A Hitchhikers Guide to the Black Arts of Earth system modelling

('or why you should not want know what is in a sausage')

AWI 2015

Both the 2-day 'introductory' and 1-day 'advance' courses are based around using and analysing the 'cGENIE' Earth system model (http://www.seao2.info/mycgenie.html). You will be working in groups of 2 (or 3) and will be accessing a computing cluster at the University of Bristol where you will be running the model. You will hence need some means of accessing the remote computer. Unless you are some sort of wizard, I suggest a laptop connected to the internet.

So … the first thing you'll need to do is bring a laptop(!) If everyone brings one each, then in a group of 2 it becomes easier to be managing the model on one laptop and analysing results or displaying instructions/documentation on the other. You'll then need to connect to the internet. (You can see that this course is going to be *hard*!) You'll also need some specific software on your laptop. The exact software will depend on your operating system, but everyone will need:

1. A terminal ('shell') window. This is no problem for linux and Mac users (you already have one built in). For Windows, either download a simple (and old) SSH client (`ssh-client`) from my website (http://www.seao2.info//cgenie/software/ssh-client.exe) or you can get hold of e.g. `PuTTY` (http://www.putty.org/).
2. A sftp (secure file transfer) client for convenience (i.e. dragging and dropping files between local and remote computers, and opening files directly on the remote computer cluster). If you have installed `ssh-client` (Windows, above) then a sftp client is already included as part of this software. If using `PuTTY` (Windows) you might try downloading WinSCP (http://winscp.net/eng/index.php). For the Mac – I am told that `Cyberduck` is OK (there are bound to be many other alternatives). For linux, maybe `FileZilla`.
3. A viewer for netCDF format spatial data. A Java viewer called `Panoply` is provided by NCAR for all platforms – http://www.giss.nasa.gov/tools/panoply/
   (Note that you will need Java installed!)
4. A simple text editor, except not the rubbish default Windows one – you need one that can display unix ASCII text without screwing it up. Options for Windows users are:
   `notepad++` (https://notepad-plus-plus.org/)
   `SciTE` (http://prdownloads.sourceforge.net/scintilla/Sc355.exe)
   (linux and Mac users need no special/different editor compared with your standard editor – everything will display just fine).

One slight caveat with the written instructions that you will be given is that they assume that you will be running Windows and using `ssh-client` (and an old version of `Panoply`). So you'll need to translate the instructions a little depending on your operating system.

If you would like to go ahead and make sure that you have all the necessary software ahead of time – fine, otherwise, we'll make sure everything is set up at the start of the first day.

It is also possible to install and run the 'cGENIE' Earth system model on a linux box (e.g. Ubuntu) or a Mac. Sets of instructions ('Quick-Start Guide') are available on my website: http://www.seao2.info/mycgenie.html

Note that it is not possible at this time to run cGENIE ('muffin' version) under Windows (at least, not without near infinite pain).

Also note that if you have trouble installing and running cGENIE on your own linux box or Mac, there may not be time to sort out the problem (and in any case I have no clue at all about Macs). If so, you'll have to access and run the model remotely. (There are also advantages to running on the remote cluster as you will see in due course.)

Day 1 – Earth system modelling for ‘newbies’

- ***Presentation (am)* – Course and methodology overview**
- ***Session* #0 *(am)* – Getting started**
  Accessing the computing cluster; installing and compiling *c*GENIE; directory structure (‘where everything is’).
  Command-line operation; how to submit jobs to a cluster queue. Use of ‘restart’ experiments and modelling methodologies.
  Visualization of model output: time-series and time-slice (2D and 3D) output.
- ***Session* #1 *(pm)* – A ‘real’(!) experiment**
  Setting up experiments: configuration files and setting parameter values.
  Exploring Earth system dynamics: ‘Snowball Earth’ and climate feedback.
- ***Session* #2 *(pm)* – ‘Poking the climate beast’**
  Applying perturbations and tracing ocean circulation.
  Exploring the stability of the Atlantic meridional overturning circulation (‘AMOC’).

Day 2 – Getting your hands dirty with carbon

- ***Session* #3 *(am)* – Poking the carbon cycle**
  CO_2 emissions and the spatial patterns of ocean acidification.
- ***Session* #4 *(pm)* – Engineering the carbon cycle**
  Sensitivity of atmospheric pCO_2 and ocean acidification to changes in the ocean’s biological pump and ‘weathering’. Ocean carbon cycle geoengineering.

Day 3 [*advanced*] – Models of past and future carbon cycling

- ***Session* #5 *(am)* – Past climates**
  Warm climates of the past. Transient vs. steady states.
- ***Session* #6 *(pm)* – Long-term controls on atmospheric pCO_2**
  Role of deep-sea sediments and the long ‘tail’ of fossil fuel CO_2 release.
  Mechanisms of glacial atmospheric pCO_2.