



iGen: An automated generator of simplified models with provable error bounds.

D. Tang and S. Dobbie

School of Earth and Environment, University of Leeds, Leeds, UK.

Climate models employ various simplifying assumptions and parameterisations in order to increase execution speed. However, in order to draw conclusions about the Earth's climate from the results of a climate simulation it is necessary to have information about the error that these assumptions and parameterisations introduce. A novel computer program, called iGen, is being developed which automatically generates fast, simplified models by analysing the source code of a slower, high resolution model. The resulting simplified models have provable bounds on error compared to the high resolution model and execute at speeds that are typically orders of magnitude faster.

iGen's input is a definition of the prognostic variables of the simplified model, a set of bounds on acceptable error and the source code of a model that captures the behaviour of interest. In the case of an atmospheric model, for example, this would be a global cloud resolving model with very high resolution. Although such a model would execute far too slowly to be used directly in a climate model, iGen never executes it. Instead, it converts the code of the resolving model into a mathematical expression which is then symbolically manipulated and approximated to form a simplified expression. This expression is then converted back into a computer program and output as a simplified model. iGen also derives and reports formal bounds on the error of the simplified model compared to the resolving model. These error bounds are always maintained below the user-specified acceptable error.

Results will be presented illustrating the success of iGen's analysis of a number of example models. These extremely encouraging results have led on to work which is currently underway to analyse a cloud resolving model and so produce an efficient parameterisation of moist convection with formally bounded error.