

1 FEBRUARY 2024

SETx-UIFL: Equitable solutions for communities caught between floods and air pollution

Collaborating institutions and PIs:

University of Texas at Austin (Paola Passalacqua), Lamar University (Liv Haselbach), Texas A&M University (Michelle Meyer), Prairie View A&M University (Noel Estwick), Oak Ridge National Laboratory (Ethan Coon)

PAOLA PASSALACQUA

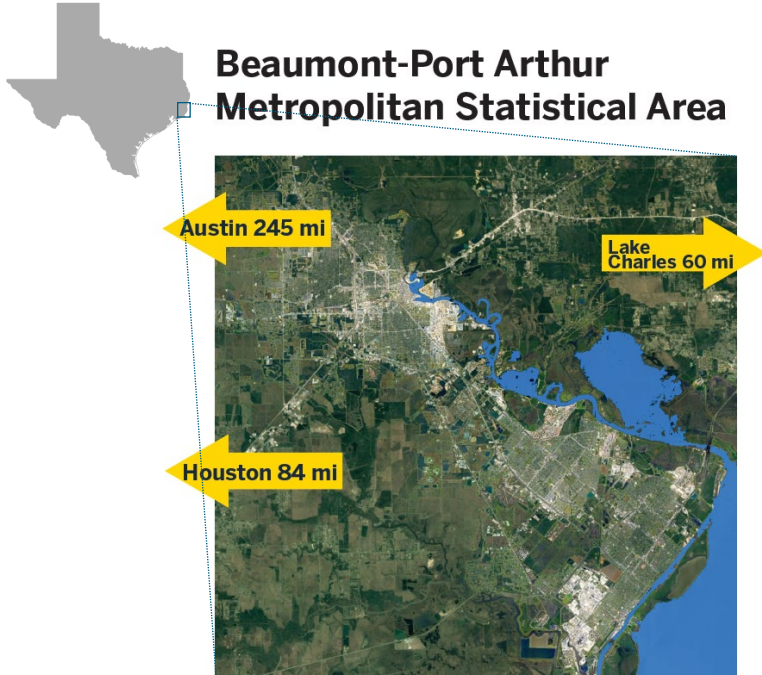
Professor, Dept. of Civil, Architectural & Environmental Engineering & Dept. of Earth and Planetary Sciences, The University of Texas at Austin



<https://www.setx-uifl.org>



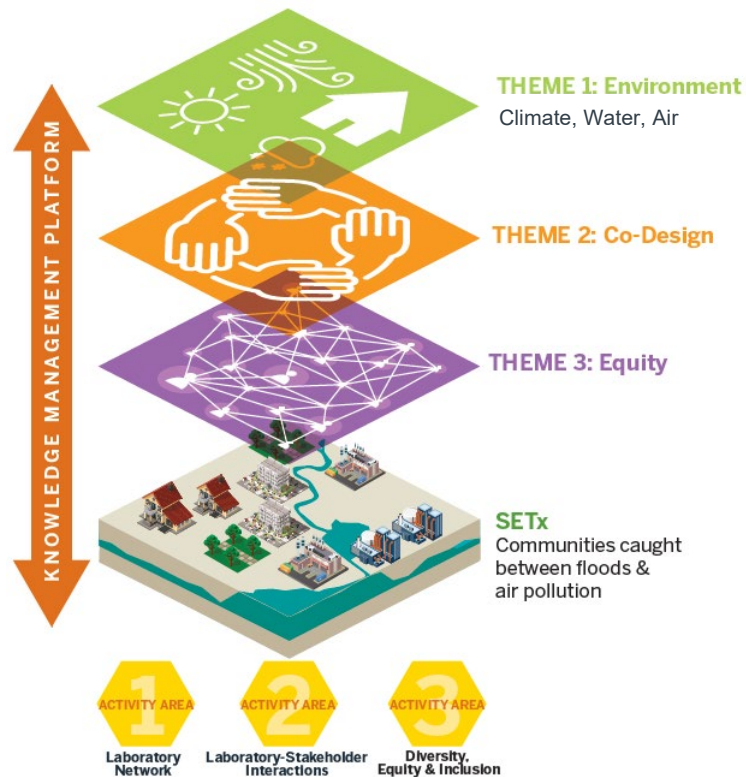
Southeast Texas: acute on chronic hazards on vulnerable communities



- Frequent acute (e.g., compound flooding) on chronic (e.g., air pollution) hazards, expected to worsen with climate change, aging infrastructure, etc.
- Continuous urban growth and increased impervious cover over past several decades
- Home to one of the largest petrochemical industrial complexes
- Ranks in the top 10% of most polluted US communities
- A quarter of families and 40% of children in poverty
- Represents conditions along the Gulf Coast

Providing better data, modeling, & planning to support climate adaptation in SETx and the Gulf Region

- Which processes and variables need to be captured in regional scale hydrological and atmospheric models so that they are representative of the conditions experienced by local communities and help inform adaptation strategies?
- How can we understand the linkages between and within natural, built, and social systems in urbanized regions to better support natural and human resilience?



We collaborate with > 100 stakeholders

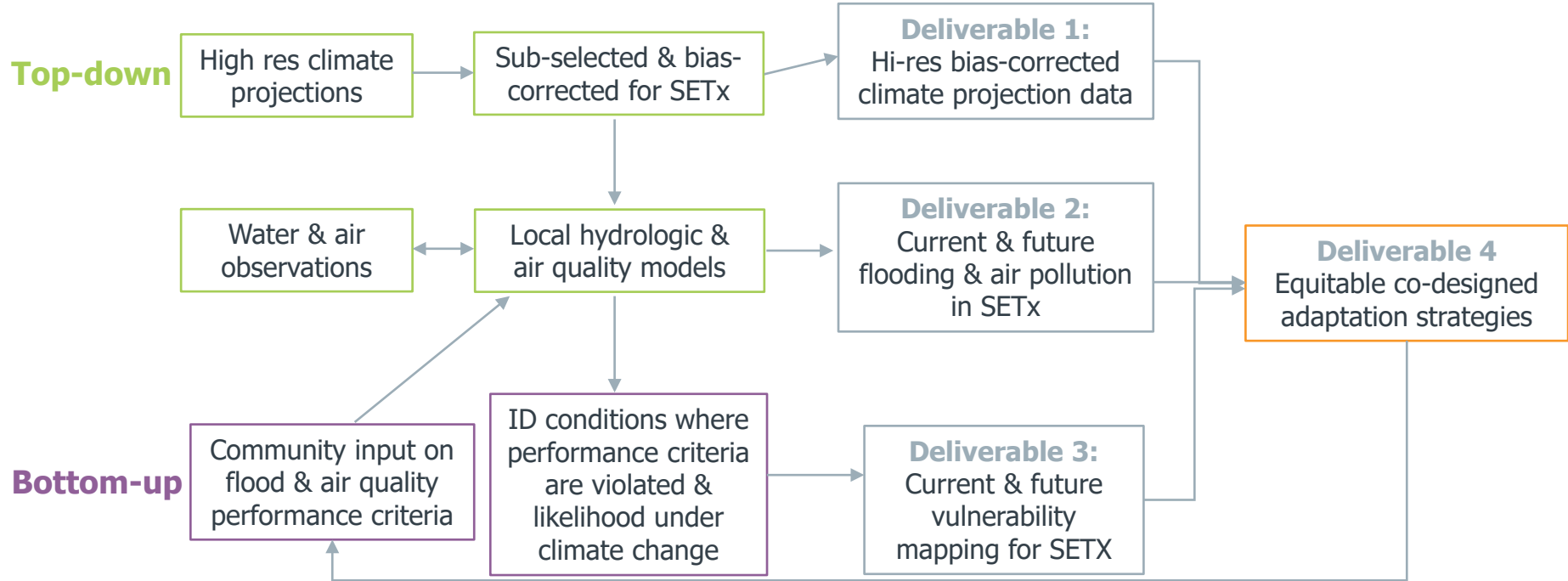
Goal: Co-develop data and decision making frameworks with stakeholders to aid community-led development of equitable climate change adaptation strategies

Approach to engagement: engage in two-way relationships between decision makers/residents and researchers to ensure stakeholder knowledge is incorporated into modeling and scenarios development and that data from SETx-UIFL research are useful for and incorporated into community-led climate adaptation decision making

- SETx-FCS (Flood Coordination Study): led by Liv Haselbach (Lamar University PI) includes SETx counties, cities, river authorities, drainage districts, industries, federal agencies
URL: <https://www.setxfloodcoordstudy.org/members.html>
- Resident groups working with Texas Target Communities and community-level stakeholders and community leaders experienced in the challenges faced by marginalized populations



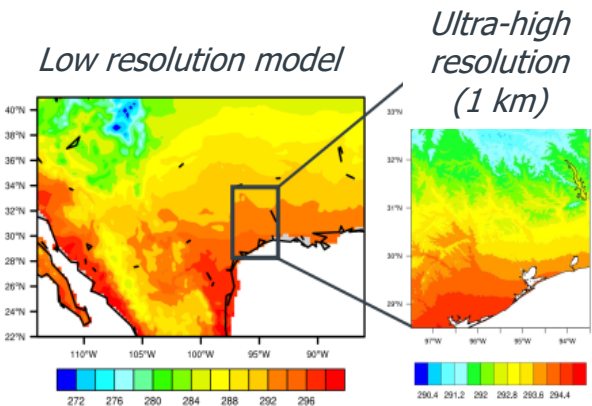
Our approach and deliverables



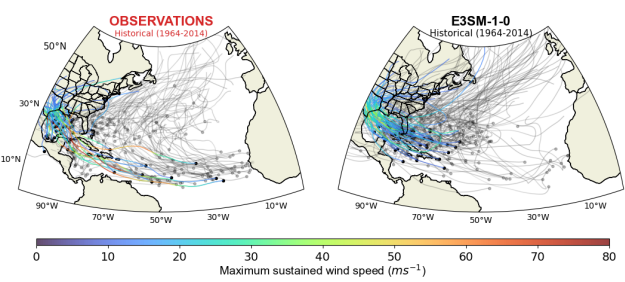
Climate Theme: high resolution climate projections for SETx

- Identified global climate models that best capture climate conditions over SETx
- Developed algorithm to create ultra-high resolution climate projections for SETx
- Piloted new techniques for capturing and projecting rainfall events that drive flood risk over SETx

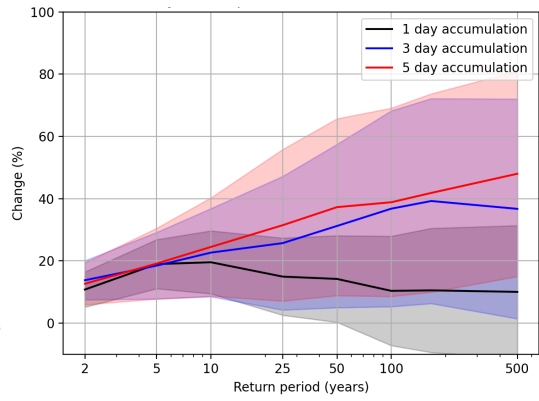
*Historical (1950-2014)
average temperature (K)*



Replicating SETx hurricane statistics in climate models to enable projection



Future change in SETx storm rainfall using new storm transposition technique



Climate: Established a locally-tailored climate dataset for downscaling to high res

First filter (35→30 GCMS): Regional Climate Basic Statistics over Southern US

*Is the model reasonable with the **big picture**?*

Second filter (30→20 GCMS): Regional Climate Pattern over Southern US

*Does the model capture the dominant weather patterns that are **important for air quality** over SETx?*

Final filter (20→10 GCMS): Regional Climate and Flooding Control Indices over SETx

*Does the model capture basic climate statistics over SETx that are most important for driving **high frequency and extreme flood events**?*

Model	Rank
MPI-ESM1-2-HR	1
CNRM-ESM2-1	2
EC-Earth3	3
CMCC-ESM2	4
FGOALS-g3	5
MRI-ESM2-0	6
GFDL-CM4	7
BCC-CSM2-MR	8
UKESM1-0-LL	9
NorESM2-MM	10
INM-CM4-8	11
ACCESS-CM2	12
IPSL-CM6A-LR	13
MIROC6	13
KACE-1-0-G	15



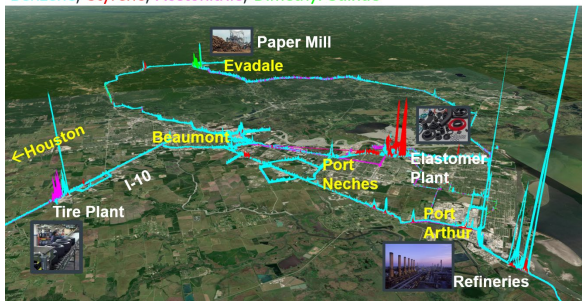
Metrics defined with input from across SETx-UIFL allow **locally-specific ranking and sub-selection of climate data**

Air: identifying pollution hot spots and predicting air toxics concentrations

Observations

Identifying Major Pollution Hotspots and Chemical Markers

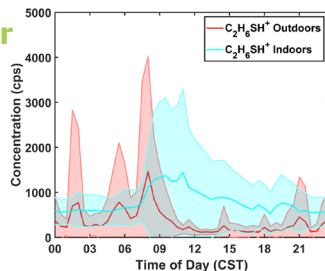
Example source markers detected by the Vocus sniffer
Benzene, Styrene, Acetonitrile, Dimethyl Sulfide



Concentrations of diverse volatile organic compound (VOC) species from many source plumes were measured using a Vocus PTR-TOF-MS (The Sniffer)

Outdoor and Indoor Stationary Measurements at a Community Site

Night-time plumes of odorous S-containing VOCs (DMS+ethanethiol)

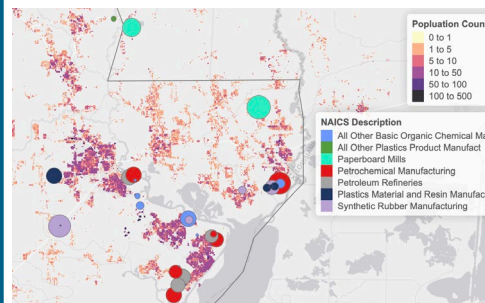


Evaluating Exposure Reduction Solutions



Affordable Indoor Air Filter
(Corsi-Rosenthal Box)

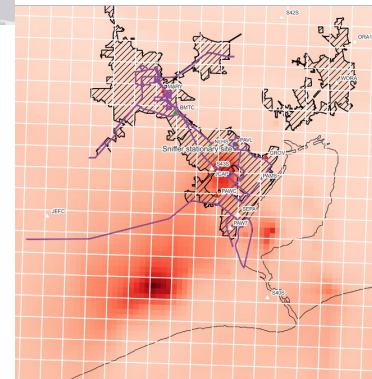
Emissions Inventories and Modeling



Population distribution and industrial facilities with benzene, styrene, acetonitrile, acetaldehyde, and/or 1,3-butadiene emissions in the EPA 2022 Toxics Release Inventory (TRI)

We use the **Comprehensive Air Quality Model with Extensions (CAMx)** to indicate contributions of different emission source categories (e.g., point, area, mobile) to predicted concentrations of air toxics regionally and at specific geographic locations

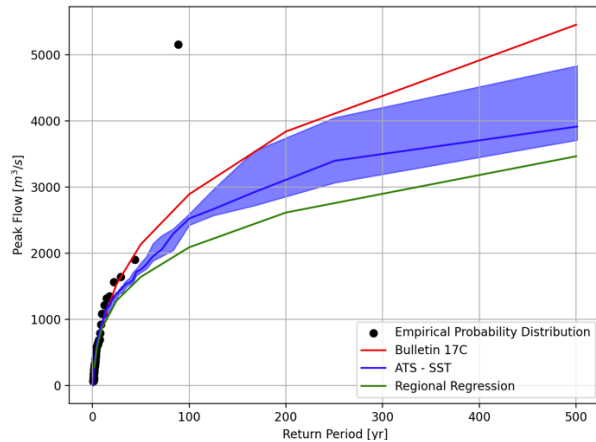
We use **Federal and state emission inventories** to characterize sources of air toxics in SETx, support atmospheric modeling and exposure assessments, and inform measurement campaigns



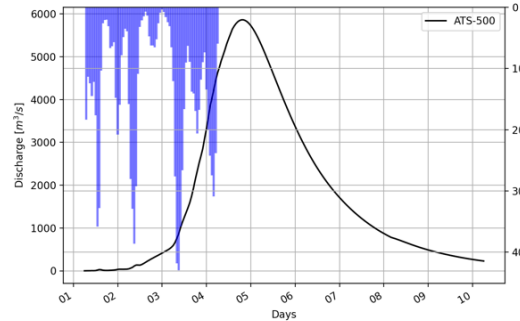
Modeled 90th percentile benzene concentrations (4/1-10/31/2019)

Water: flood modeling, flood inundation mapping, and increased observation network

- Expanded the flood monitoring sensor network by adding 5 new sensors; another 4 in progress.
- Develop & demonstrate hydrologic modeling framework: completed prototype work on Village Creek Basin, including running 5000 storm events consistent with current climate/land cover conditions.
- Simulated wetland stability and wetlands as a buffer from coastal and fluvial flooding using a coupled land surface model.



Flood frequency curve derived from 5000 storm events in Village Creek



Storm 500

Co-design: Developing connections with participants and document understanding of values that relate to climate adaptation and strategy portfolio development

Activities with Technical Task Force & Community Organization Task Force:

- Revised community engagement strategy that is sensitive to community context
- Developed recruitment materials; recruited members
- 3 meetings with task forces so far
- Obtained IRB approval -> starting interviews

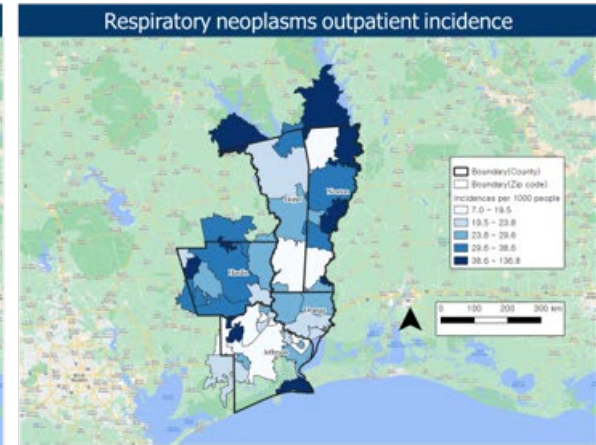
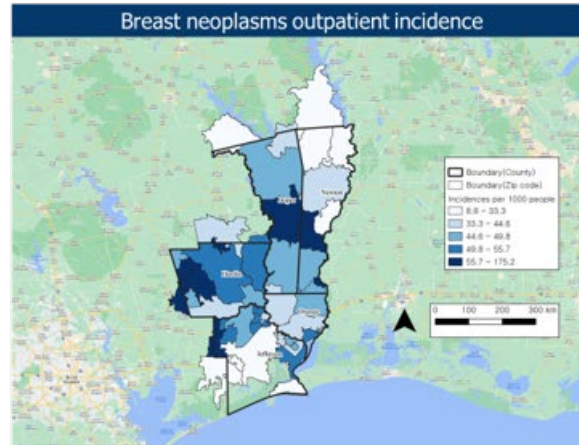
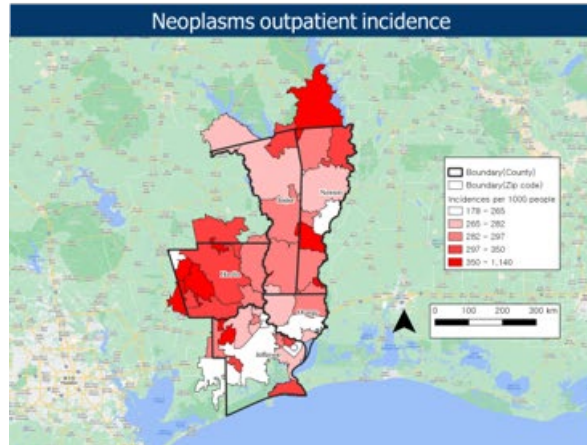
Products:

- Existing plan/policy inventory Green-Grey strategy catalog
- Model Integration Workflow via Halbouty Pump Station

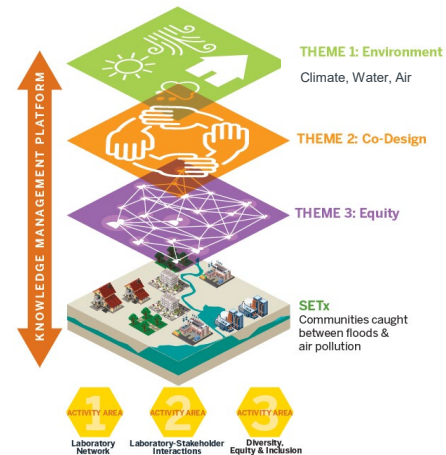



Equity: developing a region-specific indicator for social vulnerability

- Compared and contrasted existing different Social Vulnerability Indices to find differences
- Flagged areas where indices differ and are currently determining why
 - Could be the spatial resolution of the data (e.g., Census tracts versus zip codes) or different demographic data used
- Moving towards correlating these indicators with flooding and health concerns
 - Identifying where new flood sensors could go to better cover different population groups
 - Hospital visits for neoplasms (i.e., benign or malignant cells, cancer) by zip code showed positive relationship with social vulnerability, and specifically higher rates where racial and ethnic minorities live
 - Determining correlation of previous flooding events with social vulnerability



KMP - Supporting Data Collection, Integration, and Inter-team Collaboration





Setx-UIFL

The Southeast Texas Urban Integrated Field of Lab has the goal of addressing the following questions: Which processes and variables need to be included in regional scale...

read more

Followers 2 Datasets 2

Setx-UIFL

The Southeast Texas Urban Integrated Field Lab has the goal of addressing the following questions: Which processes and variables need to be captured in regional scale hydrological and atmospheric models so that they are representative of the conditions experienced by local communities and help inform adaptation strategies? And how can we understand the linkages between and within natural, built, and social systems in urbanized regions to better support natural and human resilience? The region for the SETx-UIFL is Southeast Texas (SETx), specifically the Beaumont-Port Arthur region. This urban area represents the climate adaptation needs, population diversity and vulnerability, and ecological richness that characterize many urban centers along the Gulf Coast. Beaumont has experienced continued urban expansion and increased impervious cover over the past several decades; these changes have likely led to increased urban heat island effect and reduced capacity to absorb rainwater, exacerbating existing climate risk. In addition, the Beaumont, Port Arthur area is home to one of the nation's largest petrochemical industrial complexes, which make it more vulnerable to climate-induced disasters capable of significant air toxics releases, in addition to chronic air toxic exposures that can raise the risk of cancer and other adverse health outcomes. Following the model of convergence principles, the SETx-UIFL is organized via three cross-cutting Themes, which are linked through data collection strategies and community engagement supported by a Knowledge Management Platform (KMP). Three Activity Areas (AAs) coordinate activities across the Themes and KMP to ensure impacts are useful beyond the SETx-UIFL. Broader impacts of the SETx-UIFL include: the co-development of climate scenarios with stakeholders, educational opportunities around convergence science in both formal and informal learning environments; citizen science and participatory research methods to co-design research projects and promote co-learning between residents and scholars; and broadened participation of underrepresented faculty and student groups in science and engineering to undertake community engagement in culturally and ethically appropriate ways.

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SETx-UIFL Public Abstract

This abstract describes The Southeast Texas Urban Integrated Field Lab (IFL) focused on the Beaumont-Port Arthur region. The document is the public abstract that explains aims...

PDF

PRIVATE HAND-derived Flood Inundation Maps of Southeast Texas

The purpose of this project is to share high-resolution (2m x 3m) flood inundation maps of past storm events to support planners and the impacted community. These maps are...

PDF

PRIVATE DD6 proposed Sensor Locations

Proposed new water sensors from the DD6.

PDF

Acute-on-chronic hazards

Adaptation strategies

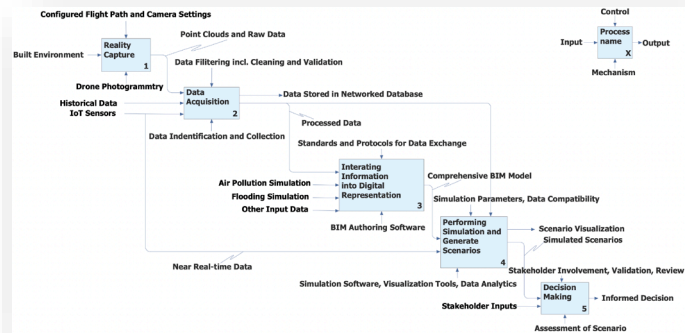
Air toxics releases

Anthropogenic alterations

Atmospheric models

Built systems

Inter-team communication through a Data Registry that enables discovery while allowing decentralized storage – CKAN (Comprehensive Knowledge Archive Network)



KMP provides a workflow that streamlines the integration of **Water** and **Air** data and facilitates visualization through web-based applications. **Co-Design** will leverage this integration and visualization to support community-led development of adaptation strategies.

Opportunities for collaboration

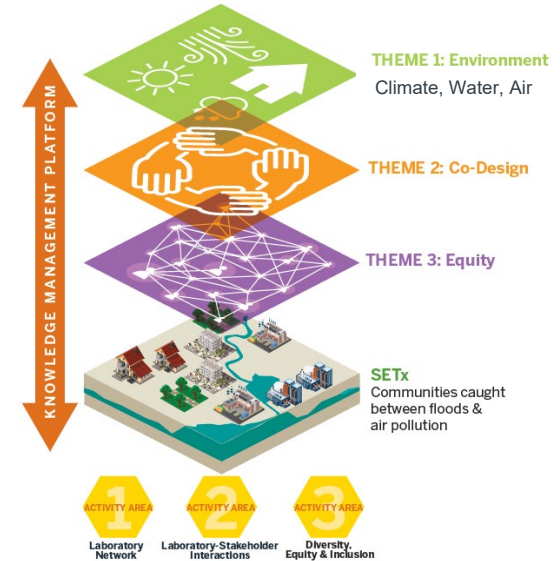


For more information:

Southeast Texas Urban Integrated Field Laboratory

Website: <https://www.setx-uifl.org>

Email: setx-uifl@utexas.edu





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