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2010

## Emergence of a scientific collaboration: DataONE case study.

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### Recommended Citation

Aydinoglu, A.U. (2010). Emergence of a scientific collaboration: DataONE case study. Presentation at the Society for the Social Studies of Science (4S) Annual Meeting, University of Tokyo, Tokyo, Japan.

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# **Emergence of a scientific collaboration: DataONE**

**August 28, 2010**

**Tokyo**

**Arsev Umur Aydinoglu**

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- Introduction
- Background
- Methods
  - DataONE
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# Introduction

- Tougher problems (global warming, energy demand, space research, financial crisis etc.)
- Big science
  - ▣ large-scale research projects that needs vast resources funded by national governments or groups of national governments. *(Weingberg, 1961)*
- Collaborative research

# Research question

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- How do multidisciplinary, multinational, and multi-institutional scientific collaborations emerge?

# Scientific Collaborations

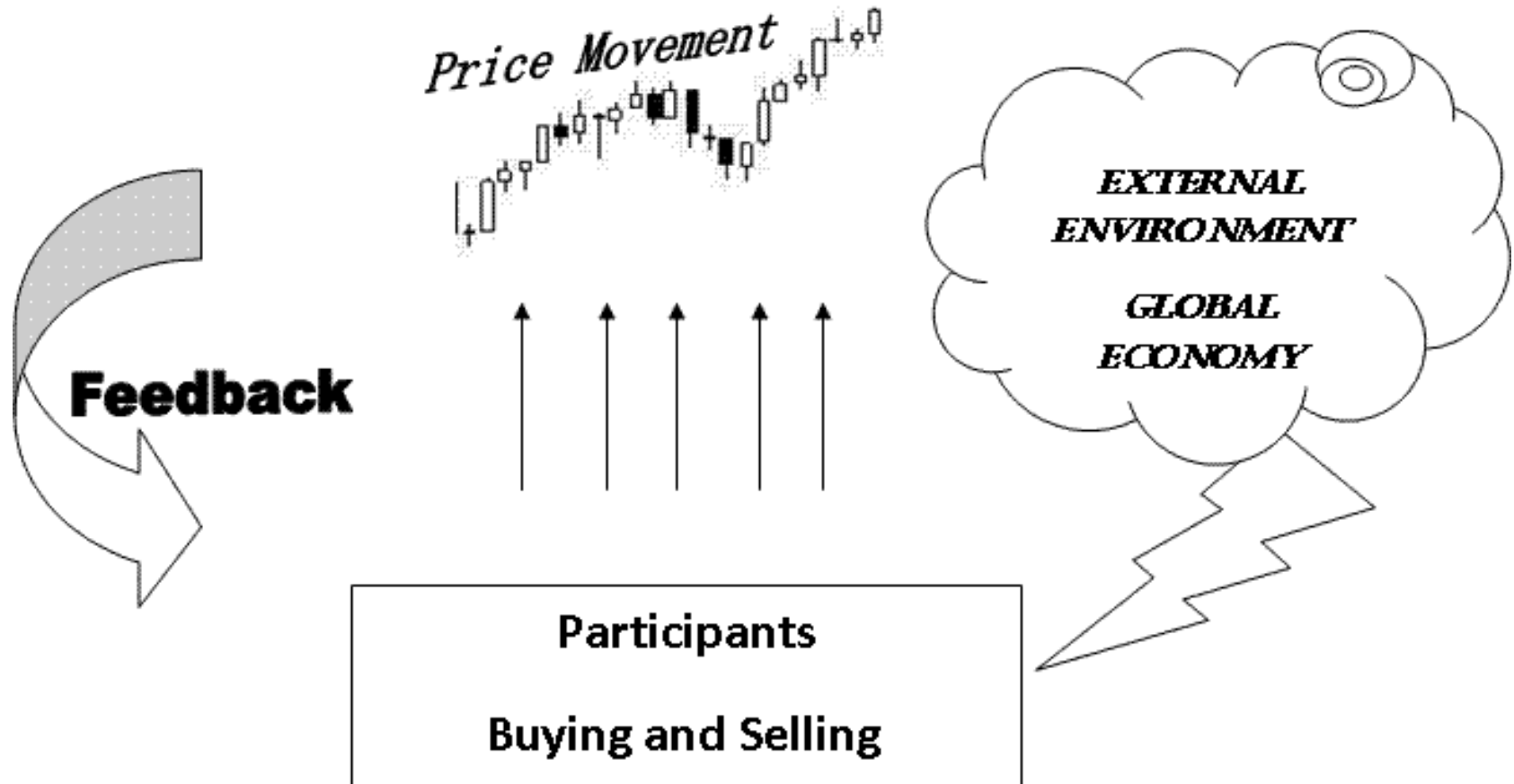


- Historical background
- Studies on scientific collaborations
- Gaps
  - ▣ The impact of new developments in ICT
  - ▣ Complexity theory perspective

# Complexity Theory

- Non-linear systems
- Chaos theory
- Complexity theory
  - Critically interacting components self-organize to form potentially evolving structures exhibiting a hierarchy of emergent system. (*self-organizing systems discussion group, 2008*).
  - Multiple agents + interactions
  - Applications in biology, computer science, philosophy, organizational studies, communication, economics, international relations.

# Complex Adaptive System



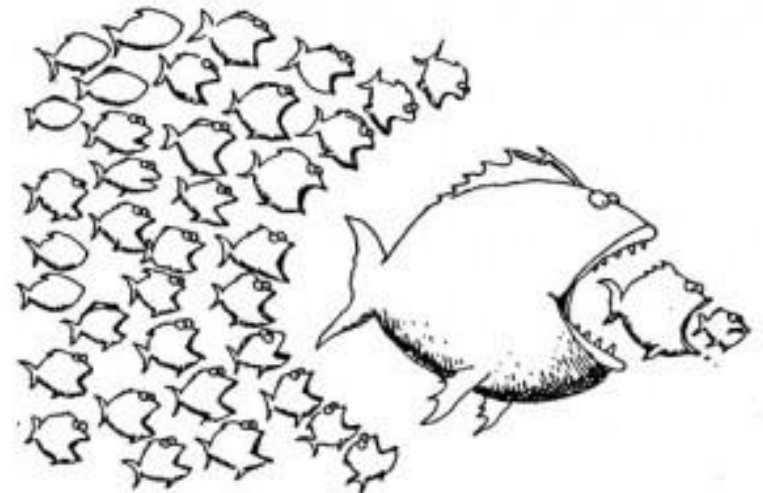


# Complexity Theory

- Systems are potentially chaotic (complex).
- Systems move from one dynamic state to the other through a discrete bifurcation process.
- Forecasting is impossible, especially at a global scale and in the long term.
- When in a chaotic state:
  - ▣ systems are "attracted" to an identifiable configuration;
  - ▣ systems, generally, have a fractal form.
- Similar actions taken by systems in a complex state will never lead to the same result.

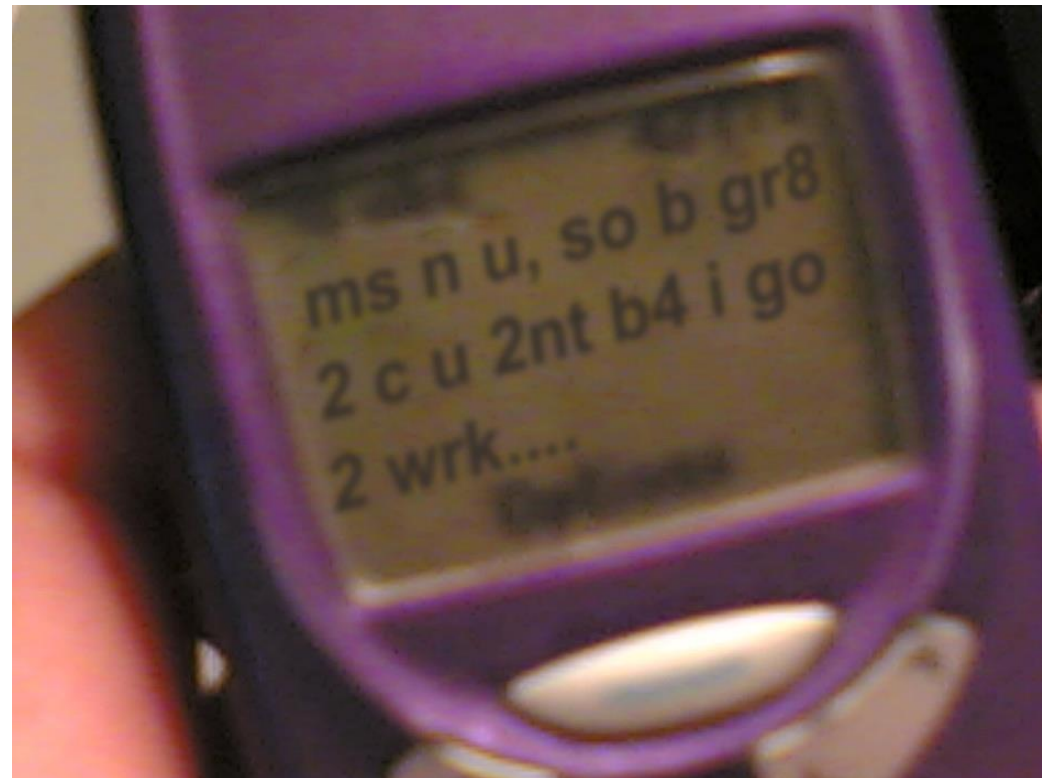
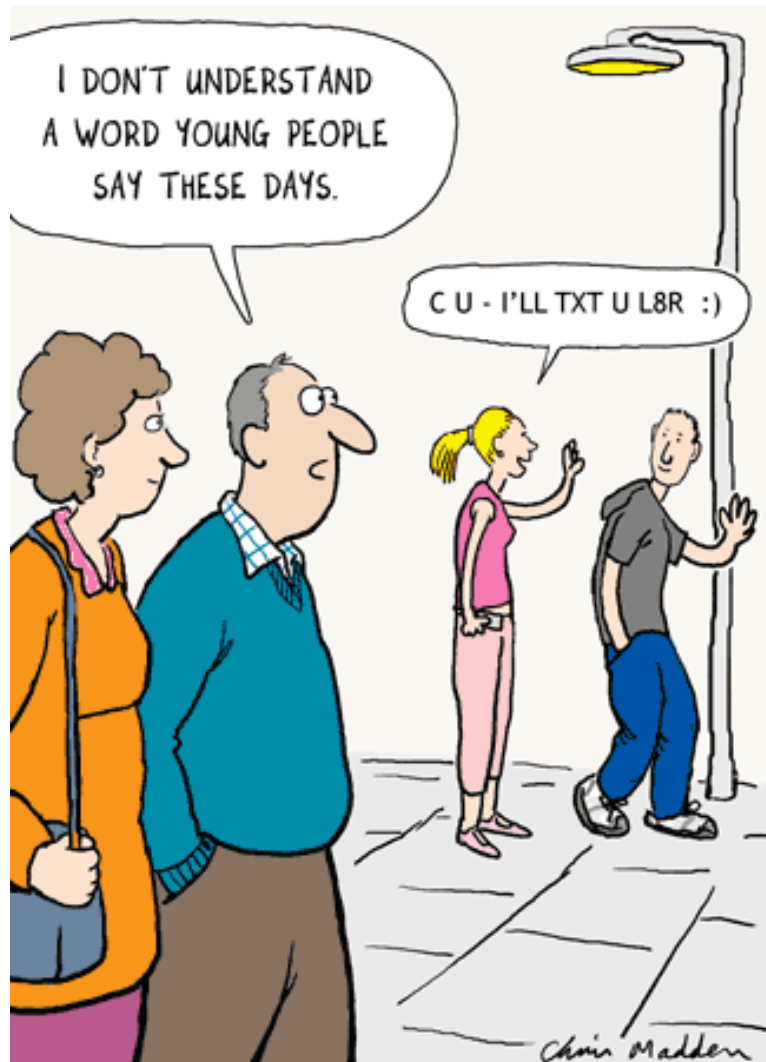
# Emergence

- Three waves of General System Theory (Sawyer, 2004)
  - ▣ Parson's Structural Functionalism
  - ▣ General Systems Theory
  - ▣ Complex Adaptive Systems
- Emergence
  - ▣ Lower level – higher level

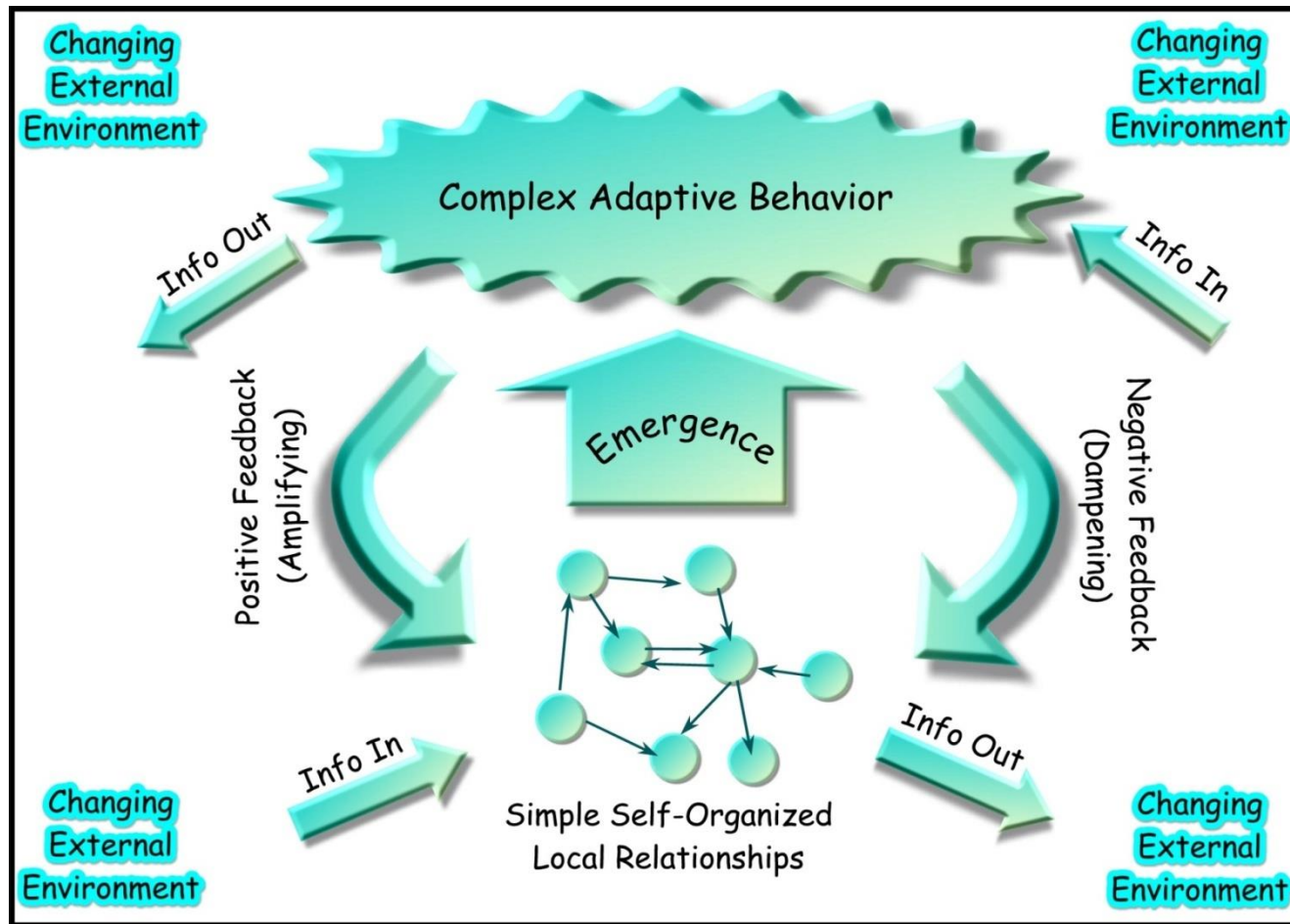


Sawyer

# Ex: SMS Language or Slang



# Emergent behavior



# Methods

- Case study
  - *“research strategy which focuses on understanding the dynamics present within single settings”* (Eisenhardt, 1989, 534)
- Deep understanding through rich data
- Multiple techniques and sources in data gathering
- Suitable for longitudinal studies

# Sample

- Information oriented sampling (*Flyberg, 2006*)
  - Selecting a case that has the potential to provide the richest data
  
- Data Collection
  - Semi-structured interviews w/ leadership team & cyberinfrastructure team (14)
  - Natural observation (2 grand meetings + daily work)
  - Online survey

# Historical background

- Office of Cyberinfrastructure
  - ▣ Supercomputer centers program (1980s)
  - ▣ High performance computing and communications (1990s)
  - ▣ Cyberinfrastructure (2000s)
    - *“the coordinated aggregation of software, hardware and other technologies as well as human expertise to support current and future discoveries in science and engineering and to integrate relevant and often disparate resources to provide a useful, usable and enabling computational and data framework characterized by broad access.”* (NSF Cyberinfrastructure Workshop, 2006)
    - Involved in tackling ‘grand challenges’.

# NSF's DataNet Vision

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- Provide the means to meet critical data needs
  - Create a structure that has a comprehensive range of expertise and ensures active participation.
  - Achieve long term sustainability
  - Provide for the full data management life cycle (creation, dissemination, & preservation), facilitate research, develop new tools and develop new capabilities for learning
- 
- Work with other DataNet Partners

**The DataNet program:** \$100 Million for 5 DataNet Partners over 5 years (\$20M each)

The First Two Funded Projects: DataONE and the Data Conservancy



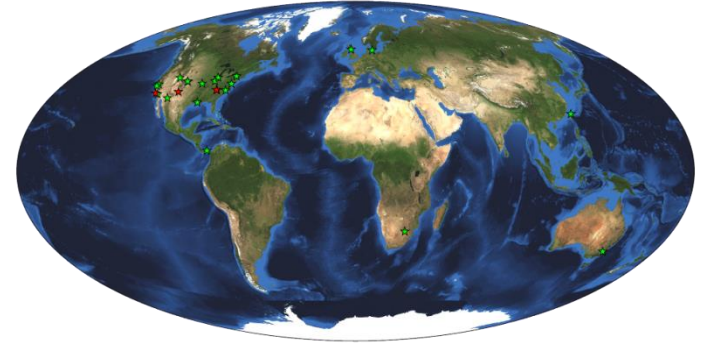
# (Observation Network for Earth)

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Universal access about to life on earth and the environment that sustains it.

Goals:

- To enable science
- Create sustainable & secure infrastructure
- Encourage broad and active community engagement
- Be useful to researchers, decision-makers, educators, students



Living with Cancer  
The changing science

Beyond England: Where The Enemy Has Its Own Surge

The Sopranos' Last Song: What Exit Will Tony Take?

# TIME

SPECIAL DOUBLE ISSUE

**The Global Warming Survival Guide**  
51 Things You Can Do to Make a Difference

2ND-QTR SIZZLE PROFITS AT 900 COMPANIES (P. 74)

PAYING FOR COLLEGE BEWARE OF THOSE HIGH 529 FEES (P. 96)

TERRORISM WHAT COMPANIES STILL NEED TO DO (P. 25)

# BusinessWeek

GLOBAL WARMING

Why Business Is Taking It So Seriously

BY JOHN CAREY (P. 60)

SPECIAL REPORT GLOBAL WARMING

# TIME

BE WORRIED.  
BE **VERY** WORRIED.

Climate change isn't some vague future problem—it's already damaging the planet at an alarming pace. Here's how it affects you, your kids and their kids as well

EARTH AT THE TIPPING POINT  
HOW IT THREATENS YOUR HEALTH

INDIA CAN HELP D—OR DESTROY IT  
MUSADERS

Adapted for A NEW GENERATION from the New York Times Bestseller

# an inconvenient truth

the crisis of global warming

## AL GORE

# nature

Eocene global warming  
Hydrothermal vents prompt methane release

Malaria persists  
Bonds oscillate as tectonic variations

Photonic crystals  
Perfected the device

Gastropod giant for fossil  
Spiral gastropods made rock stars

SPECIAL REPORT

# TIME

**HOW TO SAVE THE EARTH**

The hot and wild weather is a sign of things to come. But fresh ideas and new technology can cool us down and make this a **GREEN CENTURY**

007 at 25

# TIME

Where's the Beach?  
America's Vanishing Coastline

# TIME

## GLOBAL WARMING

Climbing temperatures. Melting glaciers. Rising seas. All over the earth we're feeling the heat. Why isn't Washington?

OCTOBER 19, 1987 \$3.95

# TIME

**The Heat Is On**

How the Earth's Climate Is Changing

Why the Ozone Hole Is Growing

Dr. Eustis's Rx for Health Care

# TIME

VANISHING OZONE

THE DANGER MOVES CLOSER TO HOME

# TIME

THE BIG DRY

# NEW YORKER

GLOBAL WARMING CARTOONS—2007-2100

NOVEMBER 28, 2005 \$3.95

JOE KLEIN ON IRAQ = BROKEBACK MOUNTAIN: GIDDY-YEP, I'M GAY

# TIME

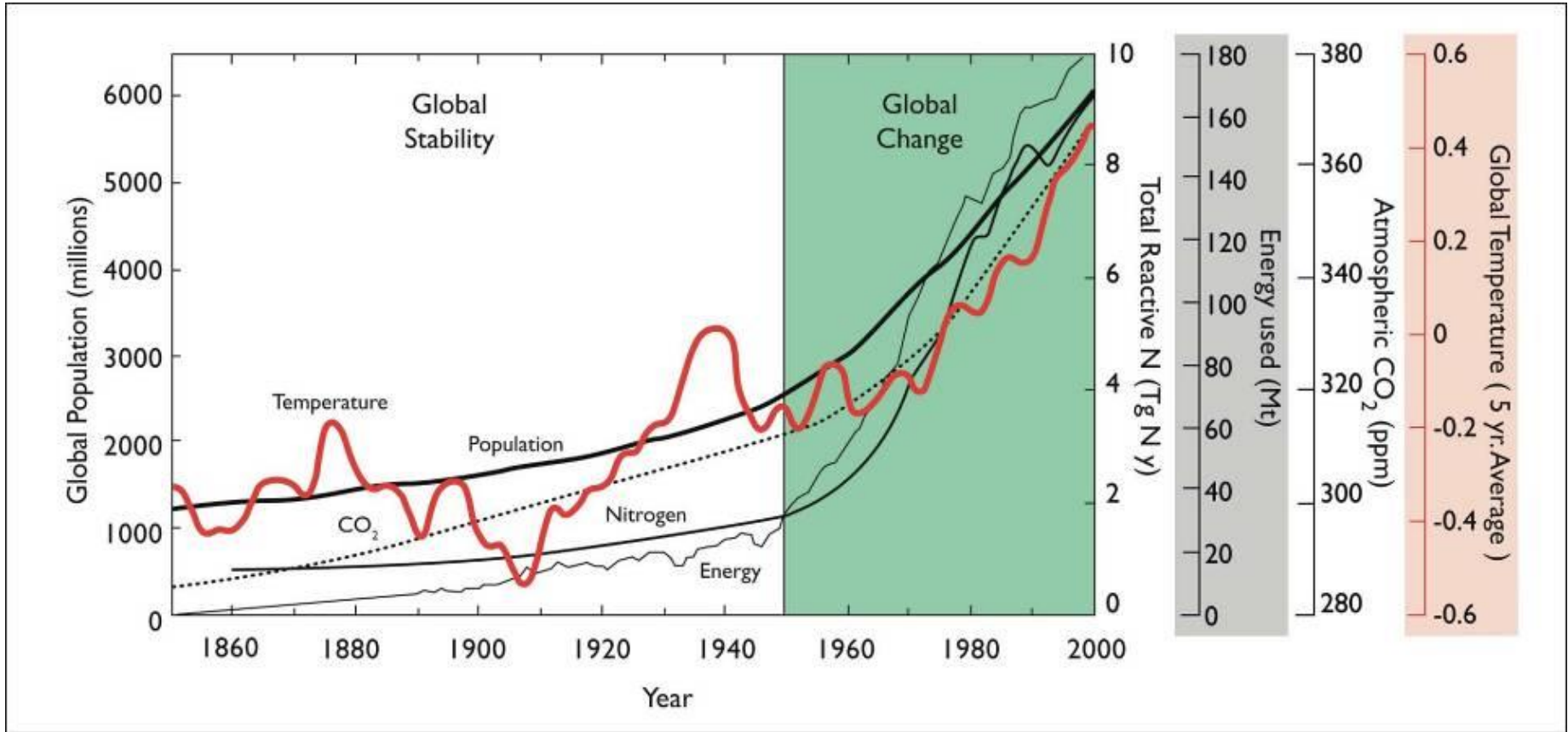
**New Orleans Blues**

It's worse than you think. Three months after Katrina, the city still suffers

BY CATHY BOOTH THOMAS

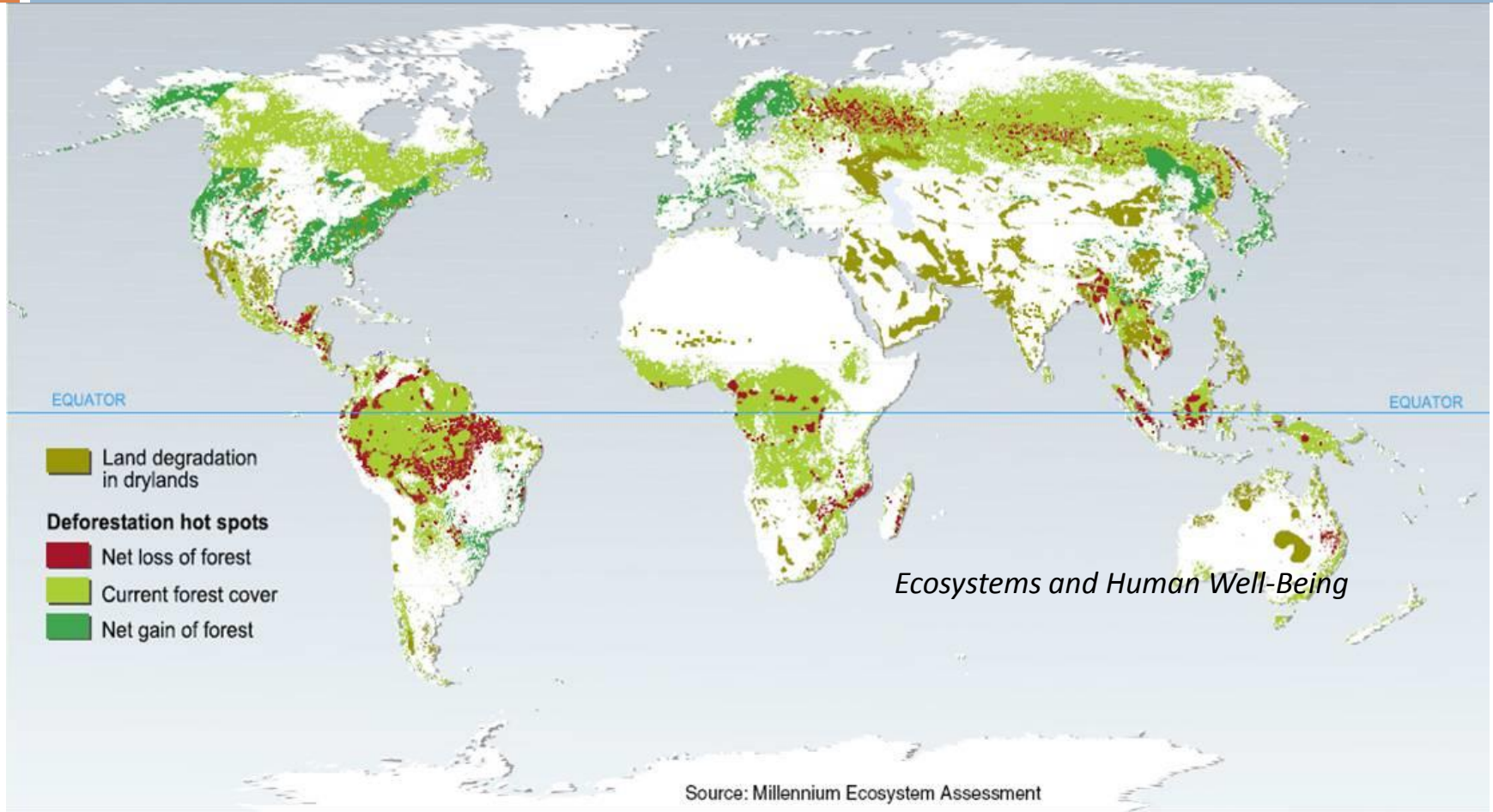


# The challenges of global change



Smith, Knapp, Collins. In press.

# Human impacts on land-based ecosystems



# Scientific challenges and data needs

- Global change is a complex scientific and societal challenge
- Community needs good data


Good data...

- ▣ build good science
- ▣ make possible wise management
- ▣ enable sound decisions

Good data need...

- ▣ solid technical infrastructure
- ▣ sound organization
- ▣ community engagement – multiple disciplines

# Nature of the collaboration



**Unidisciplinary** - researchers from a single discipline work together to address a common problem

**Multidisciplinary** - researchers from different disciplines *work independently* or sequentially, each from his or her own disciplinary-specific perspective, to address a common problem

**Interdisciplinary** - researchers from different disciplines *work jointly* to address a common problem and although some integration of their diverse perspectives occurs, participants remain anchored in their own fields

**Transdisciplinary** - researchers from different disciplines *work jointly to create a shared conceptual framework* that integrates and moves beyond discipline-specific theories, concepts, and approaches, to address a common problem

(Rosenfield, 1992)

# DataONE



# Rationale for selecting DataONE

- Timing
- Potential for emergent behavior
  - ▣ Interaction among networks
  - ▣ Systems functions cannot be localized
  - ▣ Interaction w/ complex & sophisticated language
- Convenience





# Preliminary Results 2/7

- *Counteracting forces* (individual level)
  - Different goals:
    - *“Fits to my research interest.”*
    - *“For my tenure I need to be involved in such projects.”*
    - *“I was called.”*
    - *“It was my job to facilitate.”*

# Preliminary Results 3/7

- *Strange attractors* 1/2
  - ▣ NSF Solicitation = funding



Scientific community



# Preliminary Results 4/7

## □ *Strange Attractor* 2/2

- ▣ Severity of the problem  
'Climate Change'



# Preliminary Results 5/7

- *No forecasting*
  - ▣ Developing the cyberinfrastructure
    - Know what to develop but not how to, which steps to follow, it is evolving by itself

# Preliminary Results 6/7

## □ *Interaction*

### □ Frequent and continuous communication

- f2f
- Email
- Skype
- Collaboration website

# Preliminary Results 7/7

- Notes from fieldwork
  - Constant recreation of working groups (higher level)
  - Loose leadership style
  - Emergence of an in-group language (e.g. acronym list)
  - Waves (?)

# Future Research

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- Online survey (fractals)
- DataONE & scientific collaborations
  - ▣ Longitudinal study
  - ▣ Community engagement
- Interdisciplinarity & the role of Information Science
  - ▣ Cyberinfrastructure
  - ▣ Complexity theory