

CESM Software Engineering Working Group

A selection of major activities

Presented by Bill Sacks

Credits: Many members of the SEWG and others



New / vastly expanded components

- Ocean: MOM6 (more details Wed. at 1:25 pm)
 - ▶ Functional release in CESM2.2
 - ▶ Planned to be primary ocean component in CESM3
 - ▶ Work underway includes:
 - Improving forced MOM6 compsets scientifically
 - Improving fully-coupled configuration
 - Adding biogeochemistry coupling
- Sea Ice: CICE6
 - ▶ Planned to be available starting in CESM2.3
 - ▶ Dynamic memory allocation – allows runtime changes of grid, tracers, etc.
 - ▶ Vertical thermodynamics separated – allows column testing

New / vastly expanded components

- Atmosphere: CAM undergoing major changes
 - ▶ Rewrite for Common Community Physics Package (CCPP)
 - ▶ Support for new dynamical cores: CAM-SE, FV3, MPAS
- Land: CLM now CTSM
 - ▶ Support for an expanded range of options for NWP, etc.
 - ▶ Moving towards the Functionally Assembled Terrestrial Ecosystem Simulator (FATES) as a default capability
- River: MizuRoute
 - ▶ Runs on more accurate Hydrologic Response Units rather than regular grids
 - ▶ Will enable dynamic lakes and reservoirs
- Land ice: CISM over Antarctica as well as Greenland

Community Mediator for Earth Predictive Systems (CMEPS)

New coupling architecture based on ESMF's
National Unified Operational Prediction Capability (NUOPC)
(more details Wed. at 1:05 pm)

Benefits to CESM

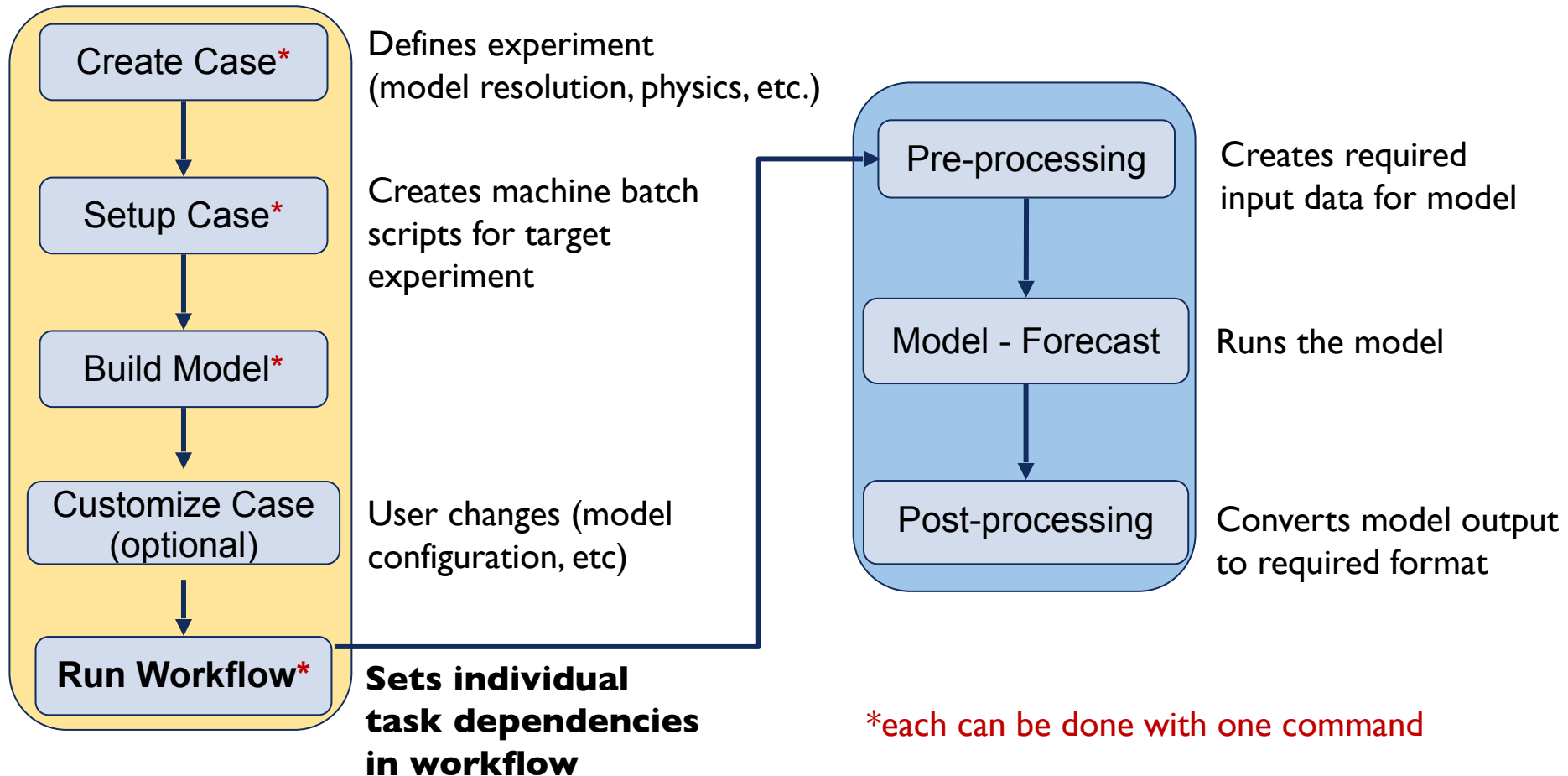
- New online regridding capability – much easier to introduce new refined grids
- New runtime sequencing via simple text file – easier to change run sequence
- New coupling capabilities – e.g., upcoming exchange grid
- New ESMF-based data models will allow online 3-d regridding and other capabilities
- Exercising CMEPS with different components and coupling strategies results in much more robust system

CESM Status

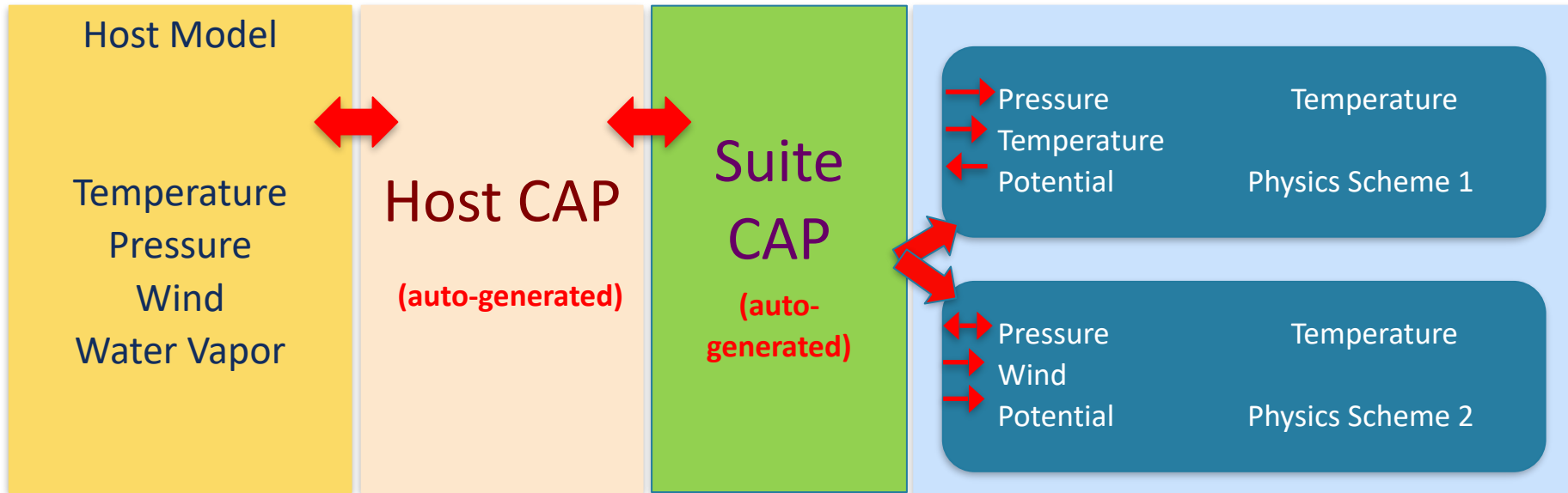
- All CESM components have NUOPC “caps”
- CMEPS planned as default architecture for CESM2.3 and beyond

New Predictive Workflow using CIME

(more details Wed. at 1:40 pm)



Common Community Physics Package Framework (CCPP)



Each scheme comes with metadata (as does the host)

The schemes are assembled into a suite

The CCPP Framework then **auto-generates the CAP code so the host model can call the suite**

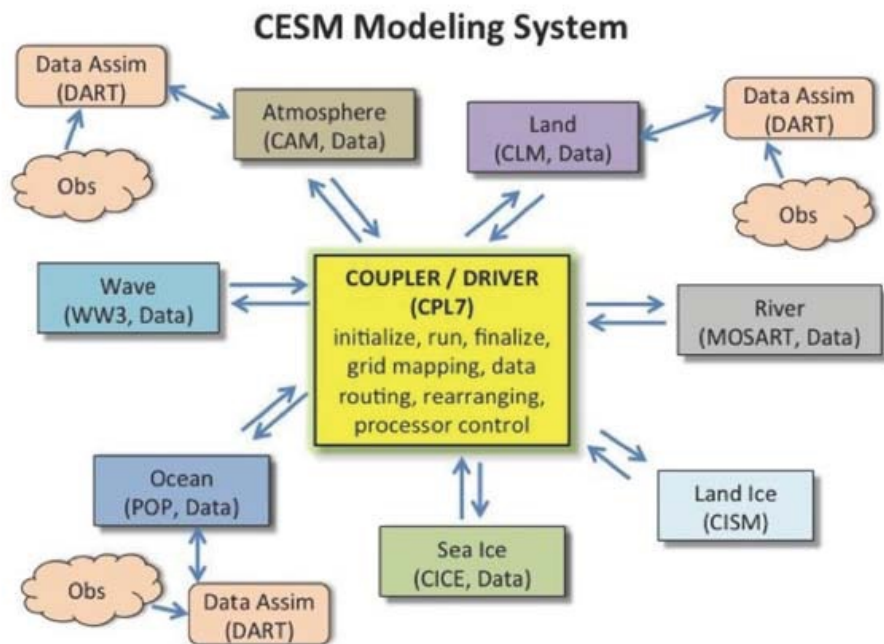
Key benefits:

- Supports portable atmospheric physics
- Physics testbed enables functional development and testing of new or existing physics schemes

```
<suite name="sample"
      version="1.0">
  <group name="physics">
    <scheme>scheme1</scheme>
    <scheme>scheme2</scheme>
  </group>
</suite>
```

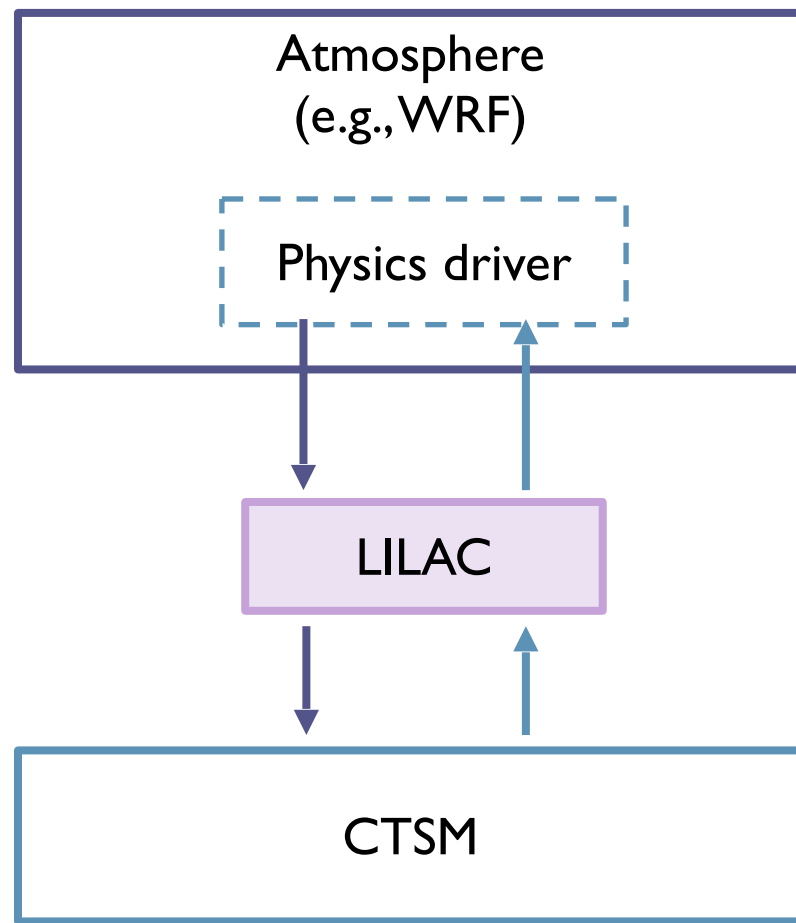
Lightweight Infrastructure for Land-Atmosphere Coupling (LILAC)

CESM hub and spoke architecture



(more details *Tuesday at 8:45 am*)

LILAC architecture



CESM Simpler Models: Update and Near-Term Plans

Currently available configurations

- SCAM (including a containerized version), Dry dynamical core, Dynamical core with idealized moisture, Radiative Convective Equilibrium aquaplanet, Aquaplanet

Configurations under development

- Gray radiation aquaplanet
- Coupled ocean aquaplanet (quasi-aqua and ridge-world)
- Pencil ocean model
- Single column earth system model (SCESM) – SCAM coupled to single-column ocean

Upcoming developments

- Incorporation of Simple Land Interface Model (SLIM) into CESM
- Development of idealized coupled modeling toolkits: simpler models query tool, tools for generation of user-defined bathymetry, continental geometries, land surface types
- Incorporation of weak temperature gradient parameterizations into SCAM

CESM in the Cloud

Present	<p>Researchers can use a validated, pre-installed CESM via Amazon Web Services (AWS): Standard Linux cluster environment, accessed via SSH</p> <p>Uses:</p> <ul style="list-style-type: none">• Research (Yale University, 200+ CESM runs on AWS)• Training (AGU/AMS workshops & others)
Coming Soon (2020)	<p>Features:</p> <ul style="list-style-type: none">• Simpler deployment (single command!)• Expanded AWS regions, node types and networks• Automatic selection of most cost effective region, node and network! <p>Information:</p> <ul style="list-style-type: none">• Performance benchmarks & cost estimates for common cases
Benefits	<ul style="list-style-type: none">• Standard platform – easier problem-solving; all have identical “systems”• Fully configurable – we can manage dependencies, libraries, tools, etc.



Improved Community Forums

<https://bb.cgd.ucar.edu/cesm/>

NCAR CGD DiscussCESM

Forums What's new Members

New posts Find threads Watched Search forums Mark forums read

DiscussCESM Forums [Information to include in help requests](#)

Supported Release **2.1.3**

The Community Earth System Model (CESM) is a fully coupled, global climate model that provides state-of-the-art computer simulations of the Earth's past, present, and future climate states. Please post your question to the most appropriate forum topic.

CSEG Announcements Threads: 54 Messages: 266 Known issue: running manage_ext... Mar 3, 2020 · sacks

Non-component-specific topics

CESM General	Threads: 2.9K	Messages: 10.9K	M How to use mpirun to reduce running time? Today at 4:10 AM · majun
CESM Community Projects	Threads: 24	Messages: 108	H Suggestions for modifying the star... Feb 19, 2020 · hannay
Infrastructure (CIME, porting, machines, scripts)	Threads: 186	Messages: 834	L step by step porting CESM2.1.3 t... Yesterday at 8:30 PM · littleddna@g
Data Models	Threads: 16	Messages: 112	N Auxiliary History Options For CLM... Thursday at 8:30 AM · nicholas_heav

Specialized Configurations

Simpler Models	Threads: 2	Messages: 4	J Surface temperature can't be belo... Jun 5, 2020 · jyBear
Paleoclimate	Threads: 70	Messages: 252	A Cheyenne mkmapdata mpiexec... Thursday at 12:49 PM · acostar@umi

Atmosphere

CAM	Threads: 1.2K	Messages: 4.8K	T How best to save initial conditions... Wednesday at 12:55 PM · teopb
CAM-Chem	Threads: 14	Messages: 40	W Does the CAM-Chem have the out... May 20, 2020 · wmingch@uw_edu
WACCM	Threads: 26	Messages: 104	D How to change ozone concentration Friday at 10:44 PM · deepashree_dut

Land, River Runoff

CTSM, CLM, MOSART, RTM	Threads: 263	Messages: 878	C Groundwater recharge CLM5 Today at 1:05 PM · cskinner
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New Posts

- C** Groundwater recharge CLM5 Latest: cskinner · Today at 1:05 PM CTSM, CLM, MOSART, RTM
- M** How to use mpirun to reduce running time? Latest: majun · Today at 4:10 AM CESM General
- S** single-point_compset I2000Clim50BgcCropGs_Error:CNBalanceCheckMod.F90 at line 351 Latest: ShirleyX · Today at 2:14 AM CTSM, CLM, MOSART, RTM
- L** step by step porting CESM2.1.3 to a new machine Latest: littleddna@gmail_com · Yesterday at 8:30 PM Infrastructure (CIME, porting, machines, scripts)
- S** The new crop types in CLM5 Latest: ShirleyX · Yesterday at 5:40 AM CTSM, CLM, MOSART, RTM

Managing Model Output for CESM3

Please consider attending this discussion
Wednesday 2:45 – 4:30 pm

We'd like input from scientists as well as
software engineers on these topics

- Standardizing model output across components
- MIP compliance
- Default output volumes
- Compression (lossy & lossless)
- Timestamps for averaged fields
- Time slice vs. time series format (output from model)
- How do we get funding for I/O initiatives?