

## ***EarthCube RCN for IS-GEO: Intelligent Systems Research to Support Geosciences***

### **Overview**

Geoscience problems are complex, heterogeneous, and dynamic. Frequently geoscience knowledge and understanding provides valuable information and insight into important societal problems related to energy, water, climate, sustainability, and our understanding of how the Earth evolves through time. Many aspects of geosciences (GEO) research pose novel open problems for intelligent systems researchers. Simultaneously, many grand challenges in the geosciences cannot be addressed without the aid of computational support and innovations.

Intelligent and Information Systems (IS) research has a very important role to play in accelerating the speed of scientific discovery in geosciences and thus in solving challenges in geosciences. Recent advances in several areas of intelligent systems, as well as increases in the amount of observational data available and mechanisms for collecting data in the geosciences in recent years, offer opportunities for innovative interdisciplinary approaches in the *IS-GEO* domains. The goal of this proposal is to jumpstart interdisciplinary research collaborations in this emerging new area so that progress can be accelerated.

The proposed EarthCube Research Coordination Network *for IS-GEO (IS-GEO RCN)* will catalyze collaborations to enable advances in our understanding of the Earth system through innovative applications of intelligent and information systems to fundamental geosciences problems. The proposed RCN activities and timeline build on recommendations and outcomes from participants in the March 2015 *IS-GEO* workshop and report. Designed activities and priority topics for the proposed *IS-GEO RCN* are also informed by ongoing cyberinfrastructure efforts, as well as visioning and strategy documents of the NSF EarthCube initiative.

To enable the network, the *IS-GEO RCN* goals will include: (1) foster an active and broad-based community across GEO and IIS areas; (2) identifying barriers to research, such as terminology differences among the disciplines involved and highlight key knowledge gaps that hinder collaboration across the disciplines; (3) establish and enhance communication channels between GEO and IIS researchers; (4) defining grand challenges in geosciences that are well suited to IIS techniques; and (5) encourage robust, long-term collaborations. Throughout the proposed 2-year RCN we envision active and ongoing interactions between researchers, students, and faculty in the proposed RCN activities. By providing avenues for IS and GEO researchers to work together the *IS-GEO RCN* will serve as both a point of contact, as well as an avenue for educational outreach across the disciplines for the nascent community of research and practice. The initial efforts are focused on connecting the communities in ways that help researchers understand opportunities and challenges that can benefit from IS-GEO collaboration.

**Intellectual Merit:** The *IS-GEO RCN* will leverage expertise from the geosciences and within computing sciences, particularly in areas of information and intelligent systems, for applications to complex domain problems across the geosciences. Geoscience data is interesting to IIS researchers because it tends to be uncertain, intermittent, sparse, multi-resolution, and multi-scale. All these areas cannot be investigated separately as they are interdependent. It is the very interdependencies and cross-disciplinary linkages that offer unique opportunities for new approaches and new discoveries.

**Broader Impacts:** The goal of the *IS-GEO RCN* is to foster interactions between the IS and GEO communities to provide advanced capabilities to geosciences. Furthermore, the educational component seeks to identify new approaches to teaching students in this new interdisciplinary area, seeking to raise a new generation of scientists that are better able to deal with geoscience challenges of the future.

## 1.1. Overview and Goals

Many aspects of geosciences research pose novel open problems for intelligent systems researchers. Geoscience data is interesting because it tends to be uncertain, intermittent, sparse, multi-resolution, and multi-scale. Data is often spatio-temporal in nature, has small sample sizes and high dimensionality, and is highly heterogeneous. A unique characteristic of geosciences research is its process-centered phenomena, studying combinations of physical, geological, chemical, biological, and ecological factors. Our understanding of such phenomena is contextualized by rich background knowledge that must be incorporated into the analysis of the data. Processes and objects often have amorphous spatio-temporal boundaries. They are so complex that visual and manipulation interfaces are key to understanding data and models. There is often a lack of ground truth, which makes evaluation and testing of models difficult. Addressing these challenges would benefit all areas of geosciences. These topics happen to be of great interest to researchers in various areas of artificial intelligence, including knowledge representation, information integration, machine learning, robotics, adaptive sensors, and intelligent interfaces.

We propose to establish an EarthCube Research Coordination Network (RCN) to support an emerging community of researchers in geosciences (GEO) and intelligent systems (IS). The EarthCube RCN for IS-GEO (IS-GEO RCN) will identify innovative cyberinfrastructure that pushes the envelope on intelligent and information systems research that will enable advances in our understanding of the Earth system. Participants will discuss how to tackle problems in heterogeneous data integration and visualization (e.g., hand-made sketches, aerial imagery, field-data repositories, stakeholder interviews), ontological reasoning with scientific metadata and mathematical models (e.g., representing uncertainty, simulation predictions, evolving theories). Additionally, participants will be asked to consider potential uses for intelligent assistants that make scientists more efficient and that facilitate information sharing, collaborative workflow design and management to support data analytics, and sophisticated machine learning techniques to analyze geosciences data. Addressing these challenges requires getting together researchers from geosciences and information systems. The IS-GEO RCN will catalyze an emerging community of interdisciplinary researchers and formulate avenues for future research on intelligent systems that will result in fundamental new capabilities for understanding the Earth system.

The recent NSF EarthCube Initiative (<http://www.earthcube.org>) opens an opportunity for collaborative research on novel information systems enhancing and supporting geoscience research efforts. EarthCube's goal is to enable geoscientists to address the challenges of understanding and predicting a complex and evolving Earth system by fostering a community governed effort to develop a common cyberinfrastructure to collect, access, analyze, share and visualize all forms of data and resources, using advanced technological and computational capabilities. Although some current EarthCube projects have incorporate intelligent systems technologies such as semantic representations and natural language processing, there is significant potential for additional intelligent systems research to tackle major geoscience challenges.

*The goal of this IS-GEO RCN is to foster interactions between the intelligent systems and geosciences communities to identify opportunities for collaborations to achieve advanced capabilities to geosciences.* In geosciences, the RCN will cover requirements and scientific innovations from Earth, ocean, polar, and atmospheric and spatial sciences. In intelligent systems, the RCN will include participation from fields such as information integration, machine learning, knowledge representation, social computing, visualization, and intelligent user interfaces. The network will be informed by existing cyberinfrastructure efforts that support the geoscience community.

It is expected that the IS-GEO network can serve as a resource to both the CISE and GEO communities of research. The network can help establish research directions and priorities for the IS-GEO community and subsequently maintain and supplement the emerging community with outreach. The network can also be

a more directed resource for connections within disciplines, for example providing new understanding among geoscientists about the intelligent systems approaches that can catalyze their research.

## 2. PREVIOUS WORK AND BACKGROUND ON IS-GEO EFFORTS

A workshop on “Intelligent Systems Research to Support Geosciences and the EarthCube Mission” was held March 26-27, 2015 at the National Science Foundation with a final report documenting the outcomes of that workshop completed in November 2015 (Gil and Pierce, 2015). The workshop was supported by a joint grant from the Directorate for Computer and Information Science and Engineering and the Directorate for Geosciences of the National Science Foundation. It was co-chaired by Dr. Yolanda Gil from the Information Sciences Institute, University of Southern California and Dr. Suzanne A Pierce from the Texas Advanced Computing Center (TACC) and Jackson School of Geosciences of The University of Texas at Austin. They are Co-Chair of the IS Steering Committee and PI respectively for this RCN.

The goal of the workshop was to identify avenues for future research on intelligent systems that will result in fundamental new insights in geosciences. In geosciences, the workshop covered requirements from earth, ocean, polar, and atmospheric and spatial sciences. In intelligent systems, the workshop included participation from fields such as information integration, machine learning, knowledge representation, semantics and metadata, geospatial computing, robotics, visualization, and augmented reality. The workshop built on the momentum of the NSF EarthCube initiative for geosciences and was informed by ongoing cyberinfrastructure efforts.

The workshop chairs designed an agenda with unique opportunities for cross-disciplinary interaction and each participant submitted position papers to highlight emerging themes in their areas of research. Discussions were organized around the data lifecycle management: data collection, data integration, data analysis, data processing, and data visualization. Workshop participants agreed that geoscience processes are very complex with high dimensionality, and the sample size of the data is typically small given the space of possible observations. Given this key observation, participants agreed that intelligent systems that incorporate scientific knowledge in the form of physical, geological, chemical, biological, ecological, and anthropomorphic processes could have a transformative effect on efforts in both IS and GEO research. The IS-GEO workshop determined that new research in intelligent and information systems for application in the geosciences is needed in the following areas (Gil and Pierce, 2015):

- **Model-driven sensing:** to support data collection in extreme or remote environments, difficult to monitor conditions, or phenomena with limited observability. Optimization strategies for data collection and adaptive sampling regimes would result in data of maximal utility to scientists.
- **Information ecosystems:** to support data and model integration across different repositories across disciplines. Improved information discovery capabilities would further inform systems-level inquiry and leverage previous research particularly to support information aggregation through georeferenced and curated datasets and integration across scales.
- **Theory-driven learning:** to support geoscience researchers working to generate models from datasets that are large and yet insufficient due to their high dimensionality or multi-scale nature, so they need to be combined with theories about physical laws and other geosciences knowledge. Additionally, new machine learning methods would be needed to study hard to observe or extreme events.
- **Interactive workspaces:** to support exploration and hypothesis development, enabling researchers to better understand not just their own areas of specialization but expand into larger integrated models of the evolving Earth system. Such frameworks would also facilitate the dynamic tracking and discovery of new research communities that are producing data or models pertaining to a common problem or geological time interval. Layered needs, where interactive

workspaces will accelerate research by supporting synthesis and integration of information and knowledge across research disciplines and sectors.

In addition, workshop participants identified areas for interaction that are crucial to foster community, the primary objectives and foci of this proposed RCN are built around the recommendations reported in the workshop report and shown below:

- **Training and capacity building:** There are not many opportunities and forums for researchers to understand the limits of the state of the art in both areas and explore potential opportunities. Basic terminology and techniques need to be explained across disciplines in order to foster understanding.
- **Collaboration opportunities:** Although advanced intelligent systems techniques are increasingly critical to advancing geosciences, there are not many opportunities and forums for researchers to explore collaborations. Holding cross-disciplinary events that include geosciences and intelligent systems researchers would greatly benefit the long-term synergistic research opportunities in these communities.
- **Grand challenges and datasets:** The availability of datasets and grand challenges tends to attract researchers to an area. Statements of grand challenges help summarize the problems and domain knowledge needed to work with a new dataset, and describe the potential impact of the results of the work. These were identified as crucial to foster community.

### **3. GOALS AND VISION FOR THE IS-GEO RCN**

The vision for the *IS-GEO RCN* vision goes beyond just creating interaction between geoscientists and computer scientists by providing active learning events and generating dialogue among participants in RCN activities. This RCN proposal takes the recommendations from outcomes of the IS-GEO workshop (Gil and Pierce, 2015) and proposes to create joint events and opportunities for the geosciences and intelligent systems communities to (1) foster an active and broad-based community across GEO and IS areas; (2) identifying barriers to research, such as terminology differences among the disciplines involved and highlight key knowledge gaps that hinder collaboration across the disciplines; (3) establish and enhance communication channels between GEO and IS researchers; (4) define grand challenges in geosciences that are well suited to IS techniques; and (5) encourage robust, long-term collaborations.

This RCN proposal is designed to establish relationships across the IS and GEO research communities, identify key challenges to geosciences that are well suited to intelligent systems research innovation, and create foundational resources to support the future growth and sustainability of the community. The ultimate goal is to create a research network that will support future IS-GEO collaborations that will engender the creation of cooperative workflows, tools, training materials, and future visions with potential to become an integral part of interdisciplinary research and discovery.

The primary goal of the proposed RCN is increased coordination of the range of researchers collaborating on intelligent systems methods to geosciences problems to understand the breadth of investigatory tools available and to better integrate the understanding and research products from these different research groups. By coordinating the activities of these various researchers, their understanding can be more efficiently integrated across the research community.

#### **Goal 1: Foster and Grow a Community across IS and GEO**

The goal is to foster an active and broad-based IS-GEO research community that supports research activities across the disciplines. To do this, the team will establish a range of activities to encourage connections and networking across IS and GEO.

*Objective 1.1:* Establish connections with narrower ongoing efforts, such as existing EarthCube funded projects and the Climate Informatics workshop series to build momentum in the community.

*Objective 1.2:* Form an EarthCube Special Interest group on IS-GEO to establish an ongoing space for collaborative efforts within EarthCube.

*Objective 1.3:* Reach out to research groups that are pursuing IS-GEO collaborations, which were identified by the IS-GEO workshop participants.

#### **Goal 2: Identify barriers to research and establish mechanisms to overcome them**

To streamline interactions and accelerate IS-GEO collaborations, important barriers must be addressed; such as terminology differences among the disciplines involved and highlight key knowledge gaps that hinder collaboration across the disciplines.

*Objective 2.1:* Conduct and facilitate workshop sessions that foster substantive dialogue among IS-GEO researchers.

*Objective 2.2:* Establish a Working Group for IS-GEO Education to evaluate potential for cross-training of students, researchers and faculty, such as offering tutorials at conferences, summer workshops, asynchronous courses, etc.

#### **Goal 3: Become the recognized center point for IS-GEO Information Seekers establish and enhance communication channels between GEO and IS researchers**

Extend the impact of the *IS-GEO RCN* by becoming the recognized place within the community for researchers and practitioners to find, pursue, and disseminate research ideas and collaboration opportunities.

*Objective 3.1:* Extend the established IS-GEO.org website to serve as a central entry point for information about events, resources, and information of use to the community.

*Objective 3.2:* Define generalizable geoscience problems and create a repository for grand challenges with associated datasets.

*Objective 3.3:* Implement social networking and communication mechanisms for IS-GEO researchers to interact and match skills and problems via meetup boards.

#### **Goal 4: Identify Grand Challenges for an IS-GEO Research Vision**

The goals of *IS-GEO RCN* will be to identify grand challenges, while also refining understanding about target areas and topics among the community members. The first objective of the RCN community will be to define key cross-over fields of interest within the IS-GEO community.

*Objective 4.1:* Identify grand challenges in the Geosciences that are well suited to IS research.

*Objective 4.2:* Identify cutting edge ideas in IS that would benefit geoscience researchers.

*Objective 4.3:* Construct a matching and cross-over map to aid researchers seeking collaborative connections and disseminate through the online website/information portal.

*Objective 4.4:* Delineate grand challenges and opportunities that are ripe for immediate progress as well as longer term efforts and needs.

#### **Goal 5: Encourage robust, long-term collaborations between GEO and IS researchers**

Extend the impact of NSF-funded IS-GEO research by encouraging activities that support awareness and build a knowledgeable community over time.

*Objective 5.1:* Form working groups to explore, define, and sustain activities in subtopics of high interest to the community.

### **4. IS-GEO RCN ACTIVITIES AND TIMELINE**

Planned activities are centered on recommendations from participants in the first IS-GEO workshop and constructing a schedule of future events that allows for bottom-up community building while generating active learning and productive outcomes with participatory design elements. Organizational support, education, training, and outreach efforts for the RCN will be coordinated by the Steering Committee to meet the needs of the *IS-GEO RCN* community. Logistical support will largely be coordinated by the PI, Dr. Pierce, with facilities and services from Texas Advanced Computing Center (TACC).

Challenges for the *IS-GEO RCN* include (1) training users across many skill levels and disciplines, (2) establishing robust relationships and collaborations among IS-GEO researchers (3) broadly promoting awareness about the overall community, and 4) aiding the establishment of resources to accelerate a transition to active IS-GEO research. To address these challenges the *IS-GEO RCN* PI and Steering Committee will organize face-to-face workshops on site at TACC and additional engagement activities in between the main workshop events, such as Steering Committee retreats, teleconferences, and attendance at EarthCube meetings.

#### **4.1. Face-to-Face Focused Workshops**

A total of 3 face-to-face workshops will be organized in years 1 and 2 with the goal of advancing substantive conversations among IS-GEO researchers and establishing awareness of IS-GEO related opportunities to accelerate advances in geosciences and intelligent systems areas. These face-to-face events will build on momentum from the 2015 IS-GEO Workshop and subsequent informal interactions at various professional conferences in the second half of 2015.

Workshop 1 (~30 participants) - The RCN plans to launch a kick-off workshop in late July or August of 2015 to build on enthusiasm and momentum with original IS-GEO participants and expand engagement to include additional members active in IS-GEO type research. Knowing that researchers from disparate-

yet-related fields benefit from cross-disciplinary learning opportunities this first face-to-face event will create an opportunity for the IS and GEO researchers to 1) meet and create relationships across specializations, 2) participate in dialogue and discussion to increase understanding across the fields, 3) begin to learn about important concepts, terms, and topics of interest, and 4) start to collect science drivers and technical details about ongoing IS-GEO collaborations.

To do this the workshop approach will convene a broad group of participants. The March 2015 IS-GEO workshop included participation by a broad and representative group of researchers, in the course of inviting participants there were numerous individuals who were unable to attend due to scheduling conflicts. The RCN team will extend invitations to these individuals, as well as others recommended by the Steering Committee. The original participant group will also be invited to participate and, if possible, remote participation options for the meeting will be offered.

The workshop format will offer large blocks of time for loosely directed, open and relatively unstructured dialogue in small group and full group sessions. A primary activity will consider identifying and defining a common lexicon initiating training, and inviting development of datasets that can be used to support training modules and pilot applications of IS techniques to GEO problems. The initial events will develop resources to assist cross-disciplinary communication with creation of a glossary and lexicon site. Host a first of its kind *“Lexithon” Challenge* to create a glossary of terminology with explanations and examples so that IS and GEO researchers can learn quickly about important concepts, tools, challenges, and definitions in the field of joint IS-GEO work. This glossary will be an evergreen document that can be modified and improved over time as the community develops. The initial lexithon will establish a first instance of an IS-GEO centric set of terms and topics that can be easily maintained and updated over time using version control systems, such as Github. This initial glossary will be informed by ongoing efforts to clarify semantic infrastructure and standards and the resultant glossary will be shared directly with the existing EarthCube Semantics Working Group for integration and comparison with the broader vocabularies.

Additional activities and discussions will center on how to define preliminary subgroups and establish a committed working group for education. Topics related to existing educational resources and next step activities that the participants are willing to undertake in order to create educational engagement to support the IS-GEO community. Ideas and contributions for training modules and development of datasets to support pilot applications of IS techniques to GEO problems will be invited.

Discovering and defining new research questions and even new fields of study that lie at the interface of core disciplinary knowledge areas requires creation of open communication and foundational understanding across the disciplines. This workshop will initiate activities to build shared understanding and knowledge in the IS-GEO Community.

Workshop 2 (~30 participants) – The second face-to-face event will advance key topics of interest and deepen the cross-disciplinary dialogue. Between the first workshop and the second we anticipate a series of interim activities (see description below) to build deeper understanding among the IS-GEO community members. While the final content and key topics will be defined by the *IS-GEO RCN* participants, we hope to convene with both a core group, as well as opening up invitations again to a broader section of the IS-GEO research community. At the meeting we expect to coordinate the presentation of training modules from active RCN members and to revisit the strategic IS-GEO Challenges and Opportunities. A primary activity will be an invited *Writing Sprint Challenge* for teams of paired IS-GEO researchers to develop overview articles for journals, training materials, and/or proposals.

Early goals for this workshop to advance conceptualization for an IS-GEO Learning Center or set of educational resources as a one-stop place within the IS-GEO, or EarthCube, website for users to seek out

information and aid connections. This effort will require that community members share existing and/or plan to develop training materials across a number of different topics of interest. Ideally the community will establish content that helps new users follow a logical approach to build skills over time, while also making the content searchable so that advanced users can quickly refer to content when they need it. The idea of inviting contributions to a Grand Challenges Repository will be discussed and evaluated as a possible mechanism for supporting exploratory applications of IS methods to GEO data, as well as, offering potential a repository for the lexicon, descriptive problem statements, datasets, training content, or other relevant content or artifacts to help the community gain traction and achieve rapid advances. More information about the resources and facilities to support planning and initial formulation by the *IS-GEO RCN* group for a *Grand Challenges Repository* is included in the Data Management Plan (DMP). Additionally, the RCN participants will be asked to think about how coordination with the existing EarthCube Use Case working group could facilitate early efforts to create/share educational resources.

Workshop 3 (~60 participants) – As the *IS-GEO RCN* activities and community build a foundation for shared understanding among researchers, the focus of activities are expected to shift toward the formulation of concise Grand Challenges for the IS-GEO community. Effectively, geosciences challenges that can benefit from IS applications and are also interesting to IS researchers by providing drivers and specifications that inspire innovation. The third and final large event proposed for the *IS-GEO RCN* is anticipated to be a culminating moment with several strands and efforts coming together among the larger community. The IS-GEO community will drive the ultimate agenda for the event, but we expect that working groups for various subthemes will provide presentations about their activities, we hope that training sessions for key areas of interest to the community may be designed and presented, and we expect to encourage the pursuit of future projects within the community. As an overarching goal the RCN activities aim to formulate avenues for future research on intelligent systems that will result in fundamental new capabilities for understanding the Earth system.

To encourage longer-term activity, Workshop 3 will incorporate a continuation of “Writing Sprints” as break out sessions so that RCN members can advance quickly on possible thematic overview articles and/or proposals among subgroup members. Additionally, we anticipate encouraging submissions to a *Grand Challenges Repository* with final RCN activities to consider hosting webinars and online working sessions to advance promising ideas. Largely, the goals of Workshop 3 will be to engage with a broad section of the IS-GEO research community, explore groundbreaking computing research problems motivated by problems in geosciences, and plan next steps for sustaining community activity.

#### **4.2. Interim Coordination**

Engagement with the IS-GEO research community will include presentations, meetups, and potentially training at professional conferences or EarthCube meetings, asynchronous and synchronous online training, and teleconference interactions with IS-GEO researchers.

##### Interim Steering Committee Retreats

The *IS-GEO RCN* Steering Committee is committed to maintain engagement with IS-GEO participants and expand visibility in broader communities. As part of the effort team members will attend and present at a number of professional conferences across geosciences and intelligent systems events. For example, the Steering Committee will plan retreat activities at the same time as major geoscientific conferences so that the group will be able to prepare for upcoming workshops, review and document ongoing outcomes, and engage actively with geoscientists across all areas of study in attendance. In 2015, the IS-GEO community organized sessions at the annual conferences for both the Geological Society of America and the American Geophysical Union. Additionally, the Steering Committee expects to attend and actively contribute to two EarthCube events each year of the RCN activities, particularly the annual All Hands Meeting. On the IS side, workshops and symposia will be proposed in co-location with major conferences, such as AAAI, IJCAI, ICML, KDD, IUI, ISWC, K-CAP, and others.



### Synchronous and Asynchronous Events

In between face-to-face workshop events, the *IS-GEO RCN* Steering Committee will host a series of regular teleconference calls and webinars. Logistically we hope to coordinate these calls with support from the primary EarthCube office. As the community defines areas of interest and need, the *IS-GEO RCN* team will work to develop regular contact points via teleconference to provide a mechanism for continuing important discussions, as well as, a way to present information from subject matter experts to increase understanding of key topics across the community.

## **5. CONCLUSIONS, EXPECTED SIGNIFICANCE AND OUTCOMES**

Support for the three innovative break out and challenge activities (e.g. the Lexithon, Writing Sprints, and IS-GEO Grand Challenges) will be provided by the IS-GEO RCN facilities and data management strategies (see the Data Management Plan for details). Each of these activities and events are designed to foster ideas to action for the IS-GEO RCN participants.

- Lexithon will provide a resource that can aid the broader community by providing an accessible entry point for researchers or students interested in learning about IS-GEO topics. The lexithon activity is the first of its kind that will help the IS and GEO participants begin to build a common vocabulary, identify key topics of interest, and construct a point of connection with the ontologies other EarthCube projects have been developing. The end product will be creation of an initial glossary that can serve as an evergreen, updateable listing for ongoing and future IS-GEO efforts.
- Writing sprints are activities that will accelerate RCN workshop participants towards active collaboration and cross-disciplinary idea sharing. By pairing IS and GEO researchers together on a focused task to capture concepts and document preliminary visions, the participants will complete a concrete product that may be useful to them while deepening relationships with members of the other disciplines.
- Grand Challenges will result in the identification and description of high impact or highly useful research topics, applications, advances that can advance both GEO and IS in the near-term and long-term. This effort will begin after participants first define a common language for terms, topics, concepts, skills, and tools during the early workshop activities, such as discussion and lexithon development.
- Outcomes, results, presentations, summary notes and observations during meetings will be documented as interim reports and updates after each workshop event or community event/activity. The *IS-GEO RCN* will follow similar practices to the original IS-GEO workshop by posting materials for events and activities on the website as a record of results, as well as serving to make the results of the RCN available to other researchers and other interested parties.

Studying the Earth as a system requires scaling up our ability to collect data where and when it matters, to integrate isolated observations into broader studies, to create models in the absence of comprehensive data, and to synthesize models from multiple disciplines and scales. Advances in intelligent systems to develop more robust sensor platforms, more effective information integration, more capable machine learning algorithms, and intelligent interactive environments have the potential to significantly transform geosciences research practices and expand the nature of the problems under study. The IS-GEO RCN proposes to catalyze interactions across disciplines so that the community can begin immediate application to geoscience research challenges.