

Workflow in CESM2

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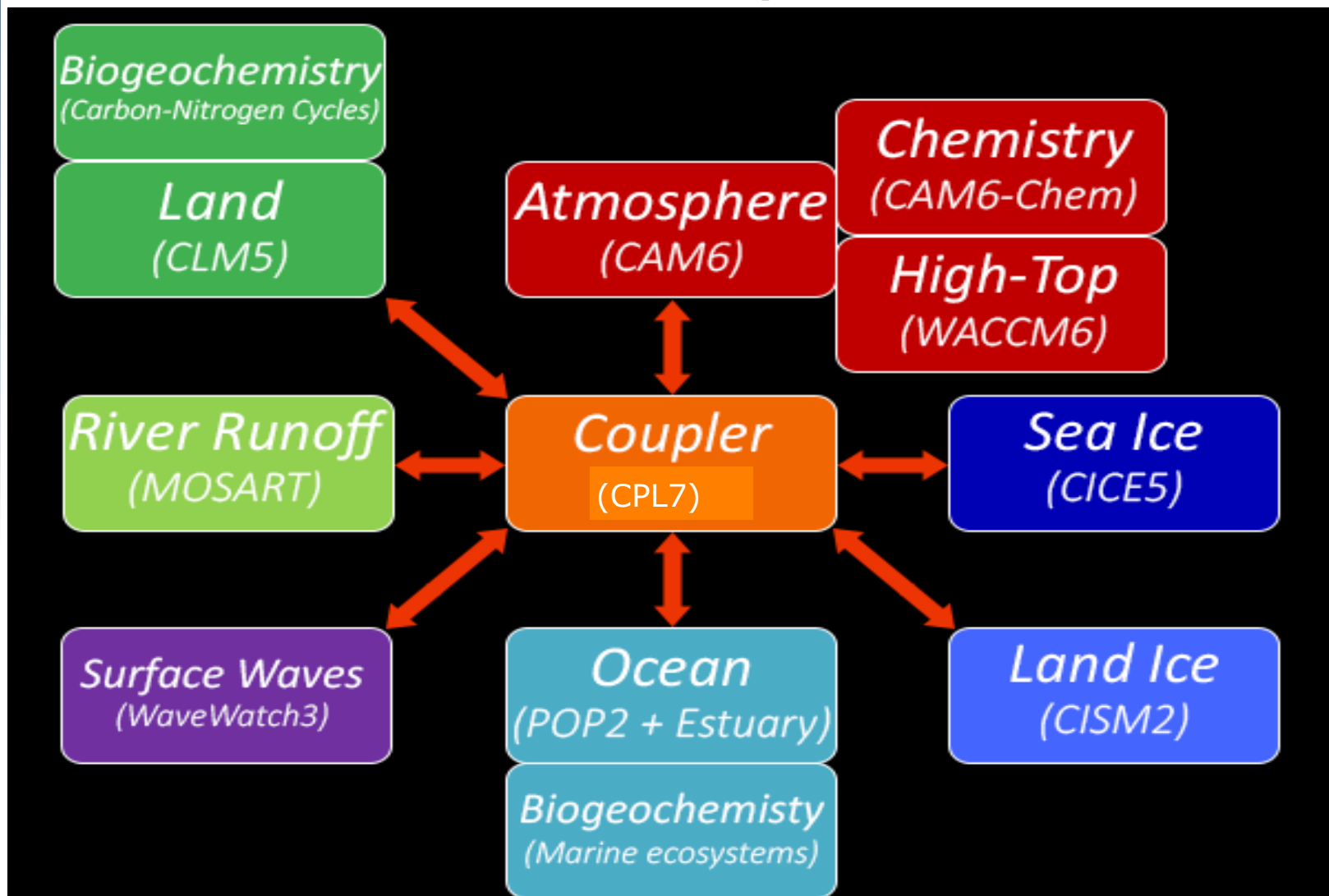
Building reproducible workflows for earth sciences

ECMWF Oct 14-16, 2019

Overview

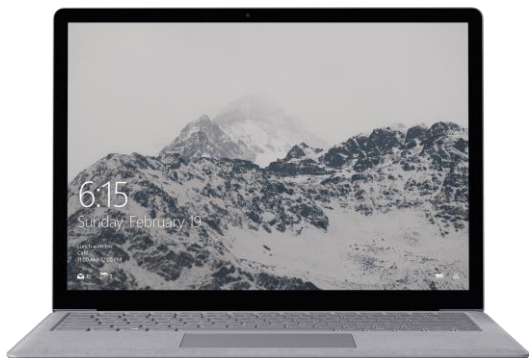
1. CESM2, CIME and the Case Control System.
2. Expanding CIME workflow capability
3. Projects using CIME workflow:
 - a. Basic experiment workflow
 - b. Ensemble workflow using CYLC
 - c. NCAR/ICCC CMIP6 Large Ensemble
 - d. Seasonal Forecast Experiment

CESM2 Components



CESM2

- Version Control
 - Each component has its own version control and governance
 - Top level repo is a collection of hashes referring to component repositories
 - Component repos may use git or svn
 - Managed via an NCAR developed tool `manage_externals`
- Supports a diverse user community and range of hardware



CESM Development Management database

Tag lists | Version: CESM2_1_z

Logged in as James Edwards | [Logout](#) | [Help](#) / [Procedures](#)

CESM2_1_z Testing and Porting Database

Planned Tags | **Alpha Tags** | Beta Tags | Release Tags | Test Reports

Show 10 entries

Search:

| Tag Name | Status | Problems Identified After Tag Creation | Answer Changes and Notes |
|------------------------------|--------------------|--|---------------------------------|
| cesm2_1_beta01 (white board) | | | |
| cesm2_1_alpha01f | Done 2018-12-11 | Chris Fischer 2018-12-03 - There are known issue with the pgi and cray compilers. - Intel 18 issues on hobart with larger tests. - PGI on hobart failes to run across multiple processors. | Erik Kluzok 2018-10-26 No |
| cesm2_1_alpha01e | Done 2018-11-15 | Chris Fischer 2018-11-16 - There are known issue with the pgi and cray compilers. - Intel 18 issues on hobart with larger tests. - PGI on hobart failes to run across multiple processors. | Double-click to edit |
| cesm2_1_alpha01d | Done 2018-10-16 | Chris Fischer 2018-10-16 - SMS_D_Ld1.f09_g17.B1850.cheyenne_intel.allactive-cmpip6 is expected to fail. - IRT_N3_PM3_Ld7.f19_g17.BHISTWs.cheyenne_intel.allactive-defaultio still failing. | |
| cesm2_1_alpha01c | Done 2018-10-04 | Chris Fischer 2018-10-04 - IRT_N3_PM3_Ld7.f19_g17.BHISTWs.cheyenne_intel.allactive-defaultio still failing. - There are known issue with the pgi and cray compilers. | |
| cesm2_1_alpha01b | Done 2018-09-18 | Chris Fischer 2018-08-30 - f19_g17.BHIST missing 2 degree co2flux_fuel_file. - f09_g17.BHIST Diagnostic CO2 answer changes. - There are known issues for the pgi and cray compilers. | |
| cesm2_1_alpha01a | Done 2018-08-10 | Double-click to edit | |

Showing 1 to 6 of 6 entries


Tag externals
* indicates current revision used in externals tagging

| Component | Who / When | Revision | Path | Clickable URL | bf?* | Exists? |
|--|--|---------------------------------|---|---|------|---------|
| cesm (1 entries) | Chris Fischer (2018-11-15) | cesm2_1_alpha01f | | https://github.com/ESCOMP/cesm/tree/cesm2_1_alpha01f | some | NA* |
| | Use cmpip6 rebase for standard B1850 and BHIST compacts - change answers for B1850, BHIST, B1850, BHM1850 and BHM1850 at f09_g17 Note - Add tests for BHM1850cmpip6 and BWC024cmip6 Fix use_init_interp with B1850 ERT test. | | | | | |
| | Update addmetdata for POP-ECT. Note Fix new pylint errors | | | | | |
| cime (3 entries) | Chris Fischer (2018-11-27) | cime_cesm2_1_rel_06 | cime | https://github.com/ESMCI/cime/tree/cime_cesm2_1_rel_06 | all | Yes* |
| | Note Fix new pyLint errors | | | | | |
| | Chris Fischer (2018-11-16) | cime_cesm2_1_rel_05 | cime | https://github.com/ESMCI/cime/tree/cime_cesm2_1_rel_05 | all | Yes |
| Note Do not include time of day in opl auxiliary hist file names | | | | | | |
| Chris Fischer (2018-11-13) | cime_cesm2_1_rel_04 | cime | https://github.com/ESMCI/cime/tree/cime_cesm2_1_rel_04 | all | Yes | |
| Note - Fix 2010 period for data GSW3v1. - Update pyCCEC to v3.0.8 | | | | | | |
| cam (5 entries) | Cheryl Craig (2018-11-26) | release_tags/cam_cesm2_1_rel_05 | components/cam | https://svn-ccsm-models.cgd.ucar.edu/cam1/release_tags/cam_cesm2_1_rel_05 | some | Yes* |
| | Change how SDVX is selected in CAM from a time component to a CAM qualifier Note SD compacts change answers | | | | | |
| | Brian Eaton (2018-11-26) | release_tags/cam_cesm2_1_rel_04 | components/cam | https://svn-ccsm-models.cgd.ucar.edu/cam1/release_tags/cam_cesm2_1_rel_04 | some | Yes |
| | Fixes for simple models w/ EUL dycore. BFB except: 1) Eulerian dycore with analytic baroclinic wave ICs and terminator chemistry. 2) Eulerian dycore with moist simple physics (kessler or t32016). | | | | | |
| | Brian Eaton (2018-11-21) | release_tags/cam_cesm2_1_rel_03 | components/cam | https://svn-ccsm-models.cgd.ucar.edu/cam1/release_tags/cam_cesm2_1_rel_03 | all | Yes |
| Note Workaround to add aircraft CO2 emissions file used by SOC to cam.input_data_list | | | | | | |
| Cheryl Craig (2018-11-15) | release_tags/cam_cesm2_1_rel_02 | components/cam | https://svn-ccsm-models.cgd.ucar.edu/cam1/release_tags/cam_cesm2_1_rel_02 | all | Yes | |
| Note Cleanup science support flags and remove failing SE test | | | | | | |
| Brian Eaton (2018-11-06) | release_tags/cam_cesm2_1_rel_01 | components/cam | https://svn-ccsm-models.cgd.ucar.edu/cam1/release_tags/cam_cesm2_1_rel_01 | all | Yes | |
| Note - Change CAM externals to use release_tag versions. - Disable ability of SE dycore to run with topography or with the new CESM advection and physics grid. The dycore may still be run for simple models and aquaplanet mode using the GLL advection. | | | | | | |

CESM2 Experiment Database

CESM Case Working Title & Details

Toggle All Details

 CMIP6 20th century experiments (1850-2014) with CAM6, interactive land (CLM5), coupled ocean (POP2) with biogeochemistry (MARBL), interactive sea ice (CICE5.1), and non-evolving land ice (CISM2.1)

CMIP6 Project Details

[Case Workflow Process Status](#)

Caseroot Settings


Case Notes

Case Diagnostics, Process and Journal Publication Links

Data Publication Options

CESM Case Working Title & Details

Toggle All Details

 CMIP6 20th century experiments (1850-2014) with CAM6, interactive land (CLM5), coupled ocean (POP2) with biogeochemistry (MARBL), interactive sea ice (CICE5.1), and non-evolving land ice (CISM2.1)

CMIP6 Project Details

| CMIP6 Fields | | CMIP6 File Global Attributes | |
|-----------------------------|--|------------------------------|--|
| Field Name | Value | Field Name | Value |
| cesm_cmip6_id | 0 | activity_id | CMIP |
| cmip6_activity_id | CMIP | branch_method | standard |
| cmip6_assign | Cecile Hannay (hannay@ucar.edu) | branch_time_in_child | 674885.000 |
| cmip6_branch_method | standard | branch_time_in_parent | 219000.000 |
| cmip6_branch_time_in_child | 674885.000 | case_id | 15 |
| cmip6_branch_time_in_parent | 219000.000 | experiment | Simulation of recent past (1850 to 2014). Impose changing conditions (consistent with observations). Should be initialised from a point early enough in the pre-industrial control run to ensure that the end of all the perturbed runs branching from the end of this historical run end before the end of the control. Only one ensemble member is requested but modelling groups are strongly encouraged to submit at least three ensemble members of their CMIP historical simulation. |
| cmip6_deckDescription | Historical simulations using CMIP6 forcings (1850-2014) | experiment_id | historical |
| cmip6_deckName | historical | parent_activity_id | CMIP |
| cmip6_ensemble_num | 1 | parent_experiment_id | piControl |
| cmip6_ensemble_size | 11 | parent_variant_label | r111p1f1 |
| cmip6_exp_id | 107 | source_id | CESM2 |
| cmip6_exp_uid | F16fc5c4-dd9e-11e6-b89b-ac72891c3257 | source_type | AOGCM BGC |
| cmip6_experiment | Simulation of recent past (1850 to 2014). Impose changing conditions (consistent with observations). Should be initialised from a point early enough in the pre-industrial control run to ensure that the end of all the perturbed runs branching from the end of this historical run end before the end of the control. Only one ensemble member is requested but modelling groups are strongly encouraged to submit at least three ensemble members of their CMIP historical simulation. | sub_experiment | none |
| cmip6_experiment_id | historical | sub_experiment_id | none |
| cmip6_mipDescription | Coupled Model Intercomparison Project | variant_info | CMIP6 20th century experiments (1850-2014) with CAM6, interactive land (CLM5), coupled ocean (POP2) with biogeochemistry (MARBL), interactive sea ice (CICE5.1), and non-evolving land ice (CISM2.1) |
| cmip6_mipName | CMIP | variant_label | r111p1f1 |

CIME:

Common Infrastructure for Modeling the Earth

A collection of earth system model infrastructure tools

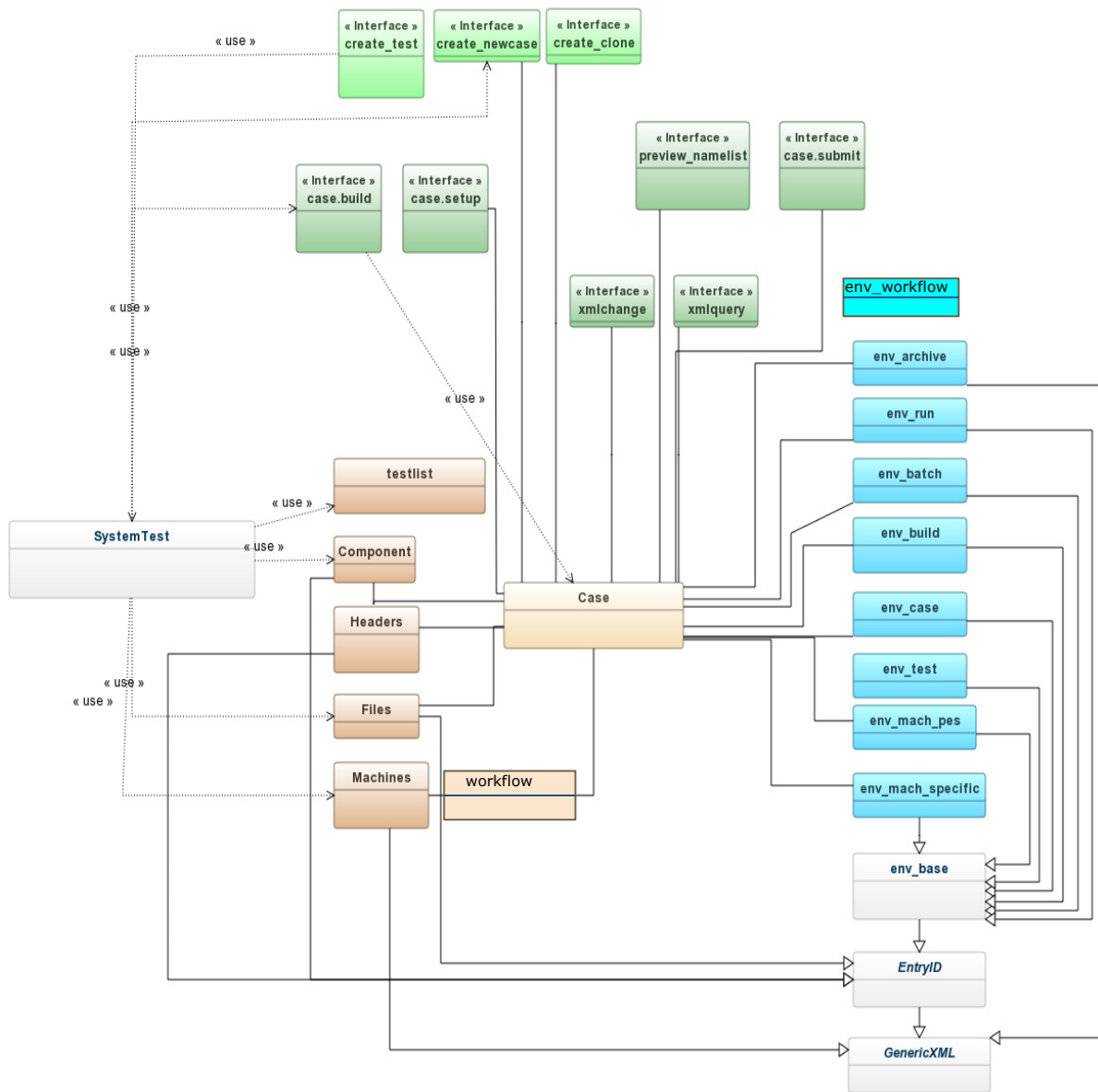
- Case Control System
 - Create, build and run an experiment
 - Unit testing
 - System testing
 - Record experiment provenance
- Inter-component Coupling Infrastructure
- Data Models (permits control of feedbacks)

CIME is used by CESM, E3SM, NORESM and is being considered for use in UFS

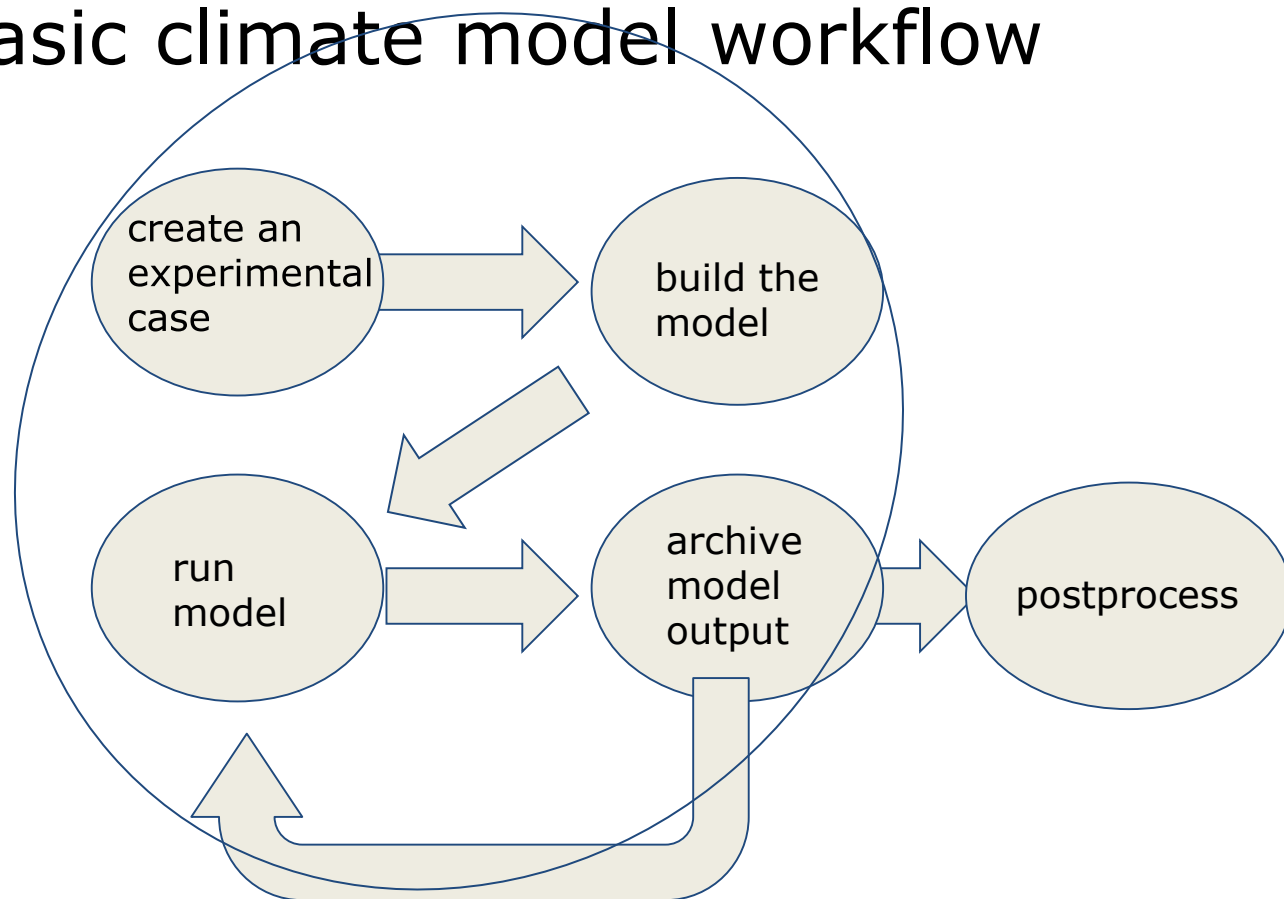
The CIME Case Control System (CCS)

The CCS is an extensible, coherent and coordinated set of object-oriented python scripts which uses a library of python objects along with data in xml to design, build and control the run of an earth system model.

The CCS has been designed to facilitate and encourage community collaboration!



Basic climate model workflow



CCS workflow generator

The CCS provides a basic workflow generator which uses queueing system native dependency tools to schedule jobs in a workflow.

Limitations:

- all jobs are submitted to queues
- no submission clock or calendar support
- limited to a single case

Use `preview_run` to view the current workflow.

XML Elements of a workflow definition.

- workflow_jobs {case, [prepend], [append]}
 - job {name}
 - template (script template to submit)
 - dependency (other job that must complete first)
 - prereq (logical to include in workflow)
 - runtime_parameters
 - task_count
 - tasks_per_node
 - walltime

Adding CYLC

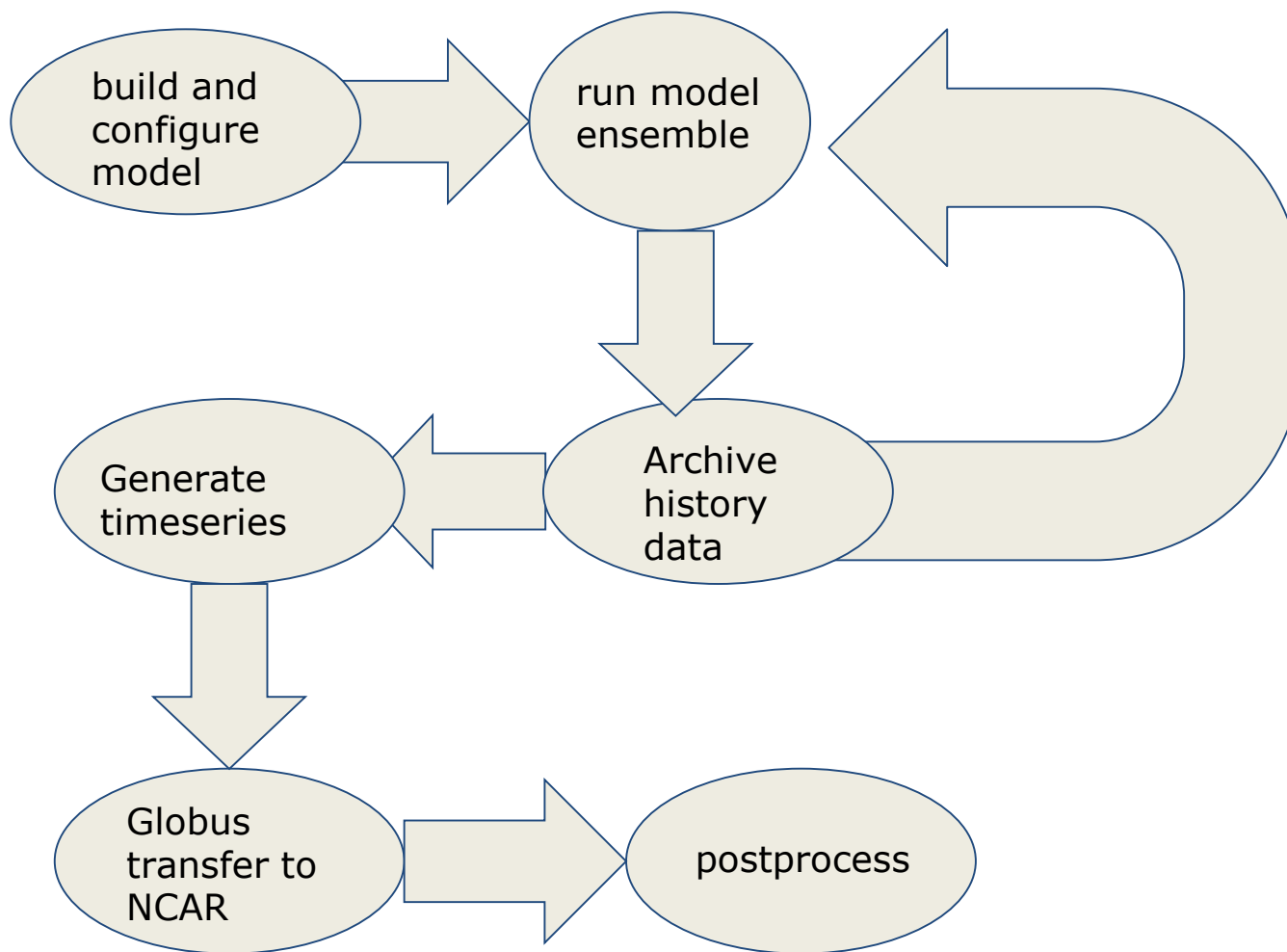
CCS provides a script **generate_cylc_workflow.py** to translate a CCS workflow to a CYLC suite.rc

- Provides support for ensembles
- Allows the user to customize workflows with all of the extensive feature set of CYLC

<https://cylc.github.io/>

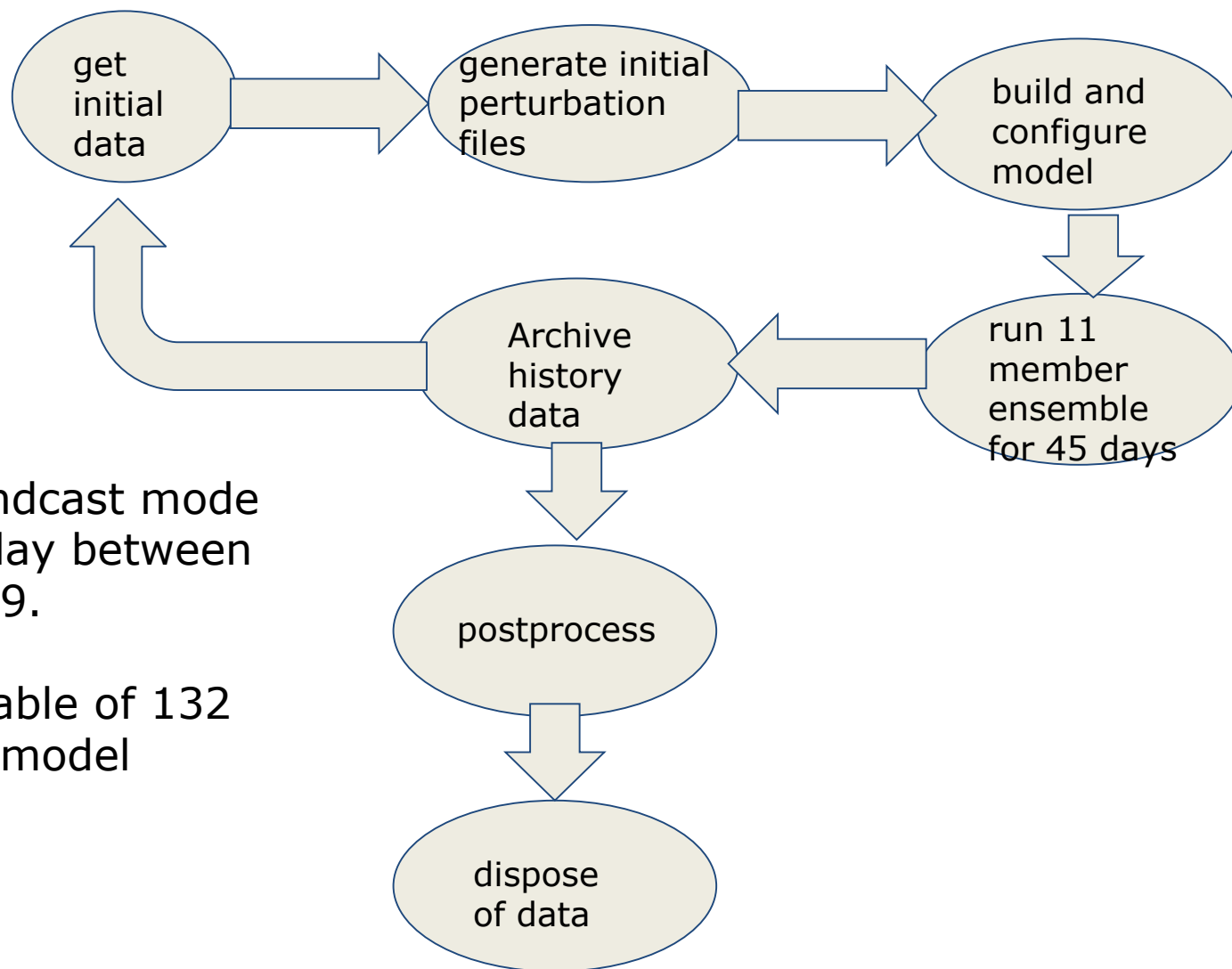
CESM2 Large Ensemble Experiment

- Cooperative project with ICCP South Korea
- 100 member ensemble climate study running from 1850-2100
- Will be run on the ICCP system Aleph with postprocessing and data storage at NCAR



NCAR/ICCP CESM2 CMIP6 Large Ensemble Experiment Workflow

Subseasonal to Seasonal prediction using CESM and CYLC



Running in hindcast mode for each Monday between 1999 and 2019.

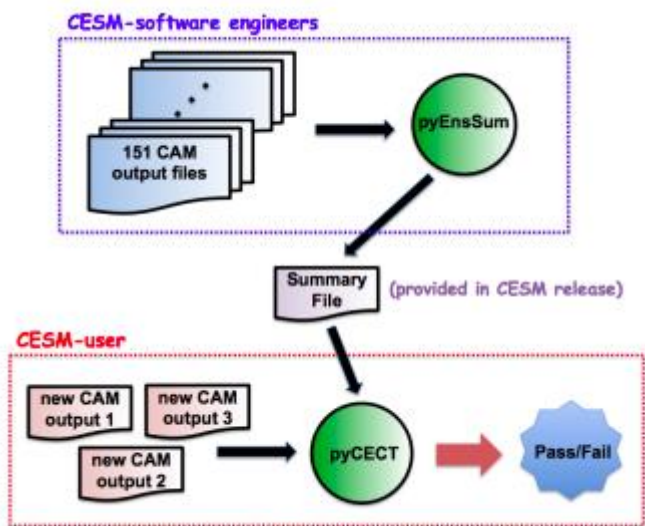
Currently capable of 132 simultaneous model simulations.

Foundational CESM2 workflow experience:

We would like to acknowledge and credit the work done by NCAR's ASAP group, especially Sheri Mickelson, in instrumenting CESM2 with CYLC for the CMIP6 experiments.

- CMIP6 Experimental Status (since August 2018)
 - Have run **979 different CESM cases**.
 - Published **690 cases**.
 - Generated **~1.3 PB of compressed (lossless)** time series files.
 - Published **~310 TB** of compressed CMIP6 files to ESGF.

CESM Ensemble verification test



CESM2 Ensemble Verification

Please see [CESM2 Python Tools](#) for details or for help with this form see [DiscussCESM](#)

ECT & UF-ECT *ONLY .NC FILES

[Switch to POP-ECT](#)

Run 1

📄 No file chosen

Run 2

📄 No file chosen

Run 3

📄 No file chosen

Important

The process will take 6-10 minutes or more to complete

CIME

github repository:

<https://github.com/ESMCI/cime>

documentation:

esmci.github.io/cime

developers guide:

<https://github.com/ESMCI/cime/wiki/CIME-Developers-Guide>

Questions?

Thank You