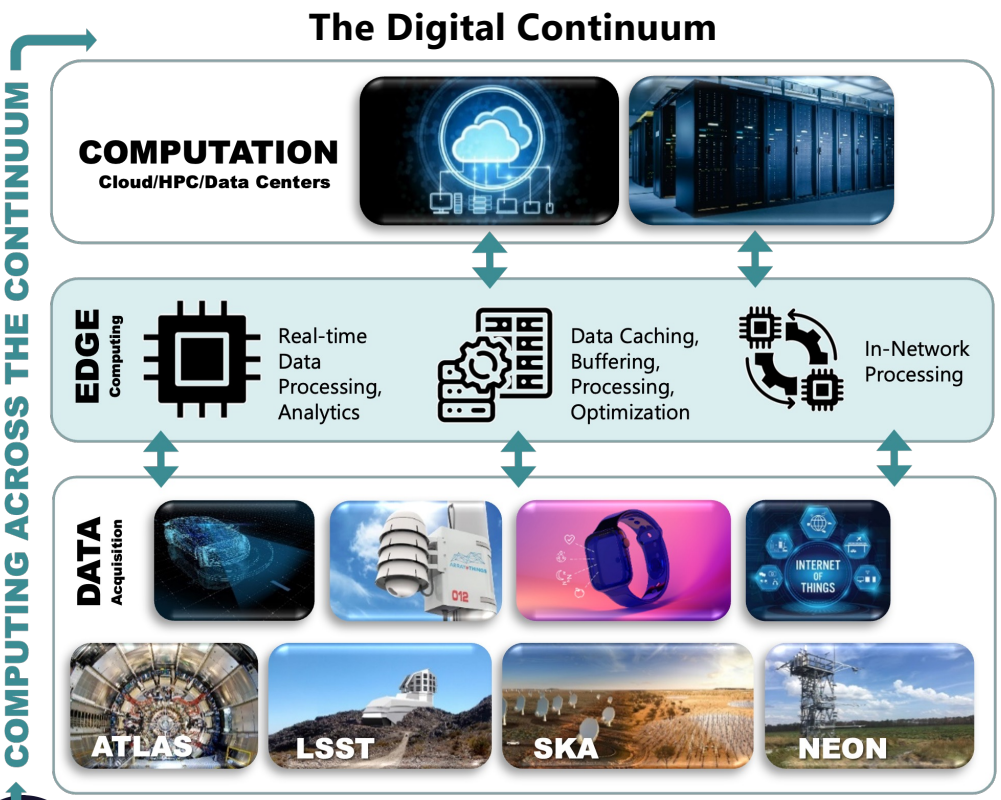
Agriculture Empowered by Supercomputing (and the Digital Continuum)

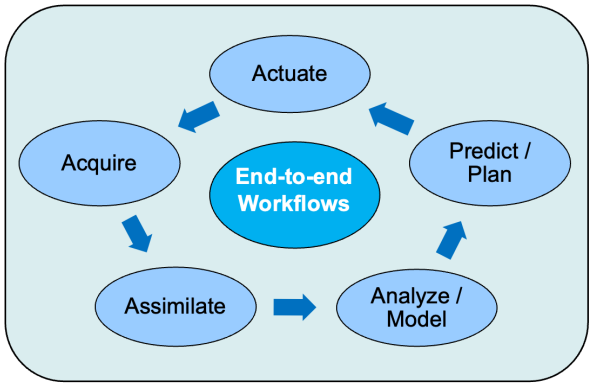
Manish Parashar
SCI Institute, University of Utah

The Digital Continuum: Opportunities & Challenges

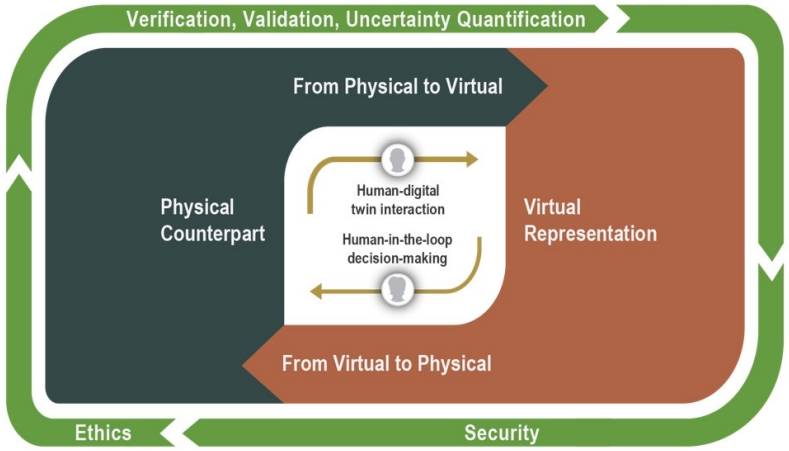


Transcendence of AI

End-to-end workflows



The Digital Continuum: Digital Twins of Complex Systems



(ChatGPT)

- Crop-Level Modeling
- Predictive Analytics for Crop Performance
- Livestock Monitoring and Management
- Optimization of Irrigation and Fertilization
- Disease Detection and Prevention

National Data Platform: Customized Data Experiences through Near Data Services

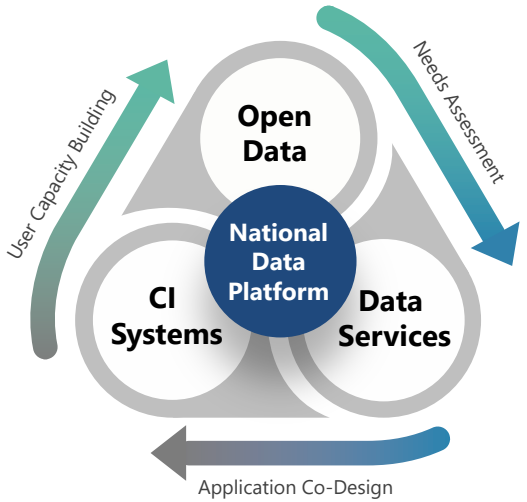
#2333609

A **federated** and **extensible** data ecosystem to promote innovation and collaboration through the equitable use of data leveraging existing and future national cyberinfrastructure capabilities.

https://www.nationaldataplatform.org/

FOCUS AREAS:

- **Platform** for data-enabled and AI-integrated workflows
  - Facilitates data registration and discovery via a **centralized hub**
  - Democratizes data access and use via **distributed points of presence**
  - Cultivates resources for **classroom education** and **data challenges**
  - Assists research and learning through **personalized workspaces**



- **Applications** in climate and AI with data diverse scientific data repositories including NSF facilities, NAIRR, NASA, USGS, NOAA and USDA

- **Partnerships** to foster scientific discovery, decision-making, policy formation and societal impact

UC San Diego · The University of Utah · University of Colorado Boulder · San Diego Supercomputer Center · SCI www.sci.utah.edu · EarthScope Consortium

Science Data Exchanges (SciDx) Services

A customizable Data-Pop software stack for in-situ data access & processing

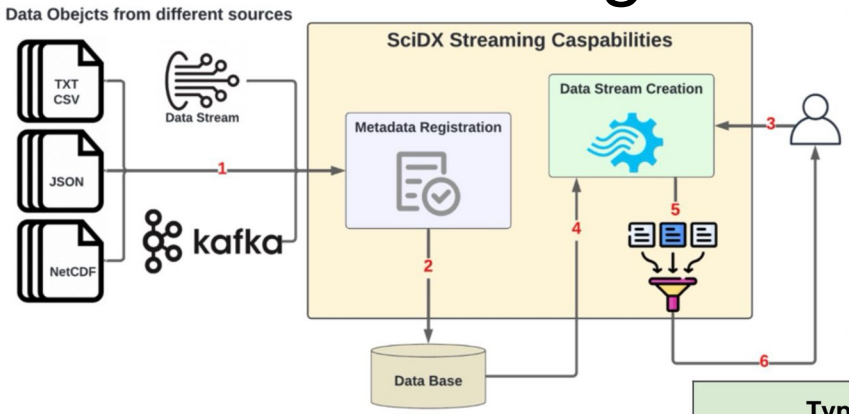
SciDx Staging Services

- Transient resources for in-situ (close to the data) data processing and access
  - High-performance in-memory processing
  - Server-side data transformations (e.g., sub-setting, reduction, user-defined analysis, etc.)
  - Caching/sharing of data, results, and data-products
  - Registration of data-triggers
- Efficient management of data in-motion
  - Streamline workflows; minimize data transfers
  - Perform ETL operations at data source

SciDx Streaming Service

- Streams registration, curation/archival for discovery and access
- User-defined operations/filters on streaming; containerized execution
- Combine streaming data with archived/playback data
- Mechanism for online data product generation (i.e., new data streams)

SciDx Streaming Service



1. Register metadata for various Data Objects
2. Store metadata
3. User queries specific data (e.g., 'Temp')
4. Retrieve data objects matching user criteria
5. Apply user-defined filters (e.g., 'a>10')
6. Deliver unified, filtered data as a stream

Type	Explanation	Example
Column Comparisons	Column-to-column comparisons	`x > y`
Mathematical Operations	Addition, subtraction, multiplication and division	`x > 10*y`
IN Operator	Check if values are in a list	`station IN ['A', 'B']`
Conditional Logic (IF-THEN-ELSE)	Apply rules based on conditional statements	`IF x > 20 THEN alert = High ELSE y = 10`
Logical Operators (AND, OR)	Combine multiple conditions using AND and OR operators	`IF x > 10 OR z = 20 THEN alert = High ELSE alert = Low`
Window-Based Filtering	Calculate aggregates (mean, sum, max, min) over sliding windows	`IF window_filter(9, sum, x > 20) THEN alert = High`

ONE-U RAI FACULTY FELLOW

Brian Codding
Anthropology

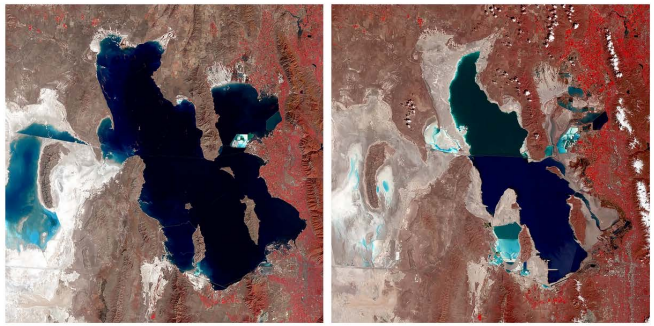
PROJECT SPOTLIGHT

Sustaining and Restoring Indigenous Socioenvironmental Systems

GOALS

- Quantify the impact of invasive species removal on hydrology and biodiversity.
- Develop an AI-based framework for soil-moisture modeling and decision making.
- Model potential for cultural keystone species reintroduction under future climate.

COLLABORATORS



A satellite view of the Great Salt Lake captured in September 1987. EROS Center, U.S.G.S. The Great Salt Lake in May 2021. EROS Center, U.S.G.S.