green roof rate, sunken green space rate, volume of detention etc) and what these individual indicators mean to the neighborhood resilience and SCP practice.
Given the ecological performance and cost of different SCP facilities/techniques, I would explore the correlation of the factors of neighborhood and the individual indicators. This step would involve the data of land use (including available open space, shared open space, paved space, street, etc), population

distribution (and other census data ideally), dem data (to calculate the amount of runoff), building footprint, built status, etc.

Current decomposition process only take into consideration land use and hydrology. I propose to include social factors including population density, build status, POI, etc, and help planners/ decision makers to prioritize the at-most risk neighborhood and adjust the funding plan.

Based on analysis of Flood Risk,

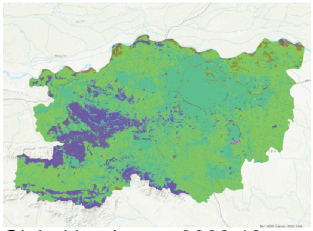
Deliverable

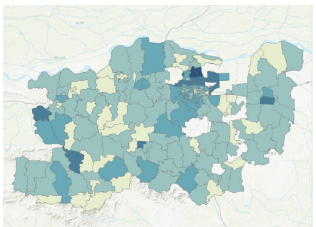


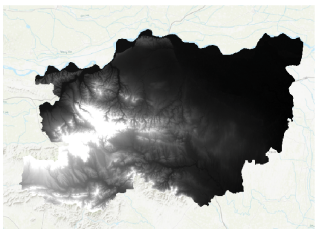
- Indicator and SCP performance analysis: it will include write-up including charts, methodology diagrams, and analysis process.
- Based on the indicator analysis between SCP facilities and neighborhood features, I would propose an interactive parametric tool (ideally) to represent how the combination of SCP facilities effect the urban resilience and neighborhood benefits. It will include data visualization and 2d/3d modeling.

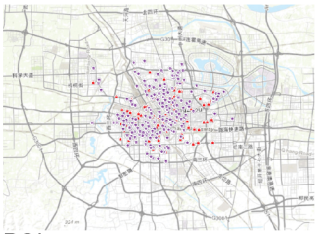
Data Summary

Data Collection:


Global landcover 2020 10m

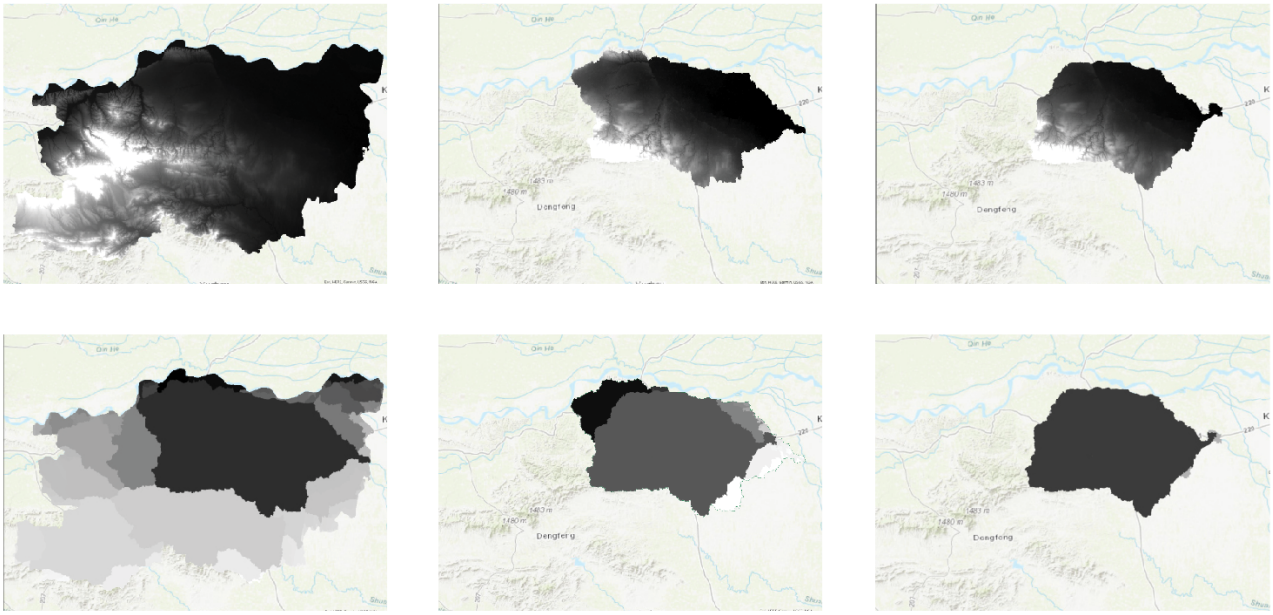

Cencus Tract


1/3rd arc-second DEM

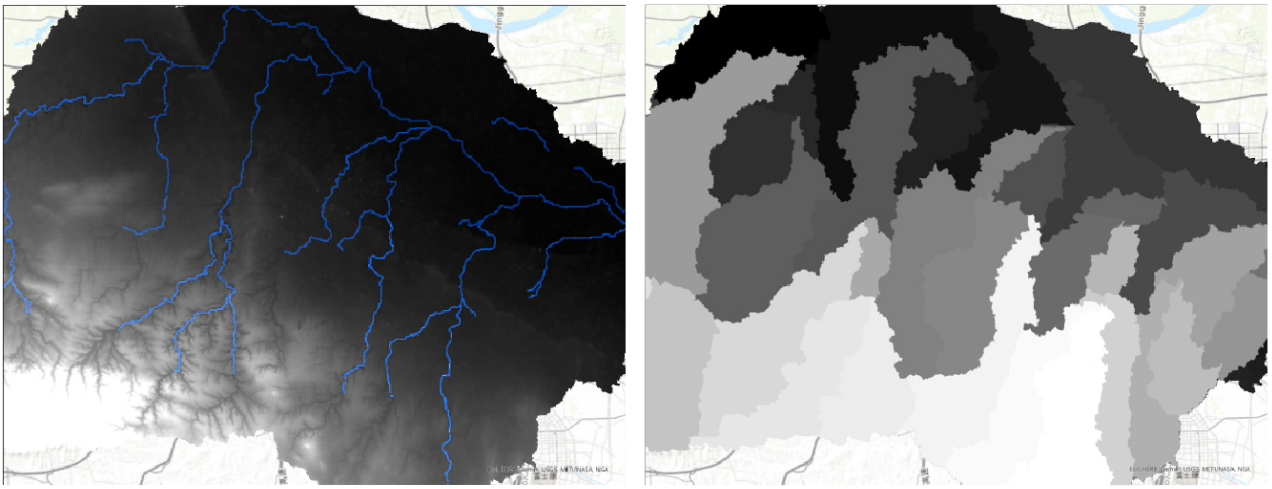

POI

Hydrography analysis:

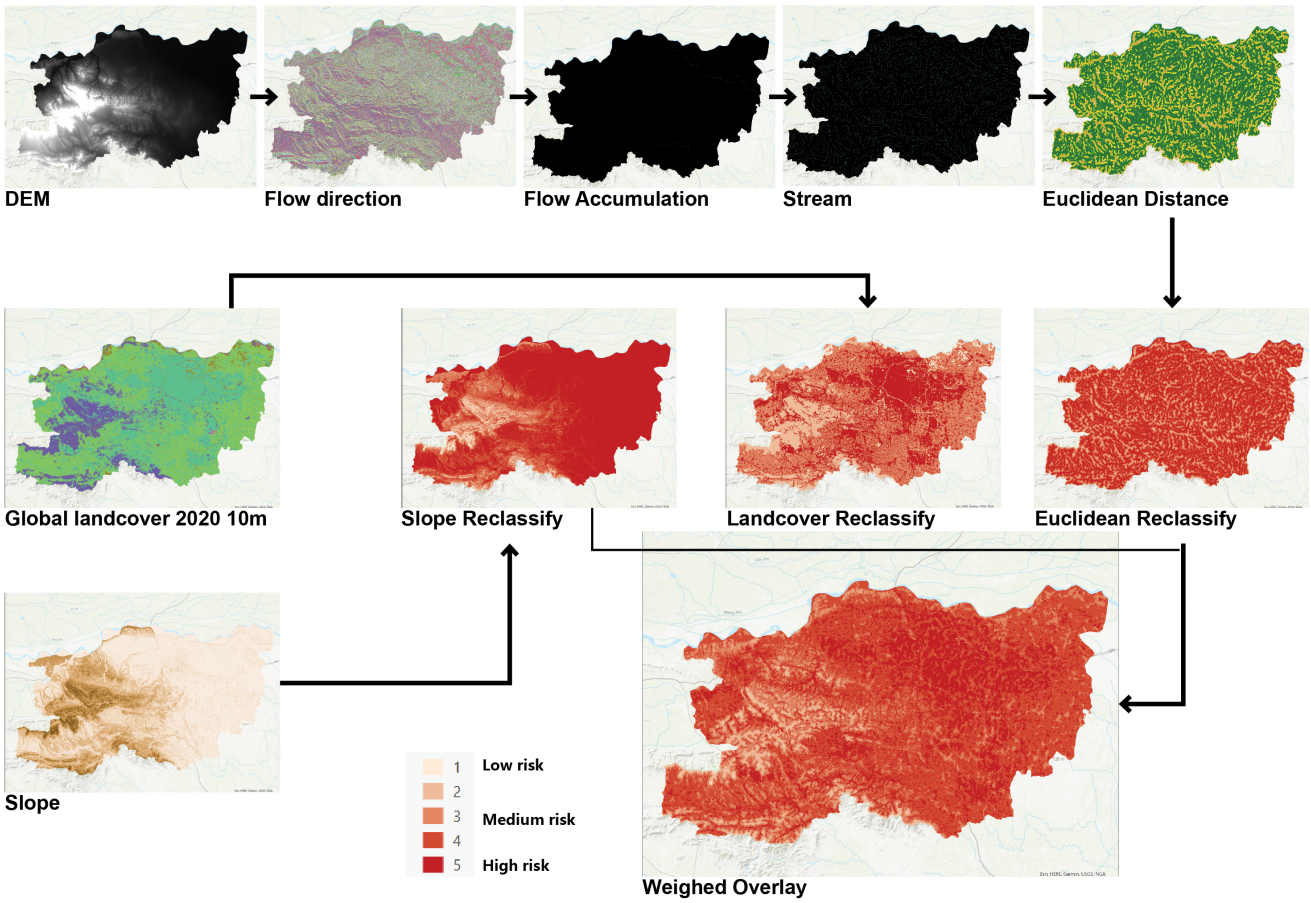
Subbasin



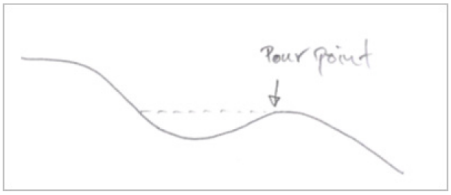
City Watershed:

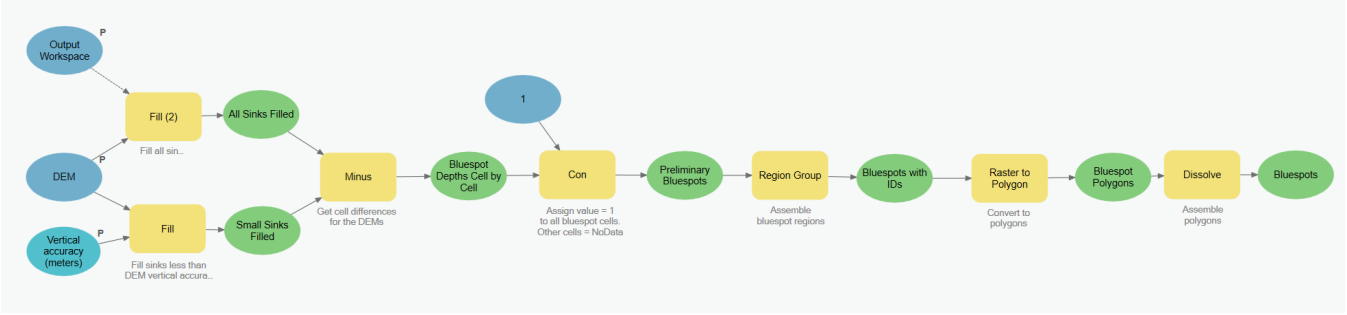


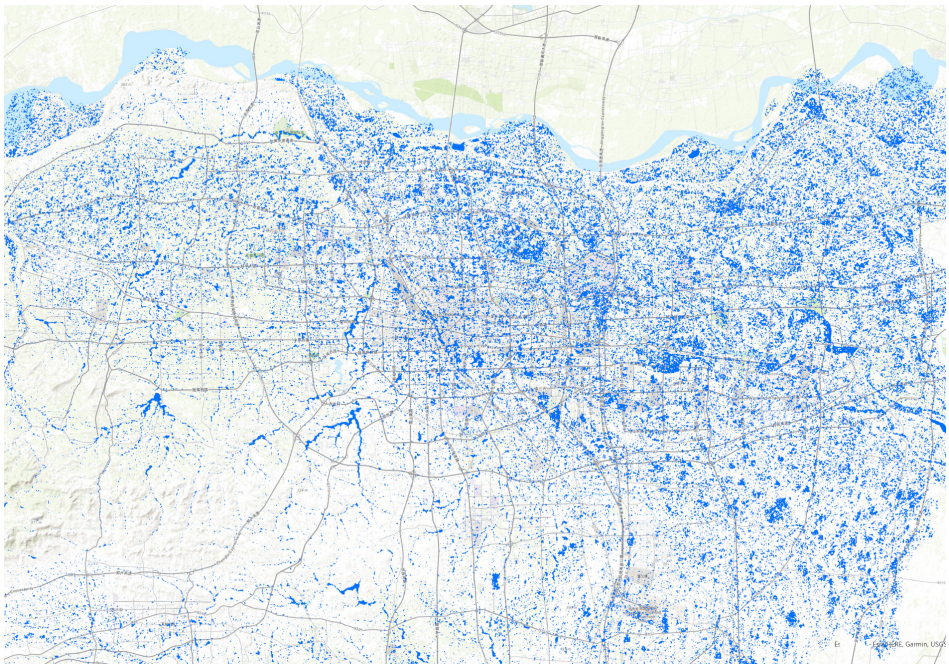
Flood map Susceptibility:



Bluespots Defining:

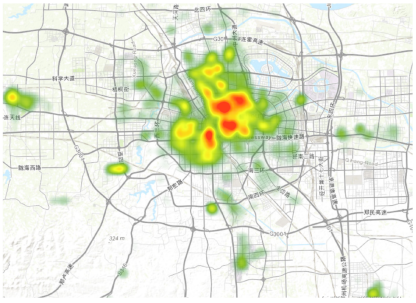




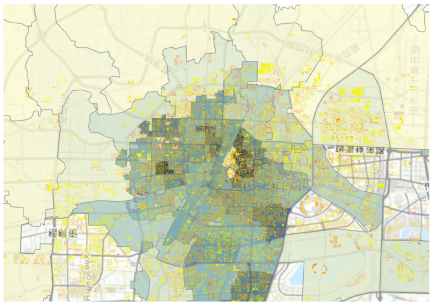


Bluespots map

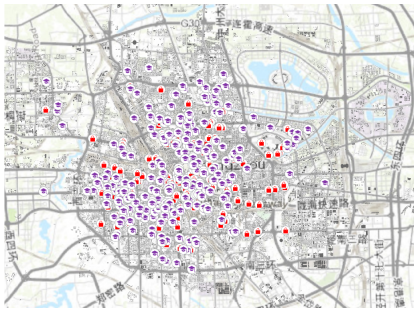
Social Indicator:



Population Density

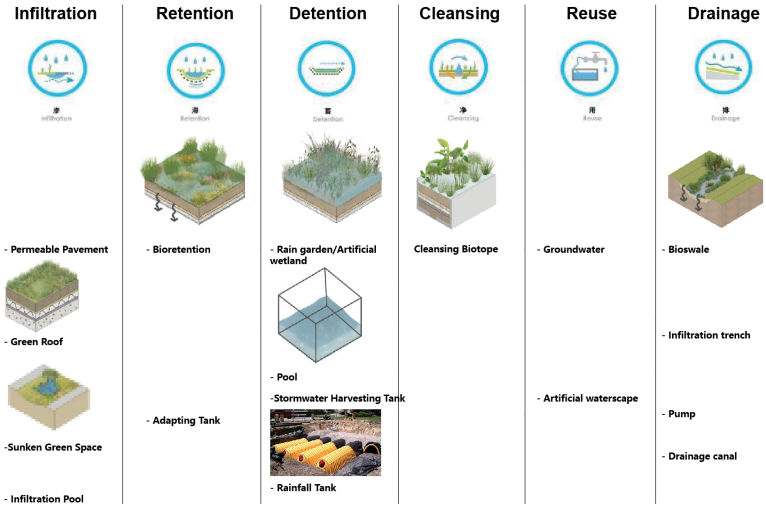


FAR



POI

SCP Facility:



User Experience

There are two key goals when the Sponge city practice:

1. To make sure the sponge city system reaches certain design targets. (**Volume capture ratio of annual rainfall.)**
2. To select the best combination of SCPs that result in the most effective and practical management strategy possible for the location of interest.

- **FOR PLANNERS/ DECISION MAKERS**

1. To prioritize the most at-risk neighborhood to have SCP intervention and adjust the funding plan.
2. Taking consideration into additional social factors, help planners to issue a more reasonable and feasible individual indicator plan (green roof rate, sunken green space ratio, etc) for developers to follow.

- **FOR DEVELOPERS & DESIGNERS**

Develop a digital tool to help developers and designers to decide the optimal SCP facility size and combination.

The tool will provide SCP facility combinations typologies with performance indicator. It will help developers and designers to decide the appropriate SCP sizing/ combination, by visualizing the

performance/ impact of SCP combination in many aspect, including volume of capture, sunken green space ratio, public space etc.