Minisymposium *Global System Dynamics and Policies*

Steven Bishop

University College London, Gower St, London WC1E 6BT, UK

This Mini-Symposium highlighted some of the best ways in which global system dynamics can assist policy makers in industry and government through powerful applications combining many disciplines taken from physical, natural and social sciences. This need for a multi-disciplinary approach has recently been recognised by the European Commission by the funding of a Coordinated Action award called GSD (see www.globalsystemdynamics.eu).

The event was opened by Ralph Dum (GSD's EU Scientific Officer). He explained that there was a considerable interest in seeing how a complex systems approach could be used to improve our understanding when it comes to setting policy.

Under the title Visualising Europe's Future, Jacquie McGlade (Executive Director of the European Environment Agency, EEA) gave an overview of the EEA's findings over recent years. She stated that science needs to provide clear evidence-based hypotheses on how we can tackle some of the local, and increasingly global, challenges. Actions have only just started, and better data and improved methods for data collection are required to monitor effectiveness, which will also help us to account for the respective costs of any such actions. One area where the EEA is at the forefront is monitoring urban development. Better data means that decision makers have more information to inform policy. Visualisation must be used to aid our understanding of the spatial planning throughout Europe.

Julian Hunt (UCL/UK's House of Lords) stated that a systems approach is extremely useful when modelling problems that involve networks of groups which may be operating at different scales but interact at certain points. In particular such an approach can be applied when there is a sudden transition in the network corresponding to a breakdown. Policy makers need to have simulations of models at their fingertips in order to be able to make crucial decisions, often in a very short time frame. The relationship between the speed of operation and the speed in which they respond to external influences is critical to system behaviour. These ideas work well on a conceptual level but clearly need more refinement for specific problems.

A.D. Fitt et al. (eds.), *Progress in Industrial Mathematics at ECMI 2008*,
Mathematics in Industry 15, DOI 10.1007/978-3-642-12110-4_25,

The focus of Klaus Hasselmann's (founding Director, the Max Planck Institute of Meteorology) talk was specifically related to policy for climate change taking into account the key socio-economic aspects. Aspects of globalisation of our businesses and economy must be taken into account when trying to develop truly effective policies. Agent-based models allow the effects of choices made by different actors (e.g. governments) to be explored. A method was presented for constructing computer-efficient coupled climate-socio-economic models. This type of model may not yet be able to be used in a predictive manner but rather as a tool for understanding how the various aspects are inter-related. This has the additional advantage of being simple enough so as to improve the interactions between the policy makers and the scientists.

Bert de Vries (Netherlands Environmental Assessment Agency and Professor of Global Change and Energy at the Copernicus Institute for Sustainable Development and Innovation of Utrecht University) explained that scenarios are a useful way of exploring our increasing complex world, particularly the climate-energy issue. It is clear that opinions and values must be taken into account. Science should offer novel, integrated ways to deal with the sustainable management in social-ecological systems or human-environment systems. Simulation and visualisation methods, such as gaming experiments, must be used to explore situations which, in turn, will improve the interface between scientific insights and uncertainties, on the one hand, and the policy makers and public on the other.

Henri Berestycki (Ecole des Hautes Etudes en Sciences Sociales, Paris and Director of the Centre d'analyse et de Mathématique Sociales of the French CNRS) heads a multidisciplinary team that uses complex systems modelling applied to problems from the social sciences. They apply methods from mathematics, including techniques from nonlinear PDEs and reaction-diffusion equations, and incorporate concepts and methods borrowed from the statistical physics of disordered systems to provide a framework for their studies. He explained that their modelling goals are two-fold. Firstly they seek models that exhibit generic properties, but then they also model specific problems, and confirm results by comparison with empirical data. In the past, efforts have been directed at biodiversity, sustainable development and on how people make a choice under social influence. Here models consider a large number of agents which have to make a binary choice (to buy or not buy) and link/compare this to the usual Nash equilibria when individual choice depends on others choice. However, as is typical of nonlinear systems we now have multiple equilibria. One particular problem discussed was the modelling of crime patterns. This work considers the diffusion of illegal behaviour, the analysis of crime time series, attempting to separate the global trend from local fluctuations.

Carlo Jaeger (PIK and Chair European Climate Forum) gave a stimulating talk based on a single figure of economic and social trends. It was a masterclass in eclectic teaching since several of the points he wished to raise had already been aired in discussions. His approach generally is to try and

promote the development of a model that prevents confusion between the various existing techniques which range from traditional economic equilibrium models to those which consider complex adaptive systems. He has been invited to demonstrate these ideas to German decision makers. However on the day, rather than discussing how any models, no matter which you choose, can be used to model rapid changes in our society or economic growth, we should first use these models to discover why our system remained stable for apparently large portions of time. Only when we can understand this will be able to consider the catalogue of inter-linked actions that lead to major shifts in human socio-economic systems.