Decision Pathways Development

Interoperable Platforms with Domain Driven Development for intelligent decision support services

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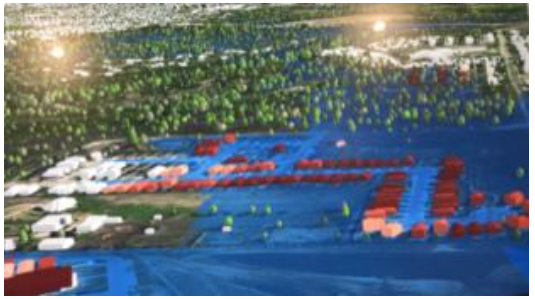
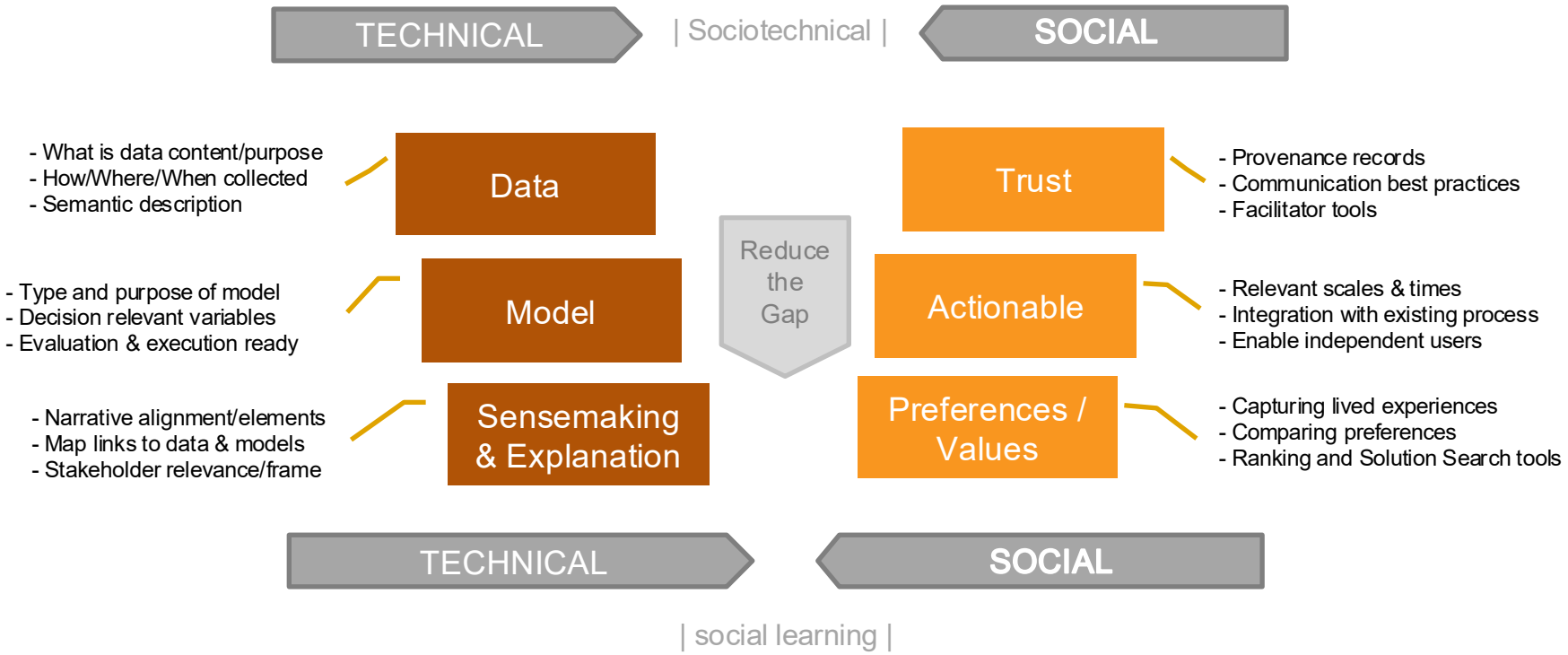
Knowledge comes in many forms



Creating dynamic user interfaces to help understand & share it

Charting the Gap - XAI



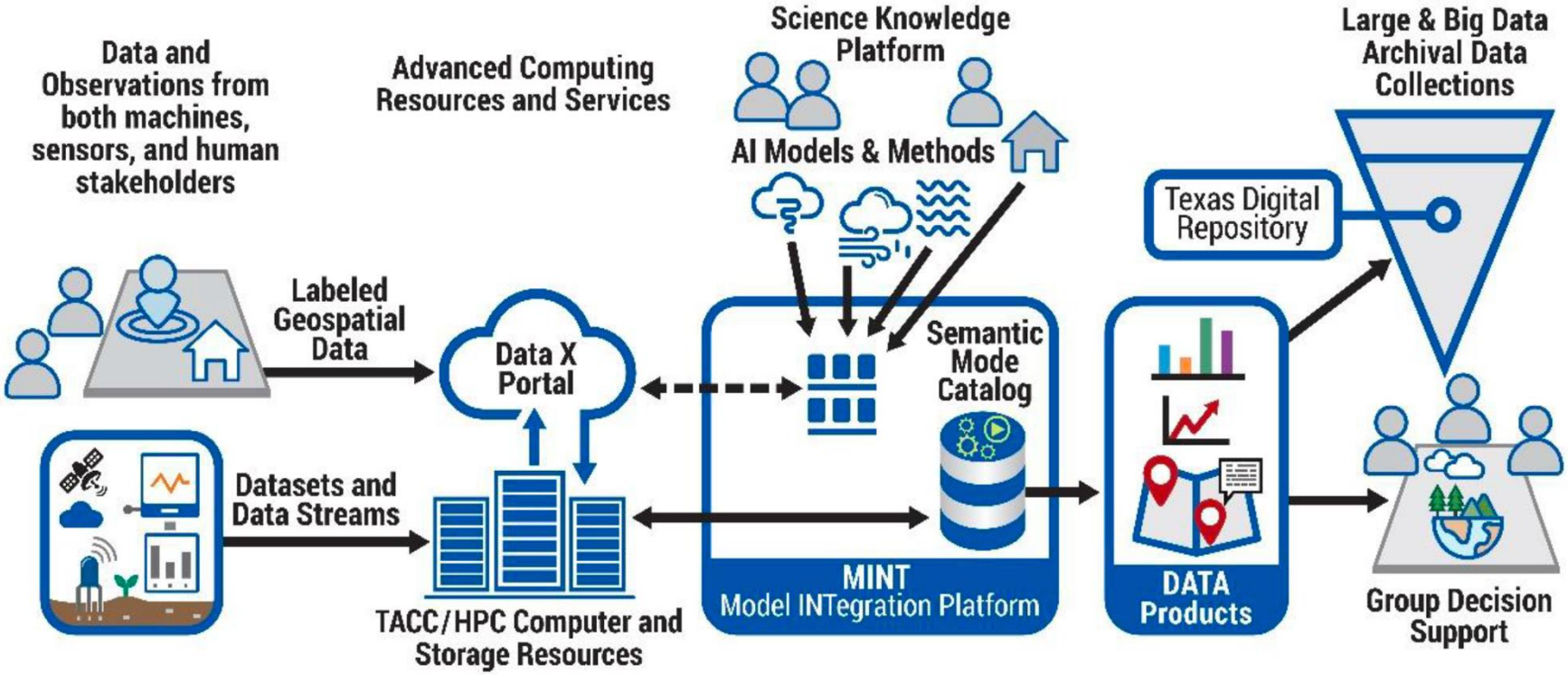


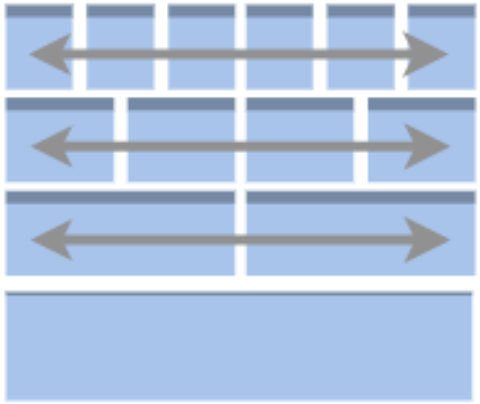
Figure 10: *Intelligent Decision Support Systems (iDSS).*

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.

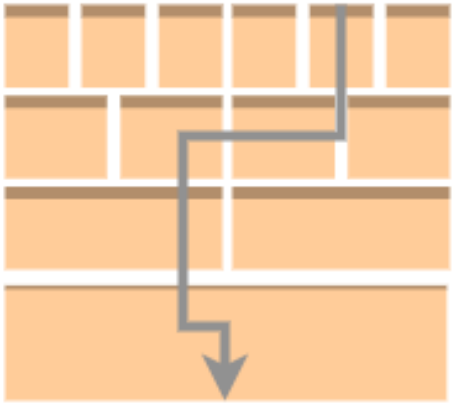
Dimensions of complex Models

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



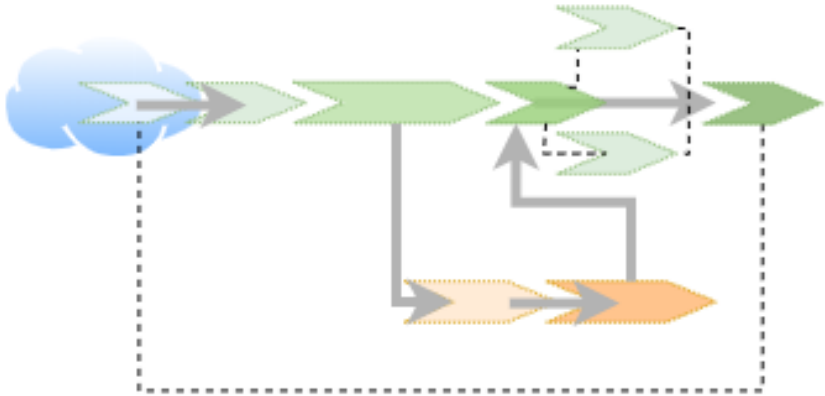
Horizontal Portfolios

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



Vertical Slicing

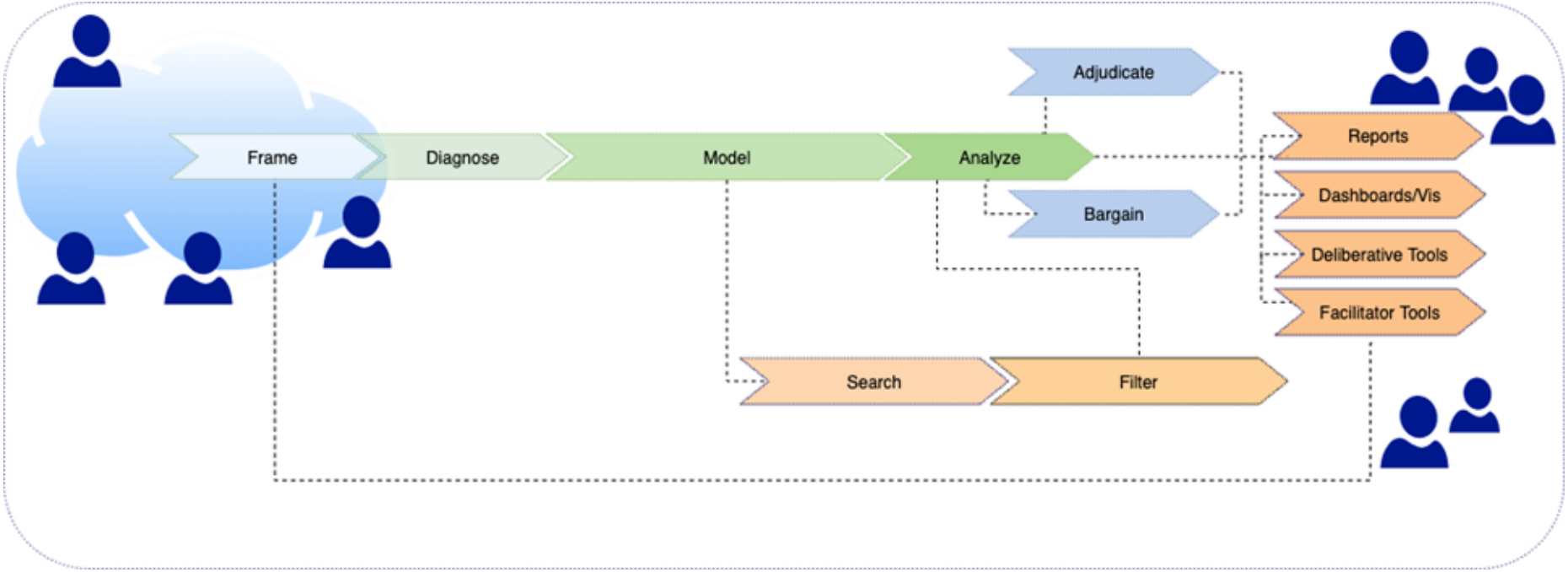
- Implement AI-augmented Services
- Instantiate Integrated Models
- Rapid End-to-End Use Case
- Experiment with Pilot Services
- Connect: Technical Analysts



Decision Pathways

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

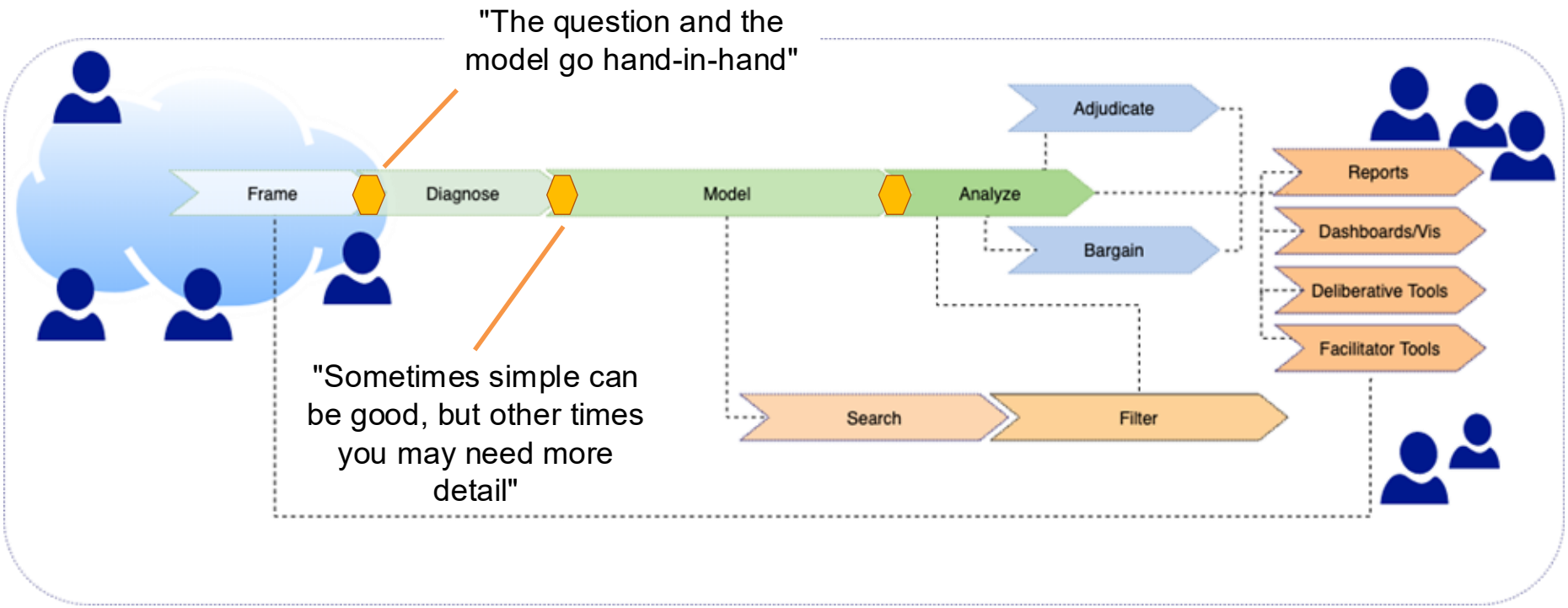
Decision Pathways Framework



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

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

Decision Pathways Framework



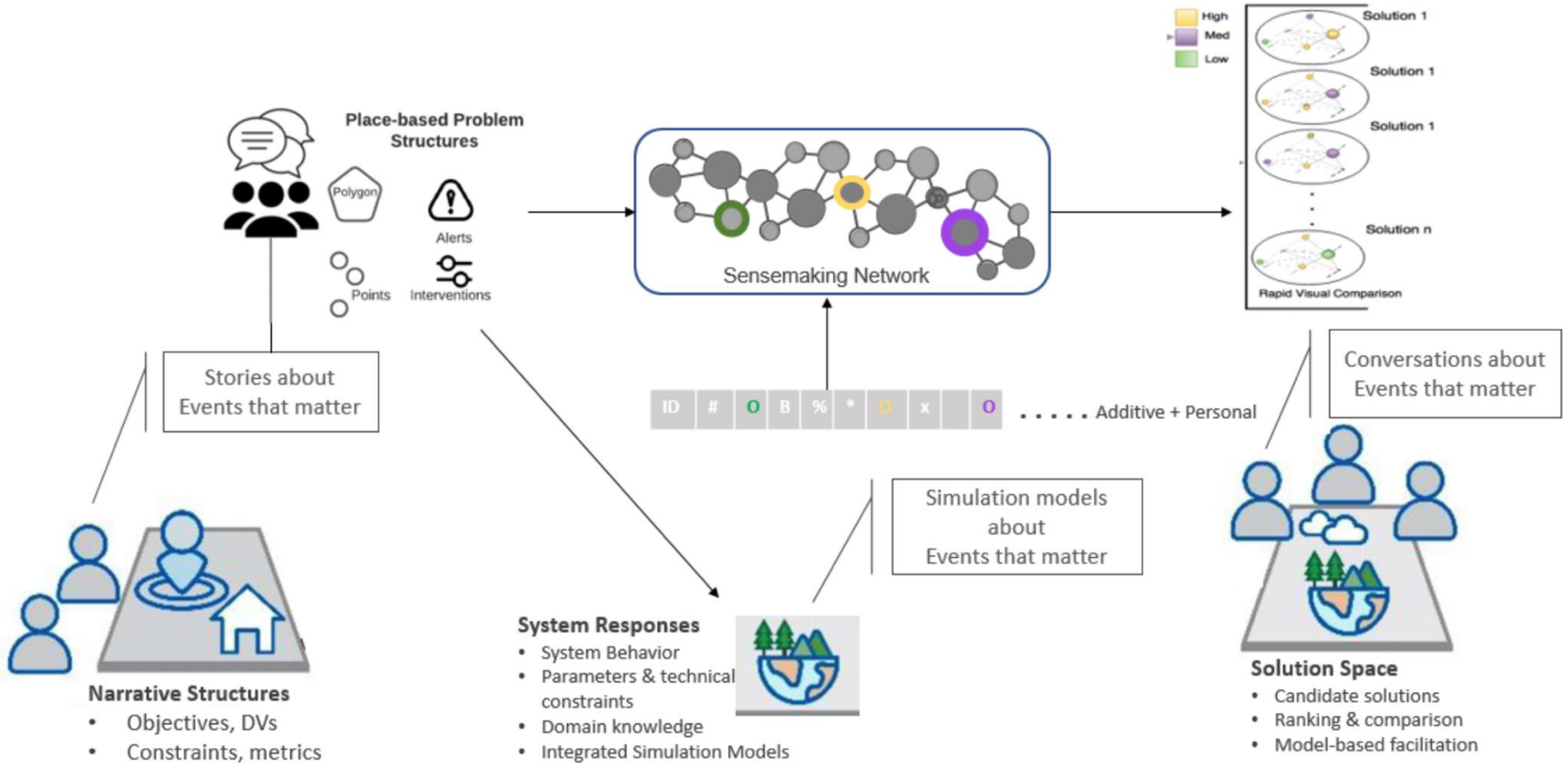
Creating a shared organizational structure to target aspects of participatory processes.

Research Focus for DSO Group

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

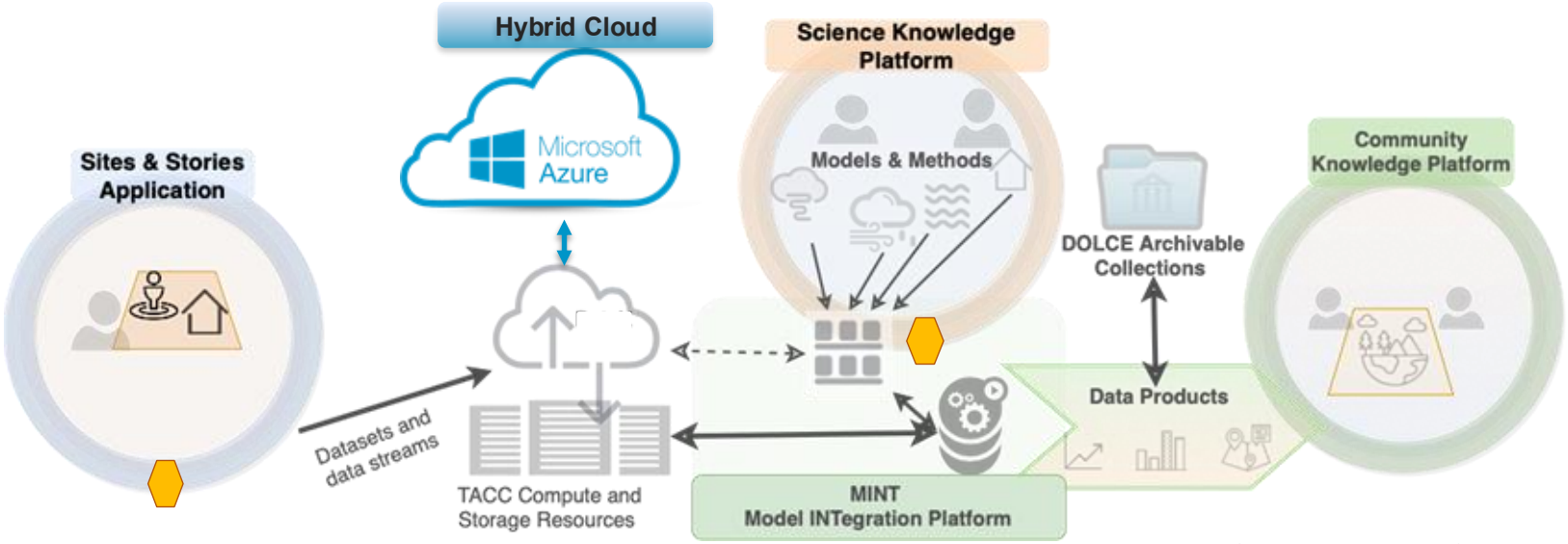
Humans-In-the-Loop

Human Computer Interaction and Knowledge Graphs



Create Deep Relational Testbed

Story Informed Collections	Problem Setup & Semantic Links	Many observations <u>for</u> models

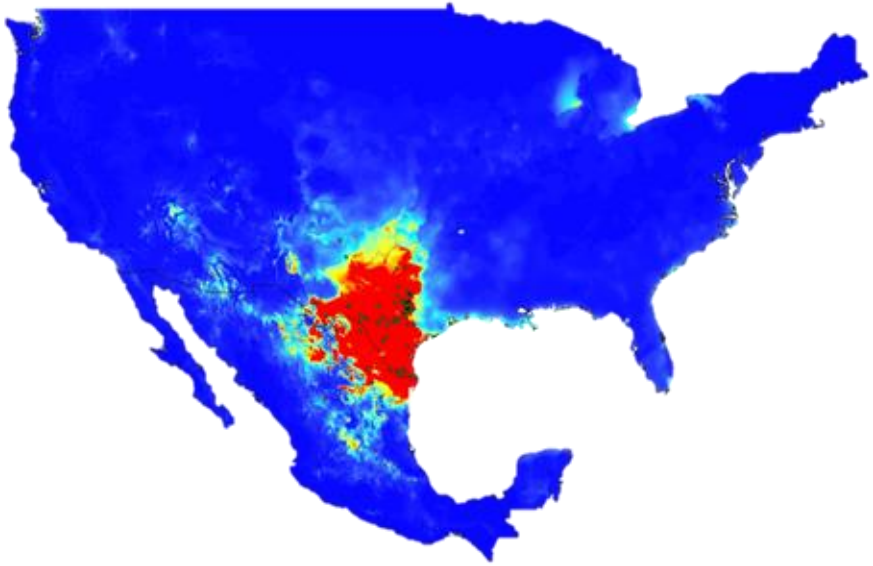


<u>Interactive Knowledge Capture</u>
- Natural User Interfaces
- AI supported annotation and labeling
- Co-designed inputs and XR
- Understanding lived experiences

<u>Model Integration</u>
- Data Fusion
- Semantic Knowledge Service
- Geospatial Webservices
- Large-scale Model Encapsulation
- Integrated Modeling

<u>Socio-technical Codesign</u>
- Group Interactions
- Modeled Products and
- XR Interactive Graphics

Fusion – Leaning In to Open



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

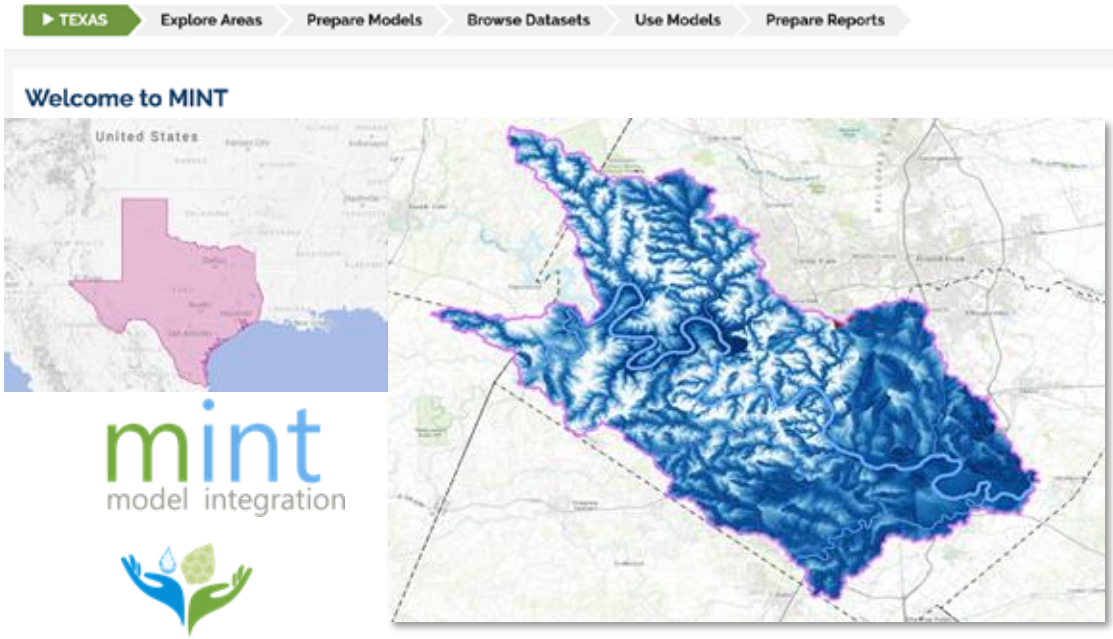
Data fusion to understand cascading impacts.

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)

Integration – Encapsulating Environments



AI-enabled Model INTegration Platform

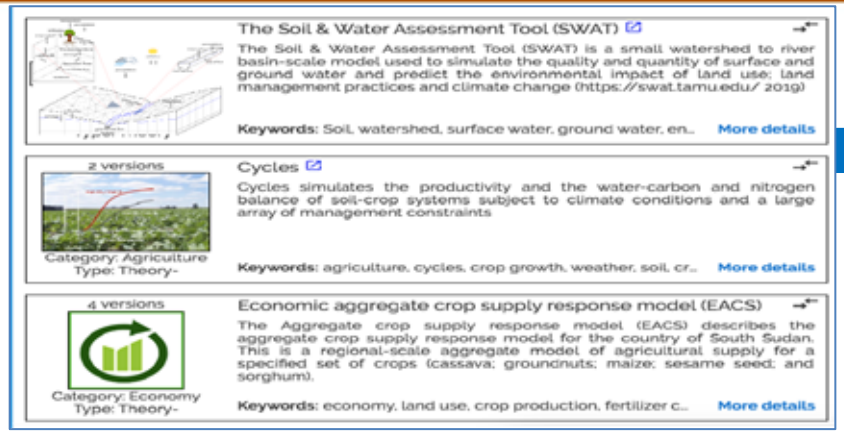
A platform for using artificial intelligence to accelerate:

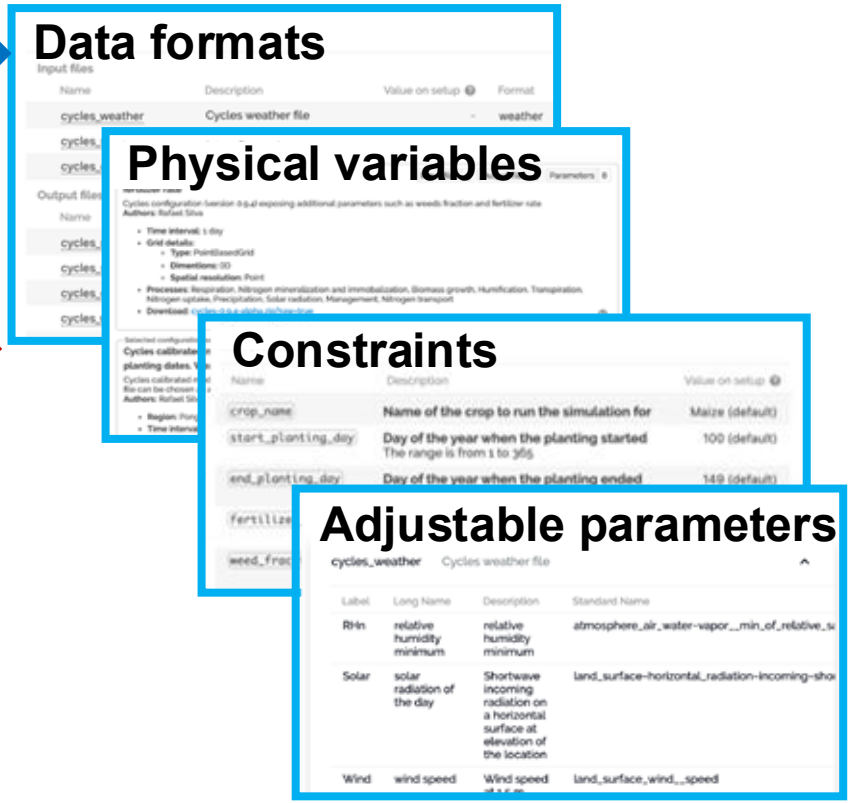
- Connecting data to models
- Composing sophisticated high-fidelity models
- Guiding analysts through easy to follow phases and steps via a user interface that simplifies the complexity.

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

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

From Models to Solutions



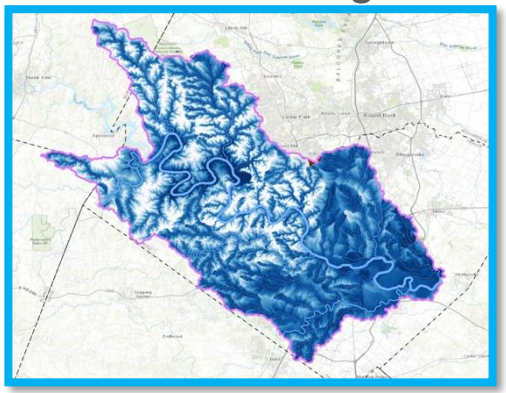


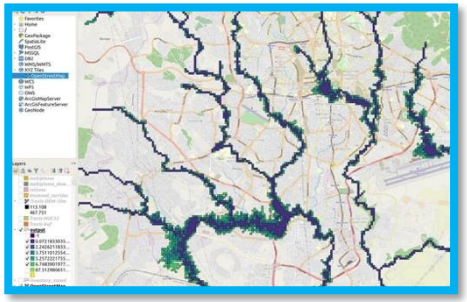
Work with Yolanda Gil, Daniel Garijo, Maximiliano Osorio, Hernan Vargas, Deborah Khider (USC), Anna Dabrowski and Lissa Pearson(UT)

mint
model integration

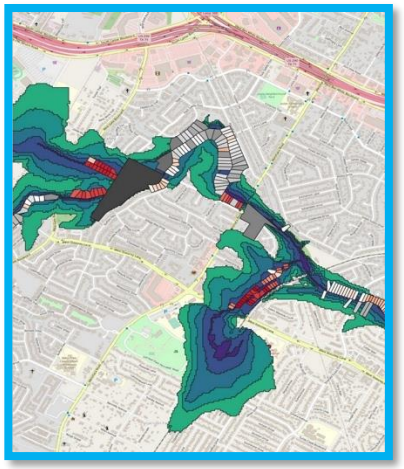
Recombine Models with Data

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



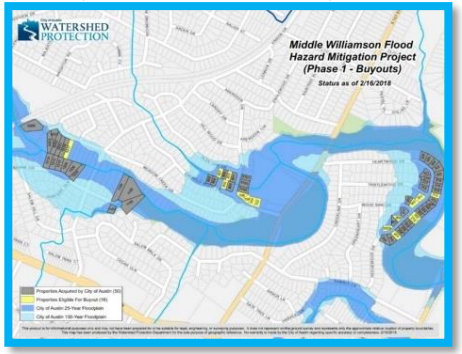


Travis County



Comparison Williamson County

Manually Constructed Buyout Map



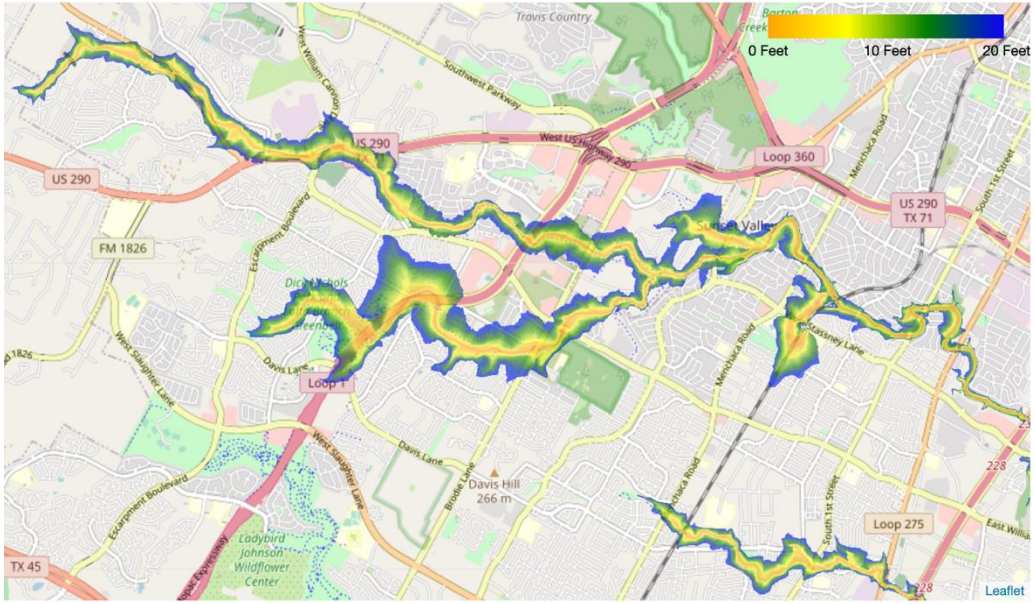
MINT Generated Vulnerability Map

Combining

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

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

Visualization of Indicator
HAND Model Results ready <10 minutes

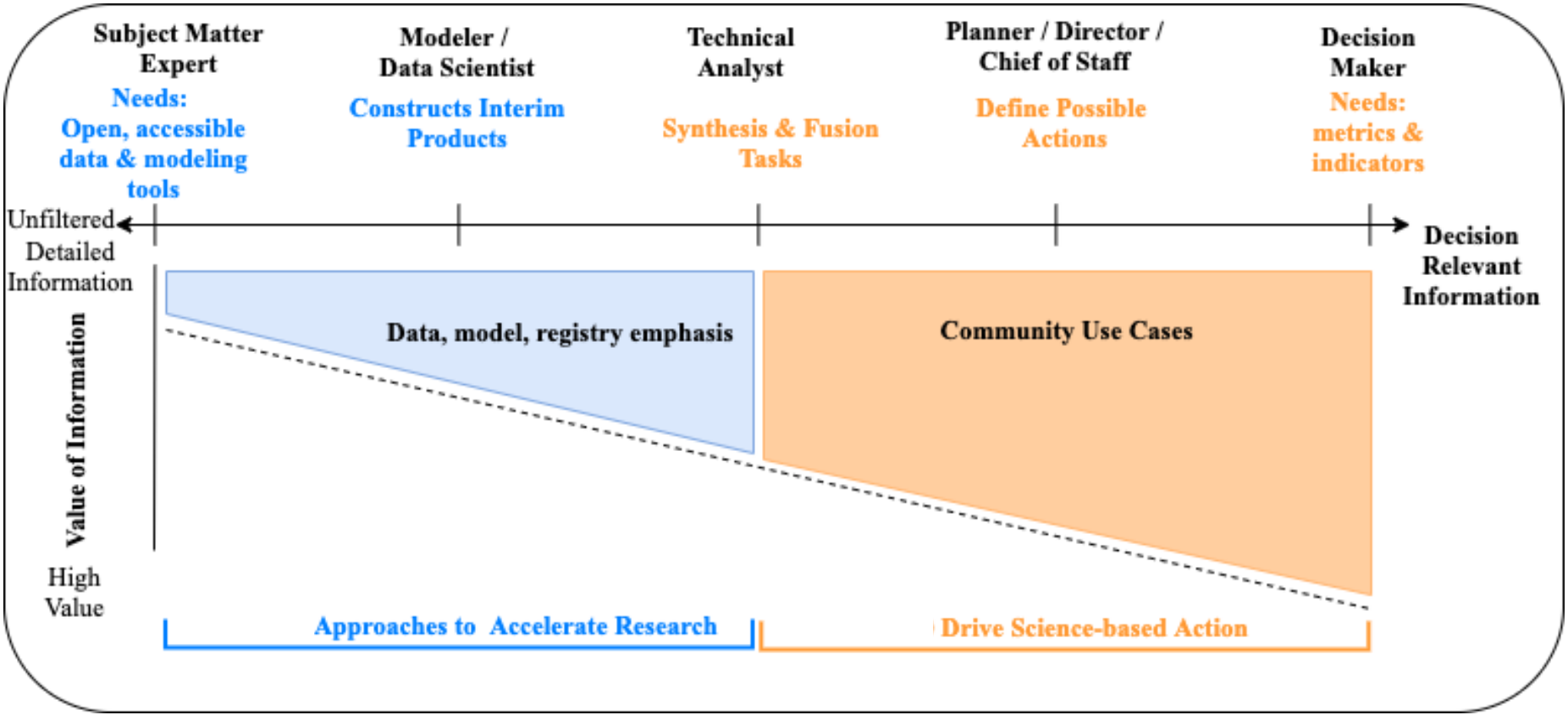


Data and Models are
The best tools we have to understand our critical Earth resources

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

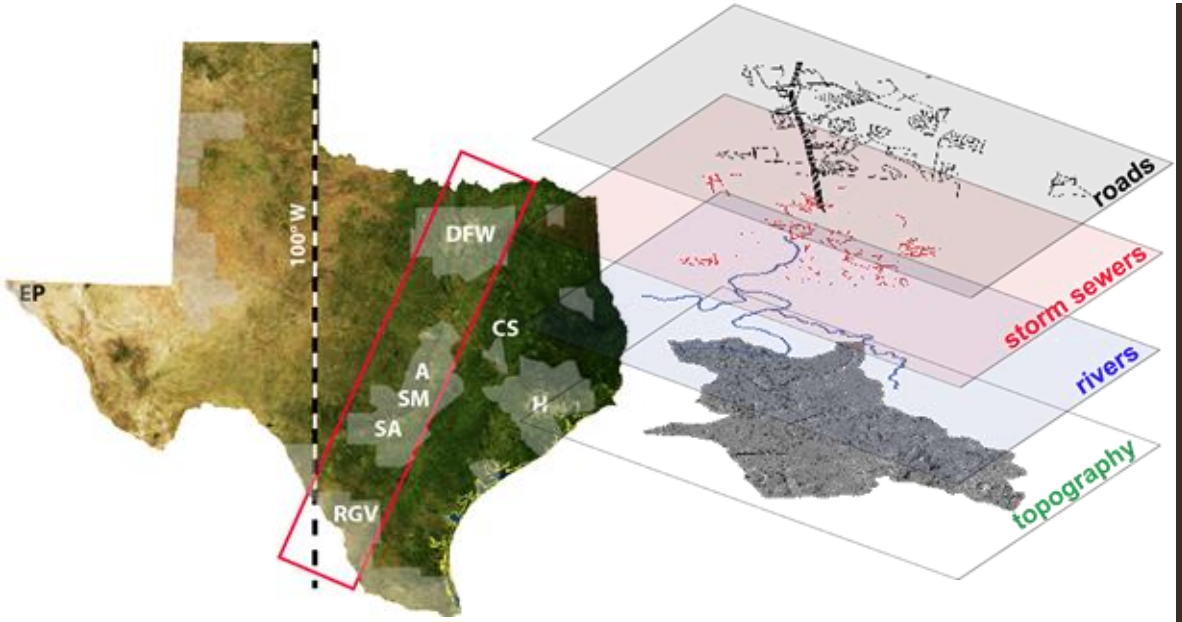
Data Fusion to Refine and Build Insight

Expanding the Application Space



Knowledge Value Chain

Flipping Knowledge Exchange



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)

Sociotechnical Infrastructure

Summary: Sites & Stories Streamlines Automation for Sensemaking

Prompts	Datasets	Analysis	Iterate	Results
Formulate specific prompts for HAI • What analysis can be done that will serve the analyst's questions? • What are possible driving and response variables? • What types of interventions are of interest?	**Create Ingest Pipelines,** • What are the relevant data collections available? • What are the useful use cases? • How can an approach be calibrated?	**Develop Approaches and Cookbooks** What are relevant datasets for driving variables • What are the characteristics of each dataset? • What datasets will not work with the models chosen? • What datasets to use?	**Set up Experimental Workbench** • What adjustments needed to make accessible? • How to set up consistent reusable resources? • How to organize orchestrate experiments with provenance tracking?	**Curation workflows, and Collections** • What are the relevant data collections we can build? • How can large collections be organized? • What are useful data collection products suitable for supporting and scaling research?

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

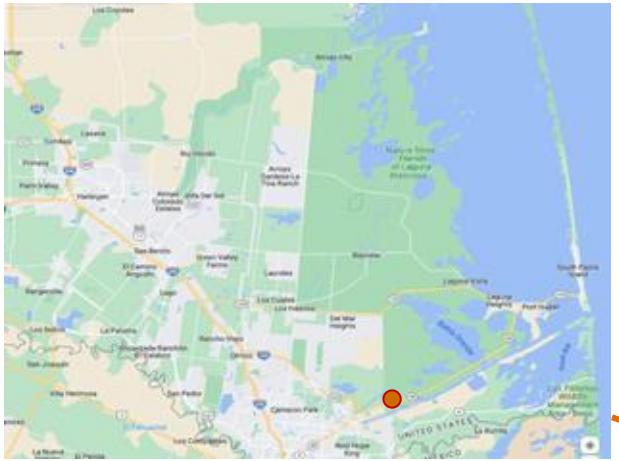
TEXAS
The University of Texas at Austin

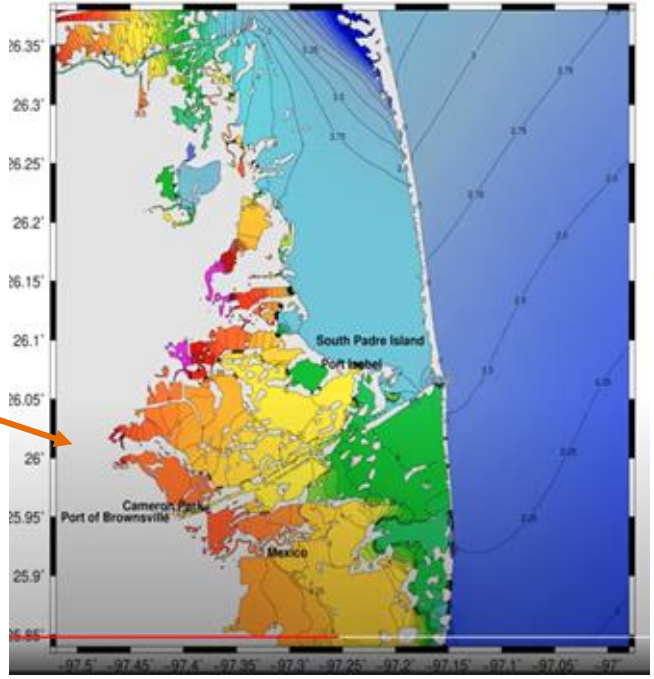
Story Informed Collections

- Many Observations
- From unstructured to accessible information

MUSEUM OF SOUTH TEXAS HISTORY

Story Informed Collections	Problem Setup & Semantic Links	Many observations for models



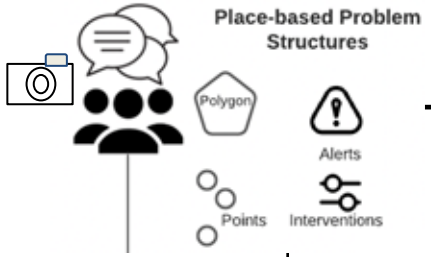


Lived Experiences

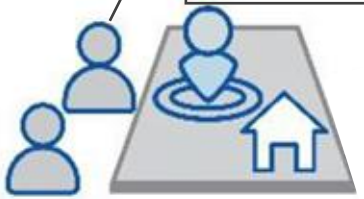
techniques and tools for

knowledge capture of unstructured data

Knowledge Capture

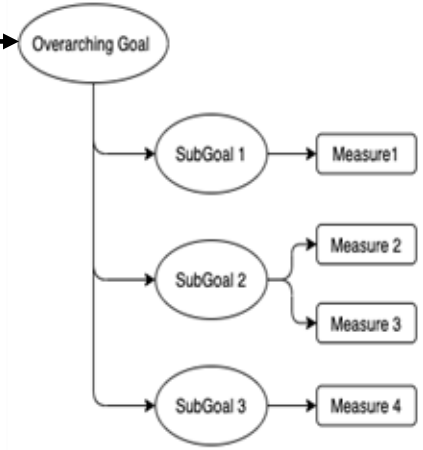


Stories about Events that matter



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



Knowledge Capture Modalities

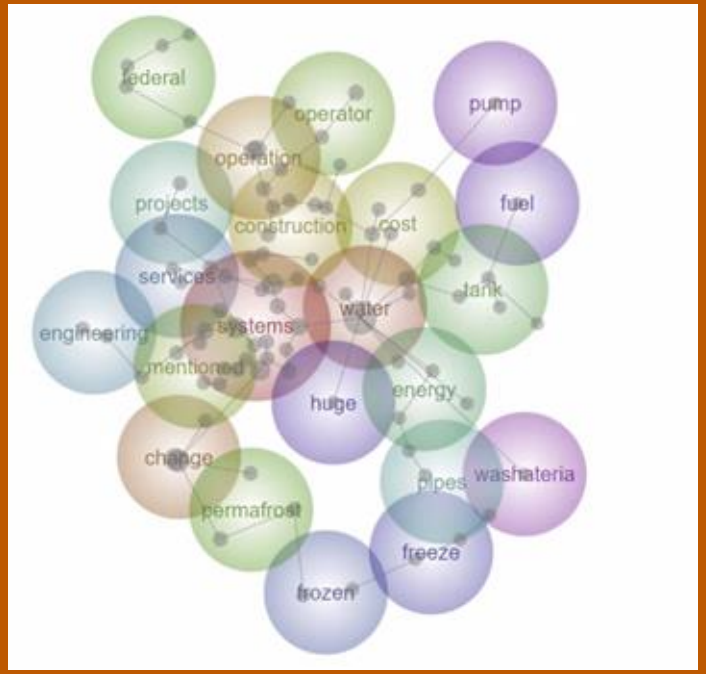
- Audio Voice Capture
- Text Annotation
- Natural User Interface
- Interactive 3D tangibles

Links with

- Simulation Model Parameters
- Semantic Data System
- Policy & Scenario Settings
- Algorithms & iDSS

Flipping Knowledge Exchange

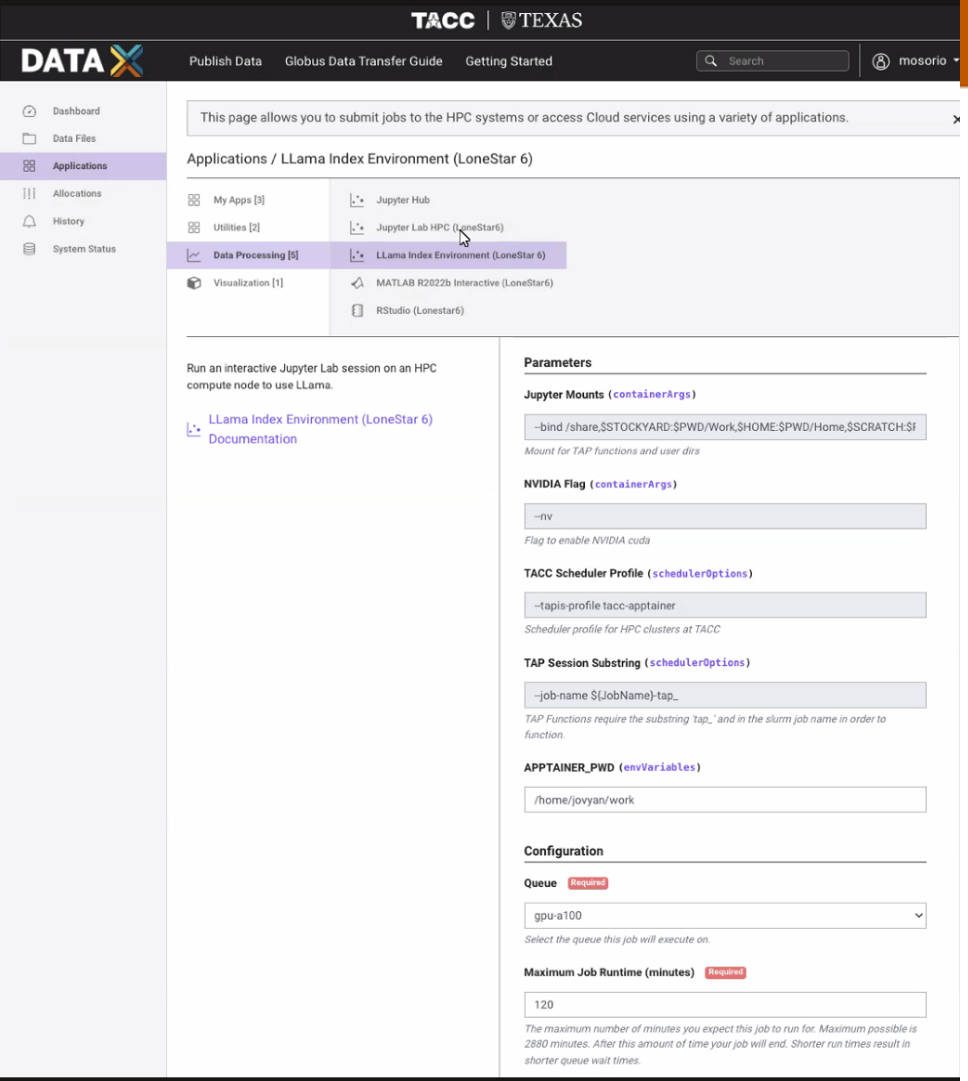
(Water Infrastructure Systems - Alaskan Case Studies)



Theme	Hits
water	430
change	199
systems	168
operation	123
operator	96
permafrost	72
cost	66
federal	60
energy	49
projects	48
construction	46
mentioned	43
engineering	41
pipes	34
freeze	33
tank	33
frozen	30

Preliminary NLP Analyses of Community Perspectives on Alaskan Water Infrastructure

Navigating the New Arctic, PI- Faust NSF Award Number # 2127353



Reusable Environments and Digital Infrastructure

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

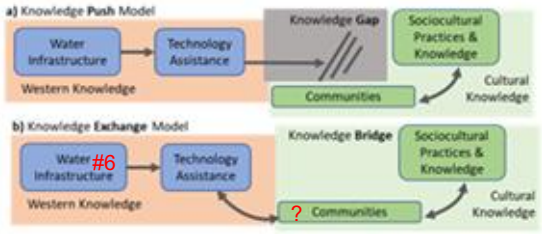
Sharable Modeling Environments
– Kubernetes and Azure
- Model Evaluation and Execution

Near Future …
- Conversational AI and Interactive Interfaces

Combined Corpera

NLP + Information Reduction
LLM + PRIM

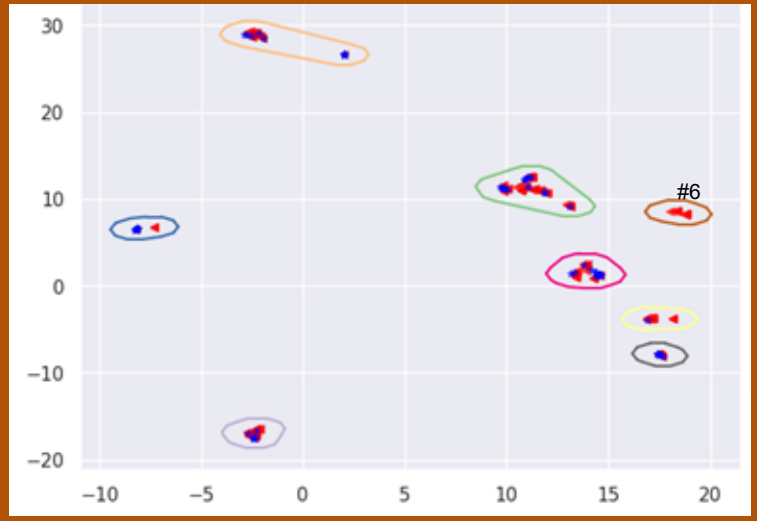
Gray Literature-to-Interviews



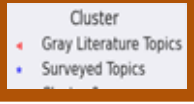
Implementation model that identifies knowledge gap and explores options for an 'exchange' approach

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



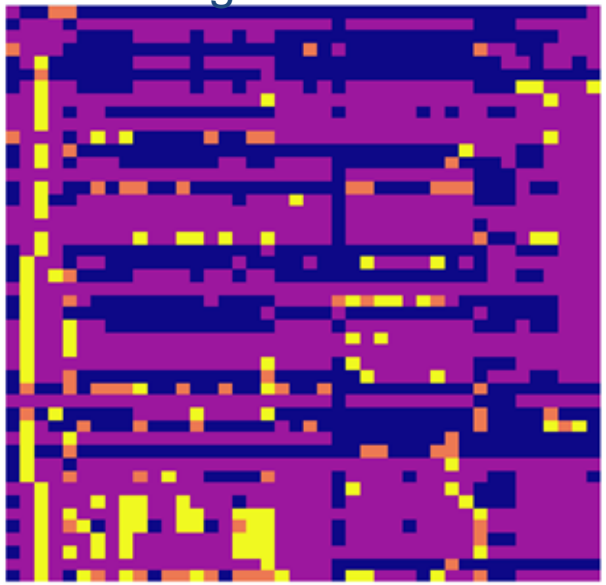
NNA Products from Research

- 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

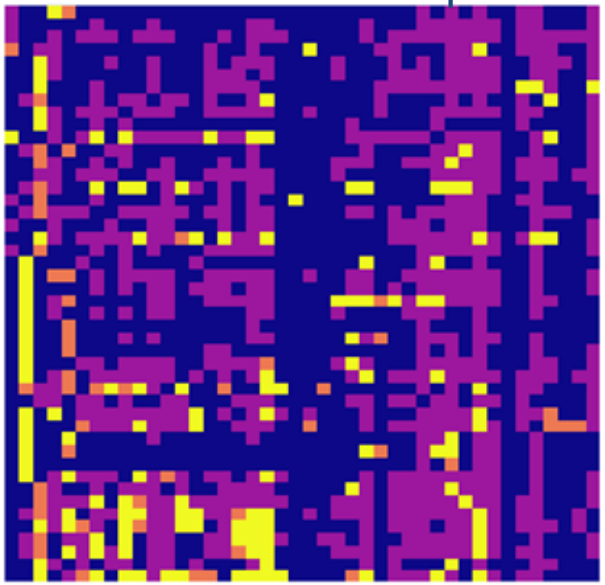
Social Science Coding with AI: Iterative development

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

Original AI



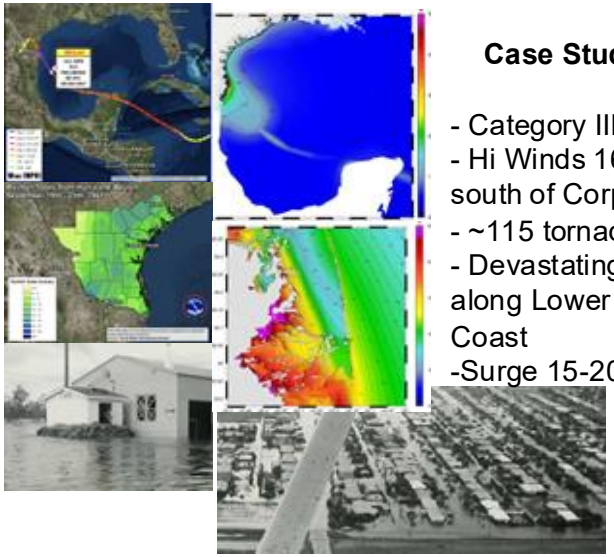
Round 1 AI Prompts



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

Story Informed Collections

Fusion Collections for Historic Events

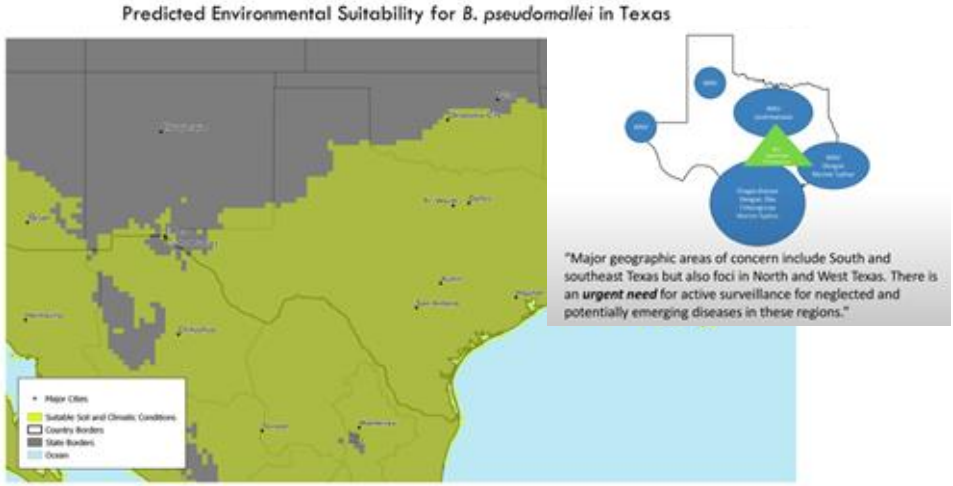


Case Study Beulah

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

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

Cascading Hazards - Floods + Infectious Disease Prediction



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

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Pierce, S.A. 2008. Pieces of a puzzle: Why transdisciplinary socioฉ\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 20จC24, 2008. Published by American Institute of Professional Geologists.

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Urban Integrated Field Laboratories
US DOE

NSF

Museum of South Texas History

Azure

Extra Slides

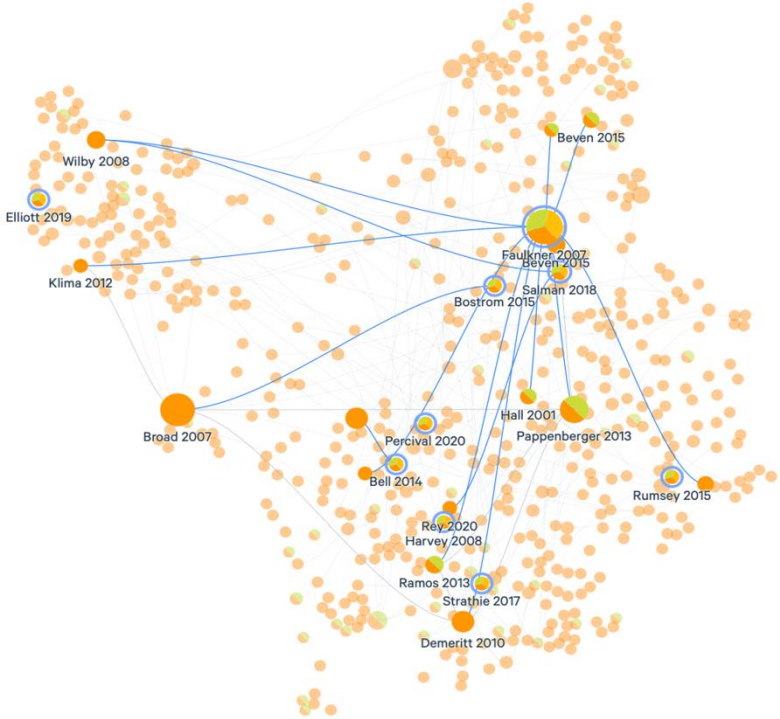
"Sometimes simple can be good, but other times you may need more detail"

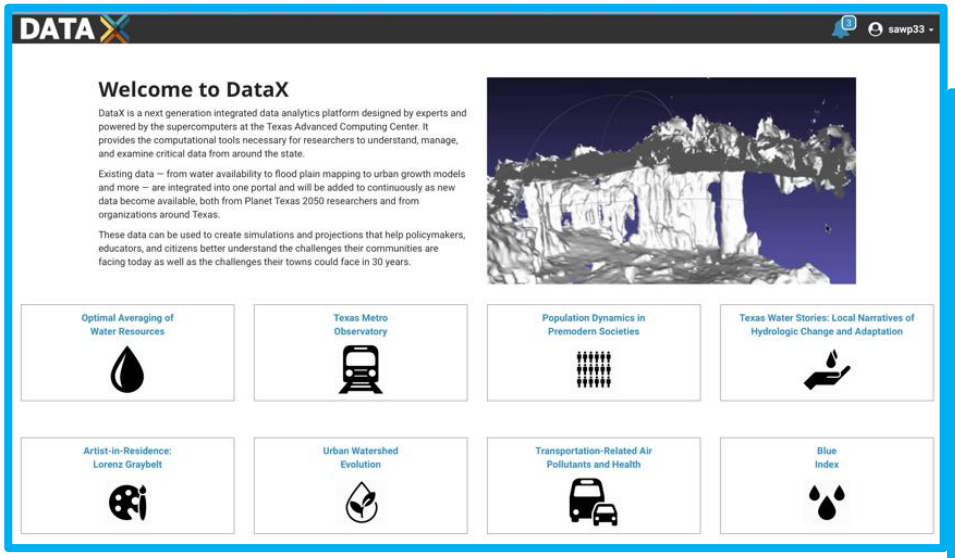
Uncertainty Comms Takeaways

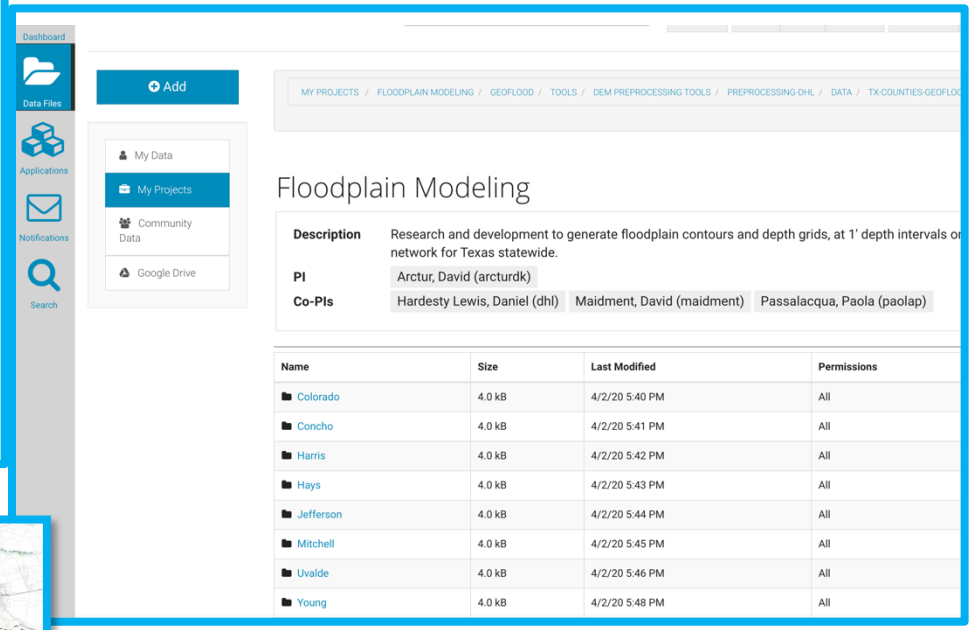
Insights from Coastal Hazards Communication:

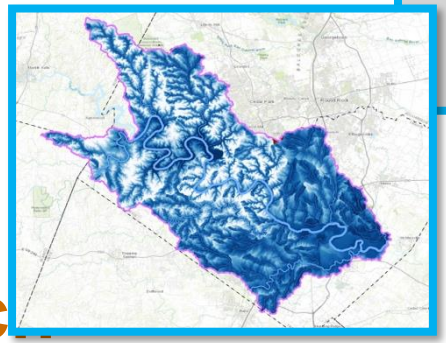
- Essentially, we need experts to agree on how to present and describe the uncertainty in models
- Uncertainty should be factored into the actionable 'so what' for end users who are given risk information
- Relevant stakeholders or end users need to be involved early
- Communication channels should be 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 -







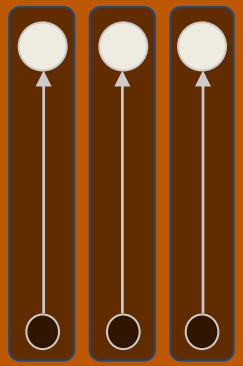


Data Workbench

Work with TACC,
Jeaime 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)

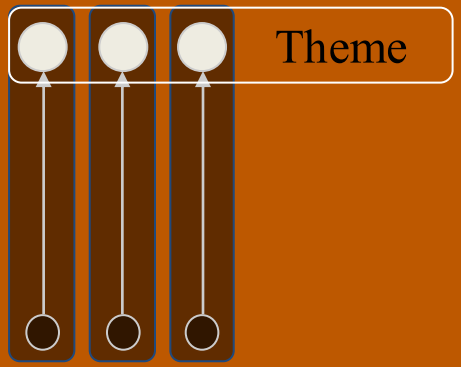
Intentionality…

Disciplinary

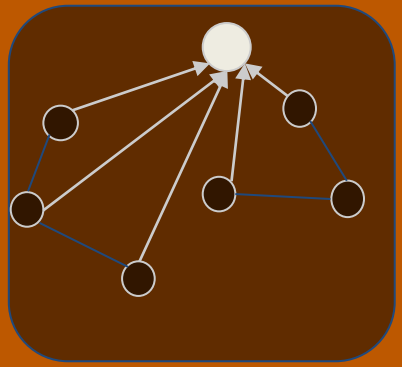


Researchers

Multidisciplinary



Interdisciplinary



Shared Research Goal

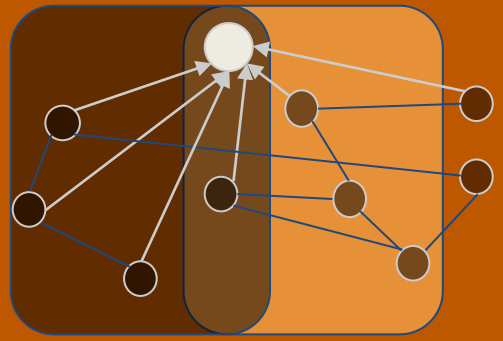
(Pennington et al., 2019)

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

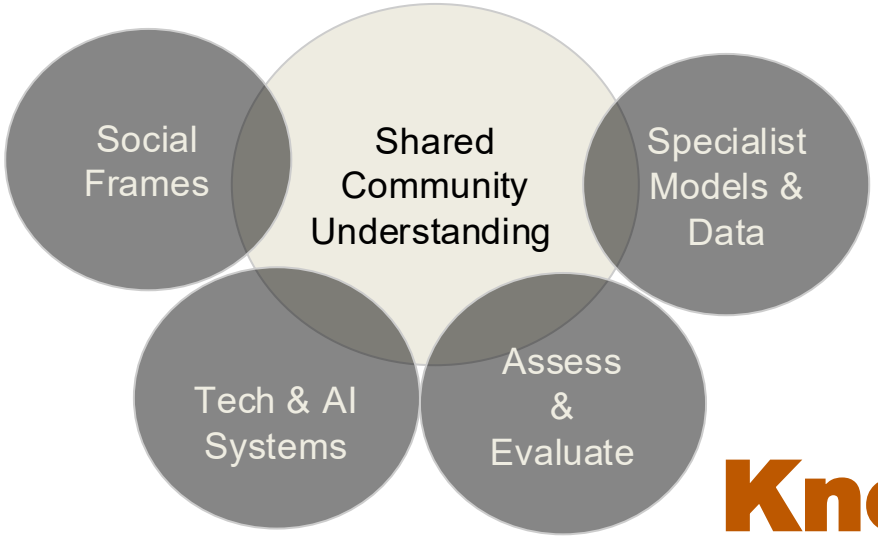
Transdisciplinary



Shared Frameworks

(Pennington et al., 2019)

Convergent Thinking



Fusion, Integration & Knowledge Exchange

Emerging Data Management Services (CSR and DMC)

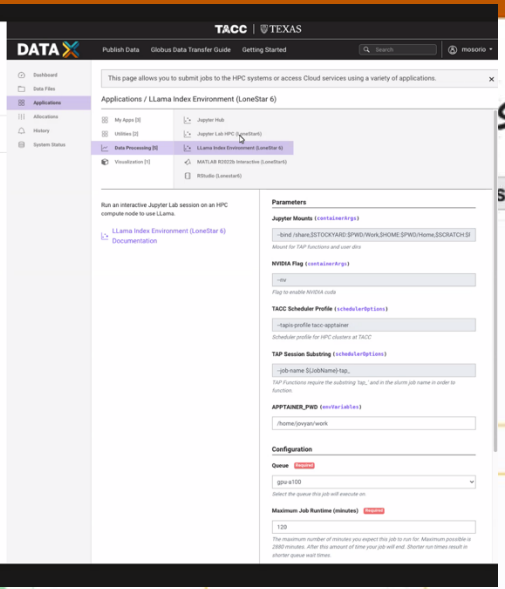
- Cookbooks Services
- MEEP / DYNAMO
- Knowledge Capture (remote data collection with disconnected / remote environments) Unstructured
- DISCOVERY - CoreDB and CoreMiddleware (mechanisms for registering data and information with our services) – data/metadata to manage and use the storage capabilities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

Reusable Code Cookbooks

Cookbook UI

Slide Subtitle

- Added LlaMa application to the DataX portal



SUALIZATION

stems

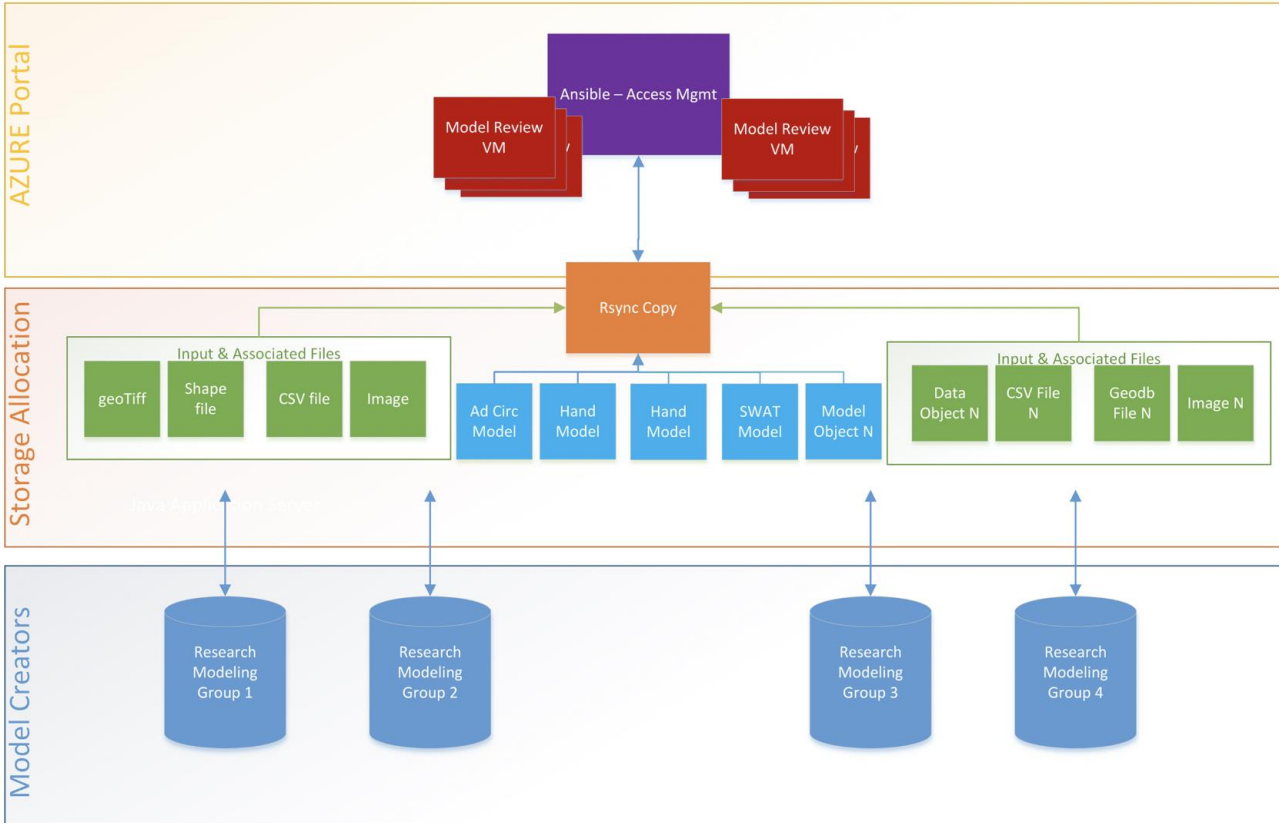
Varying Github Repo

perform tasks.

Ingest unstructured Information

- Survey123
- 4 slides nna nov.

Model Evaluation & Execution Platform

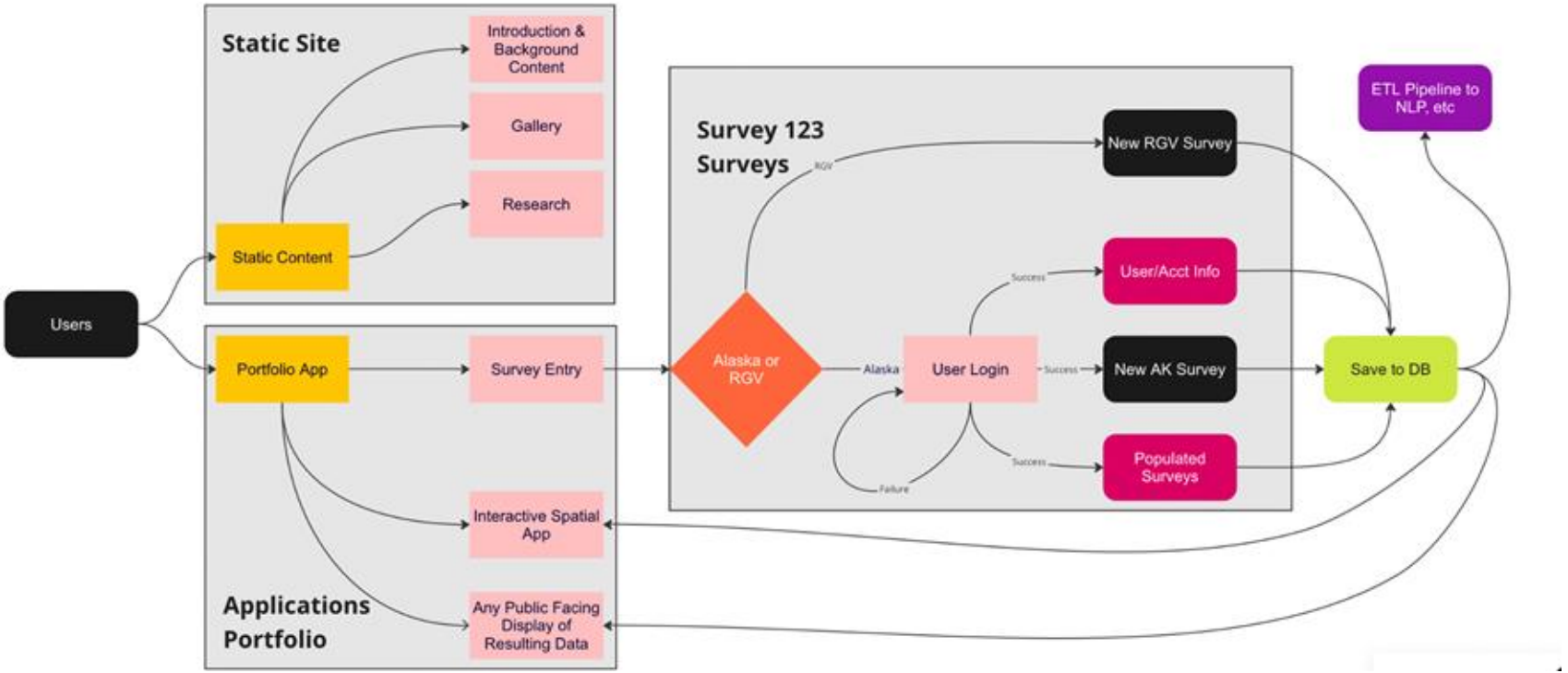


MEEP

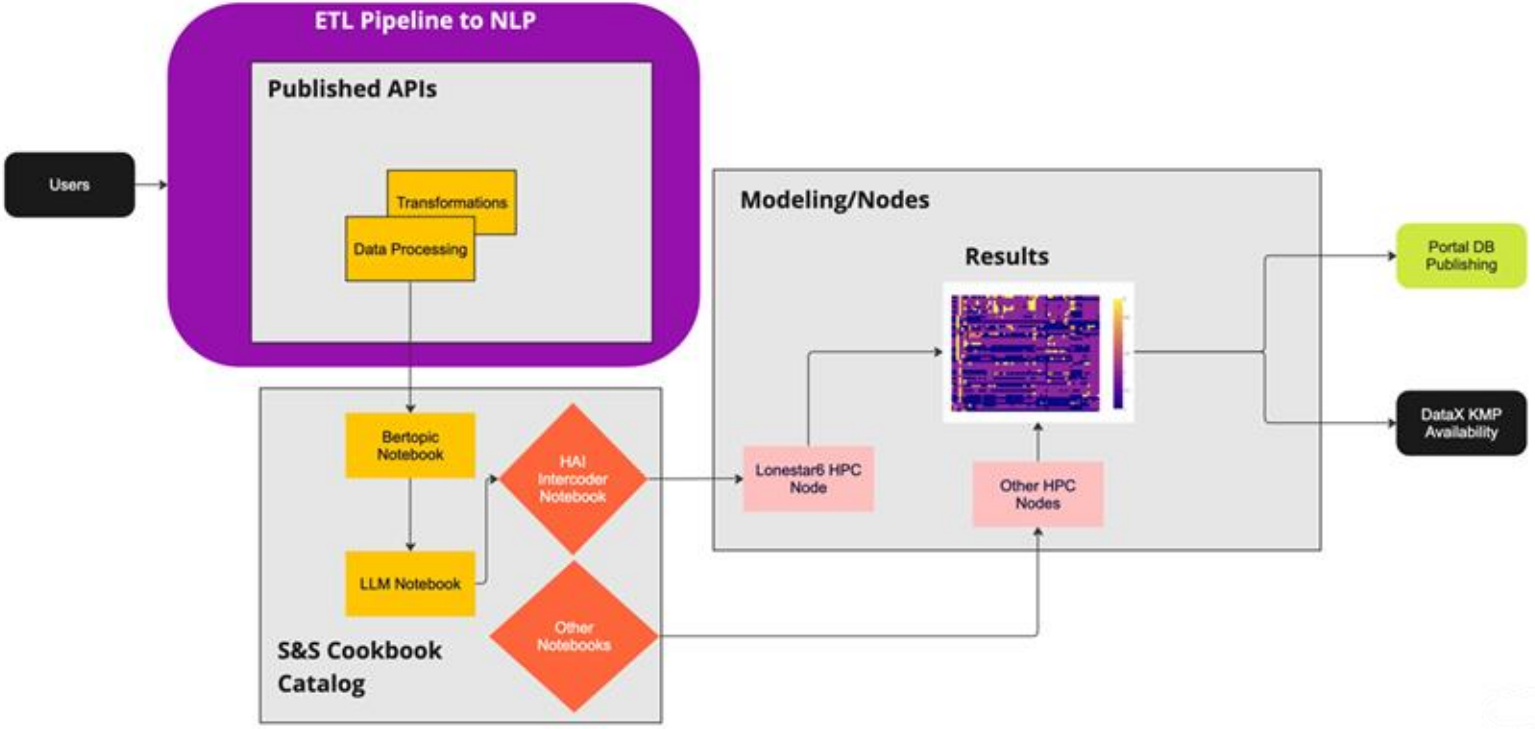
Reusable Kubernetes Services.

- 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.

Knowledge Capture Architecture



Analytical Cookbooks Architecture



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

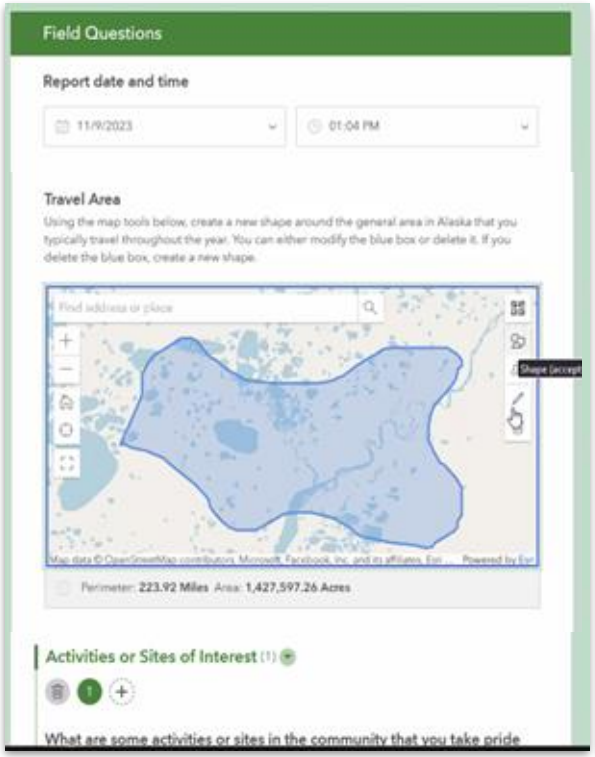
Alert! Sensitive information needs to be processed by selecting an appropriate option in following sections of this survey. Next step is to complete design for UI, apply for IRB and Secure Allocation to setup.

Researcher Profile & Interviewee Information

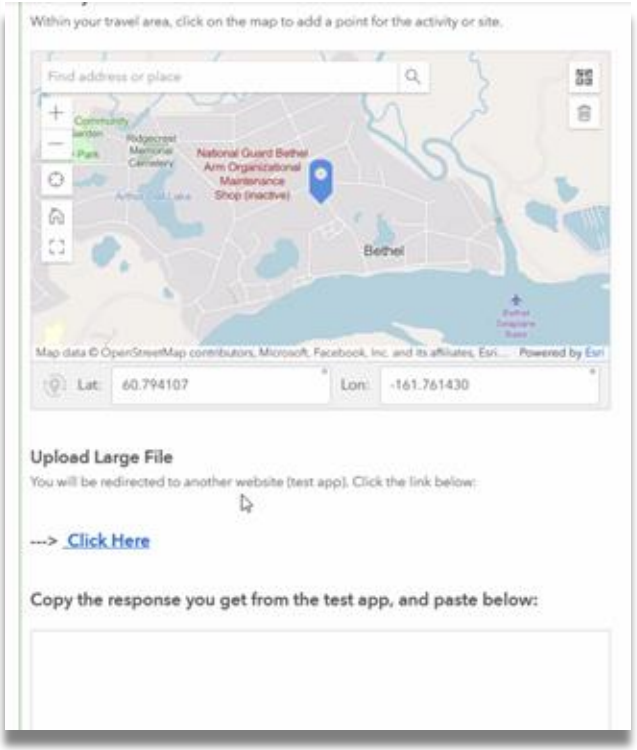
Login Credentials for Researcher only

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

Knowledge Capture Ingest Options



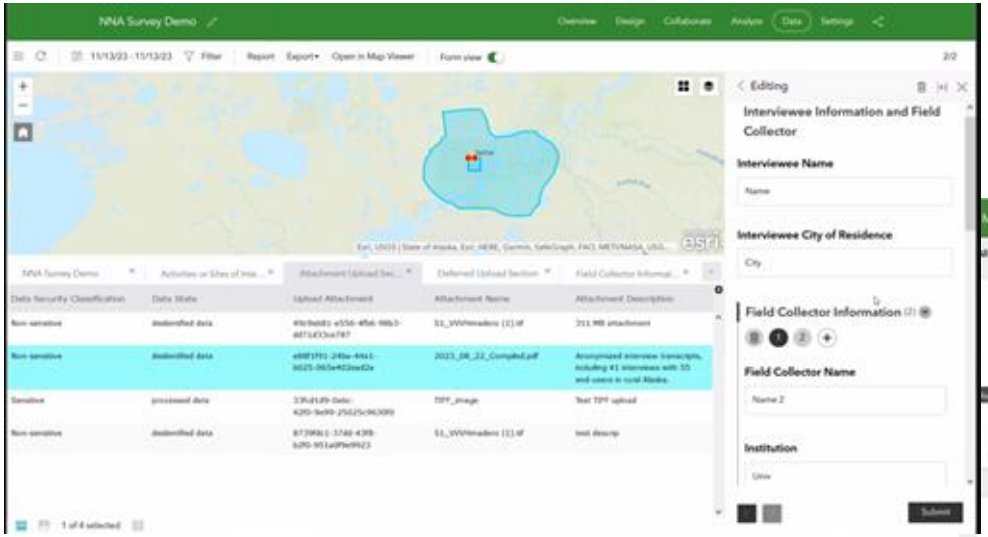
Simple Field Form



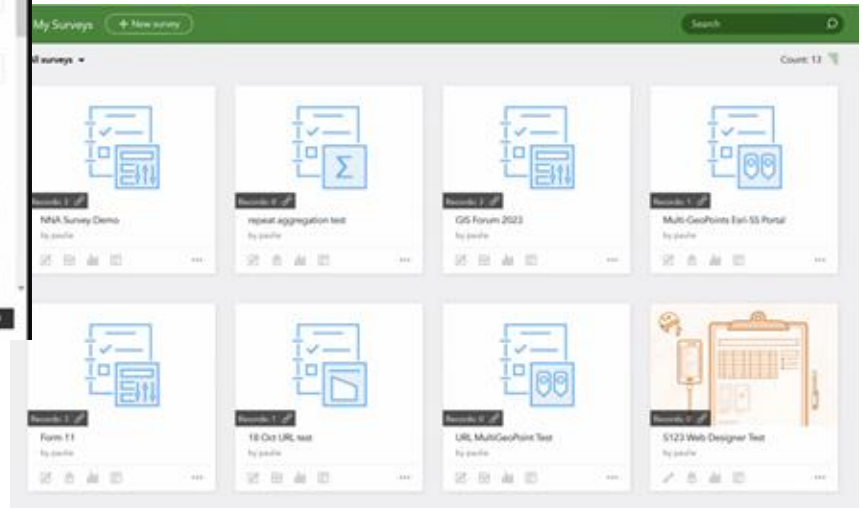
Ingest Form <1.2GB

Ingest Form <2TB

Metadata Registry & Curation



Post Processing



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