

EarthCube: a community- based cyberinfrastructure for knowledge management across the geosciences

Dr. Ana Helman

ahelman@nsf.gov

Dr. Carmen Huber

chuber@nsf.gov

U.S. National Science Foundation Europe Office

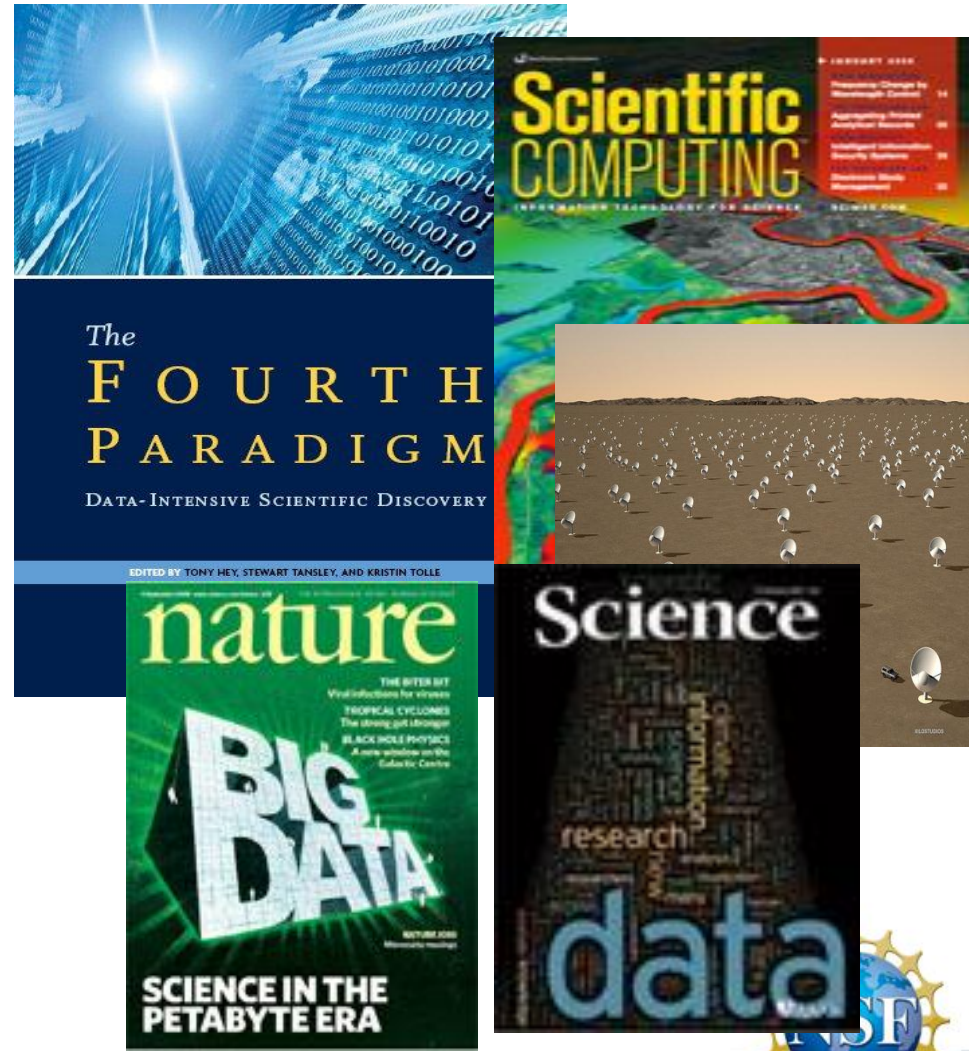
www.nsf.gov



Framing the Challenge:

Science and Society Transformed by Data

- ❖ *Modern science*
 - Data- and computation-intensive
 - Integrative, multiscale
- ❖ *Multi-disciplinary collaborations to address complexity*
 - Individuals, groups, teams, communities
- ❖ *Sea of Data*
 - Age of Observation
 - Distributed, central repositories, sensor-driven, diverse, etc

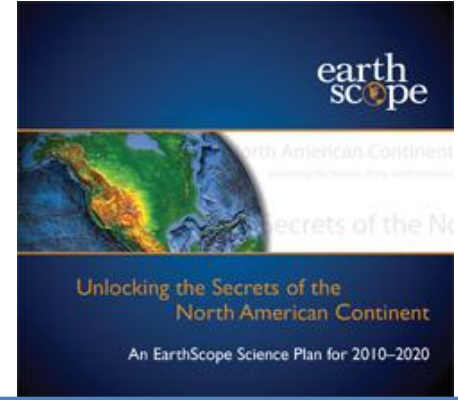




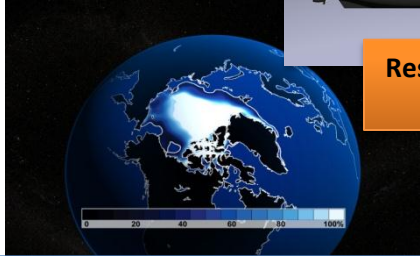
Research Vessel
Sikuliaq



Oceans



EarthScope Observatory
Network

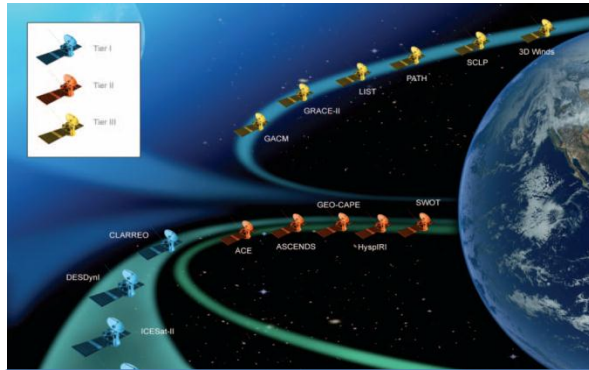


Arctic Sea Ice

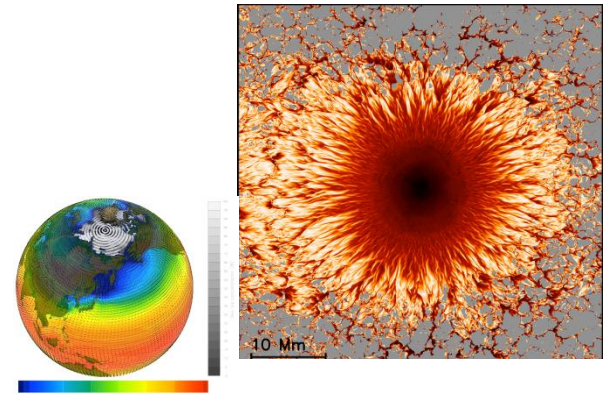
Era of Observation and Simulation



Water



Satellites

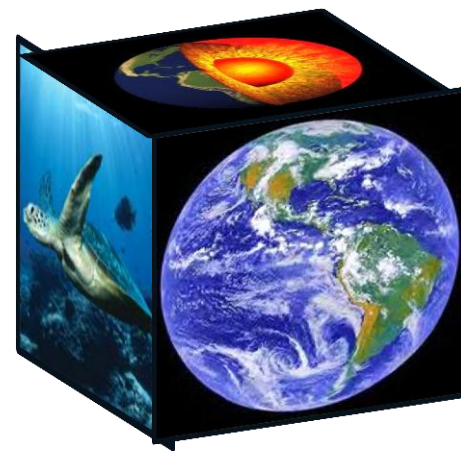


Earth System Modeling



Goal of Earth Cube

to transform the conduct of research in geosciences by supporting community-based cyberinfrastructure to integrate data and information for knowledge management across the Geosciences.

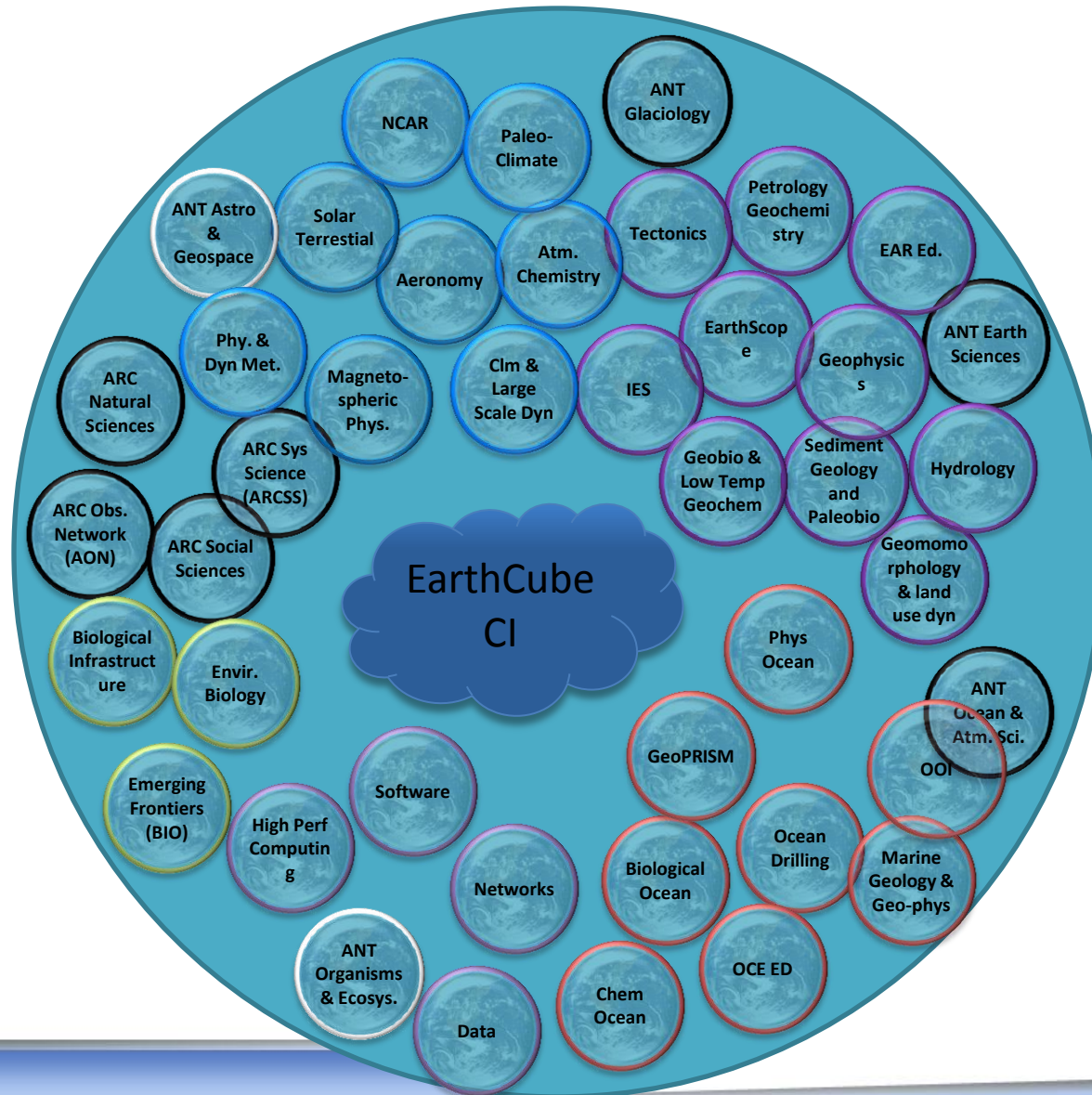


What Is Knowledge Management

- It is a human-centric context for the scientific enterprise
- Elements :
 - Easy Use and Discovery of data and information
 - Ease of collaboration and training to create knowledge
 - Access through open architecture and interworkability
 - Shared community vision/ value system
- The community will strategically connect these elements over time for the geosciences
 - The use of existing or emerging technologies will moderate the pace of development



Why EarthCube? To Advance our Science

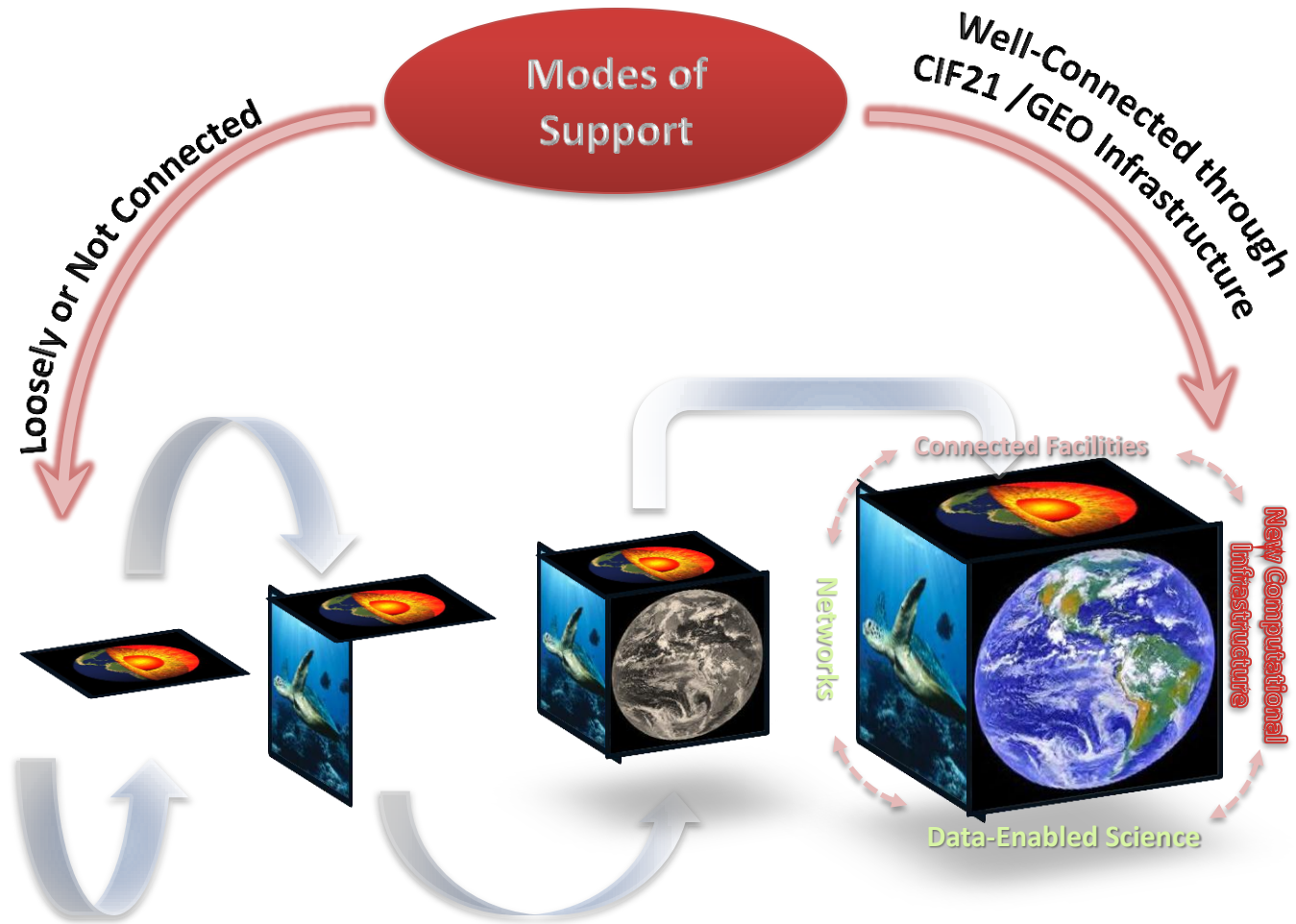


Multiple Modes of Support: a Hallmark of Success

- Traditional “modes of support” are and will continue to be essential
 - Focused grants to individual investigators or small groups
 - Focused programs that are community-driven
 - Small centers
 - Large national centers
 - Cyber-enhanced field programs
 - Cyber-enhanced observing facilities and infrastructure projects
 - NSF-wide initiatives
 - Education, outreach, and training activities
- Each mode supports both high-risk, transformative research and practical implementation
- Although each mode contributes, the modes often work independent of one another



Over Time A Unifying Architecture Needs To Be Developed



Early Insights into Motivations

Motivating questions:

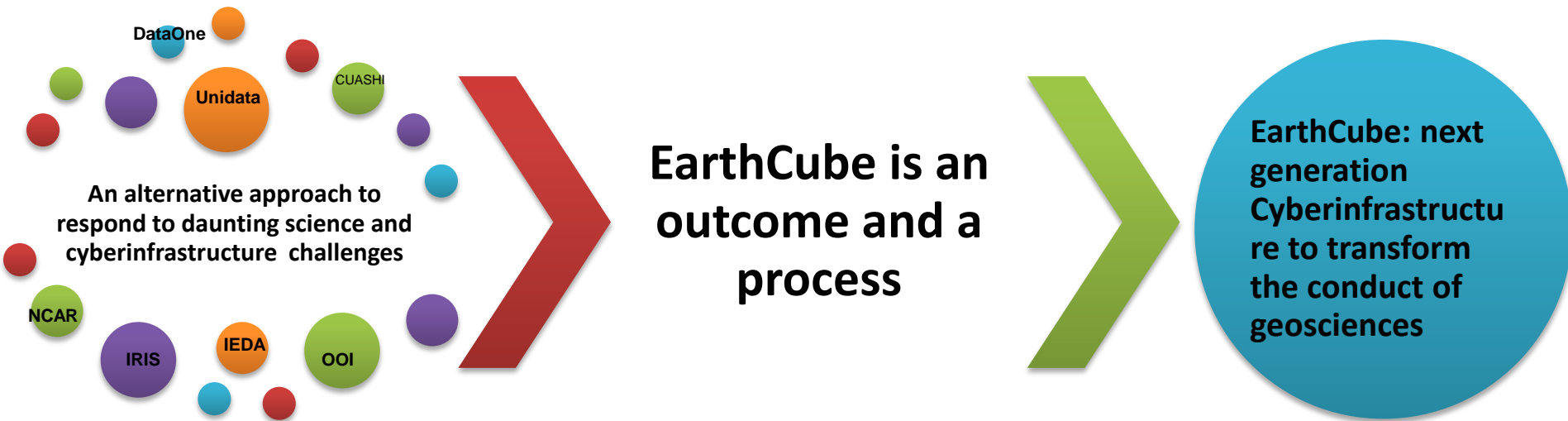
- Will geoscientists share data, models, tools, and visualizations – if you build it, will they come?
- Will geoscientists and cyber/computer scientists collaborate to advance EarthCube – what are the incentives to cooperate?
- Will interdisciplinary work occur on a sufficient scale to tackle pressing earth systems research challenges – is there a clear, shared success vision?

Top Six Barriers to Sharing Data (survey):

- No time/Not enough time for QA/QC
- No repository or known repository
- Inadequate standards, standardized formats, etc.
- Want to publish first/not be scooped
- File size too large/server size too small
- No credit/incentive for sharing



The EarthCube Strategy



The process must

- Engage all stakeholders:
 - Geosciences end-users
 - Geosciences and Cyberinfrastructure facilities
 - Cyberinfrastructure and Computer Science specialists
- Build EarthCube iteratively, with community input and assessment in yearly intervals
- EarthCube built on existing resources, understanding that different geosciences communities cannot be uniformly served

EarthCube Themes

- Community-driven process
- Collaboration, not competition
- An ongoing conversation, punctuated by virtual and face-to-face meetings
- Supported by ongoing reconnaissance
- Facilitated discussions



EarthCube: Anticipated Long-Term Outcomes

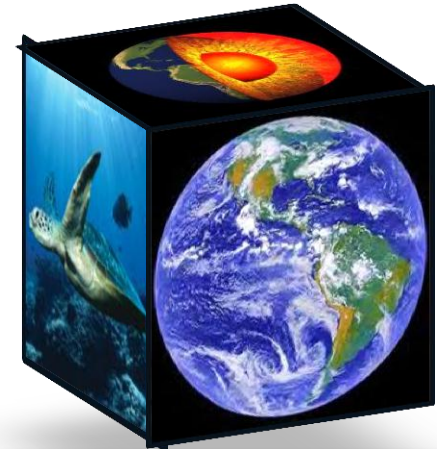
- Transformation of practices within the geosciences community spanning over the next decade
- Development of unprecedented new capabilities for researchers and educators
- Vast improvement of the productivity of the community
- Acceleration of Earth system research
- Development of a uniform framework for all of the geosciences



Building on the Internet Paradigm



**Internet for
interoperability**



**Interworkability for
collaboration**

- The Internet provided a knowledge system that transformed the modality of science
 - Unanticipated Outcomes
 - NSF's role included influencing the set of standards that were adopted
- Cyberinfrastructure investments must provide a framework of integrated and interactive services



Framework Should

- Create infrastructure of integrated and interactive services
 - transcend fields and accelerate discovery of a complex, multi-scale Earth System
- Create an interoperable digital access infrastructure
 - Provide a network that is open, extensible and sustainable
 - Include Observations, Simulations, Collaborations, and Sharing of information
- Facilitate data and metadata transfer from the field into data systems and applications
- Integrate research and education
 - Build a savvy and broadly engaged workforce



2011

- ◆ Accelerating the Community Dialog
- ◆ Defining the initial scope of EarthCube
- ◆ New starting point for collaboration

2012

- ◆ Developing convergence/consensus
- ◆ Forming recommendations for development
- ◆ Examining governance

First 'Dear Colleague Letter'

EAGER awards

Stakeholder Survey

Roadmaps

6/11

8/11

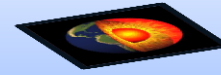
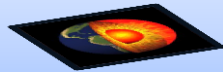
11/11

2/12

6/12

6/12

8/12



White Papers

1st Charrette

2nd Charrette

- ◆ > 10 sessions/talks EarthCube related
- ◆ More community dialog opportunities

9/12

10/12

10/12

12/12

12/12



Website to Community

Wrap-up PI Workshop

Domain Workshops

EarthCube Solicitation

Timeline



1st Charrette Organization

- NSF seeks input from wide range of sources:
 - Individuals, inst./org., representatives of scientific groups or communities
 - Facilities and managers of cyberinfrastructure endeavors
 - Industry, Federal Labs., Federal Agencies, and International Partners
- NSF establishes on-line resources and fora to:
 - Gather community inputs/requirements
 - Facilitate partnerships and collaborations
 - Encourage submission of approaches to the EarthCube design
- NSF facilitates input in three areas:
 - User Requirements
 - Technology Solutions
 - EarthCube Design Approaches

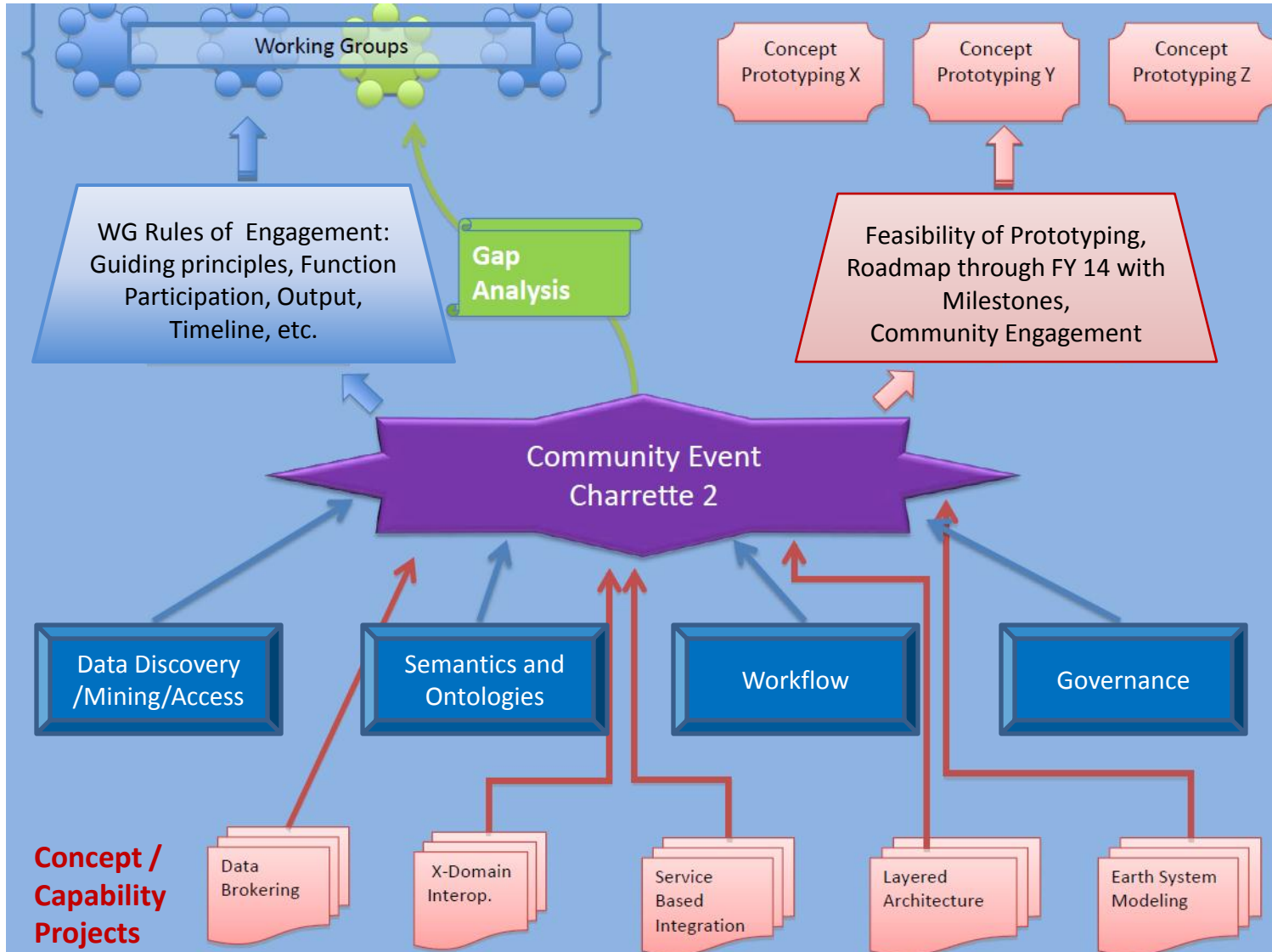


Charrette Process

- Plenary Session provides the opportunity
 - to discuss user requirements
 - refine approaches and designs for EarthCube
 - develop partnerships and new collaborations
- Remote participation and real-time comments system are available
- Summary Session
 - Comments from NSF, facilitators, and participants on process
 - NSF provides guidance on post-Charrette activities



2nd Charrette – June 2012: Roadmaps and Design



Community Groups



A Social Activity

<http://earthcube.ning.com/>

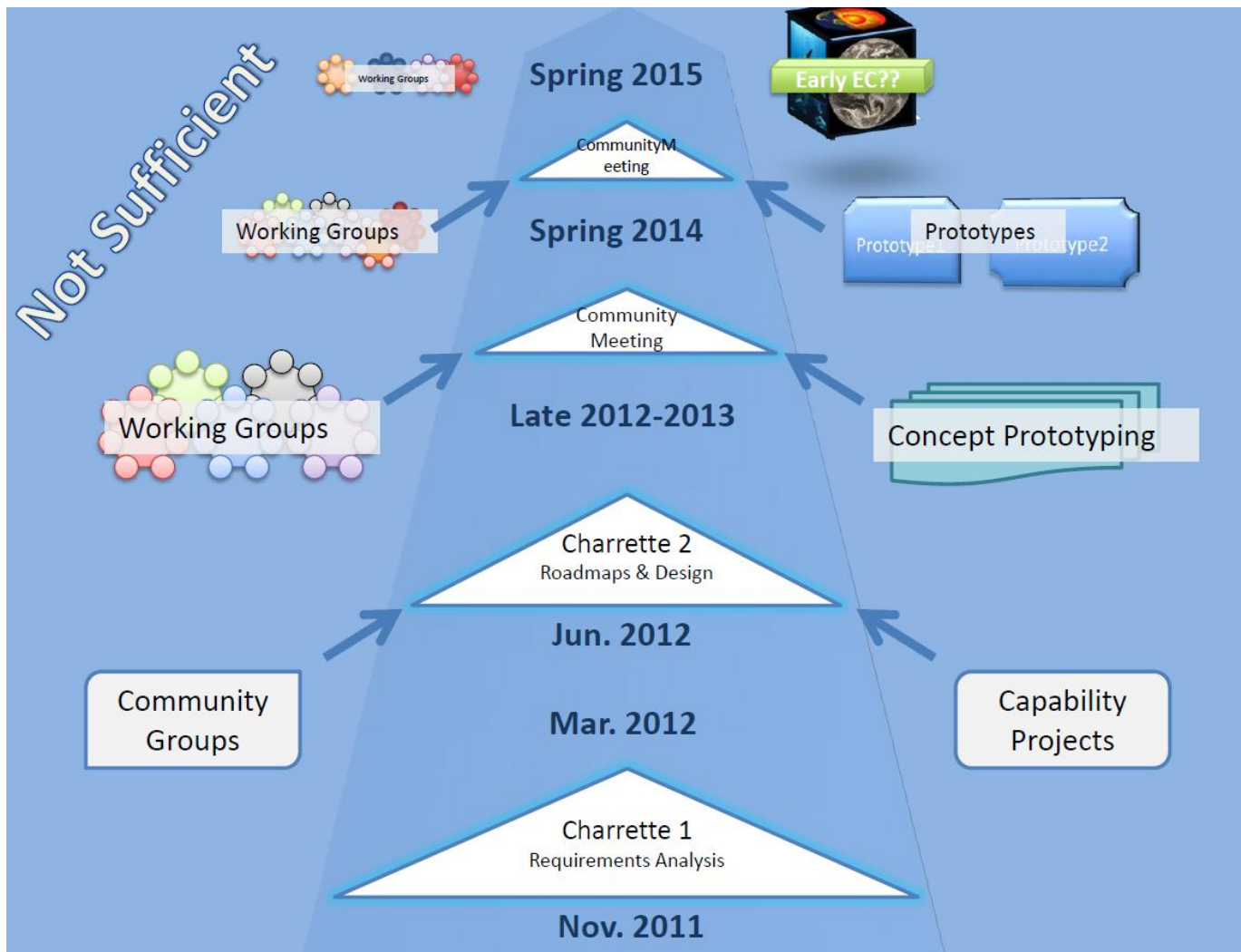
- ~1250 members to the EarthCube website
- 113 white paper submission; 185 respondents to user survey
- ~70 expression of interest emails
- 9 Comprehensive roadmaps
- 27 Groups
- Unknown number of hours of pro bono contributions by the community



The screenshot shows the EarthCube website interface. At the top, there is a navigation bar with links for home, about, groups, documents, community, events, forum, and my page. The main header features the EarthCube logo and a welcome message: "Welcome to EarthCube, transforming geosciences research for the 21st century". Below this, there is a brief description of EarthCube as a collaboration between the U.S. National Science Foundation (NSF) and Earth, computer, information, and social scientists. The website aims to transform research through the development of community-guided cyberinfrastructure to integrate information and data across the geosciences. A section titled "Get Involved" lists several ways to participate, including reading about EarthCube, becoming a member, joining groups, participating in events, checking out documents, joining Q&A sessions, and browsing photos and videos. A "PHOTOS" section displays a large image of a group of people sitting around a table in a meeting room, with a laptop open in front of them. Below the photo, there are options to "Add Photos" and "View All". A "GROUPS" section is partially visible at the bottom. On the right side, there is a sidebar with a "Welcome to EarthCube" message and a "Sign Up or Sign In" button. Below this, there is an "EVENTS" section listing several upcoming events, including "Governance Weekly Call - Time in EDT", "Envisioning Success: A Workshop for Next Generation EarthCube Scholars and Scientists", "EarthCube Domain End-User Workshop for Structural Geology and Tectonics", "EarthCube End-User Domain Workshop for EarthScope", and "GSA Town Hall meeting: EarthCube GEO Domain Workshop: Cyberinfrastructure for Paleogeoscience". A "LATEST ACTIVITY" section shows recent posts, including "Genevieve Pearthree posted events" and "Genevieve Pearthree updated an event".



EarthCube: Evolution



What We've Learned so Far

NSF:

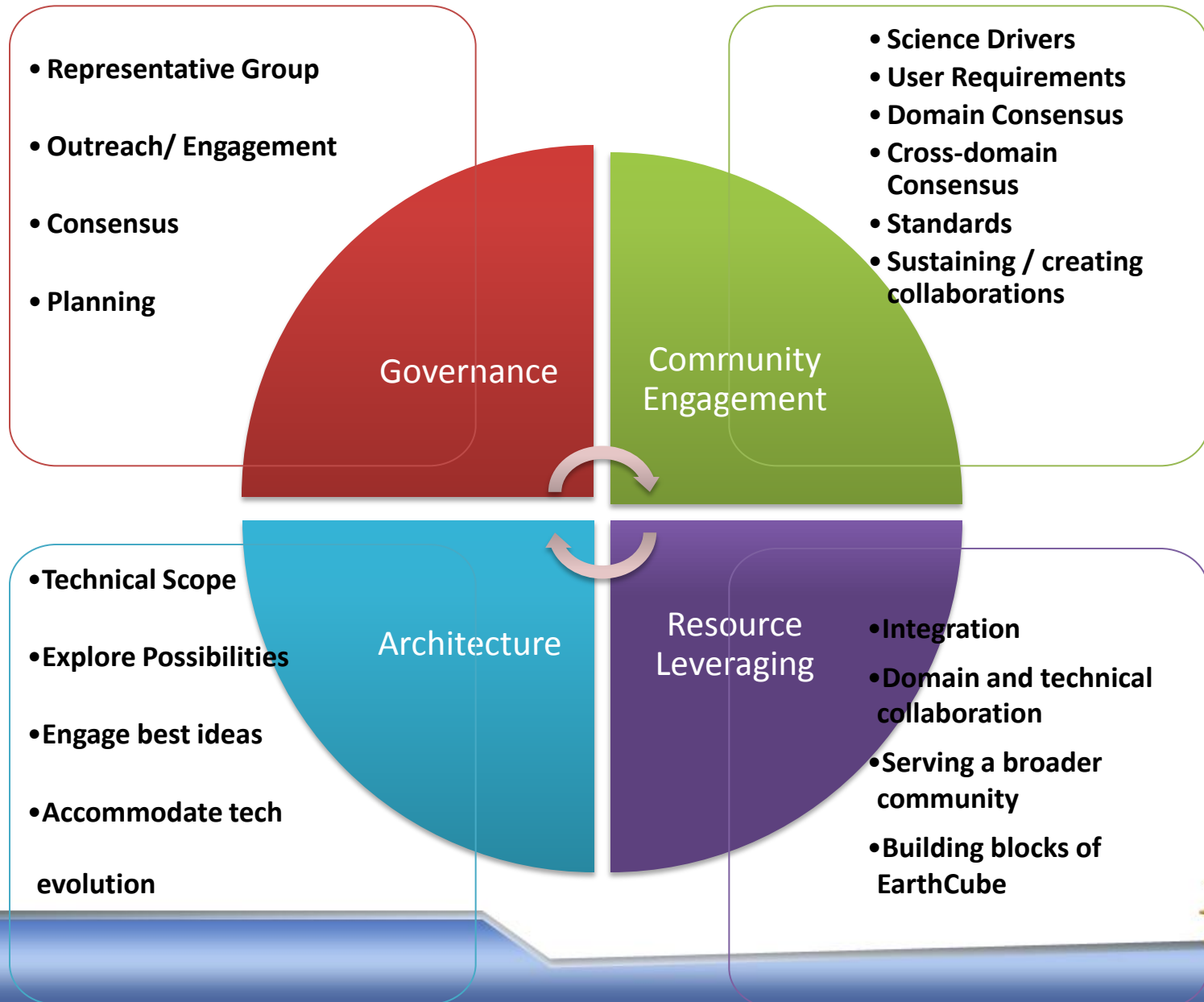
- Amazed by dedication and collaborative spirit
- Community illuminates the complexity of the effort
- A broader dialog than we anticipated (international, agency wide, community wide)
- Appreciate that NSF had never asked the question

Community:

- Getting Science done now and in the future--Science drivers and aspirations
- Similar barriers and challenges across communities
- Similar solutions w/o much cross-communication
- There is a need for order
- Assessing the distribution of resources (data and cyberinfrastructure) and access to them



2013: Thematic Focus



EarthCube Governance Functions: as Identified by the Community

- Identify and Implement an EarthCube Vision, Mission, and Goals
- Engage and Coordinate Across the EarthCube Community
- Management: Create and Implement EarthCube By-Laws and Charter
- Develop and Maintain a Viable Architecture and Concept of Operations that Enable the Realization of the Goals and Objectives of the EarthCube Vision



EarthCube Governance Guiding Principles: as Identified by the Community

- **Serve the advancement of interdisciplinary science** through collaboration among community members and with other cyberinfrastructure initiatives.
- Rely on **open, transparent processes** and shall vet and inform its decisions through active community engagement.
- Encourage **environmentally sustainable** processes and practices.
- Support development that draws from best practices based on **interoperability** and **reuse of resources**.
- Strive for the **free and open sharing** of data, information, software and services.
- **Evolve** with changing technologies, practices and user needs while remaining robust.



Test Enterprise Governance

- Two stages
 - planning
 - demonstration
- Welcome all interested organizations to apply
- Open competition, looking for the best ideas
 - engaging academic geoscientists and data facilities
 - setting priorities and fostering collaboration
- Anticipate one award, but leaving options open depending on proposals



Future Emphasis:

Engaging and Understanding Stakeholders

- Continued engagement of social scientist to assess stakeholder alignment
- Continue to support and encourage many discipline-specific workshops
 - Special emphasis of early career scientists
 - Address issues within a consistent framework
- Better understanding of technical and social motivations confronting the community



EarthCube: approach is experimental and changing –
agile, open, community-driven.

An Outcome *and* a Process

Thank you for your attention!

ahelman@nsf.gov

chuber@nsf.gov

www.nsf.gov

<http://earthcube.ning.com>

NSF: Where discoveries begin

