Actively build a prototype for a new type of Earth System Model: a Simple Integrated Model or SIM

The aim of a SIM would be to promote learning, interdisciplinary communication and end-user communication. It would not be an accurate predictive or simulation model. It could motivate later development of a more sophisticated integrated model but this would not be the primary goal. The goals would be to help researchers focused on individual components think about questions such as: ‘How would another modelling group use the outputs of your model as inputs?’ and ‘How can you use their outputs as inputs? ‘How do models link?’ ‘What are the really essential aspects of my model for exploring a specific policy question?’

If each very simple component were based on reasonably realistic basic data and parameters, SIMs would allow preliminary explorations of integrated results:
- a. What are important linkages and feedbacks?
- b. Where are non-linearities likely to be important?
- c. What sorts of simulations would be useful for policy making?
- d. When (in policy scenarios) will uncertainty propagate rather than wash out?
- e. What are the really important drivers of uncertainty

Ideally SIMs will be run by different people to explore their potential and compare results.

**Approach**

Each SIM would be targeted at a particular problem rather than trying to meet all needs. A SIM would be much simpler than a model of intermediate complexity. SIMs could be run on a PC with available and simple software (e.g. MATLAB). To reduce data needs they would have low spatial and temporal resolution. To allow multiple researchers to work with them and comment on them, they would be based on common, publicly available datasets. The linkages between components would be minimised and use specific – two input and output variables? This will make the drivers of the simulations transparent. All components may be based on a wider range of underlying data, of which some will be common. Each component would be calibrated to produce ‘reasonable’ results in defined ranges of the input and output variables. The SIMs would have a modular structure so they could use different components from different underlying models as long as the input and output variables are the same.

The complex part of a SIM will be designing a simple integrated structure to address an interesting question and making appropriate simplifications for each component so the components can link and provide useful insight despite the extreme simplicity. This will need to be done collaboratively. It could be done through a series of workshops where the goals would be to:

- a. Identify key input and output variables from each component that are consistent
- b. Define functional forms that adequately represent processes that are critical for the integrated model
c. Discuss the interpretation of SIM results

The figure below gives an indication of how a SIM that considers the effects of policies that internalise the costs of GHG emissions from land use (e.g. an agricultural emissions tax / sequestration reward – but not limited to this) might look. This isn’t fully thought through but is hopefully still helpful. There would be common databases that all three components (land use; climate and policy) would use: e.g. GIS maps of existing land use/cover, geophysical conditions (topography etc.), and climate. The only linkages into the climate model are land use related GHG emissions going in and temperature and precipitation coming out.

Red variables are exogenous starting conditions. Green variables are intermediate and final outputs.