NorESM user workshop 2023

20 - 28 Nov. 2023

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Forskningsrådet

This work was supported by the Norwegian Research Council INES (grant no. 270061)

Agenda

For this workshop we will demonstrate how to set up, build and run the NorESM model. We will go through the process two times, first time with a minimal setup and second time focusing on different options for each step.

1. Basic steps to set up a NorESM experiment, build the model and start a simulation run (Ada)
2. HPC resources provided by Sigma2 (Tomas)
3. NorESM log files (Tomas)
4. NorESM model structure (Tomas)
5. Creating a new case (Tomas)
6. Options for building the case (Alok)
7. Options for running the case (Alok)

Resources for NorESM workshop

Betzy for NorESM user workshop

During the user workshop we have access to Betzy. Most user will have access to project nn9039k till 1st Dec.

ReservationName = noresm
Accounts = nn9039k
PartitionName = normal

We are going to use mostly *normal* queue for simulation and it could have a long waiting time and you have access for around 12 days.

Goal: Everyone should be able to run 5 years simulation during first week.

Downloading the NorESM code (Ada)

- A recipe for downloading the CMIP6 version of NorESM

Downloading the NorESM code

Recipe:

1. Log on to betzy
2. Make a directory which will contain the NorESM code and the experiments
3. Enter the folder
4. Make a directory called cases. Here you will store all your NorESM experiments.
5. Get the NorESM code from GitHub
6. Enter the noresm repository
7. Checkout the CMIP6 version of NorESM
8. Get the corresponding code for the model component and cime

1. **$ ssh username@betzy.sigma2.no**
2. **$ mkdir NorESMworkshop2023**
3. **$ cd NorESMworkshop2023**
4. **$ mkdir cases**
5. **$ git clone https://github.com/NorESMhub/NorESM.git**
6. **$ cd NorESM**
7. **$ git checkout release-noresm2.0.7**
8. **$ ./manage_externals/checkout_externals**

Documentation: https://noresm-docs.readthedocs.io/en/noresm2/access/download_code.html

All the steps needed for downloading the CMIP6 version of NorESM2 from github

```
[adagj@login-2.BETZY ~]$ mkdir NorESMworkshop2023
[adagj@login-2.BETZY ~]$ cd NorESMworkshop2023/
[adagj@login-2.BETZY ~/NorESMworkshop2023]$ mkdir cases
[adagj@login-2.BETZY ~/NorESMworkshop2023]$ git clone https://github.com/NorESMhub/NorESM.git
Cloning into 'NorESM'...
remote: Enumerating objects: 10502, done.
remote: Counting objects: 100% (1494/1494), done.
remote: Compressing objects: 100% (108/108), done.
remote: Total 10502 (delta 1415), reused 1416 (delta 1384), pack-reused 9008
Receiving objects: 100% (10502/10502), 41.52 MiB | 23.31 MiB/s, done.
Resolving deltas: 100% (6903/6903), done.
[adagj@login-2.BETZY ~/NorESMworkshop2023]$ cd NorESM/
[adagj@login-2.BETZY ~/NorESMworkshop2023/NorESM]$ git checkout release-noresm2.0.7
Note: checking out 'release-noresm2.0.7'.

You are in 'detached HEAD' state. You can look around, make experimental
changes and commit them, and you can discard any commits you make in this
state without impacting any branches by performing another checkout.

If you want to create a new branch to retain commits you create, you may
do so (now or later) by using -b with the checkout command again. Example:

  git checkout -b new_branch_name

HEAD is now at 6dd4b7b... Merge pull request #473 from mvertens/feature/bug_fix
[adagj@login-2.BETZY ~/NorESMworkshop2023/NorESM]$ ./manage_externals/checkout_externals
Processing externals description file : Externals.cfg
Checking status of externals: clm, mosart, ww3, cime, cice, pop, cism, rtm, cam, blom,
Checking out externals: clm, mosart, cime, cice, cam, blom,
Processing externals description file : Externals_CLM.cfg
Checking out externals: fates, ptclm,
Processing externals description file : Externals_BLOM.cfg
Checking out externals: cvmix,
```

Hands-on session 1

Download the CMIP6 version of NorESM2:

1. **$ ssh username@betzy.sigma2.no**
2. **$ mkdir cases**
3. **$ git clone**

   https://github.com/NorESMhub/NorESM.git
4. **$ cd NorESM**
5. **$ git checkout release-noresm2.0.7**
6. **$ ./manage_externals/checkout_externals**

Basic steps to run NorESM (Ada)

- The Newbies Guide

How set up and run a standard NorESM case by executing 4 steps:

1. create a new case (the **create_newcase** script)
2. configure case (the **case.setup** script)
3. build case (the **case.build** script)
4. submit case (the **case.submit** script).

Basic steps to run NorESM: Create case

Tomas will give a detailed description in the next session

The **create_newcase** script is an executable python script located in cime/scripts

```
./create_newcase --case $PATH_TO_cases/$CASENAME --mach $MACHINE --res $RESOLUTION
--compset $COMPSET --project $PROJECT --user-mods-dir $USER_MOD_DIRS
```

--case $CASENAME -> path and name of the NorESM experiment you are creating
--mach $MACHINE -> name of the HPC you are using e.g. betzy, fram, nebula
--res $RESOLUTION -> running with 1 (f09_tn14) or 2 degree (f19_tn14) atmosphere/land resolution
--compset $COMPSETNAME -> e.g. piControl (N1850frc2), historical, ssp585, abrupt-4xCO2
--project $PROJECT -> which project provides the cpu hours you are using (e.g. nn9039k = EPOCASA)
(--user_mods_dir -> predefined namelists and source mods)

```
$ cd ~/NorESM/cime/scripts/

$ ./create_newcase --case ~/cases/N1850frc2_f19_tn14_test01_20231120 --mach betzy --res f19_tn14 --
compset N1850frc2 --project nn9039k  --pecount=S
```

`./create_newcase --help` will provide you all input options including a description

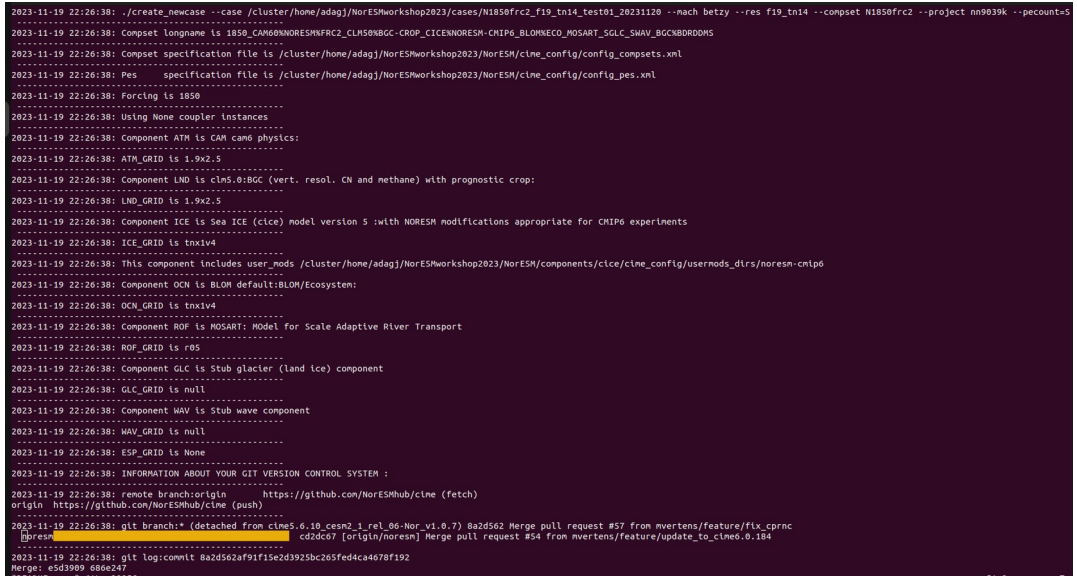
Documentation: https://noresm-docs.readthedocs.io/en/noresm2/configurations/newbie_guide.html

Basic steps to run NorESM: Create case

```
[adagj@login-2.BETZY ~/NorESMworkshop2023]$ cd NorESM/cime/scripts/
[adagj@login-2.BETZY ~/NorESMworkshop2023/NorESM/cime/scripts]$ ./create_newcase --case ~/NorESMworkshop2023/cases/N1850frc2_f19_tn14_test01_20231120 --mach betzy --res f19_tn14 --compset N1850frc2 --proj
ect nn9039k  --pecount=S
Compset longname is 1850_CAM60%NORESM%FRC2_CLM50%BGC-CROP_CICE%NORESM-CMIP6_BLOM%ECO_MOSART_SGLC_SWAV_BGC%BDRDDMS
Compset specification file is /cluster/home/adagj/NorESMworkshop2023/NorESM/cime/../cime_config/config_compsets.xml
Compset forcing is 1850
ATM component is CAM cam6 physics:
LND component is clm5.0:BGC (vert. resol. CN and methane) with prognostic crop:
ICE component is Sea ICE (cice) model version 5 :with NORESM modifications appropriate for CMIP6 experiments
OCN component is BLOM default:BLOM/Ecosystem:
ROF component is MOSART: MOdel for Scale Adaptive River Transport
GLC component is Stub glacier (land ice) component
WAV component is Stub wave component
ESP component is
Pes     specification file is /cluster/home/adagj/NorESMworkshop2023/NorESM/cime/../cime_config/config_pes.xml
Compset specific settings: name is RUN_STARTDATE and value is 0001-01-01
Machine is betzy
Pes setting: grid match    is a%1.9x2.5.+l%1.9x2.5.+oi%tnx1v4
Pes setting: machine match is betzy
Pes setting: pesize match  is S
Pes setting: grid          is a%1.9x2.5_l%1.9x2.5_oi%tnx1v4_r%r05_g%null_w%null_m%tnx1v4
Pes setting: compset       is 1850_CAM60%NORESM%FRC2_CLM50%BGC-CROP_CICE%NORESM-CMIP6_BLOM%ECO_MOSART_SGLC_SWAV_BGC%BDRDDMS
Pes setting: tasks       is {'NTASKS_ATM': 384, 'NTASKS_ICE': 236, 'NTASKS_CPL': 384, 'NTASKS_LND': 136, 'NTASKS_WAV': 12, 'NTASKS_ROF': 128, 'NTASKS_OCN': 123, 'NTASKS_GLC': 128}
Pes setting: threads     is {'NTHRDS_ICE': 1, 'NTHRDS_ATM': 1, 'NTHRDS_ROF': 1, 'NTHRDS_LND': 1, 'NTHRDS_WAV': 1, 'NTHRDS_OCN': 1, 'NTHRDS_CPL': 1, 'NTHRDS_GLC': 1}
Pes setting: rootpe      is {'ROOTPE_OCN': 384, 'ROOTPE_LND': 0, 'ROOTPE_ATM': 0, 'ROOTPE_ICE': 136, 'ROOTPE_WAV': 372, 'ROOTPE_CPL': 0, 'ROOTPE_ROF': 0, 'ROOTPE_GLC': 0}
Pes setting: pstrid      is {}
Pes other settings: {}
Pes comments: none
 Compset is: 1850_CAM60%NORESM%FRC2_CLM50%BGC-CROP_CICE%NORESM-CMIP6_BLOM%ECO_MOSART_SGLC_SWAV_BGC%BDRDDMS
 Grid is: a%1.9x2.5_l%1.9x2.5_oi%tnx1v4_r%r05_g%null_w%null_m%tnx1v4
 Components in compset are: ['cam', 'clm', 'cice', 'blom', 'mosart', 'sglc', 'swav', 'sesp', 'drv', 'dart']

This is a CESM or NorESM scientifically supported compset at this resolution.

No charge_account info available, using value from PROJECT
No project info available
cesm model version found: release-noresm2.0.7
Batch_system_type is slurm_nor
job is case.run USER_REQUESTED_WALLTIME None USER_REQUESTED_QUEUE None
job is case.st_archive USER_REQUESTED_WALLTIME None USER_REQUESTED_QUEUE None
 Creating Case directory /cluster/home/adagj/NorESMworkshop2023/cases/N1850frc2_f19_tn14_test01_20231120
This component includes user_mods /cluster/home/adagj/NorESMworkshop2023/NorESM/components/cice/cime_config/usermods_dirs/noresm-cmip6
Adding user mods directory /cluster/home/adagj/NorESMworkshop2023/NorESM/components/cice/cime_config/usermods_dirs/noresm-cmip6
[adagj@login-2.BETZY ~/NorESMworkshop2023/NorESM/cime/scripts]$
```

README

```
$ cd ~/cases/N1850frc2_f19_tn14_test01_20231120/

$ vi README.case
```



You will find the information about your case in README

Including compset long name, grid files, components, git branch, git commit etc.

README can be very useful if you want to reproduce a case (either your own or somebody else's case)

Basic steps to run NorESM: Set up the case

Enter the case folder:

```
$ cd ~/cases/N1850frc2_f19_tn14_test01_20231120/

$ ./case.setup
```

Documentation:

- https://noresm-docs.readthedocs.io/en/noresm2/configurations/newbie_guide.html
- https://noresm-docs.readthedocs.io/en/noresm2/configurations/experiments.html#create-and-configure-a-new-case
- https://noresm-docs.readthedocs.io/en/noresm2/configurations/experiment_environment.html#machine-specific-environment

Basic steps to run NorESM: Set up the case

```
$ ./case.setup
```

```
[adagj@login-2.BETZY ~/NorESMworkshop2023/cases/N1850frc2_f19_tn14_test01_20231120]$ ./case.setup
Setting resource.RLIMIT_STACK to -1 from (8388608, -1)
/cluster/home/adagj/NorESMworkshop2023/cases/N1850frc2_f19_tn14_test01_20231120/env_mach_specific.xml already exists, delete to replace
job is case.run USER_REQUESTED_WALLTIME None USER_REQUESTED_QUEUE None
Creating batch scripts
Writing case.run script from input template /cluster/home/adagj/NorESMworkshop2023/NorESM/cime/config/cesm/machines/template.case.run
Creating file .case.run
Writing case.st_archive script from input template /cluster/home/adagj/NorESMworkshop2023/NorESM/cime/config/cesm/machines/template.st_archive
Creating file case.st_archive
Creating user_nl_xxx files for components and cpl
If an old case build already exists, might want to run 'case.build --clean' before building
You can now run './preview_run' to get more info on how your case will be run
```

Basic steps to run NorESM: Build the case

After running ./case.setup you should see your case in the noresm run directory

```
$ ls /cluster/work/users/$USER/noresm/

N1850frc2_f19_tn14_test01_20231130

$ ls $USERWORK/noresm/N1850frc2_f19_tn14_test01_20231120/
  bld  run
```

bld: the build folder
run: the run folder. Here you'll find logs, output data, restart files etc. More on that later …

```
$ ./case.build
```

Creating an executable **cesm.exe**; found in $USERWORK/noresm/$CASENAME/bld

Basic steps to run NorESM: Building the case

```
[adagj@login-2.BETZY ~/NorESMworkshop2023/cases/N1850frc2_f19_tn14_test01_20231120]$ ./case.build
Building case in directory /cluster/home/adagj/NorESMworkshop2023/cases/N1850frc2_f19_tn14_test01_20231120
sharedlib_only is False
model_only is False
Setting resource.RLIMIT_STACK to -1 from (8388608, -1)
Generating component namelists as part of build
Creating component namelists
   Calling /cluster/home/adagj/NorESMworkshop2023/NorESM/components/cam//cime_config/buildnml
     ...calling cam buildcpp to set build time options
CAM namelist copy: file1 /cluster/home/adagj/NorESMworkshop2023/cases/N1850frc2_f19_tn14_test01_20231120/Buildconf/camconf/atm_in file2 /cluste
run/atm_in
   Calling /cluster/home/adagj/NorESMworkshop2023/NorESM/components/clm//cime_config/buildnml
   Calling /cluster/home/adagj/NorESMworkshop2023/NorESM/components/cice//cime_config/buildnml
     ...calling cice buildcpp to set build time options
   Running /cluster/home/adagj/NorESMworkshop2023/NorESM/components/blom//cime_config/buildnml
   Calling /cluster/home/adagj/NorESMworkshop2023/NorESM/components/mosart//cime_config/buildnml
   Calling /cluster/home/adagj/NorESMworkshop2023/NorESM/cime/src/components/stub_comps/sglc/cime_config/buildnml
   Calling /cluster/home/adagj/NorESMworkshop2023/NorESM/cime/src/components/stub_comps/swav/cime_config/buildnml
   Calling /cluster/home/adagj/NorESMworkshop2023/NorESM/cime/src/components/stub_comps/sesp/cime_config/buildnml
   Calling /cluster/home/adagj/NorESMworkshop2023/NorESM/cime/src/drivers/mct/cime_config/buildnml
Finished creating component namelists
Building gptl with output to file /cluster/work/users/adagj/noresm/N1850frc2_f19_tn14_test01_20231120/bld/gptl.bldlog.231119-223447
   Calling /cluster/home/adagj/NorESMworkshop2023/NorESM/cime/src/build_scripts/buildlib.gptl
Component gptl build complete with 1 warnings
Building mct with output to file /cluster/work/users/adagj/noresm/N1850frc2_f19_tn14_test01_20231120/bld/mct.bldlog.231119-223447
   Calling /cluster/home/adagj/NorESMworkshop2023/NorESM/cime/src/build_scripts/buildlib.mct
Building pio with output to file /cluster/work/users/adagj/noresm/N1850frc2_f19_tn14_test01_20231120/bld/pio.bldlog.231119-223447
   Calling /cluster/home/adagj/NorESMworkshop2023/NorESM/cime/src/build_scripts/buildlib.pio
Component pio build complete with 5 warnings
Building csm_share with output to file /cluster/work/users/adagj/noresm/N1850frc2_f19_tn14_test01_20231120/bld/csm_share.bldlog.231119-223447
   Calling /cluster/home/adagj/NorESMworkshop2023/NorESM/cime/src/build_scripts/buildlib.csm_share
Component csm_share build complete with 20 warnings
        - Building clm4_5/clm5_0 Library
Building lnd with output to /cluster/work/users/adagj/noresm/N1850frc2_f19_tn14_test01_20231120/bld/lnd.bldlog.231119-223447
Component lnd build complete with 6 warnings
clm built in 105.257700 seconds
Building atm with output to /cluster/work/users/adagj/noresm/N1850frc2_f19_tn14_test01_20231120/bld/atm.bldlog.231119-223447
Building ice with output to /cluster/work/users/adagj/noresm/N1850frc2_f19_tn14_test01_20231120/bld/ice.bldlog.231119-223447
Building ocn with output to /cluster/work/users/adagj/noresm/N1850frc2_f19_tn14_test01_20231120/bld/ocn.bldlog.231119-223447
Building rof with output to /cluster/work/users/adagj/noresm/N1850frc2_f19_tn14_test01_20231120/bld/rof.bldlog.231119-223447
Building glc with output to /cluster/work/users/adagj/noresm/N1850frc2_f19_tn14_test01_20231120/bld/glc.bldlog.231119-223447
Building wav with output to /cluster/work/users/adagj/noresm/N1850frc2_f19_tn14_test01_20231120/bld/wav.bldlog.231119-223447
Building esp with output to /cluster/work/users/adagj/noresm/N1850frc2_f19_tn14_test01_20231120/bld/esp.bldlog.231119-223447
sglc built in 3.534569 seconds
sesp built in 3.585518 seconds
swav built in 3.600240 seconds
Component ice build complete with 1 warnings
cice built in 101.986884 seconds
Component atm build complete with 17 warnings
cam built in 102.400266 seconds
mosart built in 162.119283 seconds
blom built in 162.120683 seconds
Building cesm with output to /cluster/work/users/adagj/noresm/N1850frc2_f19_tn14_test01_20231120/bld/cesm.bldlog.231119-223447
Component cesm exe build complete with 2 warnings
Time spent not building: 10.102813 sec
```

Basic steps to run NorESM: Submitting the case

$ ./case.submit

```
[adagj@login-2.BETZY ~/NorESMworkshop2023/cases/N1850frc2_f19_tn14_test01_20231120]$ ./case.submit
Setting resource.RLIMIT_STACK to -1 from (-1, -1)
Creating component namelists
   Calling /cluster/home/adagj/NorESMworkshop2023/NorESM/components/cam//cime_config/buildnml
CAM namelist copy: file1 /cluster/home/adagj/NorESMworkshop2023/cases/N1850frc2_f19_tn14_test01_20231120/Buildconf/camconf/atm_in file2 /cluste
run/atm_in
   Calling /cluster/home/adagj/NorESMworkshop2023/NorESM/components/clm//cime_config/buildnml
   Calling /cluster/home/adagj/NorESMworkshop2023/NorESM/components/cice//cime_config/buildnml
   Running /cluster/home/adagj/NorESMworkshop2023/NorESM/components/blom//cime_config/buildnml
   Calling /cluster/home/adagj/NorESMworkshop2023/NorESM/components/mosart//cime_config/buildnml
   Calling /cluster/home/adagj/NorESMworkshop2023/NorESM/cime/src/components/stub_comps/sglc/cime_config/buildnml
   Calling /cluster/home/adagj/NorESMworkshop2023/NorESM/cime/src/components/stub_comps/swav/cime_config/buildnml
   Calling /cluster/home/adagj/NorESMworkshop2023/NorESM/cime/src/components/stub_comps/sesp/cime_config/buildnml
   Calling /cluster/home/adagj/NorESMworkshop2023/NorESM/cime/src/drivers/mct/cime_config/buildnml
Finished creating component namelists
Checking that inputdata is available as part of case submission
Setting resource.RLIMIT_STACK to -1 from (-1, -1)
Loading input file list: 'Buildconf/cam.input_data_list'
Loading input file list: 'Buildconf/cpl.input_data_list'
Loading input file list: 'Buildconf/blom.input_data_list'
Loading input file list: 'Buildconf/cice.input_data_list'
Loading input file list: 'Buildconf/mosart.input_data_list'
Loading input file list: 'Buildconf/clm.input_data_list'
Check case OK
submit_jobs case.run
Submit job case.run
Submitting job script sbatch --time 00:59:00 --account nn9039k .case.run --resubmit
Submitted job id is 744652
Submit job case.st_archive
Submitting job script sbatch --time 0:59:00 --account nn9039k  --dependency=afterok:744652 case.st_archive --resubmit
Submitted job id is 744653
Submitted job case.run with id 744652
Submitted job case.st_archive with id 744653
[adagj@login-2.BETZY ~/NorESMworkshop2023/cases/N1850frc2_f19_tn14_test01_20231120]$
```

Monitoring your jobs: some useful commands

squeue: overview of job(s) running and the job id(s)	**$ squeue -u $USER** **$ squeue -p $PROJECT**
scontrol: see more details about the job running	**$ scontrol show job $JOBID**
scancel: stop job from running	**$ scancel $JOBID**

Note! squeue -u $USER: If you don’t see your job, it has either finished or crashed!

Monitoring jobs :
https://documentation.sigma2.no/jobs/monitoring.html

Looking at model output with ncview (Tomas)

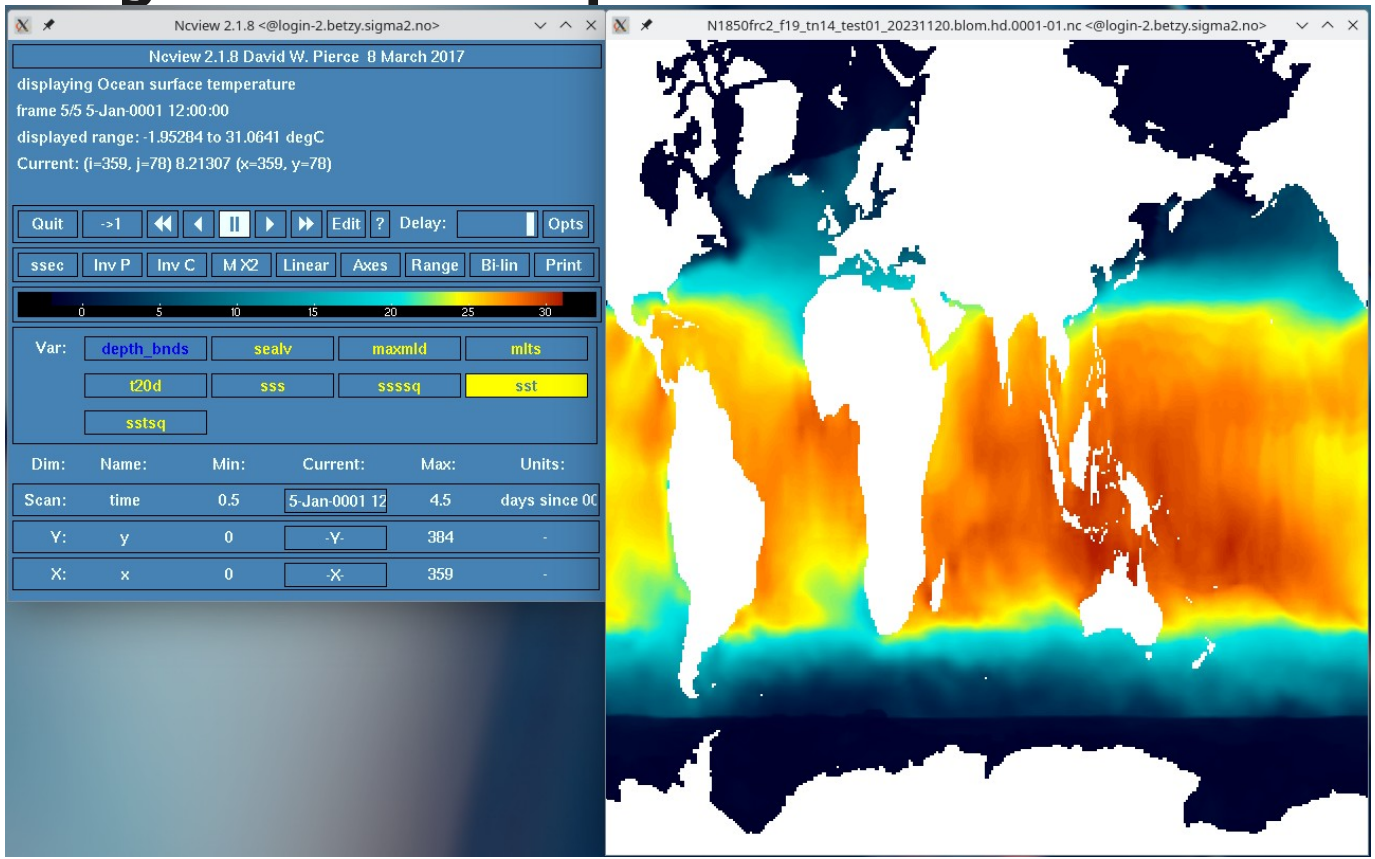
Looking at model output with ncview

- Log in with X-forwarding:
  linux/mac: $ssh -Y username@betzy.sigma2.no

- Load module for ncview:
  $module load ncview/2.1.8-gompi-2021a

- Navigate to archive directory, ocean output, and launch ncview:
  $cd $USERWORK/archive/N1850frc2_f19_tn14_test01_20231120/ocn/hist
  $ncview N1850frc2_f19_tn14_test01_20231120.blom.hd.0001-01.nc

Looking at model output with ncview



HPC resources provided by Sigma2 (Tomas)

Sigma2 HPC machines

See Sigma2 documentation for more HPC info: https://documentation.sigma2.no/hpc_machines/hardware_overview.html

Sigma2 provides 3 HPC systems:

- Betzy for large parallel jobs (Normal queue: 4-512 nodes, 4 days max walltime)
- Fram for intermediate parallel jobs (Normal queue: 1-32 nodes, 7 days max walltime)
- Saga for serial or single node jobs (Not configured for NorESM)

HPC job types: https://documentation.sigma2.no/jobs/choosing_job_types.html

	Fram	Betzy
System	Lenovo NeXtScale nx360	BullSequana XH2000
CPU type	Intel E5-2683v4 ; 2.1 GHz	AMD Epyc 7742 ; 2.25GHz
Nodes / Cores	1006 / 32256	1344 / 172032
(core / mem) per node	32 / 64 GB	128 / 256 GB
	largemem: 8x 512GB, 2x 6TB	16 Nvidia A100 GPUs

Fram and Betzy storage areas

Directory	Alias	Purpose
/cluster/home/$USER	$HOME	User data
/custer/work/users/$USER	$USERWORK	Staging and job data
/custer/work/jobs/$SLURM_JOB_ID	$SCRATCH	Per-job data
/cluster/projects/<project_name>		Project data
/cluster/shared/<folder_name>		Shared data

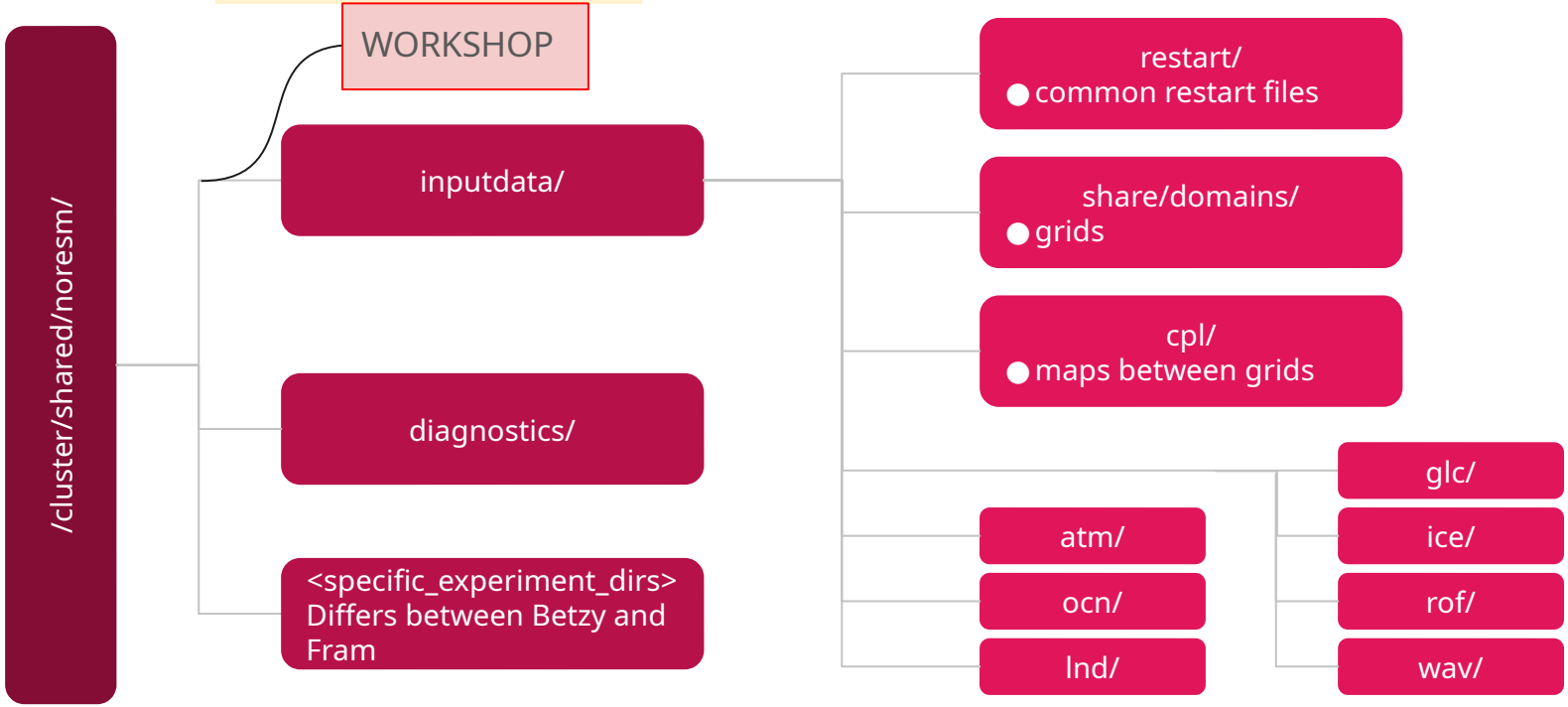
NorESM copies build and run files to subdirectories in $USERWORK. These files are not backed up,and are subject to automatic deletion after 42 days (21 days or 17 days if storage reduced to 30% or 10%, respectively). Therefore, make sure you copy output files you want to keep to a permanent storage area.

Documentation: https://documentation.sigma2.no/files_storage/clusters.html

NorESM shared resources on Fram and Betzy

Shared resources for NorESM are available on both Fram and Betzy under directory:

/cluster/shared/noresm/



Where to learn more about HPC computing

- Sigma2 “getting started” web pages:
  https://documentation.sigma2.no/getting_started/getting_started.html
- Sigma2 “Running jobs” web page:
  https://documentation.sigma2.no/jobs/overview.html
- Sigma2/NRIS training material:
  https://documentation.sigma2.no/training/material.html
- NRIS training events:
  https://www.sigma2.no/training

Web services:

- Research Data Archive : https://archive.norstore.no/
- Diagnostic output : https://ns2345k.web.sigma2.no/
- NorESM git repository : https://github.com/NorESMhub
- NIRD tootkit : https://apps.sigma2.no/
- NorESM documentation : https://noresm-docs.readthedocs.io/en/noresm2/
- NorESM inputdata Server : http://www.noresm.org/inputdata

Hands-on session 2

Create, setup, build and submit your (first?) NorESM2-LM piControl simulation
running on 4 nodes by repeating these steps:

```
$ cd ~/NorESM/cime/scripts/

$ ./create_newcase --case ~/cases/N1850frc2_f19_tn14_test01_20231120 --mach betzy --res f19_tn14 --compset N1850frc2 --project nn9039k --pecount=S

$ cd ~/cases/N1850frc2_f19_tn14_test01_20231120/

$ ./case.setup

$ ./case.build

$./case.submit
```

Log files (Tomas)

Log files produced by NorESM

NorESM produce log output for case creation, build process, run process and archiving process.

Log files in the case directory:

`CaseStatus` : Summary of all processes (case setup, build, job submission and job completion).
Good place to start looking at the logs!

`README.case` : Log for case creation

`software_environment.txt` : System environments (modules) used during model build

`logs/run_environment.txt.<id>.<time>` : System environment (modules) loaded during model run.

`<casename>` : Log for job execution, CPU, memory and disk usage.

Documentation:
https://noresm-docs.readthedocs.io/en/noresm2/output/noresm_logs.html

Log files produced by NorESM

Build logs : <workdir>/noresm/<casename>/bld/ (<workdir> = /cluster/work/users/<username>)

cesm.bldlog.<timestamp>.gz : Build the coupled model executable cesm.exe.
<component>.bldlog.<timestamp>.gz : Build log for individual model components.

Run logs : <workdir>/archive/<casename>/logs/ (assuming run and archive processes finished)

cesm.log.<jobid>.<timestamp>.gz : Run log for coupled model system.
<component>.log.<jobid>.<timestamp>.gz : Run log for individual model components.

If NorESM fails during run, you may find these log files in <workdir>/noresm/<casename>/run/ .

Archiving logs : <workdir>/archive/<casename>/

archive.log.<timestamp> : Log for short term archiving of model output.
case.log : Log for archiving of case directory.

NOTE: Archived *.gz files can be read directly using the “less” command, but can otherwise be expanded before reading: gunzip <filename>.gz

Experiment status and timing statistics

In your case directory: the file CaseStatus logs all information on what you have done and if it worked or not:

```
2021-11-10 14:45:01: case.setup starting
---------------------------------------------------
2021-11-10 14:45:02: case.setup success
---------------------------------------------------
2021-11-10 14:45:07: case.build starting
---------------------------------------------------
2021-11-10 14:51:31: case.build success
---------------------------------------------------
2021-11-10 14:52:04: case.submit starting
---------------------------------------------------
2021-11-10 14:52:12: case.submit error
ERROR: Command: 'sbatch --time 00:59:00 -q devel --account nn9560k .case.run --resubmit' failed with error 'sbatch: error: QOSGrpNodeLimit
sbatch: error: Batch job submission failed: Job violates accounting/QOS policy (job submit limit, user's size and/or time limits)' from dir '/cluster/home/adagj/NorESM/cases/N1850frc2_f19_tn14_test02_2021
1115'
---------------------------------------------------
2021-11-10 14:52:52: case.submit starting
---------------------------------------------------
2021-11-10 14:52:59: case.submit error
ERROR: Command: 'sbatch --time 00:29:00 -q devel --account nn9560k .case.run --resubmit' failed with error 'sbatch: error: QOSGrpNodeLimit
sbatch: error: Batch job submission failed: Job violates accounting/QOS policy (job submit limit, user's size and/or time limits)' from dir '/cluster/home/adagj/NorESM/cases/N1850frc2_f19_tn14_test02_2021
1115'
---------------------------------------------------
2021-11-10 14:53:32: case.submit starting
---------------------------------------------------
2021-11-10 14:53:39: case.submit error
ERROR: Command: 'sbatch --time 00:29:00 -q devel --account nn9560k .case.run --resubmit' failed with error 'sbatch: error: QOSGrpNodeLimit
sbatch: error: Batch job submission failed: Job violates accounting/QOS policy (job submit limit, user's size and/or time limits)' from dir '/cluster/home/adagj/NorESM/cases/N1850frc2_f19_tn14_test02_2021
1115'
---------------------------------------------------
2021-11-10 14:57:08: case.setup starting
---------------------------------------------------
2021-11-10 14:57:09: build.clean starting
---------------------------------------------------
2021-11-10 14:57:27: build.clean success
---------------------------------------------------
2021-11-10 14:57:28: case.setup success
---------------------------------------------------
2021-11-10 14:57:52: case.build starting
---------------------------------------------------
2021-11-10 14:59:37: case.build success
---------------------------------------------------
2021-11-10 15:00:26: case.submit starting
---------------------------------------------------
2021-11-10 15:00:34: case.submit success case.run:253485, case.st_archive:253486
---------------------------------------------------
2021-11-10 15:05:37: case.run starting
---------------------------------------------------
2021-11-10 15:05:46: model execution starting
---------------------------------------------------
2021-11-10 15:15:35: model execution success
---------------------------------------------------
2021-11-10 15:15:35: case.run success
---------------------------------------------------
2021-11-10 15:15:56: st_archive starting
---------------------------------------------------
2021-11-10 15:16:29: st_archive success
---------------------------------------------------
```

Experiment status and timing statistics

In your case directory: in the timing sub-directory; the file cesm_timing.$CASE provides information on grid type, run length, compset, processors configuration and many others.
Most important are timing statics : Model throughput, Model cost and run time

```
  Overall Metrics:
    Model Cost:             985.36   pe-hrs/simulated_year
    Model Throughput:         3.12   simulated_years/day

    Init Time   :     201.411 seconds
    Run Time    :     379.632 seconds       75.926 seconds/day
    Final Time  :       0.183 seconds

    Actual Ocn Init Wait Time     :       5.450 seconds
    Estimated Ocn Init Run Time   :       2.344 seconds
    Estimated Run Time Correction :       0.000 seconds
      (This correction has been applied to the ocean and total run times)

Runs Time in total seconds, seconds/model-day, and model-years/wall-day
CPL Run Time represents time in CPL pes alone, not including time associated with data exchange with other components

    TOT Run Time:     379.632 seconds       75.926 seconds/mday         3.12 myears/wday
    CPL Run Time:       8.458 seconds        1.692 seconds/mday       139.93 myears/wday
    ATM Run Time:     233.509 seconds       46.702 seconds/mday         5.07 myears/wday
    LND Run Time:     106.004 seconds       21.201 seconds/mday        11.17 myears/wday
    ICE Run Time:      36.725 seconds        7.345 seconds/mday        32.23 myears/wday
    OCN Run Time:     281.239 seconds       56.248 seconds/mday         4.21 myears/wday
    ROF Run Time:      18.111 seconds        3.622 seconds/mday        65.35 myears/wday
    GLC Run Time:       0.000 seconds        0.000 seconds/mday         0.00 myears/wday
    WAV Run Time:       0.000 seconds        0.000 seconds/mday         0.00 myears/wday
    ESP Run Time:       0.000 seconds        0.000 seconds/mday         0.00 myears/wday
    CPL COMM Time:    127.679 seconds       25.536 seconds/mday         9.27 myears/wday
```

Model Throughput increases to ~20 simulated_years/day if you use 4 nodes instead of 1

Experiment status and timing statistics

In your RUN directory: /cluster/work/users/$USER/noresm/$CASE/run/
You will find all the namelists; component_in files, the timing folder, restart files and rpointer.* and if your model simulation for some reason crashes; the log files.

- the cesm.log.$JOBID file can provide some hints of which component caused the crash
- the component.log.$JOBID file can provide information about which subroutine caused the crashed
- Log timestamps can be a useful way to keep track of run evolution after several model runs

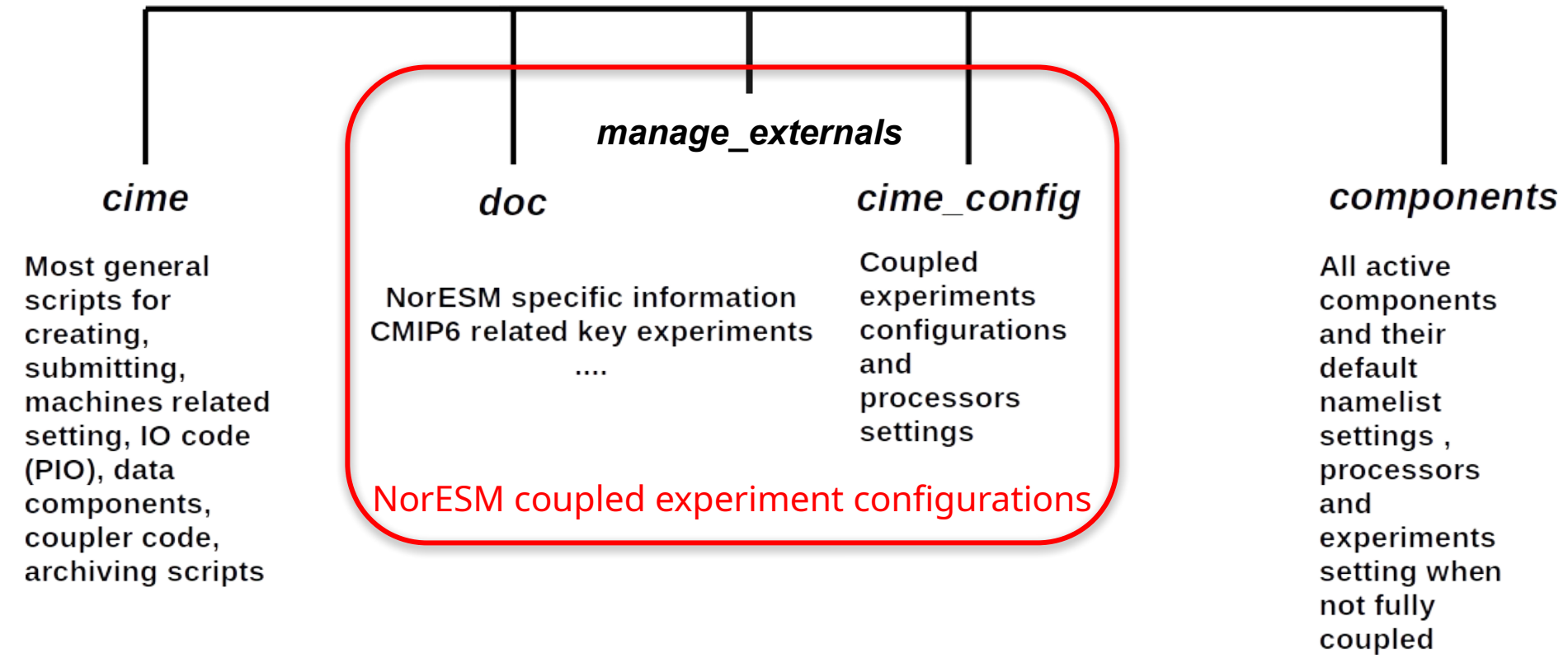
If your model simulation is successful, the log files are archived in:
/cluster/work/users/$USER/archive/$CASE/logs/

For a successful simulation the cpl.log.$JOBID.<timestamp>.gz file will end with:

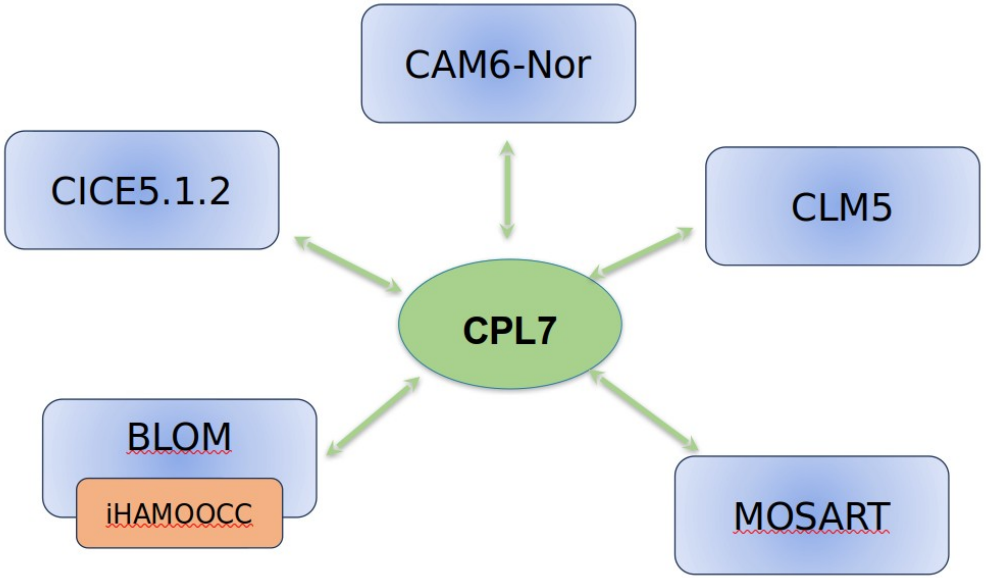
```
(seq_mct_drv): ===============          SUCCESSFUL TERMINATION OF CPL7-cesm ===============
(seq_mct_drv): ===============        at YMD,TOD =   00010106       0         ===============
(seq_mct_drv): ===============  # simulated days (this run) =        5.000  ===============
(seq_mct_drv): ===============  compute time (hrs)          =        0.105  ===============
(seq_mct_drv): ===============  # simulated years / cmp-day =        3.118  ===============
(seq_mct_drv): ===============  pes min memory highwater  (MB)      -0.001  ===============
(seq_mct_drv): ===============  pes max memory highwater  (MB)      -0.001  ===============
(seq_mct_drv): ===============  pes min memory last usage (MB)     521.612  ===============
(seq_mct_drv): ===============  pes max memory last usage (MB)    1174.614  ===============
```

NorESM model system (Tomas)

NorESM model structure



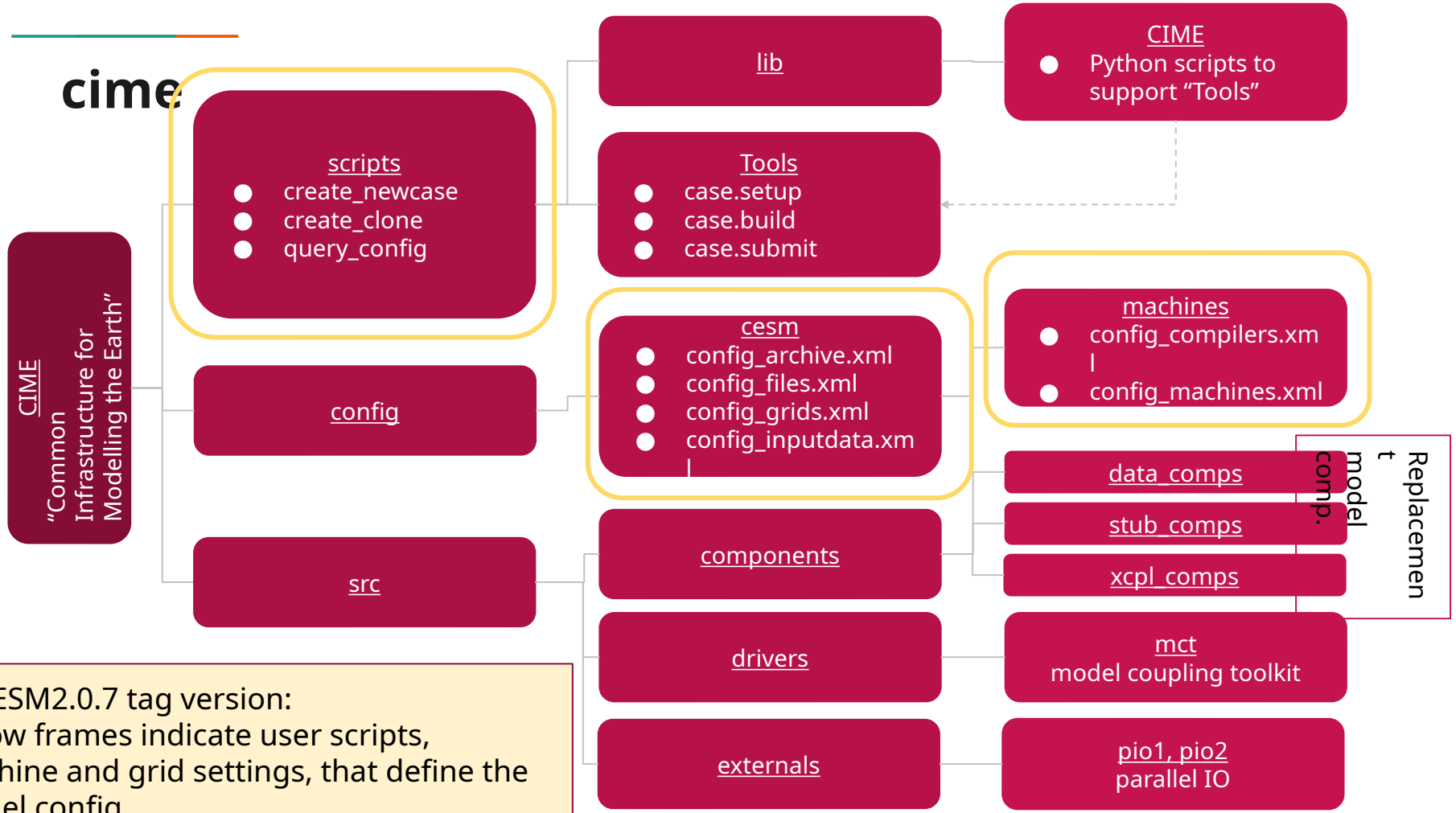
NorESM framework



NorESM2 is based on the second version of the Community Earth System Model, CESM2, and share most of the CESM2 structure, but modifies model component.

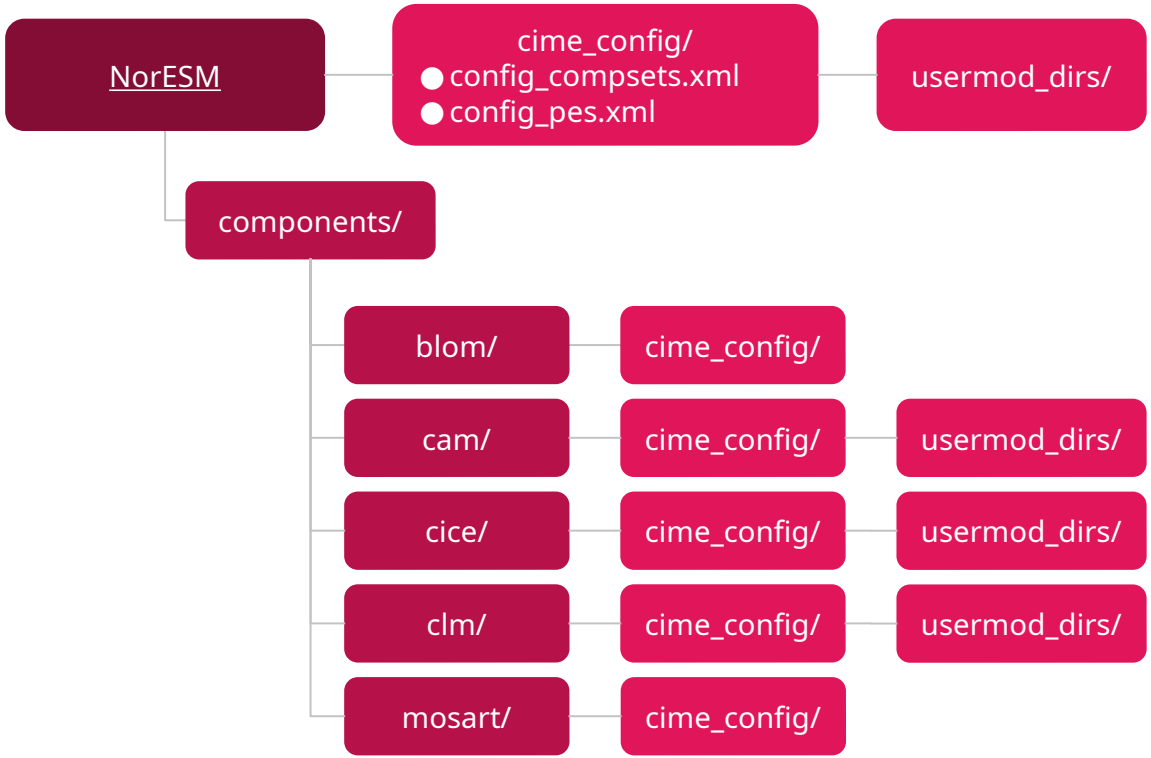
- Atmosphere model :
  CAM6-Nor replaces standard CAM
- Atmospheric chemistry:
  OsloAero6
- Ocean model :
  Isopycnic coordinate model BLOM
- Ocean biogeochemical model :
  iHAMOCC
- Sea-ice model:
  Wind drift of snow

cime



NorESM2.0.7 tag version:
Yellow frames indicate user scripts, machine and grid settings, that define the model config.

cime_config directory



Files in cime_config/ :

config_compsets.xml : compset configuration file

config_pes.xml : processor config for particular compsets

Additional component scripts

buildnml : build component namelist

buildlib : build component library

Fetching the source: *checkout_externals* script

`./manage_externals/checkout_externals`	Fetch model components defined in the `Externals.cfg` file
`./checkout_externals -e [EXTERNALS]`	Fetch model components defined in `[EXTERNALS]` file
`./checkout_externals -S`	Check status of downloaded model components
`./checkout_externals -h`	See all options for `checkout_externals`

Entries from **Externals.cfg** file :

```
[cam]
tag = cam_cesm2_1_rel_05-Nor_v1.0.5
protocol = git
repo_url = https://github.com/NorESMhub/CAM
local_path = components/cam
required = True
```

```
[clm]
tag = release-clm5.0.14-Nor_v1.0.4
protocol = git
repo_url = https://github.com/NorESMhub/ctsm
local_path = components/clm
externals = Externals_CLM.cfg
required = True
```

Setting up a new NorESM case (Tomas)

- Creating a new case or cloning existing case
- Compsets
- Grids

Creating a new case

A new case is created by running the script <NorESM>/cime/scripts/create_newcase , where <NorESM> refers to the base directory of your personal clone of NorESM.

General command structure:

```
./create_newcase
            --case <path/to/casedir/casename>          [required]
            --compset <compset_name>                   [required]
            --res <grid_name>     [required]
            --machine <machine_name>                   [optional for noresm2.0.7
(options: fram, betzy)]
            --project <project_name>                   [usually required
(options: nn????k)]
            --pecount <label/number>                   [optional (number of
cores required for job)]
            --user-mod-dirs <path/to/usermods>         [optional (used for some common
run setups)]
            --run-unsupported     [optional (used for some non-standard setups)]
```

Documentation: https://noresm-docs.readthedocs.io/en/noresm2/configurations/experiments.html

Creating a clone case

A clone case is created by running the script `<NorESM>/cime/scripts/create_clone` .

General command structure:

```
./create_clone
            --case <path/to/casedir/casename>          [required]
            --clone <path/to/existing/case>            [required]
            --project <project_name>                   [usually required (options: nn????k)]
            --user-mod-dirs <path/to/usermods>         [optional (used for some common run setups)]
            --keepexe                                  [optional (set EXEROOT
link to original build)]
```

Cloning without `--keepexe` will copy all case files, but the case needs to be re-built (run `./case.build`) before submitting a job.

Cloning a case with `--keepexe` will not create a bld/ directory (no re-build required), and the SourceMods directory will be changed to a symbolic link pointing to the original case directory.

Compsets

- An experiment with some sets of components and forcing

- List of all compsets

`./query_config --compsets` list all existing compsets;
`./query_config --compsets allactive` all fully coupled compsets;
`./query_config --compsets blom` all ocean-only compsets;
`./query_config --compsets cam` all atmosphere-only compsets;

- All compsets starting with N are NorESM related compsets

Compset string

- The compset longname has the specified order atm, lnd, ice, ocn, river, glc, wave, cesm-options
- The notation for the compset longname is

TIME_ATM[%phys]_**LND**[%phys]_**ICE**[%phys]_**OCN**[%phys]_**ROF**[%phys]_**GLC**[%phys]_**WAV**[%phys][_ESP%phys][_BGC%phys]

TIME = Time period (e.g. 1850, 2000, HIST, SSP126, SSP245, SSP370. SSP585)

ATM = [CAM40, CAM50, CAM54, CAM60] ;	LND = [CLM45, CLM50, SLND] ;	ICE = [CICE, DICE, SICE]
OCN = [DOCN, ,AQUAP, SOCN, BLOM];	ROF = [RTM, MOSART, SROF] ;	GLC = [CISM1, CISM2, SGLC]
WAV = [WW3, DWAV, XWAV, SWAV];	ESP = [SESP] ;	BGC = optional BGC scenario

- The OPTIONAL %phys attributes specify submodes of the given system
- For example DOCN%DOM is the data ocean model for DOCN
- Possible %phys choices for each component are listed.
- ALL data models must have a %phys option that corresponds to the data model mode
- Each compset node is associated with the following elements
- - lname ; alias ; support (optional description of the support level for this compset)
- Each compset node can also have the following attributes
- - grid (optional regular expression match for grid to work with the compset)

Documentation: **https://noresm-docs.readthedocs.io/en/noresm2/configurations/experiments.html** , https://noresm-docs.readthedocs.io/en/noresm2/configurations/cmip6_compsets.html#cmip6-deck-compsets

Some fully coupled compsets

<short_name> : (description)
TIME_ATM[%phys]_LND[%phys]_ICE[%phys]_OCN[%phys]_ROF[%phys]_GLC[%phys]_WAV[%phys]
[_ESP%phys][_BGC%phys]

N1850frc2 : (piControl) 1850_CAM60%NORESM%FRC2_CLM50%BGC-
CROP_CICE%NORESM-CMIP6_BLOM%ECO_MOSART_SGLC_SWAV_BGC%BDRDDMS

NHISTfrc2 : (historical) HIST_CAM60%NORESM%FRC2_CLM50%BGC-
CROP_CICE%NORESM-CMIP6_BLOM%ECO_MOSART_SGLC_SWAV_BGC%BDRDDMS

NSSP126frc2 : (scenario) SSP126_CAM60%NORESM%FRC2_CLM50%BGC-
CROP_CICE%NORESM-CMIP6_BLOM%ECO_MOSART_SGLC_SWAV_BGC%BDRDDMS

Documentation:
https://noresm-docs.readthedocs.io/en/noresm2/configurations/cmip6_compsets.html#cmip6-deck-compsets ,
https://noresm-docs.readthedocs.io/en/noresm2/configurations/cmip6_compsets.html#cmip6-scenario-compsets-only-frc2-compsets

Where to find compset definitions

- Fully coupled compsets:

  `cime_config/config_compsets.xml`

- Component specific components (not fully coupled – data atmosphere, stub atmosphere, stub or data ocean, ..)

  `cam/cime_config/config_compsets.xml`
  - `blom/cime_config/config_compsets.xml`
  - `clm/cime_config/config_compsets.xml`
  - `cice/cime_config/config_compsets.xml`
  - `cism/cime_config/config_compsets.xml`

Grid resolution

Grid definition: `cime/config/cesm/config_grids.xml`

Grids for scientifically supported NorESM2 experiments include:

Atmosphere & land:
f19 : 1.9x2.5 = 1.9 degree latitude and 2.5 degree longitude resolution = 144x96
f09 : 0.9x1.25 = 0.9 degree latitude and 1.25 degree longitude resolution = 288x192

Ocean & sea ice:
tnx1v4 : tripolar 1 degree grid = 360x384

Data atmosphere: (OMIP experiments)
T62, **TL319** : approx. 2 degree Gaussian and 0.5 degree spectral grid

More grid configurations are defined, but they may not be available on a specific HPC or may require additions to NorESM2 config files in order to work properly.

Mapping files

- There is different resolution for ocean, atmosphere and river runoff grid
- Coupler is used to interpolate/transfer fields from one grid to another grid
- Map files are generated for weight factors (cime/tools) and these factors are stored; for that purpose ESMF tool is used.
- List of some map files: `cime/config/cesm/config_grids.xml`

  `map_tnx1v4_to_fv0.9x1.25_aave_da_170609.nc` (ocean → atmosphere)
  `map_tnx1v4_to_fv1.9x2.5_aave_da_170609.nc` (ocean → atmosphere)
  `map_fv0.9x1.25_to_tnx1v4_aave_da_170609.nc` (atmosphere → ocean)
  `map_fv1.9x2.5_to_tnx1v4_aave_da_170609.nc` (atmosphere → ocean)
  `map_r05_to_tnx1v4_e1000r300_170609.nc` (river → ocean)

This will be automated in future versions of NorESM with new coupler, NUOPC, that does not require mapping files.

Hands-on session 2 : checkout_externals

In release-noresm2.0.7 there is a second externals file:
Externals_continuous_development.cfg

This file is used to build NorESM with alternative development branches of model components.

1. **Look at differences between externals files:**
   diff -u Externals.cfg Externals_continuous_development.cfg
2. **Examine status for current and alternative externals file**
   ./manage_externals/checkout_externals -S ← for current externals
   -e Externals_continuous_development.cfg -S ← for alternative externals

Symbols used by status checker:
: all is fine s : out-of-sync
o : optional source
e : empty ? : unknown (no .git or .svn) M : modified source

Hands-on session 2 : query_config

Use query_config to learn more about NorESM model options

1. **Go to scripts directory:** `cd cime/scripts`
2. **Find details about compsets N1850frc, NorESM coupled, and blom**
   `./query_config --compsets | grep N1850frc2`
   `./query_config --compsets | awk '$1 ~ /^N/'`
   `./query_config --compsets blom`
3. **Find config options for a component or data replacement**
   `./query_config --components blom` ← Active ocean component
   `./query_config --components docn` ← Data ocean component
4. **Find details about grids**
   `./query_config --grids | grep -A 2 tn14` ← All grids using tn1v4 ocean grid

Configure build and run settings for an experiment (Alok)

XML files, tools, namelists and scripts

env_mach_pes.xml :- processors set up/decomposition for various components for experiments

env_run.xml :- run time settings for experiments

env_build.xml :- setting required during building experiments

env_batch.xml :- setting related to WALLTIME for experiments

env_mach_specific.xml :- software environment related settings

xmlchange :- utility to change value in XML files

xmlquery : - utility to fetch value from XML files

do not modify XML directly; use *xmlchange*

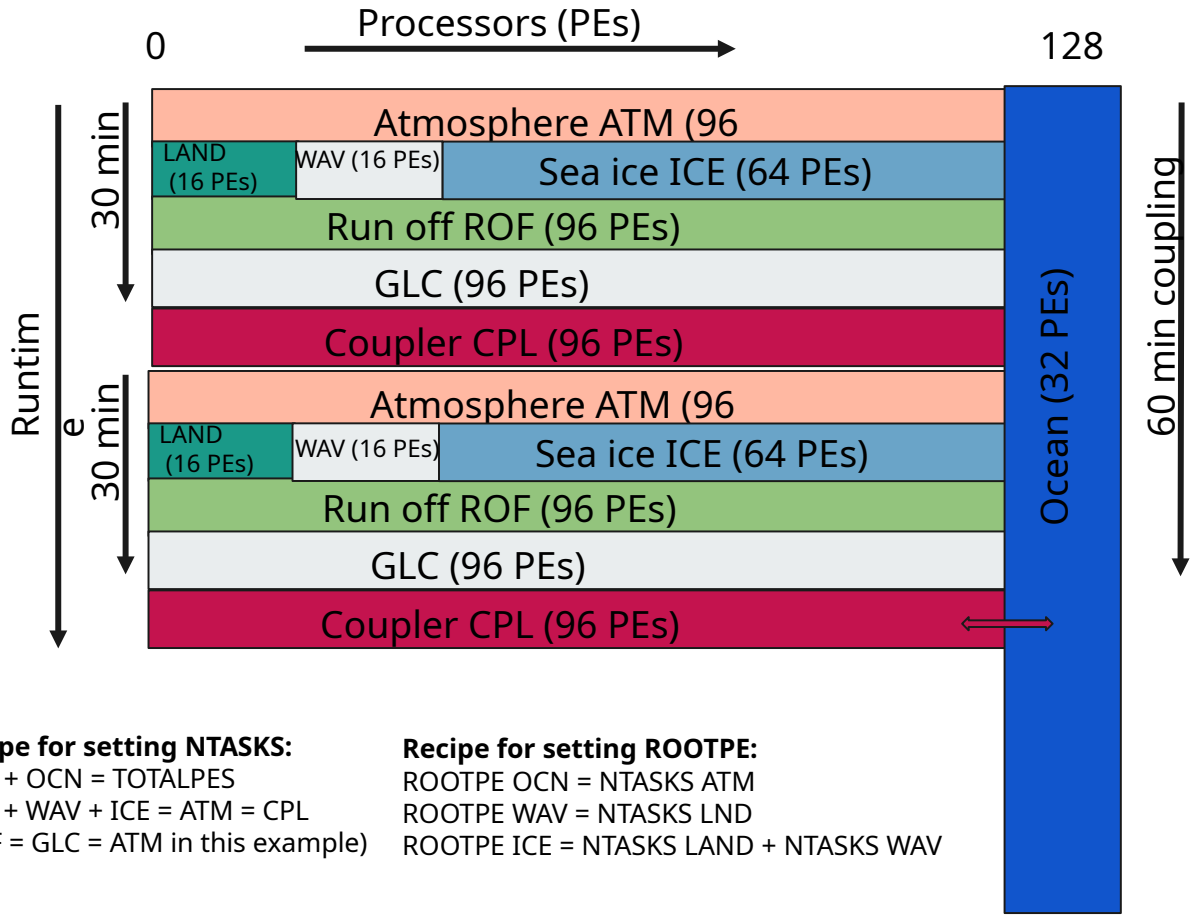
For tools/utility and scripts in more details you can always use --help option

check_input_data :- utility to check/download input data for experiments also called by *case.build*, *case.submit*

case.setup , case.build, case.submit - basic scripts to run experiments

user_nl_* , SourceMods - modified Source codes and extra/modified namelist; used for development,

Env_mach_pes.xml :- 128 CPU cores setup example




```
<entry id="NTASKS">
    <type>integer</type>
    <values>
      <value compclass="ATM">96</value>
      <value compclass="CPL">96</value>
      <value compclass="OCN">32</value>
      <value compclass="WAV">16</value>
      <value compclass="GLC">96</value>
      <value compclass="ICE">64</value>
      <value compclass="ROF">96</value>
      <value compclass="LND">16</value>
      <value compclass="ESP">1</value>
    </values>
    <desc>number of tasks for each component</desc>
  </entry>
```

```
<entry id="ROOTPE">
    <type>integer</type>
    <values>
      <value compclass="ATM">0</value>
      <value compclass="CPL">0</value>
      <value compclass="OCN">96</value>
      <value compclass="WAV">16</value>
      <value compclass="GLC">0</value>
      <value compclass="ICE">32</value>
      <value compclass="ROF">0</value>
      <value compclass="LND">0</value>
      <value compclass="ESP">0</value>
    </values>
    <desc>ROOTPE (mpi task in MPI_COMM_WORLD) for
each component</desc>
  </entry>
```

"PE Starting point"

Recipe for setting NTASKS:
ATM + OCN = TOTALPES
LND + WAV + ICE = ATM = CPL
(ROF = GLC = ATM in this example)

Recipe for setting ROOTPE:
ROOTPE OCN = NTASKS ATM
ROOTPE WAV = NTASKS LND
ROOTPE ICE = NTASKS LAND + NTASKS WAV

Create new experiments:- env_mach_pes.xml

Usually we run on more nodes. When building a case on BETZY you can set the number of nodes by setting --pecount = S, M, L or X1 when creating a case.

- NorESM2-LM (grid = f19_tn14)
  - S = 4 nodes
  - M = 8 nodes
  - X1 = 10 nodes

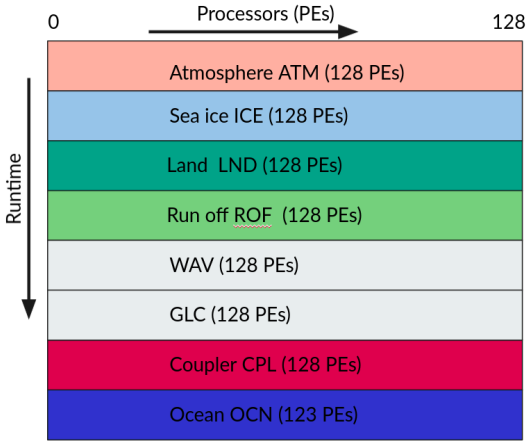
- NorESM2-MM (grid = f09_tn14)
  - S = 4 nodes
  - M = 9 nodes
  - L = 15 nodes
  - X1 = 17 nodes

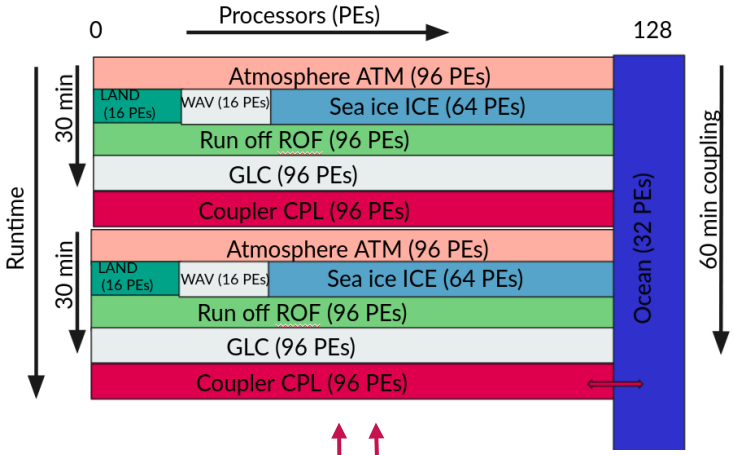
E.g. for running NorESM2-LM on 8 nodes:

```
$ cd ~/NorESM/cime/scripts/

$ ./create_newcase --case ~/cases/N1850frc2_f19_tn14_test02_20231120 --mach betzy --res f19_tn14 --compset N1850frc2 --project nn9039k --user-mods-dir cmip6_noresm_DECK --pecount=M
```

Documentation:
https://noresm-docs.readthedocs.io/en/noresm2/configurations/platforms.html#setting-number-of-nodes-on-betzy

Configure run settings: why do we care?





Cost:

- 1 node (--pecount = 128):
  - Model Cost: 729.36 pe-hrs/simulated_year
  - Model Throughput: 4.21 simulated_years/day
  - TOT Run Time: 1742.223 seconds
- 2 nodes (--pecount = 256):
  - Model Cost: 802.65 pe-hrs/simulated_year
  - Model Throughput: 7.65 simulated_years/day
  - TOT Run Time: 958.643 seconds
- 4 nodes (--pecount = 512):
  - Model Cost: 1010.31 pe-hrs/simulated_year
  - Model Throughput: 12.16 simulated_years/day
  - TOT Run Time: 603.331 seconds
- 8 nodes (--pecount = 1024):
  - Model Cost: 1634.02 pe-hrs/simulated_year
  - Model Throughput: 15.04 simulated_years/day
  - TOT Run Time: 487.899 seconds

Cost:

- 1 node (--pecount =):
  - Model Cost: 865.16 pe-hrs/simulated_year
  - Model Throughput: 3.55 simulated_years/day
  - TOT Run Time: 2066.618 seconds
- 2 nodes (--pecount = 2x):
  - Model Cost: 932.70 pe-hrs/simulated_year
  - Model Throughput: 6.59 simulated_years/day
  - TOT Run Time: 1113.970 seconds
- 4 nodes (--pecount = S):
  - Model Cost: 924.545 pe-hrs/simulated_year
  - Model Throughput: 13.29 simulated_years/day
  - TOT Run Time: 552.269 seconds
- 8 nodes (--pecount = M):
  - Model Cost: 1241.76 pe-hrs/simulated_year
  - Model Throughput: 19.79 simulated_years/day
  - TOT Run Time: 370.774 seconds

Basic steps to run NorESM: Set up the case

Enter the case folder:

```
$ cd ~/cases/N1850frc2_f19_tn14_test01_20231120/
```

./case_setup : Creates namelists and various files and directories needed to build and run the case.

- Any changes to env_mach_pes.xml, env_build.xml and env_case.xml must be made before running ./case.setup
- To run this initially for the experiment, simply run: ./case.setup
- To rerun after making changes to env_mach_pes.xml, run: ./case.setup --reset
- ./case.setup --clean do not remove user_nl_* files and Macros file

Documentation:

- https://noresm-docs.readthedocs.io/en/noresm2/configurations/newbie_guide.html
- https://noresm-docs.readthedocs.io/en/noresm2/configurations/experiments.html#create-and-configure-a-new-case
- https://noresm-docs.readthedocs.io/en/noresm2/configurations/experiment_environment.html#machine-specific-environment

Configure run setting: user namelists

In user_nl_$component you can set e.g. :

- new parameter values
- restart files
- output variables and time frequency
- activate e.g. amount of aerosol output

E.g. to change only the initial state of the sea ice, in user_nl_cice:

```
&setup_nml
 ice_ic = "/cluster/work/users/adagj/noresm/N1850frc2_f19_tn14_keyclim_snow/run/N1850_piControl_snow_KeyClim.cice.r.1855-01-01-00000.nc"
```

E.g. change some (mixing) parameters in BLOM, in user_nl_blom:

```
EGC     = 2.0
EGIDFQ   = 0.25
BDMC2 = .15
NIWGF = .5
```

Unique for user_nl_blom: it does not matter which namelist group the variable belongs to

E.g. to double the atmospheric CO2 concentration, in user_nl_cam:

```
&chem_surfvals_nl
 co2vmr        =    568.64e-6
```

Documentation:

- https://noresm-docs.readthedocs.io/en/noresm2/configurations/experiment_environment.html#user-namelists
- https://noresm-docs.readthedocs.io/en/noresm2/configurations/experiment_environment.html#user-namelists
- https://noresm-docs.readthedocs.io/en/noresm2/output/aerosol_output.html
- https://noresm-docs.readthedocs.io/en/noresm2/configurations/omips.html#modify-user-namelist-for-blom-ihamocc
- https://noresm-docs.readthedocs.io/en/noresm2/configurations/omips.html#modify-user-name-lists-for-cice
- https://noresm-docs.readthedocs.io/en/noresm2/configurations/clm.html#user-name-list-modifications

Configure run setting: user namelists

env_mach_pes.xml must be changed **before building**

In the case directory, there is a **CaseDocs** folder:

- there you'll find the namelists (i.e. component_in) containing all the input files and parameters used.
- e.g. CaseDocs/ocn_in , CaseDocs/atm_in , CaseDocs/lnd_in etc.
- *You should never have to edit the contents of this directory; it is for documentation.*
- If you wish to make changes to the component_in files, you need to change user_nl_component .

user_nl_*, env_run.xml and env_batch.xml can be changed **after building**

Documentation:
https://noresm-docs.readthedocs.io/en/noresm2/configurations/experiment_environment.html

Configure run setting: SourceMods

Warning: Excessive use of SourceMods should be avoided, as these modifications change the model behaviour and are not tracked by the git version control system.

The SourceMods folder: for **code modification(s)** beyond what is possible from user namelists

- contains sub-directories for all model component.
- Make a copy of the fortran file(s) you want to modify in the relevant sub-folder and modify the file(s) as needed before building the model.
- When compiling, the model will prioritize the modified file located under the SourceMods folder over the default version of the file located in the model source code under <noresm-base>.
- **Aerosol diagnostics and output** can be enabled by the use of SourceMods:
  - <case_folder>/**SourceMods**/src.cam/preprocessorDefinitions.h
  - #define AEROCOM: additionally 149 variables are written (+ ca. 13% CPU-time)
  - #define AEROFFL: additional radiation-diagnostics for aerosol indirect effect. Gives 8 additionally variables (+ ca. 5% CPU-time).

Documentation

https://noresm-docs.readthedocs.io/en/noresm2/configurations/experiment_environment.html?highlight=SourceMods#code-modifications

https://noresm-docs.readthedocs.io/en/noresm2/output/aerosol_output.html?highlight=SourceMods#decomposition-of-aerosol-direct-semidirect-and-indirect-radiative-forcing

Configure run setting: --user_mods_dir

-- user-mods-dir could be used for saving own special *namelists, SourceMods, ..* but, should be changed according to your needs. But in NorESM, we have used it mostly for various types of output.

The usermods under NorESM/cime_config/usermods_dirs/ include:

cmip6_noresm_DECK (AEROFFL)
cmip6_noresm_hifreq (high frequency output, AEROFFL)
cmip6_noresm_hifreq_xaer (high frequency output, AEROFFL **and** AEROCOM)
cmip6_noresm_keyCLIM (used **for** KeyCLIM experiments, AEROFFL)
cmip6_noresm_xaer (AEROFFLand AEROCOM)

To activate the cmip6_noresm_DECK usermod, run the create_newcase script with the option --user-mods-dir cmip6_noresm_DECK

Remember that the amount of diagnostics and the output frequency have a huge impact on both the run time and storage.

tation:

https://noresm-docs.readthedocs.io/en/noresm2/configurations/experiment_environment.html
https://noresm-docs.readthedocs.io/en/noresm2/output/standard_output.html
https://noresm-docs.readthedocs.io/en/noresm2/output/aerosol_output.html

Basic steps to run NorESM: Building the case

Creating an executable

```
$ ./case.build
```

- You can see all software modules in **env_mach_specific.xml** and all compiler flags in **Macros.make**
- Processors configuration in **env_mach_pes.xml**
- ./case.build – it will create namelist files and compile all the required libraries (mct, gptl, csm_share and pio) and components (cam, blom, clm, cice, ..).
- Finally, build the binary **cesm.exe**; found in /cluster/work/users/$USER/noresm/$CASENAME/bld

After this, you can modify only **env_batch.xml** and **env_run.xml**:

BUT.... if you change your mind, make a clean:
./case.setup --reset

and try again:
./case.build

Configure run settings: env_run.xml

Setting the length of the simulation:

- STOP_OPTION : nseconds,nsecond,nminutes,nhours,nhour,ndays,nmonths, nyears
- STOP_N: numerical value

```
./xmlchange STOP_OPTION=nmonths,STOP_N=6
```

Writing restart files in middle of simulation:
Restart files are written end of the simulation by default; But, if you are having a long simulation of 100 years; for safety reason you want to write restart files at some frequency you can set below option

- REST_OPTION: nseconds,nsecond,nminutes,nminute,nhours,nhour,nmonths, nyears
- REST_N: numerical value
- DOUT_S_SAVE_INTERIM_RESTART_FILES: TRUE or FALSE. Set to TRUE if you want to archive all restart files and FALSE if you only want to archive restart files from the end of the simulation

Documentation:

- https://noresm-docs.readthedocs.io/en/noresm2/configurations/experiment_environment.html
- https://noresm-docs.readthedocs.io/en/noresm2/configurations/experiment_environment.html#some-common-configuration-settings

Configure run settings: env_run.xml

Continue a simulation: when you are having WALLCLOCK time limitation on system. For example, you want to have 200 years simulation and WALLCLOCK time limitation is 5 days; you are able to simulate 10 model years/day; to complete 200 model years simulation set RESUBMIT=3, STOP_N to 50 and STOP_OPTION to nyears

- **CONTINUE_RUN** in env_run.xml; TRUE or FALSE.
  - You need all restart files and rpointer.* files in run folder.
  - Please note that CONTINUE_RUN needs to be FALSE first time you submit an experiment.
  - Will automatically be set to TRUE if the job is automatically resubmitted, i.e. if RESUBMIT > 0

- **RESUBMIT** in env_run.xml ; an integer value.
  - will auto resubmit till specified value; you will have total simulation period STOP_N*(RESUBMIT+1)

Documentation:

- https://noresm-docs.readthedocs.io/en/noresm2/configurations/experiment_environment.html
- https://noresm-docs.readthedocs.io/en/noresm2/configurations/experiment_environment.html#some-common-configuration-settings

Configure run settings: env_run.xml

Branch run

In a branch run, all components are initialized using a consistent set of restart files from a previous run. Mostly used for tuning experiments and investigating parameter space

- RUN_TYPE to “branch”
- RUN_REFDIR directory containing reference data
- RUN_REFCASE name of reference case
- RUN_REFDATE Reference date branch run
- GET_REFCASE TRUE else you have to copy data to run folder

Hybrid run

Not as strict as a branch run, all components are initialized but can have reference files from several experiments. Used e.g. for a historical experiment starting from piControl

- RUN_TYPE to “hybrid”
- RUN_REFDIR directory containing reference data
- RUN_REFCASE name of reference case
- RUN_REFDATE Reference date branch run
- GET_REFCASE TRUE else you have to copy data to run folder
- RUN_STARTDATE set the date for the beginning of the simulation

Documentation:

- https://noresm-docs.readthedocs.io/en/noresm2/configurations/experiment_environment.html
- https://noresm-docs.readthedocs.io/en/noresm2/configurations/experiment_environment.html#some-common-configuration-settings

Configure run settings: env_run.xml

Two scripts which you will find helpful (located in the case folder):

1. xmlquery: provides the information and its value which are set in the *.xml files, e.g. env_run.xml
2. xmlchange: used to change values/parameters set in the *.xml files, e.g. in env_run.xml

```
$ ./xmlquery --value STOP_OPTION,STOP_N
ndays,5
$ ./xmlchange
STOP_OPTION=nyears,STOP_N=1
$ ./xmlquery --value STOP_OPTION
nyears,1
```

If you want to look at the env_run.xml file:

```
$ vi env_run.xml
```

Documentation:

- https://noresm-docs.readthedocs.io/en/noresm2/configurations/experiment_environment.html
- https://noresm-docs.readthedocs.io/en/noresm2/configurations/experiment_environment.html#some-common-configuration-settings

Configure run setting: env_batch.xml

You also need to modify **env_batch.xml:**

- XML block for case.run
- env_batch.xml sets the arguments for the batch job commands
- Neet to set JOB_WALLCLOCK_TIME
- XML block for case.st_archive
- case.st_archive is a pending job which moves files from the run directory to the archive directory after a successful simulation.
- also here you need to set JOB_WALLCLOCK_TIME
- you can also modify project for CPU hours if required
  (usually it is set during experiment creation, but you may need to change it)

```
./xmlchange --subgroup case.st_archive JOB_WALLCLOCK_TIME=00:25:00
```

After setting the walltime for the two jobs, you can submit your case:

```
$ ./case.submit
```

Documentation:
https://noresm-docs.readthedocs.io/en/noresm2/configurations/experiment_environment.html#batch-job-environment

If you find your experiment great: Create a clone

If you really like your set up and you want to run very similar cases, you can make a clone (or several) of your case. The clone will be set up as if it was created with the same create_newcase options as the existing case (except the case name) and will have identical env_*.xml, user_nml_<component> and SourceMods files (these files can of course be modified before building the case).

The **create_clone** script is an executable python script located in cime/scripts

./create_clone --case $PATH_TO_cases/$CASENAME --clone $PATH_TO_cases/$CLONENAME

--case $CASENAME -> name of the NorESM experiment you are creating
--clone $CLONENAME -> of the case you want to clone

$ cd ~/NorESM/cime/scripts/

$ ./create_clone --case ~/cases/N1850frc2_f19_tn14_test03_20231120 --clone ~/NorESM/cases/N1850frc2_f19_tn14_test02_20231120

./create_clone --help will provide you all input options including a description

Documentation:
https://noresm-docs.readthedocs.io/en/noresm2/configurations/experiments.html?highlight=create_clone#create-a-clone-case

Hands-on session 3 -

A) piControl (N1850)
- create a new case with resolution f19_tn14
- Set --pecount=S
- make it a branch run
- reference case: N1850_f19_tn14_11062019
- reference date: 1600-01-01
- 1 mnd simulation time

B) historical (NHIST)
- create a new case with resolution f19_tn14
- Set --pecount=S
- make it a hybrid run
- reference case: N1850_f19_tn14_11062019
- reference date: 1600-01-01
- Start date: 1850-01-01
- 1 month + 1 month simulation time i.e. run for 1 month, resubmit simulation once and run for 1 more month (set RESUBMIT=1)
- Dump restart files every 10 days

C) Re-run exercise (A) for 5 years
(will be used for diagnostics next week ; change WALLTIME in env_batch.xml
For A,B we need to change only env_run.xml

Path to restart files: /cluster/shared/noresm/WORKSHOP

Documentation:
https://noresm-docs.readthedocs.io/en/noresm2/configurations/cmip6_compsets.html#reproduce-cmip6-picontrol-historical-and-ssp5-8-5-experiments

Optional extra tests

- Check how xmlquery and xmlchange work together with the xml files:
  - Assuming you want to change the total run time for NorESM, but do not remember the exact keyword, find all keywords that include STOP or CLOCK:
    ./xmlquery --partial STOP
    ./xmlquery --partial CLOCK
  - STOP_N is defined in env_run.xml, view file with “less” or grep STOP_N in env_run.xml
  - Change STOP_N value
    ./xmlchange STOP_N=10
  - Confirm change has been made in env_run.xml

Optional extra tests

- Create a clone case from (A), and add daily output for surface DMS flux from the ocean component
  - See “create_clone” from “setting up a clone case”
  - Modify “user_nl_blom”: daily output for surface DMS flux
    set SRF_DMSFLUX=4, 2, 2
    (format for output is ‘daily, monthly, yearly’, default is ‘0, 2, 2’)

- Run case (A) on normal queue for 1 month with --pecount=M to run on 8 nodes. Compare model throughput in the log file with the previous run.

- Run NorESM with data component for either atmosphere or ocean for 1 month. Compare model throughput with fully coupled run.

- Run on development queue: Set --pecount=128 when doing create_newcase ; In case:
  ./xmlchange NTASKS_OCN=123
  ./xmlchange JOB_QUEUE="devel" --subgroup case.run --force
  ./xmlchange JOB_WALLCLOCK_TIME=0:30:00 --subgroup case.run
  ./xmlchange JOB_WALLCLOCK_TIME=0:30:00 --subgroup case.st_archive