# MOCABORS site simulations in CLM5

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*Model: CLM5*
*Machine: FRAM*
*See separate document for the details of experimental design*

This is the protocol for CLM5 simulations. Follow this protocol line by line to replicate the MOCABORS site simulations.

## Making surface dataset

### Follow the script line by line

csh  #**Need to do this because the commands are in csh.**

#!/bin/csh

module load HDF5/1.8.18-intel-2017a
module load NCL/6.4.0-intel-2017a
module load NCO/4.6.6-intel-2017a
module load ESMF/6.3.0rp1-intel-2017a-HDF5-1.8.18
module load netCDF/4.4.1.1-intel-2017a-HDF5-1.8.18

##modules must be loaded by this sequence (NCL, NCO, then ESMF), or there will be incompatibility issue.

setenv ESMFBIN_PATH /cluster/software/ESMF/6.3.0rp1-intel-2017a-HDF5-1.8.18/bin

setenv CSMDATA /cluster/shared/noresm/inputdata
setenv GRIDNAME 1x1_"Sitename"
setenv CDATE `date +%y%m%d`
./mknoocnmap.pl -p "LAT,LON" -n $GRIDNAME

setenv MAPFILE `pwd`/map_${GRIDNAME}_noocean_to_${GRIDNAME}_nomask_aave_da_${CDATE}.nc
setenv GRIDFILE ../mkmapgrids/SCRIPgrid_${GRIDNAME}_nomask_c${CDATE}.nc
nohup ./mkmapdata.sh -r $GRIDNAME -f $GRIDFILE -t regional > & site_name.out&

#**nohup allows to close the popup and '> & site_name.out&' will allow output.**
#**When the \*HYDRO\* files are made, it is finished.**

#The directory path may be different between CLM in NorESM and CLM in CTSM. Be careful.
cd ../../../../cime/tools/mapping/gen_domain_files/

setenv OCNDOM domain.ocn_noocean.nc
setenv ATMDOM domain.lnd.{$GRIDNAME}_noocean.nc

setenv INC_NETCDF /cluster/software/netCDF/4.4.1.1-intel-2017a-HDF5-1.8.18/include
setenv LIB_NETCDF /cluster/software/netCDF/4.4.1.1-intel-2017a-HDF5-1.8.18/lib64

./gen_domain -m $MAPFILE -o $OCNDOM -l $ATMDOM

#**Now the domain files are made**

cd ../../../../components/clm/tools/mksurfdata_map/

**#Before executing mksurfdata.pl, check the directory. Sometimes they are written for the NCAR machine. In fram, our shared input files are in /cluster/share/noresm/inputdata. Also, the number of pfts have been modified from 78 to 16. Do this in all files (mksurfdata_map.namelist and mksurfdata.pl).**

./mksurfdata.pl -r usrspec -usr_gname $GRIDNAME -usr_gdate $CDATE

**#Next step is to extract forcing data. We use cruncep data. The data are extracted to /cluster/shared/noresm/lnd_inputdata/1x1_Hurdal/atm/datm7/atm_forcing.datm7.cruncep_qianFill.0.5d.v7.c160715/ Originally, they are in /cluster/shared/noresm/inputdata/atm/datm7/atm_forcing.datm7.cruncep_qianFill.0.5d.v7.c160715/ Use Lei's ncl script to extract the forcing data.**

**#Creating a new case for the spinup. The spinup will be in two parts: 1) 1000yr spinup 2) 200yr additional spinup. The reason for this is to build up soil C under the pre-industrial condition. It needs to start with 'cold start', 'accelerated spinup' on and arbitrary initial conditions (no finidat). Loop over 1901-1920 with aerosol clim_1850.**

**Accelerated spinup**

./create_newcase --machine fram --case ../../cases/1x1_Hurdal_AD_spinup --res CLM_USRDAT --compset I2000Clm50BgcCruGs --run-unsupported --project nn9560k
**#The compset has to be I2000Clm50BgcCruGs because pt simulations cannot support CISM.**

setenv MYCSMDATA /cluster/shared/noresm/inputdata
setenv GRIDNAME 1x1_{sitename}
setenv GENDOM_PATH $USERWORK/cases/CLM1PT/1x1_{sitename}
setenv OCNDOM domain.ocn_{$GRIDNAME}.nc
setenv ATMDOM domain.lnd.{$GRIDNAME}.nc

./xmlchange DIN_LOC_ROOT=$MYCSMDATA
./xmlchange DIN_LOC_ROOT_CLMFORC=/cluster/shared/noresm/inputdata/atm/datm7
./xmlchange ATM_DOMAIN_PATH=$GENDOM_PATH,LND_DOMAIN_PATH=$GENDOM_PATH
./xmlchange ATM_DOMAIN_FILE=$ATMDOM,LND_DOMAIN_FILE=$ATMDOM
./xmlchange CLM_USRDAT_NAME=$GRIDNAME
./xmlchange CALENDAR=NO_LEAP
./xmlchange STOP_OPTION=nyears,STOP_DATE=10010101,STOP_N=1000
./xmlchange DATM_PRESAERO=clim_1850
./xmlchange CLM_NML_USE_CASE=1850_control
./xmlchange RUN_STARTDATE=0001-01-01
./xmlchange DATM_CLMNCEP_YR_ALIGN=1901
./xmlchange DATM_CLMNCEP_YR_START=1901
./xmlchange DATM_CLMNCEP_YR_END=1920
./xmlchange CLM_ACCELERATED_SPINUP="on" <-This allows for accelerated spinup for the first 1000 years.
./xmlchange CLM_FORCE_COLDSTART="on"
./xmlchange PTS_MODE="TRUE"
./xmlchange PTS_LAT="60.3"
./xmlchange PTS_LON="11.0"
./xmlchange MOSART_SIMYR="1850"
./xmlchange CCSM_CO2_PPMV="284.7"

./case.setup

```
sed -i "s/00:59:00/09:59:00/g" env_batch.xml
```
**copy #SBATCH  --qos=preproc to .case.run**

```
cat <<EOF>user_nl_clm
create_crop_landunit = .TRUE.
init_interp_fill_missing_with_natveg = .true.
fsurdat =
'/cluster/work/users/hannalee/CLM1PT/1x1_Hurdal/surfdata/surfdata_1x1_Hurdal_16pfts_Irrig_CMIP6_sim
yr1850_c190122.nc'
paramfile = '/cluster/projects/nn2345k/site_simulations/site_inputdata/lnd/clm2/pftdata/
clm5_params.c171017.nc'
hist_nhtfrq = -8760 !ths allows output file to be every 20 years
EOF

cat <<EOF>user_nl_datm
 dtlimit = 1.5,1.5,1.5
 fillalgo = 'nn','nn','nn'
 fillmask = 'nomask','nomask','nomask'
 mapalgo = 'nn','nn','nn'
 mapmask = 'nomask','nomask','nomask'
 streams = 'datm.streams.txt.1x1_Hurdal.Solar 1901 1901 1920',
        'datm.streams.txt.1x1_Hurdal.Precip 1901 1901 1920',
        'datm.streams.txt.1x1_Hurdal.TPQW 1901 1901 1920'
 taxmode = 'cycle','cycle','cycle'
 tintalgo = 'coszen','nearest','linear'

EOF

./case.build
```

**#Need to create datm.streams.txt.1x1_Hurdal.XXX files and copy them into the run directory.**

```
./case.submit
```

**#There was a problem resubmitting the case. Alok had to change something** in
/cluster/work/users/hannalee/noresm2_clm5_0_01/components/clm/src/main/ncdio_pio.F90.in
See line 2435
```
          count(2) = size(data,dim=2)  !Alok: problem with switching dimension
          if (present(switchdim)) count(2) = size(temp,dim=2) !Alok: problem with switching dimension
```

**Final spinup**

**#Now make a new case and do 200 yr spinup. Note: accelerated spinup off, cold start off but other
conditions are the same. Need to set finidat at user_nl_clm.**

```
./create_newcase --machine fram --case ../../cases/1x1_Hurdal_final_spinup --res CLM_USRDAT --compset
I2000Clm50BgcCruGs --run-unsupported --project nn9560k

setenv MYCSMDATA /cluster/shared/noresm/inputdata
setenv GRIDNAME 1x1_Hurdal
setenv GENDOM_PATH $USERWORK/cases/CLM1PT/1x1_Hurdal
setenv OCNDOM domain.ocn_{$GRIDNAME}.nc
setenv ATMDOM domain.lnd.{$GRIDNAME}.nc

./xmlchange RUN_TYPE=hybrid
```

```
./xmlchange RUN_REFCASE=1x1_Hurdal_AD_spinup
./xmlchange DIN_LOC_ROOT=$MYCSMDATA
./xmlchange DIN_LOC_ROOT_CLMFORC=/cluster/shared/noresm/inputdata/atm/datm7
./xmlchange ATM_DOMAIN_PATH=$GENDOM_PATH,LND_DOMAIN_PATH=$GENDOM_PATH
./xmlchange ATM_DOMAIN_FILE=$ATMDOM,LND_DOMAIN_FILE=$ATMDOM
./xmlchange CLM_USRDAT_NAME=$GRIDNAME
./xmlchange CALENDAR=NO_LEAP
./xmlchange STOP_OPTION=nyears,STOP_N=200
./xmlchange RUN_REFDATE=1001-01-01
./xmlchange DATM_CLMNCEP_YR_ALIGN=1901
./xmlchange DATM_CLMNCEP_YR_START=1901
./xmlchange DATM_CLMNCEP_YR_END=1920
./xmlchange DATM_PRESAERO=clim_1850
./xmlchange CLM_NML_USE_CASE=1850_control
./xmlchange RUN_STARTDATE=0001-01-01
./xmlchange DATM_CLMNCEP_YR_ALIGN=1901
./xmlchange DATM_CLMNCEP_YR_START=1901
./xmlchange DATM_CLMNCEP_YR_END=1920
./xmlchange PTS_MODE="TRUE"
./xmlchange PTS_LAT="60.3"
./xmlchange PTS_LON="11.0"
./xmlchange MOSART_SIMYR=1850
./xmlchange CCSM_CO2_PPMV=284.7

#user_nl_clm
create_crop_landunit = .TRUE.
init_interp_fill_missing_with_natveg = .true.
finidat =
'/cluster/work/users/hannalee/noresm/1x1_Hurdal_final_spinup/run/1x1_Hurdal_AD_spinup.clm2.r.1001-
01-01-00000.nc'
fsurdat =
'/cluster/work/users/hannalee/cases/CLM1PT/1x1_Hurdal/surfdata/surfdata_1x1_Hurdal_16pfts_Irrig_CMIP
6_simyr1850_c190122.nc'
paramfile = '/cluster/projects/nn2345k/site_simulations/site_inputdata/lnd/clm2/pftdata/
clm5_params.c171017.nc'
hist_nhtfrq = -8760

sed -i "s/00:59:00/02:59:00/g" env_batch.xml
```
**copy #SBATCH  --qos=preproc to .case.run**

**#Need to add this line in .case.run #SBATCH  --qos=preproc**

**#Need to copy files from 1x1_Hurdal_AD_spinup/run to 1x1_Hurdal_final_spinup/run**
rpointer files
stream files
restart files


**Transient simulations**

```
./create_newcase --machine fram --case ../../cases/1x1_Hurdal_hist --res CLM_USRDAT --compset
I2000Clm50BgcCruGs --run-unsupported --project nn9560k

setenv MYCSMDATA /cluster/shared/noresm/inputdata
setenv GRIDNAME 1x1_{sitename}
setenv GENDOM_PATH $USERWORK/cases/CLM1PT/1x1_{sitename}
```

```
setenv OCNDOM domain.ocn_{$GRIDNAME}.nc
setenv ATMDOM domain.lnd.{$GRIDNAME}.nc

./xmlchange DIN_LOC_ROOT=$MYCSMDATA
./xmlchange DIN_LOC_ROOT_CLMFORC=/cluster/shared/noresm/inputdata/atm/datm7
./xmlchange ATM_DOMAIN_PATH=$GENDOM_PATH,LND_DOMAIN_PATH=$GENDOM_PATH
./xmlchange ATM_DOMAIN_FILE=$ATMDOM,LND_DOMAIN_FILE=$ATMDOM
./xmlchange CLM_USRDAT_NAME=$GRIDNAME
./xmlchange CALENDAR=NO_LEAP
./xmlchange CCSM_BGC=CO2A,CLM_CO2_TYPE=diagnostic,DATM_PRESAERO=trans_1850-2000
./xmlchange STOP_N=100,STOP_OPTION=nyears,RUN_STARTDATE=1901-01-01
./xmlchange RUN_TYPE=hybrid,RUN_REFCASE=1x1_Hurdal_final_spinup,RUN_REFDATE=0201-01-01
./xmlchange DATM_CO2_TSERIES=20tr
./xmlchange DATM_CLMNCEP_YR_ALIGN=1901
./xmlchange DATM_CLMNCEP_YR_START=1901
./xmlchange DATM_CLMNCEP_YR_END=2000
./xmlchange PTS_MODE="TRUE"
./xmlchange PTS_LAT="60.3"
./xmlchange PTS_LON="11.0"

./case.setup


sed -i "s/00:59:00/02:59:00/g" env_batch.xml
```

**copy #SBATCH  --qos=preproc to .case.run**

```
#user_nl_clm
create_crop_landunit = .TRUE.
init_interp_fill_missing_with_natveg = .true.
finidat = '/cluster/work/users/hannalee/noresm/1x1_Hurdal_hist/run/1x1_Hurdal_final_spinup.clm2.r.0201-01-01-00000.nc'
fsurdat =
'/cluster/work/users/hannalee/cases/CLM1PT/1x1_Hurdal/surfdata/surfdata_1x1_Hurdal_16pfts_Irrig_CMIP6_simyr1850_c190122.nc'
paramfile = '/cluster/projects/nn2345k/site_simulations/site_inputdata/lnd/clm2/pftdata/
clm5_params.c171017.nc'

#user_nl_datm
 dtlimit = 1.5,1.5,1.5,1.5,1.5
 fillalgo = 'nn','nn','nn','nn','nn','nn'
 fillmask = 'nomask','nomask','nomask','nomask','nomask','nomask'
 mapalgo = 'nn','nn','nn','nn','nn','nn'
 mapmask = 'nomask','nomask','nomask','nomask','nomask','nomask'
 streams = 'datm.streams.txt.1x1_Hurdal.Solar 1901 1901 2000',
       'datm.streams.txt.1x1_Hurdal.Precip 1901 1901 2000',
       'datm.streams.txt.1x1_Hurdal.TPQW 1901 1901 2000',
       'datm.streams.txt.presaero.trans_1850-2000 1849 1849 2006',
       'datm.streams.txt.topo.observed 1 1 1',
       'datm.streams.txt.co2tseries 1860 1860 2015'
 taxmode = 'cycle','cycle','cycle','cycle','cycle','cycle'
 tintalgo = 'coszen','nearest','linear','linear','lower','linear'

./case.build
```

**#Need to add this line in .case.run #SBATCH  --qos=preproc**

**#Need to copy files from 1x1_Hurdal_final_spinup/run to 1x1_Hurdal_hist/run**
rpointer files
stream files
make datm.streams.txt.co2tseries.20tr to datm.streams.txt.co2tseries
restart files
Make sure the surface datasets are in the directory designated in fsurdat.

**Note: There was a problem with column number mismatch. This was because the column number for fsurdat for 1850 and 2000 were different in one of the points. For transient simulation, this has to be 1850 and even for the scenario simulations. The only time 2000 file is used is when conducting current day simulation only.**

**\*Note2: For some reason, the forcing data can only be 100 years. So the simulation until 2005 should be split into two simulations. First run 100yrs and submit again to make it 2005. The RCP simulations start from 2006. Remember to set the dates in the usr_nl_datm for only for the years simulating.**

./xmlchange RUN_STARTDATE=2001-01-01
./xmlchange STOP_N=5
./xmlchange DATM_CLMNCEP_YR_ALIGN=2001
./xmlchange DATM_CLMNCEP_YR_START=2001
./xmlchange DATM_CLMNCEP_YR_END=2005
Change years to 2001 and 2005 in user_nl_datm

**Future simulations**

./create_newcase --machine fram --case ../../cases/1x1_Hurdal_rcp85 --res CLM_USRDAT --compset I2000Clm50BgcCruGs --run-unsupported --project nn9560k

setenv MYCSMDATA /cluster/shared/noresm/inputdata
setenv GRIDNAME 1x1_Hurdal
setenv GENDOM_PATH $USERWORK/CLM1PT/1x1_Hurdal
setenv OCNDOM domain.ocn_{$GRIDNAME}.nc
setenv ATMDOM domain.lnd.{$GRIDNAME}.nc

./xmlchange DIN_LOC_ROOT=$MYCSMDATA
./xmlchange DIN_LOC_ROOT_CLMFORC=/cluster/shared/noresm/inputdata/atm/datm7
./xmlchange ATM_DOMAIN_PATH=$GENDOM_PATH,LND_DOMAIN_PATH=$GENDOM_PATH
./xmlchange ATM_DOMAIN_FILE=$ATMDOM,LND_DOMAIN_FILE=$ATMDOM
./xmlchange CLM_USRDAT_NAME=$GRIDNAME
./xmlchange CALENDAR=NO_LEAP
./xmlchange task_count=1
./xmlchange STOP_N=95, STOP_OPTION=nyears
./xmlchange DATM_PRESAERO=rcp8.5
./xmlchange DATM_CO2_TSERIES=rcp8.5
./xmlchange RUN_STARTDATE=2006-01-01
./xmlchange DATM_CLMNCEP_YR_ALIGN=2006
./xmlchange DATM_CLMNCEP_YR_START=1982
./xmlchange DATM_CLMNCEP_YR_END=2005

./xmlchange RUN_TYPE=hybrid,RUN_REFCASE=1x1_Hurdal_hist,RUN_REFDATE=2006-01-01,GET_REFCASE=FALSE

./case.setup

user_nl_datm
 dtlimit = 1.5,1.5,1.5

```
 fillalgo = 'nn','nn','nn'
 fillmask = 'nomask','nomask','nomask'
 mapalgo = 'nn','nn','nn'
 mapmask = 'nomask','nomask','nomask'
 streams = 'datm.streams.txt.1x1_Hurdal.Solar 2006 1982 2005',
        'datm.streams.txt.1x1_Hurdal.Precip 2006 1982 2005',
        'datm.streams.txt.1x1_Hurdal.TPQW 2006 1982 2005'
 taxmode = 'cycle','cycle','cycle'
 tintalgo = 'coszen','nearest','linear'
 anomaly_forcing = 'Anomaly.Forcing.Precip',
               'Anomaly.Forcing.Temperature',
                              'Anomaly.Forcing.Pressure',
                              'Anomaly.Forcing.Humidity',
              'Anomaly.Forcing.Uwind',
                              'Anomaly.Forcing.Vwind',
                              'Anomaly.Forcing.Shortwave',
                              'Anomaly.Forcing.Longwave'


user_nl_clm
create_crop_landunit = .TRUE.
init_interp_fill_missing_with_natveg = .true.
finidat = '/cluster/work/users/hannalee/noresm/1x1_Hurdal_rcp85/run/1x1_Hurdal_hist.clm2.r.2006-01-01-
00000.nc'
fsurdat =
'/cluster/work/users/hannalee/cases/CLM1PT/1x1_Hurdal/surfdata/surfdata_1x1_Hurdal_16pfts_Irrig_CMIP
6_simyr1850_c190122.nc'
paramfile = '/cluster/projects/nn2345k/site_simulations/site_inputdata/lnd/clm2/pftdata/
clm5_params.c171017.nc'

./case.build
```

**#Need to add this line in .case.run #SBATCH  --qos=preproc**

**#Need to copy files from 1x1_Hurdal_hist/run to 1x1_Hurdal_rcp85/run**
rpointer files
stream files
make datm.streams.txt.co2tseries.rcp85 to datm.streams.txt.co2tseries
restart files
Make sure the surface datasets are in the directory designated in fsurdat.


<span style="color:red">**copy #SBATCH  --qos=preproc to .case.run**</span>

<span style="color:red">**Very important!**</span>
<span style="color:red">**Need to change 'cime/src/components/data_comps/datm/cime_config/namelist_definition_datm.xml'**</span>
<span style="color:red">**L1631-1638 Anomaly.Forcing to rcp85. The default is rcp45.**</span>
<span style="color:red">**Need to change this every time the scenario changes.**</span>


**Error log**

**Resubmit doesn't work**
/noresm-dev-clm5_0_012/components/clm/src/main/ncdio_pio.F90.in
in subroutine
subroutine ncd_io_2d_{TYPE} around line 1789
and add line
if(present(switchdim)) count(2) = size(data,dim=1)
just after

count(2) = size(data,dim=1)

**When the atm.log file says** unexpected end-of-file, then check if the data.stream files are correct