**Run Multiple GCAM Scenarios in Parallel**

This tutorial is intended to familiarize you with configuring and running multiple GCAM scenarios at the same time on HTCondor.

Similar to running a single GCAM scenario on the cluster, you will need the following items:

* **Compressed configuration files:** This single file ending in *tar.gz* contains modified GCAM configuration files for all scenarios you wish to run. A description of important files can be found below:

Diagram

Description automatically generated

* **Shell scripts:** You must have one shell script per scenario (see above). These scripts ending in *.sh* contain all of the commands that will move the configuration files in your *tar.gz* file to their designated locations within GCAM, run GCAM, and then create and send an output *tar.gz* file back to your home directory on your designated submit server.

* **Submit file:** This file ending in *.sub* contains information regarding the file names, object locations, and computing space required for each scenario you wish to run. Different from a single scenario, the submit file for multiple scenarios contains variables denoted by $(variable). These variables are summoned from the text file and correspond to the unique scenarios you wish to run. The *.sub* file is submitted to HTCondor using the command condor\_submit <file name>.sub. A description of the example submit file can be found below:

Diagram

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* **Text file:** This file ending in *.txt* contains a list of variables that correspond to the unique scenarios you wish to run. Variables are listed one item per line for as many lines as you need. The *queue* function will summon these variables one at a time and run each scenario on a HTCondor machine as they become available. A preview of the example text file can be found below:

A picture containing text

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**Step 1. Log into your designated CHTC submit server.** Use the ssh command to log into your submit server. If you are not on the UW-Madison network, make sure you have activated your VPN.

**Step 2. Transfer your tar.gz file, all relevant shell (.sh) scripts, your submit (.sub) file, and your text (.txt) file from your personal computer to your submit server.** Use the [Cyberduck GUI](https://cyberduck.io/) or the sftp/scp process via the command line to transfer your input files from your personal computer to your home directory (e.g. /home/bbadger) on your designated CHTC submit server.

**Step 3. Submit your run to HTCondor.** Use the condor\_submit <file name>.sub command to submit only your *.sub* file to HTCondor. This file will summon your configuration *tar.gz* file and shell scripts from your home directory as needed.

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**Step 4. Check your runs periodically.** You can monitor the progress of your jobsby typing the command condor\_q into the command line. Upon submitting your request, you will be notified which cluster your runs were submitted to and receive a unique job ID for each scenario. The condor\_q queue shows the job ID, submission date/time, and run status for each submission you make in chronological order. In the case of multiple scenarios, HTCondor will assign each scenario within your submission a unique job ID using decimals (see below).

Your jobs will begin in *IDLE* and then transition to *RUN*. This process typically takes less than five minutes, but depends on the computing space required for your runs and overall demand on the cluster. After your jobs transition to *RUN*, it may take 1-2 hours for the reference scenario to reach the *DONE* status and up to 7 hours for the policy scenario to reach the *DONE* status.

A screenshot of a computer

Description automatically generated with medium confidence

**Step 5. Your output *tar.gz* files will appear in the home directory of your submit server.** As your jobs finish, they will transition one at a time from *RUN* to *DONE* in condor\_q and an output *tar.gz* file will appear in the home directory of your designated CHTC submit server, along with:

* a *docker\_stderror* file (useful for checking errors with the Docker)
* an *interactive.log* file (useful for checking errors with the GCAM run)
* a *.err* file (log of any errors that occurred during the run)
* a *.out* file (log of output that would be printed in the terminal window when run on your personal computer)

A screenshot of a computer

Description automatically generated with medium confidence

**Step 6. Transfer the output to your personal computer.** Transfer all of the output *tar.gz* files from your CHTC submit server to your personal computer by using the [Cyberduck GUI](https://cyberduck.io/) or the sftp/scp process via the command line.

**Step 7. Un-tar the output files and view their contents.** On your personal computer, navigate to the location where you downloaded the output *tar.gz* files. Un-tar the output files by double-clicking on each file in your file browser or by typing tar -zxvf <file name>.tar.gz into the command line for each output file. Each folder should include:

* an output *database\_basexdb* that you can view in ModelInterface
* a *main\_log.txt* file that gives a detailed log of the model run process
* an *output.csv* file containing your desired queries

**Step 8. Check the log files for errors.** To ensure that your GCAM scenarios have run successfully, open each of your *main\_log.txt* files in a text editor such as [Sublime Text](https://www.sublimetext.com/). At the bottom of the file there is a summary of the run, detailing the run times of various processes and any errors that occurred. The second line of this segment of code should read: *All model periods solved correctly.*