Instructions for the lab projects

Project 1: How would a poleward shift of the storm tracks affect meridional overturning?

In my folders, this experiment is called `exp01`

Script: `/g/data/hh5/WS2019/vxl581/WS2019_scripts/qsub_raijin_exp01`
Input file required:
`/g/data/hh5/WS2019/vxl581/WS2019_scripts/pre/co2/co2_data.560.18l`
Outputs:
`/g/data/hh5/WS2019/vxl581/exp01/`

To produce a new CO_2 input file
- Copy the folder `$Mk3LHOME/pre/co2/` in your own directory
- load the intel compiler to use the pre-written script:
  `module load intel-fc/17.0.1.132`
- type the following commands (to produce a file for a 560ppm CO_2 concentration):
  `make`
  `./pset –n 18`
  `./radint –c 560`
- Rename the file created named (`co2_data`)
- Move this file in a folder for the modified inputs
- Delete your own copy of the `pre/co2/` folder (for space purposes more than anything).
- Copy the control experiment run script and rename (`qsub_raijin_ctl01`)
- In the run script:
    o Modify the line that copies the co2 input file into the run directory so that the newly created co2 file is copied instead.
    o Change the name of the experiment for the output files name (`run = ctl01`; this goes in the name for the outputs from the atmosphere submodel)
    o Change the name of the experiment for the job submission (`#PBS –N ctl01`)
- Copy the control experiment input script and rename (`input_ctl01`)
- In the input script:
    o Rename the `runtype` for the experiment name (this goes in the name for the outputs from the atmosphere submodel)
- Run the script

Project 2: Could sudden improvements in carbon capture and storage technologies help reset the Earth's climate?

In my folders, this experiment is called `exp02`

Script: `/g/data/hh5/WS2019/vxl581/WS2019_scripts/qsub_raijin_exp02`
Input file required:
`/g/data/hh5/WS2019/vxl581/WS2019_scripts/pre/co2/co2_data.560.18l`
Outputs:
`/g/data/hh5/WS2019/vxl581/exp02/`

To produce a new CO_2 input file
- Copy the folder `$Mk3LHOME/pre/co2/` in your own directory
- load the intel compiler to use the pre-written script:
    `module load intel-fc/17.0.1.132`
- type the following commands (to produce a file for a 560ppm CO_2 concentration):
    `make`
    `./pset -n 18`
    `./radint -c 560`
- Rename the file created named (`co2_data`)
- Move this file in a folder for the modified inputs
- Delete your own copy of the `pre/co2/` folder (for space purposes more than anything).
- Copy the control experiment run script and rename (`qsub_raijin_ctl01`)
- In the run script:
    o Modify the line that copies the co2 input file into the run directory so that the newly created co2 file is copied instead.
    o Change the name of the experiment for the output files name (`run = ctl01`; this goes in the name for the outputs from the atmosphere submodel)
    o Change the name of the experiment for the job submission (`#PBS -N ctl01`)
    o Add a line at the beginning of the while loop (before launching the model) to replace the co2 input file for the standard pre-industrial 280ppm file within the run directory:
`if ($year > 25) cp $Mk3LHOME/core/data/atmosphere/co2/co2_data.280ppm.18l $PBS_JOBFS/co2_data.18l`
- Copy the control experiment input script and rename (`input_ctl01`)
- In the input script:
    o Rename the `runtype` for the experiment name (this goes in the name for the outputs from the atmosphere submodel)
- Run the script

Project 3: Why was the Sahara 'green' during the mid-Holocene?

In my folders, this experiment is called `exp03`

<u>Script</u>: `/g/data/hh5/WS2019/vxl581/WS2019_scripts/qsub_raijin_exp03`
<u>Input file required</u>:
`/g/data/hh5/WS2019/vxl581/WS2019_scripts/pre/co2/co2_data.260.18l`
<u>Outputs</u>:
`/g/data/hh5/WS2019/vxl581/exp03/`

To produce a new CO_2 input file
- Copy the folder `$Mk3LHOME/pre/co2/` in your own directory
- load the intel compiler to use the pre-written script:
  `module load intel-fc/17.0.1.132`
- type the following commands (to produce a file for a 260ppm CO_2 concentration):
  `make`
  `./pset -n 18`
  `./radint -c 260`
- Rename the file created named (`co2_data`)
- Move this file in a folder for the modified inputs
- Delete your own copy of the `pre/co2/` folder (for space purposes more than anything).
- Copy the control experiment run script and rename (`qsub_raijin_ctl01`)
- In the run script:
  - o Modify the line that copies the co2 input file into the run directory so that the newly created co2 file is copied instead.
  - o Change the name of the experiment for the output files name (`run = ctl01`; this goes in the name for the outputs from the atmosphere submodel)
  - o Change the name of the experiment for the job submission (`#PBS -N ctl01`)
- Copy the control experiment input script and rename (`input_ctl01`)
- In the input script:
  - o Rename the `runtype` for the experiment name (this goes in the name for the outputs from the atmosphere submodel)
  - o Change the bpyear value to -6000 (6000 years before present)
- Run the script

Project 4: What are the different changes in north-south transport in the ocean and atmosphere if Greenland melted versus Antarctica?

In my folders, this experiment is called `exp04_A` for the Antarctic ice sheet melting and `exp04_G` for the Greenland ice sheet melting.

Scripts: `/g/data/hh5/WS2019/vxl581/WS2019_scripts/qsub_raijin_exp04_A` and `/g/data/hh5/WS2019/vxl581/WS2019_scripts/qsub_raijin_exp04_G`
Input file required:
`/g/data/hh5/WS2019/vxl581/WS2019_scripts/pre/hosing/hosemask_A`
`/g/data/hh5/WS2019/vxl581/WS2019_scripts/pre/hosing/hosemask_G`
Outputs:
`/g/data/hh5/WS2019/vxl581/exp04_A/`
`/g/data/hh5/WS2019/vxl581/exp04_G/`

To produce a new hosing mask to provide as an input file
- Copy the file `$Mk3LHOME/core/data/atmosphere/hosing/` in your own directory (it is a text file)
- Use `vi` to edit the hosing mask (or `nano` or whichever editor). **All 7 must not be touched**. Where the numbers are 1, freshwater will be added.
    - ○ Antarctica: The default mask provided is setup to add freshwater within the Southern Ocean (SO) all around Antarctica (this was used for the `exp04_A` experiment).
    - ○ Greenland: Replace all the 1 by 0 in the SO. Then replace 0 around Greenland for 1.
    N.B.: There is more than one correct answer on how to define these masks. For example, one might want to focus the hosing to the south of Greenland to be more realistic, or all around as a thought experiment. The same goes for Antarctica, to be more realistic, the hosing could be along iceberg melting tracks (mostly extending northwards east of the peninsula) and near the coast, or all over the SO.
- Rename the files created (e.g. `hosemask_A` and `hosemask_G`)
- Move this file in a folder for the modified inputs
- Copy the control experiment run script and rename (`qsub_raijin_ctl01`)
- In the run script:
    - ○ Add a line before the 'while loop' and after other files are copied which copies the correct hosing mask to the run directory
    - ○ Change the name of the experiment for the output files name (`run = ctl01`; this goes in the name for the outputs from the atmosphere submodel)
    - ○ Change the name of the experiment for the job submission (`#PBS -N ctl01`)
- Copy the control experiment input script and rename (`input_ctl01`)
- In the input script:
    - ○ Rename the `runtype` for the experiment name (this goes in the name for the outputs from the atmosphere submodel)
    - ○ Add these lines under the '&coupling' section:
        ```
        hosing_flag=T
        hosing_rate=1.0
        ```
    These tells the model to look for a hosing mask and hose accordingly and to hose at a rate of 1Sv.
- Run the script

Project 5: Could the climate effects of increasing CO₂ emissions be offset by the Earth's surface reflecting more sunlight?

In my folders, this experiment is called `exp05_1` for double CO2 experiment and `exp05_2` for land's reflection experiment

<u>Script</u>: `/g/data/hh5/WS2019/vxl581/WS2019_scripts/qsub_raijin_exp05_1`
and `/g/data/hh5/WS2019/vxl581/WS2019_scripts/qsub_raijin_exp05_2`
<u>Input file required:</u>
`/g/data/hh5/WS2019/vxl581/WS2019_scripts/pre/co2/co2_data.560.18l`
`/g/data/hh5/WS2019/vxl581/WS2019_scripts/pre/albedo/albedo1.nc`
<u>Outputs:</u>
`/g/data/hh5/WS2019/vxl581/exp05_1/`
`/g/data/hh5/WS2019/vxl581/exp05_2/`

To produce a new CO₂ input file
- Copy the folder `$Mk3LHOME/pre/co2/` in your own directory
- load the intel compiler to use the pre-written script:
    `module load intel-fc/17.0.1.132`
- type the following commands (to produce a file for a 560ppm CO₂ concentration):
    `make`
    `./pset -n 18`
    `./radint -c 560`
- Rename the file created named (`co2_data`)
- Move this file in a folder for the modified inputs
- Delete your own copy of the `pre/co2/` folder (for space purposes more than anything).
- Copy the vegetation type mask
    `$Mk3LHOME/core/data/atmosphere/basic/albedo.nc`
- Use matlab or python to replace all the grid cell with an albedo lesser than 0.999 for 0.999 (or use my code
    `/g/data/hh5/WS2019/vxl581/WS2019_scripts/code/AdjustAlbedo.m`)
- Copy the control experiment run script and rename (`qsub_raijin_ctl01`)
- In the run script, for `exp05_1`:
    o Modify the line that copies the co2 input file into the run directory so that the newly created co2 file is copied instead.
    o Change the name of the experiment for the output files name (`run = ctl01`; this goes in the name for the outputs from the atmosphere submodel)
    o Change the name of the experiment for the job submission (`#PBS -N ctl01`)
- In the run script, for `exp05_2`:
    o Add a line before the 'while loop' and after the `/atmosphere/basic/` files are copied which copies the correct albedo mask to the run directory.
    o Change the name of the experiment for the output files name (`run = ctl01`; this goes in the name for the outputs from the atmosphere submodel)
    o Change the name of the experiment for the job submission (`#PBS -N ctl01`)
- Copy the control experiment input script and rename (`input_ctl01`)
- In the input script:
    o Rename the `runtype` for the experiment name (this goes in the name for the outputs from the atmosphere submodel)
- Run the script

Project 6: What is the impact on regional climate if the Amazon was completely forested versus completely deforested and in worlds with and without global warming?

In my folders, this experiment is called `exp06`

<u>Script</u>: `/g/data/hh5/WS2019/vxl581/WS2019_scripts/qsub_raijin_exp06`
<u>Input file required</u>:
`/g/data/hh5/WS2019/vxl581/WS2019_scripts/pre/veg/sibvegtA.nc`
<u>Outputs</u>:
`/g/data/hh5/WS2019/vxl581/exp06/`

- Copy the vegetation type mask
  `$Mk3LHOME/core/data/atmosphere/basic/sibvegt.nc`
- Use matlab or python to select the grid cells between the longitude indexes 51 and 60 and the latitude indexes between 20 and 35 that are equal to 1 (that's the Amazon) and replace by 7 (grass). Vegetation types:

1	Broadleaf evergreen trees (tropical forest)
2	Broadleaf deciduous trees
3	Broadleaf and needleleaf trees
4	Needleleaf evergreen trees
5	Needleleaf deciduous trees
6	Broadleaf trees with ground cover (savannah)
7	Groundcover only (perennial)
8	Broadleaf shrubs with groundcover
9	Broadleaf shrubs with bare soil
10	Dwarf trees and shrubs with groundcover
11	Bare soil
12	Winter wheat and broadleaf deciduous trees
13	Perpetual ice

  (or use my code
  `/g/data/hh5/WS2019/vxl581/WS2019_scripts/code/AdjustVeg.m`)
- Copy the control experiment run script and rename (`qsub_raijin_ctl01`)
- In the run script:
    o Add a line before the 'while loop' and after the `/atmosphere/basic/` files are copied which copies the correct vegetation mask to the run directory.
    o Change the name of the experiment for the output files name (`run = ctl01`; this goes in the name for the outputs from the atmosphere submodel)
    o Change the name of the experiment for the job submission (`#PBS -N ctl01`)
- Copy the control experiment input script and rename (`input_ctl01`)
- In the input script:
    o Rename the `runtype` for the experiment name (this goes in the name for the outputs from the atmosphere submodel)
- Run the script