The future of earth system modelling

Bryant J. McAvaney

Bureau of Meteorology Research Centre[1]

Attempts to construct computer models of the planet we inhabit have been many and varied especially over the past century. Today we are living at a time when modelling the entire earth system is not only scientifically and technically possible but also some large modelling centres have already successfully demonstrated fairly complete earth science modelling systems.

There has always been some uncertainty just what constitutes an "earth system model". There has also always been a hierarchy of models purporting to be "earth system models" often determined by limitations in computing power rather than limitations in imagination as to what should be included. Until now the most prominent earth system models have belonged to the (self termed) class of "earth system models of intermediate complexity" (EMIC). An EMIC attempts to include as many relevant aspects of the physical and biogeochemical system as possible but often does not include details of atmospheric chemistry and seldom includes any aspects of the socio-economic realm. In parallel with the development of EMICs has been the development of higher resolution fully three dimensional models of the earth system that includes fairly complete descriptions of the atmosphere, ocean, cryosphere, lithosphere and biosphere and (more recently) the social sciences. This has been prompted by two intertwined causes, the concern about climate change and its socio-economic impacts policy initiatives on one hand and the rapid rise in computing power on the other.

The amazing progress of the past three years in many modelling centres points to an explosion of activity in the immediate future. This multi-disciplinary, cross-cultural and trans-national activity will require new ways of working, new ways of evaluating complex systems, new paradigms of what constitutes a "good model" and new mathematical forms to describe the potentail self regulation the earth system model. Some modellers of the physical climate system are very vocal in expressing their concern about the inherent multiplication of uncertainty in such an endeavour. However the challenge to undertake the most complex modelling initiative ever attempted has already been taken up.

The current Coordinated Observation and Prediction of the Earth System (COPES) initiative of the World Climate Research Program and the associated Earth Science Systems Partnership between the WCRP, IGBP and UNHDP illustrate just how important Earth System Modelling has become at the level of international scientific coordination level.

The next decade promises to be a very exciting time. It is to be hoped that Australia can contribute.

1 Adjunct Professor in Physical Geography, Macquarie University, Australia.

EDF Chair in Sustainable Development, Ecole Polytechnique, France