

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

<http://gsi.cigi.illinois.edu/>

Twitter: #GSIfuture

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*PEARC18/Pittsburgh, PA  
July 24, 2018*

# Co-PIs



Donna Cox, NCSA/UIUC



Daniel Katz, NCSA/UIUC



Paul Morin  
University of Minnesota



Margaret Palmer  
University of Maryland

# Steering Committee

- Shaowen Wang, UIUC (chair)
- Donna Cox, NCSA/UIUC
- Michael Goodchild, University of California – Santa Barbara (chair of the advisory committee)
- Daniel S. Katz, NCSA/UIUC
- Paul Morin, University of Minnesota
- Anand Padmanabhan, UIUC (project manager)
- Margaret Palmer, University of Maryland

# External Advisory Committee

- Luc Anselin, University of Chicago
- Michael Batty, University College London
- Michael Goodchild, University of California – Santa Barbara (chair)
- David Maidment, University of Texas – Austin
- George Percivall, the Open Geospatial Consortium
- Victoria Stodden, UIUC
- E. Lynn Usery, USGS
- Nancy Wilkins-Diehr, San Diego Supercomputer Center/University of California, San Diego

# Goal

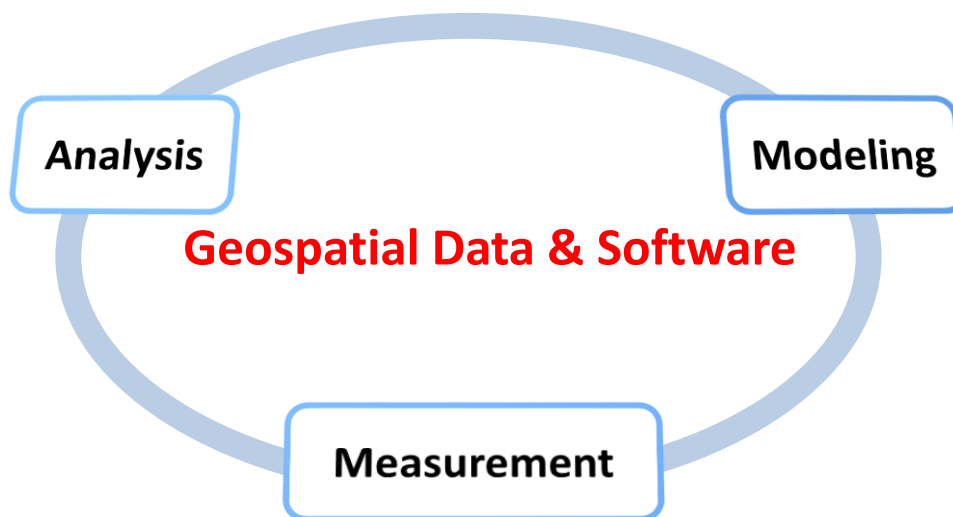
- Conceptualize a Geospatial Software Institute (GSI) as a long-term hub of excellence to serve diverse research and education communities

# Big Scientific and Societal Challenges

- Climate change
- Emergency management
- Food security
- Population growth
- Sustainability
  - Energy
  - Environment
  - Water
- Urbanization
- Etc.

**Increasing geospatial problems  
and questions!**

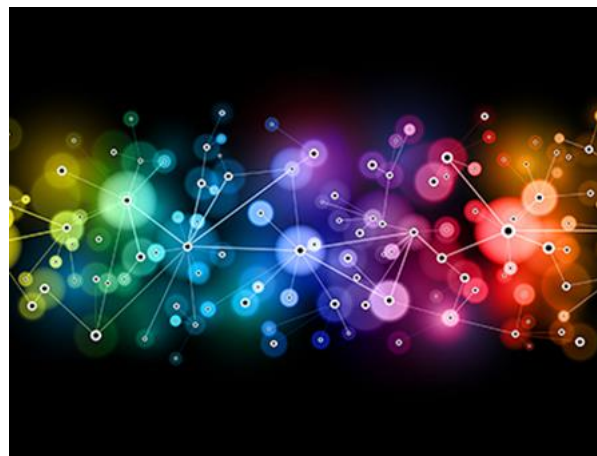
# Convergence





**HARNESSING THE DATA REVOLUTION**

Other words in the cloud include: MATHEMATICAL, STATISTICAL, COMPUTATIONAL, FOUNDATIONS, INFERENCE, SEMANTICS, EHR, ANALYTICS, PRIVACY, OPEN, PUBLIC ACCESS, DISCOVERY, REPOSITORIES, EDUCATION, WORKFORCE, DATA SCIENCE, FUNDAMENTAL RESEARCH, CYBERSECURITY, DOMAIN SCIENCE CHALLENGES, SBE, BIO, REPRODUCIBILITY, STATISTICS, RESEARCH DATA, CYBERINFRASTRUCTURE, MACHINE LEARNING, VISUALIZATION, GIS, DATA MINING, MODELING, INTEROPERABILITY, HUMAN-DATA INTERFACE, SYSTEMS ARCHITECTURE, and INTERNET OF THINGS.





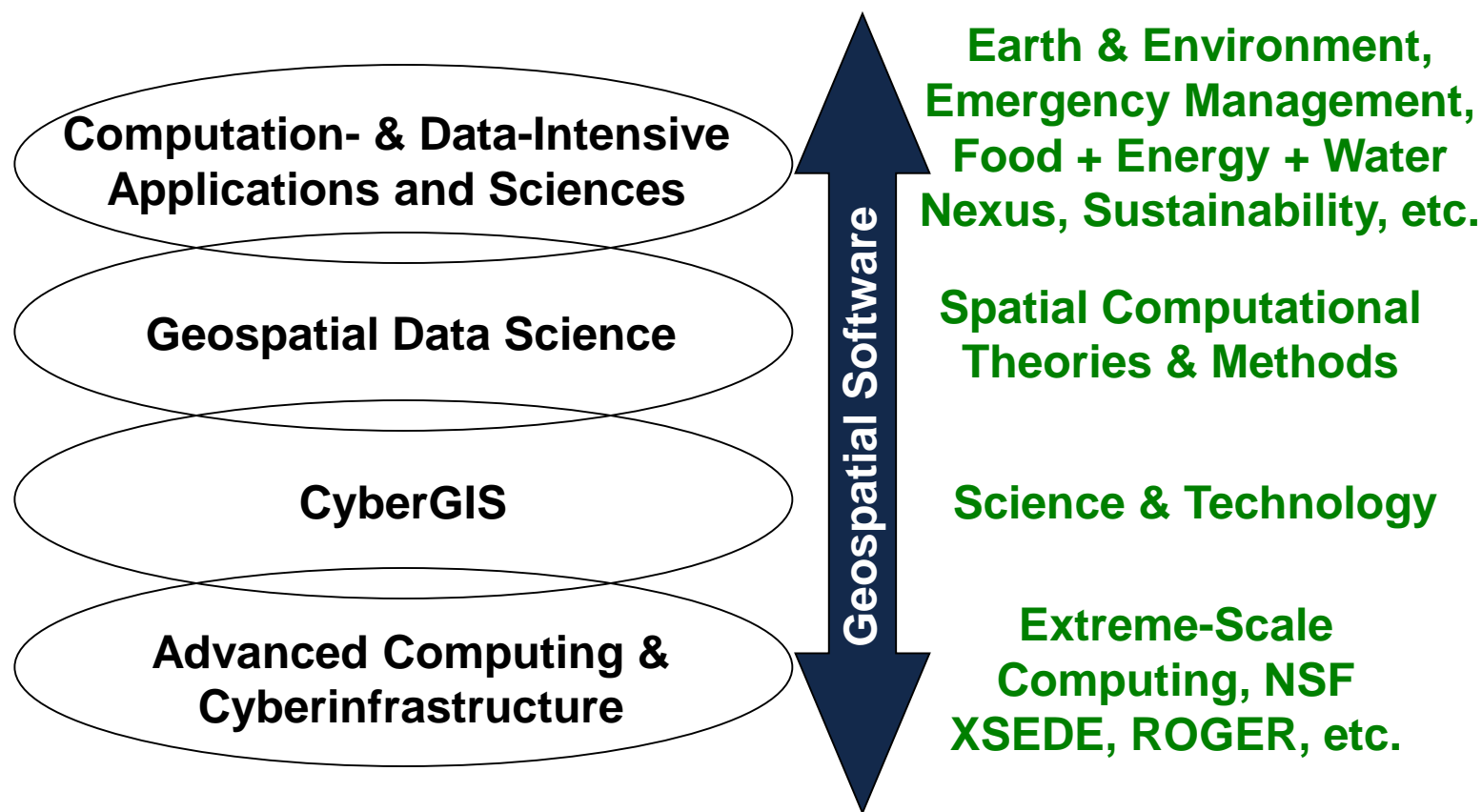
# Geospatial Data Complexity

- 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

# Context



# Geospatial Data Science @ Scale

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

**NSF DIBBs: Scalable Capabilities for Spatial Data Synthesis**

# 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



GeoJournal Library 118

Shaowen Wang · Michael F. Goodchild Editors

**CyberGIS for Geospatial Discovery and Innovation**

This book elucidates how cyberGIS (that is, new-generation geographic information science and systems (GIS) based on advanced computing and cyberinfrastructure) transforms computation- and data-intensive geospatial discovery and innovation. It comprehensively addresses opportunities and challenges, roadmaps for research and development, and major progress, trends, and impacts of cyberGIS in the era of big data. The book serves as an authoritative source of information to fill the void of introducing this exciting and growing field. By providing a set of representative applications and science drivers of cyberGIS, this book demonstrates how cyberGIS has been advanced to enable cutting-edge scientific research and innovative geospatial application development. Such cyberGIS advances are contextualized as diverse but interrelated science and technology frontiers. The book also emphasizes several important social dimensions of cyberGIS such as for empowering deliberative civic engagement and enabling collaborative problem solving through structured participation. In sum, this book will be a great resource to students, academics, and geospatial professionals for learning cutting-edge cyberGIS, geospatial data science, high-performance computing, and related applications and sciences.

Wang · Goodchild Eds.

CyberGIS for Geospatial Discovery  
and InnovationGeography  
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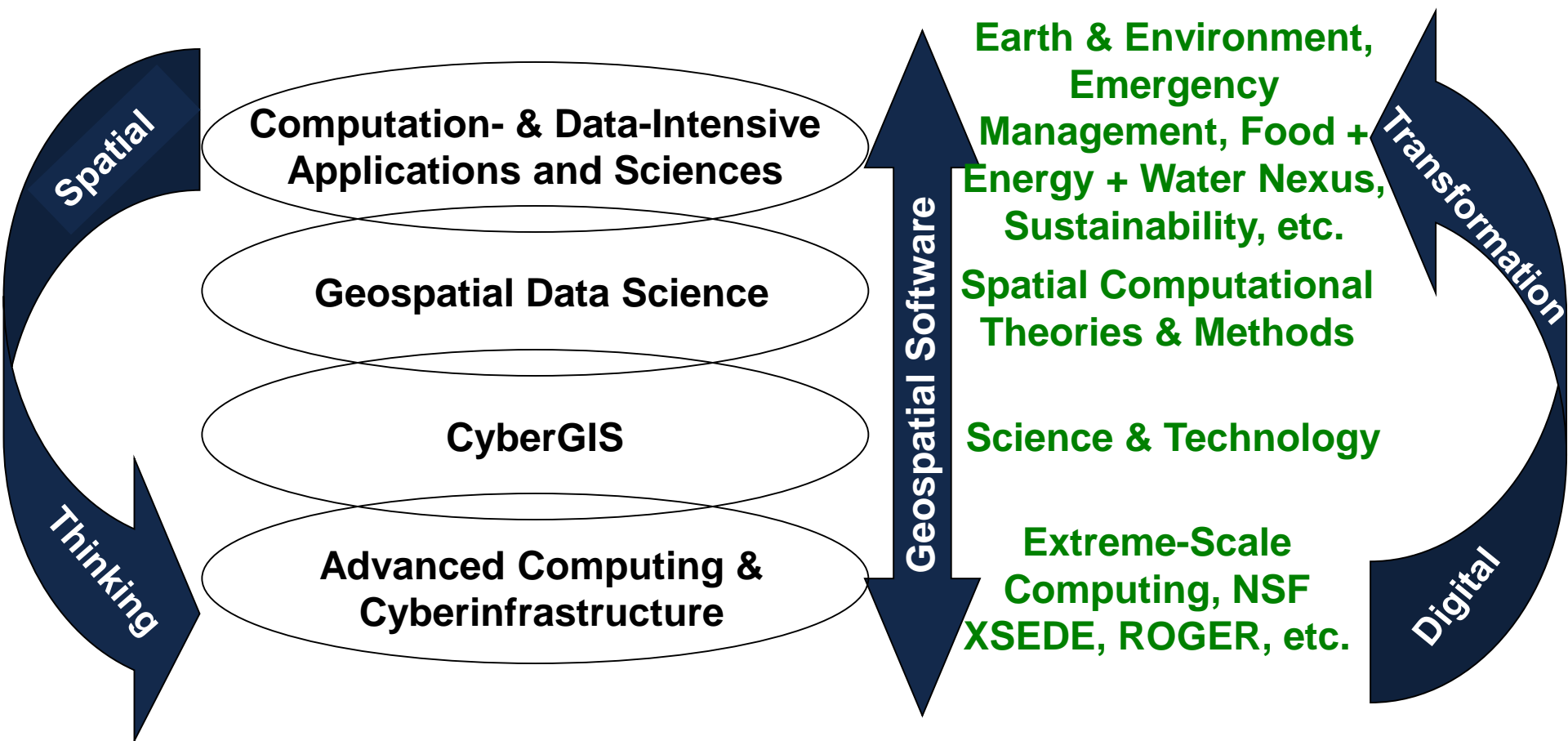
▶ [springer.com](http://springer.com)

GeoJournal Library 118

Shaowen Wang · Michael F. Goodchild  
Editors**CyberGIS for  
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Discovery and  
Innovation**

Springer

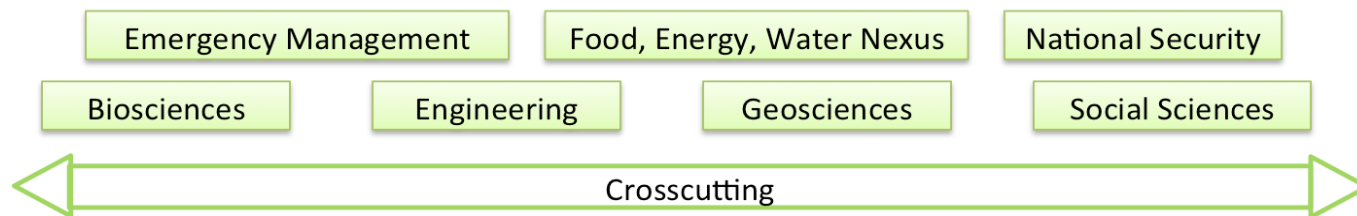
# Vision



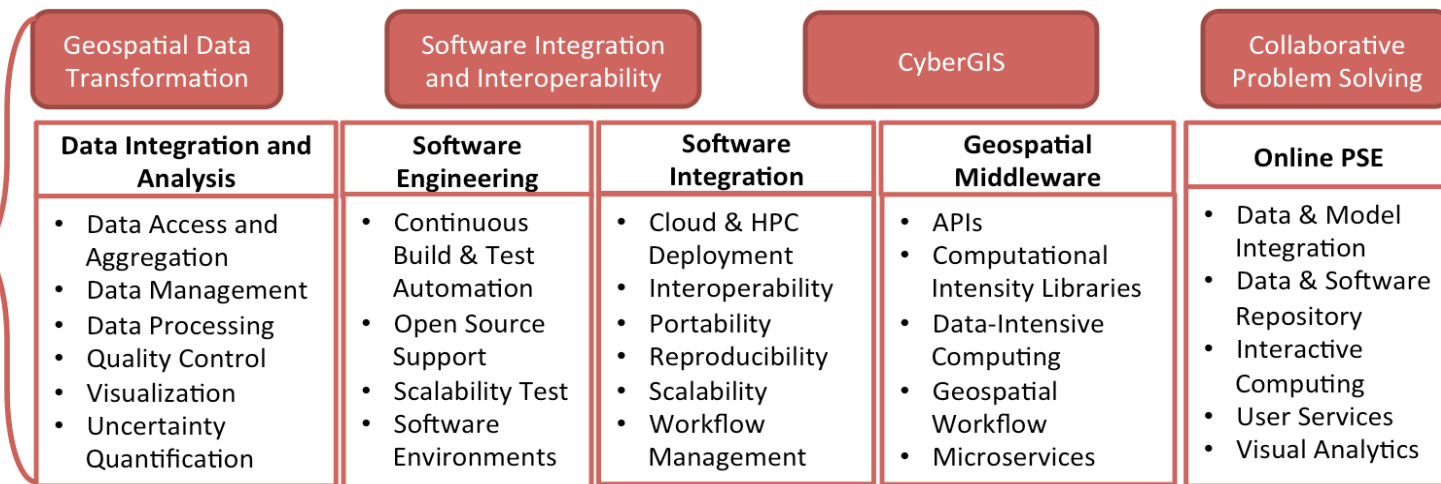


# Ecosystem

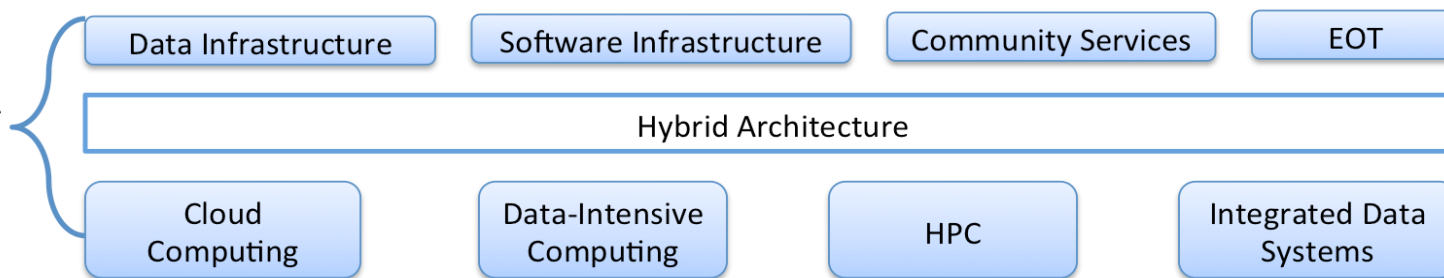
## Domain Communities and Sciences



## GSI Capabilities and Services

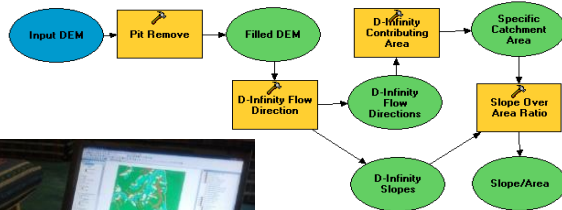


## Advanced CI Capabilities

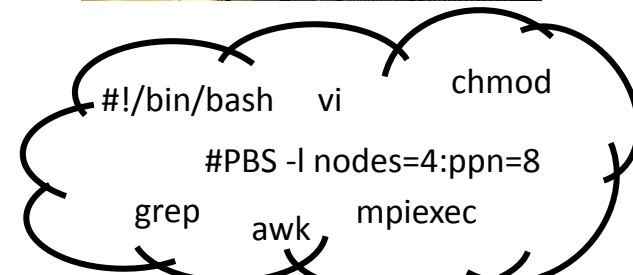


# A Digital Divide

## Hydrologic Experimentation and Modeling



## Data-Intensive & High-Performance Computing



```
-bash-3.2$ ls tddata
logan      LoganOutlet.sbn      LoganOutlet.shp      LoganOutlet.shx
LoganOutlet.dbf      LoganOutlet.sbx      LoganOutlet.shp.xml
-bash-3.2$ ls tddata/logan
logan.tif
-bash-3.2$ ls
eric      logan.tif      run.bash      taudem.bash      taudem_submit.sh
lsdu      run_all.bash  run_taudem.sh taudem_041959  tddata
-bash-3.2$ run_taudem.sh pitremove -z logan -fel loganfel
-russ.1b-net
-bash-3.2$
```

*From David Tarboton*

# Three Workshops

- Workshop 1: Mission and vision, January 28-30, 2018, Los Angeles, California
- Workshop 2: Use cases and core technical capabilities, July 15-17, 2018, Chicago, Illinois
- Workshop 3: Strategic plan and roadmap, January, 2019, Washington DC

## **Program of the First Workshop**

**<http://gsi.cigi.illinois.edu/workshop/agenda/>**

# Leadership

- Focus on fundamental scientific and societal challenges
- Prepare the future workforce
- Bridge the digital divide
- Enable open collaboration
  - Academia
  - Government
  - Industry
  - Etc.
- Foster innovation

# Advanced Cyberinfrastructure (CI) Ecosystem

- 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

# Education and Workforce Development

- 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



# Research and Software Capabilities

- Enable transformative sciences
  - For example, autonomous data collection systems are producing incredible amounts of data and many communities are using geospatial data collected by such systems
  - Software development for systems processing such data is very diverse and uncoordinated.
- Allow any researchers anywhere to have easy access to geospatial big data and related software based on the integration of diverse data worlds
- Blend well with commercial and open source activities through leading the change of tackling challenging research problems rather than competing with industry

## **Program of the Second Workshop**

**<http://gsi.cigi.illinois.edu/workshop2/agenda/>**



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## All Videos



1:35:02

GSI Workshop 2 July 17 Morning  
Session 3

16 views · July 17



32:22

GSI Workshop 2 July 17 Morning  
Session 2

9 views · July 17



1:28:51

GSI Workshop 2 July 17 Morning  
Session 1

15 views · July 17



1:25:15

GSI Workshop 2 July 16  
Afternoon Session 3

14 views · July 16



1:14:31

GSI Workshop 2 July 16  
Afternoon Session 2

19 views · July 16



19:37

GSI Workshop 2 July 16  
Afternoon Session 1

12 views · July 16



1:16:53

GSI Workshop 2 July 16 Morning  
Session 2

72 views · July 16



2:10:14

GSI Workshop 2 July 16 Morning  
Session 1

227 views · July 16

# 1st 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



**William Barley, UIUC**



**Rebecca Vandewalle, UIUC**









# Grand Opportunity!

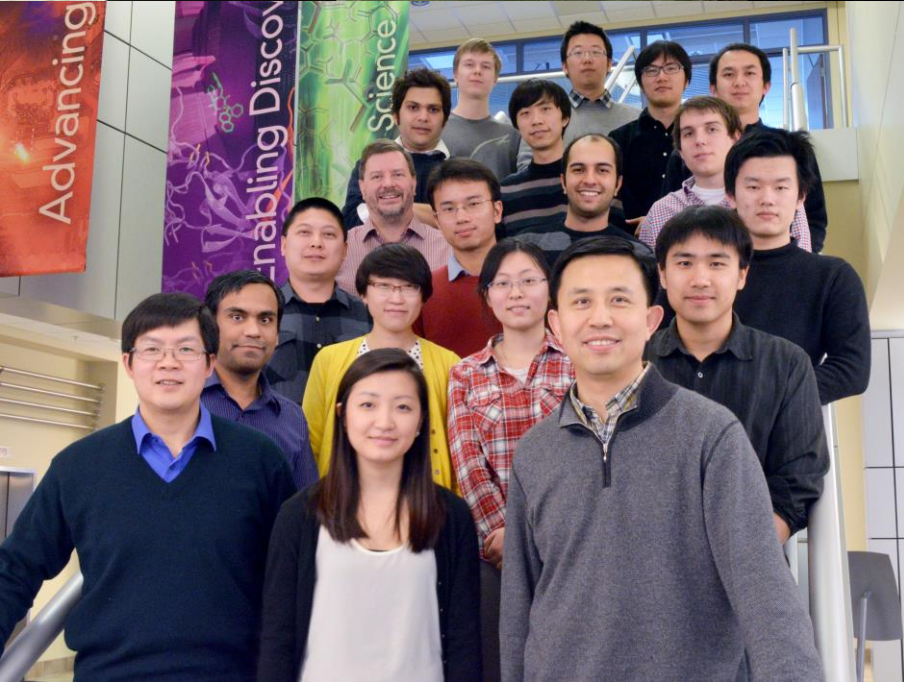
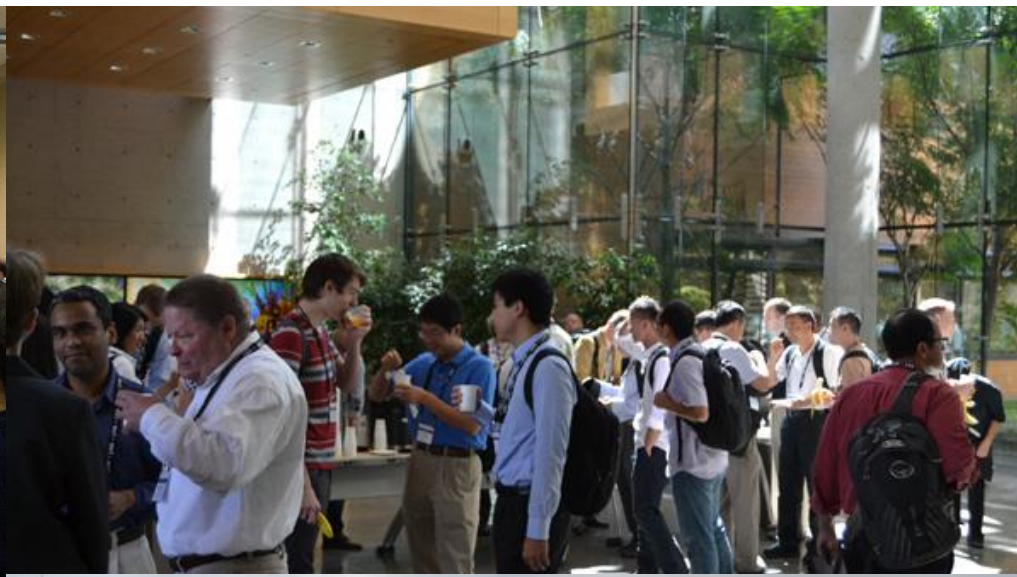
*Revolutionize discovery and innovation  
across many fields through synergistically  
advancing geospatial computing, data  
science, and software at scale*

# Acknowledgments

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- BCS-0846655
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- OAC-1443080
- OAC-1429699
- OAC-1047916
- XSEDE

- **US Geological Survey**



# Thanks !

- **Comments / Questions?**
- **Email: [shaowen@illinois.edu](mailto:shaowen@illinois.edu)**