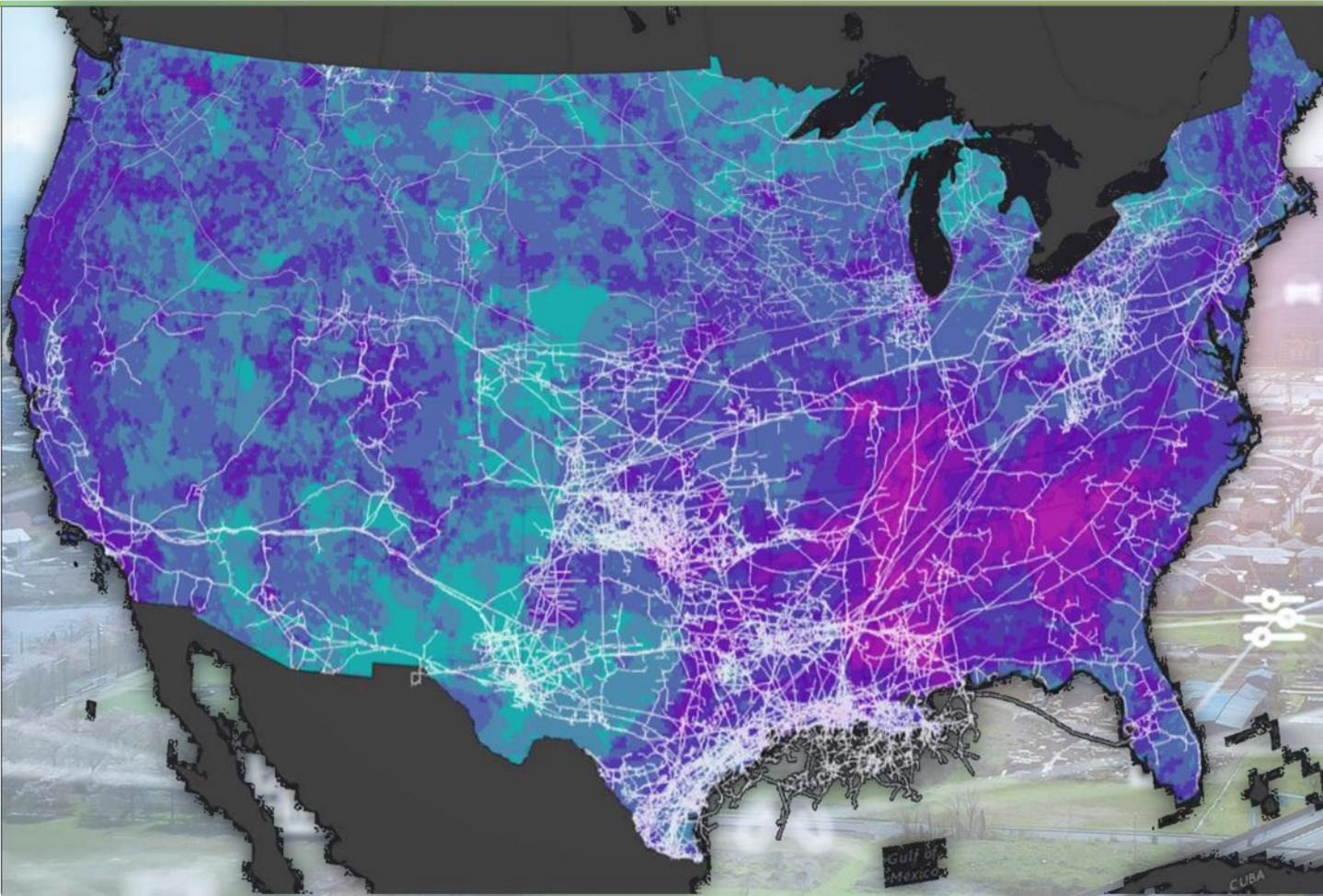


Leveraging AI and Spatial Data to Unlock Pipeline Integrity Insights: NETL's Advanced Infrastructure Integrity Model (AIIM)



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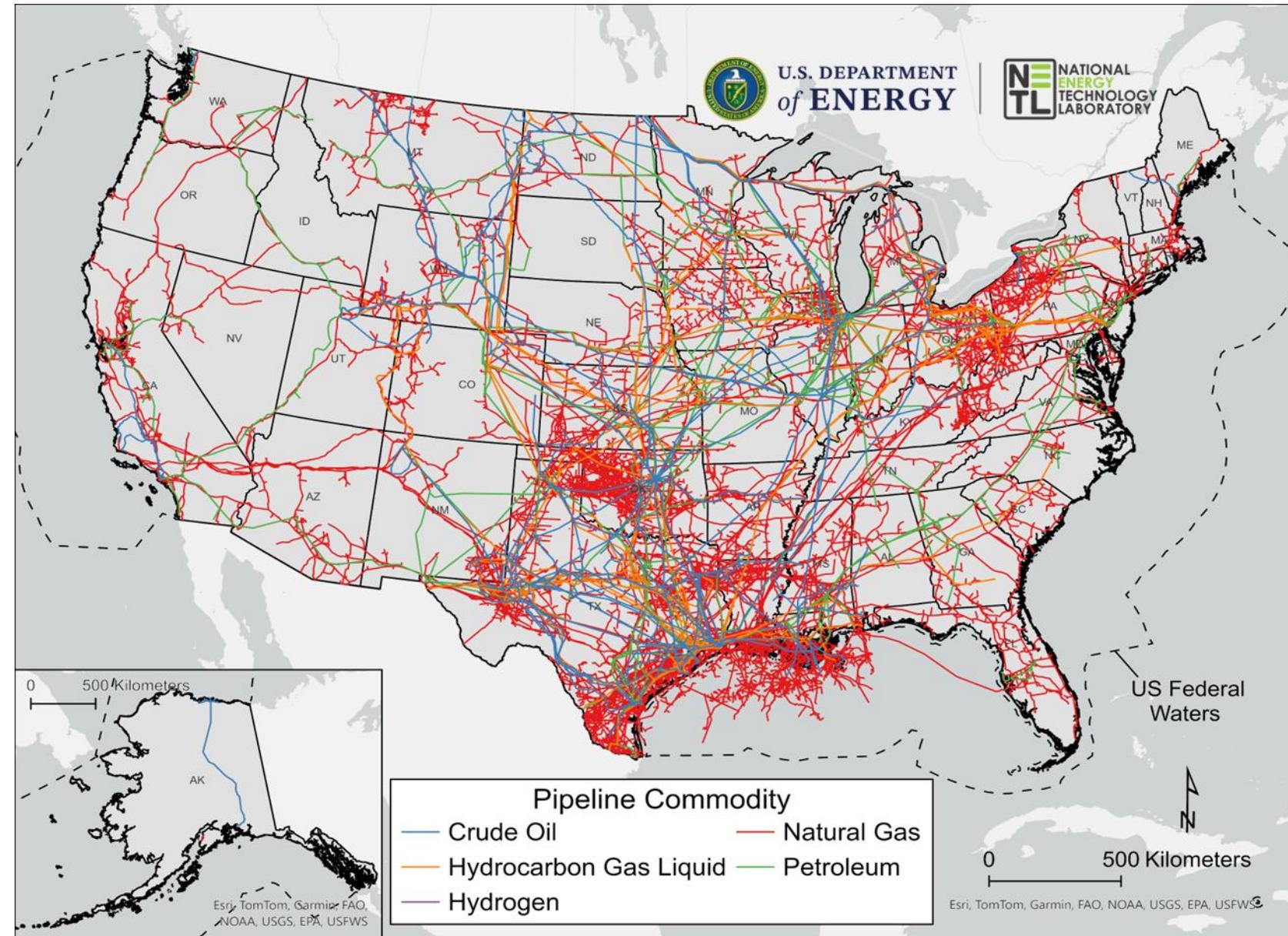
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- Maintaining the integrity of natural gas infrastructure plays a **critical role in ensuring energy security**
- **Robust, data-driven foundational AI models** for pipeline integrity can help address risk management and mitigation issues
- Trusted foundational models can help with **industry adoption and accelerate innovation** by enhancing integrity predictions, reduce costs, and informing infrastructure build-out



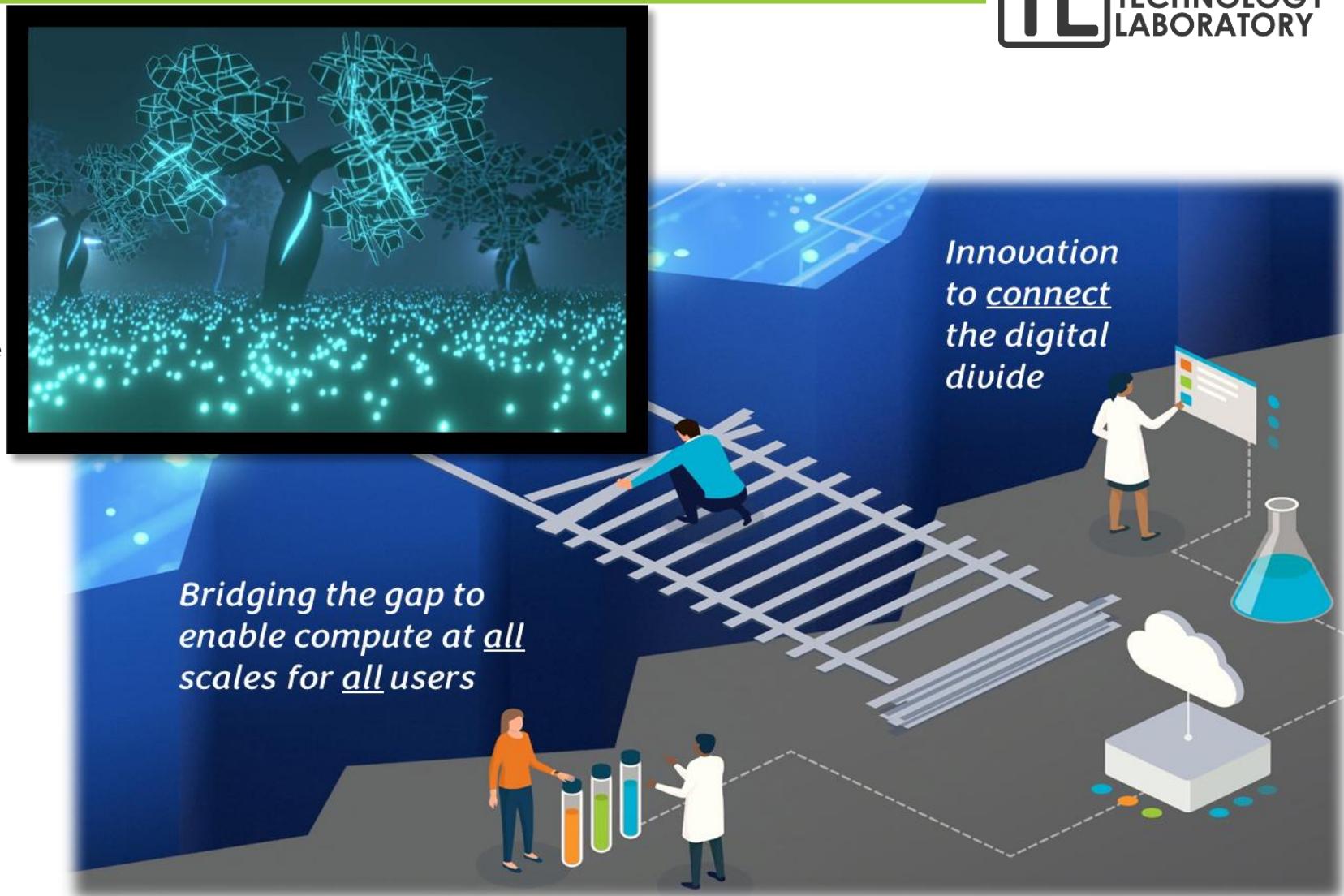
Data: keystone to digital innovation

- **AI foundational models are heavy data consumers**
- **Many data-driven projects are starved for information**

Crowd Flower study estimates 80% of researcher project time is spent searching for relevant, existing data

<https://visit.figure-eight.com/2015-data-scientist-report>

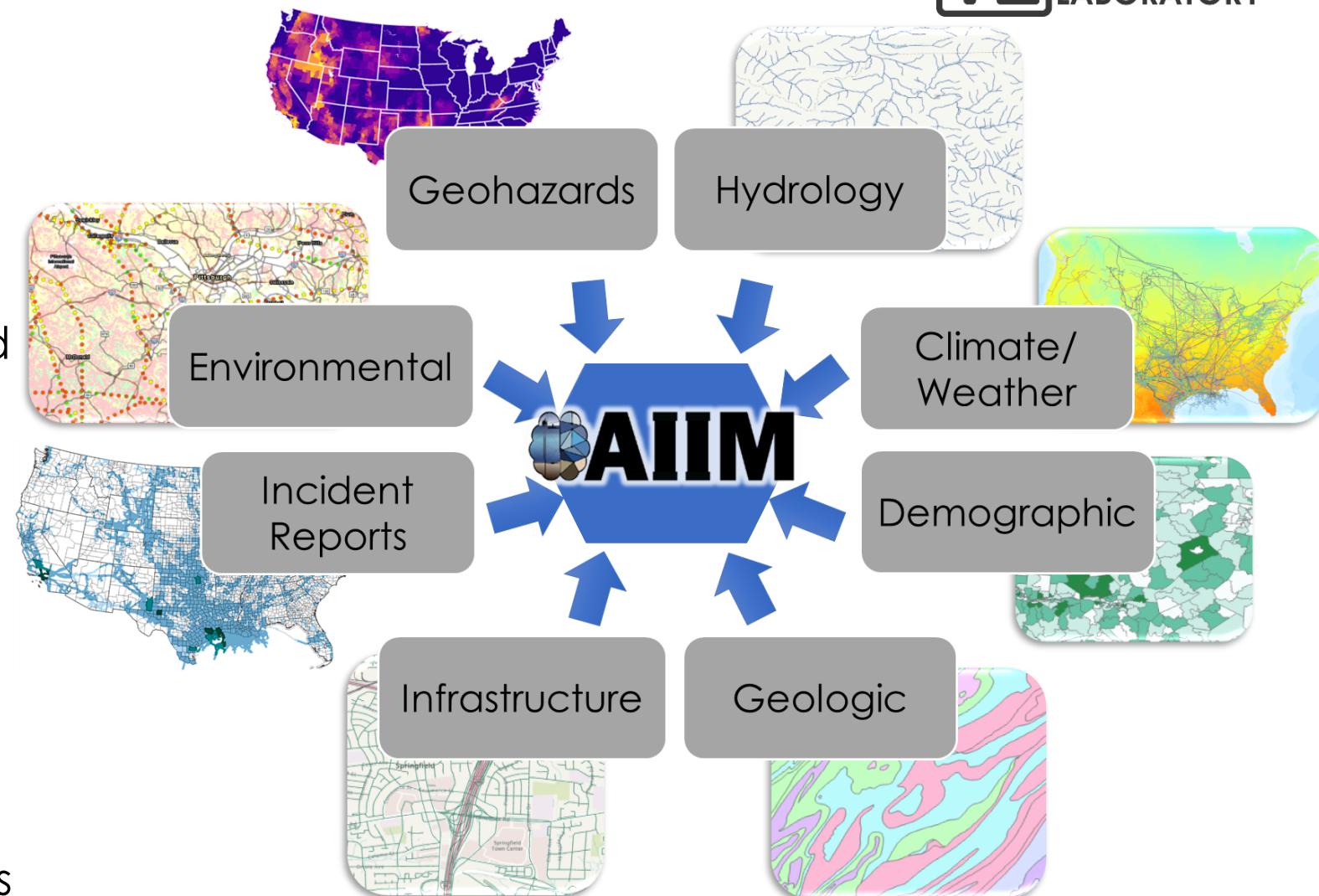
- **Requires access to data resources from different sensors, disciplines, and resources to improve our understanding of the system and improve model performance in forecasting integrity**



Advanced Infrastructure Integrity Model (AIIM)



- Released in 2022
- A big-data-driven, artificial intelligence/machine learning (AI/ML) foundational model
- Originally designed to assess offshore energy infrastructure and forecast remaining lifespan and integrity risk
- Generalist nature of model is allowing us to update now for onshore infrastructure
- Leverages data spanning the natural-engineered system to inform local predictions from multiple machine learning models



Amassing Big Data for AIIM



Onshore Data

348k+ miles of pipelines

including a grid of **500k+ points along every km of pipe, integrated with 350 associated stress-related values:**

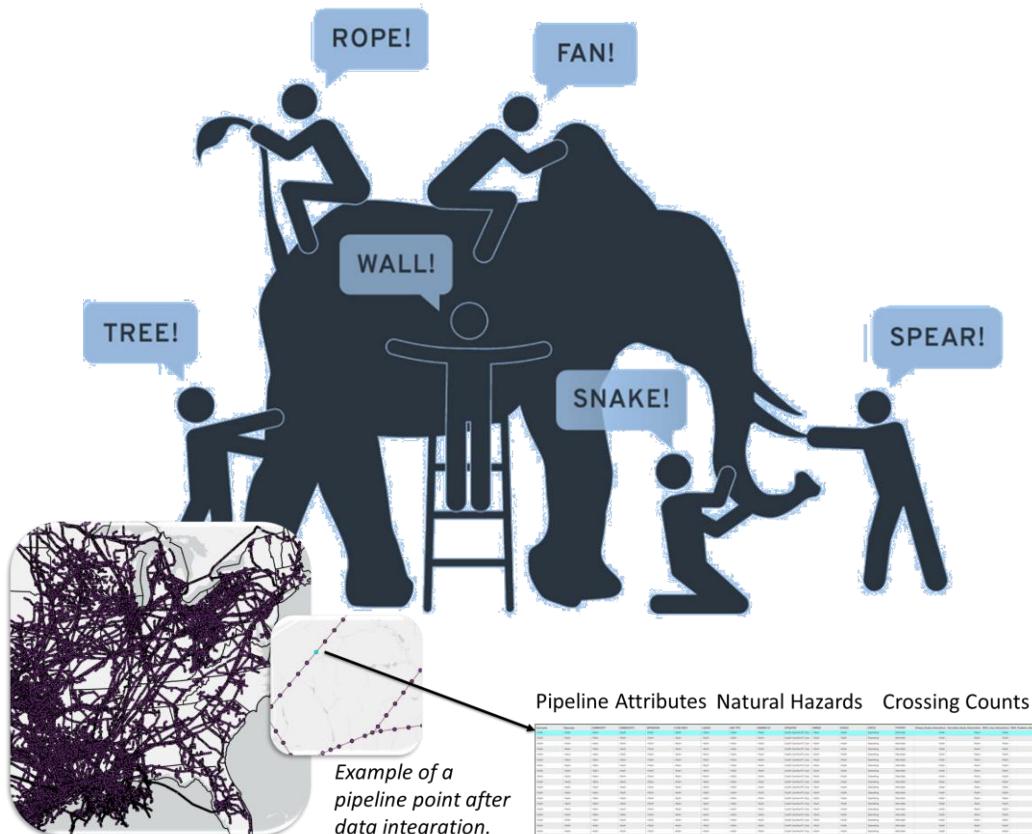
environmental and geohazard layers

proximity to infrastructure

biochemical data

35+ years of PHMSA pipeline incidents

Using the Whole to Inform Local Trends & Predictions



Offshore Data

11k+ platform records

47k+ miles of pipelines

55k+ well records

51k+ environmental and geohazard layers

46GB+ biochemical data

Spatio-temporal production data at the well, platform, and lease block level

70+ years of platform incidents

30+ years of pipeline incidents

50.6GB of monthly ship trackline data



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AIIM data, model & insights* available on

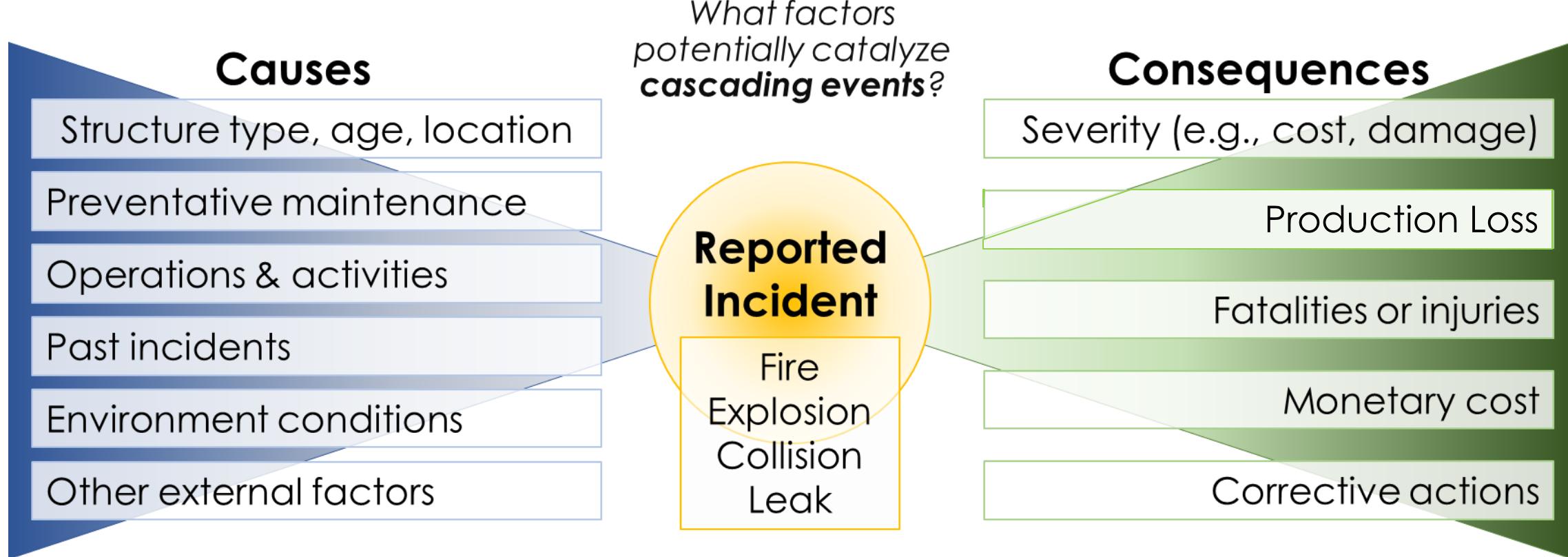


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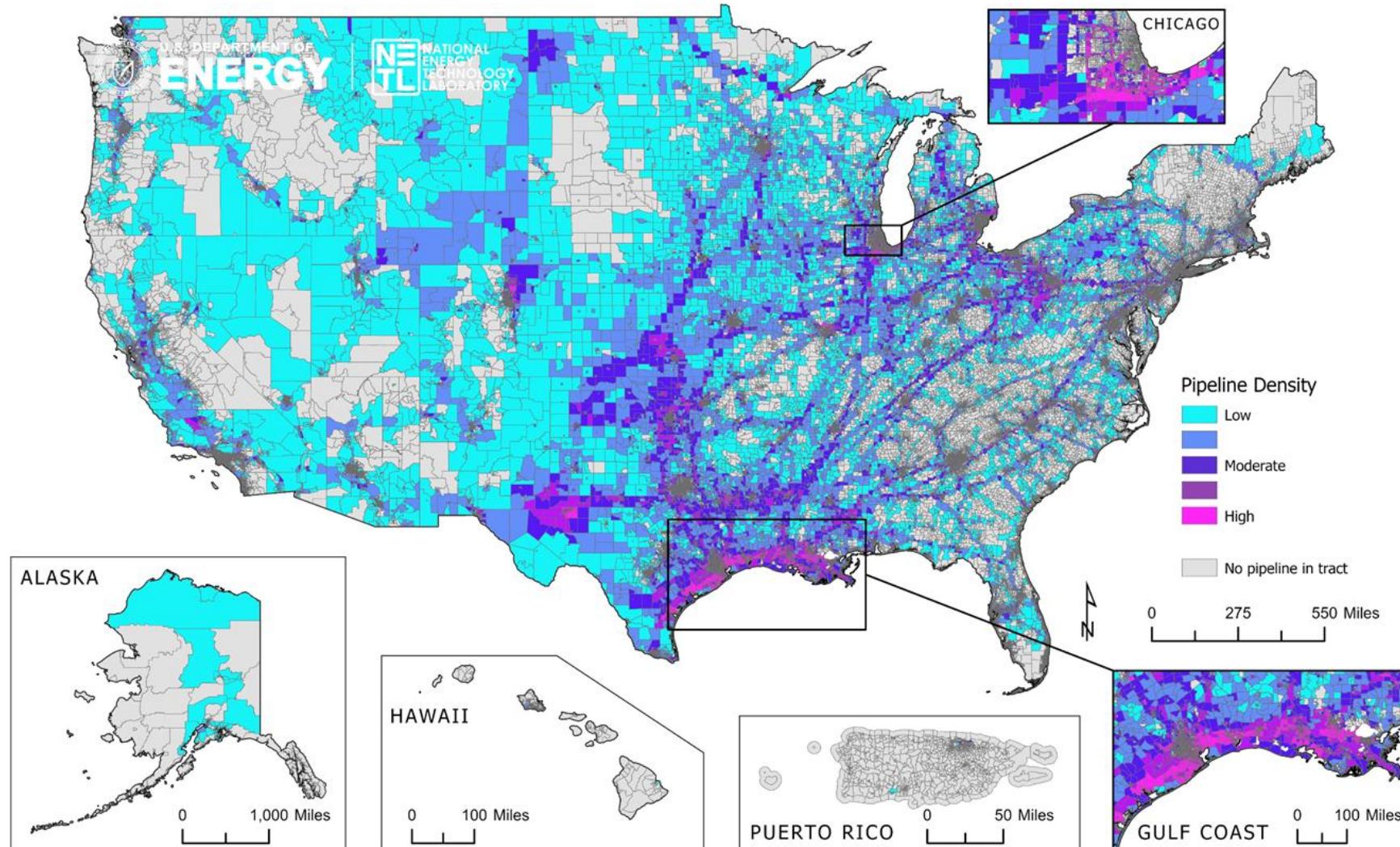
Expanding Analytics on Reported Incidents



Examining Risk Cause and Effect



Looking at data trends for onshore pipelines



The AIIM Approach:

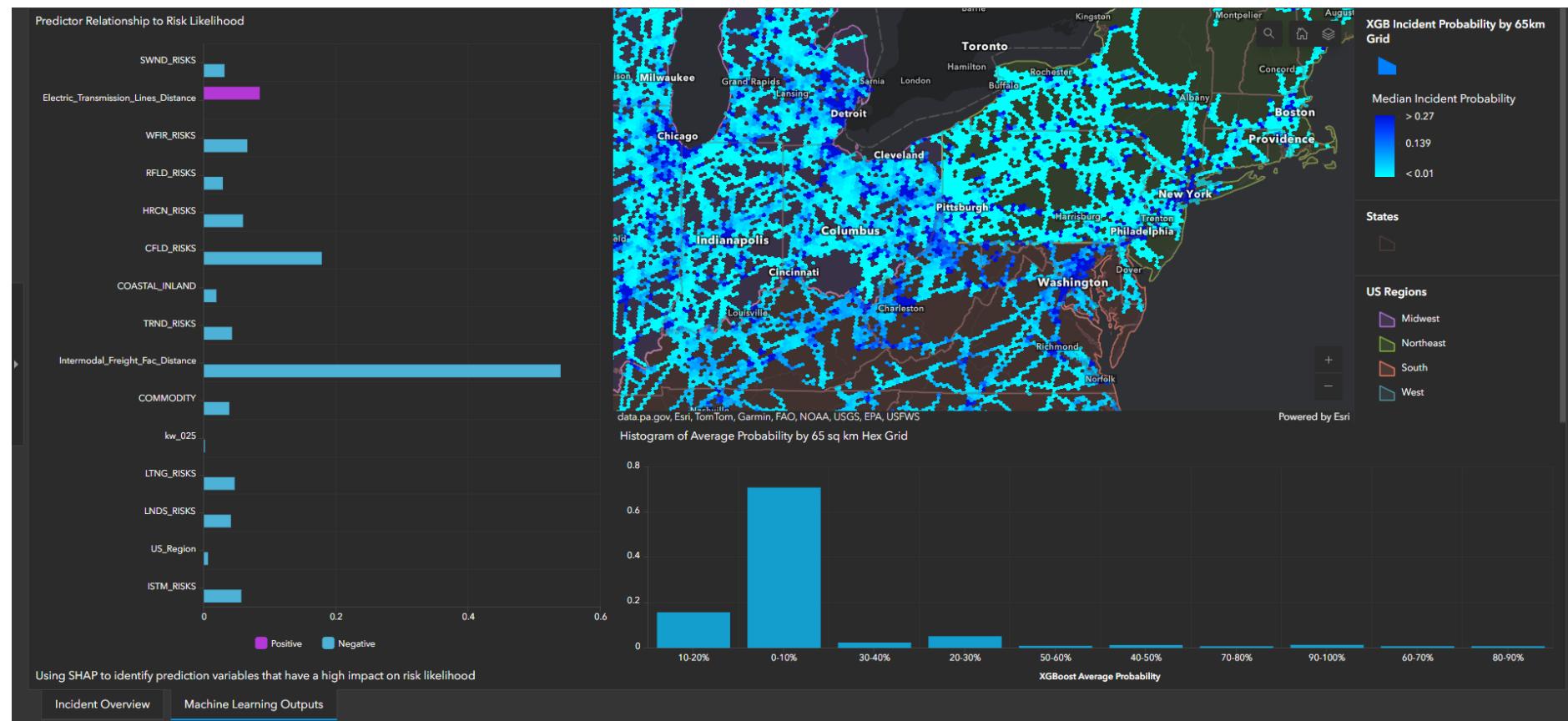
Utilize Multi-ML Models for ensemble-type model insights



Models Included:

- Gradient Boosted Decision Trees (GBDT) (Dyer et al. 2022)
- Artificial Neural Network (ANN) (Dyer et al. 2022)
- Geographically Weighted Regression (Nelson et al. 2021)

Model output insights, including feature importance, will be accessible along with incident trends



In progress of integrating AIIM model & output insights for onshore pipelines into a dashboard for easy review and use – scheduled for release to EDX at end of October 2025



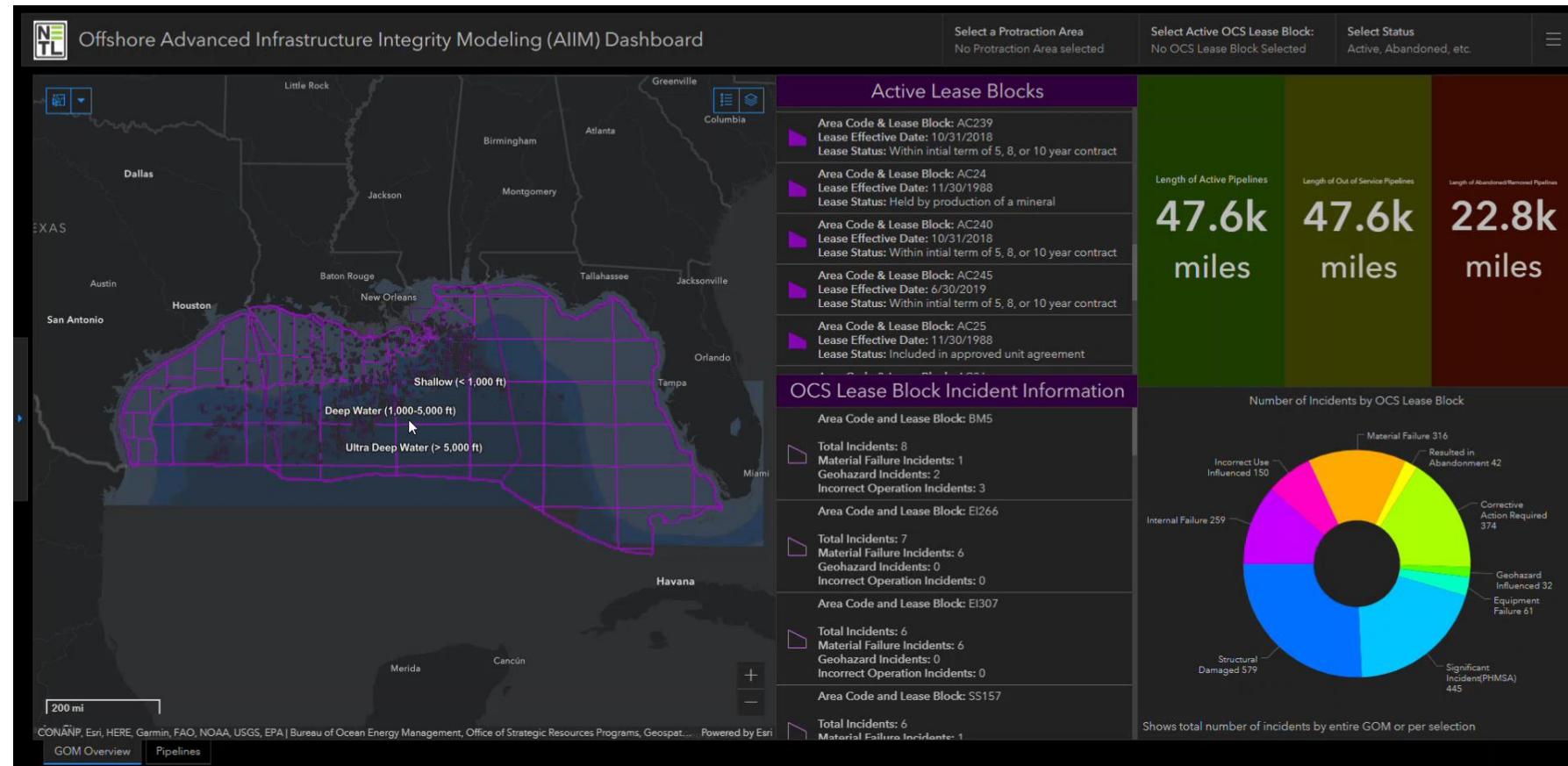
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AIIM Dashboard

Delivering Data- and Model-Driven Insights



- Developed as an **ESRI Dashboard** to support data visualization & interrogation
- Contains **pipeline data** and model results
- Adding in **updated platform data** and model results
- Enable spatially querying by **areas of interest** (lease blocks, protraction areas, etc.)



Database & web tool available



Catherine Schooley, Lucy Romeo, Dakota Zaengle, Isabelle Pfander, Rodrigo Duran, Jennifer Bauer, Kelly Rose, (2024) Advanced Infrastructure Integrity Modeling Dashboard, <https://edx.netl.doe.gov/dataset/offshore-aiim-dashboard>



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NETL RESOURCES

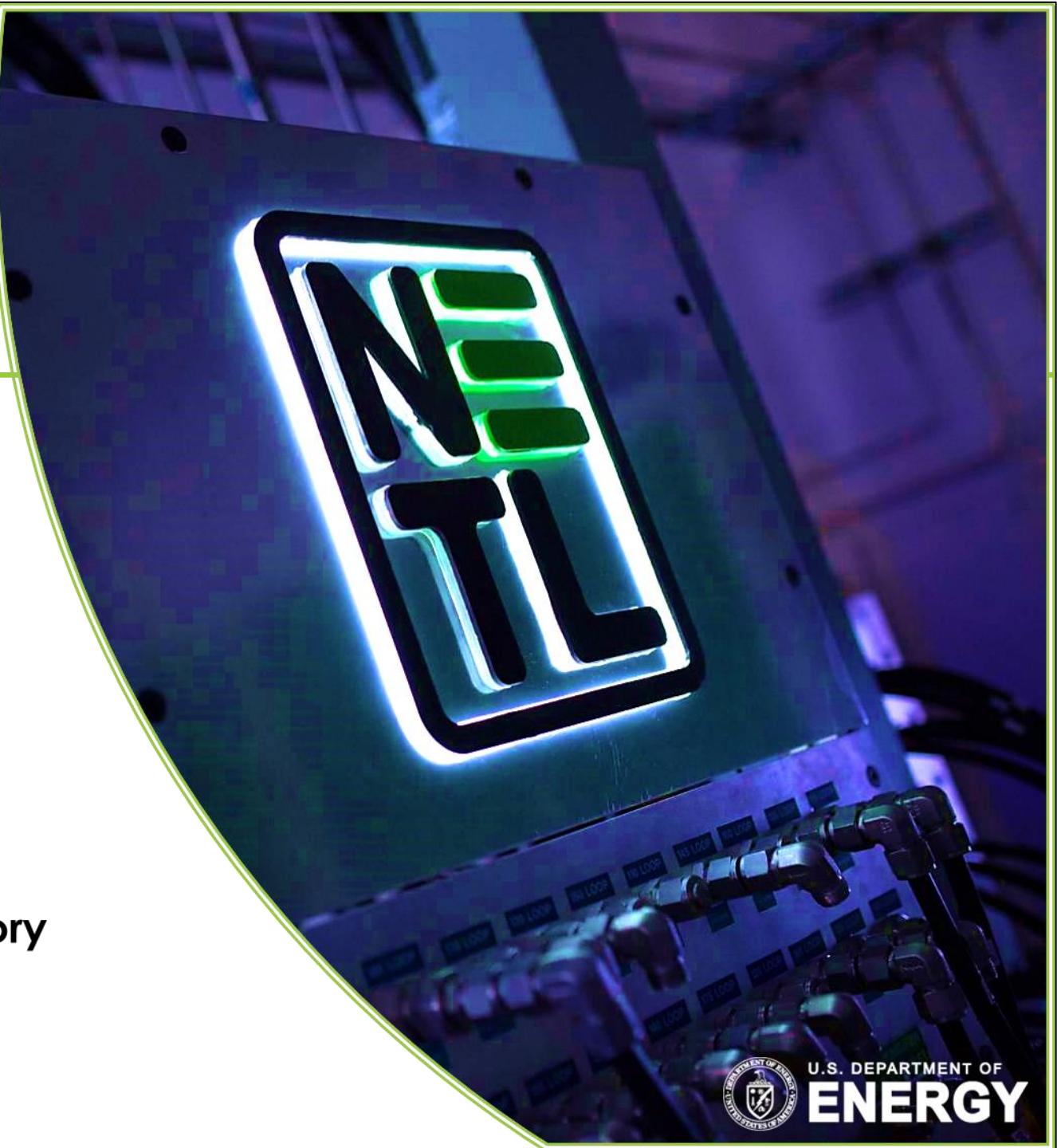
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