The Oil Drum: Europe
DISCUSSIONS ABOUT ENERGY AND OUR FUTURE

Mission Earth

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The seminar **"Mission Earth - Modeling and Simulation for a Sustainable Future"** (http://www.inf.ethz.ch/personal/fcellier/AGS/AGSME_2009.html) was held in Zurich on Jan 26 2009, organized by Francois Cellier and Andreas Fischlin. It was a rare occasion of a truly interdisciplinary meeting where people from different fields of modeling were given a chance to present their work and exchange views. Climate modelers and resource modelers haven't interacted very much, so far; however, resource depletion will surely have a strong effect on the future of earth's climate. While we are still far from integrated world models that take into account all factors, economic as well as environmental, this seminar was a first attempt at understanding what issues are involved.

The "Mission Earth" meeting was about three kinds of models: *climate models, world models,* and *resource exploitation models*.

Climate models are designed to predict the evolution of the earth's climate system, mainly in view of the forcing caused by the emissions of greenhouse gases such as CO2. The results of these models form the basis of the reports periodically published by the international panel on climate change (IPCC). These are very sophisticated models, the result of decades of work by thousands of scientists. The models take into account the physical interactions of the various elements of the atmosphere, geosphere, hydrosphere, etcetera. The latest versions arrive to simulate climate down to the details of single clouds. Normally, the emissions of greenhouse gases from fossil fuels are calculated as a parameter external to the core of the model.

Resource exploitation (or depletion) models are specifically designed to describe the cycle of production of a resource, often a geological one such as crude oil. In their simplest form, these models are very rough: little more than summing up what is believed to be extractable from a geological point of view. More sophisticated models have their ancestor in the well known "Hubbert model", which assumes that the production of the resource will follow a bell shaped curve. Although very simplified, the Hubbert model is robust and has been used for predictions

about production trends which have turned out to be often accurate over a range of several years in the future. The Hubbert curve is, actually, a stripped down version of more complex models of resource exploitation that can be created using system dynamics.

World models put together all parameters, including climate and resources, and try to predict the evolution of the whole world's system, including not only the environment but also the economy, agriculture, pollution, and the human population. The best known of these models is the “World3” model developed by the MIT group of Meadows and based the work of Jay Forrester in the 1960s. The results of the first comprehensive study performed using this model was published in 1972 in the form of the report called “The Limits to Growth”. This model remains in use with some modifications and the latest results of the world simulations were published in 2004 by the same authors of the first report. In this, as in other similar models, the physical elements of the system are defined in terms of “stocks” (e.g. mineral reserves) and much attention is paid on the dynamic evolution of stocks according to a complex system of feedbacks which depend on assumptions on people's behavior (e.g., population growth). Although historically older than climate models, world models are far less sophisticated. That is due to the decline in interest in the 1980s, when these models where subjected to a wave of politically oriented criticism. As a result, funding for this field of research disappeared and, still today, it is extremely difficult to find. At present, the situation appears to be changing, but progress in this field is still slow.

At the meeting in Zurich, we could see how large was the distance, actually a chasm, between climate modelers and world/resource modelers. A climate scientist present at the discussion said that he was quite surprised to hear that energy production was going to peak and decline. He had never heard of such a thing. On the other hand, as a resource modeler, I confess that I was amazed by the level of sophistication reached by climate modelers. I had not even imagined that you could model the world's climate at the level of single clouds!

As you may imagine, the core of the discussion at the "Mission Earth" meeting was on how the dynamic models of resource depletion would affect climate models. As always, a model, no matter how sophisticated, cannot be more reliable than the data it uses in input. You don't have to think that climate modelers are naïve in this respect; on the contrary, the people responsible for the IPCC reports made a considerable effort in describing emission scenarios according to the state of the art data and economic models. The problem is that state of the art models of the economy don't include collapse, whereas that is exactly what world models predict. So, it was Dolores Garcia, independent scientist based in Brighton, who connected the dots with her integrated model. She showed a version of the world3 model that incorporates greenhouse gas emissions. Her results suggest that the concentration of CO_2 might stabilize at around 600 ppm by the end of 21st century - much less than what is the standard result of the models described in the IPCC reports. Qualitatively, these results are similar to those recently reported by De Sousa and Mearns on TOD and to those published by Nel and Cooper in "Energy Policy" (2009).

Obviously, the uncertainty in this kind of estimates is enormous. First, the collapse of the industrial society can't be seen as an actual prediction; it just as a possible scenario, very uncertain both in quantitative terms as in terms of the times involved. Second, collapse – if an when it occurs – will certainly lower CO_2 emissions, but the final CO_2 concentration and its effects on temperature can't be calculated except as a rough approximation. Finally, there is little comfort in knowing that we need an industrial collapse to be saved from a catastrophic global warming. One day, we may develop truly integrated world models where economic and climatic factors are taken into account together at a level of detail comparable to the presently purely climatic models. But we are not there yet. For the time being, we must do with the models we have and use the old principle that says that you can never predict the future exactly and that, therefore, you must always be prepared for the worst.

Personally, I am a fan of simple and robust models, and at the seminar I presented a study in which myself and my coworker Alessandro Lavacchi developed what we call a “mind sized” dynamic model of resource depletion. We hope to be able to place our results on line very soon. The paper by Dolores Garcia should also be on line soon on TOD. I would like to thank Francois Cellier and Andreas Fischlin who did excellent work with this seminar. They should do it again.

References

Nel W. P. and C. J. Cooper, "Implications of fossil fuel constraints on economic growth and global warming", Energy Policy 37, 166 (2009).

Mearns, E.; De Sousa, L. 2008 "Fossil fuel ultimates and CO2 emission scenarios. "The Oil Drum, http://europe.theoildrum.com/node/4807