CESM Tutorial

NCAR Earth System Laboratory
CESM Software Engineering Group

CCSM 4.0 (released April 2010)
CESM 1.0 (released June 2010)
……
CESM 1.0.4 (released Feb 2012)

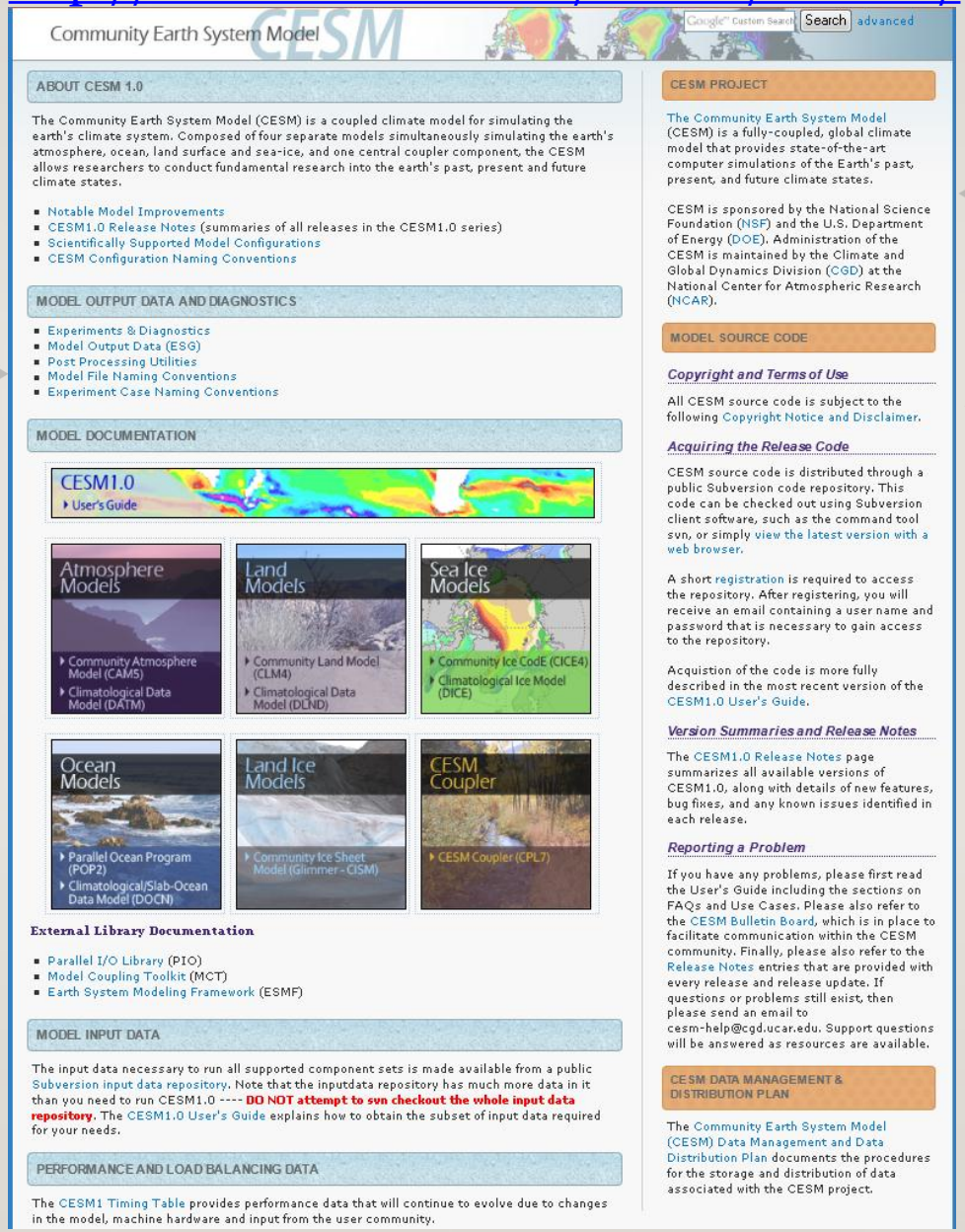
NCAR is sponsored by the National Science Foundation

Outline

- Release Homepage on Web
- Software & Hardware Requirements
- One-Time Setup
  - A) Registration and Source Code Download
  - B) Create an Input Data Root Directory
  - C) Porting
- Creating & Running a Case
  - 1) Create a New Case
  - 2) Configure the Case
  - 3) Build the Executable
  - 4) Initial Run and Output Data
  - 5)Continuation Runs
- Getting More Help
- Appendix

CESM 1.0 Release Web Page

http://www.cesm.ucar.edu/models/cesm1.0/



Notable Improvements →

Data, Diagnostics, Post-Processing Tools →

User's Guide →

Component Model Documentation →

External Libraries →

Input Data →

Timing Table →

← *Background and Sponsors*

← *Copyright and Terms of Use*

← *How to Acquire the Code*

← *Version Summaries*

← *Reporting Problems, Known Problems*

Software/Hardware Requirements

- Subversion client (version 1.4.2 or greater)
- Fortran and C compilers (recommend pgi, intel, or ibm xlf compilers)
- NetCDF library (recommend netcdf4.1.3 or later)
- MPI (MPI1 is adequate, Open MPI or MPICH seem to work on Linux clusters)
- [Note: Other external libraries (ESMF, MCT, PIO) are included in CESM source code, and do not have to be separately installed.]

- CESM currently runs "out of the box" today on the following machines
- bluefire – NCAR IBM AIX
- jaguarpf (titan) – ORNL Cray XT6
- hopper – NERSC Cray XE6
- kraken – NICS Cray XT5
- intrepid – ANL IBM Bluegene/P
- janus – Univ Colorado HPC cluster
- pleiades – NASA SGI ICE cluster

.....

- and a few others

Basic Work Flow

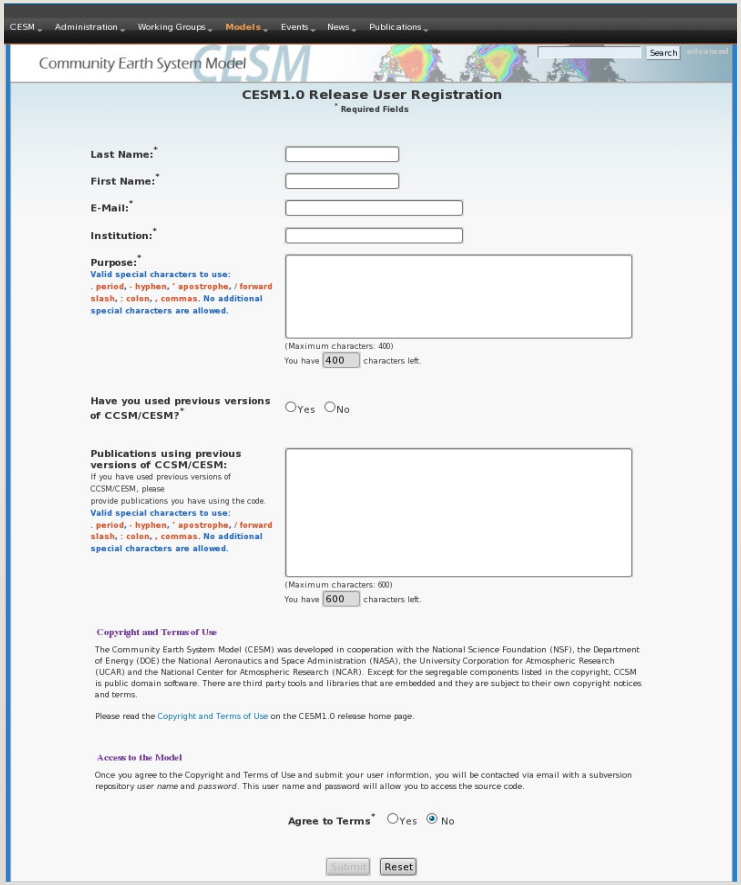
(*or how to set up and run an experiment)*

- **One-Time Setup Steps**
  - **(A) Registration and Download**
  - **(B) Create an Input Data Root Directory**
  - **(C) Porting**

- **Creating & Running a Case**
  - **(1) Create a New Case**
  - **(2) Configure the Case**
  - **(3) Build the Executable**
  - **(4) Run the Model: Initial Run and Output Data Flow**
  - **(5) Run the Model: Continuation Run(s)**

(A) Registration

- **Go to CESM1.0 home page:**
- **http://www.cesm.ucar.edu/models/cesm1.0/**
- **Right hand column has a link to the registration page, click on it**
- **Register -- you will be emailed a username and password**



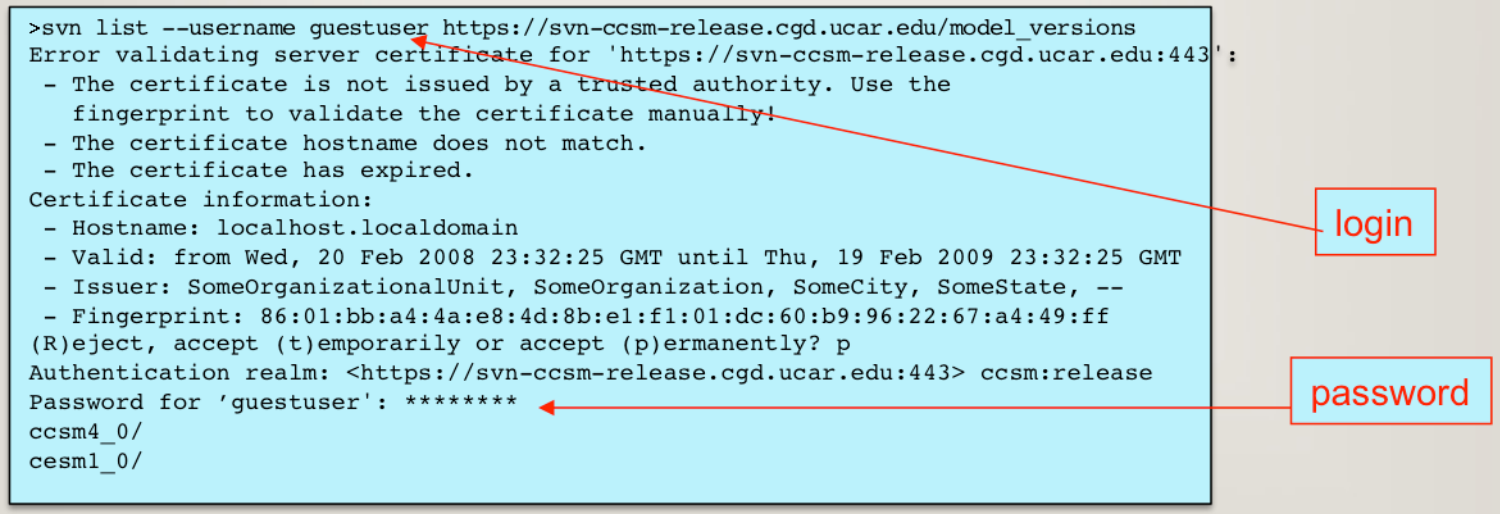
(A) Download the Source Code

- Code and input datasets are in a subversion repository
- Get subversion at http://subversion.apache.org/
- You need to download source code – but scripts will automatically download input data

```
svn list --username guestuser
```

https://svn-ccsm-release.cgd.ucar.edu/model_versions

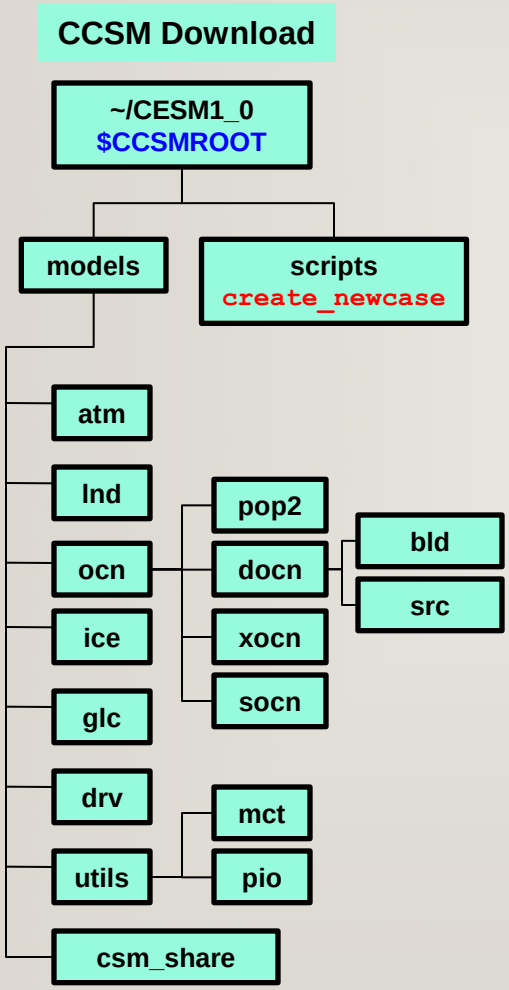
```
>svn list --username guestuser https://svn-ccsm-release.cgd.ucar.edu/model_versions
Error validating server certificate for 'https://svn-ccsm-release.cgd.ucar.edu:443':
 - The certificate is not issued by a trusted authority. Use the
   fingerprint to validate the certificate manually!
 - The certificate hostname does not match.
 - The certificate has expired.
Certificate information:
 - Hostname: localhost.localdomain
 - Valid: from Wed, 20 Feb 2008 23:32:25 GMT until Thu, 19 Feb 2009 23:32:25 GMT
 - Issuer: SomeOrganizationalUnit, SomeOrganization, SomeCity, SomeState, --
 - Fingerprint: 86:01:bb:a4:4a:e8:4d:8b:e1:f1:01:dc:60:b9:96:22:67:a4:49:ff
(R)eject, accept (t)emporarily or accept (p)ermanently? p
Authentication realm: <https://svn-ccsm-release.cgd.ucar.edu:443> ccsm:release
Password for 'guestuser': ********
ccsm4_0/
cesm1_0/
```




```
svn co --username guestuser
```

https://svn-ccsm-release.cgd.ucar.edu/models_versions/cesm1_0_4

(A) Overview of Directories (initial model download)



Basic Work Flow

- **One-Time Setup Steps**
  - **(A) Registration and Download**
  - **(B) Create an Input Data Root Directory**
  - **(C) Porting**

- **Creating & Running a Case**
  - **(1) Create a New Case**
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(B) Create an Inputdata Root Directory

- The inputdata area contains all input data required to run the model
- Location specified in the scripts by the $DIN_LOC_ROOT_CSMDATA variable in file env_run.xml

- On supported machines - populated inputdata directory already exists
- On non-supported machines - need to create inputdata root directory
- Ideally directory is shared by a group of users to save disc space
- Initially inputdata directory is empty – data is added on an as-needed basis

- *Do NOT download input data manually* (ie. by using svn co)

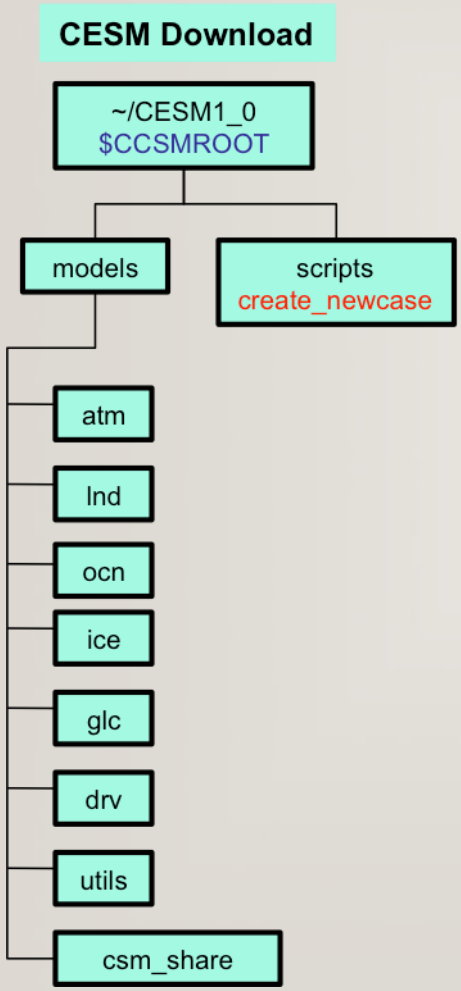
- The script check_input_data is used to download input data
- Checks if necessary data is available in inputdata directory
- Downloads *only* the data needed for a particular run (more later)
- Puts the data in the proper subdirectories of the input data directory tree and creates the proper subdirectories if necessary

- *Do NOT download input data manually*

(B) Overview of Directories (+ inputdata directory)

INPUTDATA Directory

/fs/cgd/csm/inputdata
$DIN_LOC_ROOT_CSMDATA



Basic Work Flow

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(C) Porting

- Porting details are outside scope of tutorial –see User's Guide on web and tutorial Appendix

- On supported machines - no porting is necessary

- On new machines – porting will need to be done

- If the new machine is similar to a supported machine then porting can be relatively easy

- Porting might also be more challenging – a lot depends on the specifics of your machine

- See User's Guide

Work Flow: Super Quick Start

These unix commands built and ran the model on a supported machine: "bluefire"

```
# go to root directory of source code download
cd /path/to/source/code/download/cesm1_0/

# go into scripts subdir
cd scripts

# (1) create a new case in your home dir
./create_newcase -case ~/mycase.01 -res f19_g16 -compset B_1850 -mach bluefire

# go into the case you just created in the last step
cd ~/mycase.01/

# (2) configure the case
./configure -case

# (3) build the executable
./mycase.01.bluefire.build

# (4) submit an initial run to the batch queue
bsub < mycase.01.bluefire.run

# check status of job and output files
bjobs
source Tools/ccsm_getenv
ls -lFt $RUNDIR
ls -l logs

# when the initial run finishes, change to a continuation run
./xmlchange -file env_run.xml -id CONTINUE_RUN -val TRUE

# (5) submit a continuation run to the batch queue
bsub < mycase.01.bluefire.run

# check status of job and output files
bjobs
ls -lFt $RUNDIR
ls -l logs
```

Basic Work Flow

- **One-Time Setup Steps**
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- **Creating & Running a Case**
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Work Flow: Super Quick Start

These unix commands built and ran the model on a supported machine named "bluefire"

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# (1) create a new case in your home dir
./create_newcase -case ~/mycase.01 -res f19_g16 -compset B_1850 -mach bluefire

# go into the case you just created in the last step
cd ~/mycase.01/

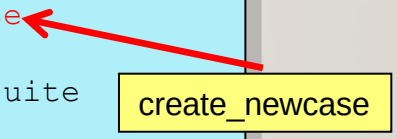
# (2) configure the case
./configure -case

..............
```

(1) Create a New Case

- Go to the scripts directory: …/CESM1_0_4/scripts/
- create_newcase is the tool that generates a new case
- Scripts are a combination of csh, perl, sh, and xml
- First step – run create_newcase

```
CESM1_0/scripts>ls -l
total 400
-rw-r--r--    1 userx   ncar          18596 May 12 11:33 ChangeLog
-rw-r--r--    1 userx   ncar            168 May 12 11:33 README
-rw-r--r--    1 userx   ncar            103 May 12 11:33 SVN_EXTERNAL_DIRECTORIES
drwxr-xr-x   10 userx   ncar           8192 May 12 11:33 ccsm_utils
-rwxr-xr-x    1 userx   ncar          19039 May 12 11:33 create_clone
-rwxr-xr-x    1 userx   ncar          52338 May 12 11:33 create_newcase
-rwxr-xr-x    1 userx   ncar          18253 May 12 11:33 create_test
-rwxr-xr-x    1 userx   ncar           9643 May 12 11:33 create_test_suite
drwxr-xr-x    3 userx   ncar           8192 May 12 11:33 doc
-rwxr-xr-x    1 userx   ncar           1255 May 12 11:33 link_dirtree
-rw-r--r--    1 userx   ncar            295 May 12 11:33 sample_compset_file.xml
-rw-r--r--    1 userx   ncar            851 May 12 11:33 sample_pes_file.xml
```



(1) About `create_newcase`

- `./create_newcase -help` lists all the available options
- Most often only four options are used: case, compset, res, and mach

```
CESM1_0/scripts>./create_newcase -help
SYNOPSIS
     create_newcase [options]
OPTIONS
     User supplied values are denoted in angle brackets (<>).  Any value that contains
     white-space must be quoted.  Long option names may be supplied with either single
     or double leading dashes.  A consequence of this is that single letter options may
     NOT be bundled.

     -case <name>          Specifies the case name (required).
     -compset <name>       Specify a CESM compset (required).
     -res <name>           Specify a CCSM grid resolution (required).
     -mach <name>          Specify a CESM machine (required).
     -pecount <name>       Value of S,M,L,X1,X2 (optional). (default is M).
     -pes_file <name>      Full pathname of pes setup file to use (will overwrite default settin
     -compset_file <name> Full pathname of compset setup file to use. (optional)

     -help [or -h]         Print usage to STDOUT (optional).
     -list                 Only list valid values for compset, grid settings and machines (optional).
     -silent [or -s]       Turns on silent mode - only fatal messages issued (optional).
     -verbose [or -v]      Turn on verbose echoing of settings made by create_newcase (optional).
     -xmlmode <name>       Sets format of xml files; normal or expert (optional). (default is normal)

     The following arguments are required for a generic machine. Otherwise, they will be ignored.

     -scratchroot <name>           ccsm executable directory (EXEROOT will be scratchroot/CASE) (char)
     -din_loc_root_csmdata <name>  cesm input data root directory (char)
     -max_tasks_per_node <value>   maximum mpi tasks per machine node (integer)

     The following two arguments turn on single point mode.
     If one is given -- both MUST be given.

     -pts_lat <value>      Latitude of single point to operate on (optional)
     -pts_lon <value>      Longitude of single point to operate on (optional)
```

(1) create_newcase: Four Required Arguments

```
./create_newcase -case ~/cases/mycase1 -res f19_g16 -compset B_1850
                 -mach bluefire
```

- "case" is the name and location of the case being created
  - ~/cases/mycase1
- "res" specifies the model resolutions (or grid)
  - Format is [atm/lnd grid]_[ocn/ice grid]
  - Equivalent short and long names (f19_g16 == 1.9x2.5_gx1v6)
- "compset" specifies the "component set"
  - component set specifies component models, forcing scenarios and physics options for those models
  - Equivalent short and long names (B1850CN == B_1850_CN)
- "mach" specifies the machine that will be used.
  - "supported" machines tested regularly, eg. bluefire, jaguar, franklin, intrepid
  - "prototype" machines are not tested regularly, eg. prototype_frost
  - "generic machines" provide a starting point for porting, eg. generic_ibm
- values set on the command line are "locked down" in case directory
  - file `env_case.xml` contains these "locked down" variables

(1) Valid Values for res, compset, and mach

- `./create_newcase -list`
  - lists all the valid choices for these command line options

```
CESM1_0/scripts>./create_newcase -list

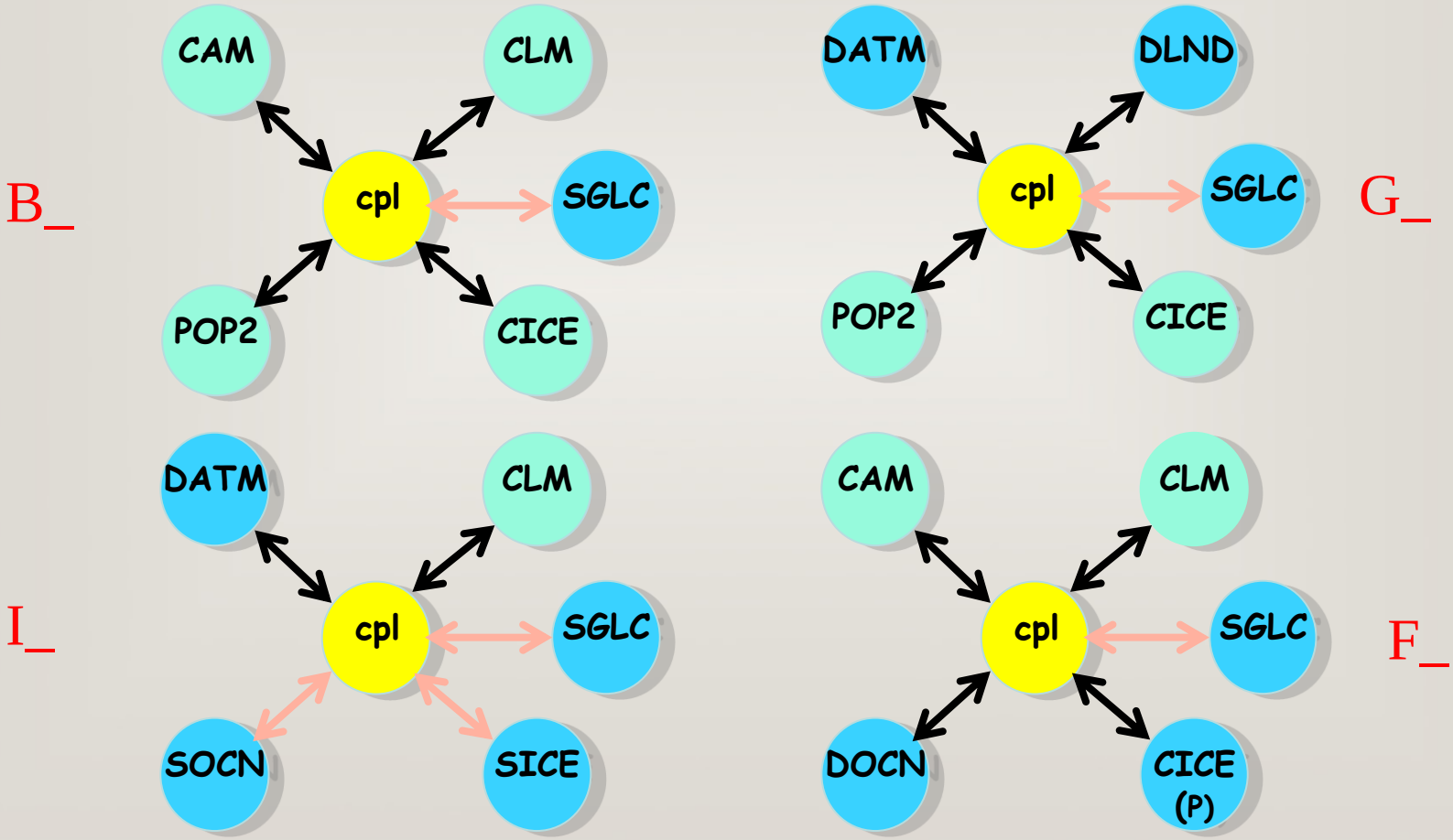
  RESOLUTIONS:  name (shortname)
    0.9x1.25_0.9x1.25 (f09_f09)
    0.9x1.25_gx1v6 (f09_g16)
    1.9x2.5_1.9x2.5 (f19_f19)
    1.9x2.5_gx1v6 (f19_g16)
    T31_gx3v7 (T31_g37)
    ne30np4_1.9x2.5_gx1v6 (ne30_f19_g16)

  COMPSETS:  name (shortname): description (status)
    A_PRESENT_DAY (A)
         Description: All data model
    B_2000 (B)
         Description: All active components, present day
    B_1850 (B1850)
         Description: All active components, pre-industrial
    F_AMIP (FAMIP)
         Description: Default resolution independent AMIP is INVALID
    F_2000_CN (FCN)
         Description: Stand-alone cam default, prescribed ocn/ice with CN
    G_NORMAL_YEAR (G)
         Description: Coupled ocean ice with COREv2 normal year forcing
    I_2000 (I)
         Description: Active land model with QIAN atm input data for 2003 and Satellite phenology (SP), CO2 level
                      and Aerosol deposition for 2000
    I_1850 (I1850)
         Description: Active land model with QIAN atm input data for 1948 to 1972 and Satellite phenology (SP), CO2
                      level and Aerosol deposition for 1850

  MACHINES:  name (description)
    bluefire (NCAR IBM p6, os is AIX, 32 pes/node, batch system is LSF)
    intrepid (ANL IBM BG/P, os is BGP, 4 pes/node, batch system is cobalt)
    jaguarpf (ORNL XT5, os is CNL, 12 pes/node, batch system is PBS)
    prototype_ranger (TACC Linux Cluster, Linux (pgi), 1 pes/node, batch system is SGE)
    generic_linux_pgi (generic linux (pgi), os is Linux, batch system is PBS, user-defined)
    generic_linux_intel (generic linux (intel), os is Linux, batch system is PBS, user-defined)
```

More on CESM component sets

- Plug and play of components (e.g. atm) with different component models (e.g. cam, datm, etc)



(1) Result of Running `create_newcase`

```
./create_newcase -case ~/cases/mycase1 -res f19_g16 -compset B_2000 -mach bluefire
```

```
For both a quick start as well as a detailed summary of creating and running
a CESM model case, see the CESM1.0 User's Guide at
http://www.cesm.ucar.edu/models/cesm1.0

IMPORTANT INFORMATION ABOUT SCIENTIFIC VALIDATION

   CESM1.0 has the flexibility to configure cases with many different
   combinations of component models, grids, and model settings, but this
   version of CESM has only been validated scientifically for the following
   fully active configurations:

      1.9x2.5_gx1v6   B_1850_CN
      1.9x2.5_gx1v6   B_1850_RAMPCO2_CN
      1.9x2.5_gx1v6   B_1850-2000_CN

      1.9x2.5_gx1v6   B_1850_CAM5

    ……..

   please refer to the individual component web pages at
   http://www.cesm.ucar.edu/models/cesm1.0

************************************************************
Component set     : B_2000 (B)
Desc              : All active components, present day
************************************************************

Creating  ~/cases/mycase1

Locking file ~/cases/mycase1/env_case.xml
Successfully created the case for bluefire
```

warning message

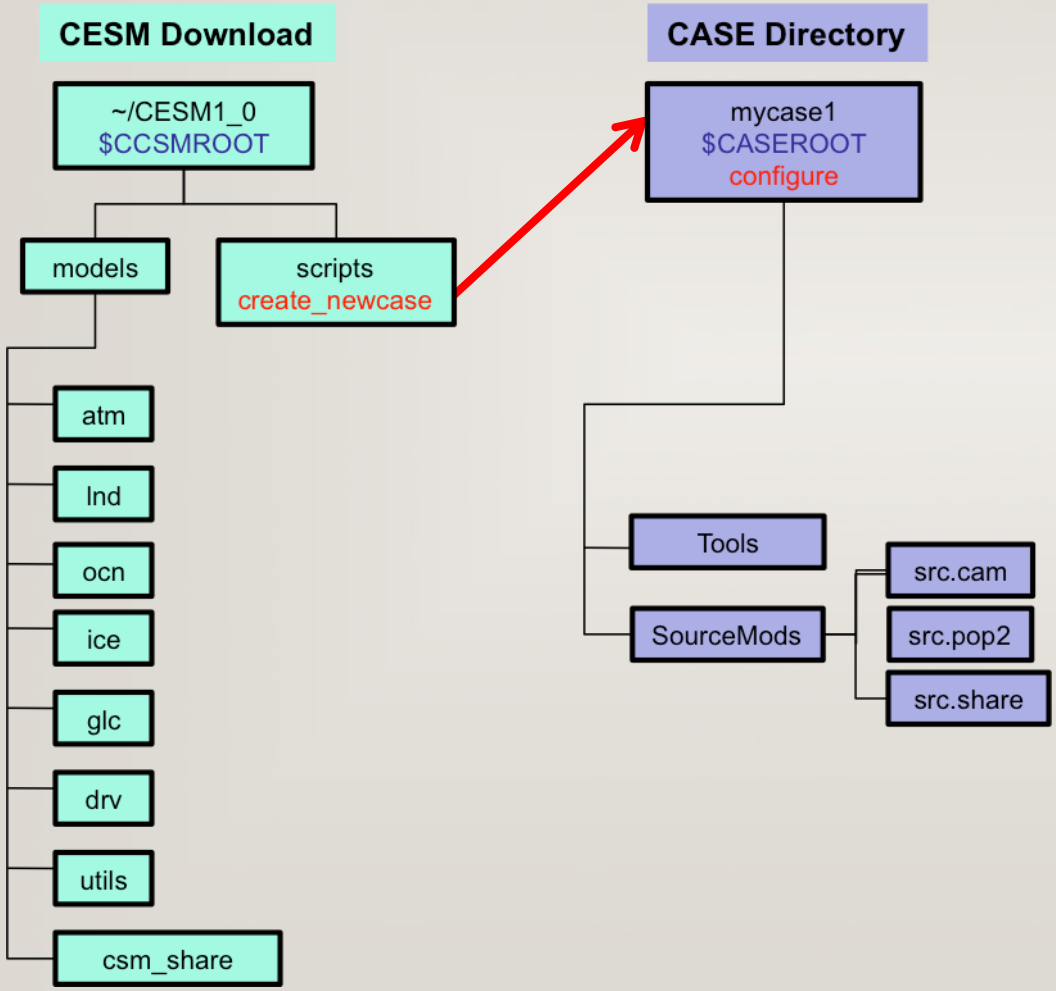
case location

success

(1) Overview of Directories (+ create_newcase)

INPUTDATA Directory

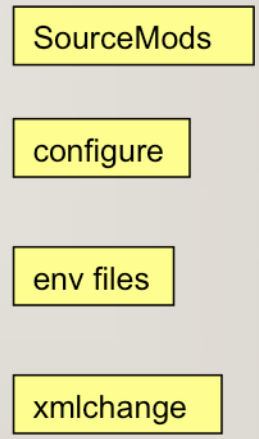
/fs/cgd/csm**/inputdata**
$DIN_LOC_ROOT_CSMDATA



(1) Case Directory After Running `create_newcase`

- `SourceMods` - directory for case specific code modifications
- `configure` - script used in the next step, step (2)
- `env_*.xml` - contains environment variables (more on this later)
- `xmlchange` - script that changes xml (env) variable values

```
CESM1_0/scripts> cd ~/cases/mycase1
cases/mycase1>ls -l
total 64
drwxr-xr-x    2 userx   ncar           8192 May 13 14:32 LockedFiles
-rw-r--r--    1 userx   ncar          10687 May 13 14:32 Macros.bluefire
drwxr-xr-x    2 userx   ncar           8192 May 13 14:32 README
-rw-r--r--    1 userx   ncar             66 May 13 14:32 README.case
drwxr-xr-x    9 userx   ncar           8192 May 13 14:32 SourceMods
drwxr-xr-x    4 userx   ncar           8192 May 13 14:32 Tools
-rwxr-xr-x    1 userx   ncar           9330 May 12 11:33 check_input_data
-rwxr-xr-x    1 userx   ncar          10092 May 12 11:33 configure
-rwxr-xr-x    1 userx   ncar           3085 May 12 11:33 create_production_test
-rw-r--r--    1 userx   ncar           4433 May 13 14:32 env_build.xml
-rw-r--r--    1 userx   ncar           5635 May 13 14:32 env_case.xml
-rw-r--r--    1 userx   ncar           7029 May 13 14:32 env_conf.xml
-rw-r--r--    1 userx   ncar           5915 May 13 14:32 env_mach_pes.xml
-rwxr-xr-x    1 userx   ncar           2199 May 13 14:32 env_mach_specifi
-rw-r--r--    1 userx   ncar          10466 May 13 14:32 env_run.xml
-rwxr-xr-x    1 userx   ncar          10388 May 12 11:33 xmlchange
```



About .xml Files: Format & Variables

- Contains variables used by scripts -- some can be changed by the user
- Here's a snippet of the `env_run.xml` file

```
<!--"sets the run length in conjunction with STOP_N and STOP_DATE, valid values: none,never,nst
eps,nstep,nseconds,nsecond,nminutes,nminute,nhours,nhour,ndays,nday,nmonths,nmonth,nyears,nyea
r,date,ifdays0,end (char) " -->
<entry id="STOP_OPTION"   value="ndays"  />

<!--"sets the run length in conjunction with STOP_OPTION and STOP_DATE (integer) " -->
<entry id="STOP_N"   value="5"  />

<!--"logical to turn on short term archiving, valid values: TRUE,FALSE (logical) " -->
<entry id="DOUT_S"   value="TRUE"  />

<!--"local short term archiving root directory (char) " -->
<entry id="DOUT_S_ROOT"   value="/ptmp/$CCSMUSER/archive/$CASE"  />
```

- "id" - variable name
- "value" – variable value
- <!--- text --> description above the entry
- To modify a variable in an xml file – use **`xmlchange`**

  > **`xmlchange -help`**

  > **`xmlchange -file env_run.xml -id STOP_N -val 20`**

  (Can edit `env_*.xml` file manually -- but be careful about introducing formatting errors)

About .xml Files: How They Change the Build and Run

- **env_case.xml**
  - Set by `create_newcase` and cannot be modified
- **env_conf.xml**
  - Specifies component information
  - Can change the physics of a model – be very careful about this
- **env_mach_pes.xml**
  - Specifies layout of components on hardware processors
  - Use this to tune performance - scientific results do not depend on component/processor layout
- **env_build.xml**
  - Specifies build information
- **Macros.***
  - Specifies Makefile compilation variables
- **env_mach_specific**
  - Sets modules and paths to libraries (e.g. MPI)
  - Can change compiler options, libraries, etc.
  - Part of porting is to set variables here
- **env_run.xml**
  - Sets run time information
  - User interacts with this file most frequently

```
<entry id="NTASKS_ATM"    value="64"  />
<entry id="NTHRDS_ATM"    value="1"   />
<entry id="ROOTPE_ATM"    value="0"   />

<entry id="NTASKS_LND"    value="64"  />
<entry id="NTHRDS_LND"    value="1"   />
<entry id="ROOTPE_LND"    value="0"   />

<entry id="NTASKS_ICE"    value="64"  />
<entry id="NTHRDS_ICE"    value="1"   />
<entry id="ROOTPE_ICE"    value="0"   />

<entry id="NTASKS_OCN"    value="64"  />
<entry id="NTHRDS_OCN"    value="1"   />
<entry id="ROOTPE_OCN"    value="0"   />

<entry id="NTASKS_CPL"    value="64"  />
<entry id="NTHRDS_CPL"    value="1"   />
<entry id="ROOTPE_CPL"    value="0"   />
```

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These unix commands built and ran the model on a supported machine named "bluefire"

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cd scripts

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./create_newcase -case ~/cases/mycase.01 -res f19_g16 -compset B_1850 -
mach bluefire

# go into the case you just created in the last step
cd ~/cases/mycase.01/

# (2) configure the case
./configure -case

# (3) build the executable
./mycase.01.bluefire.build

…
```
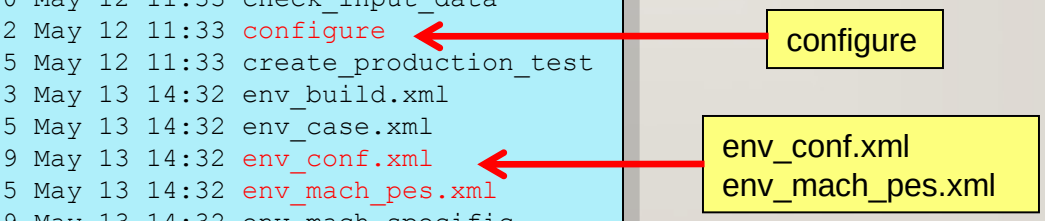

(2) Configure the Case

- Run `./configure -case`
- Generates
  - Buildconf directory with `buildnml`, `buildexe`, and `input_data_list` files
  - case `*.build` and `*.run` scripts

- Locks `env_conf.xml` and `env_mach_pes.xml`
- Modify `env_conf.xml` and `env_mach_pes.xml` *before running configure*

```
CESM1_0/scripts> cd ~/cases/mycase1
cases/mycase1>ls -l
total 64
drwxr-xr-x    2 userx   ncar          8192 May 13 14:32 LockedFiles
-rw-r--r--    1 userx   ncar         10687 May 13 14:32 Macros.bluefire
drwxr-xr-x    2 userx   ncar          8192 May 13 14:32 README
-rw-r--r--    1 userx   ncar            66 May 13 14:32 README.case
drwxr-xr-x    9 userx   ncar          8192 May 13 14:32 SourceMods
drwxr-xr-x    4 userx   ncar          8192 May 13 14:32 Tools
-rwxr-xr-x    1 userx   ncar          9330 May 12 11:33 check_input_data
-rwxr-xr-x    1 userx   ncar         10092 May 12 11:33 configure
-rwxr-xr-x    1 userx   ncar          3085 May 12 11:33 create_production_test
-rw-r--r--    1 userx   ncar          4433 May 13 14:32 env_build.xml
-rw-r--r--    1 userx   ncar          5635 May 13 14:32 env_case.xml
-rw-r--r--    1 userx   ncar          7029 May 13 14:32 env_conf.xml
-rw-r--r--    1 userx   ncar          5915 May 13 14:32 env_mach_pes.xml
-rwxr-xr-x    1 userx   ncar          2199 May 13 14:32 env_mach_specific
-rw-r--r--    1 userx   ncar         10466 May 13 14:32 env_run.xml
-rwxr-xr-x    1 userx   ncar         10388 May 12 11:33 xmlchange
```



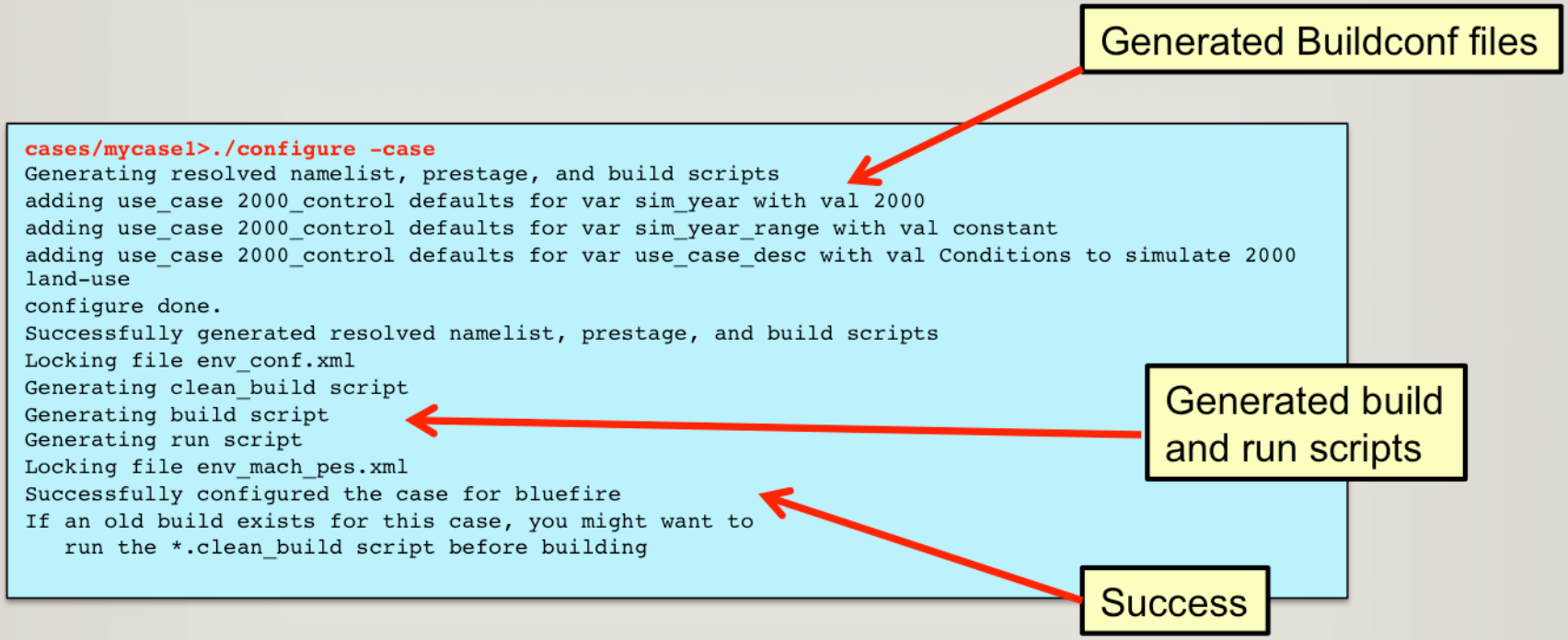
(2) About configure

> `./configure -help`

```
NAME

      configure - configures the model for a given resolution, component set
      and machine.

SYNOPSIS

      configure [-case] [-cleannamelist] [-cleanmach] [-cleanall]
```

- `./configure -case`
  - Configures the case
- `./configure -cleanall`
  - Unlocks `env_conf.xml` and `env_mach_pes.xml`
  - "Backs up" `Buildconf/` and run scripts
  - Modify `env_conf.xml` and `env_mach_pes.xml` and type `configure -case` again
- `./configure -cleanmach`
  - Unlocks only `env_mach_pes.xml`
  - "Backs up" run scripts
  - Modify `env_mach_pes.xml` and type `configure -case` again

(2) Running `configure`

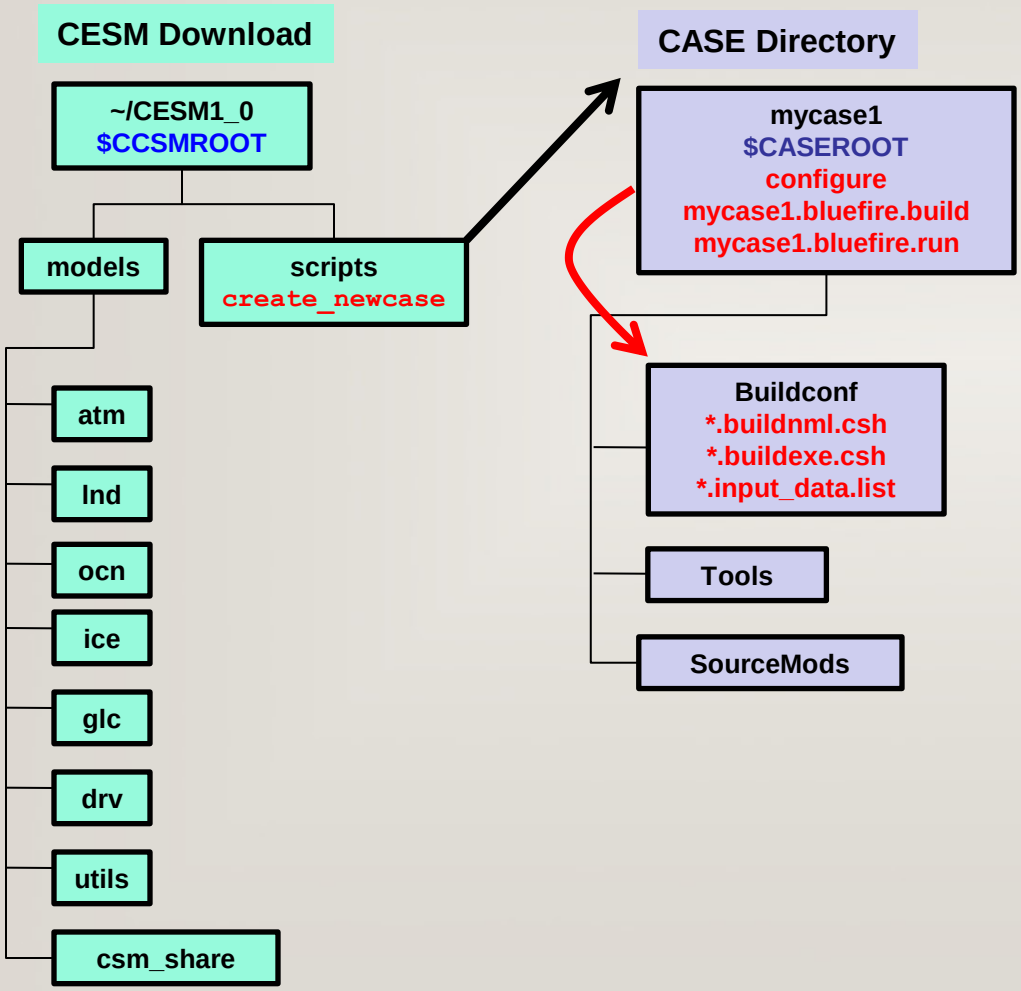


NCAR Earth System Laboratory

INPUTDATA Directory

/fs/cgd/csm/inputdata
$DIN_LOC_ROOT_CSMDATA

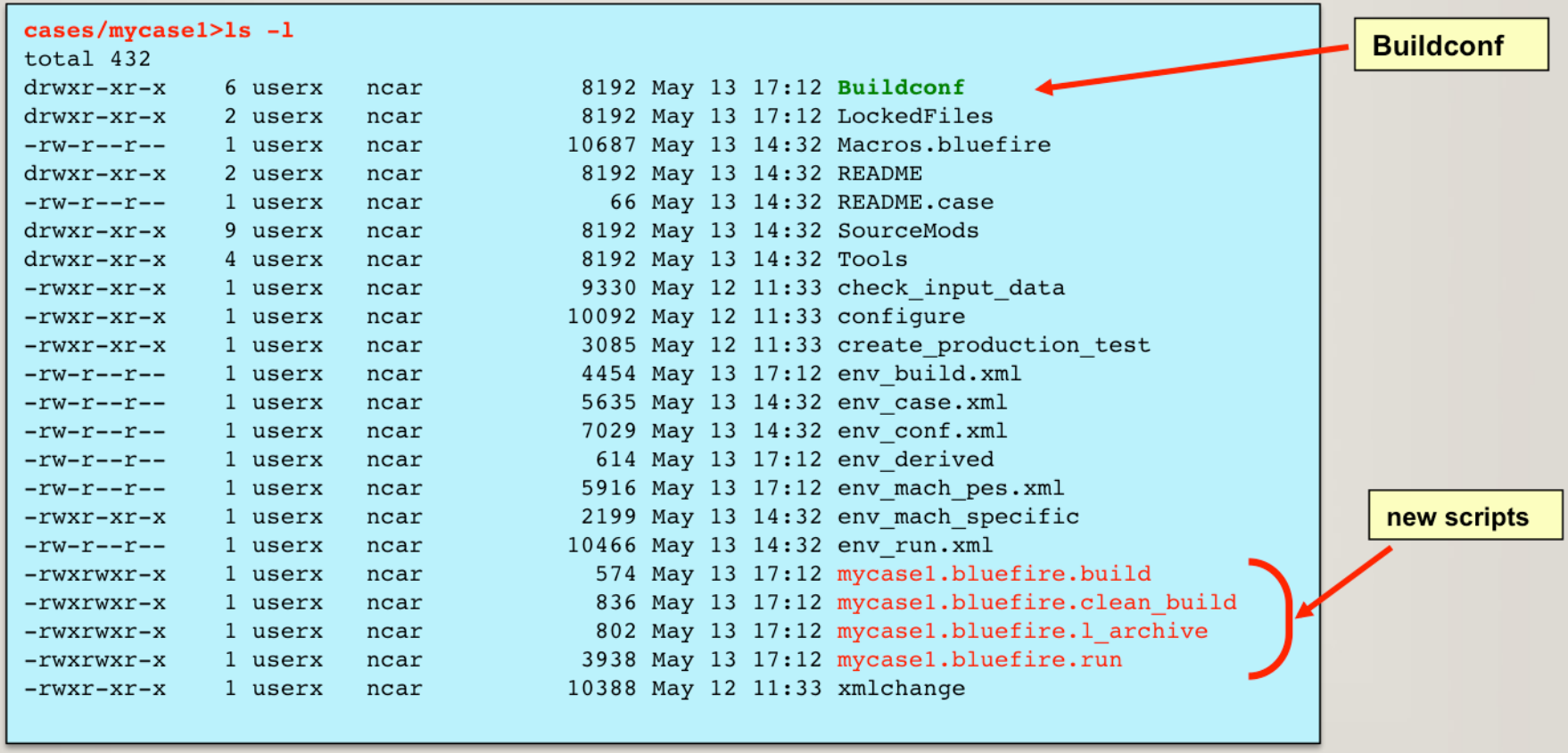
(2) Overview of Directories (+ configure)



(2) Case Dir After Running `configure`

- `configure` adds the Buildconf directory and populates it
- `configure` generates build, clean_build, run, and archive scripts

```
cases/mycase1>ls -l
total 432
drwxr-xr-x    6 userx    ncar          8192 May 13 17:12 Buildconf
drwxr-xr-x    2 userx    ncar          8192 May 13 17:12 LockedFiles
-rw-r--r--    1 userx    ncar         10687 May 13 14:32 Macros.bluefire
drwxr-xr-x    2 userx    ncar          8192 May 13 14:32 README
-rw-r--r--    1 userx    ncar            66 May 13 14:32 README.case
drwxr-xr-x    9 userx    ncar          8192 May 13 14:32 SourceMods
drwxr-xr-x    4 userx    ncar          8192 May 13 14:32 Tools
-rwxr-xr-x    1 userx    ncar          9330 May 12 11:33 check_input_data
-rwxr-xr-x    1 userx    ncar         10092 May 12 11:33 configure
-rwxr-xr-x    1 userx    ncar          3085 May 12 11:33 create_production_test
-rw-r--r--    1 userx    ncar          4454 May 13 17:12 env_build.xml
-rw-r--r--    1 userx    ncar          5635 May 13 14:32 env_case.xml
-rw-r--r--    1 userx    ncar          7029 May 13 14:32 env_conf.xml
-rw-r--r--    1 userx    ncar           614 May 13 17:12 env_derived
-rw-r--r--    1 userx    ncar          5916 May 13 17:12 env_mach_pes.xml
-rwxr-xr-x    1 userx    ncar          2199 May 13 14:32 env_mach_specific
-rw-r--r--    1 userx    ncar         10466 May 13 14:32 env_run.xml
-rwxrwxr-x    1 userx    ncar           574 May 13 17:12 mycase1.bluefire.build
-rwxrwxr-x    1 userx    ncar           836 May 13 17:12 mycase1.bluefire.clean_build
-rwxrwxr-x    1 userx    ncar           802 May 13 17:12 mycase1.bluefire.l_archive
-rwxrwxr-x    1 userx    ncar          3938 May 13 17:12 mycase1.bluefire.run
-rwxr-xr-x    1 userx    ncar         10388 May 12 11:33 xmlchange
```



(2) Files in the Buildconf/ Directory (Created by `configure`)

- The configure script fills the `Buildconf/` directory which contains
- Component `buildnml.csh` scripts
- Component `buildexe.csh` scripts
- Component `input_data_list`

```
cases/mycase1>ls -l Buildconf/
total 448
-rwxr-xr-x    1 userx   ncar            850 May 13 17:12 cam.buildexe.csh
-rwxr-xr-x    1 userx   ncar           3625 May 13 17:12 cam.buildnml.csh
-rwxr-xr-x    1 userx   ncar           1508 May 13 17:12 cam.input_data_list
drwxr-xr-x    2 userx   ncar           8192 May 13 17:12 camconf
-rwxr-xr-x    1 userx   ncar            480 May 13 17:12 ccsm.buildexe.csh
-rwxr-xr-x    1 userx   ncar           1414 May 13 17:12 cice.buildexe.csh
-rwxr-xr-x    1 userx   ncar           3292 May 13 17:12 cice.buildnml.csh
-rwxr-xr-x    1 userx   ncar            379 May 13 17:12 cice.input_data_list
drwxr-xr-x    2 userx   ncar           8192 May 13 17:12 ciceconf
-rwxr-xr-x    1 userx   ncar           1174 May 13 17:12 clm.buildexe.csh
-rwxr-xr-x    1 userx   ncar           2269 May 13 17:12 clm.buildnml.csh
-rwxr-xr-x    1 userx   ncar            702 May 13 17:12 clm.input_data_list
drwxr-xr-x    2 userx   ncar           8192 May 13 17:12 clmconf
-rwxr-xr-x    1 userx   ncar             42 May 13 17:12 cpl.buildexe.csh
-rwxr-xr-x    1 userx   ncar          10507 May 13 17:12 cpl.buildnml.csh
-rwxr-xr-x    1 userx   ncar           1665 May 13 17:12 csm_share.buildlib
-rwxr-xr-x    1 userx   ncar           1965 May 13 17:12 mct.buildlib
-rwxr-xr-x    1 userx   ncar           2412 May 13 17:12 pio.buildlib
-rwxr-xr-x    1 userx   ncar           5546 May 13 17:12 pop2.buildexe.csh
-rwxr-xr-x    1 userx   ncar          29056 May 13 17:12 pop2.buildnml.csh
-rwxr-xr-x    1 userx   ncar           1012 May 13 17:12 pop2.input_data_list
drwxr-xr-x    2 userx   ncar           8192 May 13 17:12 pop2doc
-rwxr-xr-x    1 userx   ncar            588 May 13 17:12 sglc.buildexe.csh
-rwxr-xr-x    1 userx   ncar             78 May 13 17:12 sglc.buildnml.csh
```

Basic Work Flow

- **One-Time Setup Steps**
  - **(A) Registration and Download**
  - **(B) Create an Input Data Root Directory**
  - **(C) Porting**

- **Creating & Running a Case**
  - **(1) Create a New Case**
  - **(2) Configure the Case**
  - **(3) Build the Executable**
  - **(4) Run the Model: Initial Run and Output Data Flow**
  - **(5) Run the Model: Continuation Run(s)**

Work Flow: Super Quick Start

These unix commands built and ran the model on a supported machine named "bluefire"

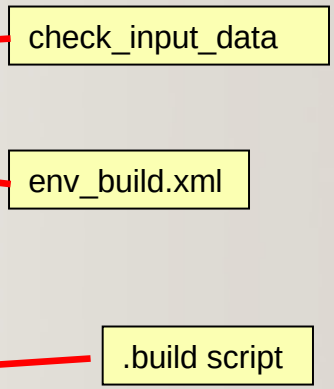
```
# go to root directory of source code download
cd /path/to/source/code/download/cesm1_0/

# go into scripts subdir
cd scripts

# (1) create a new case in your home dir
./create_newcase -case ~/cases/mycase.01 -res f19_g16 -compset B_1850 -mach bluefire

# go into the case you just created in the last step
cd ~/cases/mycase.01/

# (2) configure the case
./configure -case

# (3) build the executable
./mycase.01.bluefire.build

# (4) submit an initial run to the batch queue
bsub < mycase.01.bluefire.run

. . . . . .
```

(3) Build the Model

- Use the `*.build` script
- Modifications before build
  - Change `env_build.xml` values *before* running `*.build`
  - Introduce modified source code in `SourceMods/` before building
- To redo build, run `*.clean_build` first
- The `*.build` script
  - Checks for missing input data
  - Creates directory for executable code and model namelist files
  - Locks `env_build.xml`
  - Builds the individual component libraries and model executable
- If any inputdata is missing,
  - Build aborts, but provides a list of missing files
  - Run `./check_input_data -export` to acquire missing data
  - This will use svn to put required data in the inputdata directory
  - Then re-run build script

(3) The *.build script

```
cases/mycase1>ls -l
total 432
drwxr-xr-x    6 userx    ncar          8192 May 13 17:12 Buildconf
drwxr-xr-x    2 userx    ncar          8192 May 13 17:12 LockedFiles
-rw-r--r--    1 userx    ncar         10687 May 13 14:32 Macros.bluefire
drwxr-xr-x    2 userx    ncar          8192 May 13 14:32 README
-rw-r--r--    1 userx    ncar            66 May 13 14:32 README.case
drwxr-xr-x    9 userx    ncar          8192 May 13 14:32 SourceMods
drwxr-xr-x    4 userx    ncar          8192 May 13 14:32 Tools
-rwxr-xr-x    1 userx    ncar          9330 May 12 11:33 check_input_data
-rwxr-xr-x    1 userx    ncar         10092 May 12 11:33 configure
-rwxr-xr-x    1 userx    ncar          3085 May 12 11:33 create_production_test
-rw-r--r--    1 userx    ncar          4454 May 13 17:12 env_build.xml
-rw-r--r--    1 userx    ncar          5635 May 13 14:32 env_case.xml
-rw-r--r--    1 userx    ncar          7029 May 13 14:32 env_conf.xml
-rw-r--r--    1 userx    ncar           614 May 13 17:12 env_derived
-rw-r--r--    1 userx    ncar          5916 May 13 17:12 env_mach_pes.xml
-rwxr-xr-x    1 userx    ncar          2199 May 13 14:32 env_mach_specific
-rw-r--r--    1 userx    ncar         10466 May 13 14:32 env_run.xml
-rwxrwxr-x    1 userx    ncar           574 May 13 17:12 mycase1.bluefire.build
-rwxrwxr-x    1 userx    ncar           836 May 13 17:12 mycase1.bluefire.clean_build
-rwxrwxr-x    1 userx    ncar           802 May 13 17:12 mycase1.bluefire.l_archive
-rwxrwxr-x    1 userx    ncar          3938 May 13 17:12 mycase1.bluefire.run
-rwxr-xr-x    1 userx    ncar         10388 May 12 11:33 xmlchange
```

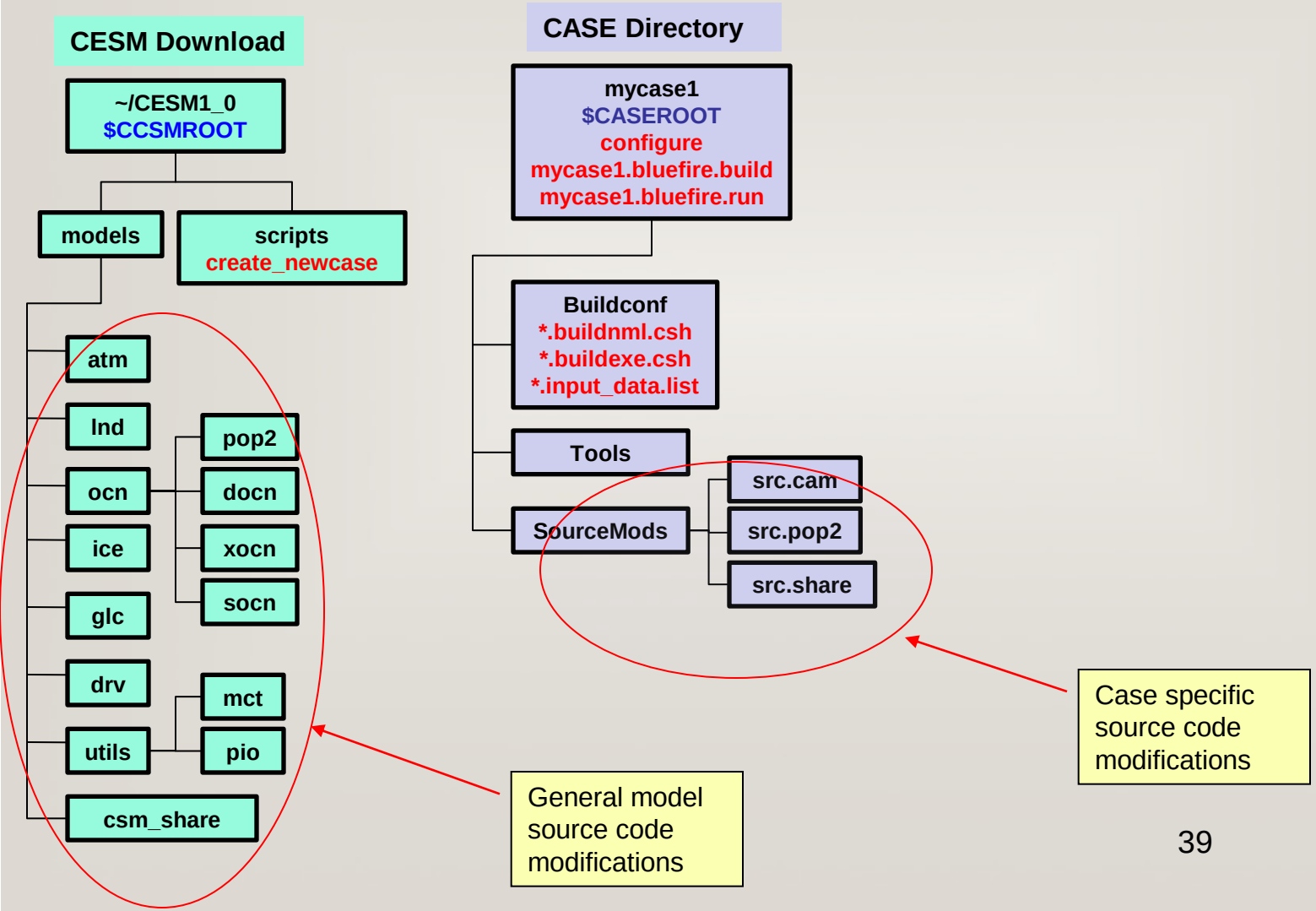


(3) Modifying Source Code

Code modified in `models/` will apply to all new cases created – A BAD IDEA

Modified code in the CASE `SourceMods/` subdirectory applies to that case only

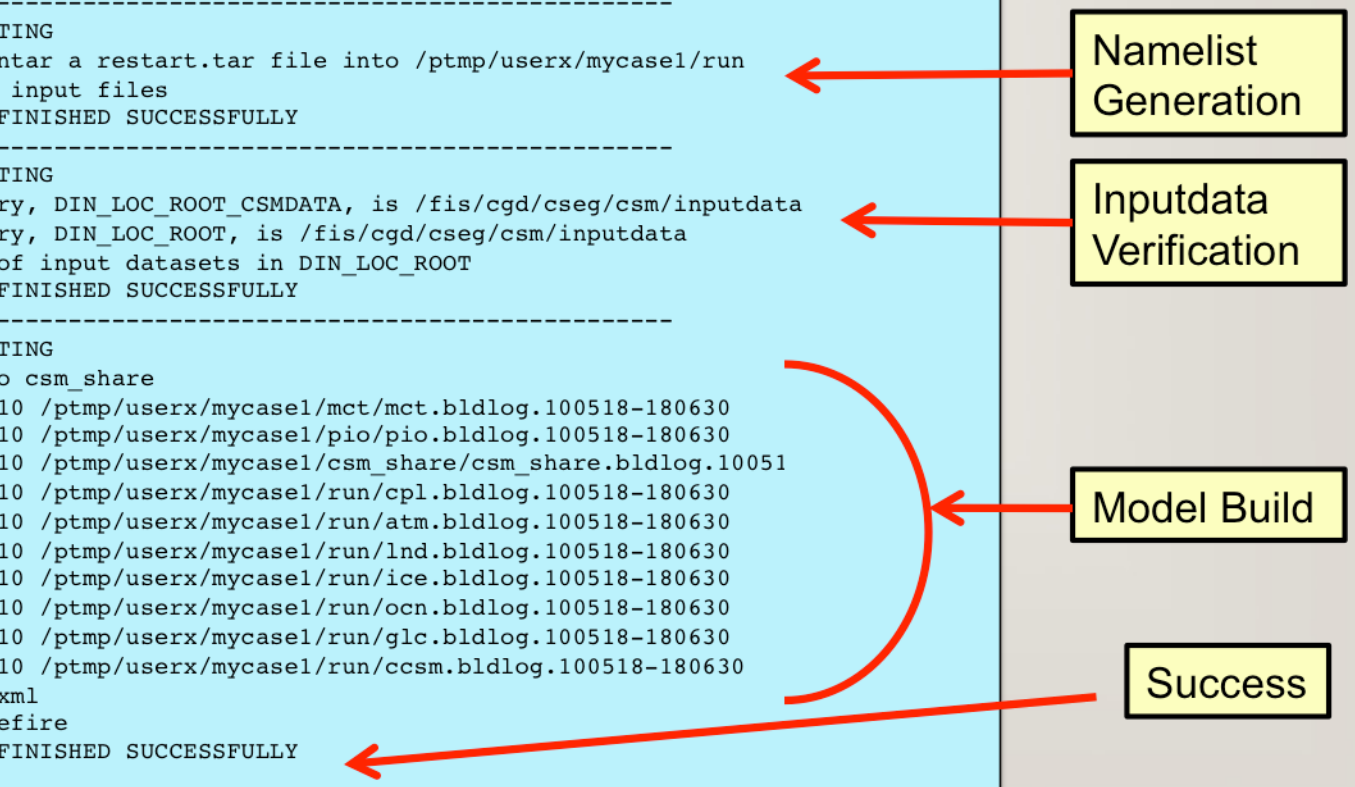
Files in `SourceMods/` must be in proper subdirectory, eg. pop2 code in src.pop2



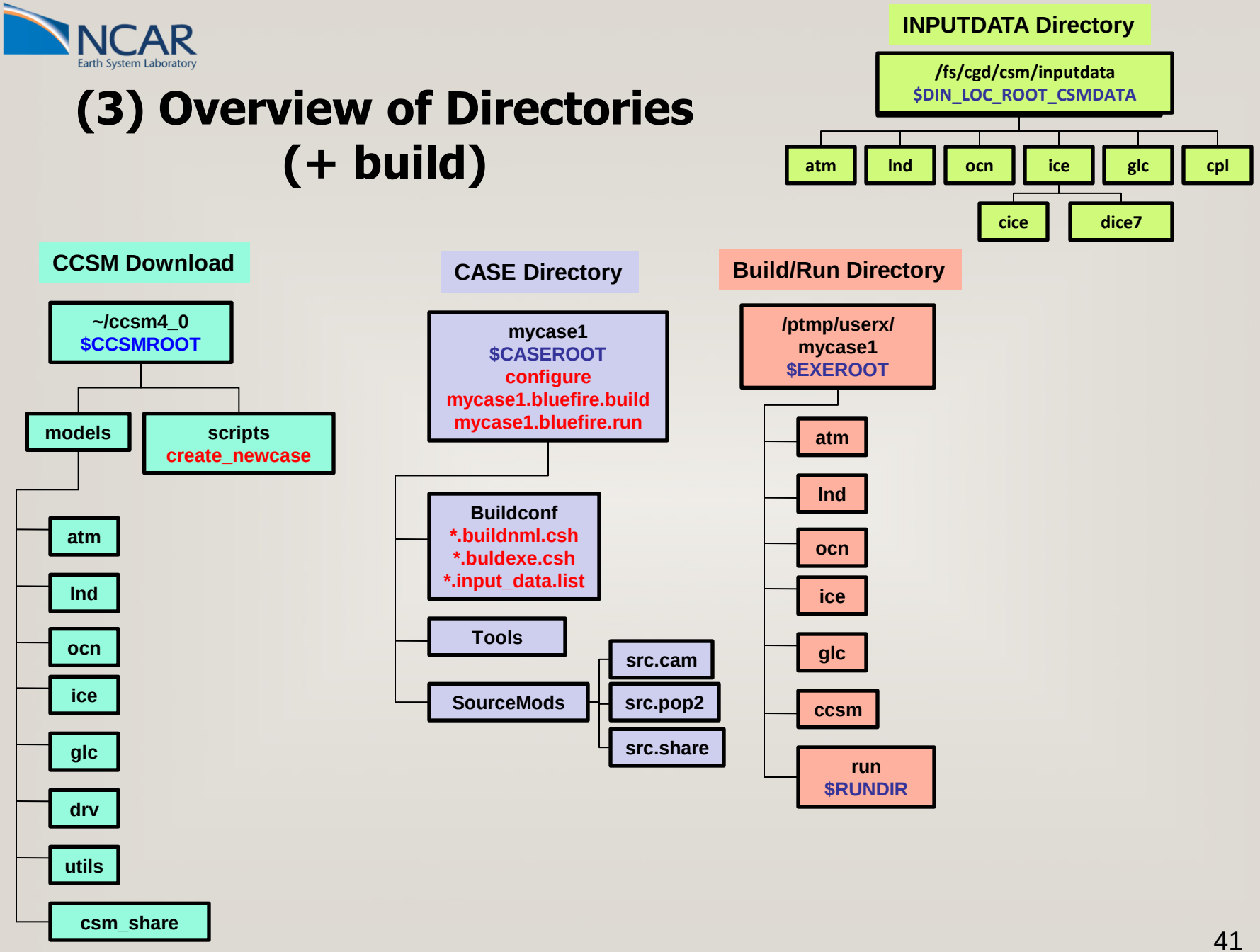
(3) Running the .build Script

- Checks for missing input data
- Aborts if any input data is missing
- Builds the component model libraries and executable by running the `*.buildexe.csh` scripts for each component

```
cases/mycase1>./mycase1.bluefire.build
------------------------------------------------------------------------
 CESM BUILDNML SCRIPT STARTING
 - To prestage restarts, untar a restart.tar file into /ptmp/userx/mycase1/run
 - Create modelio namelist input files
 CESM BUILDNML SCRIPT HAS FINISHED SUCCESSFULLY
------------------------------------------------------------------------
 CESM PRESTAGE SCRIPT STARTING
 - CESM input data directory, DIN_LOC_ROOT_CSMDATA, is /fis/cgd/cseg/csm/inputdata
 - Case input data directory, DIN_LOC_ROOT, is /fis/cgd/cseg/csm/inputdata
 - Checking the existence of input datasets in DIN_LOC_ROOT
 CESM PRESTAGE SCRIPT HAS FINISHED SUCCESSFULLY
------------------------------------------------------------------------
 CESM BUILDEXE SCRIPT STARTING
 - Build Libraries: mct pio csm_share
Tue May 18 18:06:34 MDT 2010 /ptmp/userx/mycase1/mct/mct.bldlog.100518-180630
Tue May 18 18:07:21 MDT 2010 /ptmp/userx/mycase1/pio/pio.bldlog.100518-180630
Tue May 18 18:08:16 MDT 2010 /ptmp/userx/mycase1/csm_share/csm_share.bldlog.10051
Tue May 18 18:08:59 MDT 2010 /ptmp/userx/mycase1/run/cpl.bldlog.100518-180630
Tue May 18 18:08:59 MDT 2010 /ptmp/userx/mycase1/run/atm.bldlog.100518-180630
Tue May 18 18:10:25 MDT 2010 /ptmp/userx/mycase1/run/lnd.bldlog.100518-180630
Tue May 18 18:11:43 MDT 2010 /ptmp/userx/mycase1/run/ice.bldlog.100518-180630
Tue May 18 18:12:43 MDT 2010 /ptmp/userx/mycase1/run/ocn.bldlog.100518-180630
Tue May 18 18:14:52 MDT 2010 /ptmp/userx/mycase1/run/glc.bldlog.100518-180630
Tue May 18 18:14:53 MDT 2010 /ptmp/userx/mycase1/run/ccsm.bldlog.100518-180630
 - Locking file env_build.xml
 - Locking file Macros.bluefire
 CESM BUILDEXE SCRIPT HAS FINISHED SUCCESSFULLY
```



(3) Overview of Directories (+ build)



(3) Your $RUNDIR after running .build

```
cases/mycase1> source Tools/ccsm_getenv
cases/mycase1> echo $RUNDIR
    > /ptmp/userx/mycase1/run
cases/mycase1> ls -al $RUNDIR
```

```
cases/mycase1>ls -l $RUNDIR
total 167552
-rw-r--r--    1 userx   ncar          9960 May 18 18:10 atm.bldlog.100518-180630.gz
-rw-r--r--    1 userx   ncar          2867 May 18 18:06 atm_in
-rw-r--r--    1 userx   ncar           133 May 18 18:06 atm_modelio.nml
-rw-r--r--    1 userx   ncar          1398 May 18 18:15 ccsm.bldlog.100518-180630.gz
-rwxr-xr-x    1 userx   ncar      84463482 May 18 18:15 ccsm.exe
-rw-r--r--    1 userx   ncar           120 May 18 18:08 cpl.bldlog.100518-180630.gz
-rw-r--r--    1 userx   ncar           133 May 18 18:06 cpl_modelio.nml
-rw-r--r--    1 userx   ncar            50 May 18 18:06 drv_flds_in
-rw-r--r--    1 userx   ncar          2545 May 18 18:06 drv_in
-rw-r--r--    1 userx   ncar           589 May 18 18:14 glc.bldlog.100518-180630.gz
-rw-r--r--    1 userx   ncar           133 May 18 18:06 glc_modelio.nml
-rw-r--r--    1 userx   ncar          2569 May 18 18:12 ice.bldlog.100518-180630.gz
-rw-r--r--    1 userx   ncar          3279 May 18 18:06 ice_in
-rw-r--r--    1 userx   ncar           133 May 18 18:06 ice_modelio.nml
-rw-r--r--    1 userx   ncar          4591 May 18 18:11 lnd.bldlog.100518-180630.gz
-rw-r--r--    1 userx   ncar          1918 May 18 18:06 lnd_in
-rw-r--r--    1 userx   ncar           133 May 18 18:06 lnd_modelio.nml
-rw-r--r--    1 userx   ncar          3668 May 18 18:14 ocn.bldlog.100518-180630.gz
-rw-r--r--    1 userx   ncar           133 May 18 18:06 ocn_modelio.nml
-rw-r--r--    1 userx   ncar         14976 May 18 18:06 pop2_in
-rw-r--r--    1 userx   ncar          1882 May 18 18:06 seq_maps.rc
```

executable

.bld.log files

namelist files

Basic Work Flow

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Work Flow: Super Quick Start

These unix commands built and ran the model on a supported machine named "bluefire"

```
# go to root directory of source code download
cd /path/to/source/code/download/cesm1_0/

# go into scripts subdir
cd scripts

# (1) create a new case in your home dir
./create_newcase -case ~/mycase.01 -res f19_g16 -compset B_1850 -mach bluefire

# go into the case you just created in the last step
cd ~/mycase.01/

# (2) configure the case
./configure -case

# (3) build the executable
./mycase.01.bluefire.build

# (4) submit an initial run to the batch queue
bsub < mycase.01.bluefire.run

# check status of job and output files
bjobs
source Tools/ccsm_getenv
ls -lFt $RUNDIR
ls -l logs

. . . . .
```

(4) Running the Model: Initial Run

- May want to edit `env_run.xml` file before running (e.g. change run length)
- May also want to modify component namelist settings
- Can change `env_run.xml` variables
- Or directly in the `Buildconf/*.buildnml.csh` files
- The run script
  - Generates the namelist files in $RUNDIR (again)
  - Verifies existence of input datasets (again)
  - DOES NOT build (or re-build) the executable

```
cases/mycase1> bsub < mycase1.bluefire.run
```

```
cases/mycase1>bsub < mycase1.bluefire.run
Job <40597> is submitted to queue <regular>.
```

```
cases/mycase1> bjobs
```

```
cases/mycase1>bjobs
JOBID   USER    STAT  QUEUE      FROM_HOST   EXEC_HOST   JOB_NAME   SUBMIT_TIME
40597   userx   PEND  regular    be1105en                mycase1    May 18 18:30
```

(4) Output in Your CASE Directory

A job completed successfully if "`SUCCESSFUL TERMINATION OF CPL7-CCSM`" appears near end of the cpl.log file

```
cases/mycase1>ls -l
total 512
drwxr-xr-x    6 userx    ncar          8192 May 18 18:32 Buildconf
drwxr-xr-x    2 userx    ncar          8192 May 18 18:06 CaseDocs
drwxr-xr-x    2 userx    ncar          8192 May 18 18:15 LockedFiles
-rw-r--r--    1 userx    ncar         10687 May 13 14:32 Macros.bluefire
drwxr-xr-x    2 userx    ncar          8192 May 13 14:32 README
-rw-r--r--    1 userx    ncar            66 May 13 14:32 README.case
drwxr-xr-x    9 userx    ncar          8192 May 13 14:32 SourceMods
drwxr-xr-x    4 userx    ncar          8192 May 13 14:32 Tools
-rwxr-xr-x    1 userx    ncar          9330 May 12 11:33 check_input_data
-rwxr-xr-x    1 userx    ncar         10092 May 12 11:33 configure
-rwxr-xr-x    1 userx    ncar          3085 May 12 11:33 create_production_test
-rw-r--r--    1 userx    ncar          4475 May 18 18:32 env_build.xml
-rw-r--r--    1 userx    ncar          5635 May 13 14:32 env_case.xml
-rw-r--r--    1 userx    ncar          7029 May 13 14:32 env_conf.xml
-rw-r--r--    1 userx    ncar           614 May 18 18:37 env_derived
-rw-r--r--    1 userx    ncar          5916 May 13 17:12 env_mach_pes.xml
-rwxr-xr-x    1 userx    ncar          2199 May 13 14:32 env_mach_specific
-rw-r--r--    1 userx    ncar         10466 May 13 14:32 env_run.xml
drwxr-xr-x    3 userx    ncar          8192 May 18 18:37 logs
-rw-r--r--    1 userx    ncar           270 May 18 18:37 poe.stderr.40597
-rw-r--r--    1 userx    ncar          2013 May 18 18:37 poe.stdout.40597
-rwxrwxr-x    1 userx    ncar           574 May 13 17:12 mycase1.bluefire.build
-rwxrwxr-x    1 userx    ncar           836 May 13 17:12 mycase1.bluefire.clean_build
-rwxrwxr-x    1 userx    ncar           802 May 13 17:12 mycase1.bluefire.l_archive
-rwxrwxr-x    1 userx    ncar          3938 May 13 17:12 mycase1.bluefire.run
drwxr-xr-x    2 userx    ncar          8192 May 18 18:37 timing
-rwxr-xr-x    1 userx    ncar         10388 May 12 11:33 xmlchange
cases/mycase1>ls -l logs
total 272
-rw-r--r--    1 userx    ncar         29882 May 18 18:37 atm.log.100518-183212.gz
drwxr-xr-x    2 userx    ncar          8192 May 18 18:15 bld
-rw-r--r--    1 userx    ncar         19115 May 18 18:37 ccsm.log.100518-183212.gz
-rw-r--r--    1 userx    ncar          4998 May 18 18:37 cpl.log.100518-183212.gz
-rw-r--r--    1 userx    ncar         18732 May 18 18:37 ice.log.100518-183212.gz
-rw-r--r--    1 userx    ncar          9384 May 18 18:37 lnd.log.100518-183212.gz
-rw-r--r--    1 userx    ncar         18534 May 18 18:37 ocn.log.100518-183212.gz
cases/mycase1>ls -l timing
total 32
-rw-r--r--    1 userx    ncar          6204 May 18 18:37 ccsm_timing.mycase1.100518-183212
-rw-r--r--    1 userx    ncar          3711 May 18 18:37 ccsm_timing_summary.100518-183212.gz
```

Copies of the Current Namelist Input Files

stdout/err

Log Files

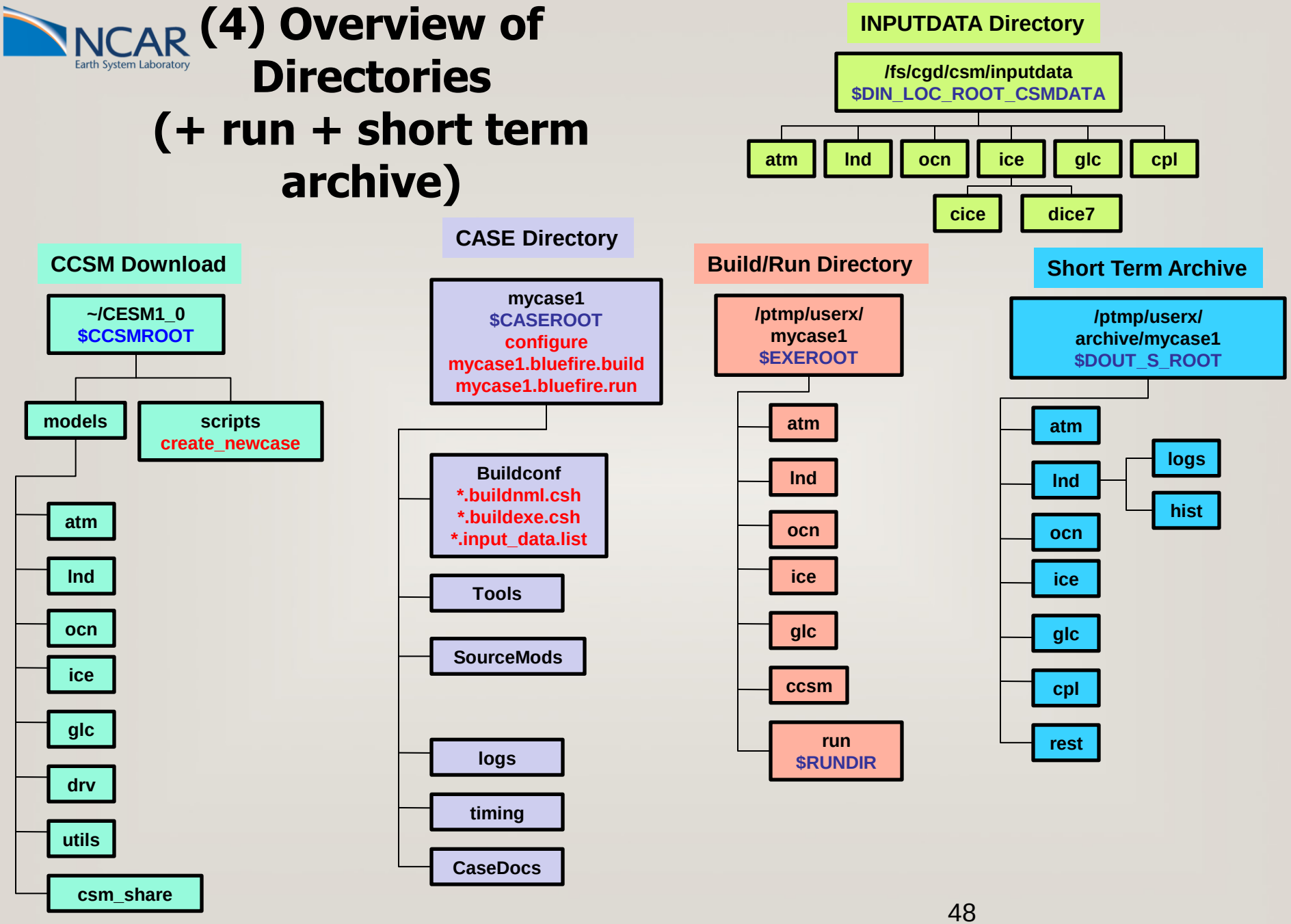
Timing Files

(4) Output in Short Term Archiving Directory

- Output data is originally created in ***$RUNDIR***
- When the run ends, output data is moved into a short term archiving directory, ***$DOUT_S_ROOT***
  - Cleans up the $RUNDIR directory
  - Migrates output data away from a possibly volatile $RUNDIR
  - Gathers data for the long term archive script

```
cases/mycase1>echo $DOUT_S_ROOT
/ptmp/userx/archive/mycase1
cases/mycase1>ls -l $DOUT_S_ROOT
total 1024
drwxr-xr-x    4 userx   ncar          65536 May 18 18:37 atm
drwxr-xr-x    4 userx   ncar          65536 May 18 18:37 cpl
drwxr-xr-x    4 userx   ncar          65536 May 18 18:37 dart
drwxr-xr-x    3 userx   ncar          65536 May 18 18:37 glc
drwxr-xr-x    4 userx   ncar          65536 May 18 18:37 ice
drwxr-xr-x    4 userx   ncar          65536 May 18 18:37 lnd
drwxr-xr-x    4 userx   ncar          65536 May 18 18:37 ocn
drwxr-xr-x    3 userx   ncar          65536 May 18 18:37 rest
cases/mycase1>ls -l $DOUT_S_ROOT/cpl
total 256
drwxr-xr-x    2 userx   ncar          65536 May 18 18:37 hist
drwxr-xr-x    2 userx   ncar          65536 May 18 18:37 logs
cases/mycase1>ls -l $DOUT_S_ROOT/cpl/logs/
total 256
-rw-r--r--    1 userx   ncar          19115 May 18 18:37 ccsm.log.100518-183212.gz
-rw-r--r--    1 userx   ncar           4998 May 18 18:37 cpl.log.100518-183212.gz
cases/mycase1>ls -l $DOUT_S_ROOT/ocn/hist
total 436608
-rw-r--r--    1 userx   ncar              3 May 18 18:32 mycase1.pop.dd.0001-01-02-00000
-rw-r--r--    1 userx   ncar           2787 May 18 18:36 mycase1.pop.do.0001-01-02-00000
-rw-r--r--    1 userx   ncar              3 May 18 18:32 mycase1.pop.dt.0001-01-02-00000
-rw-r--r--    1 userx   ncar           1183 May 18 18:36 mycase1.pop.dv.0001-01-02-00000
-rw-r--r--    1 userx   ncar       27046596 May 18 18:36 mycase1.pop.h.nday1.0001-01-02.nc
-rw-r--r--    1 userx   ncar       78164092 May 18 18:33 mycase1.pop.h.once.nc
-rw-r--r--    1 userx   ncar      117965260 May 18 18:32 mycase1.pop.hv.nc
```

(4) Overview of Directories (+ run + short term archive)



Basic Work Flow

- **One-Time Setup Steps**
  - **(A) Registration and Download**
  - **(B) Create an Input Data Root Directory**
  - **(C) Porting**

- **Creating & Running a Case**
  - **(1) Create a New Case**
  - **(2) Configure the Case**
  - **(3) Build the Executable**
  - **(4) Run the Model: Initial Run and Output Data Flow**
  - **(5) Run the Model: Continuation Run(s)**

Work Flow: Super Quick Start

These unix commands built and ran the model on a supported machine named "bluefire"

```
# go to root directory of source code download
cd /path/to/source/code/download/cesm1_0/

# go into scripts subdir
cd scripts

# (1) create a new case in your home dir
./create_newcase -case ~/mycase.01 -res f19_g16 -compset B_1850 -mach bluefire

# go into the case you just created in the last step
cd ~/mycase.01/

# (2) configure the case
./configure -case

# (3) build the executable
./mycase.01.bluefire.build

# (4) submit an initial run to the batch queue
bsub < mycase.01.bluefire.run

# check status of job and output files
bjobs
source Tools/ccsm_getenv
ls -lFt $RUNDIR
ls -l logs

# when the initial run finishes, change to a continuation run
./xmlchange -file env_run.xml -id CONTINUE_RUN -val TRUE

# (5) submit a continuation run to the batch queue
bsub < mycase.01.bluefire.run

# check status of job and output files
bjobs
ls -lFt $RUNDIR
ls -l logs
```

(5) Running the Model: Continuation Runs

- Start with a short initial run, described in step (4)
- Examine output to verify that the run is doing what you want
- If the initial run looks good, step (5) is a continuation run

- Change CONTINUE_RUN to TRUE in env_run.xml
- Change STOP_OPTION to run the model longer

- May want to turn on auto-resubmit option in env_run.xml (RESUBMIT)

- May want to turn on “long term archiving” in env_run.xml (DOUT_L_MS)

(5) Long Term Archiving

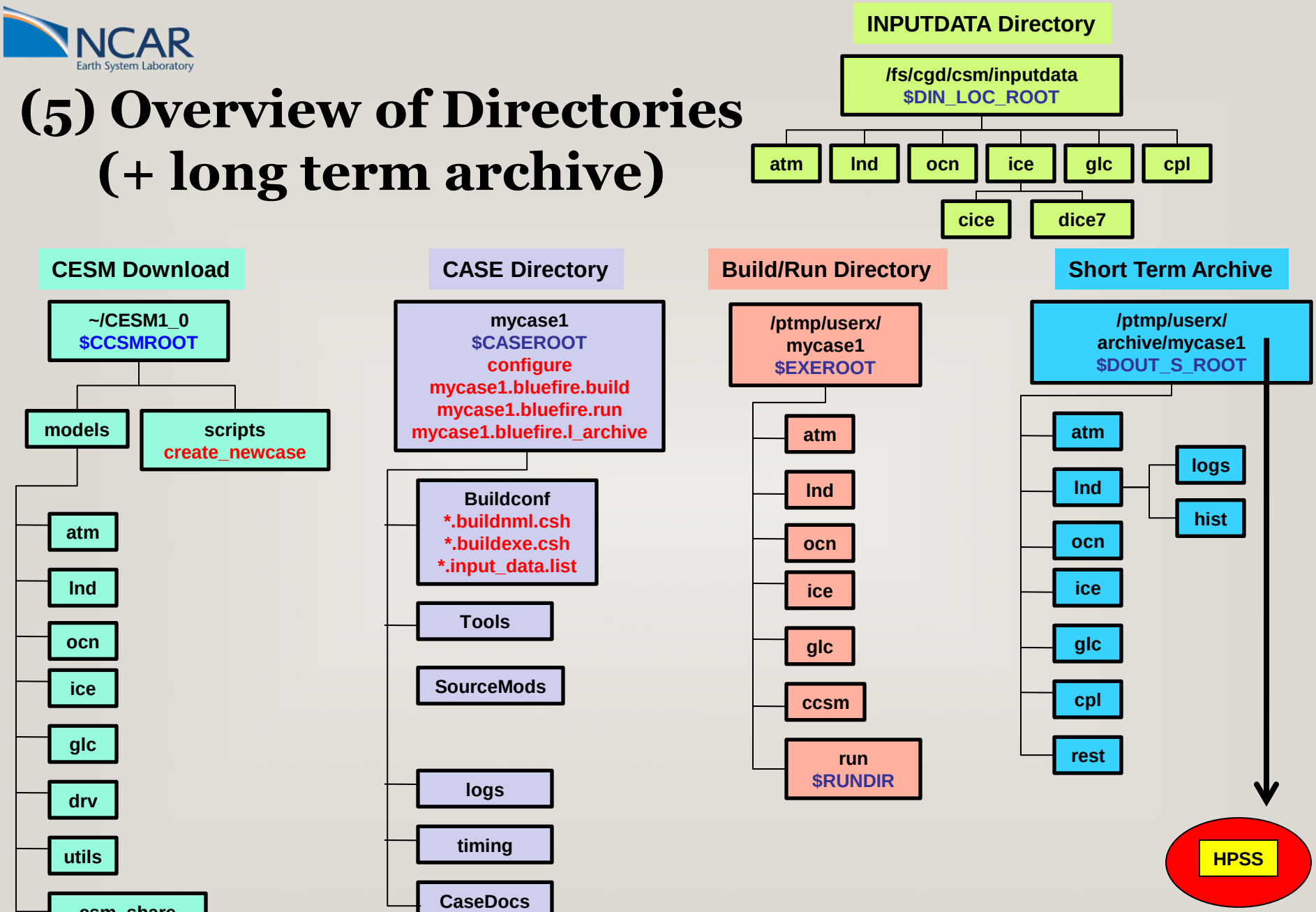
- **Why?**
  - **Migrates output data away from a possibly volatile $DOUT_S_ROOT into a permanent long-term storage area**
  - **Long term archiving script moves data conveniently and in parallel**

- **To turn on short term archiving (default is on)**
  - **Set DOUT_S to TRUE in `env_run.xml`**

- **To turn on long term archiving (default is off)**
  - **Set DOUT_L_MS to TRUE and set DOUT_L_MSROOT in `env_run.xml`**
  - **Causes run script to automatically submit a long term archiver job (`*.l_archive`) at the end of every successful run.**

- **Long term archiver**
  - **Moves data from the short term archive directory to a long term archiving system (e.g. HPSS) - if one exists**
  - **Runs in batch on one processor**
  - **Can run in parallel with a production job; will not interfere**

(5) Overview of Directories (+ long term archive)



More Information/Getting Help

- Model User Guides (please provide feedback)
  - http://www.cesm.ucar.edu/models/cesm1.0.4/
  - CESM Users Guide and Web-Browseable code reference
  - CAM, CLM, POP2, CICE, Data Model and CPL7 Users Guides
- CESM Bulletin Board
  - http://bb.cgd.ucar.edu/
  - Facilitate communication among the community
  - Ask questions, look for answers
  - Many different topics
- CESM Release Page Notes
  - http://www.ccsm.ucar.edu/models/cesm1.0.4/tags/
  - Notes significant bugs or issues as they are identified
- Model output is available on the Earth System Grid
  - http://www.earthsystemgrid.org
- Getting Help - email
  - cesm-help@cgd.ucar.edu
  - Questions will be answered as resources are available

Thank You!

Appendix

- **A) Steps: Review and Undo**
- **B) Production Runs**
- **C) Debugging**
- **D) Porting**
- **E) Timing, Performance, Load Balancing**
- **F) Testing**

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To advance understanding of weather, climate, atmospheric composition and processes;
To provide facility support to the wider community; and,
To apply the results to benefit society.

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Appendix A: Steps, Review and Undo

Step	"Undo" Command	Associated env Files
create_newcase	rm –rf $CASE & rerun	env_case.xml
configure -case	configure –cleanall	env_conf.xml env_mach_pes.xml
$CASE*.build	$CASE*.clean_build	env_build.xml Macros.*
$CASE*.run	rerun $CASE*.run	env_run.xml
short term archive	set DOUT_S to FALSE	env_run.xml
$CASE*.l_archive	set DOUT_L to FALSE	env_run.xml

Appendix B: Production Runs

- **Verify**
- configuration and inputs
- performance, throughput, cost, and load balance
- exact restart for the production configuration. Use "create_production_test" in the case directory.
- **Carry out an initial run and write out a restart set at the end of the run**
- Set STOP_OPTION to "nmonths", set STOP_N
- Set REST_OPTION==STOP_OPTION and REST_N==STOP_N to get a restart at end of run
- **When initial run is complete**
- Set CONTINUE_RUN to TRUE in env_run.xml this puts the model in restart mode and the model will start again from the last restart set
- Reset STOP_N to a larger value if appropriate
- Leave REST_OPTION==STOP_OPTION and REST_N==STOP_N
- **To turn on short term archiving**
- Set DOUT_S to TRUE in env_run.xml
- **To turn on long term archiving**
- Set DOUT_L_MS to TRUE in env_run.xml
- Causes the run script to automatically submit a long term archiver job at the end of every successful run. The long term archiver moves data from the short term archive directory to a mass storage system, runs in batch on one processor, can run in parallel with a production job, and will not interfere with a production job or vice versa.
- **To turn on the auto resubmit feature**
- Set RESUBMIT to an integer > 0 in env_run.xml; this causes the run script to resubmit itself after a successful run and decrement the RESUBMIT variable by 1. The model will automatically resubmit until the RESUBMIT variable is decremented to 0.

Appendix C: Debugging

- The CESM scripts will trap invalid env variable values and types when possible and produce an error message
- The scripts can detect when the model needs to be re-configured or re-built due to changes in setup (env and Macros) files and an error message will be produced.
- If input data is not available locally, it will be downloaded automatically. If that data is not available on the CESM input data server, an error message will be produced.
- "configure –cleanall" backs up the build, run, and Buildconf files and resets them to original values. Manual changes to namelist values or batch submission settings will be lost in this step and have to be reimplemented manually. The old copies are placed under the MachinesHist directory in the case directory.
- If the build step fails, an error message will be produced and point users to a specific build log file.
- If a run does NOT complete properly, the stdout file often produces an error message like "Model did not complete – see …/cpl.log…". That cpl log file is associated with the run but may not contain a relevant error message. All the log files will need to be reviewed.
- If a run does NOT complete properly, short term archiving is NOT executed and the timing files are NOT generated. In addition, log files are NOT copied into the case logs directory. Review the stdout/stderr files in the case directory and "cd" to the $RUNDIR directory and systematically check the latest log files for error messages.
- If a run does NOT complete properly, check whether it timed out because it hit the batch time limit. If it hit the time limit, does it appear to have been running when it timed out or did it hang before it timed out? Check the timestamps on the log files in $RUNDIR and check the timestamps of the daily timers in the cpl.log file.

Appendix D: Porting – Machines Directory

- **Go to the scripts directory**
- **ccsm_utils/Machines contains machine specific information, porting changes will occur there**

```
CESM1_0/scripts>ls -l
total 400
-rw-r--r--    1 userx   ncar          18596 May 12 11:33 ChangeLog
-rw-r--r--    1 userx   ncar            168 May 12 11:33 README
-rw-r--r--    1 userx   ncar            103 May 12 11:33 SVN_EXTERNAL_DIRECTORIES
drwxr-xr-x   10 userx   ncar           8192 May 12 11:33 ccsm_utils
-rwxr-xr-x    1 userx   ncar          19039 May 12 11:33 create_clone
-rwxr-xr-x    1 userx   ncar          52338 May 12 11:33 create_newcase
-rwxr-xr-x    1 userx   ncar          18253 May 12 11:33 create_test
-rwxr-xr-x    1 userx   ncar           9643 May 12 11:33 create_test_suite
drwxr-xr-x    3 userx   ncar           8192 May 12 11:33 doc
-rwxr-xr-x    1 userx   ncar           1255 May 12 11:33 link_dirtree
-rw-r--r--    1 userx   ncar            295 May 12 11:33 sample_compset_file.xml
-rw-r--r--    1 userx   ncar            851 May 12 11:33 sample_pes_file.xml
```

ccsm_utils

```
CESM1/scripts>ls -l ccsm_utils
total 112
drwxr-xr-x    3 userx   ncar           8192 May 12 11:33 Build
drwxr-xr-x    3 userx   ncar           8192 May 12 11:33 Case.template
drwxr-xr-x    3 userx   ncar           8192 May 12 11:33 Components
drwxr-xr-x    3 userx   ncar           8192 May 12 11:33 Machines
drwxr-xr-x    3 userx   ncar           8192 May 12 11:33 Testcases
drwxr-xr-x    3 userx   ncar           8192 May 12 11:33 Testlists
drwxr-xr-x    5 userx   ncar           8192 May 12 11:33 Tools
```

Machines

Appendix D (cont): Porting - Methods

- This is not as easy as we'd like it to be; see the CESM1 Users Guide for more details
- Generic Machine Method
- Create a case using one of the generic machines and the following create_newcase options
  - -scratchroot (generic high level run directory, ie. /ptmp/userx)
  - -din_loc_root_csmdata (location of inputdata directory)
  - -max_tasks_per_node (max number of mpi tasks per node)
- configure -case
- Search for "GENERIC_USER", read those comments and edit as needed
  - Macros.* (for build settings)
  - env_mach_specific (for local machine settings)
  - *.run (for batch and launch settings)
- Once things are working, back port the mods to some new machine specific scripts (see below)
- Specific Machine Method
- cd scripts/ccsm_utils/Machines
- copy a set of "close" machine specific files to your machine name
  - cp Macros.bluefire Macros.mine
  - cp env_machopts.bluefire env_machopts.mine
  - cp mkbatch.bluefire mkbatch.mine
- Edit those files based on your machine configuration as best as you can
- Add an entry in config_machines.xml for your machine (copy and paste) and edit those variables based on your machine
- cd back to the script directory
- create a case using your new machine entry (ie. mine) and test (see above)

Appendix D (cont): Porting - Tips

- Review your local-machine specific documentation and be prepared to reference it as you proceed.
- Prior to starting, know which compiler you want to use and review batch submission and job launching, especially for MPI jobs
- netcdf needs to be installed and you need to know how to link to it.
- With both generic or machine specific approaches, the goal is the same. You want to be able to setup and run CESM cases "out of the box" on your local machine and to be able to share that capability between multiple people. In other words, you want to port to a new machine once and be (mostly) done.
- With either the generic or machine specific approach, there will likely be several iterations between testing the case and updating the machine specific files before things work "out of the box". Be patient.
- Start with an X compset and demonstrate an ability to create a case, build, and run "out of the box" before moving on to move complex configurations. X is an "all dead" configuration that is fast, requires minimal memory, requires minimal input datasets, runs in relatively arbitrary processor layouts, and will test the full coupler implementation with MPI.
- Generally, CESM builds all the components using a single CESM specified Makefile and Macros file. The exceptions are MCT and PIO which are built on the fly in CESM but leverage their own build systems. If you are having problems building MCT or PIO, look for the string "CONFIG_ARGS" in the Macros file. There are independent CONFIG_ARGS for MCT and PIO. Those config_arg options are passed to the MCT and PIO build systems. See other machines Macros files in scripts/ccsm_utils/Machines for examples of the CONFIG_ARGS settings on other machines and review the MCT or PIO build logs for errors. Errors generally occur more often in the configure/setup step of the MCT and PIO build than in the build itself.
- Reference the CESM users guide and see current implementations for other machines in the **scripts/ccsm_utils/Machines** directory.

Appendix E: Timing

- **env_mach_pes.xml sets the component pe layout, to change it**
- **modify env_mach_pes.xml**

  mycase1> ./configure –cleanmach

  mycase1> ./configure –case

  mycase1> ./mycase1.bluefire.clean_build

  mycase1> ./mycase1.bluefire.build

  mycase1> bsub < mycase1.bluefire.run
- **Timing Files**
- **See mycase1/logs/cpl.log* file to verify completion and get throughput, basic timing and memory output. cpl.log* also provides timing for each model day run so temporal variability in cost can be assessed.**
- **See mycase1/timing/ccsm_timing.mycase1.* file for throughput and load balance (next slide)**
- **See mycase1/timing/ccsm_timing_summary.* for individual rawer model timing output**

mycase1>tail -20 logs/cpl.log.100519-210440

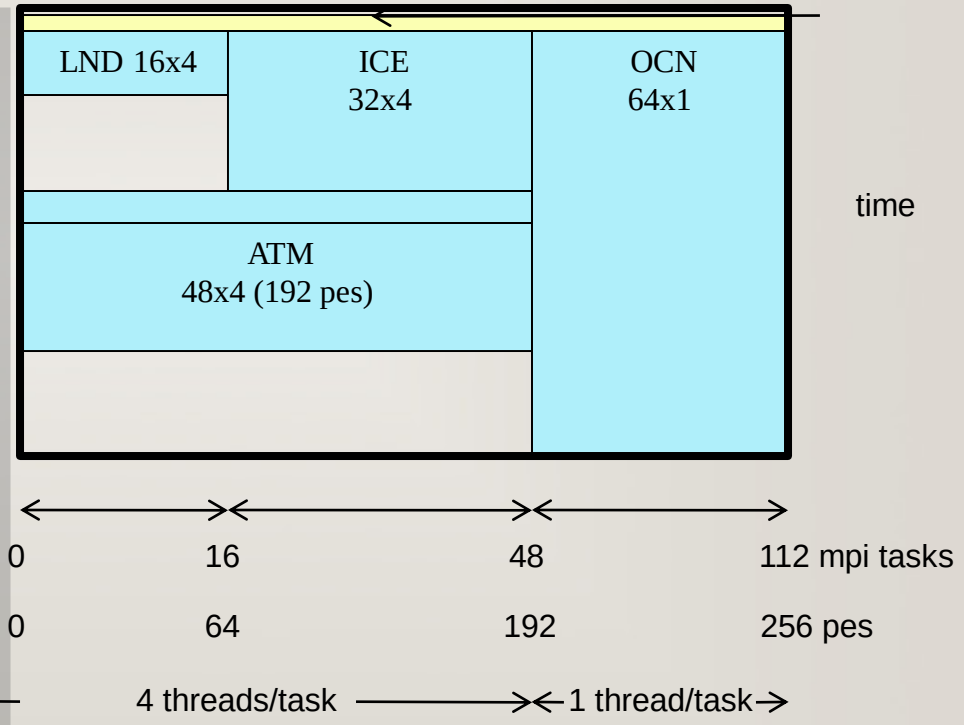
```
tStamp_write: model date =    10120       0 wall clock = 2010-05-19 21:11:07 avg dt =    16.43 dt =    16.12
tStamp_write: model date =    10121       0 wall clock = 2010-05-19 21:11:23 avg dt =    16.43 dt =    16.34

(seq_mct_drv): ===============       SUCCESSFUL TERMINATION OF CPL7-CCSM ===============
(seq_mct_drv): ===============         at YMD,TOD =    10121       0      ===============
(seq_mct_drv): ===============  # simulated days (this run) =    20.000  ===============
(seq_mct_drv): ===============  compute time (hrs)          =     0.091  ===============
(seq_mct_drv): ===============  # simulated years / cmp-day =    14.410  ===============
(seq_mct_drv): ===============  pes min memory highwater  (MB)  324.382  ===============
(seq_mct_drv): ===============  pes max memory highwater  (MB)  787.038  ===============
```

Appendix E (cont): Performance & Load Balance

- **Load Balance**
- **Set STOP_OPTION to 'ndays', STOP_N to 20, REST_OPTION to 'never'**

mycase1>cat timing/ccsm_timing.mycase1.100519-210440

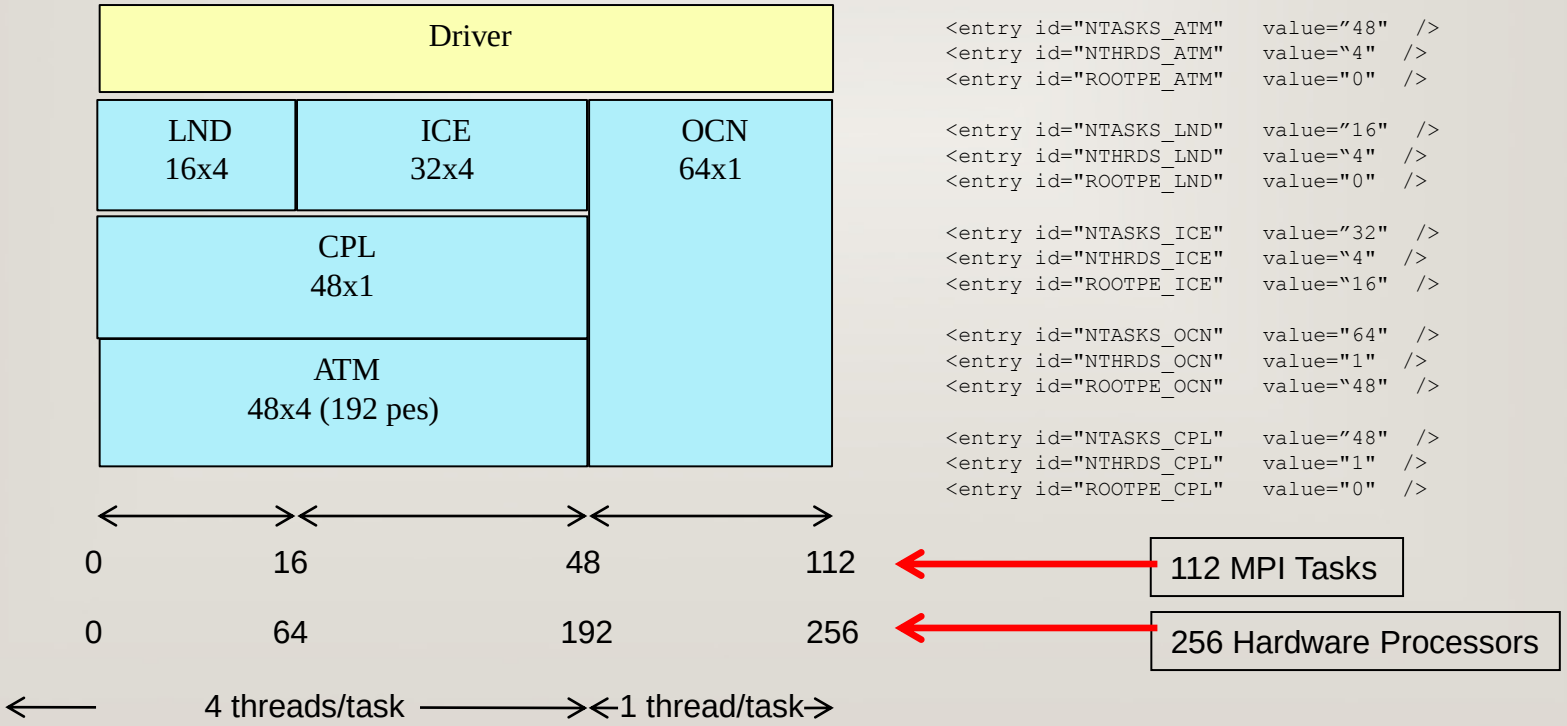
```
 component       comp_pes    root_pe   tasks  x threads
 ---------        ------     -------   ------   ------
 cpl = cpl        48          0        48     x 1
 glc = sglc       64          0        64     x 1
 lnd = clm        64          0        16     x 4
 ice = cice       128         16       32     x 4
 atm = cam        192         0        48     x 4
 ocn = pop2       64          48       64     x 1

 total pes   : 256

 Overall Metrics:
   Model Cost:             213.62   pe-hrs/simulated_year
   Model Throughput:        14.38   simulated_years/day

   Init Time   :      56.365 seconds
   Run Time    :     329.209 seconds       16.460 seconds/day
   Final Time  :       0.071 seconds

   TOT Run Time:     329.209 seconds       16.460 seconds/mday
   LND Run Time:      23.406 seconds        1.170 seconds/mday
   ICE Run Time:     122.689 seconds        6.134 seconds/mday
   ATM Run Time:     107.499 seconds        5.375 seconds/mday
   OCN Run Time:     328.911 seconds       16.446 seconds/mday
   GLC Run Time:       0.000 seconds        0.000 seconds/mday
   CPL Run Time:      13.536 seconds        0.677 seconds/mday
```



Appendix E (cont): Load Balancing & env_mach_pes.xml

- **Some env_mach_pes.xml variables are**
- **NTASKS_* - number of mpi tasks assigned to the component**
- **NTHRDS_* - number of openmp threads per mpi task for the component**
- **ROOTPE_* - global mpi task rank of the component root mpi task**

FOR EXAMPLE:




```
<entry id="NTASKS_ATM"   value="48"  />
<entry id="NTHRDS_ATM"   value="4"  />
<entry id="ROOTPE_ATM"   value="0"  />

<entry id="NTASKS_LND"   value="16"  />
<entry id="NTHRDS_LND"   value="4"  />
<entry id="ROOTPE_LND"   value="0"  />

<entry id="NTASKS_ICE"   value="32"  />
<entry id="NTHRDS_ICE"   value="4"  />
<entry id="ROOTPE_ICE"   value="16"  />

<entry id="NTASKS_OCN"   value="64"  />
<entry id="NTHRDS_OCN"   value="1"  />
<entry id="ROOTPE_OCN"   value="48"  />

<entry id="NTASKS_CPL"   value="48"  />
<entry id="NTHRDS_CPL"   value="1"  />
<entry id="ROOTPE_CPL"   value="0"  />
```

Appendix F: Testing

- **create_production_test script in the case directory**

- **create_test in the scripts directory**
- **Generates an automated CESM test**
- **create_test –list produces a list of available tests**
- **To use:**

CESM1_0/scripts> ./create_test -testname ERS.f19_g16.X.bluefire -testid t1
CESM1_0/scripts> cd ERS.f19_g16.X.bluefire.t1
CESM1_0/scripts/ERS.f19_g16.X.bluefire.t1> ./ERS.f19_g16.X.bluefire.t1.build
CESM1_0/scripts/ERS.f19_g16.X.bluefire.t1> bsub < ERS.f19_g16.X.bluefire.t1.test
CESM1_0/scripts/ERS.f19_g16.X.bluefire.t1> cat TestStatus

```
CESM1_0/scripts/ERS.f19_g16.X.bluefire.t1>cat TestStatus
PASS   ERS.f19_g16.X.bluefire
```

Note: DO NOT submit the run script, submit the test script

- **create_test_suite in the scripts directory**
- **to generate a suite of tests listed in a specific file**