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MODELING FOR SUSTAINABILITY

An expert workshop to explore needs and opportunities for future research, with special emphasis on possible Sino-European projects

Beijing, May 11/12, 2009

Convened by:
Integrated Risk Governance Project
[www.irg-project.org]
Global System Dynamics and Policies
[www.globalsystemdynamics.eu]

In collaboration with:
Academy of Disaster Reduction and Emergency Management
[www.adrem.org.cn]
Asian Conference on Risk Assessment and Management
[www.irisknet.cn/earam]
European Climate Forum
[www.european-climate-forum.net]

Purpose

The workshop will explore how new computing technologies can help improving models needed for purposes of sustainable development. It will do so by focusing on four areas of risk management:

- Climate and energy security
- Financial crisis
- Natural disasters
- Water shortage

Background

The current worldwide financial and economic crisis has exposed a serious dilemma in the use of computer models for management and policy: in today's world, many decisions need to be informed by computer models, but models currently available have turned out to be insufficient, in critical situations sometimes even misleading. This dilemma is particularly relevant with regard to sustainable development.
Consider the case of financial markets. Central banks, commercial banks and other financial operators cannot perform their daily business without heavily relying on computer models. Of course the models currently used work quite well in some range of ‚normal' market behavior – otherwise they would have been dismissed long ago. However, these models have blinded scholars and decision-makers first to the build-up of the current crisis, and then to its dimensions once the crisis started to unfold. „We trace the deeper roots of this failure to the profession's insistence on constructing models that, by design, disregard the key elements driving outcomes in real-world markets".[1] In this situation, there is an urgent need to develop a new generation of models that help decision-makers to perceive the risks and opportunities involved in situations where the normal course of affairs breaks down in important respects.

Looking at the financial crisis from a perspective of sustainable development, it is particularly worrisome that current models have ignored the possibility of interactions between energy markets and financial markets.[2] More generally speaking, current techniques for representing risk and uncertainty in computer models focus on cascades of events that are known to be causally related, thereby neglecting the challenges posed by interactions between risks that seem unrelated according to common knowledge. An instructive example is given by the ice-storms that hit China at the beginning of 2008: the interaction between these storms, the Chinese tradition of New Year holidays, and rapidly changing transport and energy networks led to an unprecedented situation requiring „leadership when events don't play by the rules".[3]

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[1] Colander, D., Föllmer, H., Haas, A., Goldberg, M., Juselius, K., Kirman, A., Lux, T., Sloth, B. (2009) The Financial Crisis and the Systemic Failure of Academic Economics. Kiel Working Paper 1489, Kiel Institute for the World Economy.
[2] Hamilton, J. (2009) Causes and Consequences of the Oil Shock of 2007-08, Brookings Papers on Economic Activities, Conference Draft.
[3] Weick, K.E. (2002) Leadership when events don't play by the rules. Reflections, 4 (1), 30-32.

By combining advances in a range of different disciplines, however, in many cases computer models can be improved so as to address these difficulties. Such advances include new visualization tools suitable for media use, like map-based technologies for natural hazards assessment, grid computing for geographical information systems, and Bayesian learning for dealing with uncertainty. Two examples deserve special attention here:

1) *An improved understanding of socio-ecological systems (SES).* Recent work in this area helps to „think outside the box", by paying attention to linkages between very different components of such systems and to the ways in which specific systems may switch from a normal course of affairs into an emergency mode.[4] A key question then is whether after the emergency the system will return to its previous normal state or whether it will develop a new kind of normality (figure 1).

2) *New techniques to model complex systems*. Multi-agent modelling provides key tools required to study socio-ecological systems so as to combine economic, social, and environmental processes. Important instances of such systems are contemporary cities.[5] Multi-agent models can be used to specify socio-ecological

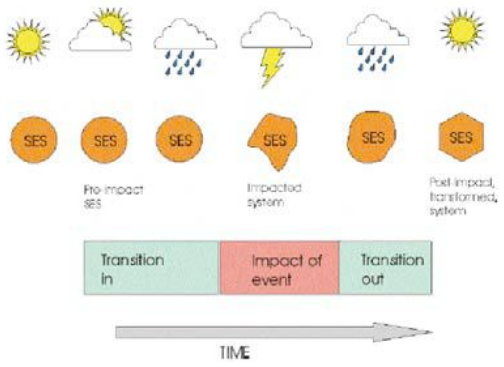

Figure 1: Critical transitions in socio-ecological systems.[6]

systems so as to distinguish between normal modes of operation and emergencies. They can address key challenges of current economic models,[7] and can help decision-makers to design robust strategies in situations where the search for an optimal course of action would be futile.[8]

[4] Young, O.R., Berkhout, F., Gallopin, G.C., Janssen, M.A., Ostrom, E., van der Leeuw, S. (2006) The globalization of socio-ecological systems: An agenda for scientific research. Global Environmental Change, 16, 304–316.

[5] Hunt, J. (ed) (2005) London's Environment: Prospects for a Sustainable World City. London, Imperial College Press.

[6] IRG-Project (2009) Science Plan, www.irg-project.org.

[7] Mandel, A., et al. (2009) Lagom generiC: an agent-based model of growing economies, ECF working paper 1/2009

[8] Shi, P., et al. (2005) Model for Disaster Reduction and Sustainable Development, Journal of Natural Disasters, 14, 1-7.

The workshop is an important step in the development of a research community developing modelling tools for integrated risk governance in a perspective of sustainable development. In this spirit, it will build on a series of previous events:

- „Complexity Science and Public Policy“, Erice, Italy, Centro Ettore Majorana, Oct. 4-8, 2008.
- „Towards the Next Generation of Climate Policy Models“, Berlin, Hilton, Nov. 13-14, 2008.
- „Is There a Mathematics of Social Entities?“, Berlin, Harnack House of the Max Planck Society, Dec. 14-19, 2008.
- "Agent-Based Modelling for Sustainable Development", Venice, Ca' Foscari, April 2-4, 2009.

And the results of the workshop in turn will be fed into subsequent events like:

- “Sustainable Development: A Challenge for European Research”, Brussels, Charlemagne Building, May 26-28, 2009.
- “Web-based Community Climate Policy Models”, Bekkjarvik, Norway, June 22-26, 2009.
- “Dynamics for Policy Making”, London, The House of Lords, July 2, 2009.
- “Summer Institute for Advanced Study of Disaster and Risk”, Beijing Normal University, Academy for Disaster Reduction and Emergency Management, August 2-15, 2009.

For further information see the websites of the organizers.

Agenda

The workshop will be based on two input papers for each topic that are made available to participants on the websites of the organizers (www.irg-project.org & www.globalsystemdynamics.eu).

Monday, May 11

13:30 Registration and Tea/Coffee

14:00 *Introduction*

Welcome by Vice Minister Liu Yanhua, Chinese Ministry of Science and Technology / CNC-IHDP

Welcome by the EU Ambassador to China, Mr. Serge Abou

Welcome by Prof. Shi Peijun, Vice-President of Beijing Normal University, Vice-Dean of the Academy for Disaster Reduction and Emergency Management

Keynote: Complex systems and integrated policies for environmental hazards, Lord Julian Hunt FRS, University College London / Centre for Polar Observation & Modelling

14:45 Presentation round by participants

15:00 *Climate and Energy Security*
Chair: Dr. Qian Ye, IRG-Project Beijing Office, Beijing Normal University and Consortium for Capacity Building, University of Colorado, USA

Huntington, H.G., Brown, S.P.A. (2003) Energy Security and Global Climate Change Mitigation. Stanford Energy Modelling Forum, Occasional Paper 55.
Jochem, E., Jaeger, C. et al. (2008) Investments for a Climate-Friendly Germany. Potsdam, German Federal Ministry for the Environment (BMU).

16:30 Tea/Coffee

17:00 *Financial Crisis*
Chair: Prof. Carlo Jaeger, PIK Potsdam and Beijing Normal University

<u>Input Papers:</u>

Colander, D. et al. (2009) The Financial Crisis and the Systemic Failure of Academic Economics. Kiel Working Paper 1489, Kiel Institute for the World Economy.
Hamilton, J. (2009) Causes and Consequences of the Oil Shock of 2007-08, Brookings Papers on Economic Activities, Conference Draft.

19:00 End of Session

20:00 Workshop Dinner

Tuesday, May 12

09:00 *Natural disasters*
Chair: Prof. Shi Peijun, ADREM, Beijing Normal University

Input Papers:

IRG-Project (2009) Science Plan, ww.irg-project.org
Shi Peijun (2006) Discussion on Establishing an Integrated Risk Information Management Platform. Workshop on International Framework for Development of Disaster Reduction Technology List, Tsukuba, Japan.

10:30 Tea/Coffee

11:00 *Water shortages*
Chair: Prof. Steven Bishop, University College London

Input Papers:

Liu, J., Williams, J.R., Zehnder, A.J.B., Yang, H. (2007) GEPIC – modelling wheat yield and crop water productivity with high resolution on a global scale. Agricultural Systems, 94, 478-493.
Janssen, M.A., Walker, B.H., Langridge, J., Abel, N. (2000) An adaptive agent model for analyzing co-evolution of management and policies in a complex rangeland system. Ecological Modelling, 131, 249–268.

13:00 Lunch

14:00 *Concluding Discussion*
Chair: Prof. Carlo Jaeger

15:30 Closure of workshop