**Installing CliMT**

Create and activate a Python 3.6 env in conda ([Managing environments — conda documentation](https://docs.conda.io/projects/conda/en/latest/user-guide/tasks/manage-environments.html))

* conda create -n climt\_env python=3.6
* conda activate climt\_env

(Get miniconda if not already installed

[Installing Miniconda - Anaconda](https://www.anaconda.com/docs/getting-started/miniconda/install#linux))

Download and install the heatwave\_sampling branch of Ai33L/climt

* git clone <https://github.com/Ai33L/climt.git> -b heatwave\_sampling
* cd climt
* pip install -r requirements\_dev.txt
* sudo apt-get install -y gcc g++
* sudo apt-get install -y gfortran-9 gfortran
* python setup.py develop
* pip install numba matplotlib

**PARAM installation**

Conda is already available on PARAM. Sudo rights are not available, however the packages that need sudo rights (gcc, g++ and gfortran) are already installed.

* source /home/apps/DL-conda/bin/activate
* conda create -n climt\_env python=3.6
* conda activate climt\_env

Change directory to where you wish to install climt, e.g the home directory

* git clone https://github.com/Ai33L/climt.git -b heatwave\_sampling
* cd climt
* pip install -r requirements\_dev.txt
* In climt/climt/\_lib/Makefile, under libopenblas.a → change FC=gfortran-9 to be FC=gfortran
* python setup.py develop
* pip install numba matplotlib zarr

Possible issues

* No such file or directory: 'make': 'make' → sudo apt-get install make

**Next steps**

From the climt\_env environment, run climt\_test.py

* python climt\_test.py → should output numbers 1-30 and finish running in a few seconds
* This ensures that climt has been installed properly!

Run climt\_run.py (expected runtime : ~3 mins)

* pip install zarr (data storage module)
* Download and place the file ‘spinup\_3yr’ in the same directory → the model loads from this state
* python climt\_run.py → runs the model for 10 days and saves daily data to folder called ‘climt\_run’
* Note : If the code cannot find spinup\_3yr, provide full path to this file in line 56 of the climt\_run.py code
* Note: Instead of providing the full path of the file in line 56. Just change the name from ‘spinup\_3yr’ to ‘spinup\_3yr.gz’. This seems to have helped in my case.

**First objective**

Understanding how climt\_run.py works

* Lines 36 - 56 → creating the model using climt and loading the state from file
* Lines 90-125 → running the model and storing data to file

Run open\_data.py to load, print and plot this data

In short, get familiarised with the code! The 1000 year run is just a scaled-up version of climt\_run.py.

**Spinup and Climatology**

See init\_and\_clim.py

* Very similar to the climt\_run code
* The purpose of init\_and\_clim.py is to create the same model as in climt\_run.py, and spin it up to equilibrium (This was the code that generated spinup\_3yr).
* After spinup, the model is run further to calculate climatologies.
* The spinup time can be set in line 76 and the climatology period can be set at line 88 (both are set to one year for now).
* Run this code for small spin up and climatology periods first! Setting spinup time to 3 yrs and climatology period of 30 years will take around 3-4 days of runtime (iirc). So convince yourselves that the code and output works correctly before doing this run ;)
* This code should output two files : a spinup file and a climatology file.

Changing model configurations

* The model has two parameters that can be configured, (a) soil\_conf and (b) rad\_conf. The baseline model has soil\_conf=0.7 and rad\_conf=6
* Soil conf is the factor by which land surface relative humidity is scaled over land. The value of 0.7 sets land relative humidity to be 70% of the specific relative humidity. Setting a lower value for this parameter makes the land surface drier.
* Rad\_conf is the optical depth of the atmosphere at the equator. Setting a higher value of rad\_conf makes the atmosphere absorb more outgoing radiation, warming the model atmosphere.
* From my experiments, lowering soil\_conf from 0.7 to 0.33 (or) increasing rad\_conf from 6 to 6.75 warms all land (between 20 and 60 degrees, both hemispheres) by around 3 degrees. You can verify this - change one parameter at a time!

**Data saving**

For a guide on how to convert climt dictionaries to xarray datasets, see the folder ‘data saving’

* The guide is in the form of a jupyter notebook, with an accompanying climt\_dict file
* Download both to the local system where climt\_env exists
* Install jupyter notebook if not already installed
* Add climt\_env to jupyter notebook as a kernel ([How to add your Conda environment to your jupyter notebook](https://medium.com/@nrk25693/how-to-add-your-conda-environment-to-your-jupyter-notebook-in-just-4-steps-abeab8b8d084))

**Heatwave analysis**

Code for heatwave sampling and analysis can be found in the folder ‘heatwave analysis’, along with an accompanying ‘guide’ file.