Webinar: Conceptualizing a National Geospatial Software Institute

NSF SI2-S2I2 Conceptualization: Geospatial Software Institute (GSI)

Tuesday, December 17th: 3 – 4pm CT

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National Center for Supercomputing Applications/University of Illinois

Co-PI

Michael F. Goodchild

University of California - Santa Barbara

Chair of the advisory committee

Daniel S. Katz

National Center for Supercomputing Applications

Co-PI

Paul Morin

University of Minnesota

Co-PI

Margaret Palmer

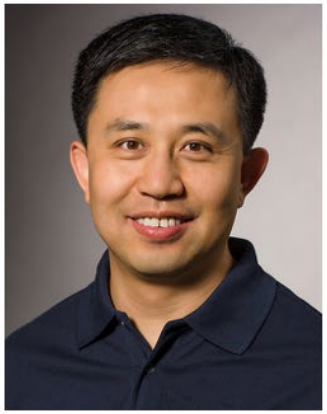
University of Maryland

Co-PI

Anand Padmanabhan

University of Illinois at Urbana-Champaign

Project Manager



Shaowen Wang

University of Illinois at Urbana-Champaign

Chair, PI

Advisory Committee

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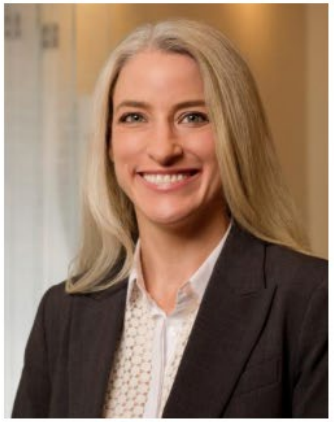
University of Chicago

Michael Batty
University College London

David Maidment
University of Texas-Austin



Victoria Stodden
University of Illinois at Urbana-Champaign

George Percivall
Open Geospatial Consortium

E. Lynn Usery
United States Geological Survey

Nancy Wilkins-Diehr
San Diego Supercomputer Center/University of California, San Diego

Background

Cyberinfrastructure for Sustained Scientific Innovation (CSSI) - Data and Software:
Elements and Frameworks

PROGRAM SOLICITATION
NSF 18-531

REPLACES DOCUMENT(S):
NSF 17-500, NSF 17-526

National Science Foundation

Directorate for Computer & Information Science & Engineering
Office of Advanced Cyberinfrastructure

Directorate for Biological Sciences

Directorate for Education & Human Resources

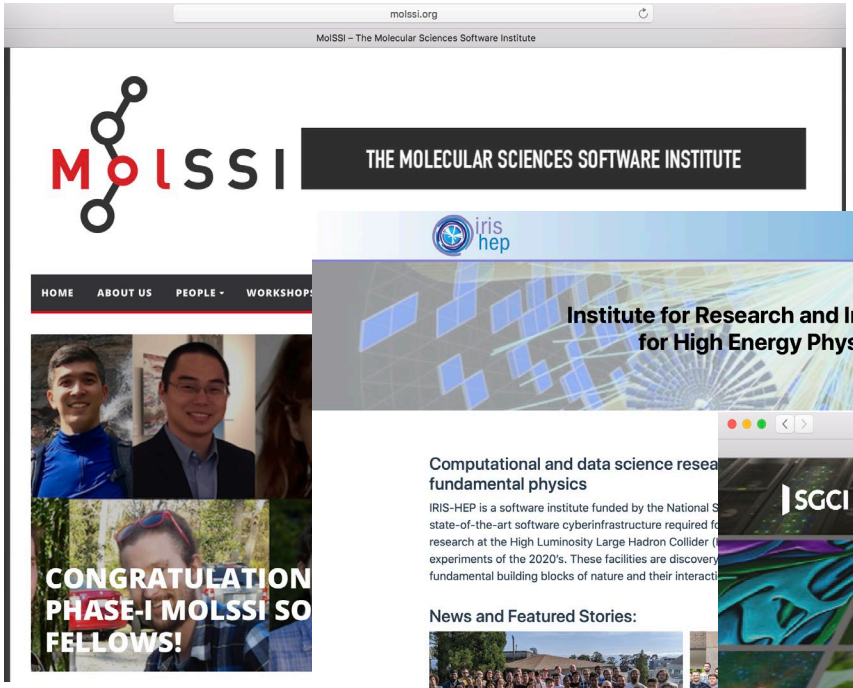
Directorate for Engineering

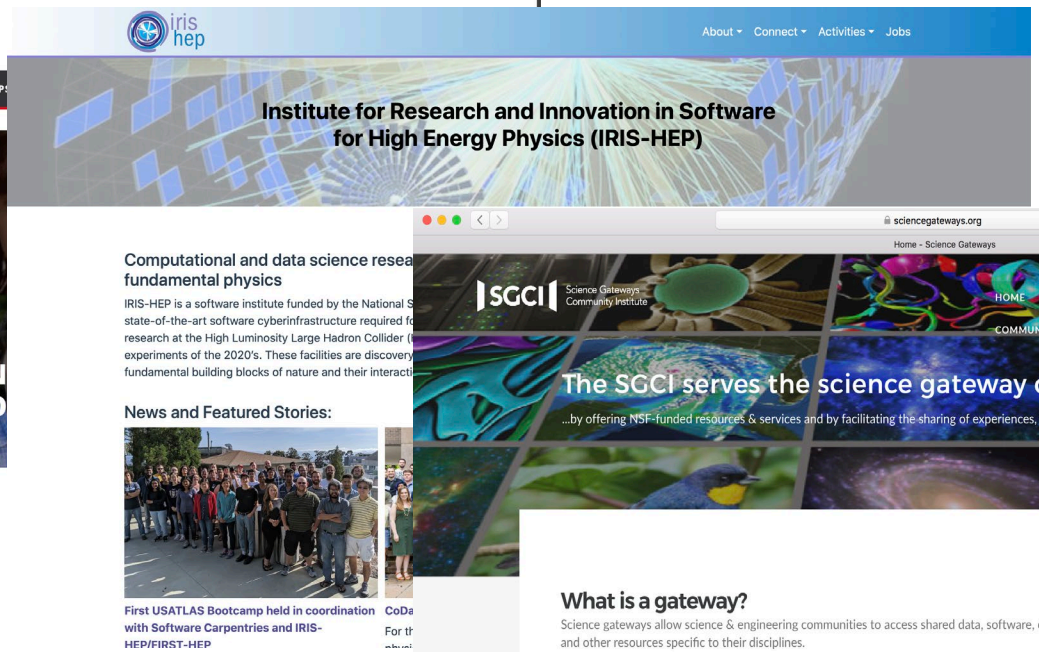
Directorate for Geosciences

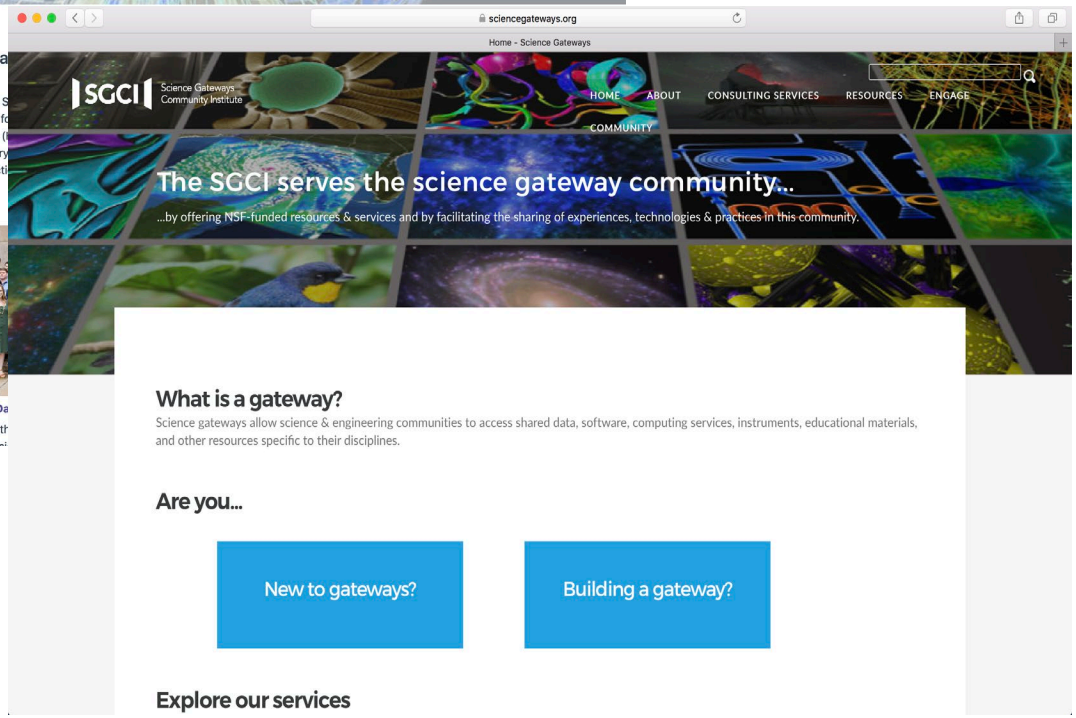
Directorate for Mathematical & Physical Sciences

Directorate for Social, Behavioral & Economic Sciences

Existing NSF Software Institutes







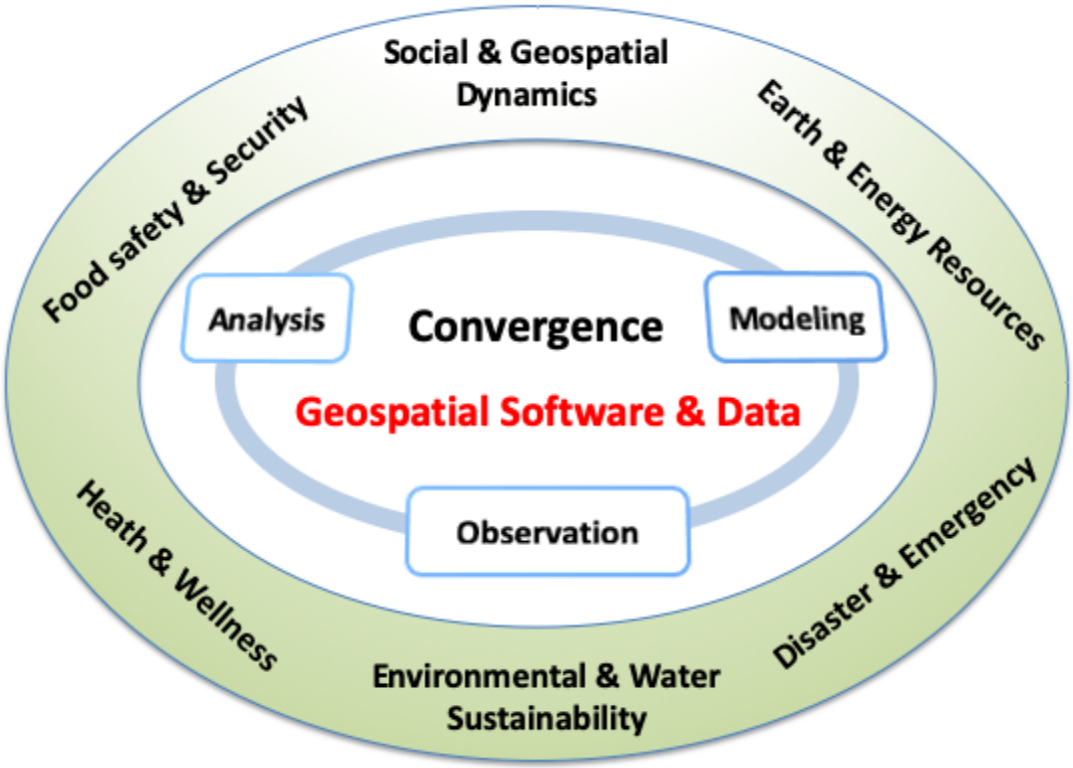
Geospatial Data Complexity

- Dynamic
- Distributed sharing
- Heterogeneous
- Massive
- Multi-scale
- Privacy
- Quality
- Uncertainty

Geospatial Software

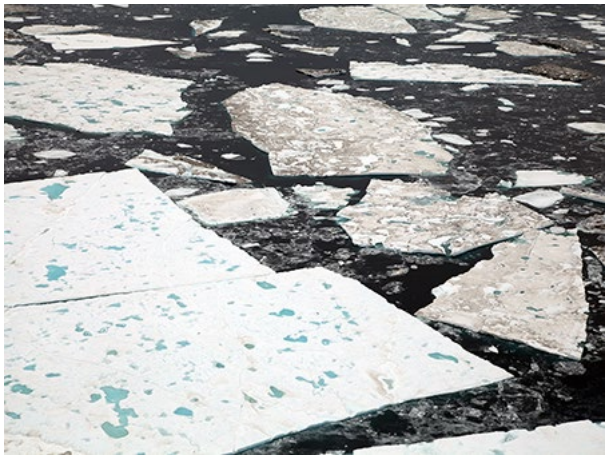
- Software for transforming geospatial (geo & spatial) data into information, knowledge, and intelligence
- Fusion of rapidly changing multidisciplinary sciences and technologies

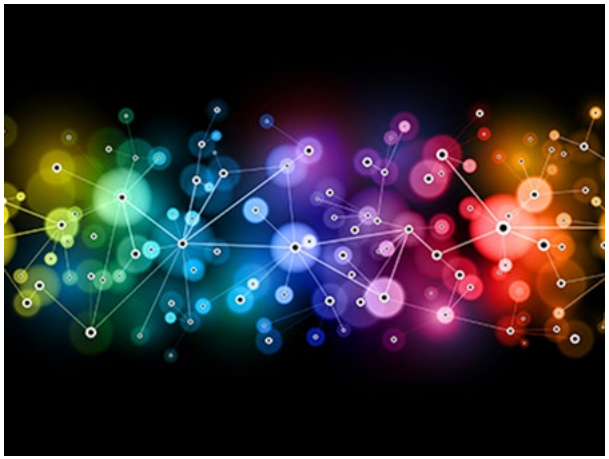
Big Scientific and Societal Challenges



Increasing geospatial problems and questions!

Matching Well with NSF's Big Ideas





https://www.nsf.gov/news/special_reports/big_ideas/

Conceptualization Process

- Three Workshops
- Community Survey
- AAG-UCGIS Summer School

Three Workshops – 76 Position Papers Accepted

- Workshop 1: Mission and vision
  - https://gsi.cigi.illinois.edu/workshop/position-papers/
- Workshop 2: Use cases and core capabilities
  - https://gsi.cigi.illinois.edu/workshop2/position-papers/
- Workshop 3: Strategic plan and governance
  - https://gsi.cigi.illinois.edu/workshop3/position-papers/

Community Survey

http://bit.ly/gssusersurvey

Electronic Consent Form For Voluntary Participation in a Research Project
(NSF SI2-S2I2 Conceptualization: Geospatial Software Institute):

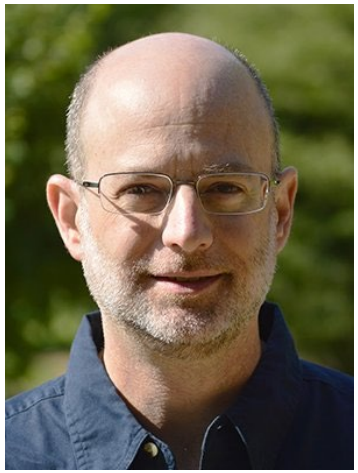
Assessing the Needs and Practices of the Geospatial Software Community

This research project is being conducted by Shaowen Wang from the Department of Geography at the University of Illinois at Urbana-Champaign (UIUC). It has been funded by the National Science Foundation. Your participation is completely voluntary and you must be 18 years of age or older to participate. You are free to decline to participate. You may choose to withdraw from participation at any time without penalty or negative repercussion. The decision to participate, decline, or withdraw from participation will have no effect on your status at or future relations with the University of Illinois.

The goal of this project is to conduct research to understand the current needs of the geospatial software community. The main activities in the survey will involve answering a series of questions regarding the geospatial software that you currently use and what you use it for. We will also ask you a few questions about your education, occupation, and institutional affiliation. This activity should take you about 15 minutes to complete. While you may not directly benefit from your participation in this project, your response will allow the researchers to better understand the needs of the geospatial software community and to design innovative

Survey Team at UIUC

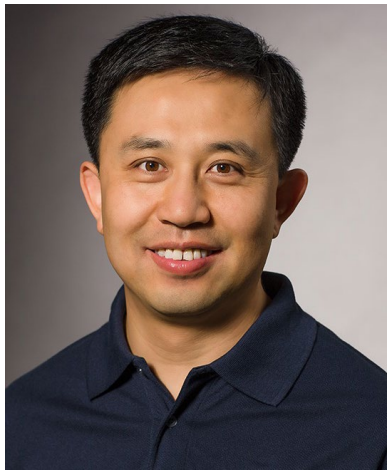
William Barley



Dan Katz

Anand Padmanabhan

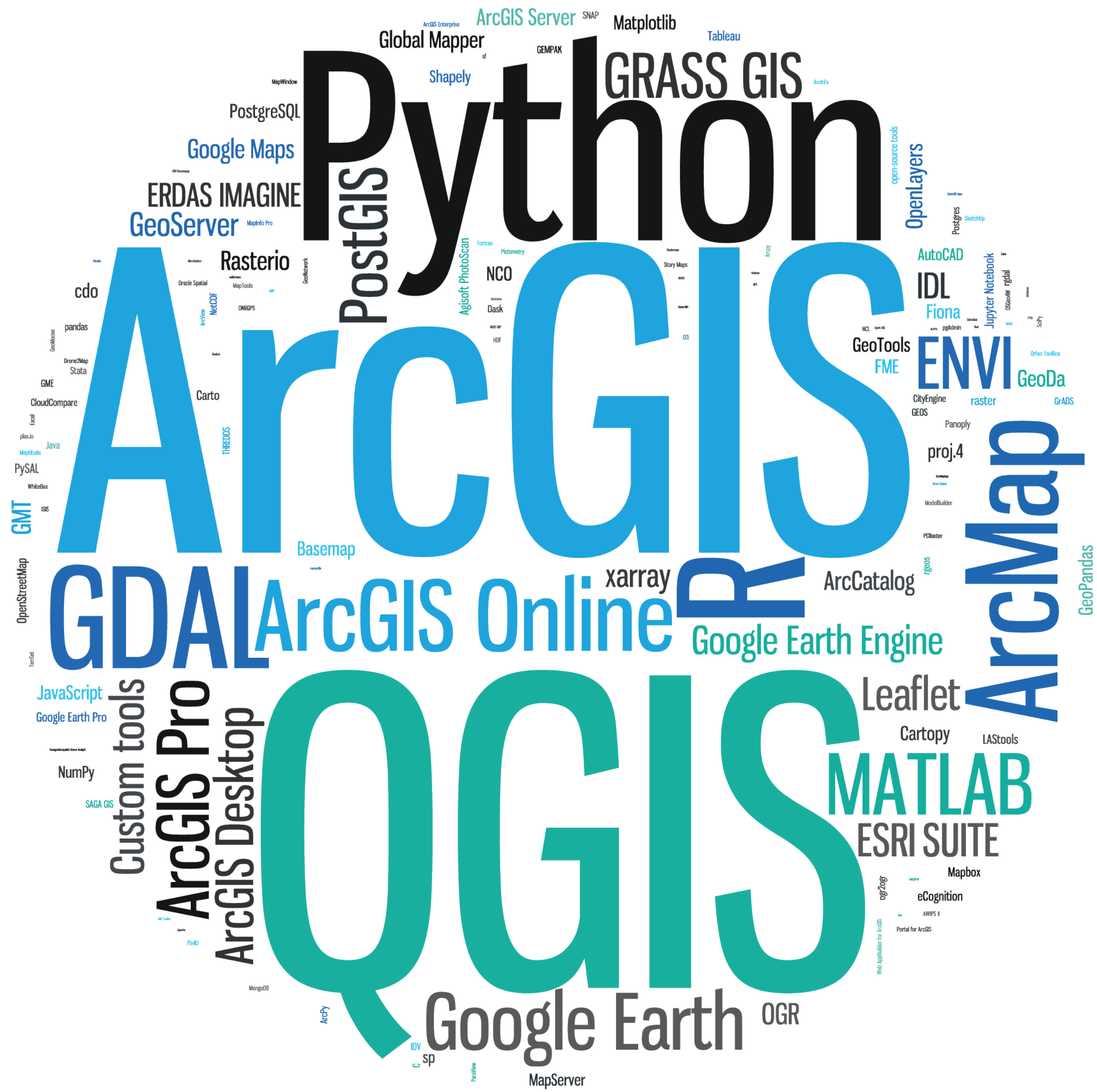
Rebecca Vandewalle



Shaowen Wang

Toward a sustainable social and technical ecosystem to enable geospatial-inspired discovery and innovation

Toward a sustainable social and technical ecosystem to enable geospatial-inspired discovery and innovation



Survey Findings – William Barley

ILLINOIS CyberGIS Center
FOR ADVANCED DIGITAL AND SPATIAL STUDIES

AAG American Association of Geographers

University Consortium for Geographic Information Science

AAG-UCGIS Summer School 2019

Reproducible Problem Solving with CyberGIS and Geospatial Data Science

University of Illinois at Urbana-Champaign

Monday July 8 - Saturday July 13, 2019

In July 2019, a week-long summer school on *Reproducible Problem Solving with CyberGIS and Geospatial Data Science* will be co-led by the CyberGIS Center for Advanced Digital and Spatial Studies (CyberGIS Center) at the University of Illinois at Urbana-Champaign (UIUC), American Association of Geographers (AAG), and University Consortium for Geographic Information Science (UCGIS). Approximately 30 graduate students and early career scholars will learn to collaborate in developing novel solutions to complex problems and to take advantage of geospatial data science and cutting-edge scientific advances and technical capabilities of cyberGIS (e.g., CyberGIS-Jupyter and Virtual ROGER: cybergis.illinois.edu/infrastructures). Participants will experience the types of collaborative and professional interactions that are key to addressing reproducible geospatial problem solving in the context of computation- and/or data-intensive research involving confidential geospatial data. The program is built on the success of the inaugural UCGIS Summer School in 2017, and ideal for those working on interdisciplinary and transdisciplinary topics, including but not limited to: data-driven social and environmental sciences, digital humanities, geospatial artificial intelligence, and remote sensing big data.

This Summer School will be hosted on the UIUC campus at Urbana, Illinois, USA from Monday July 8 to Saturday July 13, 2019. If you are a graduate student or early-career scholar new to cyberGIS and geospatial data science and want to learn more about integrating them into your research, or are already working on cyberGIS and/or geospatial data science approaches, this Summer School will offer new and exciting opportunities for your professional development, and will help you build connections with others in related fields. UIUC will offer travel awards through generous support of the National Science Foundation (NSF) for participating in the Summer School.

Member Login

Search our site... Search

Announcements

Guido Cervone, from Penn State University, the winner of the 2019 Carolyn Merry Mentoring Award!

Apply Today for a Spot in our Summer School 2019! Funded!

Meet the 2019 TRELIS Cohort!

Iowa's Marc Armstrong Selected as a 2019 UCGIS Fellow

Current GIS&T Job Listings

Upcoming Events

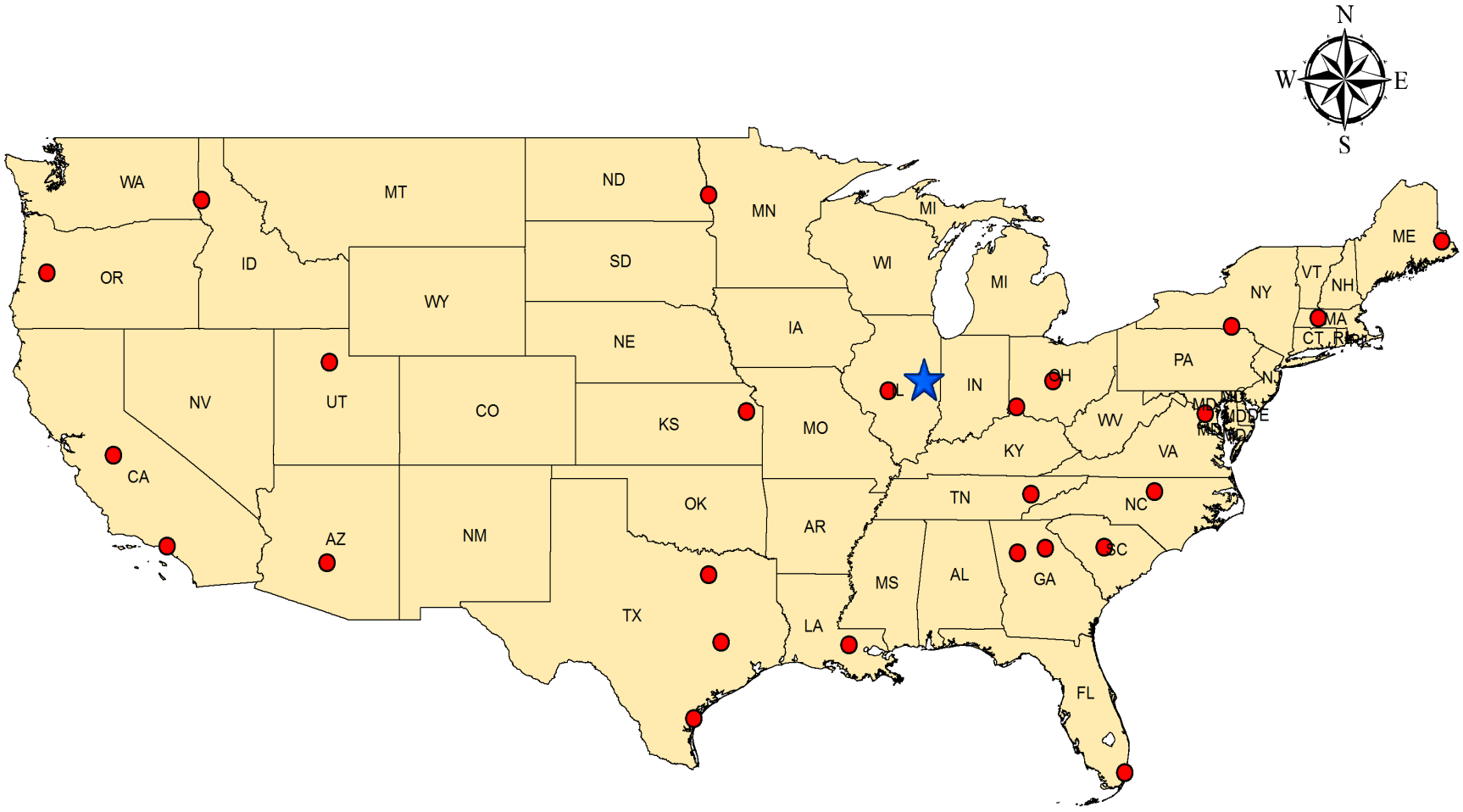
Fri Apr 26, 2019
April 2019 Board Meeting
Category: Board Meetings

Sat Jun 8, 2019
TRELIS Washington DC 2019
Category: Other Events

Mon Jun 10, 2019
Symposium 2019
Category: Symposium

View Full Calendar

Toward a sustainable social and technical ecosystem to enable geospatial-inspired discovery and innovation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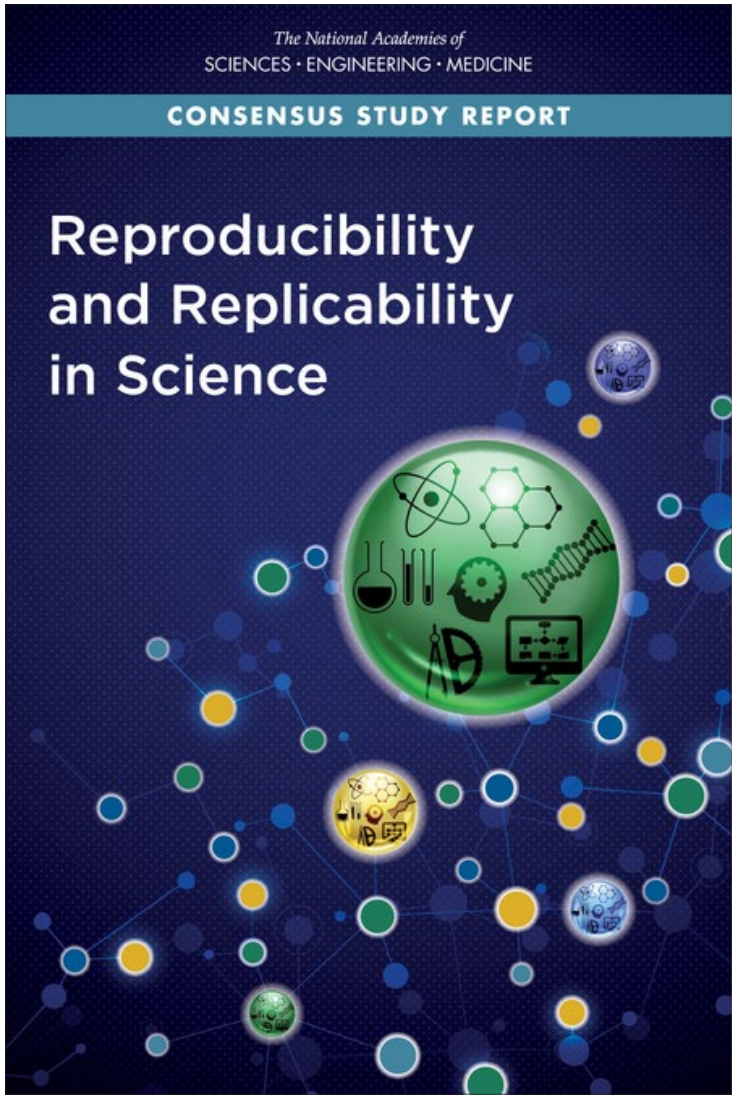
Distribution of 2019 summer school participants
University of Illinois at Urbana Champaign
Participants' institutions


Reproducibility in Computational and Data-enabled Science
Victoria Stodden
School of Information Sciences and NCSA
University of Illinois at Urbana-Champaign
GIS Summer School in Reproducibility
NCSA
July 8, 2019
Reproducibility in Computational and Data-enabled Science



COMMITTEE ON REPRODUCIBILITY AND REPLICABILITY IN SCIENCE

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LORENA A. BARBA, School of Engineering and Applied Science, George Washington University
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JENNIFER HEIMBERG, *Study Director*
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REBECCA MORGAN, Senior Librarian
THELMA COX, Program Coordinator (beginning January 2019)
LESLEY WEBB, Program Assistant (September 2018 through January 2019)
GARRET TYSON, Program Assistant (September 2017 through August 2018)
ERIN HAMMERS FORSTAG, *Consultant Writer*

[1] Member of the National Academy of Medicine
[2] Member of the National Academy of Engineering
[3] Member of the National Academy of Sciences
[4] Resigned from the committee on July 24, 2018
[5] Resigned from the committee on October 11, 2018

https://www.nap.edu/catalog/25303/reproducibility-and-replicability-in-science

Computational Reproducibility - Victoria Stodden

- Reproducible, transparent, and scalable geospatial software: Enable researchers to harness the geospatial data revolution for discovery and innovation by combining geospatial software and data at scale, in reproducible and transparent ways
- Structured guidance for computational reproducibility: Establish structured guidance for computational reproducibility in scientific research and education that are dependent on geospatial software


University Consortium for GEOGRAPHIC INFORMATION SCIENCE
ILLINOIS
CyberGIS Center
FOR ADVANCED DIGITAL AND SPATIAL STUDIES
UCGIS-CyberGIS Center@UIUC
Award for Advancing Reproducib
Geospatial Research


University Consortium for
GEOGRAPHIC INFORMATION SCIENCE
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CyberGIS Center
UCGIS-CyberGIS Center@UIUC
Award for Advancing Reproduc
Geospatial Research

Geospatial Digital Workforce: Diana Sinton

- Increase the nation's workforce capability and capacity to utilize geospatial big data and software for knowledge discovery supported by critical spatial thinking, and to further innovate geospatial software and advance related sciences


8 Core Areas
Technologies
Problem Solving
Geographic Information Science
Computational Science
Spatial Modeling & Analytics
Cyber-Infrastructure
Parallel Computing
Geospatial Data
Cyber GIScience Literacy
Big Data
Spatial Thinking
Interdisciplinary Communication
Computational Thinking


AAG
American Association of Geographers
ICPSR
INSTITUTE FOR SOCIAL RESEARCH
UNIVERSITY OF MICHIGAN
S.T.A.R. Lab
ILLINOIS
bit.ly/gvde_guidelines

Ethical and Open Geospatial Software: Coline Dony

- Promote a culture of ethical and open geospatial software driven by diverse communities

Mission

- Transform geospatial software, cyberinfrastructure (CI), and data science across many fields to revolutionize diverse discovery and innovation by enhancing computational transparency and reproducibility

Vision

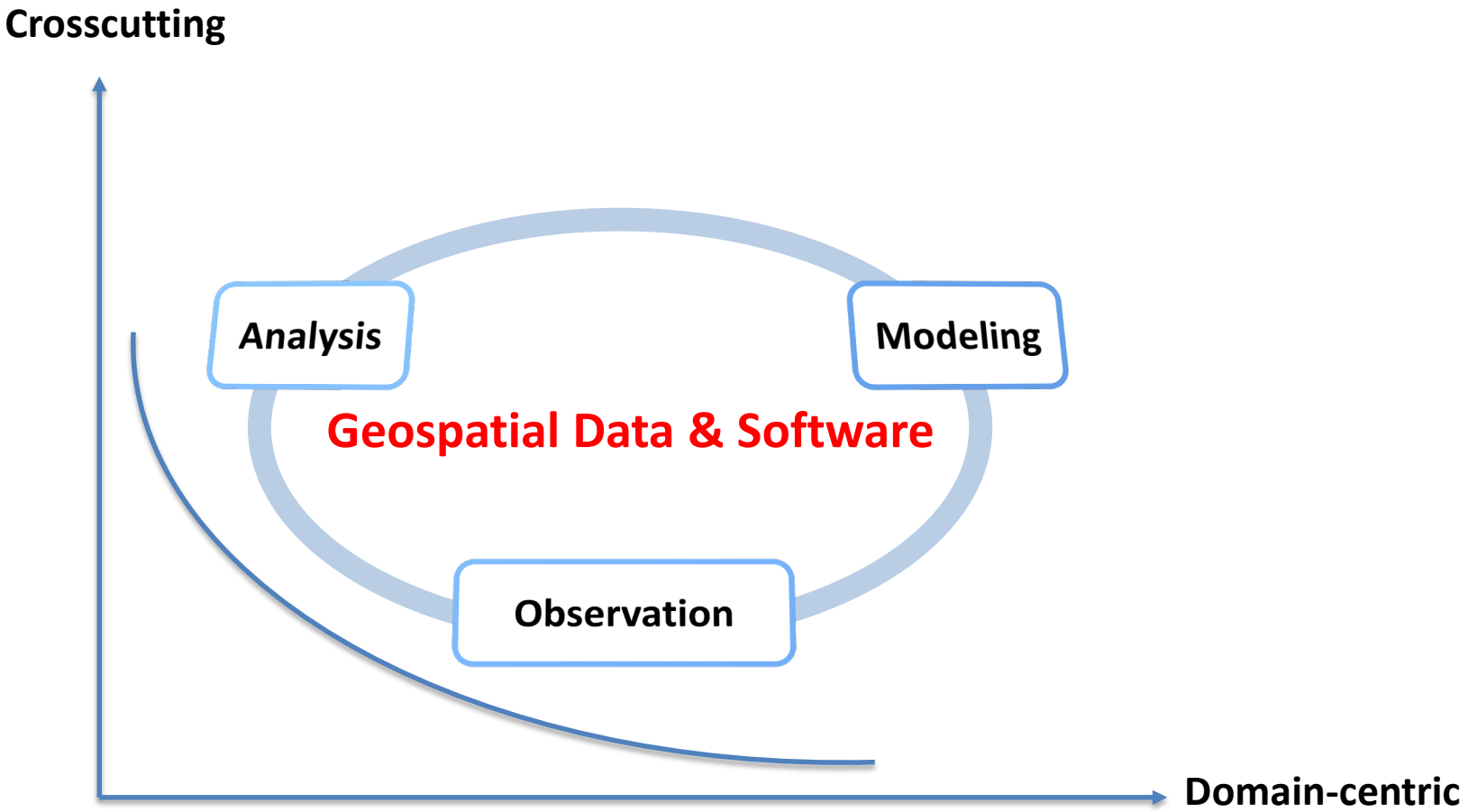
- A sustainable social and technical ecosystem to enable geospatial-inspired innovation and discovery

Goals

- Reproducible, transparent, and scalable geospatial software: Enable researchers to harness the geospatial data revolution for discovery and innovation by combining geospatial software and data at scale, in reproducible and transparent ways
- Geospatial digital workforce: Increase the nation's workforce capability and capacity to utilize geospatial big data and software for knowledge discovery supported by critical spatial thinking, and to further innovate geospatial software and advance related sciences
- Ethical and open geospatial software: Promote a culture of ethical and open geospatial software driven by diverse communities
- Structured guidance for computational reproducibility: Establish structured guidance for computational reproducibility in scientific research and education that are dependent on geospatial software
- High-performance and data-intensive geospatial software: Further the convergence of high-performance geospatial software with advancements in data-intensive and high-performance computing

The context of GSI's mission, vision, and goals

Science Drivers – Geospatial Convergence

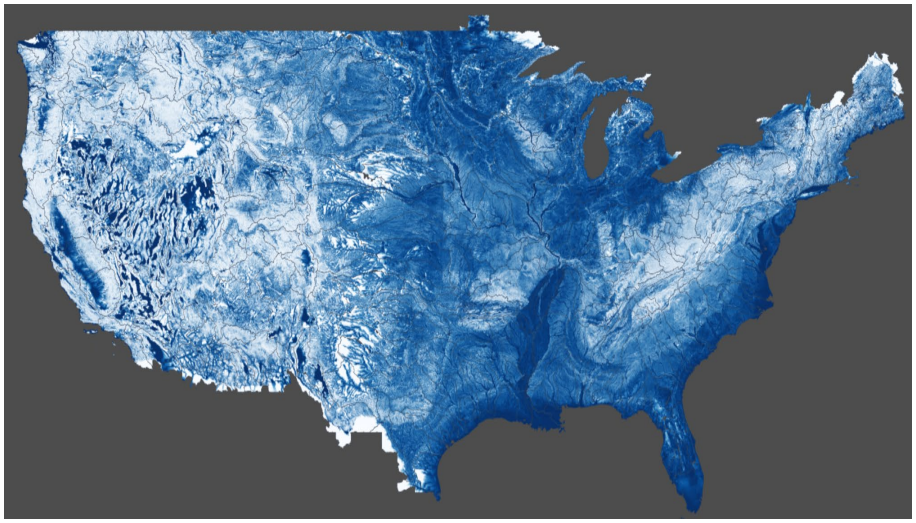


Principles of Engaging Science Drivers: Mike Goodchild

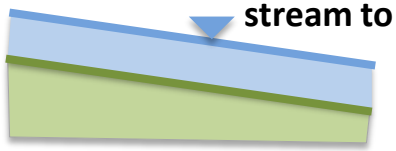
Social Science Example: Ned English

Map Flood Inundation at Continental Scale

Catchments and Flowlines



Digital Elevation Model

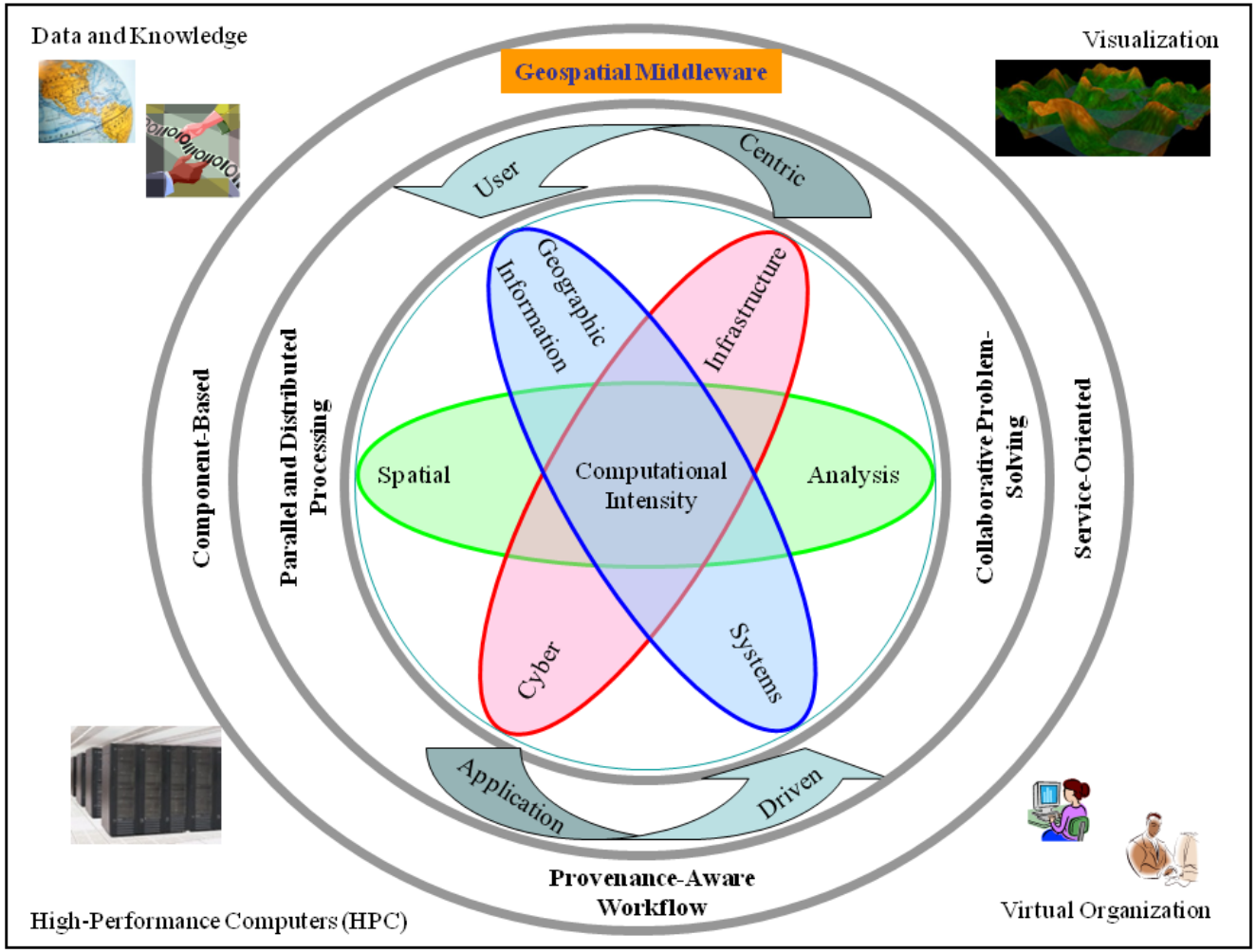


Height Above Nearest Drainage (HAND)
(relative elevation of land surface cell above cell in stream to which it flows)

Liu, Y. Y., Maidment, D. R., Tarboton, D. G., Zheng, X., and Wang, S. (2018) "A CyberGIS Integration and Computation Framework for High-Resolution Continental-Scale Flood Inundation Mapping". *Journal of the American Water Resources Association*, DOI:10.1111/1752-1688.12660

"Combination of detailed GIS representation of stream network and supercomputing to determine the flow is transformative – CyberGIS has delivered a major success for the nation!" **– Dr. David Maidment @ 2015 CyberGIS All Hands Meeting**

CyberGIS in a Nutshell



Wang, S. (2010) "A CyberGIS Framework for the Synthesis of Cyberinfrastructure, GIS, and Spatial Analysis." *Annals of the Association of American Geographers*, 100(3): 535-557

NSF CyberGIS Software Project ~$4.8 million, Year: 2010-2017

Principal Investigator
- Shaowen Wang

Co-Principal Investigators
- Luc Anselin
- Budhendra Bhaduri
- Timothy Nyerges
- Nancy Wilkins-Diehr

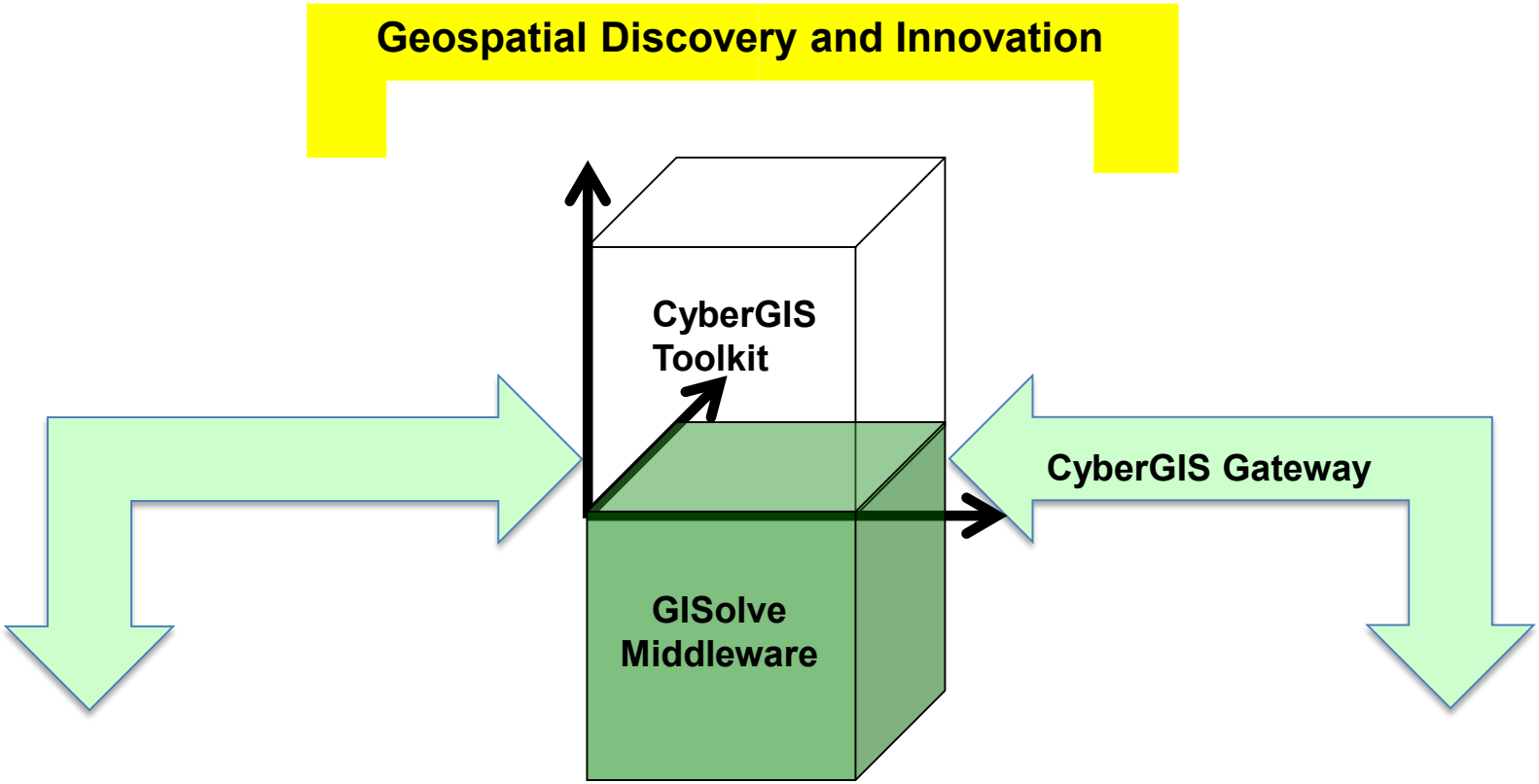
Senior Personnel
- Michael Goodchild
- Sergio Rey
- Marc Snir
- David Tarboton
- E. Lynn Usery

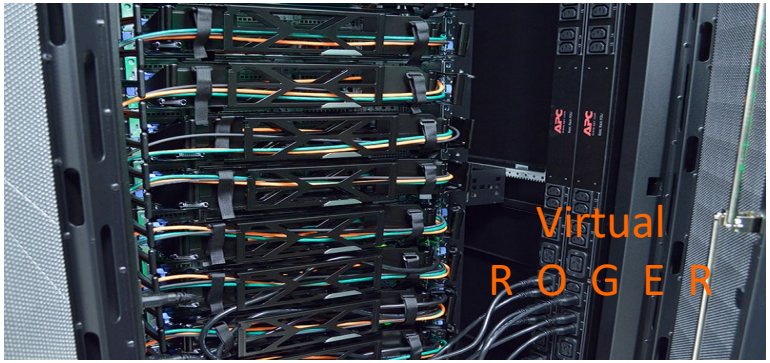
Chair of the Science Advisory Committee
- Michael Goodchild

Project Manager
- Anand Padmanabhan

Project Staff
- ASU: Wenwen Li and Rob Pahle
- ORNL: Ranga Raju Vatsavai
- SDSC: Choonhan Youn
- UIUC: Yan Liu and Anand Padmanabhan
- Graduate and undergraduate students

Industrial Partner: Esri
- Steve Kopp and Dawn Wright

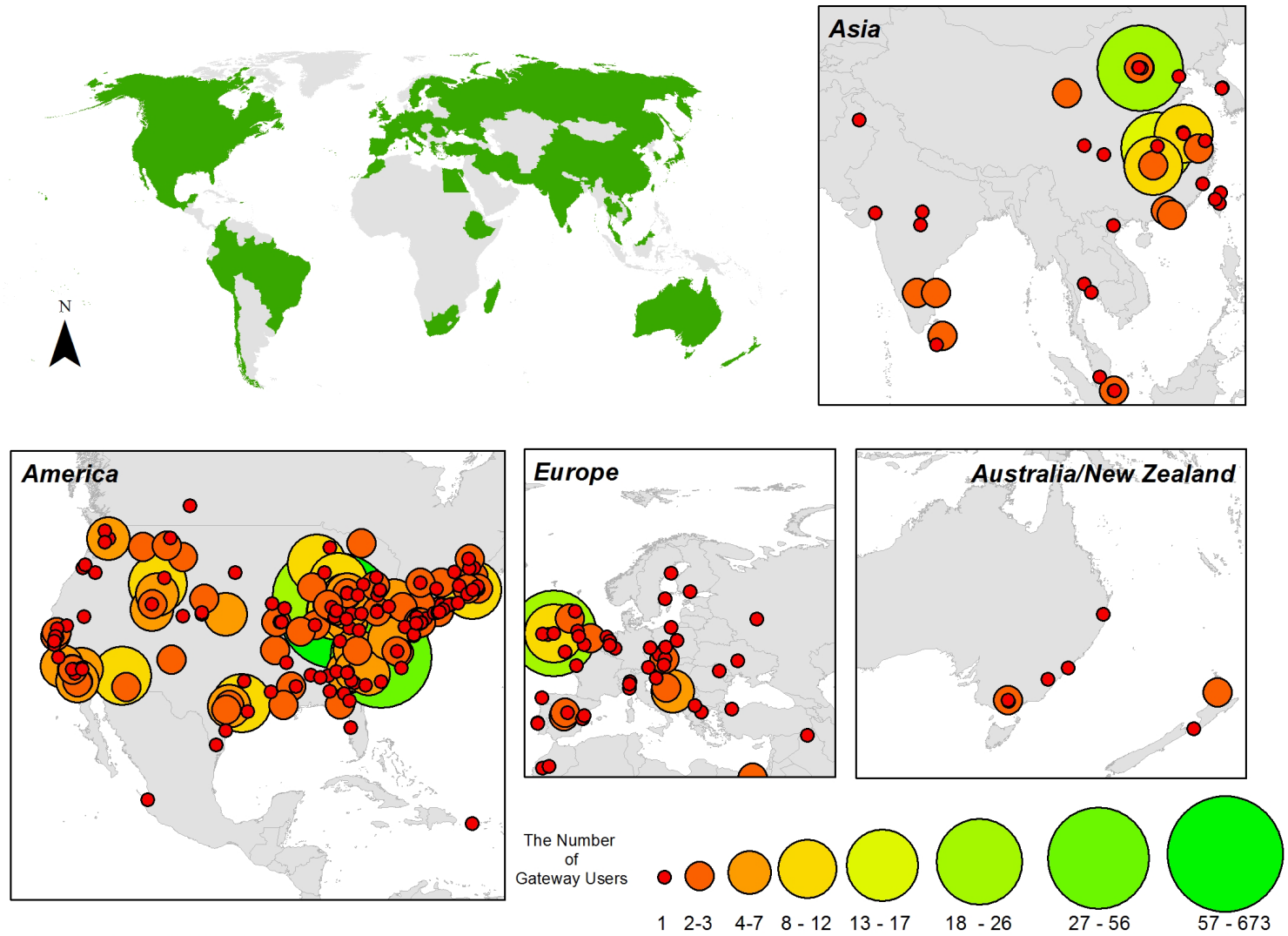




http://cybergis.illinois.edu

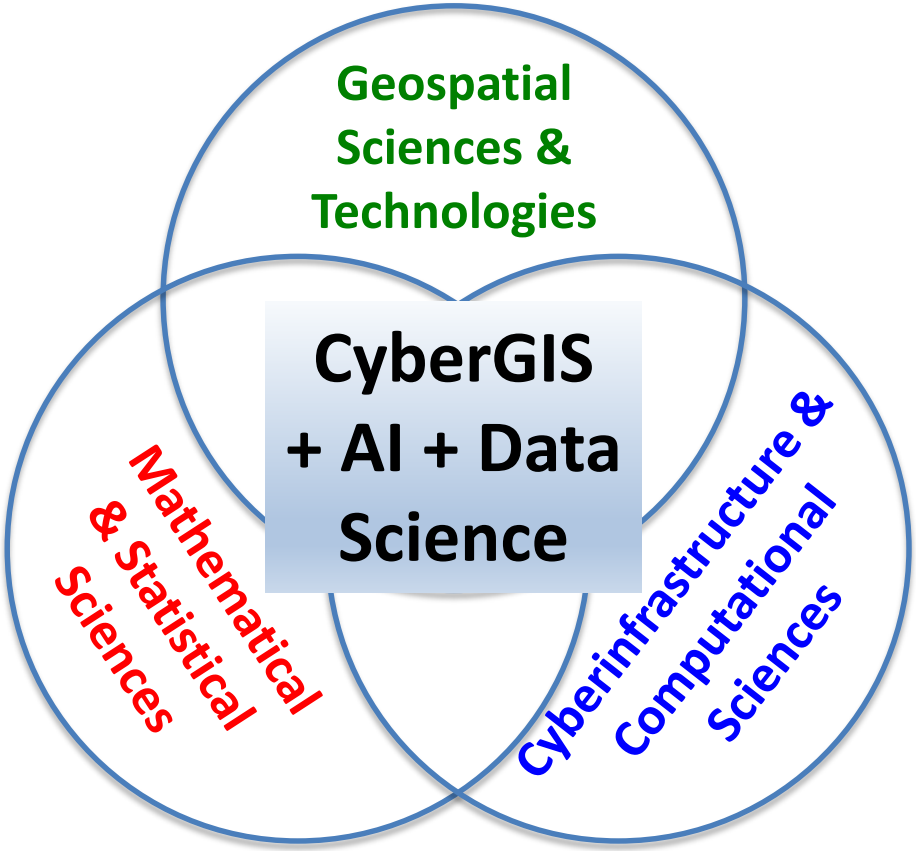
www.xsede.org

Toward a sustainable social and technical ecosystem to enable geospatial-inspired discovery and innovation



Wang, S., Liu, Y., and Padmanabhan, A. 2016. “Open CyberGIS Software for Geospatial Research and Education in the Big Data Era”. *SoftwareX*, 5: 1-5

Geospatial Data Science



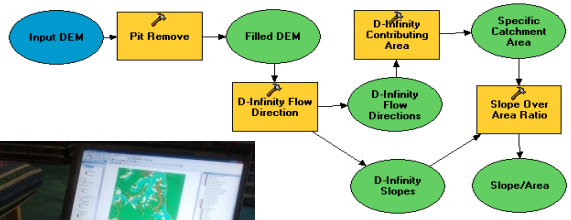
Geospatial Data Science @ Scale

- Geospatial
  - Distribution
  - Dependence
  - Integration
  - Heterogeneity
  - Representation
  - Uncertainty
  - Etc.
- Computational
  - Complexity vs. intensity
  - Reproducibility vs. validity
  - Performance vs. reliability
  - Etc.

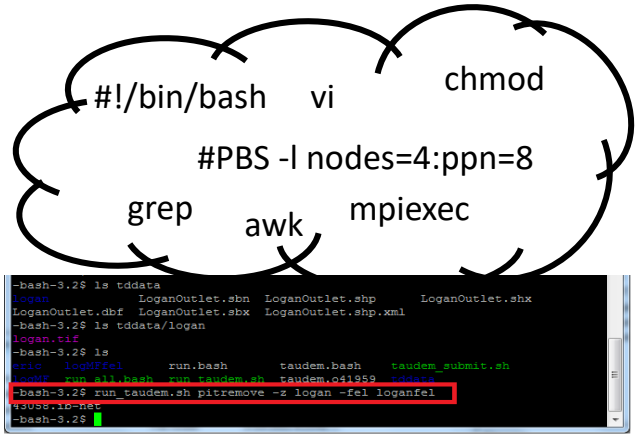
Reproducibility

A Digital Divide - David Tarboton

Hydrologic Experimentation and Modeling

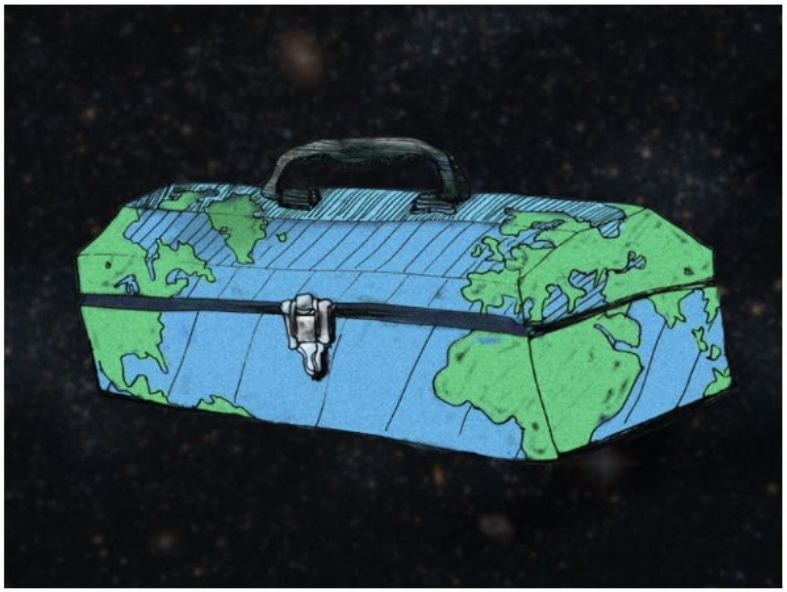


Data-Intensive & High-Performance Computing



It's Time to Shift Emphasis Away from Code Sharing

Building well-documented, citable frameworks for Earth data analysis will encourage scientific replicability by addressing the underlying issues that inhibit code sharing.



As a community of Earth scientists, we need to develop holistically designed numerical toolboxes to ensure accuracy, transparency, and replicability. Credit: Adam S. Nelsen

By Chad A. Greene and Kaustubh Thirumalai 20 February 2019

Have you ever watched a student struggle to perform a seemingly straightforward analytical procedure? It may be a routine preprocessing step, like detrending a time series or removing a seasonal cycle, but somehow the simple operations can stymie a student for weeks. It's tempting to assume that young people with their short attention spans are unwilling or unable to think through the task at hand,

Students may have little choice but to blindly tinker with code until things seem to work.

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@AGU_Eos

Storytelling is the new "it" thing in communication. Learn how @theAGU & @AGU_SciComm can help you get started.

By @EcologyOfShane #AGU100
#scicommeos.org/agu-news/agu-h...

AGU Has a Story to Tell - Eos
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Shining a Spotlight on LGBTQ+ Visibility in STEM

News 17 June 2019
Ceramics Trace a 14th Century Indonesian Tsunami

https://eos.org/opinions/its-time-to-shift-emphasis-away-from-code-sharing

jupyter HAND Last Checkpoint: Last Wednesday at 1:41 PM (autosaved)

Logout | Control Panel

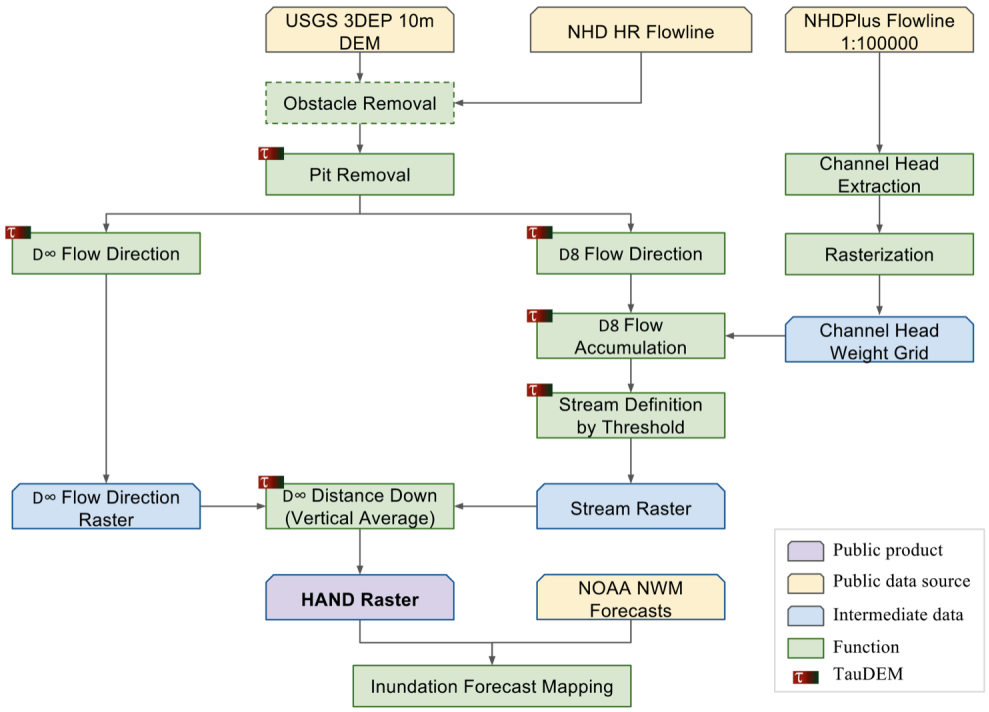
File Edit View Insert Cell Kernel Widgets Help | Not Trusted | Python 2

Run | Markdown

HAND and Flood Emergency Response

This Jupyter notebook illustrates the HAND workflow and its use in example flood emergency scenarios. The study area is Onion Creek (HUC10 code 1209020504)

It is also a demonstration of conducting geospatial anlysis with opensource toolkits(gdal) + online Jupyter interface



- We use CyberGIS' accelerated TauDEM version for d8 and d∞ flow direction calculation
  - More about TauDEM

Illinois Data Bank + Deposit Dataset Find Data Policies Help Log in with NetID

CyberGIS-Jupyter HAND Example Notebook

Citation:

Yin, Dandong; Wang, Shaowen (2018): CyberGIS-Jupyter HAND Example Notebook. University of Illinois at Urbana-Champaign. https://doi.org/10.13012/B2IDB-6316661_V2

Export Citation If you use this dataset, please cite it.

Copy persistent link to clipboard... Persistent link for this item: https://doi.org/10.13012/B2IDB-6316661_V2

Dataset Description	The dataset contains a complete example (inputs, outputs, codes, intermediate results, visualization webpage) of executing Height Above Nearest Drainage HAND workflow with CyberGIS-Jupyter.
Subject	Technology and Engineering
Keywords	cybergis; hydrology; Jupyter
License	CC BY
Corresponding Creator	Shaowen Wang
Downloaded	16 times

[-] Versions in Illinois Data Bank

Version	DOI	Comment	Publication Date
2	**10.13012/B2IDB-6316661_V2**	**Removed some unnecessary words, updated section information, updated subfolders and labels.**	**2018-12-13**
1	10.13012/B2IDB-6316661_V1		2018-12-12

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CyberGIS-Jupyter_HAND_Example.zip	607 MB	File

[+] Change Log

CyberGIS-Jupyter

Open Web App

Authors: Dandong Yin
Owners: Fangzheng Lu · Dandong Yin
Resource type: Web App Resource
Created: Sep 26, 2018 at 5:53 p.m.
Last updated: Sep 26, 2018 at 6:56 p.m. by Dandong Yin

Abstract

Jupyter environment set in CyberGIS Center for interaction with HPC

Subject Keywords

HPC CyberGIS

How to cite

Yin, D. (2018). CyberGIS-Jupyter, HydroShare, http://www.hydroshare.org/resource/c477900488744e4a8e1df21326e4789b Copy

Received: 11 February 2018 | Revised: 9 September 2018 | Accepted: 15 September 2018

DOI: 10.1002/cpe.5040

WILEY

RESEARCH ARTICLE

CyberGIS-Jupyter for reproducible and scalable geospatial analytics

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Summary

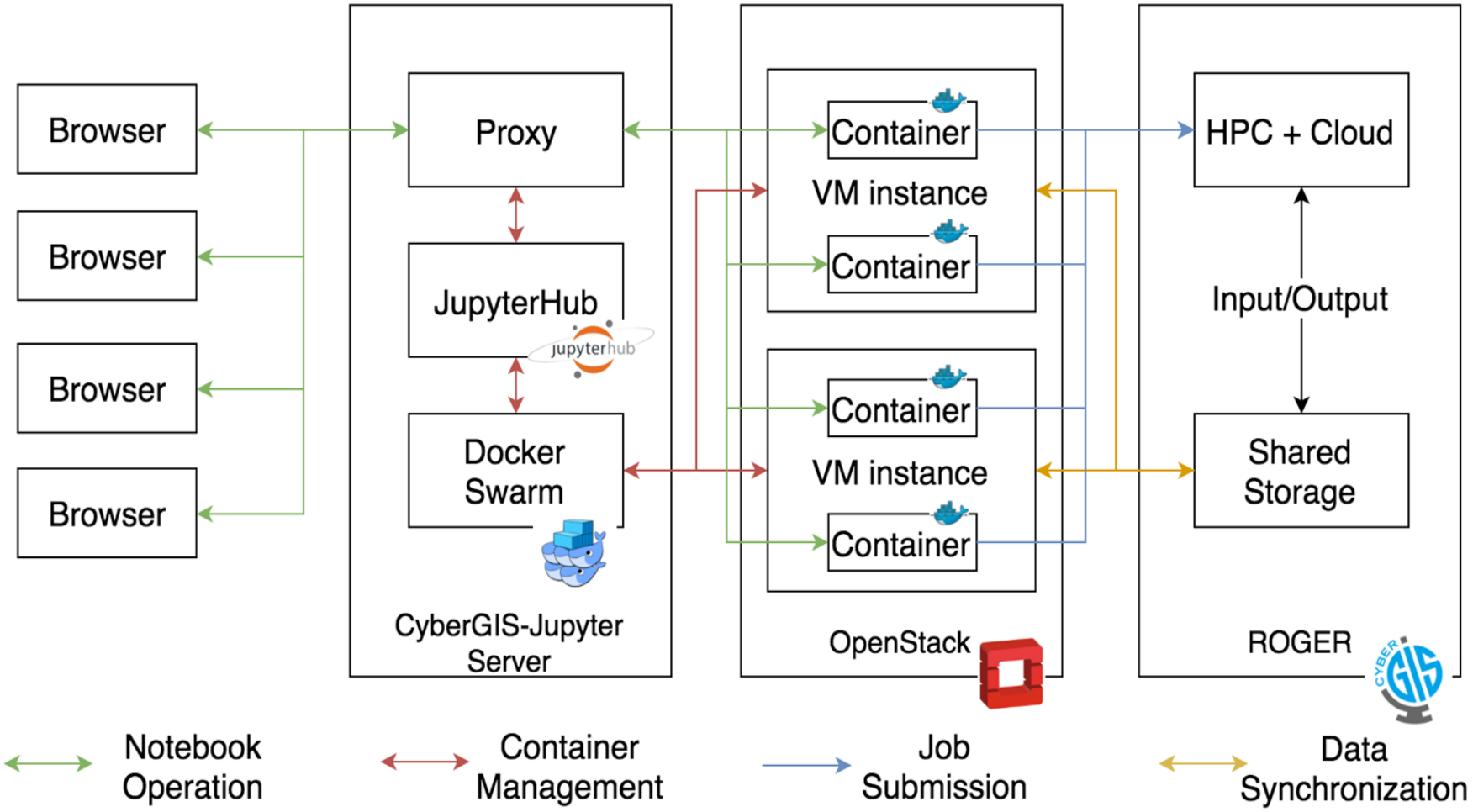
The interdisciplinary field of cyberGIS (geographic information science and systems (GIS) based on advanced cyberinfrastructure) has a major focus on data- and computation-intensive geospatial analytics. The rapidly growing needs across many application and science domains for such analytics based on disparate geospatial big data poses significant challenges to conventional GIS approaches. This paper describes CyberGIS-Jupyter, an innovative cyberGIS framework for achieving data-intensive, reproducible, and scalable geospatial analytics using Jupyter Notebook based on ROGER, the first cyberGIS supercomputer. The framework adapts the Notebook with built-in cyberGIS capabilities to accelerate gateway application development and sharing while associated data, analytics, and workflow runtime environments are encapsulated into application packages that can be elastically reproduced through cloud-computing approaches. As a desirable outcome, data-intensive and scalable geospatial analytics can be efficiently developed and improved and seamlessly reproduced among multidisciplinary users in a novel cyberGIS science gateway environment.

KEYWORDS

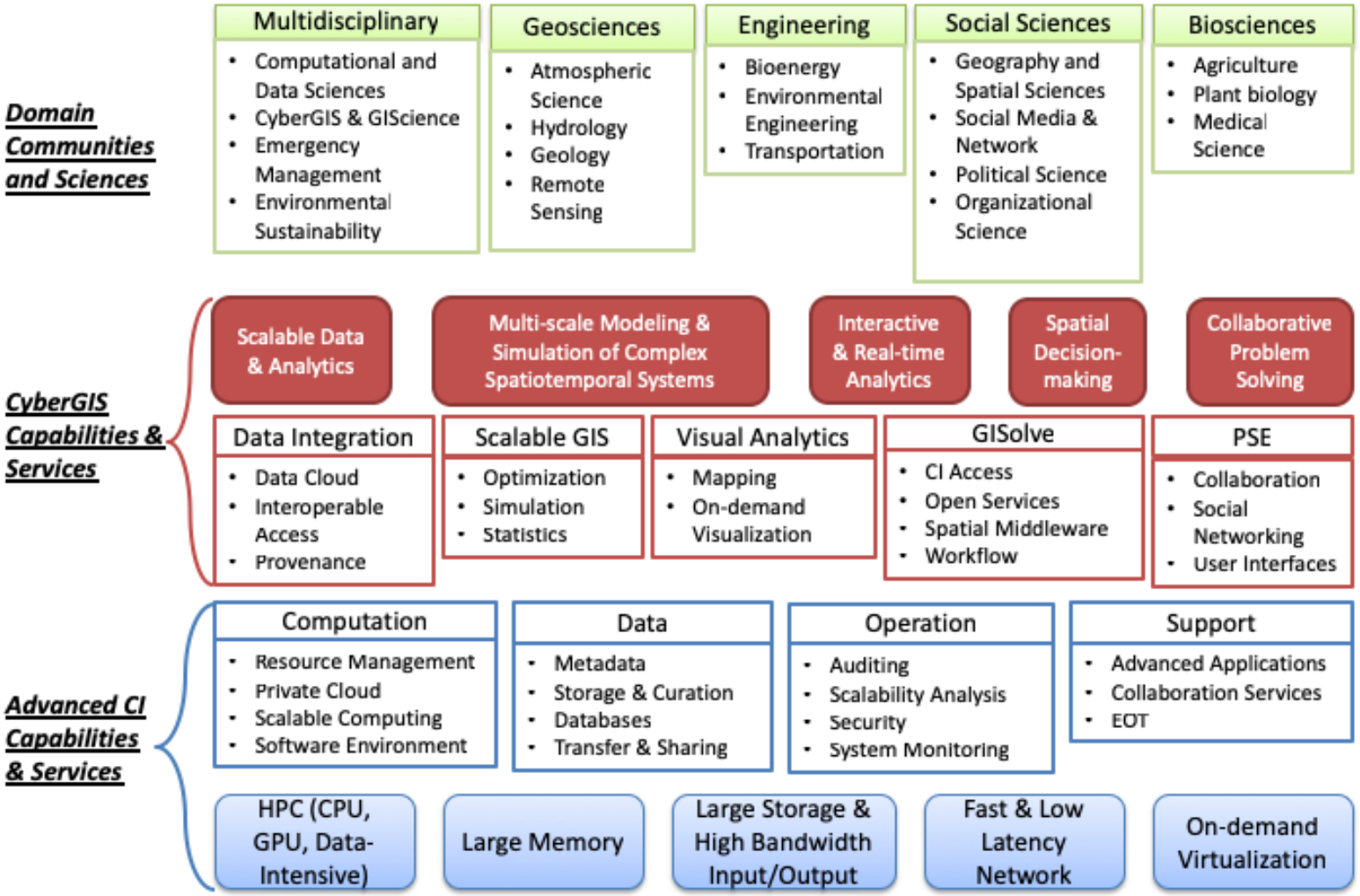
cloud computing, computational reproducibility, cyberGIS, geospatial big data

Yin, D., Liu, Y., Hu, H., Terstriep, J., Hong, X., Padmanabhan, A., and Wang, S. (2018) “CyberGIS-Jupyter for Reproducible and Scalable Geospatial Analytics”. *Concurrency and Computation: Practice and Experience*, https://doi.org/10.1002/cpe.5040

CyberGIS-Jupyter Architecture

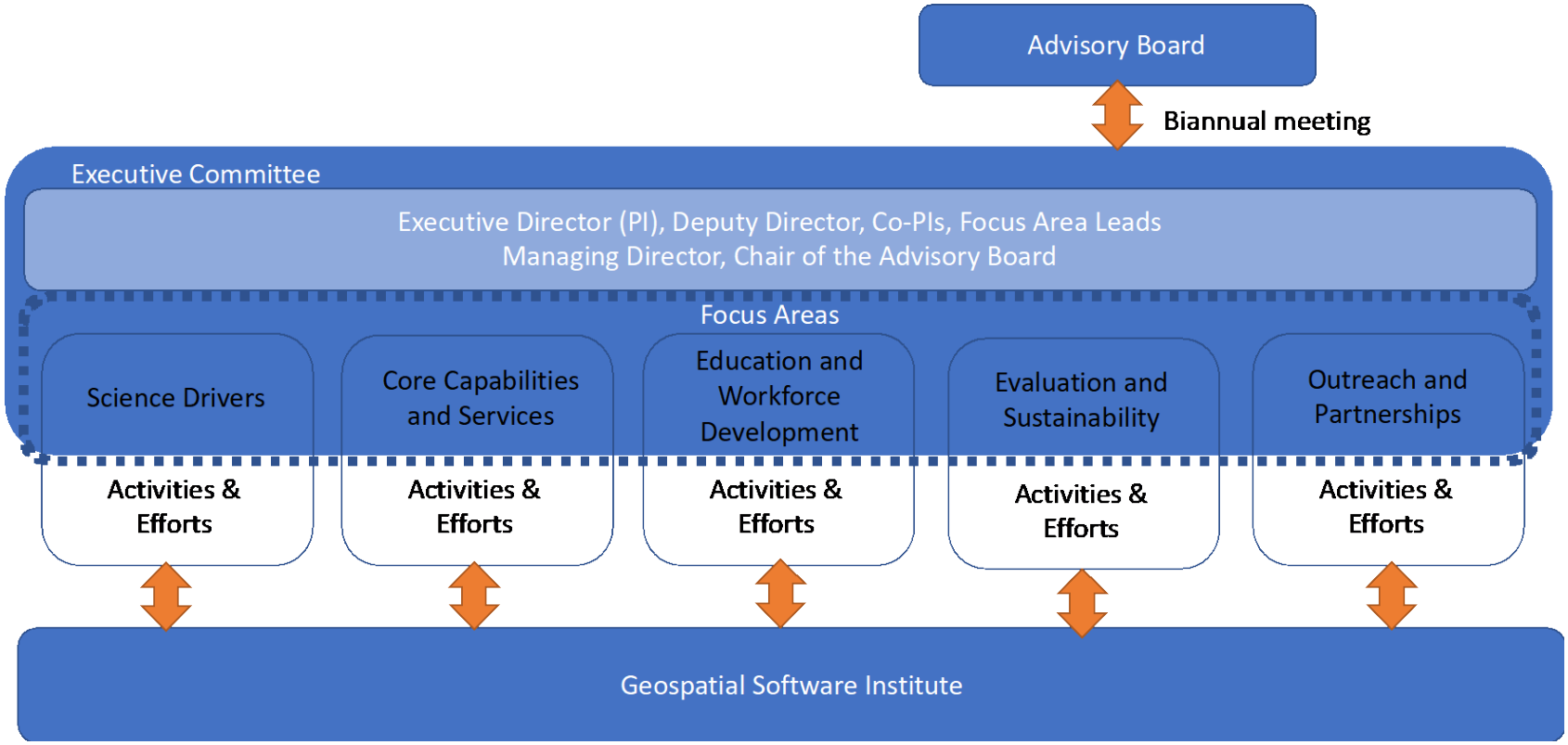


Toward a sustainable social and technical ecosystem to enable geospatial-inspired discovery and innovation



Wang, S. (2019) Cyberinfrastructure. ***The Geographic Information Science & Technology Body of Knowledge*** (2nd Quarter 2019 Edition), John P. Wilson (Ed.). DOI: 10.22224/gistbok/2019.2.4

Organization Structure and Governance



Education and Workforce Development - Eric Shook

- Equip geospatial communities with rigorous computational and data sciences and software engineering skills
- Meet users where they are and have capabilities for users who are not savvy computationally
- Combine formal and informal education for nurturing and serving diverse learning communities

Advanced CI Ecosystem – Anand Padmanabhan

- Engage and support communities (e.g., business, humanities, and social sciences) that are currently not well represented in the national and international CI ecosystem
- Serve as a conduit for bringing capabilities, processes and people together to tackle complex scientific problems while cross-fertilizing innovations of geospatial sciences and software
- Integrate with and leverage advanced CI (e.g., NSF Big Data Hubs, CyberGIS, TRIPODS, and XSEDE) to achieve high-quality, interoperable, and scalable software for broad impacts

Core Capabilities and Services – Carol Song

- **Deep**: To help users of geospatial data and software to tackle the challenges of scale and complexity of utilizing geospatial data in modeling, analytics, visualization and decision making to solve high-impact research problems and societal challenges
- **Wide**: To enable broader use of geospatial software and data especially by non-traditional and diverse geospatial software users, and train the next generation of researchers and workforce in creating and using geospatial software following the FAIR science principles
- **Transparent**: To promote and enable transparency and reproducibility of data-driven research and innovation by engaging both geospatial data producers and consumers in developing structured guidance, and employing an inclusive governance model

Partnerships – George Percivall

- Academic & International
  - AAG
  - AGILE
  - AGU
  - CyberGIS
  - ESIP
  - GIScience
  - UCGIS
  - XSEDE
  - Etc.
- Government
  - CDC
  - DOE
  - EPA
  - NASA
  - NGA
  - NIH
  - USGS
  - Etc.
- Industry
  - DigitalGlobe
  - Esri
  - Google
  - HDF
  - Kitware
  - LimnoTech
  - OGC
  - Etc.

Outreach – Donna Cox

Sustainability – Dan Katz

Evaluation – Margaret Palmer

Leadership

- Focus on fundamental scientific and societal challenges
- Prepare the future workforce
- Bridge the digital divide
- Foster open collaboration
- Enable discovery and innovation

Grand Opportunity!

Revolutionize discovery and innovation across many fields through synergistically advancing geospatial cyberinfrastructure, sciences, and software!

GSI

Toward a sustainable social and technical ecosystem to enable geospatial-inspired discovery and innovation

Community Inputs – So Important!

- For this webinar
  - https://gsi.cigi.illinois.edu
  - Recording will be available in early January 2020
- Strategic plan
  - http://bit.ly/GSI-StrategicPlan
- Twitter hashtag
  - #GSIfuture

Acknowledgments

- **National Science Foundation**
  - BCS-0846655
  - IIS-1354329
  - **OAC-1743184**
  - OAC-1443080
  - OAC-1429699
  - OAC-1664119
  - OAC-1551492
  - OAC-1047916
  - XSEDE

Thanks !

- **Comments / Questions?**
- **Email: shaowen@illinois.edu**