**Kansas City Disasters II**

*Analyzing Precipitation and Land Cover Data to Refine the Assessment of Urban Flood Vulnerability*

**Project Team**

***Project Team:***

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**Project Overview**

***Project Synopsis:***

The Kansas City Disasters II project aimed to address water quality concerns of marginalized communities in Wyandotte County, Kansas. The team utilized NASA Earth observations to examine the impact of land cover variation on stormwater retention, runoff values, and potential pollutants. U.S. Census data were then utilized to identify the demographics of regions where polluted stormwater is not retained and determine census blocks that are prime candidates for green infrastructure projects.

***Abstract:***

Beyond the physical damage caused by pluvial flood events, stormwater runoff pollutes waterways, posing a threat long after the rain has ceased. This contamination is compounded in historically disinvested neighborhoods in Wyandotte County by high levels of impervious surface cover, a combined sewer system, and socioeconomic vulnerability. While the DEVELOP Kansas City Disasters I team performed water quantity analyses to assess flood vulnerability, there has been little research into water quality concerns related to stormwater retention and combined sewer system overflows (CSOs). The Kansas City Disasters II team investigated rainfall from 2000 to 2020 in Google Earth Engine (GEE) using NASA Earth observation products from the Global Precipitation Measurement (GPM IMERG) as inputs into the Natural Capital Project’s Integrated Valuation of Ecosystem Services and Tradeoffs (InVEST) Stormwater Retention Model. The team utilized this model to produce stormwater retention ratios across Wyandotte County to identify areas where land is not retaining stormwater and its associated pollutants, exposing surrounding regions to waterway contamination. The team then used U.S. Census data to create a social vulnerability index which was compared to the model’s retention outputs. The results suggested that the most vulnerable block groups were located in Northeast Wyandotte where populations are burdened by poor stormwater retention and compounding social vulnerabilities. The end products provided partners from Groundwork USA and Groundwork Northeast Revitalization Group (NRG) with an analysis of the distribution of stormwater retention and purification in Wyandotte County and an identification of points of intervention for Groundwork NRG’s future green infrastructure projects.

***Key Terms:***

Wyandotte County, urban stormwater, water quality, InVEST, combined sewer system overflow (CSO),

remote sensing, retention, avoided pollution

***National Application Area Addressed:*** Disasters

***Study Location:*** Wyandotte County, KS Watersheds

***Study Period:*** 2000 - 2020

***Community Concerns:***

* Wyandotte County, KS is especially vulnerable to extreme flood events due to its location on a floodplain. During these events, runoff picks up an array of pollutants that end up in surface and groundwater.
* Wyandotte County uses a combined sewer system which can overflow and discharge untreated storm and wastewater into nearby streams, rivers, and other waterbodies in what is known as combined sewer overflows (CSO’s).
* At high levels, contaminants from both stormwater runoff and CSO’s can present a range of human health effects as well as threaten aquatic ecosystems.
* Due to rapid urbanization and the discriminatory practice of redlining, marginalized communities in Wyandotte County, Kansas are located in areas with high amounts of impervious surface cover. They lack natural and built stormwater management that would otherwise protect neighborhoods from runoff and associated pollutants.

***Project Objectives:***

* Examine stormwater retention ratios across Wyandotte County using the InVEST Stormwater Retention Model to identify areas prone to polluted runoff
* Map demographic data from the census in order to investigate the relationship between land surface cover/stormwater retention rates and low-income minority populations

***Previous Term:***

2022 Summer (MA) – Kansas City Disasters

**Partner Overview**

***Partner Organizations:***

|  |  |  |
| --- | --- | --- |
| **Organization** | **Contact (Name, Position/Title)** | **Partner Type** |
| **Groundwork USA** | Jalisa Gilmore, Manager of Equity and Resilience Programs  Lawrence Hoffman, Deputy Director of GIS | End User |
| **Groundwork USA, Groundwork Northeast Revitalization Group** | Adri Showalter Matlock, Operations Director | End User |

***Decision-Making Practices & Policies:***

Groundwork USA is a network of local organizations advocating for environmental justice and the Northeast Revitalization Group (NRG) is a Groundwork trust established in Kansas City, KS. Currently Groundwork relies on maps of heat disparities to address other climate inequities resulting from impervious land cover but lacks comprehensive geospatial data to identify the areas with low rates of stormwater retention. These areas are most prone to polluted runoff in Wyandotte County. Due to frequent flooding and CSO’s in historically disinvested neighborhoods, Groundwork NRG is seeking an improved method to identify areas most vulnerable to polluted water from stormwater runoff in order to site mitigation and advocacy projects. NRG has relied on community accounts of water contamination gathered through listening sessions, workshops and canvassing. While still essential, community input has met limitation in terms of eliciting adequate action from policymakers to address these environmental inequities and has added difficulty in identifying specific strategic points of intervention based on the landscape.

**Earth Observations & End Products Overview**

***Earth Observations:***

|  |  |  |
| --- | --- | --- |
| **Platform & Sensor** | **Parameter** | **Use** |
| **GPM IMERG** | Precipitation | Used to summarize annual precipitation data for Wyandotte County, KS to input into the InVEST Stormwater Retention Model |

***Ancillary Datasets:***

* U.S. Census Bureau Block Group Shapefile – used for environmental justice analysis
* Unified Government of Wyandotte County Parcel data – vacant land parcel data used for environmental justice analysis
* United States Department of Agriculture Gridded Soil Survey Geographic Database – soil type data for the InVEST model inputs
* United States Geological Survey National Land Cover Database – land use and land cover data for the InVEST model inputs
* National Stormwater Quality Database – event mean coeffiecient values for the biophysical table InVEST model input

***Modeling:***

* InVEST Stormwater Retention Model (Dr. Kenton Ross, NASA DEVELOP) – used to determine stormwater retention ratios/volumes, runoff ratios/volumes, and avoided pollutant loads for Nitrogen, Phosphorous, and Suspended Solids across the landscape

***Software & Scripting:***

* Google Earth Engine – used to generate the precipitation inputs in the InVEST models
* ArcGIS Pro 3.0.2 – used for raster manipulation and map generation

***End Products:***

|  |  |  |  |
| --- | --- | --- | --- |
| **End Product** | **Earth Observations Used** | **Partner Benefit & Use** | **Software Release Category** |
| **Maps of Stormwater Retention Ratios and Volumes** | GMP IMERG | These maps will allow partners to identify regions in Kanas City where soil is retaining stormwater and where intervention is needed. | N/A |
| **Maps of Avoided Pollutant Values** | GPM IMERG | These maps will provide partners visualization of areas where soil is not retaining pollutants from stormwater, exposing surrounding regions to water contamination. | N/A |
| **Land Cover Change and Retention Change Maps** | GMP IMERG | These maps will demonstrate land cover change from 2001 to 2019 as well as the associated change in retention, showing the relationship between retention and impervious surface cover and identifying areas for intervention. | N/A |
| **Green Infrastructure Candidate Maps** | GMP IMERG | These maps will identify 10 census blocks, that based off of socioeconomic vulnerability and poor retention capability, that would be prime candidates for green infrastructure projects. | N/A |

***Product Benefit to End User:***

The end results of this project will provide the partners with the ability to use the InVEST stormwater retention model to produce maps of stormwater runoff and retention values, highlighting the distribution of land capable of decontaminating stormwater before release to surface and groundwater. The maps of socioeconomic vulnerability will also provide end users with a clear understanding of which communities are deprived of this ecosystem service and how they are impacted given pre-existing vulnerabilities. These maps will also inform decision-making surrounding placement of green infrastructure projects such as rain gardens, green roofs, etc. to improve stormwater management. With these tools complementing community input, end users will be able to more effectively allocate funds to the communities lacking natural stormwater management services as well as advocate for a more equitable sewershed update plan.

**References**

Hamel, P., Guerry, A. D., Polasky, S., Han, B., Douglass, J. A., Hamann, M., Janke, B., Kuiper, J. J., Levrel, H., Liu, H., Lonsdorf, E., McDonald, R. I., Nootenboom, C., Ouyang, Z., Remme, R. P., Sharp, R. P., Tardieu, L., Viguié, V., Xu, D., … Daily, G. C. (2021). Mapping the benefits of nature in cities with the invest software. *Npj Urban Sustainability*, *1*(1). <https://doi.org/10.1038/s42949-021-00027-9>

*InVEST User Guide*. InVEST User Guide - InVEST +VERSION+ documentation. (n.d.). Retrieved September 22, 2022, from <https://invest-userguide.readthedocs.io/en/3.5.0/>

Zhou. (2019). Correlations of stormwater runoff and quality: Urban pavement and property value by land use at the parcel level in a small sized American city. *Water*, *11*(11), 2369. <https://doi.org/10.3390/w11112369>

Zoppou, C. (2001). Review of urban storm water models. *Environmental Modelling & Software*, *16*(3), 195–231. <https://doi.org/10.1016/s1364-8152(00)00084-0>

**Project Summary Checklist**

The Project Summary is your go-to document for project information. The content in this document is compiled for reporting to NASA HQ and is often shared with future teams, partners, and the Capacity Building and Applied Sciences Programs. You can use this to complete your project page on DEVELOPedia.

###### ***General Writing & Formatting***

* The formatting for each section should match the template:
  + All text is Garamond, 11-point font.
  + Science advisor affiliations are in parentheses.
  + Bullets are used for the Community Concerns, Project Objectives, Ancillary Datasets, Modeling, and Software & Scripting sections.
* Write in past tense (except for the Product Benefit to End User and the Project Continuation Plan sections – write those in the future tense). Use active voice as much as possible. Here are examples in the past passive and past active voice:
  + Past passive: Three 2-L samples were taken at a depth of between 0.1 and 0.5 m at the down-wind end of each wetland.
  + Past active: Each of the three groups took 2-L samples at a depth of between 0.1 and 0.5 m at the down-wind end of each wetland.
  + [www.englishpractice.com/improve/active-passive-voice-simple-tense/](http://www.englishpractice.com/improve/active-passive-voice-simple-tense/)
* *Each paragraph should have at least three sentences.*
* Spell out acronyms the first time they are used. No need to define an acronym in the text if it is already defined in the abstract.
* Change “(s)” for any given section
  + For example, “National Application Areas Addressed” on the template should read either:
    - National Application Area Addressed: Application Area 1
    - National Application Areas Addressed: Application Area 1, Application Area 2

## **Project Overview**

###### ***Header***

* Please note that there is text in the cover page Header which needs to be updated
  + If you’re using the Microsoft Word Online version the Header text may not be visible to you. Select "Header" in the upper right-hand corner and edit "Insert DEVELOP Node Name (Ex. Virginia – Langley)" appropriately.

###### ***Project Synopsis***

* This short overview provides a **brief** and **catchy** synopsis of the project and its objectives for media sources. Avoid going into great detail like listing out your Earth observations.
* **Word count limit**: 1 to 3 sentences; 80 to 100 words

###### ***Abstract***

While not a separate deliverable, the abstract appears in the Project Summary, Tech Paper, Poster, and on the DEVELOP website. It is a short summary of your project that introduces the problem, partners, NASA EO, results, and significance. The abstract “lives” in the project summary until the final draft.

* **Word count limit:** 150-250 words and only one paragraph.
* Write in past tense and avoid passive voice.
* Acronyms should be spelled out the first time they are used in the abstract, and then also the first time they are used in the text.
* There should be no citations in the abstract.
* Any changes made to the abstract should be reflected in your final draft in the Project Summary.
  + If you need to make changes to your abstract *after* you’ve submitted the Project Summary FD, send any updated versions to the Project Coordination team and ensure that the updated version is used on any subsequent deliverables and on your project page on DEVELOPedia.
* The Abstract **must** include the following:
  + What the problem was
  + Who the decision makers are and what the decision being made is
  + The partner organization(s) with whom you partnered
  + What NASA Earth observations were involved
  + What you did in response to the problem
  + What the benefits or outcomes are/will be
  + What your results were
* Abstract best practices:
  + The abstract should be fully contained and give the reader a good grasp of the project.
  + While there is a maximum word limit, say it with fewer words if able.
  + State the most important information first.
  + Write in active voice and avoid passive words like “might” or “could” – use powerful language.
  + Spell out all acronyms except NASA.
  + Do not define terms.
  + Read other projects’ abstracts for inspiration.
  + Any major restrictions or limitations on results (if results are included) should be stated.
  + Reread the abstract. Did it answer: **who, what, when, where,** and **why?** If it didn’t, revise it!
  + Don’t forget to add results for the final draft – feel free to include a placeholder sentence in your rough draft.

###### ***Key Terms***

* This is a list of key words and terms that can be used to search for your project.
* When choosing keywords, do not include words already listed in your project title.
* Pick terms that describe your project well and are specific to your project. Try to avoid simply listing the Earth observations you used.
* Only capitalize any acronyms or proper nouns. Do not capitalize the first term if it is not a proper noun.
* **Word count limit**: 2 to 8 key terms

###### ***Study Location and Study Period***

* List each state in the study area section with its postal acronym
  + Ex: Western shore of Lake Michigan bordering WI, IL, and IN
* If working on a seasonal project, include study period months as well as years.

###### ***Community Concerns***

* All bullet points should be in complete sentences and have periods.
* Relate the problem back to the community (or communities). Avoid general statements or describing the problem itself – be specific about how the issue impacts the community.

###### ***Project Objectives***

* Objectives should not be in complete sentences or have periods.
* These should match the objectives you put in your Presentation and Poster (optional) deliverables.
* Be succinct and start each objective with a strong action verb.

## **Partner Overview**

###### ***Partner Organization Table***

* Follow proper partner nomenclature and include the full partner org name with any larger/umbrella orgs first.
  + Ex: National Park Service (umbrella organization), Glen Canyon National Recreation Area (specific office being partnered with)
* If there is more than one point of contact (POC) for an organization, list them in the same box separated by semi-colon.
* List end users first. Each partner is **either** an end user **or** a collaborator, not both.
* Boundary organizations are also listed as either a collaborator or an end user, and the notation for boundary organization is at the end of the listing.
* If you add or remove any partners during the term, **make sure to notify the Project Coordination team!**

###### ***Decision-Making Practices & Policies***

* **Word count limit**: one paragraph
* Describe the decision-making practices employed by the end user(s) and/or any policies in play that oversee the management of a certain area, land cover type, or issue?
* Solely focus on the partners’ current decision-making process, not what your project willcontribute.

## **Earth Observation & End Products Overview**

###### ***Earth Observation Table***

* List each instrument on an individual line, even if the parameter and use are the same.
  + Example: Landsat 5 TM, Landsat 7 ETM+, and Landsat 8 OLI should all be in separate rows.
* Use past tense in the Use column.
* List the platform then the sensor, not just the sensor (e.g. ISS ECOSTRESS, not just ECOSTRESS)

###### ***Ancillary Datasets***

* List any non-satellite or airborne datasets used. Do not list satellite datasets or other Earth observations in this section.
* List the creator organization first, then the name of the dataset, then what you used it for.

###### ***Modeling***

* The point of contact should be someone in contact with the team who has experience running and troubleshooting the model. The POC does not need to be someone affiliated with the group that produced the model.
* If you did not use modeling in your project, delete this section.

###### ***Software & Scripting***

* List any software or scripts you used in your project. For software or languages with a version number, include that as well. (e.g. “Esri ArcMap 10.5 – used for map creation and data processing”)

###### ***End Product(s) Table***

* This table is different from the one listed in the project proposal!**Do not** copy and paste from the proposal.
* Write in future tense for the Partner Benefit & Use column.
* Double-check the Software Release categories with your Fellow (if applicable)

###### ***Product Benefit to End User***

* Describe how the results and end products of this project will benefit the end user’s decision-making process. What are the short-term considerations of this work for your partner? Long term?
* Write in future tense.
* **Word count limit**: one paragraph

###### ***Project Continuation Plan***

* Remove this entire section for one term projects or projects that will not continue to another term.
* Describe what is being handed off after the conclusion of your term and how the next term can build off of your team’s work.

## **References**

* Use APA format only for your citations.
* List any sources that helped you write your Project Summary. Do not cite sources in-text.
* Use 1 to 5 citations – save the full list for your tech paper!

## **Checklist**

* Delete checklist before FD submission.