

# Sustainability + IT

## *Reporting on a Workshop on the Role of Information Sciences and Engineering in Sustainability (RISES)*

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Presented to the SEEDM Workshop  
May 3, 2011 • Arlington, VA



<http://cra.org/cc> • <http://cccblog.org>



# Overview

- A two-day workshop held in Washington, DC, February 3-4, 2011
- Approximately 60 participants
- Multi-disciplinary, with focus on computing
- *Goal: to identify new research opportunities in CISE that address sustainability objectives*

The screenshot shows the website for the Computing Community Consortium (CCC). The header includes the CCC logo and the text "Computing Community Consortium" with the tagline "We support the computing research community in creating compelling research visions and the mechanisms to realize these visions." Below the header is a navigation menu with links for HOME, YOUR VISION, PLANS, ACTIVITIES, RESOURCES, ABOUT, and CRA. A search bar is also present. The main content area features a list of research areas: NetSE, XLayer, Cyber Physical Systems, Global Development, Robotics, Architecture, Big Data Computing, HealthIT, SEES IT, Theoretical CS, Interactive Tech, EDTECH, LISP1, and Open Source. The featured article is titled "Role of Information Sciences and Engineering in Sustainability (RISES)" and includes an overview, goals, and logistics information. A video player shows "RISES Opening Remarks by computingresearch".

<http://cra.org/cc/seesit>

# Workshop structure

- Three half-day sessions
  - Two plenary talks, followed by breakout discussions
    - Tim Killeen (NSF/GEO AD), Bill Rouse (Georgia Tech), and Michael Meyer (Georgia Tech)
    - Government panel (DoE Office of Science, ARPA-E, NIST)
    - Bill Tomlinson (UC-Irvine), Carla Gomes (Cornell)
  - Breakouts on CISE research areas as well as sustainability areas
  - Breakouts on “big data,” systems integration, and modeling/simulation
- Fourth “wrap-up” session comprising a workshop-wide discussion



# Organizing committee

- Bob Sproull, Oracle (co-chair)
- Randy Bryant, CMU (co-chair)
- Doug Fisher, Vanderbilt
- Erwin Gianchandani, CRA/CCC
- Carla Gomes, Cornell
- Bill Rouse, Georgia Tech
- Prashant Shenoy, UMass-Amherst
- David Waltz, Columbia
- Krishna Kant, NSF/CISE



# Sustainability



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# Defining *sustainability*

- “Meeting the needs of present and future generations while substantially reducing poverty and the planet’s life support systems”
- Spans natural and built environments, incl. energy, transportation, climate, and biodiversity
- Existing rate of resource consumption and an environmental impact that cannot be sustained

# Sustainability goals

- Decreasing overall energy consumption, while increasing use of renewable energy sources
- Improving transportation to minimize energy usage
- Adapting to climate change by conserving natural habitats
- Eliminating waste by designing products for full reuse and moving toward zero-loss of non-renewable resources
- *Sustainable ecosystem: decision making not based on current costs only, but also future costs and renewability*

# CISE + sustainability



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# "Big data" + sustainability

- Temporal *and* geographic data sets
- Very large, heterogeneous
- Varying levels of confidence
- Oftentimes incomplete
- Examples:
  - Graphical structures, sampled measurements, images, extensive notes/comments, social network data, etc.
  - DNA assays of individual creatures and plants
  - Traffic pattern data
  - *A particular challenge in the area of climate research*
- *(Meta)data provenance/federation/curation/visualization/analytics/archiving*

# Core needs

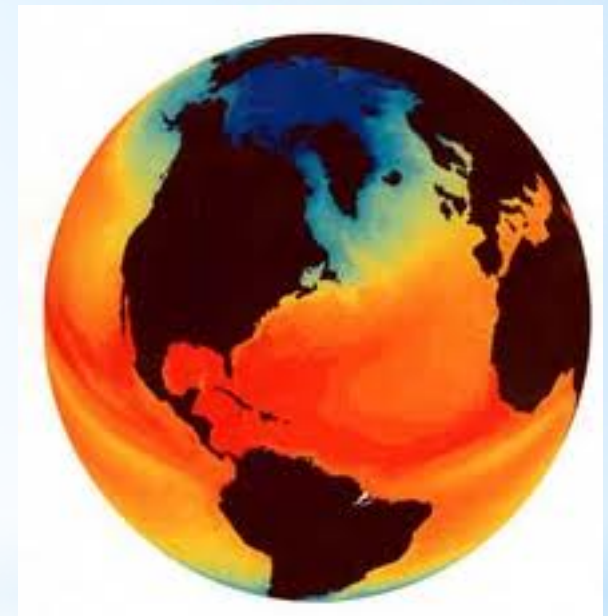
- Common infrastructures of techniques, software, and services to support these data
- One or more “centers” that combine sustainability research, research into the systems aspects of sustainability research, and hosting particular databases
- Benefits: weather modeling, land-use planning and modeling, logistics planning for energy and transportation systems

# Privacy and security

- Smart grids, ride sharing and transportation management, etc., will involve aggregations of personal data
- Systems with feedback (e.g., the smart grid) inherently are easy targets for disruption
- Newer and better techniques to provide privacy & security, and to garner the public's trust in these systems

# Modeling & simulation

- Simplifying scaling up simulations to the limits of computing power that we have available
- Routinely conforming simulations to observed data
- Testing, debugging, and verifying models and simulations
- Particularly in sustainability:
  - Finding better ways to model and simulate human behavior and behavior changes
  - Making models more transparent to permit non-modelers to inspect and debate



# Additional CISE areas

- Optimization
  - New objective functions and algorithms
  - E.g., optimizing wind turbine farm locations, smart buildings, etc.
- Intelligent systems
  - Smart grids
  - Automatically monitoring traffic patterns
  - Monitoring & controlling building environment systems
  - Detecting patterns of animal behavior or crop performance
- Human-centered & social computing
- Cyber-physical systems
- Systems engineering & system integration

# "Green IT"

- "Power-aware life-cycle computing"
- "Energy harvesting"
  - Sensors in a cornfield
  - Sensors embedded in structures/vehicles
- More power-efficient microprocessors
- Dynamic data management software to optimize energy efficiency
- Lots of effort in industry here, so academy must be aware of it



# Some new ideas

- Sustainability of sustainable data
- Breadth of the sustainability space + richness of the computational problems
- Challenges particularly in energy and transportation
- Improving the quality and transparency of models
- Understanding human needs and preferences, and encouraging behavioral changes
- Enabling citizen science





# Questions?

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- Phone: 202-266-2936
- Online: <http://cra.org/ccc/seesit>

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