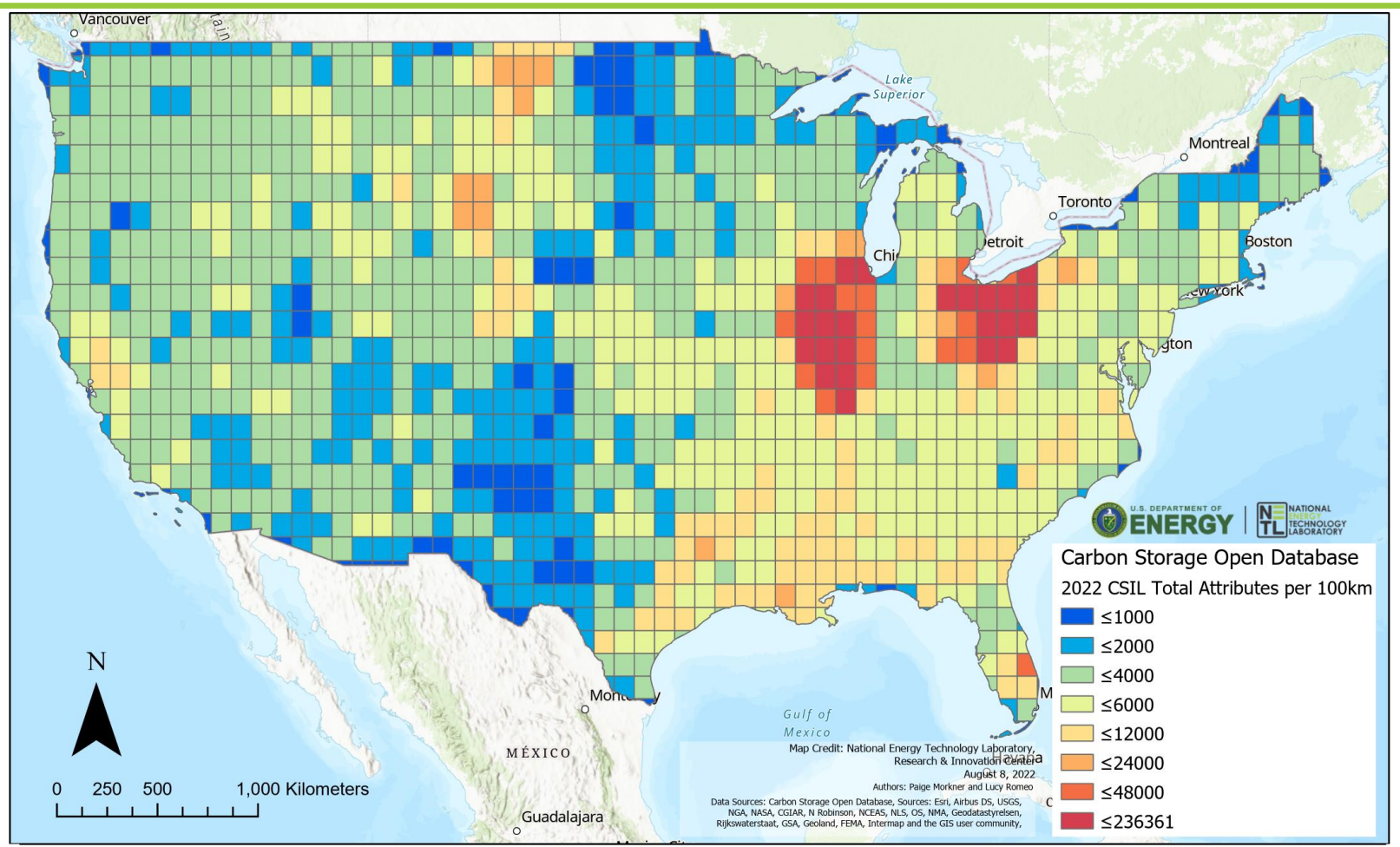
An Updated Carbon Storage Open Database - Geospatial Data Aggregation to Support Scaling-Up Carbon Capture and Storage

Paige Morkner
NETL Support Contract
Research Innovation Center



2022 Carbon Management Project Review Meeting
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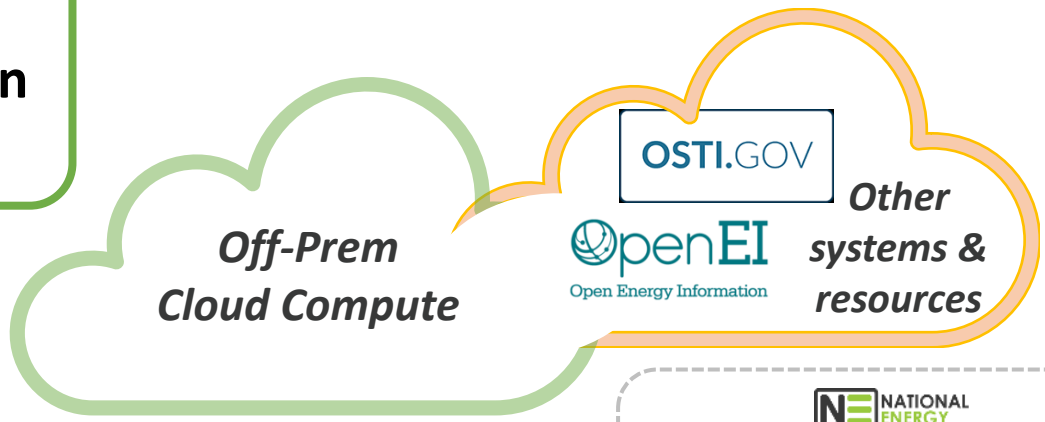
Carbon Storage Data – Importance

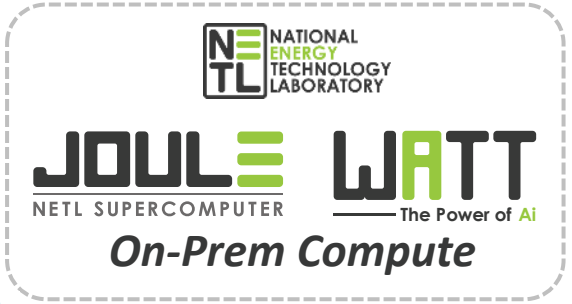
Using AI/ML, millions of data features and attributes have been integrated and preserved across the USA in support of advanced carbon storage (CS) projects

This effort has already aided SMART-CS, NRAP and outside entities (e.g., major industry operators) to drive subsurface modeling, machine learning, and insights for a range of end user needs

EDX supports:

- **RCSP, CarbonSafe, NRAP data ingestion**
- **Data mining to aggregate authoritative, open-source resources relevant to CS researchers**
- **Integration of other fossil energy (FE) resources**
- **Access, visualization, and interaction with CS data collections via NETL EDX mapping platforms Natcarb Viewer and Geocube**
- **Reuse of data by new FE projects via EDX Collaborative Workspaces and more…**





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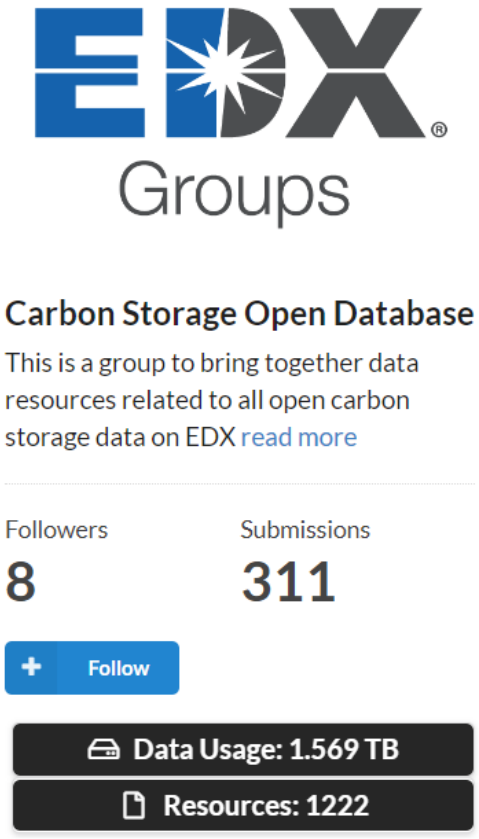
EDX++ FRAMEWORK

…ensuring compliance with Federal/DOE regulations

…ensuring preservation and access to DOE FE knowledge and data resources

Workflow for Open Data Collection

Analyze and catalog data from EDX



Collection of geospatial data from disparate websites

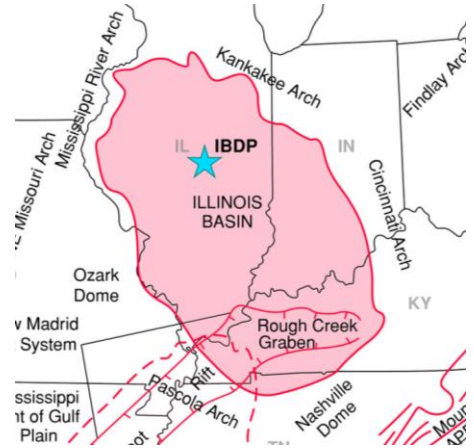
Aggregation of resources into central database

Cataloging and collection of metadata

Integration of metadata and data into EDX++ framework and online mapping platform

Open-Source Data Collection and Sources

Total Shapefiles and Raster Files	Source
312	2019 Carbon Storage Open Database, curated from the Regional Carbon Sequestration Partnerships websites, REST servers, and EDX
3	USGS Carbon Dioxide Storage Resources Assessment, 2013
8	Basal Cambrian Raster layers from EERC on EDX
160	Shapefiles from the FutureGen 2.0 Technical Data on EDX
360	Havorka et al. CO2 Brine Database (Texas BEG)
49	The Illinois State Geologic Survey Illinois Basin Decatur Project data on EDX
892	Total Number of Layers in Geodatabase



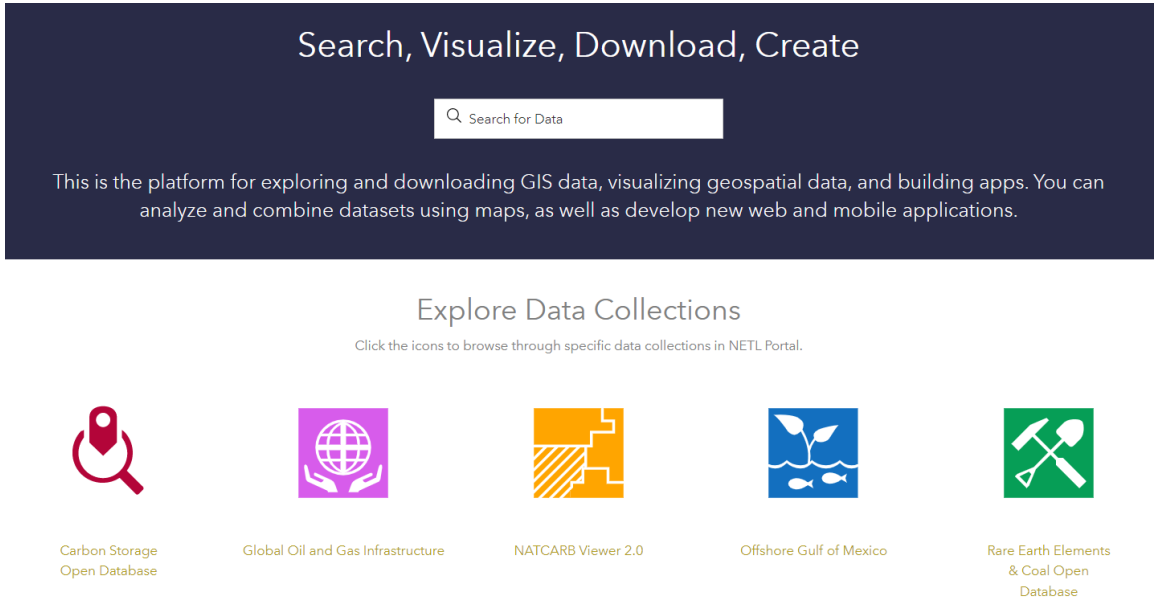
Data Aggregation and Metadata Cataloging

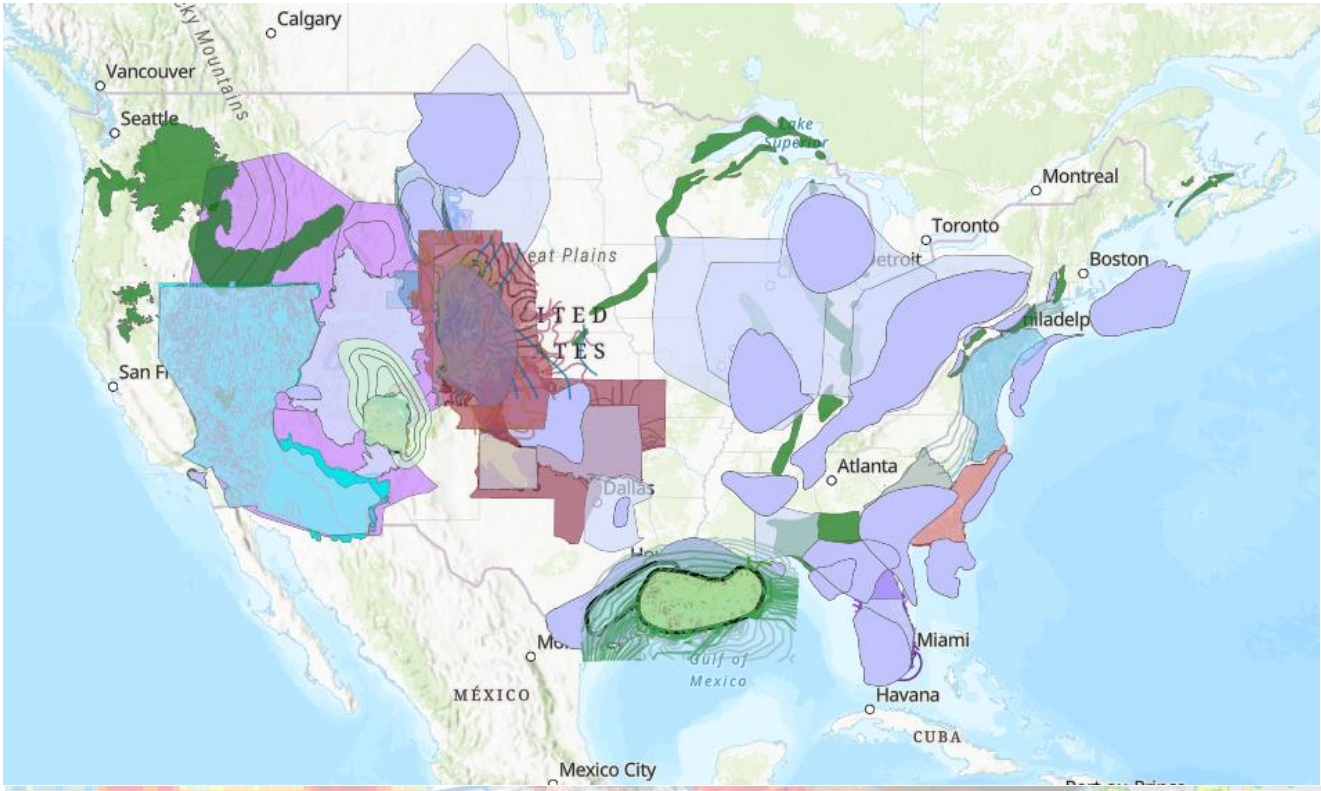
- Metadata are cataloged to provide and develop information for data display on online mapping platform, GeoCube
- Information recorded for each data layer:
  - File Name
  - Layer name (displayed)
  - Sensitive or confidential markings?
  - Spatial extent
  - Category
  - Keywords
  - Source
  - Citation

Collection	Category
Carbon Storage	Boundaries and Roads Utilities
Carbon Storage	CSS Projects and Field Data
Carbon Storage	Geologic Contours
Carbon Storage	Geology
Carbon Storage	Geomorphology
Carbon Storage	Groundwater
Carbon Storage	Landcover Classification
Carbon Storage	Mine
Carbon Storage	Remote Sensing Data
Carbon Storage	Structure
Carbon Storage	Surface Hydrology
Carbon Storage	Well Data

Data Mapping and Availability – GeoCube Integration

- GeoCube has been migrated to leverage EDX++ capabilities to host geospatial data
- New website, maps, and capabilities for visualization of the Carbon Storage Open Database, NATCARB, and other geospatial data collections

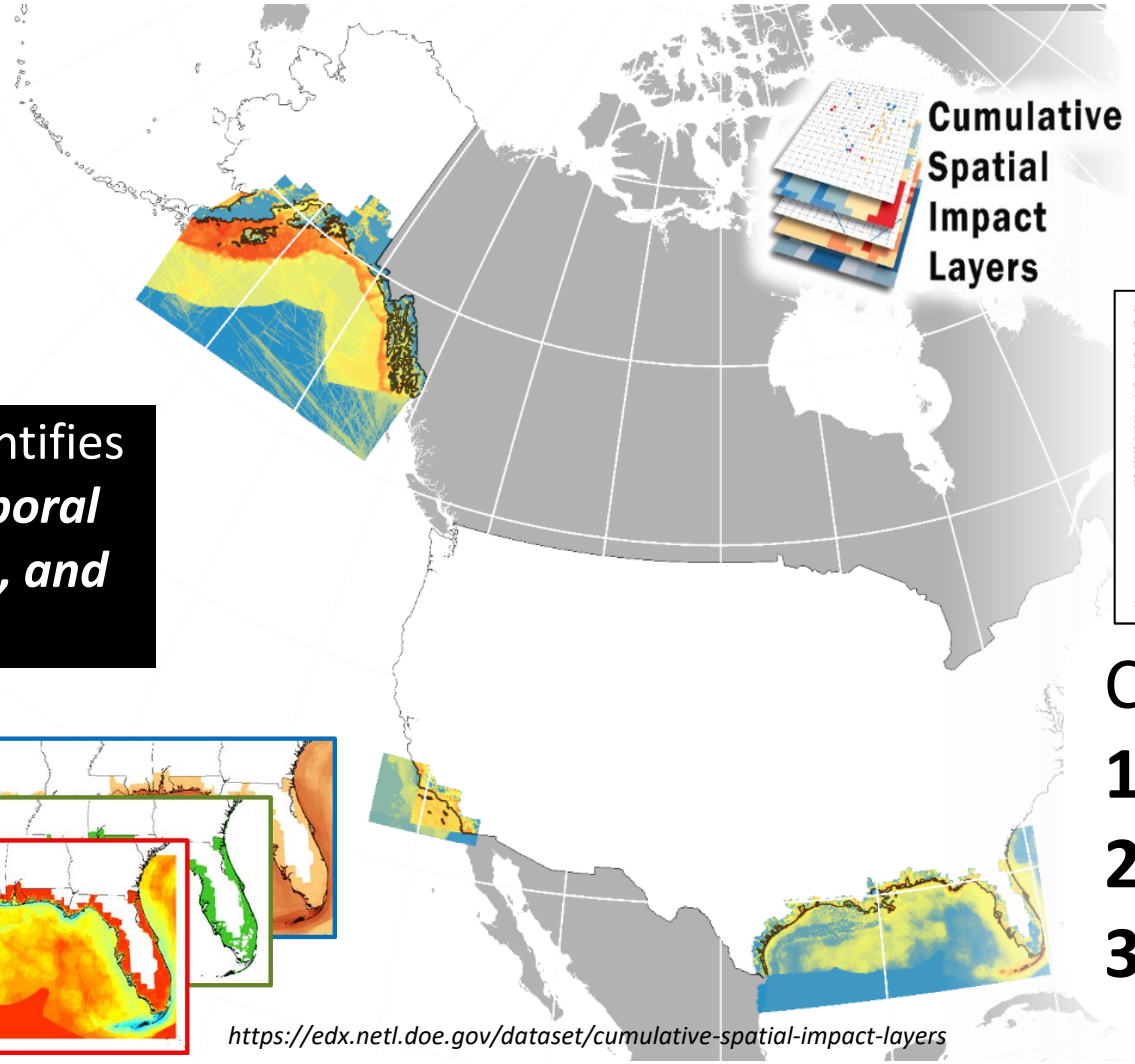




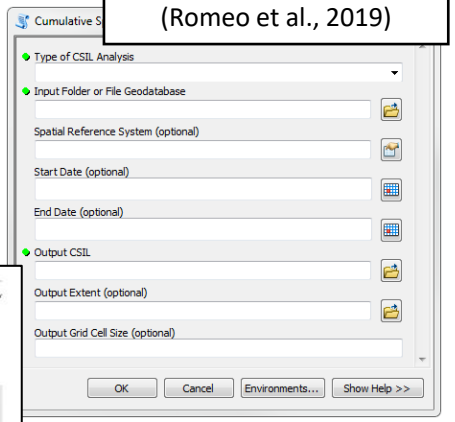
CSIL: Cumulative Spatial Impact Layers™

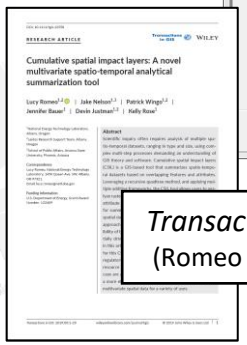
The Cumulative Spatial Impact Layer (CSIL) Tool was used to analyze data density of the updated 2022 Carbon Storage Open Database to compare to 2019 database

GIS-based tool that rapidly quantifies ***big*** and ***disparate spatio-temporal*** data into a ***useful, informative, and understandable resource***

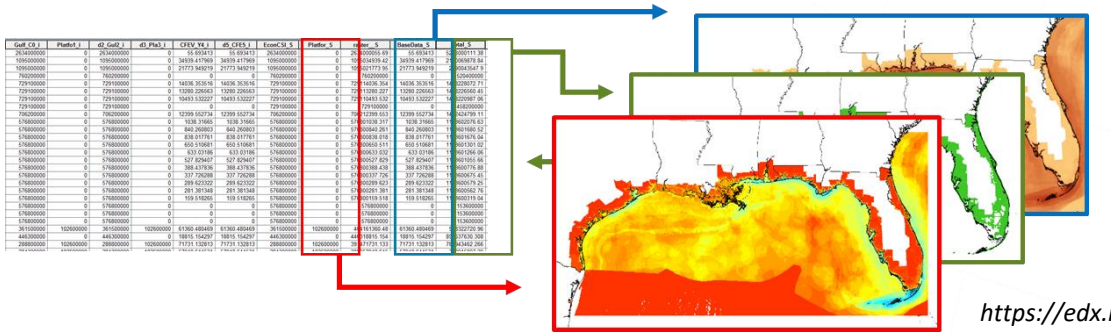


Desktop Tool for ArcGIS
(Romeo et al., 2019)





Transactions in GIS
(Romeo et al., 2019)

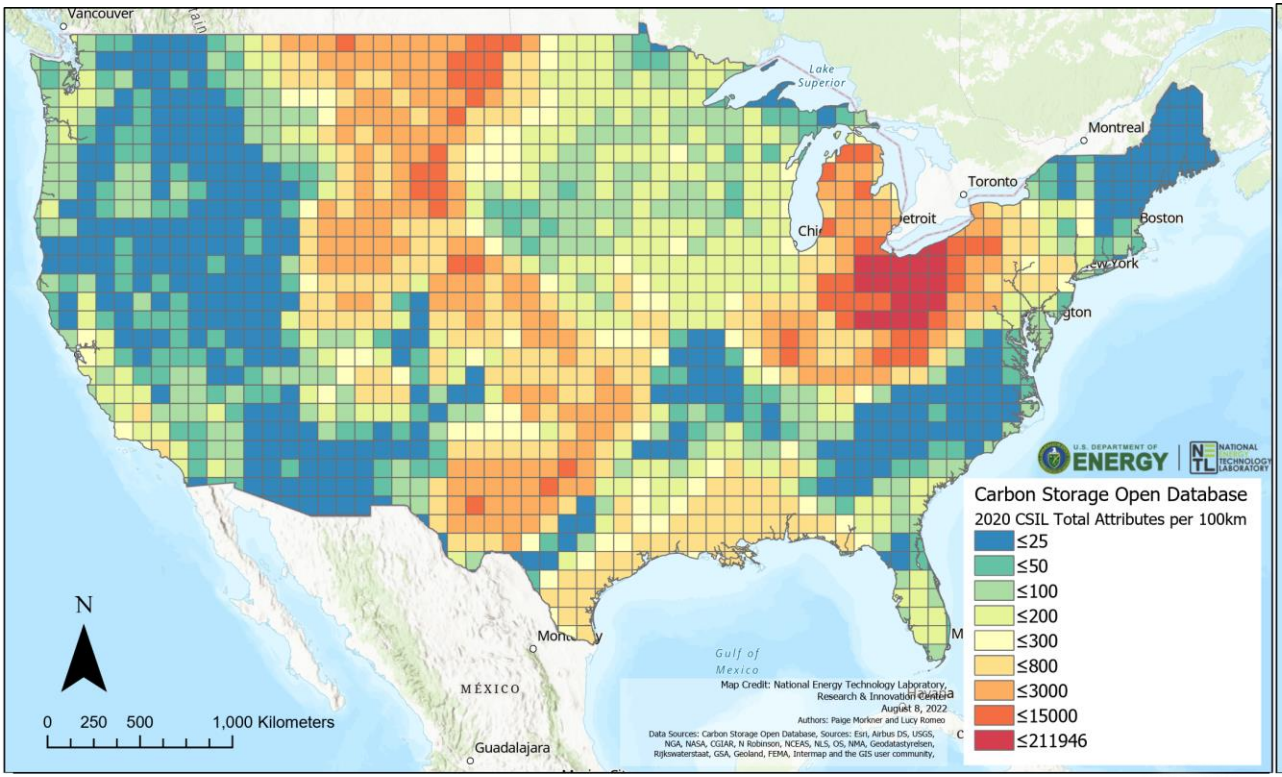


CSILs can evaluate:

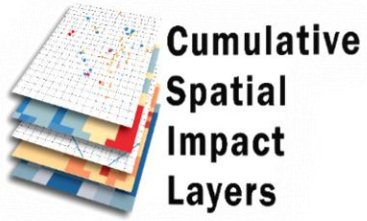
1. **Spatial density,**
2. **Spatial presence**
3. **Attributes**

https://edx.netl.doe.gov/dataset/cumulative-spatial-impact-layers

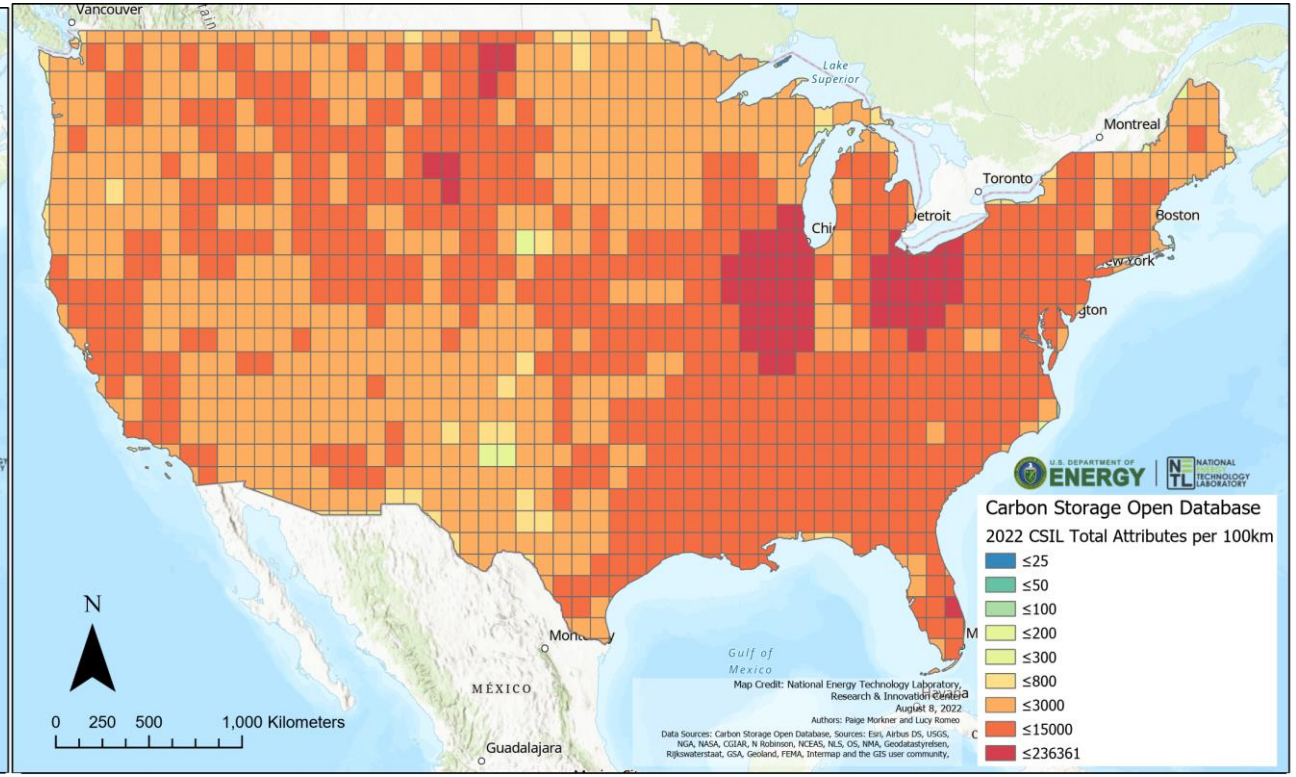
Producing the Final Database – Analyzing Data Density



2019 Carbon Storage Open Database on GeoCube



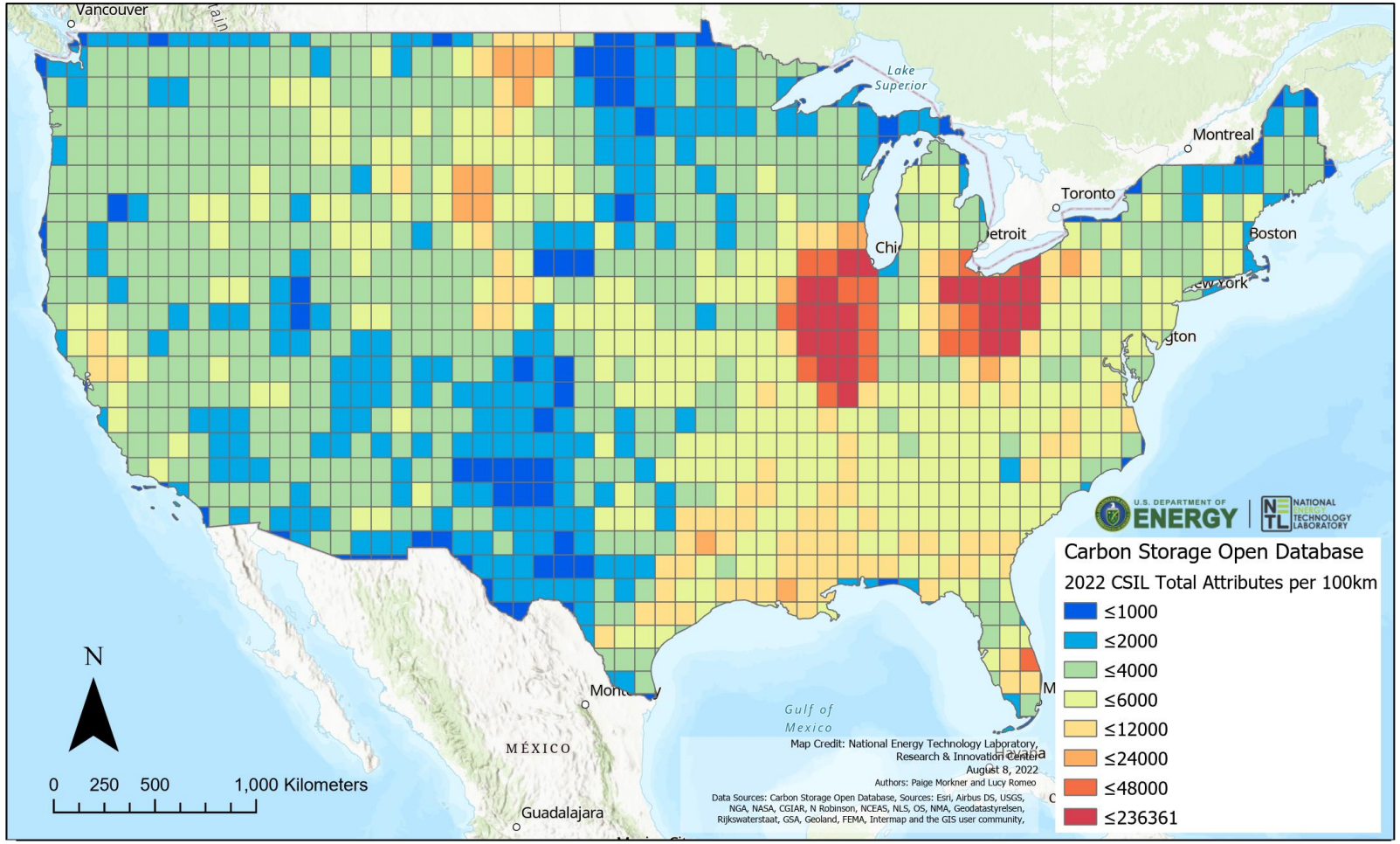
Cumulative Spatial Impact Layers



2022 Carbon Storage Open Database on GeoCube with 580 additional shapefiles and rasters

More Data, More Opportunities!

- Additional data layers are available within the Carbon Storage Open Database on GeoCube
- Data continues to be added to EDX, and will be targeted for integration into the collection in EY22+
- Groups on EDX also continue to grow as data is added by DOE-FECM CCS collaborators
- Data in GeoCube will be linked with the DisCO2ver platform planned through EDX4CCS FWP



NETL RESOURCES

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Organization Chart

Project Partners
U.S. Dept. of Energy
National Energy Technology Laboratory
RCSPs – Big Sky Carbon Sequestration Partnership, Southwest Partnership, Southeast Regional Carbon Sequestration Partnership, Midwest Regional Carbon Sequestration Partnership, Midwest Geological Sequestration Consortium, Plains CO2 Reduction Partnership
CarbonSAFE projects
SMART
National Risk Assessment Partnership

Lead Organization
NETL

Principal Investigators
Kelly Rose, Jennifer Bauer

Task 28
Curation of Carbon Storage R&D Products Through Advanced Data Computing Solutions

Lead: Jennifer Bauer
Team: Kelly Rose, Chad Rowan, Michael Sabbatino, Paige Morkner, Lucy Romeo, TJ Jones, Aaron Barkhurst, Vic Baker, and other Matric Software Engineers and Developers

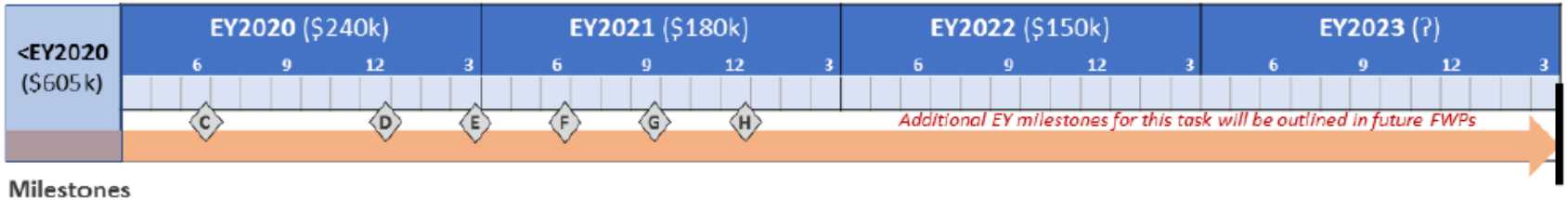
Task 27.0
Next Generation Development, Deployment, and Modernization of Database, Tools, Online Viewer, and Atlas

Lead: Jennifer Bauer
Team: Kelly Rose, Paige Morkner, Michael Sabbatino, Patrick Wingo, Andrew Bean, Aaron Barkhurst, and other Matric Software Engineers and Developers

Gantt Chart

Task 27.0: Project Timeline Overview

Natcarb - Next Generation Development, Deployment, and Modernization of Database, Tools, Online Viewer, and Atlas (PIs: Paige Morkner, Jennifer Bauer)



Milestones

Number	Expected Completion Date	Milestone Description
EY20.27.C	06/30/2020	Identify tools and models that will be targeted for integration and inclusion within the Natcarb Viewer.
EY20.27.D	12/31/2020	Outline report/manuscript on updated technical capabilities of Natcarb Viewer.
EY20.27.E	03/31/2021	Release update of Natcarb Viewer and Natcarb Database to EDX.
EY21.27.F	06/30/2021	Catalog additional datasets, models, and text-based resources on EDX for future integration into the Natcarb Viewer and GeoCube.
EY21.27.G	09/30/2021	Catalog datasets returned from SmartSearch results targeting known data gaps in existing Natcarb and Open Carbon Storage Databases.
EY21.27.H	12/31/2021	Document capabilities to be incorporated in advanced spatial search capability for discovering spatial data from EDX and GeoCube.

Chart Key
- Milestone
- Project Completion
- Go/No-Go Timeframe

Impact

Key Accomplishments/Deliverables	Value Delivered
• 2018, Enhanced interface and updates to Natcarb Viewer and release through EDX (Barkhurst et al., 2018; Bauer et al., 2018) • 2019, Integration of advanced data use tools in Natcarb Viewer & GeoCube to improve data access and use • 2020, Integration of open-source data to develop Open Carbon Storage Database (Morkner et al., 2020) • 2021, Manuscript detailing innovative data integration strategies used to aggregate Natcarb, RCSP, and open CS data sources (Morkner et al., in review) • 2022, Support updates to Natcarb database and CS estimates	• Produce a robust subsurface data framework that provides **improved data access, data discoverability, and ease of use within the CS community.** • Integrate **online, advanced analytics and models to help facilitate research** across the CS community. • Support development of content and materials for Carbon Storage Atlas updates.

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* Task 27.0 is updating content into an existing tool with no development of a technology. Therefore, no TRL is assigned.