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Market-Oriented Conceptual Design for Earth Cube: A Manifesto for Advancing Science

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Abstract

EarthCube is an evolving socio-technical system that seeks to facilitate scientific research through the integration and sharing of geosciences data and resources. This paper presents a market manifesto for science, outlining the conceptual design and architecture of the EarthCube system, its principles related to architecture and data management, and the requirements synthesized from various EarthCube communities. The paper also explores key perspectives on Earth and presents GEAR's approach to addressing these perspectives, leading to the development of the EarthCube system. The paper concludes by summarizing the achievements of the EarthCube initiative and highlighting the potential future directions for this emerging field.

Keywords: *EarthCube, socio-technical system, data management, geosciences, conceptual design, architecture, scientific research, GEAR*

INTRODUCTION

The EarthCube initiative seeks to address the challenges associated with integrating and sharing geosciences data and resources across scientific disciplines and institutions. EarthCube is an evolving socio-technical system that aims to promote scientific discovery, innovation, and collaboration by facilitating data and resource sharing. This paper presents a market manifesto for science, outlining the conceptual design and architecture of the EarthCube system, its principles related to architecture and data management, and the requirements synthesized from various EarthCube communities.

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EarthCube as an Evolving Socio-Technical System: a Market Vision:

EarthCube is a socio-technical system that seeks to promote scientific research and collaboration through the integration and sharing of geosciences data and resources. EarthCube's vision is to create a platform that supports the development of innovative scientific methods, technologies, and applications through the use of shared data and resources. EarthCube's market vision is to promote the growth of a market for scientific data and resources that will facilitate the creation of new businesses and industries based on the use of geosciences data. **See Figure: 1**

Conceptual design and architecture

The EarthCube system is designed as a distributed network of interconnected data and resource centers that facilitate the integration and sharing of geosciences data and resources. The system is designed to be flexible and scalable, allowing it to adapt to changing scientific needs and requirements. The EarthCube architecture consists of several layers, including the data and resource layer, the middleware layer, and the application layer. Each layer is designed to support the development of specific scientific applications and services.

EarthCube principles related to architecture and data management

The EarthCube initiative is guided by several principles related to architecture and data management. These principles include openness, interoperability, scalability, sustainability, and security. The EarthCube architecture is designed to be open and interoperable, allowing data and resources to be easily shared across different scientific domains and institutions. The system is also designed to be scalable and sustainable, enabling it to adapt to changing scientific needs and requirements while maintaining a high level of reliability and performance. Finally, the EarthCube system is designed to be secure, ensuring the confidentiality and integrity of sensitive data and resources.

Requirements synthesis: The EarthCube initiative has identified several requirements for the EarthCube system, synthesized from various EarthCube communities. These requirements include the need for a flexible and scalable system that can adapt to changing scientific needs and requirements, support for the development of innovative scientific methods and applications, and the ability to integrate and share geosciences data and resources across different scientific domains and institutions.

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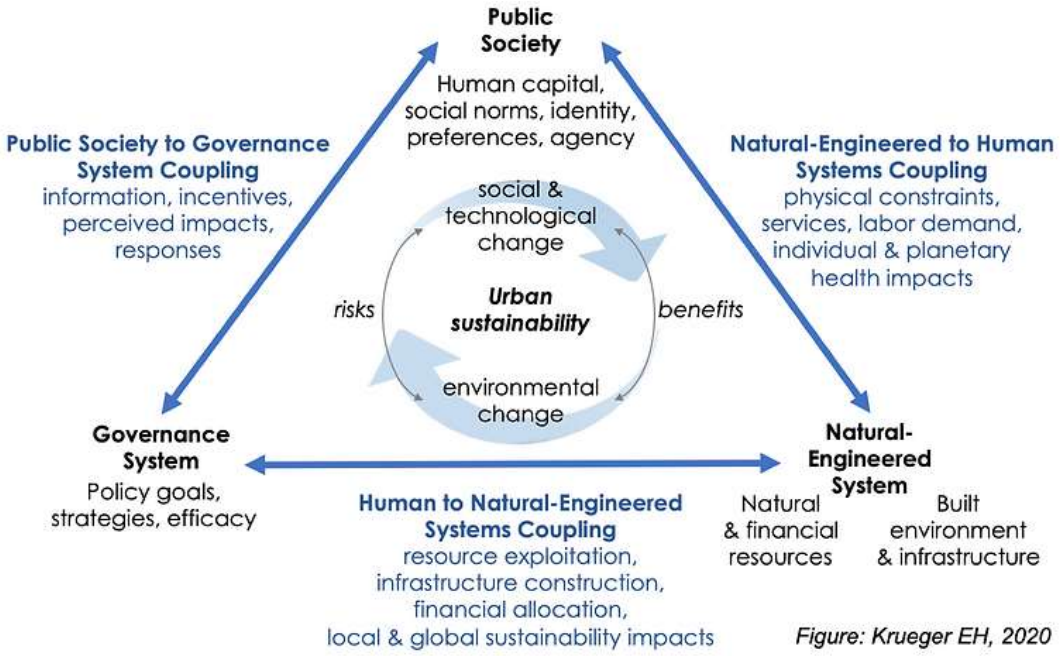
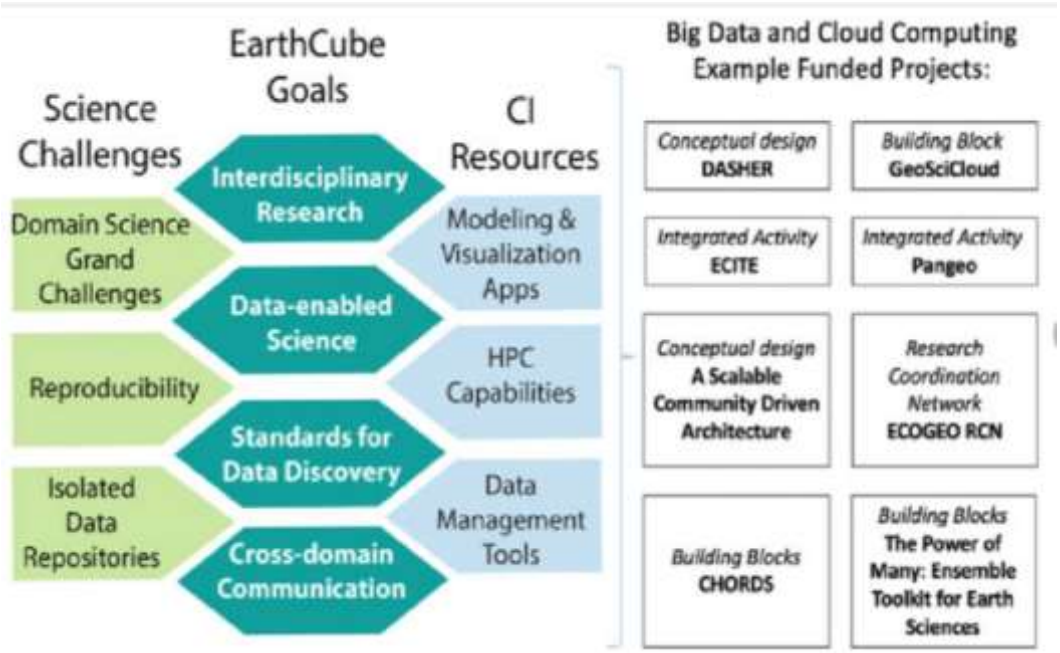


Figure: Krueger EH, 2020

EarthCube communities and their needs: The EarthCube initiative brings together a diverse range of communities with different scientific needs and requirements. These communities include scientists, researchers, educators, and industry professionals. The EarthCube system is designed to address the needs of these communities by providing a platform for data and resource sharing, collaboration, and innovation.



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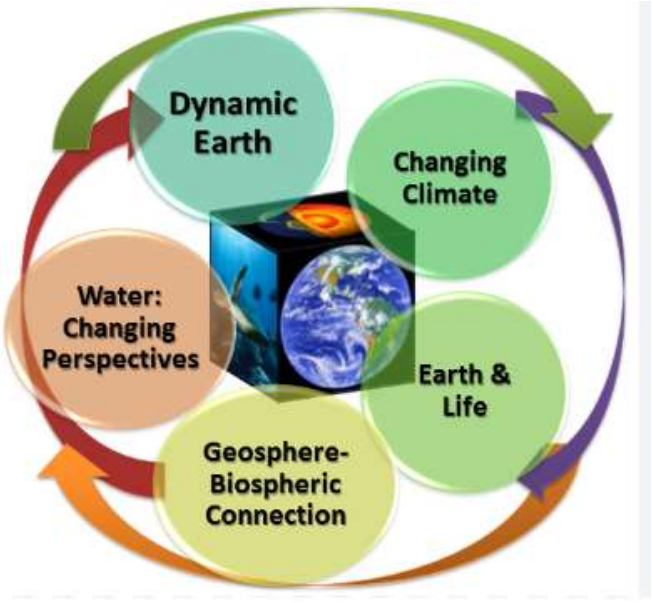
Enterprise View: Key perspectives on Earth: The EarthCube initiative takes an enterprise view of Earth, recognizing that the Earth is a complex system that requires a holistic approach to understanding and managing its resources. This enterprise view encompasses several key perspectives on Earth, including the need to address global challenges such as climate change, the need for integrated and interdisciplinary approaches to scientific research, and the need for effective data and resource management.

GEAR's approach: GEAR, or the Geoscience Advancement through EarthCube Resource, is a community-driven project that aims to advance the development and implementation of the EarthCube system. GEAR takes a bottom-up approach, working closely with EarthCube communities to identify their needs and requirements and to develop solutions that meet those needs. GEAR also focuses on promoting the use of standards and best practices for data and resource management to ensure that the EarthCube system is interoperable and scalable.

The EarthCube System: The EarthCube system has made significant progress since its inception, with several key achievements to date. These include the development of the EarthCube architecture, the establishment of several EarthCube data and resource centers, the creation of standards and best practices for data and resource management, and the development of several scientific applications and services that leverage EarthCube data and resources.



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