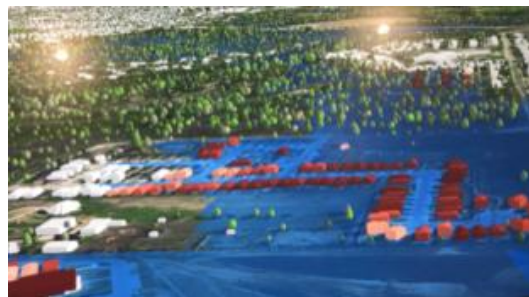


Decision Pathways Development

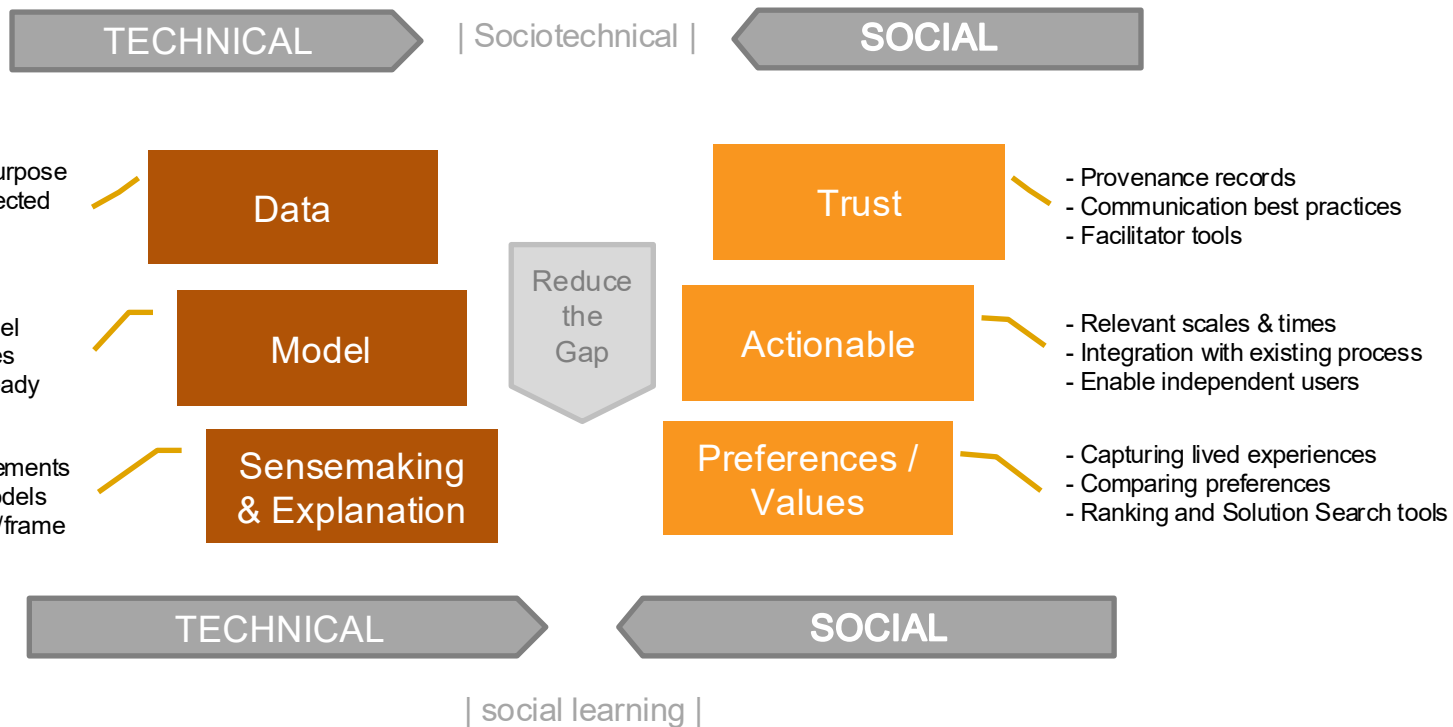
Interoperable Platforms with Domain Driven Development for intelligent decision support services

Dr. SUZANNE A. PIERCE

Decision Support Office, Texas Advanced Computing Center, The University of Texas at Austin



Creating dynamic user interfaces to help understand & share it



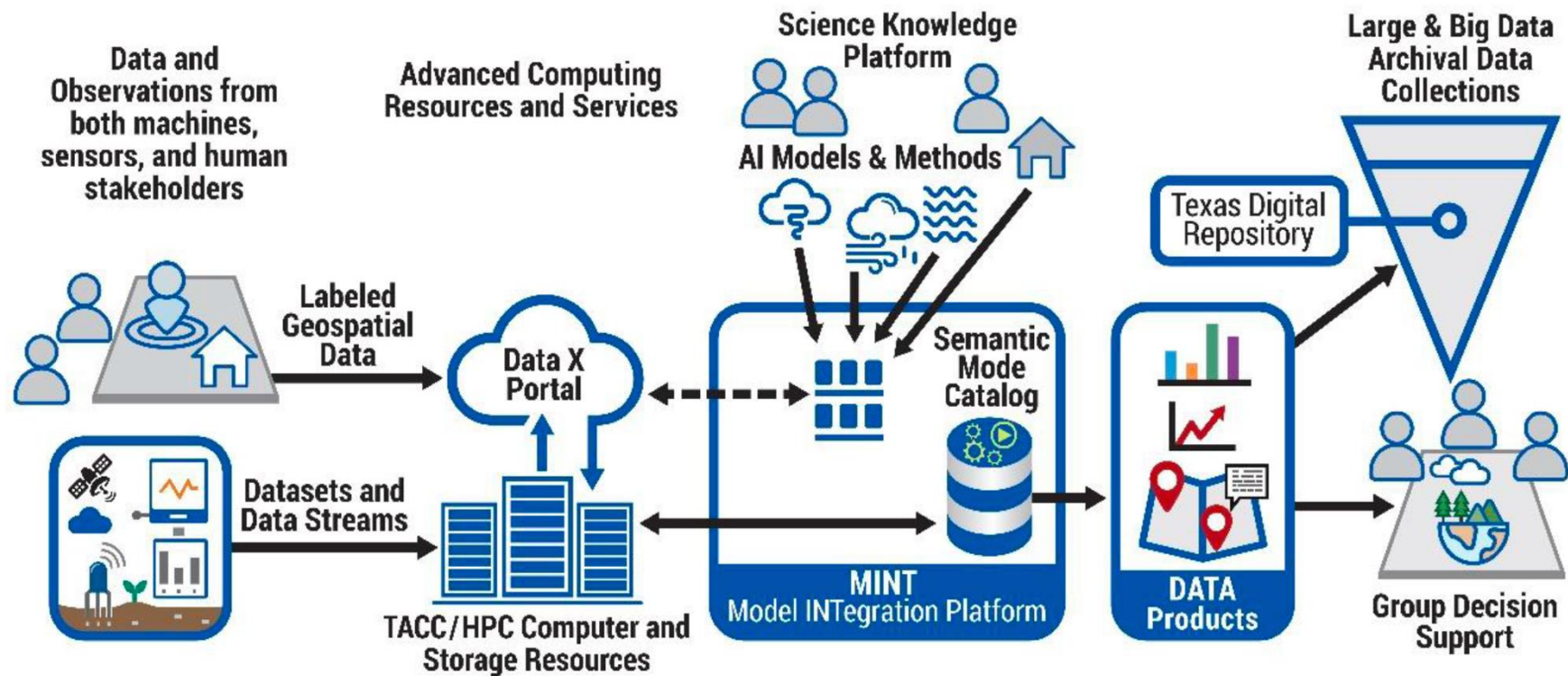
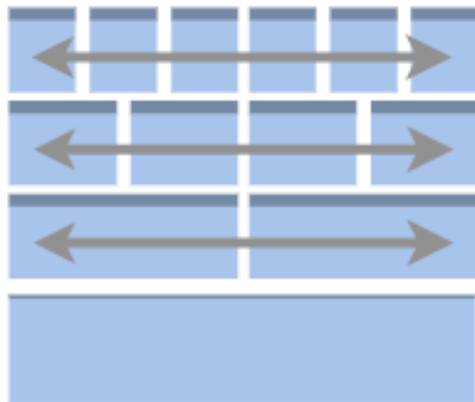


Figure 10: Intelligent Decision Support Systems (iDSS).

References:

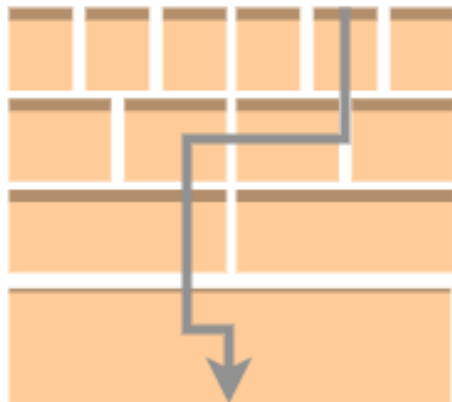
Pierce, S.A., Powell, J., Dabrowski, A., Hardesty-Lewis, D., Pearson, M., Gil, Y.M., in prep, iDSS cyberecosystem design for Planet Texas 2050.
 Gil, Y.M., et al., 2021, Artificial Intelligence for Modeling Complex Systems: Taming the Complexity of Expert Models to Improve Decision Making, Journal of the ACM.

What perspectives can inform the design and implementation of Applied Decision Support Systems?



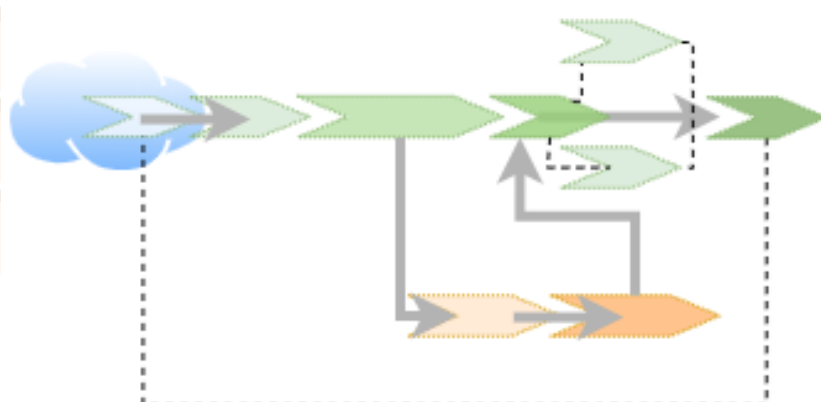
Horizontal Portfolios

- Survey Available Services
- Define Feature Requests for iDSS
- Design FAIR Model Services
- Connect with Research Communities
- Connect: Modelers & Data Scientists



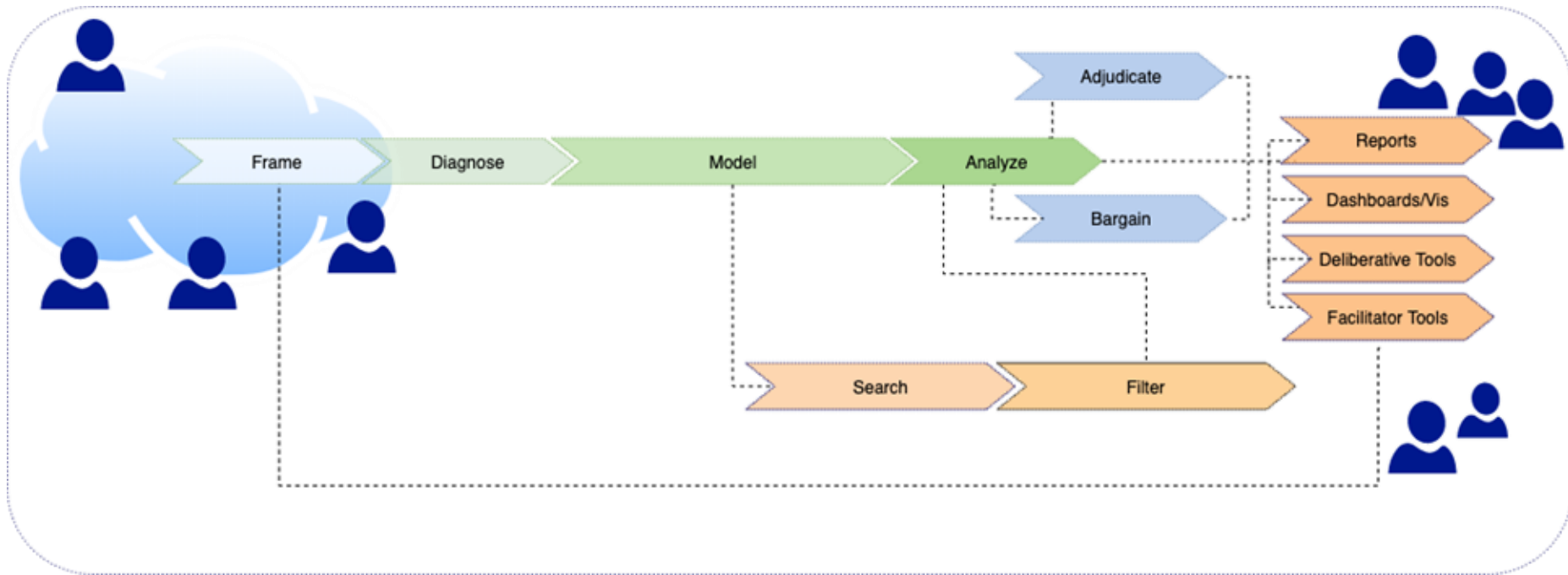
Vertical Slicing

- Implement AI-augmented Services
- Instantiate Integrated Models
- Rapid End-to-End Use Case
- Experiment with Pilot Services
- Connect: Technical Analysts



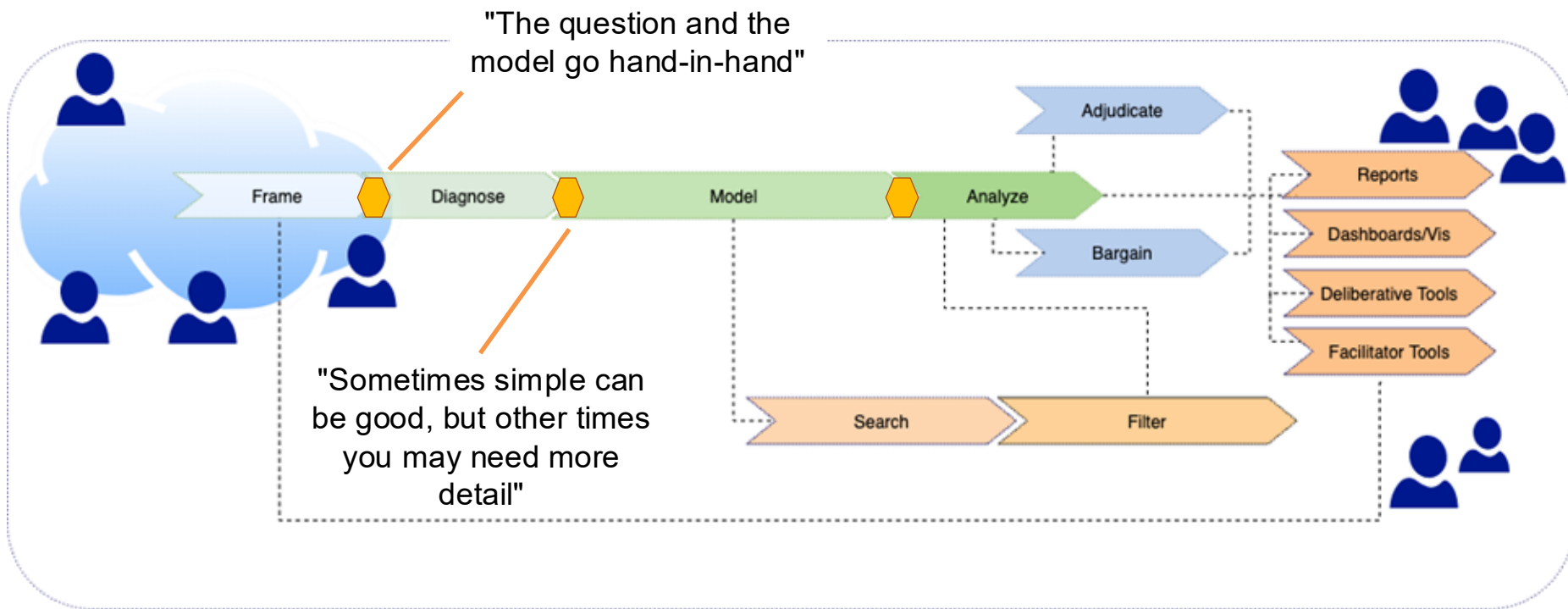
Decision Pathways

- Design Sociotechnical Processes
- Refine Participatory Modeling Methods
- Flex Test Services & Events
- Co-Design with Non-Academic Communities
- Connect: Planners and Stakeholders



Creating a shared organizational structure to target aspects of participatory processes.

(Pierce, 2008; Gil et al., 2021)



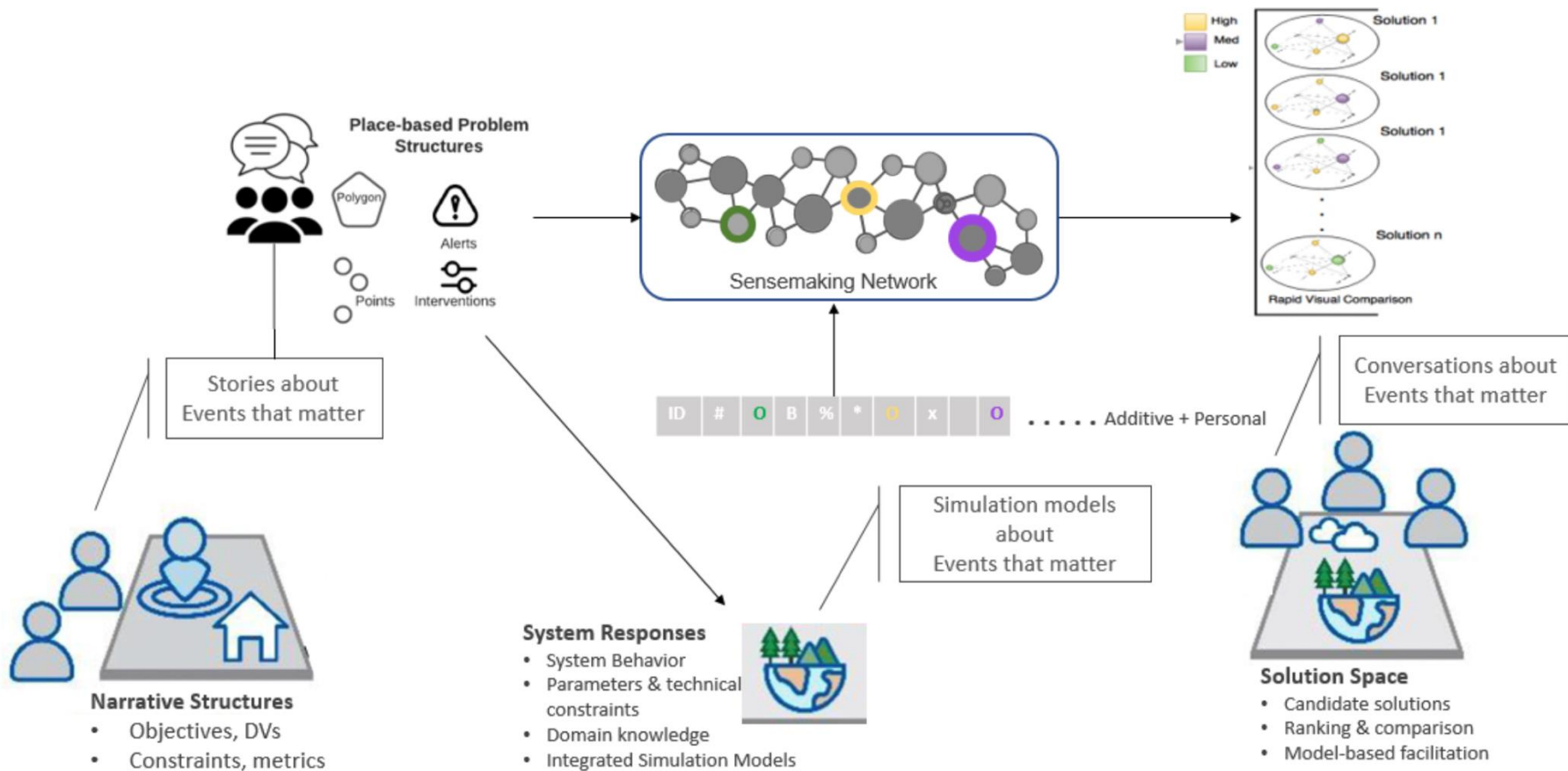
Creating a shared organizational structure to target aspects of participatory processes.



Research Focus for DSO Group

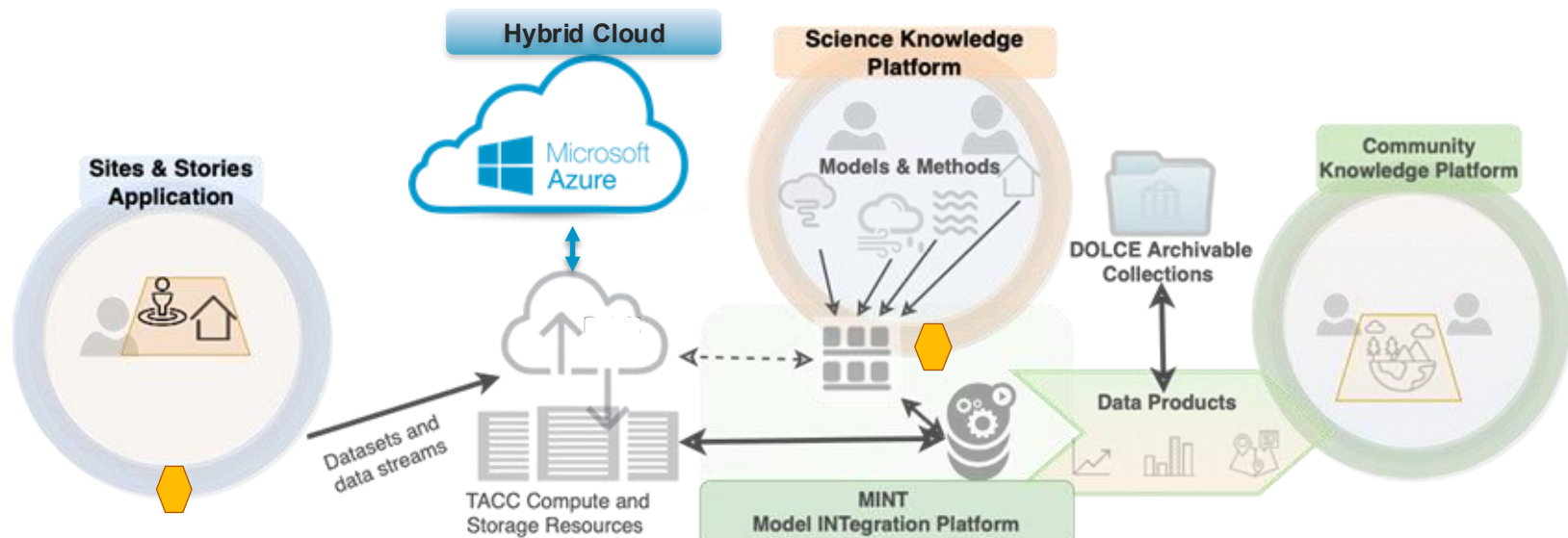
(Pierce, 2008; Gil et al., 2021)

Humans-In-the-Loop



Story Informed Collections

Problem Setup & Semantic Links

 Many observations for models


Interactive Knowledge Capture

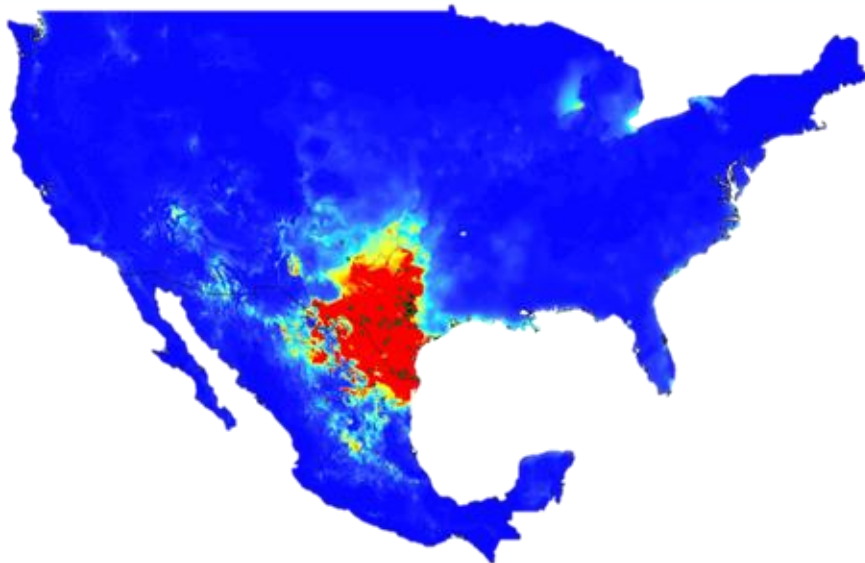
- Natural User Interfaces
- AI supported annotation and labeling
- Co-designed inputs and XR
- Understanding lived experiences

Model Integration

- Data Fusion
- Semantic Knowledge Service
- Geospatial Webservices
- Large-scale Model Encapsulation
- Integrated Modeling

Socio-technical Codesign

- Group Interactions
- Modeled Products and
- XR Interactive Graphics



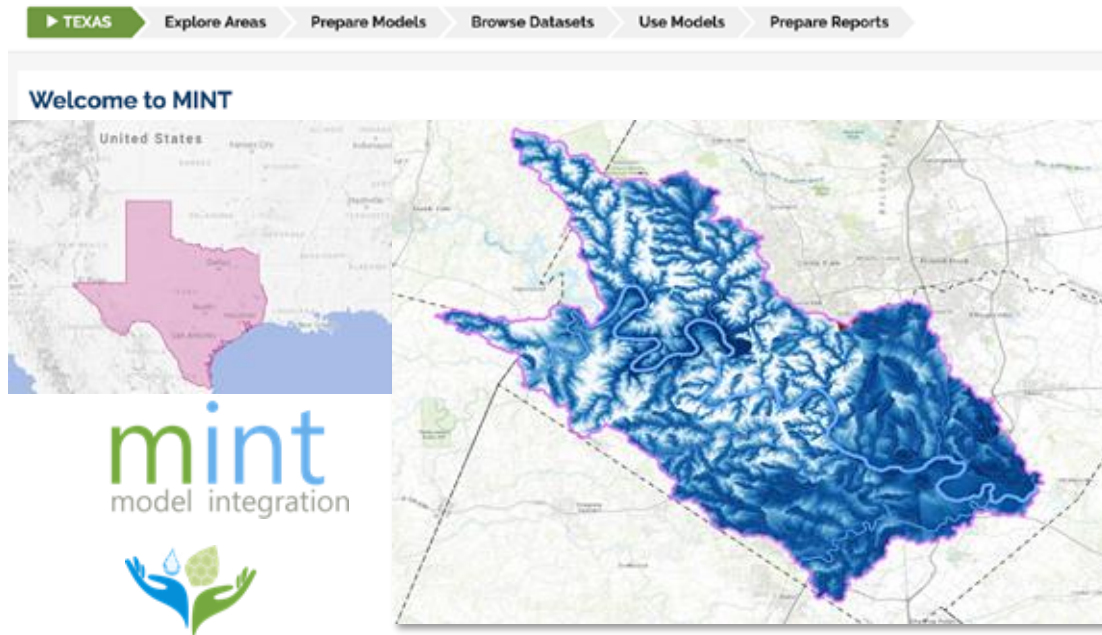
Mapped projection of environmental conditions that favor infectious disease spread in Deep South Texas, 2021 produced by Paty Feria, UT RGV

Data fusion to understand
cascading impacts.

What is Decision Support in the Wild?

- Team developing **data fusion** approaches to make effective and timely climate-related decisions.
- ~2021 - Open geospatial analytics informed medical decisions related to infectious disease identification (*meliodosis*)
- Success because data and map were **shared openly**
- the result was unexpected **emphasizes need to support wound science**

Work with Clint Dawson, Katy Brown, Michale Shensky (UT) Paty Feria (UTRGV), Francisco Guajardo (MOST)



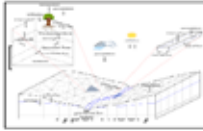
AI-enabled Model INTeegration Platform

A platform for using artificial intelligence to accelerate:

- Connecting data to models
- Composing sophisticated high-fidelity models
- Guiding analysts through easy to follow phases and steps via a user interface that simplifies the complexity.

Clint Dawson, Brent Porter, Daniel Hardesty-Lewis (UT) Yolanda Gil, Daniel Garijo, Deborah Khider (USC)

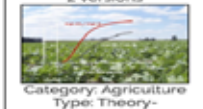
(Gil et al., 2021; Garijo et al., 2019)



The Soil & Water Assessment Tool (SWAT)

The Soil & Water Assessment Tool (SWAT) is a small watershed to river basin-scale model used to simulate the quality and quantity of surface and ground water and predict the environmental impact of land use, land management practices and climate change (<https://swat.tamu.edu/> 2019)

Keywords: Soil, watershed, surface water, ground water, en... [More details](#)



2 versions

Cycles

Cycles simulates the productivity and the water-carbon and nitrogen balance of soil-crop systems subject to climate conditions and a large array of management constraints

Category: Agriculture
Type: Theory-

Keywords: agriculture, cycles, crop growth, weather, soil, cr... [More details](#)



4 versions

Economic aggregate crop supply response model (EACS)

The Aggregate crop supply response model (EACS) describes the aggregate crop supply response model for the country of South Sudan. This is a regional-scale aggregate model of agricultural supply for a specified set of crops (cassava; groundnuts; maize; sesame seed; and sorghum).

Category: Economy
Type: Theory-

Keywords: economy, land use, crop production, fertilizer c... [More details](#)

Data formats

Name	Description	Value on setup	Format
cycles_weather	Cycles weather file	-	weather

Physical variables

Name	Description	Value on setup
cycles	Cycles configuration: Section 0.0.0.0 exposing additional parameters such as weeds fraction and fertilizer rate	Authors: Rufael Sile
cycles	Time interval: 1 day	
cycles	Grid details	
cycles	Type: PointBasedGrid	
cycles	Dimensions: (0)	
cycles	Spatial resolution: Point	
cycles	Processes: Respiration, Nitrogen mineralization and immobilization, Biomass growth, Humification, Transpiration, Nitrogen uptake, Precipitation, Solar radiation, Management, Nitrogen transport	
cycles	Download: Download configuration file	

Constraints

Name	Description	Value on setup
crop_name	Name of the crop to run the simulation for	Maize (default)
start_planting_day	Day of the year when the planting started The range is from 1 to 365	100 (default)
end_planting_day	Day of the year when the planting ended	149 (default)
fertilizer		
weed_frac		

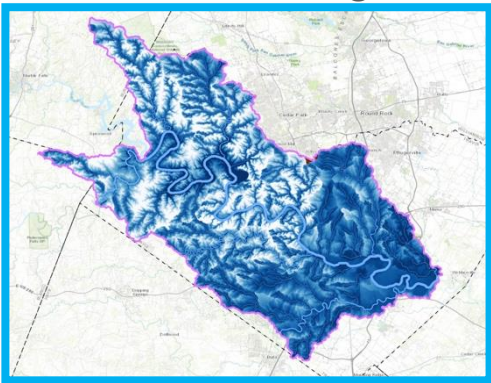
Adjustable parameters

Label	Long Name	Description	Standard Name
Rh _{in}	relative humidity minimum	relative humidity minimum	atmosphere_air_water-vapor__min_of_relative_humid
Solar	solar radiation of the day	Shortwave incoming radiation on a horizontal surface at elevation of the location	land_surface-horizontal_radiation-incoming-sho
Wind	wind speed	Wind speed	land_surface_wind_speed

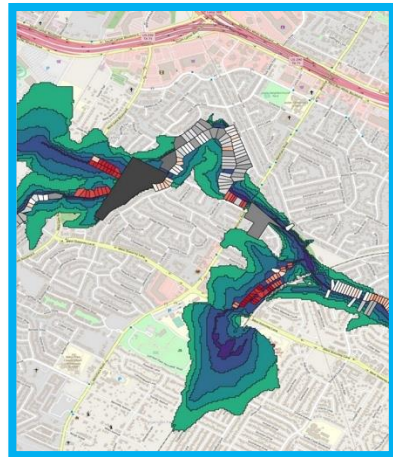


Work with Yolanda Gil, Daniel Garijo, Maximiliano Osorio, Hernan Vargas, Deborah Khider (USC), Anna Dabrowski and Lissa Pearson(UT)

Automating assessment using portable flood model workflow with higher resolution base data



Travis County



Comparison Williamson County

Manually Constructed Buyout Map



MINT Generated Vulnerability Map

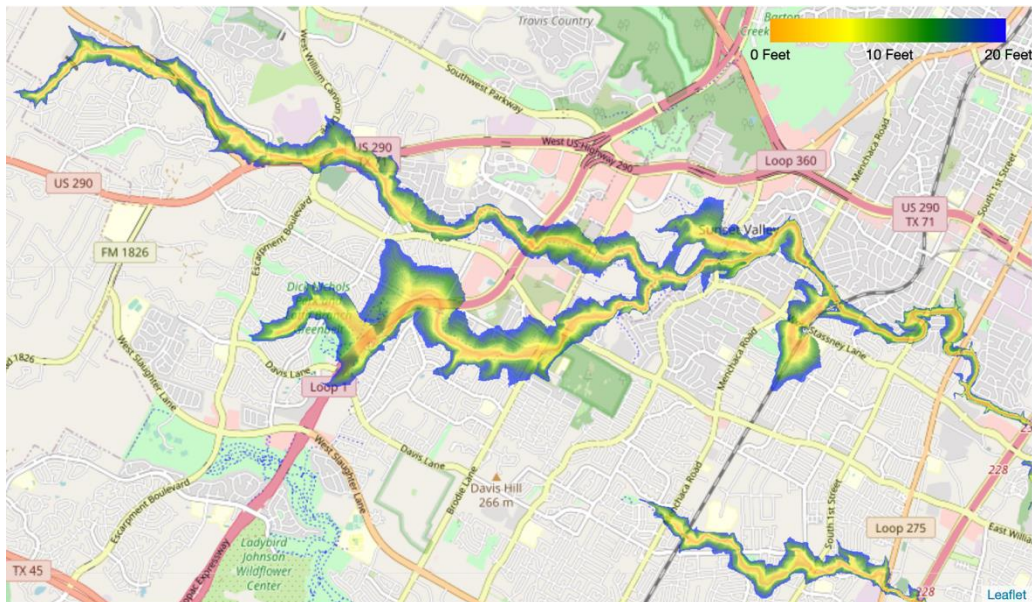


Combining

- Terrain (10 m, 1 meter next)
- Population
- Urban Land Use

Work with Daniel Hardesty Lewis, David Arctur and Paola Passalacqua (UT)

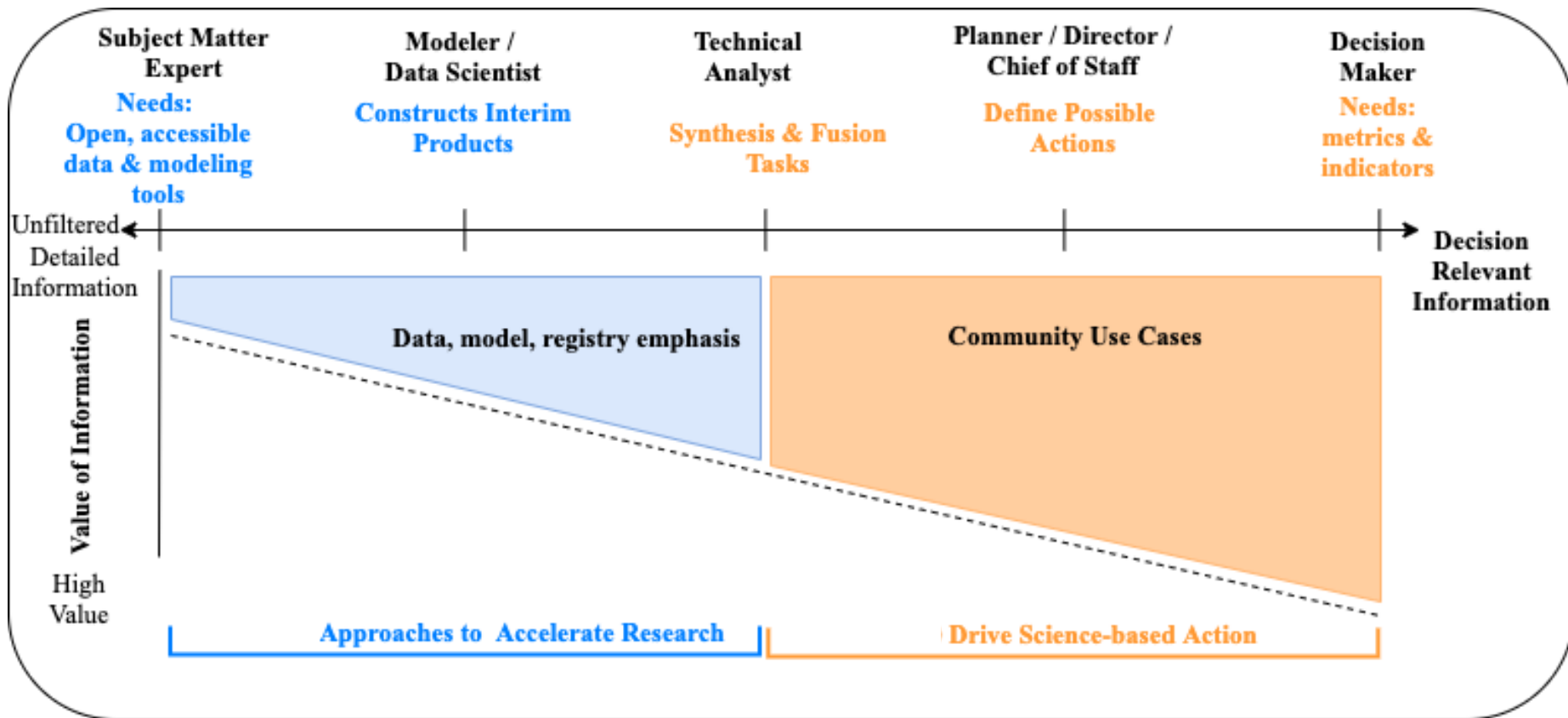
Visualization of Indicator HAND Model Results ready <10 minutes



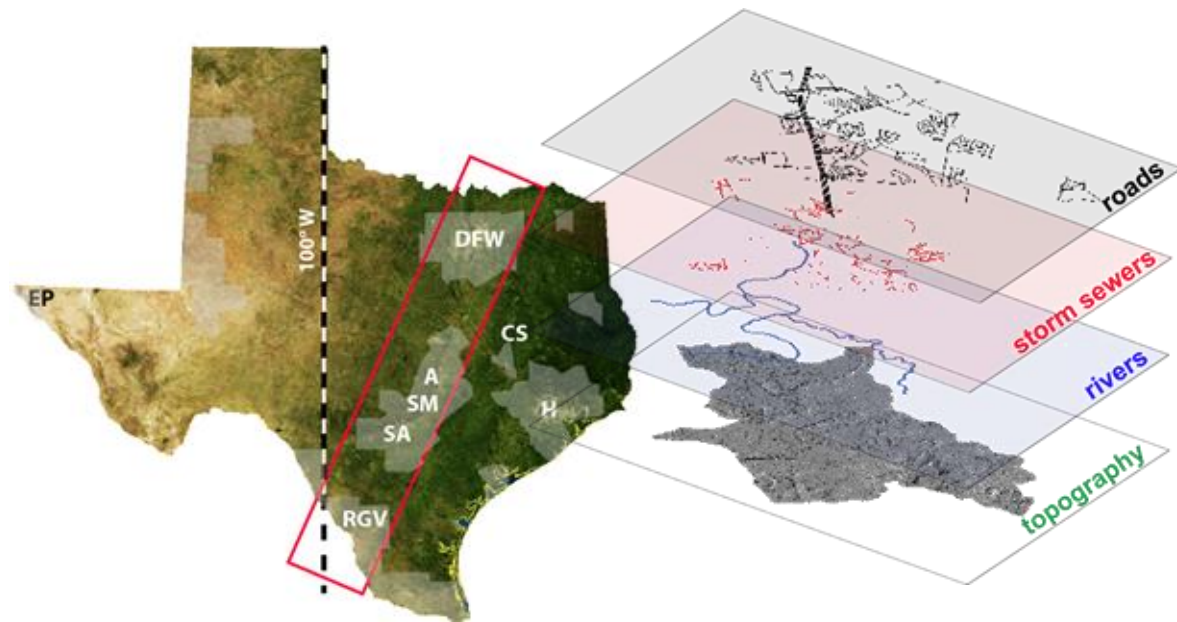
Data and Models are
The best tools we have to understand
our critical Earth resources

However, information contained within
data and models is often
misunderstood or misinterpreted by
people who need to use it to make
group decisions.

Data Fusion to Refine and Build Insight



Knowledge Value Chain



Place-based Knowledge to Inform Decision Frames & Models

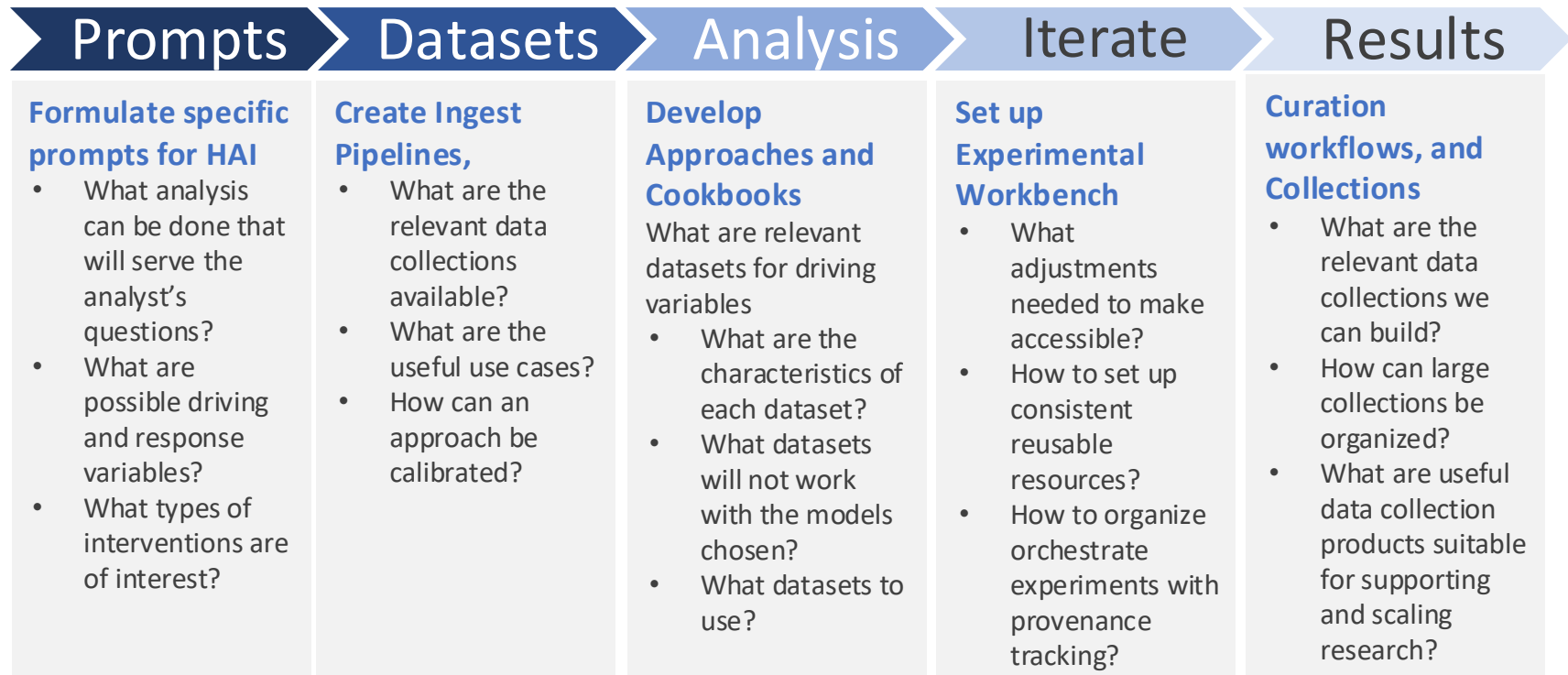
Connect Knowledge Management with Community Contexts

Linking lived experiences to simulation models of disaster events

- Goal to train artificial intelligence & improve simulation model predictions
- Understand decision problem frames
- Develop event-based collections

Work with Clint Dawson, Katy Brown, Will Mobley, Lydia Fletcher (UT), Francisco Guajardo (MOST)

Summary: Sites & Stories Streamlines Automation for Sensemaking



S&S provides mechanisms to collect unstructured knowledge to assist and accelerate sensemaking steps

Recentering Communities

- Knowledge comes in many forms
 - data & models are powerful tools
 - Human-AI partnerships promise to accelerate our ability to respond
 - Our stories and lived experiences are powerful



Story Informed Collections

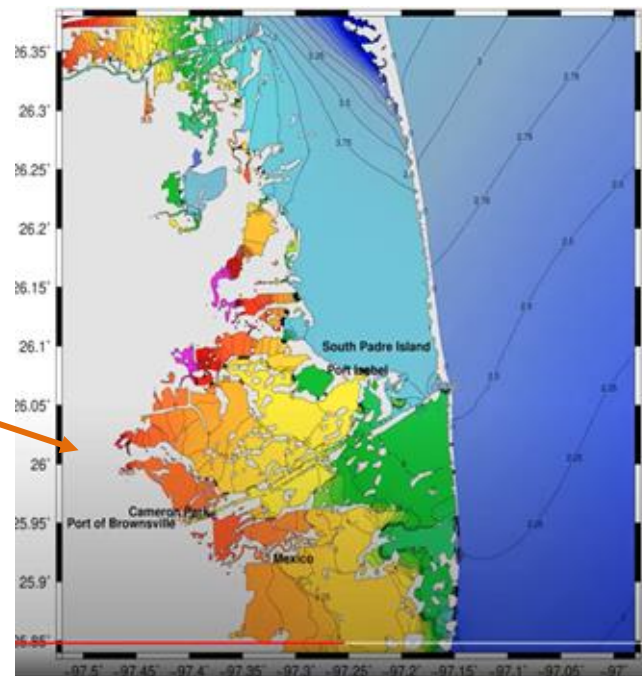
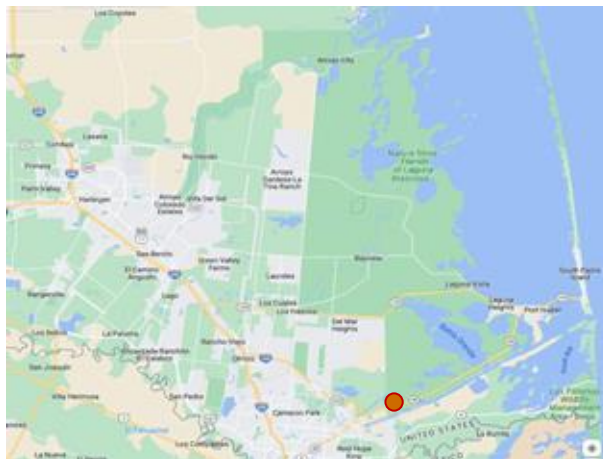


- **Many Observations**
- **From unstructured to accessible information**

Story Informed Collections

Problem Setup & Semantic Links

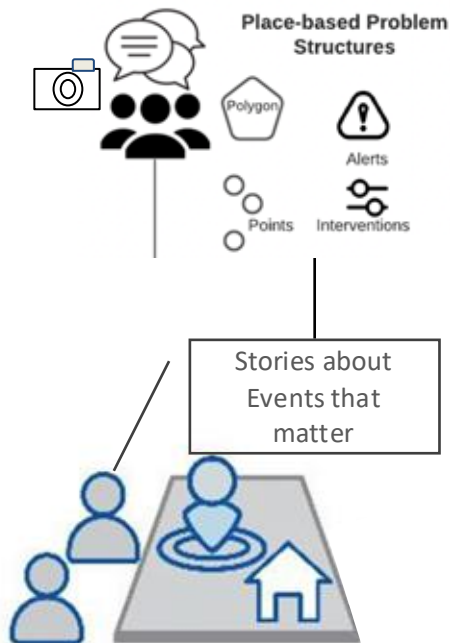
Many observations for models



Lived Experiences

techniques and tools for

knowledge capture of
unstructured data

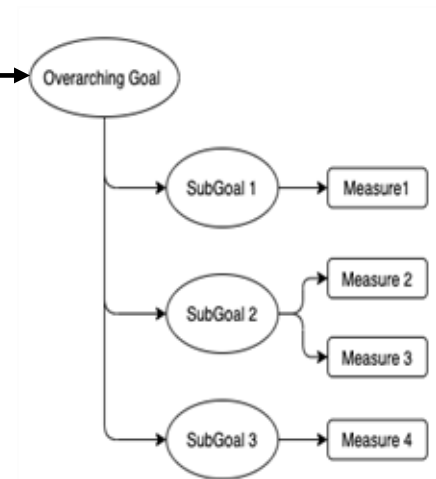


Knowledge Capture Modalities

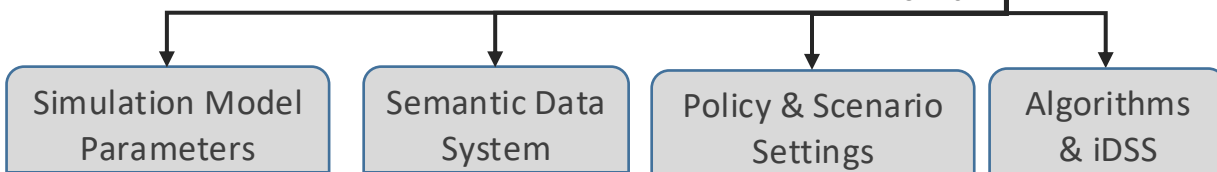
- Audio Voice Capture
- Text Annotation
- Natural User Interface
- Interactive 3D tangibles

Fundamental Questions		Frame
Why	Problem description	Objectives
What	History & Past Events	Decision Variables
Knowledge	Issues Activities Elements	Constraints
Concerns	What are they Who is responsible	Sentiment
Actions	Who can do something What can they do	Interventions and Metrics
Evaluation	Best possible outcome Worst possible outcome	Success or Failure criteria

Goals Hierarchy

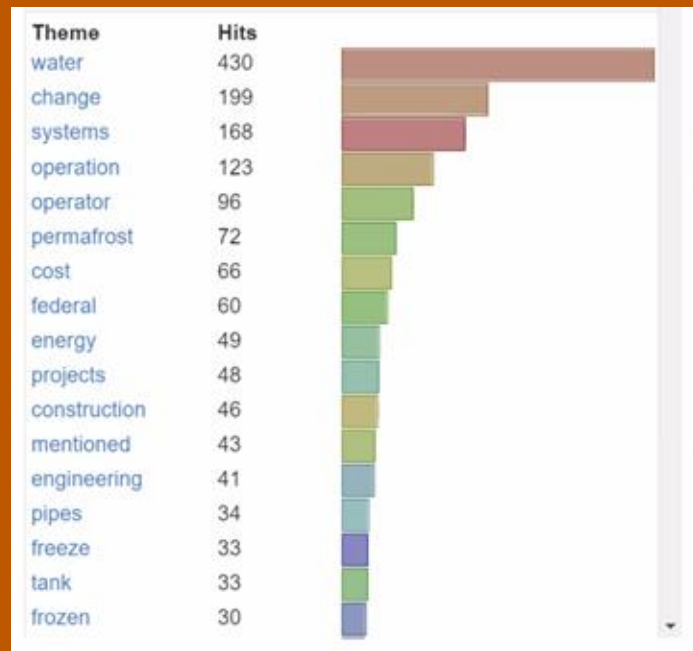
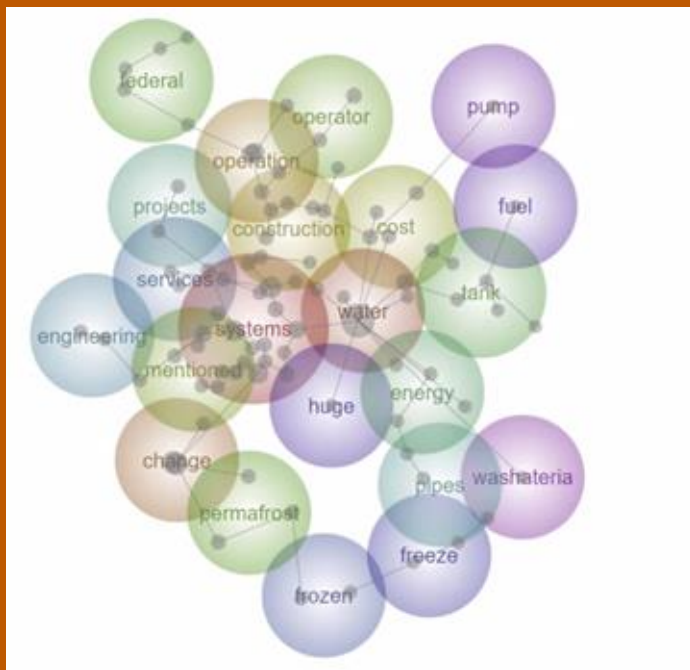


Links with



Flipping Knowledge Exchange

(Water Infrastructure Systems - Alaskan Case Studies)



Preliminary NLP Analyses of Community Perspectives on Alaskan Water Infrastructure



TACC | TEXAS

DATA X

Publish Data Globus Data Transfer Guide Getting Started

Search mosorio

Dashboard Data Files Applications Allocations History System Status

This page allows you to submit jobs to the HPC systems or access Cloud services using a variety of applications.

Applications / LLama Index Environment (LoneStar 6)

- My Apps [3]
 - Jupyter Hub
 - Jupyter Lab HPC (LoneStar6)
 - LLama Index Environment (LoneStar 6)**
- Utilities [2]
 - MATLAB R2022b Interactive (LoneStar6)
 - RStudio (LoneStar6)
- Data Processing [5]
- Visualization [1]

Run an interactive Jupyter Lab session on an HPC compute node to use LLama.

[LLama Index Environment \(LoneStar 6\) Documentation](#)

Parameters

Jupyter Mounts (containerArgs)

`--bind /share,$STOCKYARD:$PWD/Work,$HOME:$PWD/Home,$SCRATCH:$`

Mount for TAP functions and user dirs

NVIDIA Flag (containerArgs)

`--nv`

Flag to enable NVIDIA cuda

TACC Scheduler Profile (schedulerOptions)

`--tapis-profile tacc-apptainer`

Scheduler profile for HPC clusters at TACC

TAP Session Substring (schedulerOptions)

`--job-name ${JobName}-tap_`

TAP Functions require the substring "tap_" and in the slurm job name in order to function.

APPTAINER_PWD (envVariables)

`/home/jovyan/work`

Configuration

Queue Required

`gpu-a100`

Select the queue this job will execute on.

Maximum Job Runtime (minutes) Required

`120`

The maximum number of minutes you expect this job to run for. Maximum possible is 2880 minutes. After this amount of time your job will end. Shorter run times result in shorter queue wait times.

Reusable Environments and Digital Infrastructure

Code Cookbooks

- 1st example Large Language Models on premise
- Service in Alpha testing
- Other cookbooks in prep

Sharable Modeling Environments

- Kubernetes and Azure
- Model Evaluation and Execution

Near Future ...

- Conversational AI and Interactive Interfaces

NLP + Information Reduction
LLM + PRIM

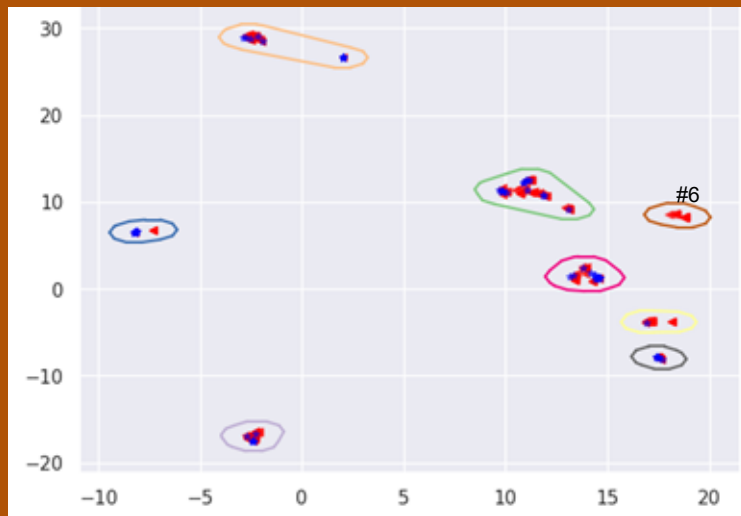
Gray Literature-to-Interviews



Implementation model that identifies knowledge gap and explores options for an 'exchange' approach

Mapping Knowledge Gaps

Cluster	Rules
0 (n=69)	Focuses on Background information but not Tribal Governance
1 (n=35)	Focus on Federal Policies but did not address chemicals
2 (n=45)	Addressed Environment and Regulations
3 (n=20)	Failed to State or Potable Water
4 (n=13)	Does not address Environment or Potable Water
5 (n=39)	Does not address Potable water, but focused on Water Received by the User, and System Breakdowns
6 (n=15)	Does not address Federal Policies or Background information, but focused on Strategic Planning
7 (n=17)	No Rules found



Combined Gray Literature Clusters
Reduced Using UMAP

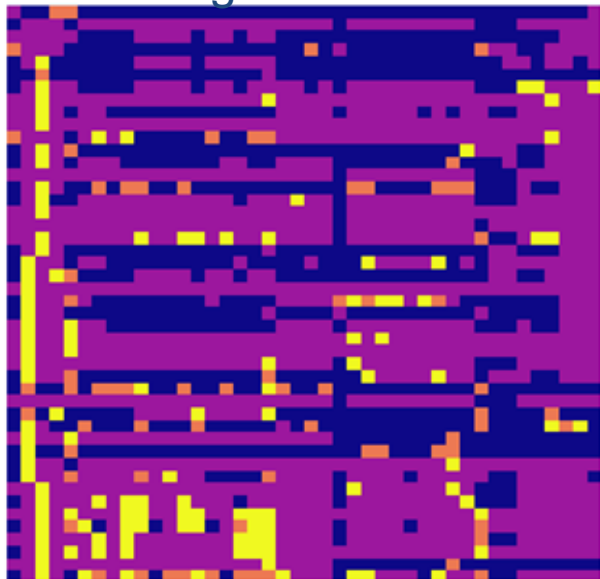
NNA Products from Research

- ❖ Intertopic Overlay figure and results for manuscript
- ❖ Identified initial gap to explore as an example to develop methods (cluster 6)
- ❖ Map and understand links in overlapping clusters (priority clusters 1, 5, 7)
- ❖ Document approach and create shareable jupyter notebooks for LLM+PRIM approach

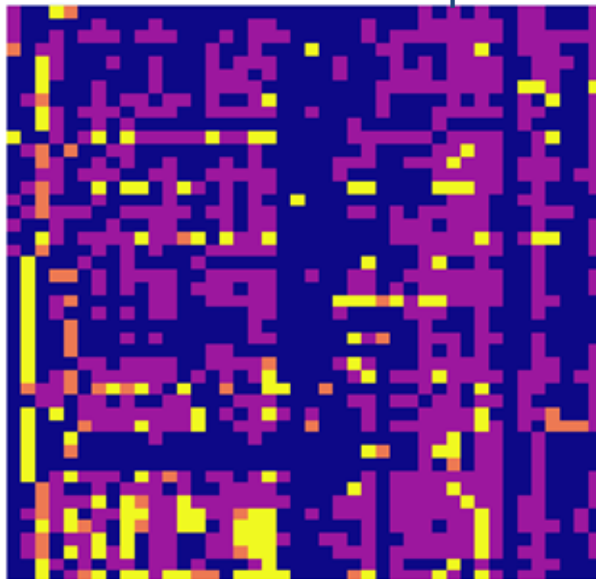
Social Science Coding with AI: Iterative development

Using Heatmaps to compare matrix of coding output from Human vs AI

Original AI



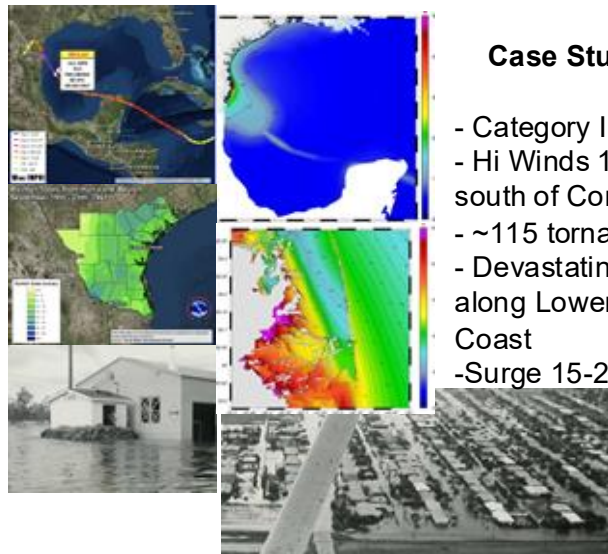
Round 1 AI Prompts



	Human Code	AI Code	
	+	+	True Pos.
	+	-	False Neg.
	-	+	False Pos.
	-	-	True Neg.

Story Informed Collections

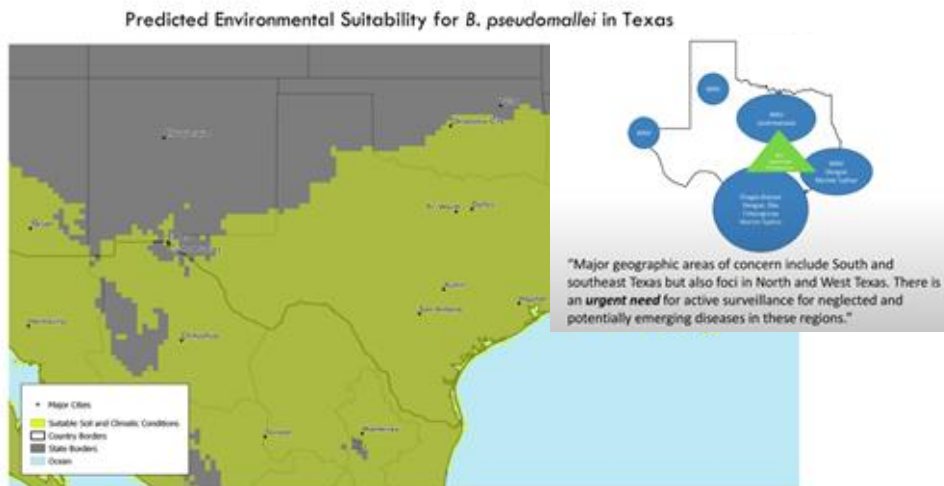
Fusion Collections for Historic Events



Case Study Beulah

- Category III Hurricane
- Hi Winds 160 mph south of Corpus Christi
- ~115 tornadoes
- Devastating storm along Lower Texas Coast
- Surge 15-20 ft

Cascading Hazards - Floods + Infectious Disease Prediction



(Pierce, Dawson, Wells, in prep - Large Data Collections & Provenance)

(Brown & Shensky, in development - Disease Vulnerability Map)

*Gil, Y., Garijo, D., Khider, D., Knoblock, C. A., Ratnakar, V., Osorio, M., Vargas, H., Pham, M., Pujara, J., Shbita, B., Vu, B., Chiang, Y.Y., Felman, D., Lin, Y., Song, H., Kumar, V., Khandelwal, A., Steinbach, M., Tayal, K., Xu, S., Pierce, S.A., Pearson, L., Hardesty-Lewis, D., Deelman, E., Ferreira da Silva, F., Manaya, R., Kemanian, A., Shi, Y., Leonard, L., Peckham, S., Stoica, M., Cobourn, K., Zhang, Z., Duffy, C., & Shu, L. (2021). Artificial intelligence for modeling complex systems: taming the complexity of expert models to improve decision making. *ACM Transactions on Interactive Intelligent Systems*, 11(2), 1-49.*

Pennington, D., Ebert-Uphoff, I., Freed, N., Martin, J., Pierce, SA, 2019, Bridging sustainability science, earth science, and data science through interdisciplinary education, Sustainability Science, <https://doi.org/10.1007/s11625-019-00735-3>, pp. 1-15.

Pierce, S.A. 2008. Pieces of a puzzle: Why transdisciplinary socio\technical tools are necessary to address water resources policy, presented at the 2008 Meeting of the American Institute of Professional Geologists, Arizona Hydrological Society, and 3rd International Professional Geology Conference, Flagstaff, Arizona, USA, September 20\24, 2008. Published by American Institute of Professional Geologists.

Contact:



spierce@tacc.utexas.edu



[@helpfultangent](#)



Thanks to our Partners and Funders



Extra Slides

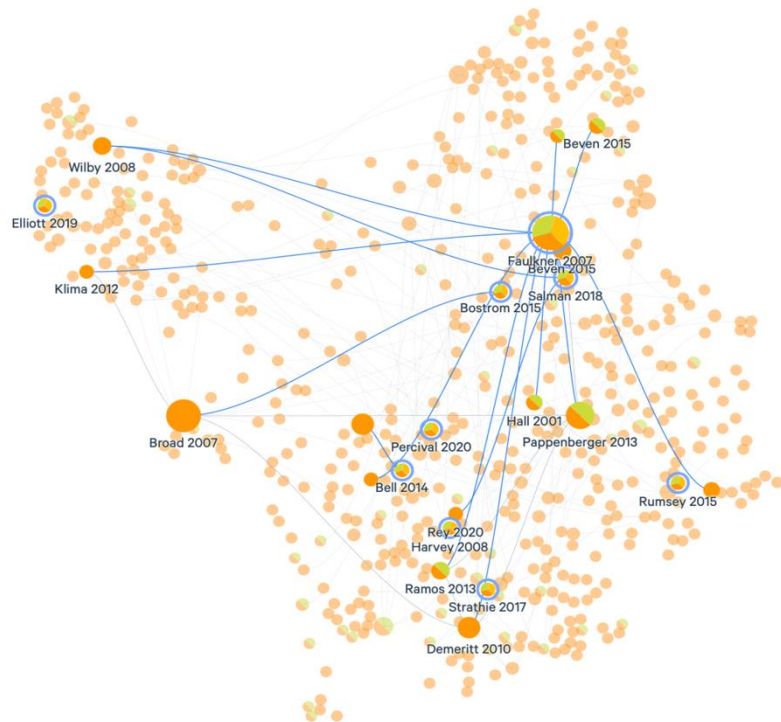
"Sometimes simple can be good, but other times you may need more detail"



Insights from Coastal Hazards Communication:

- Essentially, we need experts to agree on how to present and describe the uncertainty in models
- Uncertainty should be factored into the actionable 'so what' for end users who are given risk information
- Relevant stakeholders or end users need to be involved early
- Communication channels should be flexible and robust enough to handle updates to understandings of uncertainty
- There is a collection of literature providing uncertainty visualization guidelines, language/wording strategies, and best uses with numbers and probabilities.

AI-Supported Systemic literature -

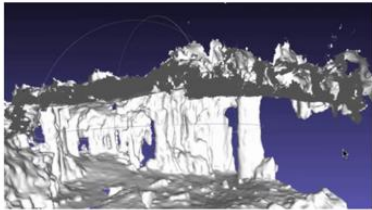


Welcome to DataX

DataX is a next generation integrated data analytics platform designed by experts and powered by the supercomputers at the Texas Advanced Computing Center. It provides the computational tools necessary for researchers to understand, manage, and examine critical data from around the state.

Existing data – from water availability to flood plain mapping to urban growth models and more – are integrated into one portal and will be added to continuously as new data become available, both from Planet Texas 2050 researchers and from organizations around Texas.

These data can be used to create simulations and projections that help policymakers, educators, and citizens better understand the challenges their communities are facing today as well as the challenges their towns could face in 30 years.



Optimal Averaging of Water Resources



Texas Metro Observatory



Population Dynamics in Premodern Societies



Texas Water Stories: Local Narratives of Hydrologic Change and Adaptation



Artist-in-Residence: Lorenz Graybelt



Urban Watershed Evolution



Transportation-Related Air Pollutants and Health



Blue Index



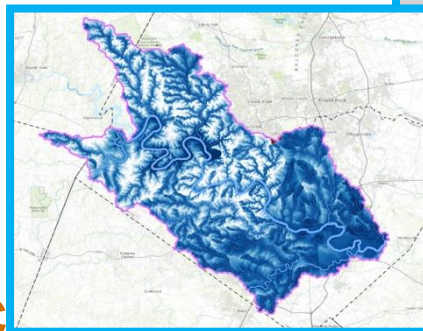
Floodplain Modeling

Description Research and development to generate floodplain contours and depth grids, at 1' depth intervals or network for Texas statewide.

PI Arctur, David (arcturdk)

Co-PIs Hardesty Lewis, Daniel (dhl) | Maidment, David (maidment) | Passalacqua, Paola (paolap)

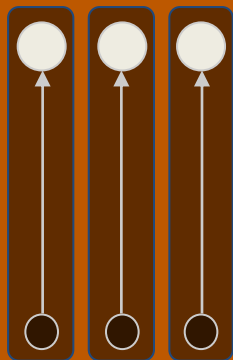
Name	Size	Last Modified	Permissions
Colorado	4.0 kB	4/2/20 5:40 PM	All
Concho	4.0 kB	4/2/20 5:41 PM	All
Harris	4.0 kB	4/2/20 5:42 PM	All
Hays	4.0 kB	4/2/20 5:43 PM	All
Jefferson	4.0 kB	4/2/20 5:44 PM	All
Mitchell	4.0 kB	4/2/20 5:45 PM	All
Uvalde	4.0 kB	4/2/20 5:46 PM	All
Young	4.0 kB	4/2/20 5:48 PM	All



*Work with TACC,
Jeaine Powell, Anna Dabrowski, Daniel Hardesty Lewis,
Lissa Pearson, Joon Yeh Chuah, Vera Belcher, Nathan
Franklin, Sarah Gray, Tracy Brown, Smruti Padhy,
Anagha Jamthe, Joe Stubbs, (and many others)*

Intentionality...

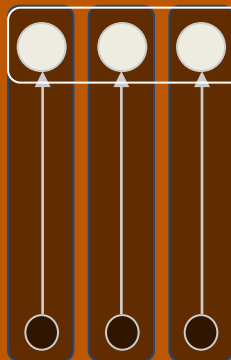
Disciplinary



Goals

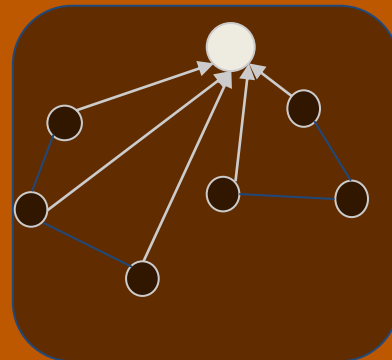
Researchers

Multidisciplinary



Theme

Interdisciplinary



Shared Research Goal

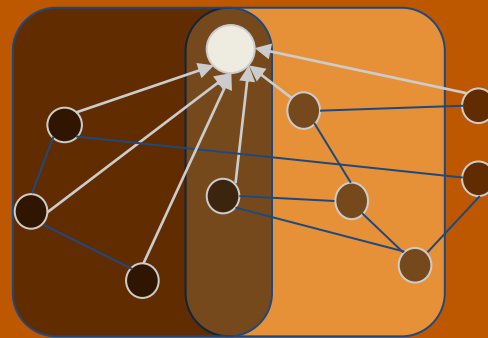
(Pennington et al., 2019)

<https://youtu.be/sUFiRri79QI>

Intentionality...

- Embrace Transdisciplinarity
 - Wicked problems carry multiple perspectives
 - Develop shared vocabularies
 - Design new frameworks, theories, approaches, descriptive protocols
 - Assure research is reusable
 - Warning - limited # of relationships we can carry

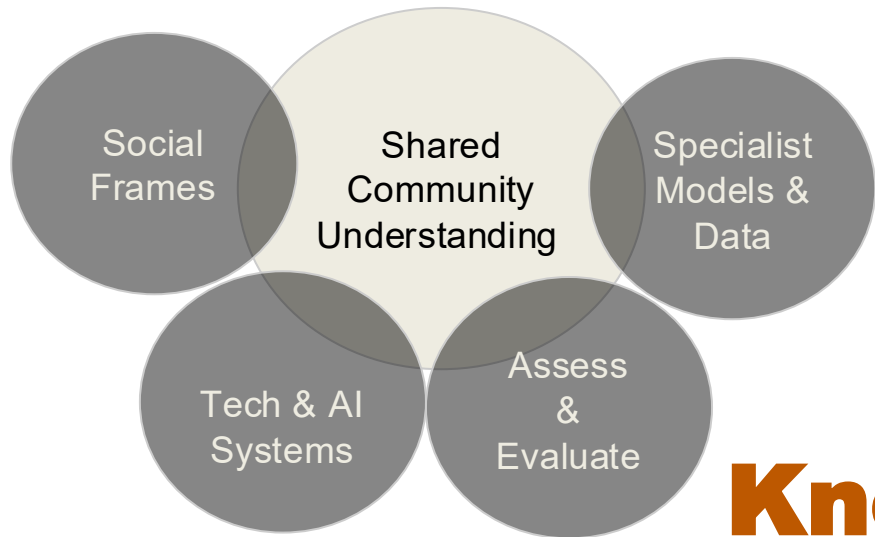
Transdisciplinary



Shared Frameworks

(Pennington et al., 2019)

Convergent Thinking



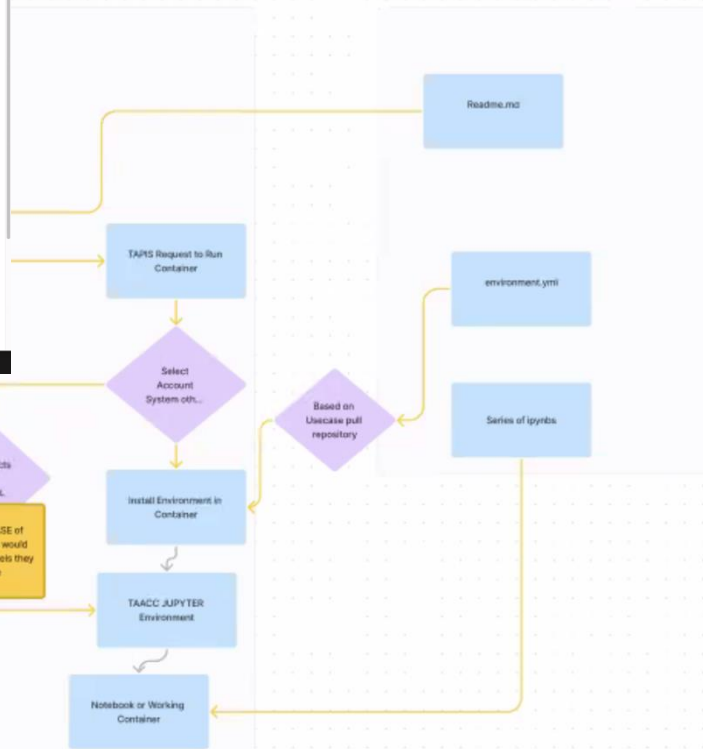
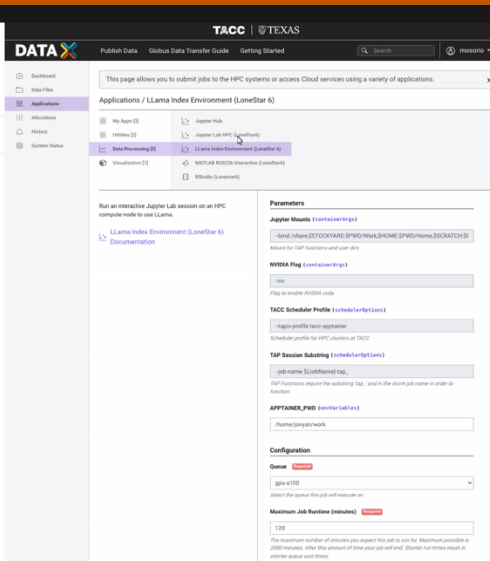
Fusion, Integration & Knowledge Exchange

Emerging Data Management Services (CSR and DMC)

- Cookbooks Services
- MEEP / DYNAMO
- Knowledge Capture (remote data collection with disconnected / remote environments)
Unstructured
- DISCOVERY - CoreDB and CoreMiddleware (mechanisms for registering data and information with our services) – data/metadata to manage and use the storage capabilities at tacc

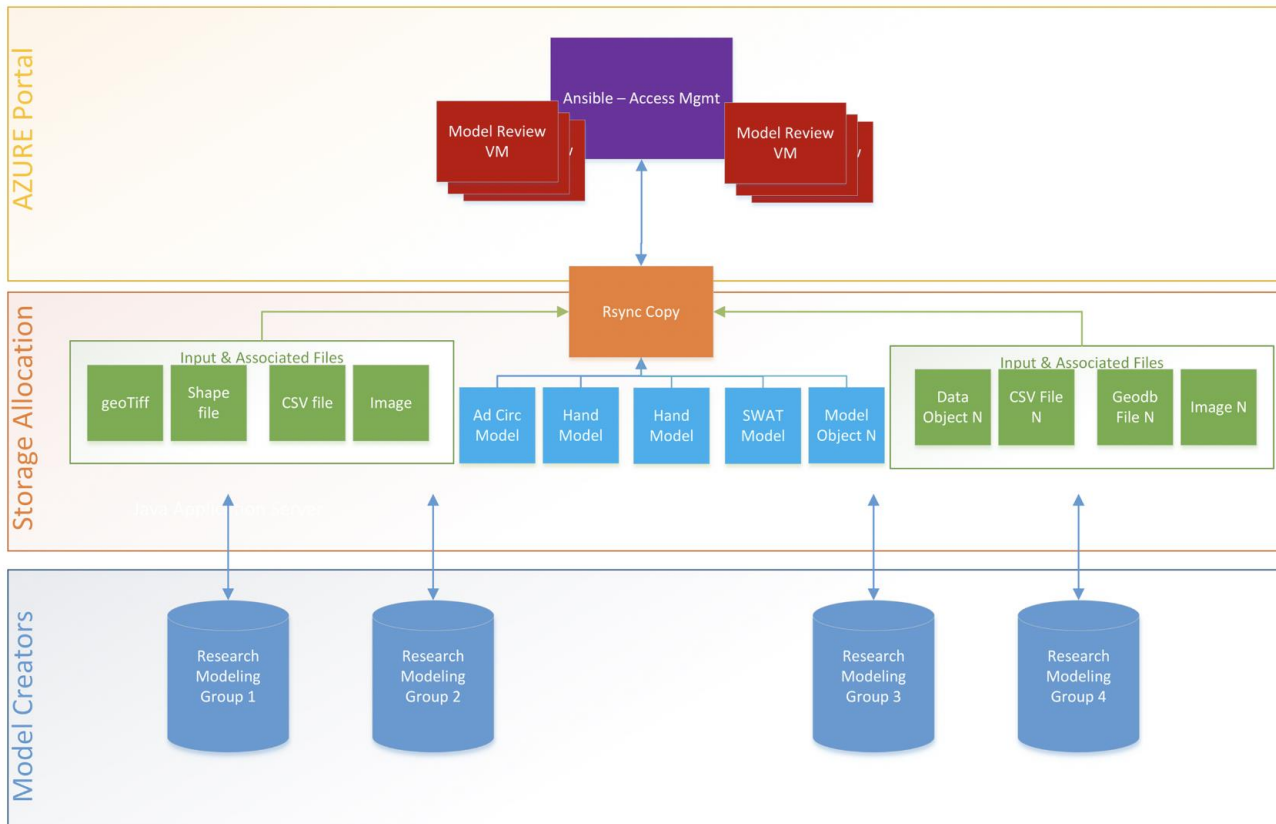
Slide Subtitle

- Added LLaMa application to the DataX portal



Ingest unstructured Information

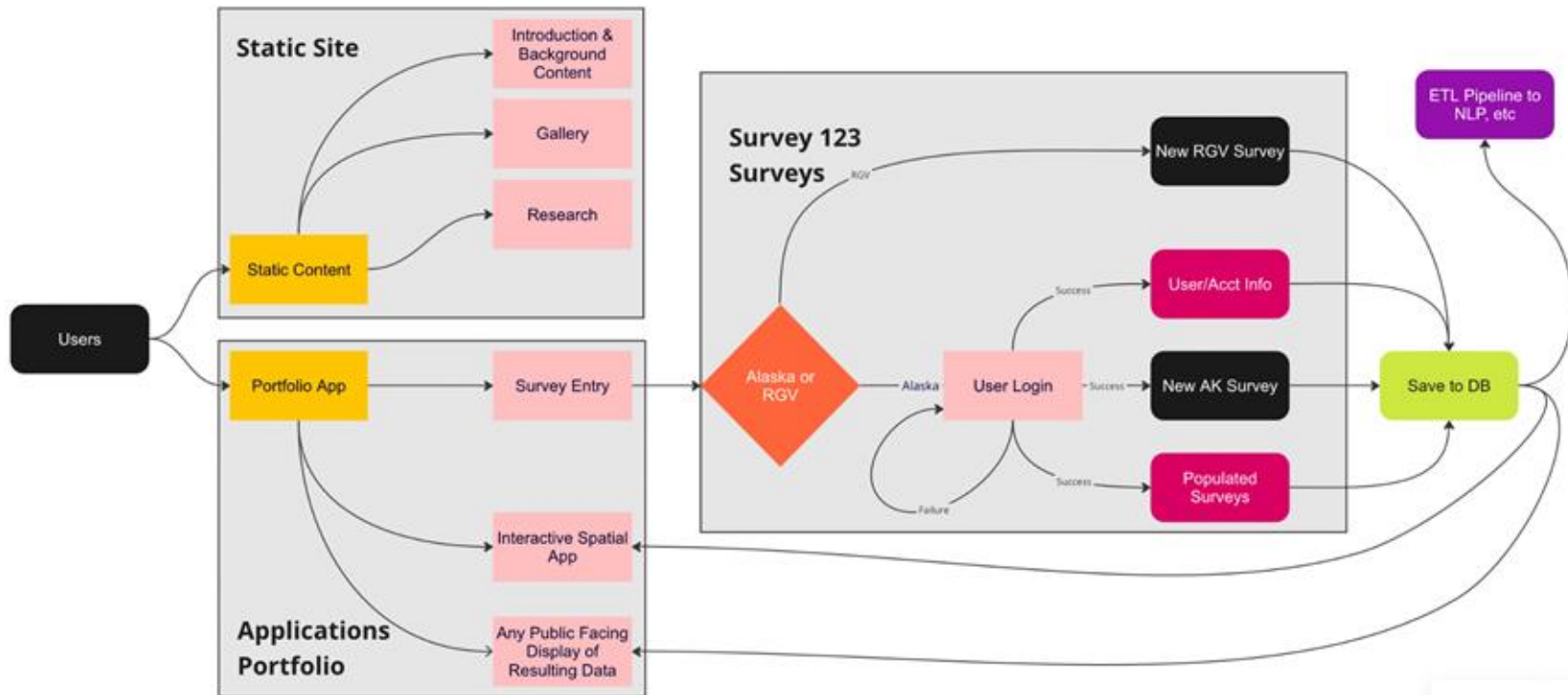
- Survey123
- 4 slides nna nov.

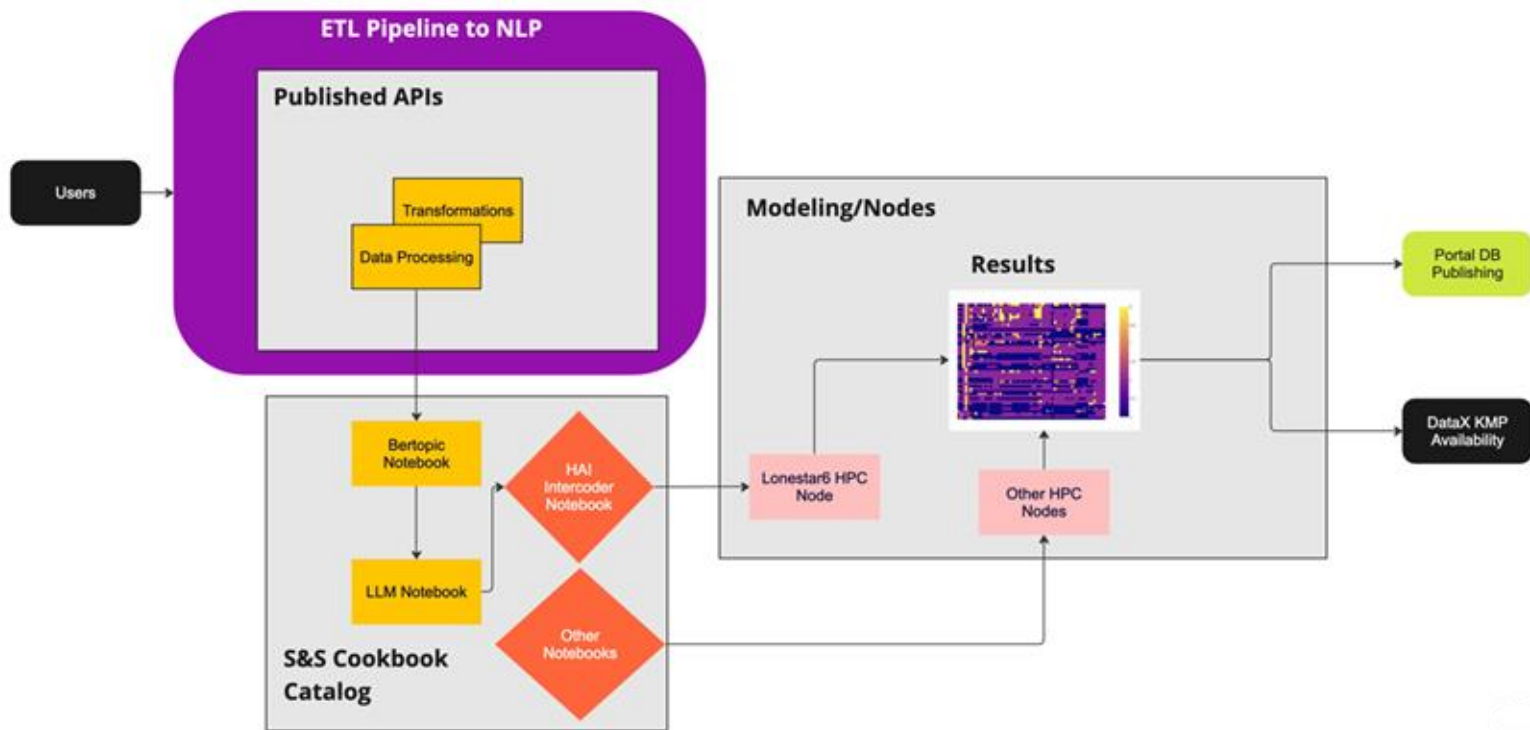


MEEP

Reusable Kubernetes Services.

- Pre-conditioning an architecture so users can scale up desktop modeling
- Used for state program to share large inputs/outputs and evaluate/test model versions.





Connected versus Disconnected Access

If remote Researcher needs to load Survey123 application their phone prior to departure. Additionally, researchers will need to pre-load a map collection for study region.

Sensitive versus Non-Sensitive Data

Alert! Sensitive information needs to be processed by selecting an appropriate option in following sections of this survey. Next step is to complete design for UI, apply for IRB and Secure Allocation to setup.

Researcher Profile & Interviewee Information

Login Credentials for Researcher only

Interviewee information for recordkeeping (need input from IRB/NNA)



Field Questions

Report date and time

11/9/2023 01:08 PM

Travel Area

Using the map tools below, create a new shape around the general area in Alaska that you typically travel throughout the year. You can either modify the blue box or delete it. If you delete the blue box, create a new shape.

Find address or place

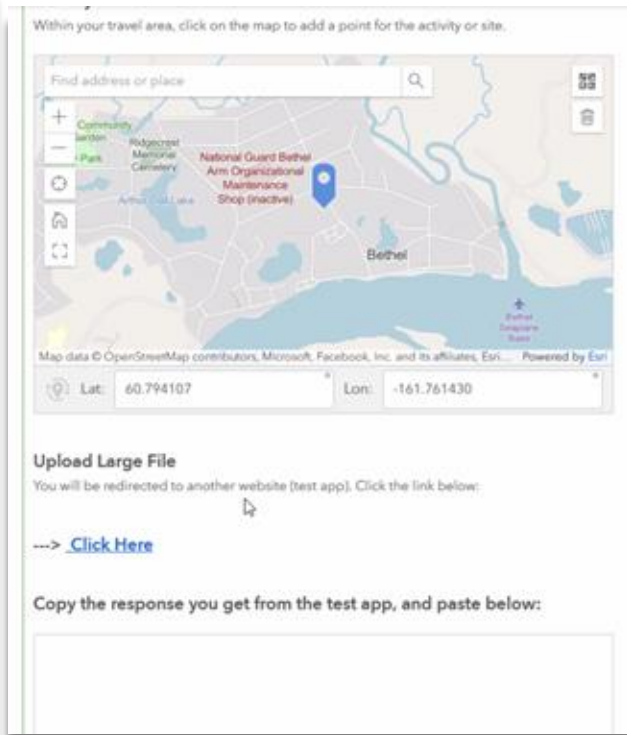
Map data © OpenStreetMap contributors, Microsoft, Facebook, Inc. and its affiliates, Esri. Powered by Esri

Perimeter: 223.92 Miles Area: 1,427,597.26 Acres

Activities or Sites of Interest (1)

What are some activities or sites in the community that you take pride

Simple Field Form



Within your travel area, click on the map to add a point for the activity or site.

Find address or place

Map data © OpenStreetMap contributors, Microsoft, Facebook, Inc. and its affiliates, Esri. Powered by Esri

Lat: 60.794107 Lon: -161.761430

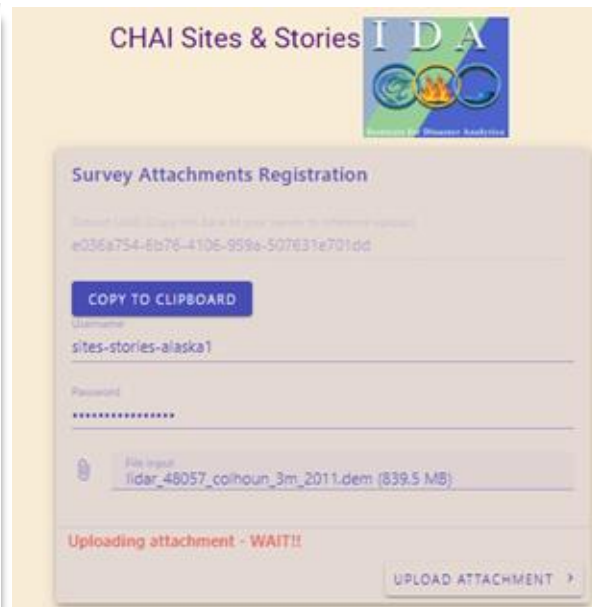
Upload Large File

You will be redirected to another website (test app). Click the link below:

---> [Click Here](#)

Copy the response you get from the test app, and paste below:

Ingest Form <1.2GB



CHAI Sites & Stories **IDA**

Survey Attachments Registration

Upload Large File (max 2GB) or paste response to attachment upload

e036a754-6b76-4106-959a-507631e701dd

COPY TO CLIPBOARD

Username

sites-stories-alaska1

Password

File upload

lidar_48057_cohoun_3m_2011.dem (839.5 MB)

Uploading attachment - WAIT!!

UPLOAD ATTACHMENT

Ingest Form <2TB

NNA Survey Demo

Overview Design Collaborate Analyze **Data** Settings

11/13/23 - 11/13/23 Filter Report Export Open in Map Viewer Form view

2/2

Editing

Interviewee Information and Field Collector

Interviewee Name

Name

Interviewee City of Residence

City

Field Collector Information (2)

Field Collector Name

Name 2

Institution

Uttw

Submit

Attachment (Upload Section)	Delimited (Upload Section)	Field Collector Information
Data Security Classification	Data State	Upload Attachment
Non-sensitive	Identified data	47674682-4556-4566-8863-8874534787
Non-sensitive	Identified data	4987171-2466-4663-8874-8874534787
Sensitive	Processed data	2394129-4663-4270-8699-235235963089
Non-sensitive	Identified data	873980-2-1740-4398-8290-95140969823

1 of 4 selected

Post Processing

My Surveys + New survey Search

Count: 13

Records 1 of 13

NNA Survey Demo
by profile

Records 2 of 13

repeat aggregation test
by profile

Records 3 of 13

GIS Forum 2023
by profile

Records 4 of 13

Multi-GeoPoints Earl-SS Portal
by profile

Records 5 of 13

Form 11
by profile

Records 6 of 13

18 Oct URL test
by profile

Records 7 of 13

URL MultiGeoPoint Test
by profile

Records 8 of 13

S123 Web Designer Test
by profile

Collection Assembly

Next Steps

Currently - loaded metadata into portal
File is loaded into storage at TACC;
Next Steps ETL (e.g. setup database for queryable data objects)
Metadata visible in portal, but digital object stored at TACC (working out the piping)
Digital object accessible via direct upload to portal, but limited to 1000 rows of object

