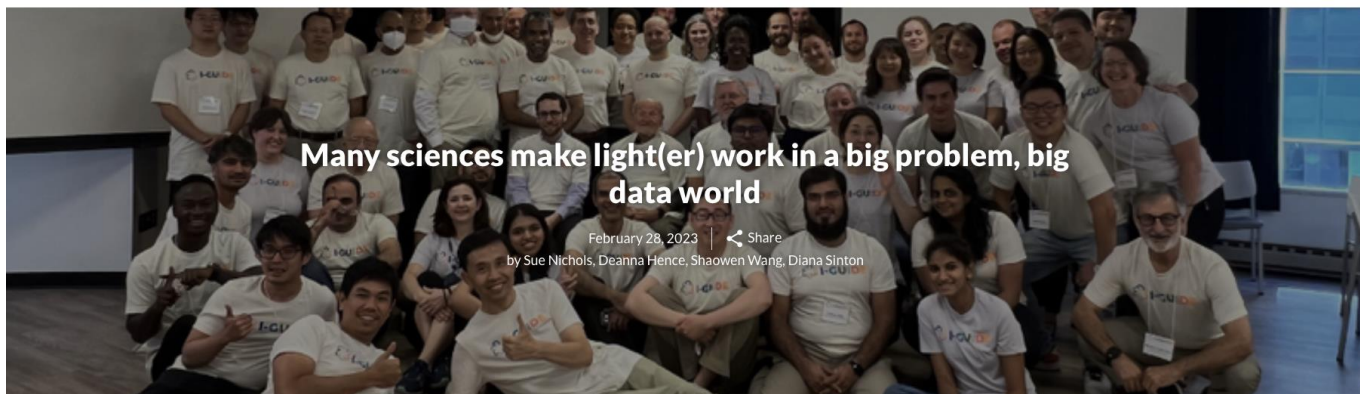




Introduction to I-GUIDE

Shaowen Wang
University of Illinois Urbana-Champaign





It's raining cats and dogs when a hydrologist, a climatologist, a statistician, an economist, and a geospatial scientist walk into a bar. The bar is just down the road from a big old dam and they'd each glanced toward it when they'd pulled into the parking lot.

After a few weeks of steady rain, the whole dam area has been on everyone's mind. The hydrologist is thinking about the last time this dam overtopped. The climatologist and the statistician are debating how extreme this amount of precipitation would be considered and what may come in the future. The economist is remembering how disruptive flooding in this area is to the local businesses that export their goods to distant places, and the geospatial scientist is estimating the extensive numbers of vulnerable neighborhoods downriver.

Geospatial Newsletters

Keep up to date with the latest geospatial trends!

SIGN UP

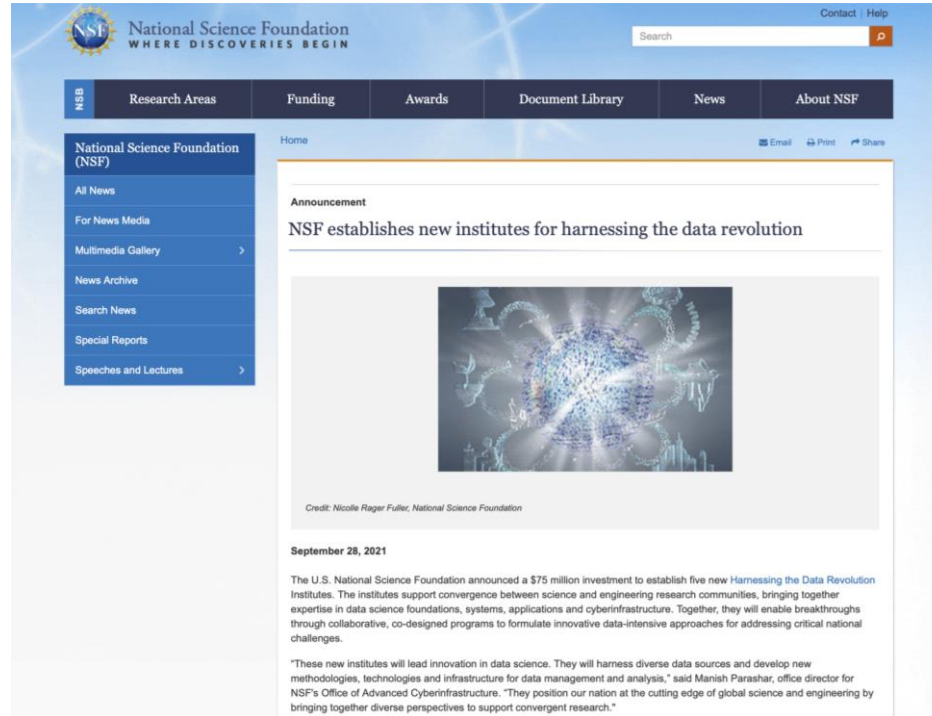
From Our Homepage

Mapping Languages: A Lesson in All Mapmaking

The Power of Place: Place-based Inquiry through Story

<https://www.directionsmag.com/article/12127>

Harnessing the Data Revolution

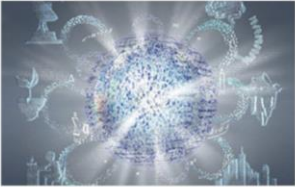


The screenshot shows the NSF website with a blue header and a dark navigation bar. The main content area features a news announcement titled "NSF establishes new institutes for harnessing the data revolution". The announcement includes a date of September 28, 2021, and a paragraph describing a \$75 million investment in five new institutes. A quote from Manish Parashar is also included.

National Science Foundation (NSF)

Announcement

NSF establishes new institutes for harnessing the data revolution



Credit: Nicole Rager Fuller, National Science Foundation

September 28, 2021

The U.S. National Science Foundation announced a \$75 million investment to establish five new *Harnessing the Data Revolution* Institutes. The institutes support convergence between science and engineering research communities, bringing together expertise in data science foundations, systems, applications and cyberinfrastructure. Together, they will enable breakthroughs through collaborative, co-designed programs to formulate innovative data-intensive approaches for addressing critical national challenges.

"These new institutes will lead innovation in data science. They will harness diverse data sources and develop new methodologies, technologies and infrastructure for data management and analysis," said Manish Parashar, office director for NSF's Office of Advanced Cyberinfrastructure. "They position our nation at the cutting edge of global science and engineering by bringing together diverse perspectives to support convergent research."

https://www.nsf.gov/news/special_reports/announcements/092821.jsp

<http://i-guide.io>

Collaborating Institutions



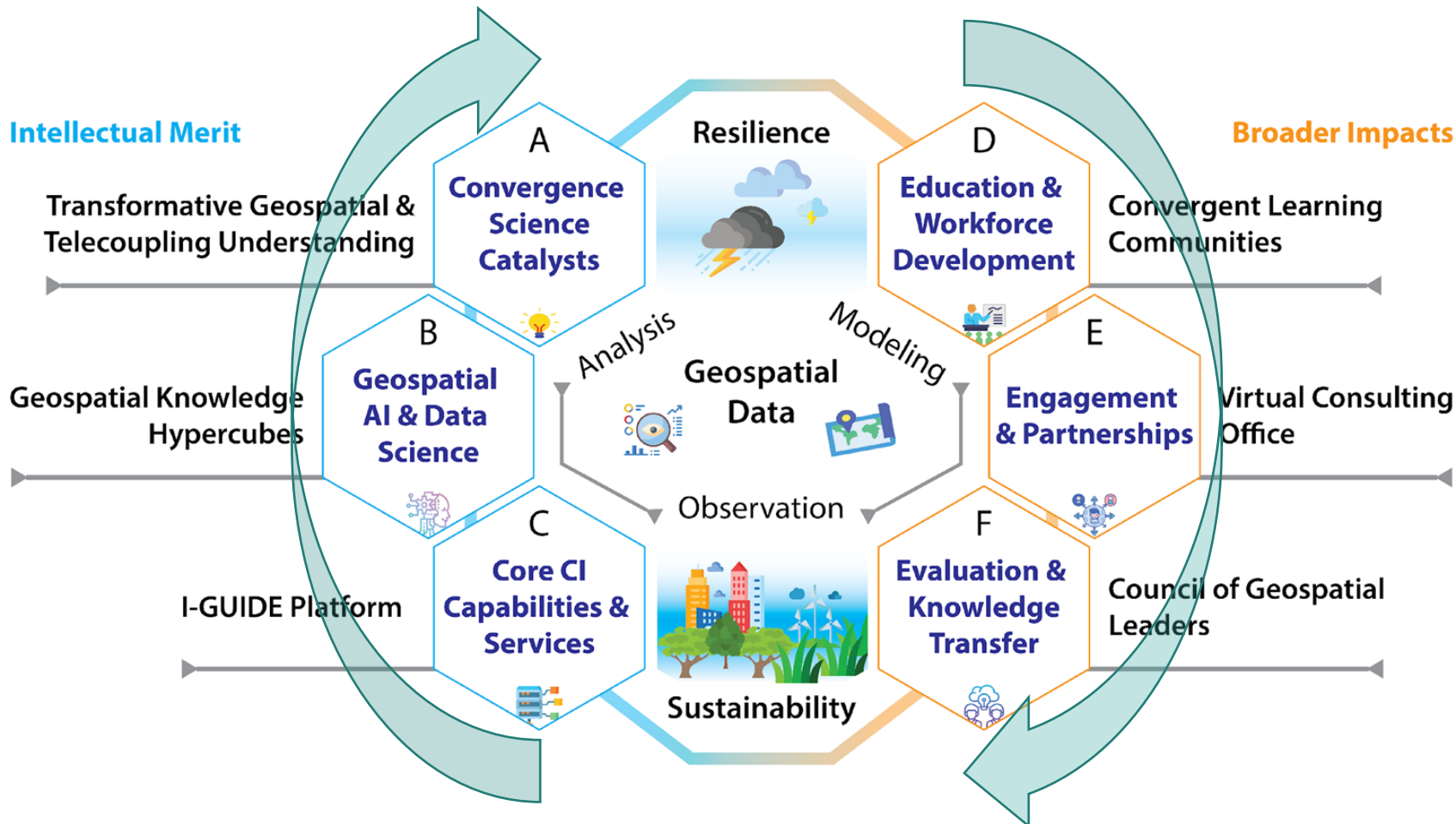
Vision

- Digital discovery and innovation through harnessing the geospatial data revolution

Mission

- Transform convergence and geospatial sciences for holistic sustainability solutions

Intellectual Merit



Convergence

“integrating knowledge, methods, and expertise from different disciplines and forming novel frameworks to catalyze scientific discovery and innovation”



https://www.nsf.gov/crssprgm/nano/reports/MCR_2020-1020_PrinciplesOfConvergenceInNatureSociety_JNR_27p.pdf

Diverse Disciplines

- Atmospheric science
- Computer science
- Data science
- Ecology
- Economics
- Environmental science and engineering
- Geographic information science
- Human-environment and geographical sciences
- Hydrology and water sciences
- Industrial engineering
- Information science
- Sociology
- Statistics

Map, Connect, Discover



<https://www.un.org/sustainabledevelopment/blog/2015/12/sustainable-development-goals-kick-off-with-start-of-new-year/#>

Map

- Patterns
- Processes
- Pattern & process interactions
- Digital twins



<https://medium.com/@thegeospatialnews/the-fascinating-world-of-gis-an-introduction-a0a48e160ffd>

Causal inference

Received: 25 October 2017 | Revised: 27 May 2018 | Accepted: 18 July 2018
DOI: 10.1111/tgis.12477

RESEARCH ARTICLE

WILEY **Transactions**
in GIS

Geoexpression: A Petri network framework for representing geographic process concurrency

Austin V. Davis^{1,2,3} | Shaowen Wang^{1,2,4,5,6}

¹CyberInfrastructure and Geospatial Information Laboratory, University of Illinois at Urbana-Champaign, Urbana, Illinois

²Department of Geography and Geographic Information Science, University of Illinois at Urbana-Champaign, Urbana, Illinois

³Environmental Laboratory, U.S. Army Engineer Research and Development Center, Vicksburg, Mississippi

⁴Department of Computer Science, University of Illinois at Urbana-Champaign, Urbana, Illinois

⁵Department of Urban and Regional Planning, University of Illinois at Urbana-Champaign, Urbana, Illinois

⁶National Center for Supercomputing Applications, University of Illinois at Urbana-Champaign, Urbana, Illinois

Correspondence

Austin V. Davis, Environmental Laboratory, U.S. Army Engineer Research and Development Center, Vicksburg, MS.
Email: austin.v.davis@usace.army.mil

Abstract

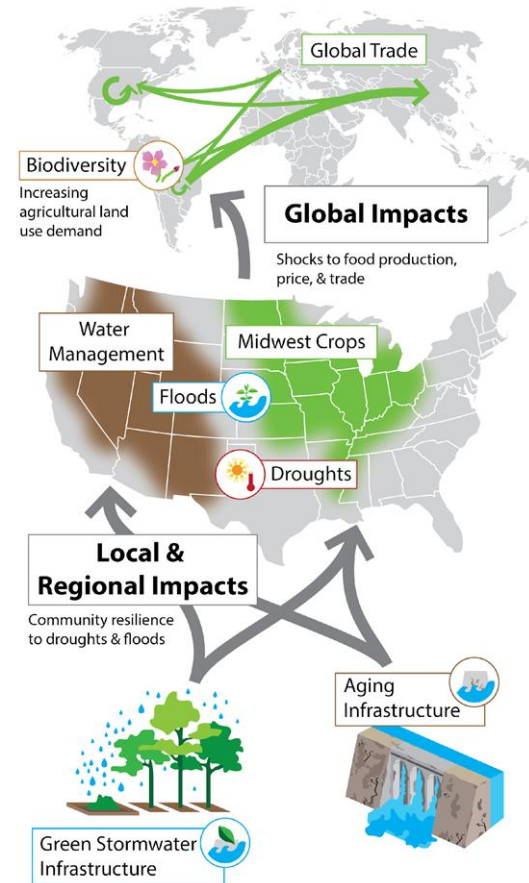
We present a novel framework called *geoexpression* for representing geographic process concurrency and discuss its implications for geographic dynamic modeling. Unapt representations of geographic process concurrency can lead to non-deterministic geographic dynamic modeling outcomes, excessive cognitive burdens when reasoning about how concurrent processes interact, and even inconsistent results. After demonstrating the importance of geographic process concurrency, we examine how the characteristics of geographic process concurrency are missing from other state-of-the-art geographic process representations. The *geoexpression* framework adopts Petri networks to allow researchers to understand how to relate geographic process concurrency to observed modeling patterns. Of interest are the real-world geographic patterns formed by concurrent geographic processes.

1 | INTRODUCTION

This article examines important characteristics missing from state-of-the-art representations of geographic processes with regard to concurrency. We investigate: what *geographic process concurrency* is and what opportunities for improved computational models exist by explicitly representing geographic process concurrency in a way that is mutually understandable by the human and the machine. Unapt representations of *geographic process concurrency* can lead to non-deterministic geographic dynamic modeling outcomes, excessive cognitive burdens when

Convergence Science Catalysts

- ❖ Hydroclimatic extremes and associated vulnerability
- ❖ Socioeconomic impacts of potential climate induced disasters
- ❖ Global-local-global analysis of sustainability from the perspectives of biodiversity, fertilizer, and land use
- ❖ Telecoupling, food commodity (soybean/corn), production and trade, disasters, and land use/cover change in distant regions

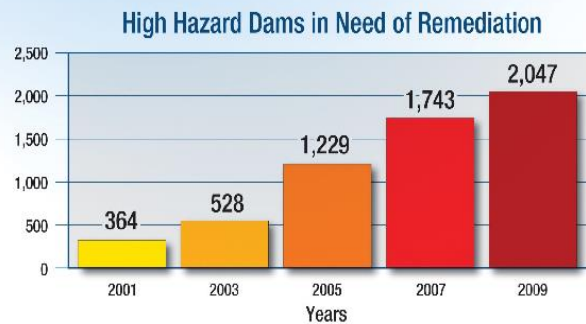
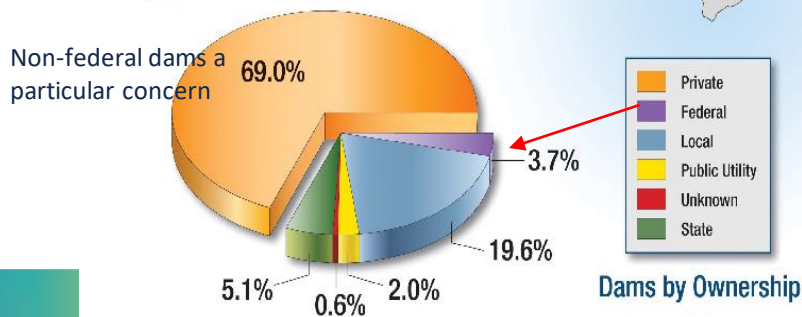
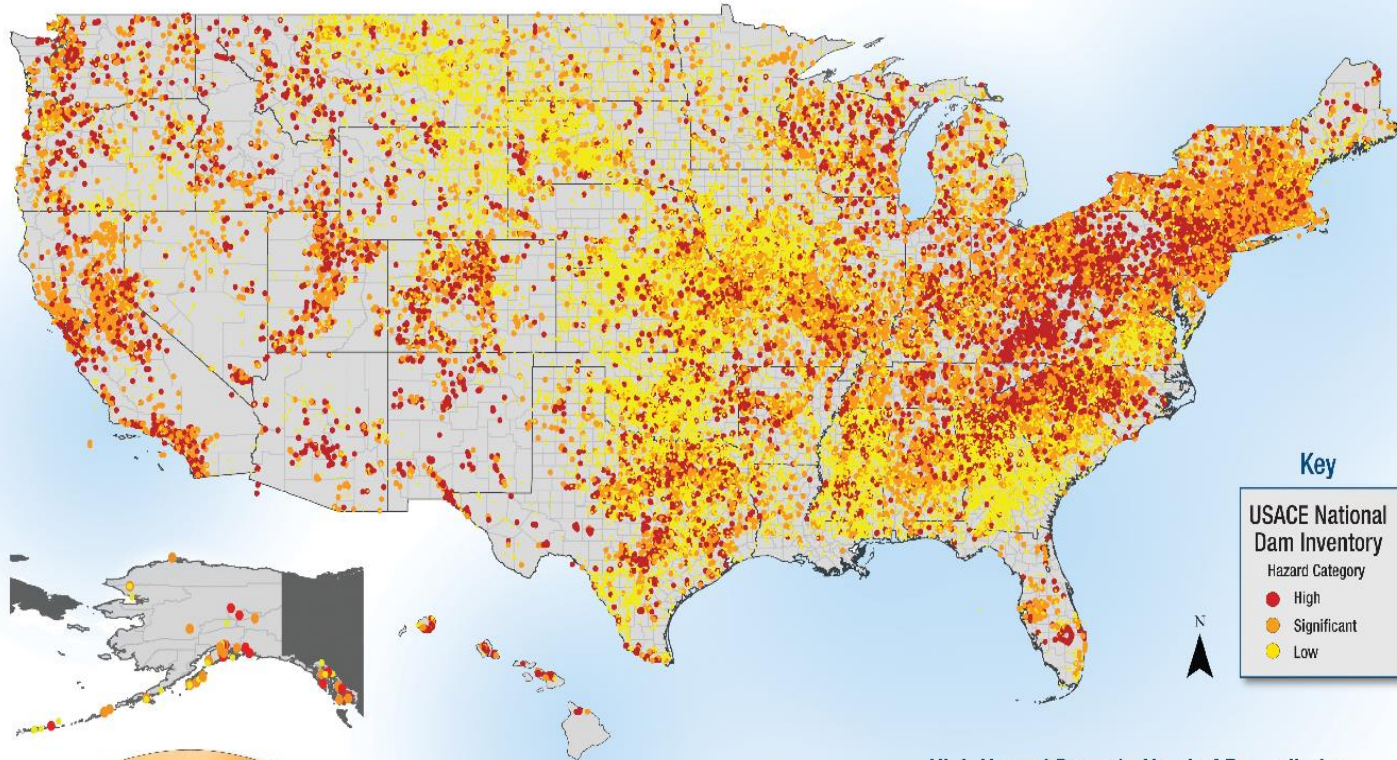


Aging Dams

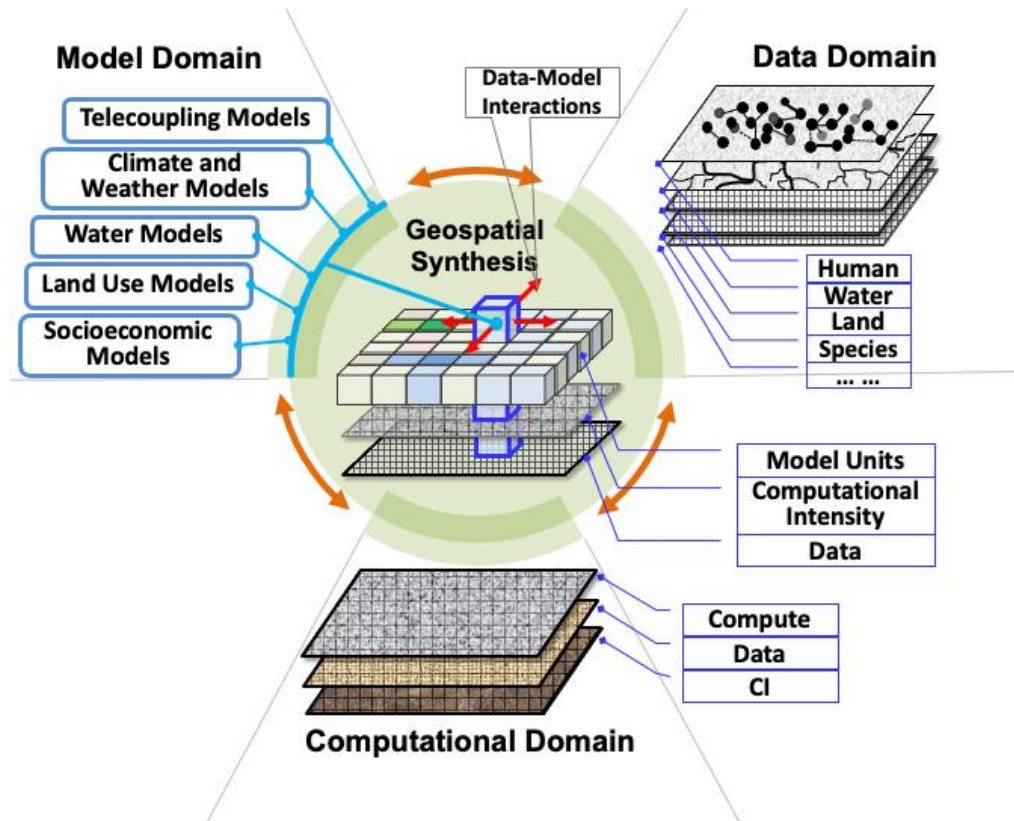
...

Median Age (57 years) > Design Life (50 years)

State of Maintenance Largely Unknown



Geospatial Knowledge Hypercube

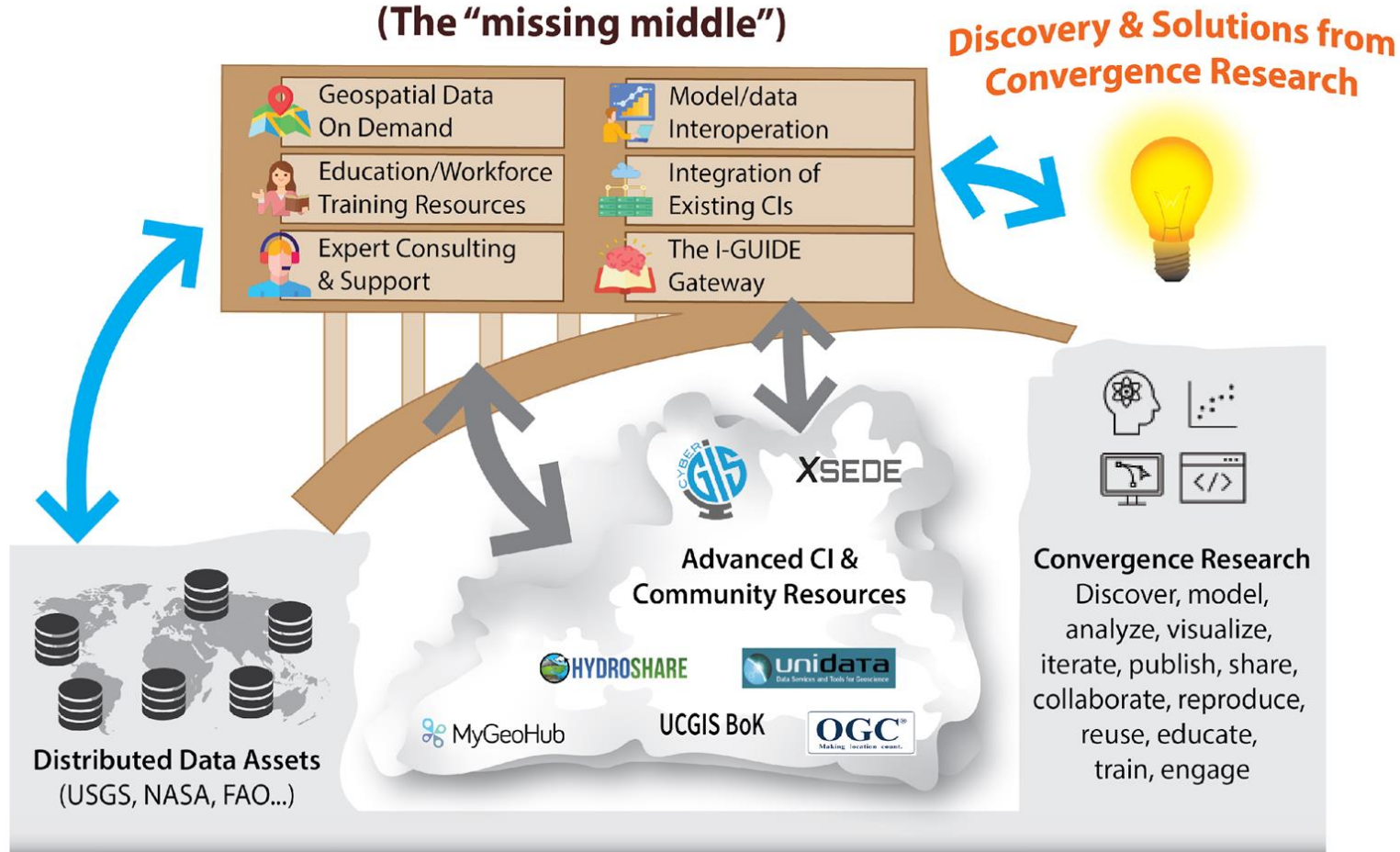


Connect

- Data
- Communities
- Domain knowledge
- Learning resources
- Partners

I-GUIDE Platform

The I-GUIDE Platform (The “missing middle”)



<https://iguide.illinois.edu/platform/>



Launch I-GUIDE Notebooks

Launch I-GUIDE Data Catalog

Additional Resources

I-GUIDE Data & Computation Resources

Geospatial Data Science Curriculum

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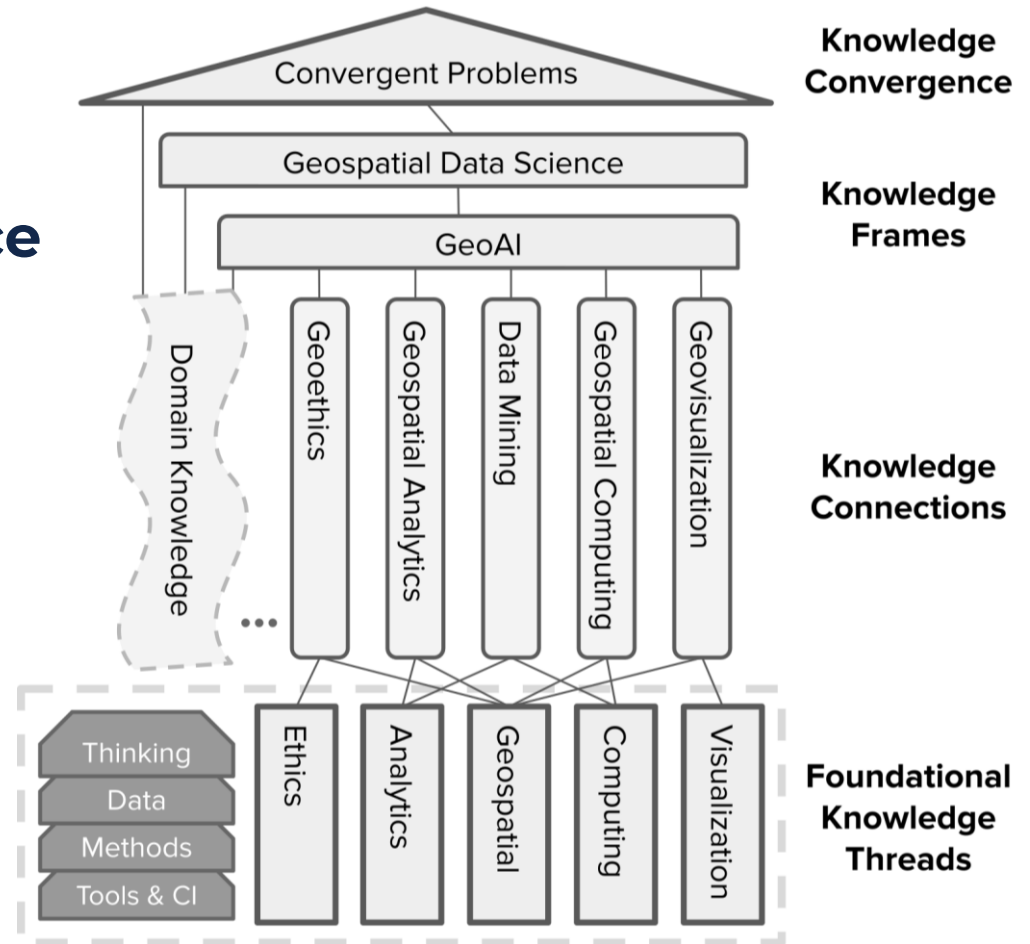
I-GUIDE *PLATFORM*

The I-GUIDE platform is designed to harness the vast, diverse, and distributed geospatial data at different spatial and temporal scales and make them broadly accessible and usable to convergence research and education enabled by cutting-edge cyberGIS and cyberinfrastructure.

Partners



Convergence Curriculum for Geospatial Data Science



Council of Geospatial Leaders



Richard Butgereit

Geospatial Insurance Consortium



Charles Catlett

Argonne National Laboratory



Damandeep Kochhar

HERE Technologies



Daniel Sui

Virginia Tech University



Susan Paddock

NORC at the University of Chicago



Barbara Ryan

World Geospatial Industry Council



Siva Ravada


Oracle




Dan Reed

University of Utah, and the National Science Board

Virtual Consulting Office (<https://iguide.illinois.edu/i-guide-vco/>)

 I-GUIDE

Overview ▾ Stories & Outreach ▾ Initiatives & Resources ▾ Contact Us

 I-GUIDE Virtual Consulting Office

I-GUIDE's virtual consulting office (VCO) showcases innovative research and education. The VCO addresses the ongoing needs of pertinent communities and partners. Past VCO sessions are available as recordings from their respective links below.





Upcoming Sessions


- An Overview of Cartograms and Gastner's Flow-based Algorithm
 - **Presenter:** Adam Tonks, University of Illinois
 - **When:** Tuesday, March 21, 2023, at 12 pm Central time
 - **Register here:** <https://illinois.zoom.us/join/join?jzlvOurgD4jGdeJt8f4JallfYRte6uSa3>




Previous Sessions, Recordings Available

- [02/28/2023] [The I-GUIDE Cyberinfrastructure Platform for enabling integrative discovery](#)
- [02/14/2023] [Understanding Remote Connections: A Gentle Introduction to Telecoupling, Metacoupling, and the Telecoupling Toolbox](#)
- [02/07/2023] [Convergence Curriculum for Geospatial Data Science](#)
- [01/24/2023] [SIMPLE-G: A multiscale framework for integration of economic and biophysical determinants of sustainability](#)
- [11/14/2022] [The Convergence Curriculum for Geospatial Data Science: Open Resources for You and Your Learners](#)
- [11/02/2022] [CyberGIS-Compute: Enabling Simplified Access to High Performance Computing for your Geospatial Computation](#)
- [10/12/2022] [Communicating Science: Identifying What You Want and How to Get It](#)
- [08/30/2022] [GeoEDF: A Framework for Designing and Executing Geospatial Research Workflows](#)
- [07/22/2022] [CyberGIS-Compute: Geospatial Middleware for Simplifying Access to High-Performance Computing](#)

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Institute for Geospatial Understanding through an Integrative Discovery Environment (I-GUIDE)
is supported by the National Science Foundation

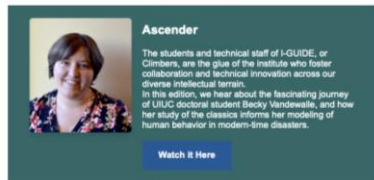
This material is based upon work supported by the National Science Foundation under award No. 2118329. Any opinions, findings, conclusions, or recommendations expressed in this material are those of the author(s) and do not necessarily reflect the views of the National Science Foundation.

Community Newsletters (<http://i-guide.io>)



Sustainability and resilience are among the biggest challenges the world faces today, especially regarding climate change. Meeting those challenges means both collecting as much data about our world as possible and harnessing that data. I-GUIDE is a big part of harnessing that data revolution.

[Read More](#)



I-GUIDE Webinar Series

I-GUIDE's webinar series showcases the innovative research and education advanced by I-GUIDE, collaborators and partners.

Upcoming Webinars:

- Visual Storytelling with Data: From the Basics to

I-GUIDE Virtual Consulting Office Hours

The Virtual Consulting Office hosts interactive demonstrations, workshops and discussions that gather the knowledge and experience within I-GUIDE with that of the broader community.

Upcoming Workshops:

- Communicating Science: Identifying



Geothics in a Geospatial Data Science Curriculum

Ethics in software engineering, data management, and analysis is critical within data-driven research. Listen to researcher Peter Darrich describe the distinctive role of geothics as a component of the I-GUIDE Convergence Curriculum in this overview [video](#).



Discover

- Scientific knowledge
- Convergence science in action
- GeoEthics

Global drivers of groundwater sustainability stress in the US

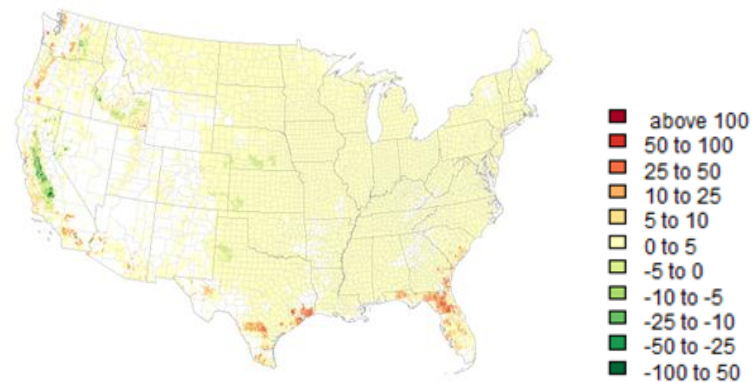
(1) Significant implication of global food demand for US water resources



Spillover effects of groundwater sustainability policy

(2) Fruit and vegetable production is likely to move from California to Florida in response to water restriction policy in the Western US

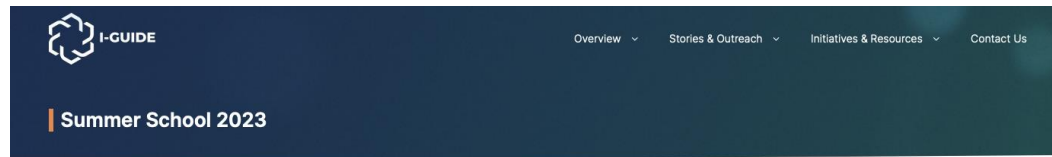
% change in cropland area due to groundwater sustainability restrictions



Haqiqi, I., Bowling, L. C., Jame, S. A., Hertel, T., Baldos, U., & Liu, J. (in review). **Global Drivers of Local Water Stresses and Global Responses to Local Water Policies in the United States.** *Environmental Research Letters*.

I-GUIDE Summer School

<https://iguide.illinois.edu/summer-school-2023/>



Summer School 2023 Apply Logistics Sponsors

Convergence Science in Action

UCAR campus in Boulder, Colorado
August 7-11, 2023

The Institute for Geospatial Understanding through an Integrated Discovery Environment, I-GUIDE, will lead a week-long Summer School in August 2023 on *Convergence Science in Action*. Certain complex and compelling societal problems require a convergent research approach, when knowledge, tools, and modes of thinking from multiple disciplines are strategically integrated and merged. About 25 graduate students and early career scholars will collaborate with project members of I-GUIDE to develop novel solutions to complex problems that rely on computation- or data-intensive geospatial data science. The participants will experience the collaborative and professional interactions that are key to comprehensively working on convergence science problems, including geoeconomics, geo-enabling reproducible and open science, geovisualization, and geoAI and spatial data science via cloud and high-performance computing.

This year our application areas will include topics such as climate change, biodiversity, water security, sustainable development, and implications of these as studied via social science data.

The Summer School will be hosted on the UCAR campus in Boulder, Colorado, from Monday August 7 to Friday, August 11, 2023. If you are a graduate student or early-career scholar new to geospatial data science and want to learn more about integrating this into your research, or are already working with data-intensive geospatial science approaches, this Summer School will offer new and exciting opportunities for your professional development, and will help you develop interdisciplinary skills and build new connections with others in related fields.

Organizers

- Mohan Ramamurthy, UCAR (mohan@ucar.edu)
- Anand Padmanabhan, UIUC (apadmana@illinois.edu)
- Eric Shook, University of Minnesota, Twin Cities
- Diana Sinton, University Consortium for Geographic Information Science
- Shaowen Wang, UIUC

Have questions? Please reach out to Mohan Ramamurthy or Anand Padmanabhan.

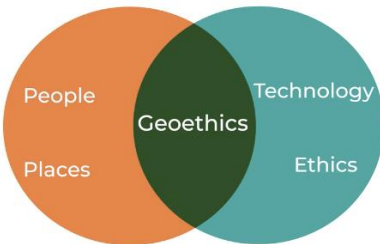


Geoethics

The lack of computational reproducibility support and data ethics guidance is a major challenge for integrative knowledge infrastructure. This key area of activity for I-GUIDE involves supporting the process of decision-making around sharing data and data-driven research outcomes. These include issues of privacy, consent, equity, assessment of benefits and harms, transparency, and integrity in research practices and use of AI algorithms.

Geoethics is a central area of our Convergence Curriculum for Geospatial Data Science. Listen to I-GUIDE researcher Peter Darch explain why integrating this structural guidance for computational reproducibility and data ethics from the start is so important.

An overview of geoethics from I-GUIDE's Peter Darch.



Geoethics Resources

- GIS Ethics Case Studies, <https://gisethics.org>. This recently updated and expanded collection of case studies is a classic contribution for this field, curated and maintained by Penn State University.
- Data and Society, <https://datasociety.net>. Data & Society advances public understanding of the social implications of data-centric technologies and automation.
- AI Now, <https://ainowinstitute.org>. The AI Now Institute at New York University is an interdisciplinary research center dedicated to understanding the social implications of artificial intelligence.

Share this:



I-GUIDE Forum 2023

- Location: The Forum at Columbia University, New York City, USA
- Time: October 4th – 6th, 2023
 - Pre-conference workshops on October 4th
 - Main conference on October 5th and 6th
- Theme: Harnessing the geospatial data revolution for sustainability solutions

<https://iguide.illinois.edu/forum-2023/>

Forum 2023

Harnessing the Geospatial Data Revolution for Sustainability Solutions

October 4 - 6, 2023



Join us at the I-GUIDE Forum 2023, an international conference for a groundbreaking event focused on “Harnessing the Geospatial Data Revolution for Sustainability Solutions.” As the world becomes increasingly interconnected, harnessing the power of geospatial data is more critical than ever before. At this Forum, we’ll explore innovative ways to leverage geospatial data to tackle some of the most pressing sustainability challenges of our time.

With a diverse range of speakers and topics, I-GUIDE Forum 2023 is an exciting event for anyone interested in the intersection of geospatial science & technology and sustainability. Don’t miss out on this opportunity to connect with like-minded peers, learn from leading experts, and gain insights that will help make the world more sustainable.

Information about speakers, sessions, and registration will be announced soon!

The I-GUIDE Forum 2023 will be held at:

[The Forum at Columbia University](#)

601 W 125th St, New York, NY 10027.

Map of The Forum at Columbia University



I-GUIDE Team



Thanks!

- **Comments / Questions?**
- **Contact: shaowen@illinois.edu**
- **Twitter: swuiuc**