

CESM2 Software Update

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Outline

- CMIP6 Computational Performance
- Cheyenne Status
- CESM2 new user-friendly infrastructure features
 - CIME
 - New porting capabilities with CIME
 - New Post-Processing capabilities
 - New Automated Workflow for CMIP6

CESM2.0 Performance YS

Configuration	Resolution	# of PEs	ThruPut yrs/day	Cost PE-hours/yr
Fully Coupled (B1850 case)	1-degree (f09_g16)	4224	22	4563
Ocean Spinup (GECO case)	1-degree (T62_g16)	1616	84	927
Land Spinup (I case)	1-degree (f09_g16)	2432	161	368
WACCM/DOCN (FW1850 case)	1-degree (f09_f09)	9600	6	33086

Ocean spinup: 2000 years Land spinup: 1000 years

<http://www.cesm.ucar.edu/models/cesm2.0/timing2.0/>
<http://www.cesm.ucar.edu/models/cesm2.0/timing2.0-spinup/>

Current work is ongoing to optimize cheyenne performance

Cheyenne Status- CESM2.0 Code Base

- **Porting Status:**
 - CESM2.0 code ported to cheyenne
- **Testing:**
 - all system regression tests done on yellowstone are also done on cheyenne
- **Creating cases:**
 - scripts no longer need a machine name – auto-detect the platform
 - `./create_newcase -case foo -compset B1850 -res f09_g16`

Cheyenne Status – Older Code

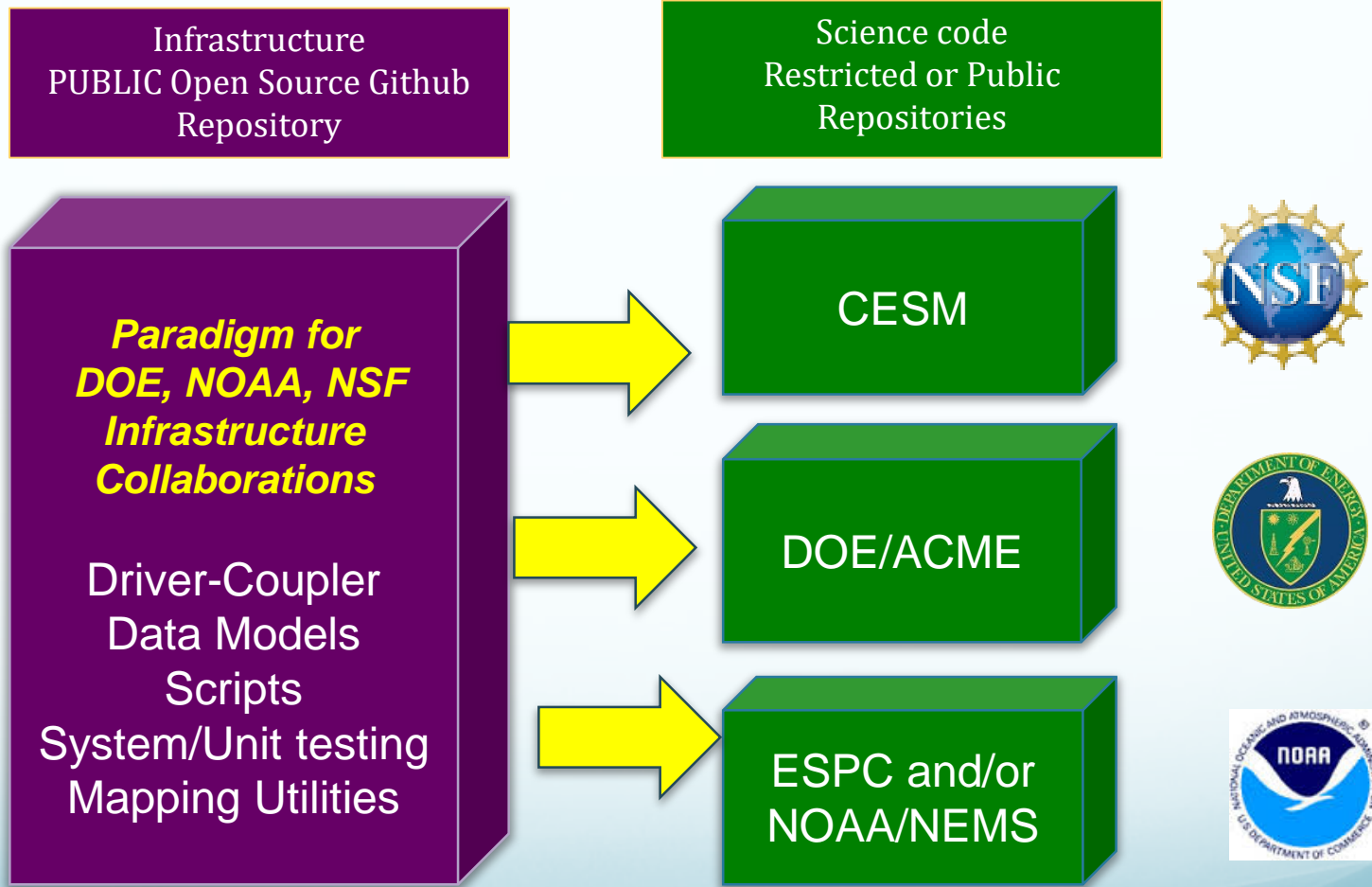
- Following has already been ported:
 - Large Ensemble (LENS) configuration
 - Several other ASD configurations
- Following will be ported **as early as possible – but likely after the release**
 - CESM1.0.x
 - CESM1.2.2
 - Last Millennium configuration (LME)
- Only scientifically supported configurations will be tested as part of the port
- **README** will be provided for users to port other configurations (e.g. beta tags)
- CESM Forum will be monitored to answer questions on porting problems

Porting



CIME

(new python-based CESM infrastructure)



addresses needs of multiple efforts

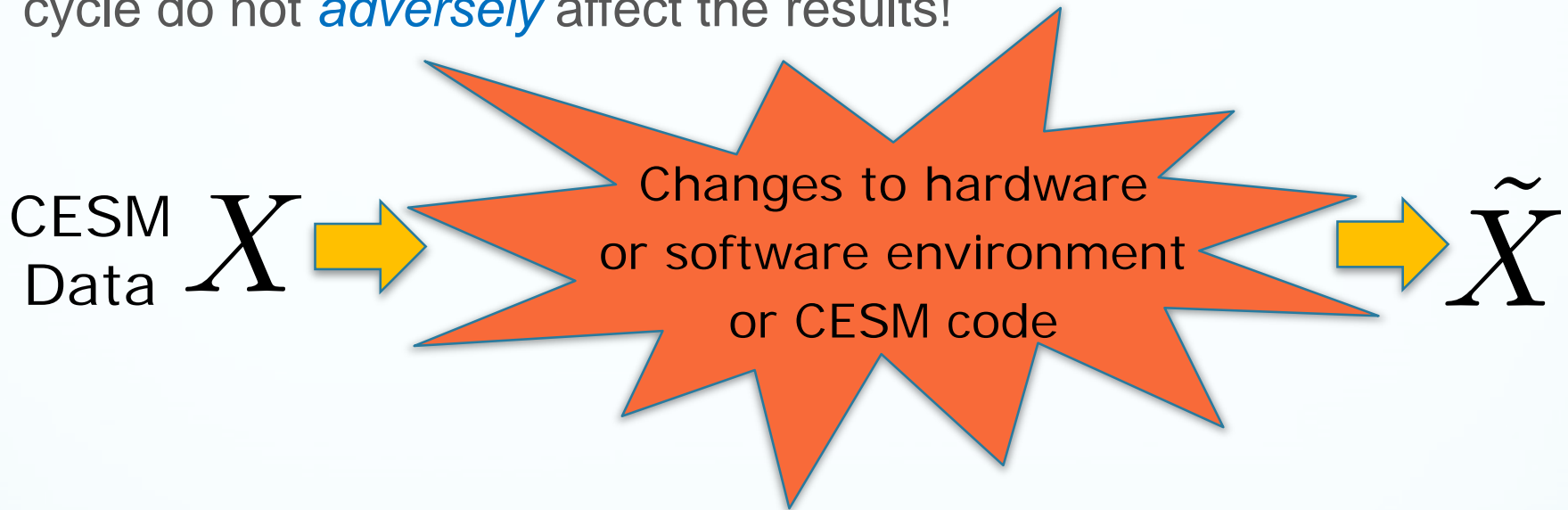
CESM2 Porting

- CIME will make porting to other platforms MUCH easier in CESM2 and beyond
- **Improved porting process** will make it easier for community to port to different machines (linux clusters, laptops, ...)
- **Improved porting verification** leverages CIME ensemble consistency tests

Software Quality Assurance for CESM



Goal: Insure that changes during the CESM development life cycle do not *adversely* affect the results!




Question: If $X \neq \tilde{X}$, is the new result correct?



Is the new data *statistically distinguishable* from the original?

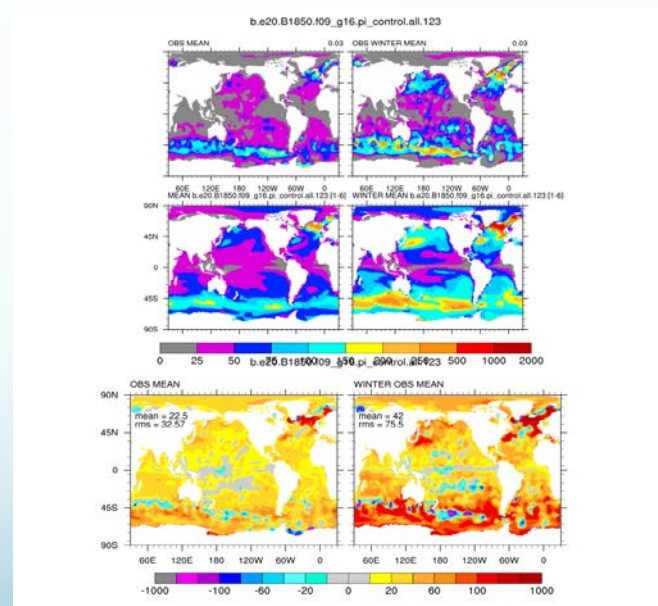
CESM-ECT Suite of Tools

Tool	Target Module	Ensemble Simulation
CAM-ECT	CAM, CLM	annual average
 UF-CAM-ECT ("ultra-fast")	CAM, CLM	9 th timestep
POP-ECT	POP, CICE	monthly average at month 12

- used routinely for CESM port-verification
 - (new machines/compilers)
- uncovered multiple errors in software and hardware stack
 - (expect *pass* but get *fail*)
- modifications expected to be climate-changing will *fail* the test

Take away: enables "letting go" of bit-for-bit reproducibility!

Post Processing and Diagnostics



CESM Post-Processing Tools

- **New user-friendly integration of post-processing diagnostics into CIME experiment cases**
 - Diagnostics (for atm, lnd, ice, ocn) are now parallel and much faster:
 - CMIP6 features have been added – transformation to CMOR compliant output
 - Regularly used on yellowstone and cheyenne for CESM2.0 development and ASD experiments
- **CESM2.0 support:**
 - **Will be supported on yellowstone and cheyenne for the CESM2.0 release.**
 - **Support for other platforms will follow in post-release updates.**

https://github.com/NCAR/CESM_postprocessing

create_postprocess

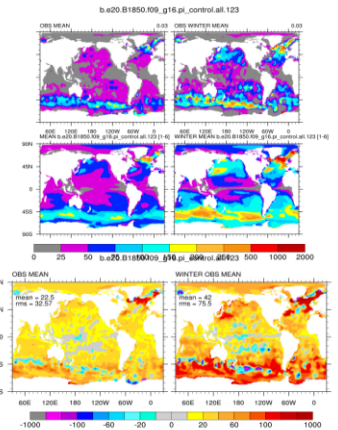
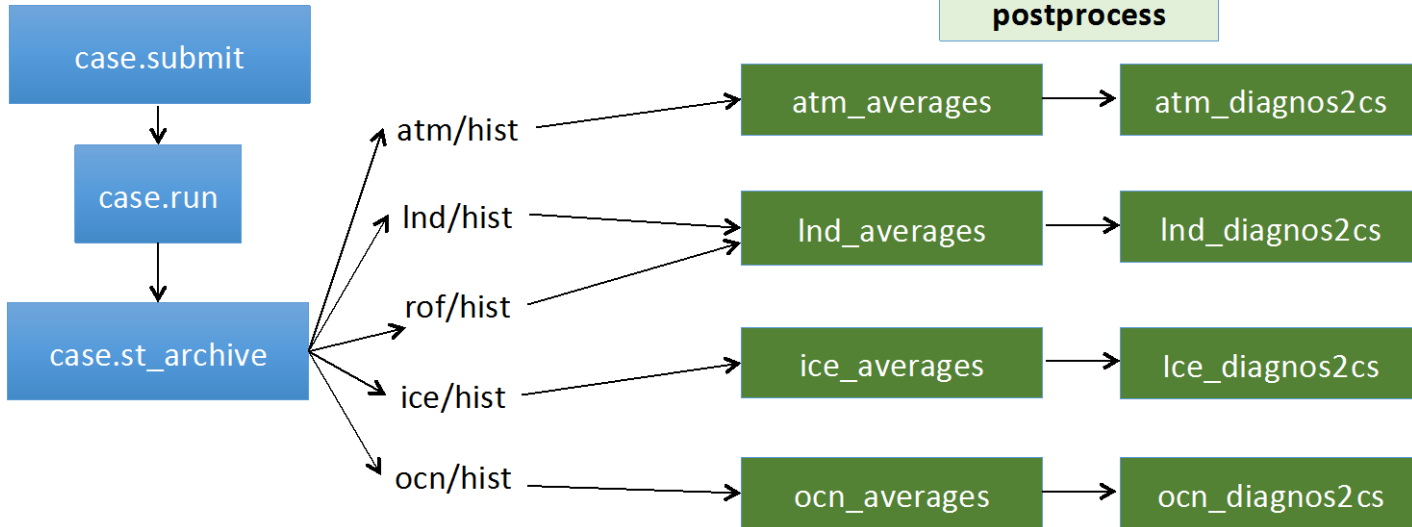
New command included with the CESM_Postprocessing Tools

```
create_newcase -case mycase -compset B1850 -res r09_g16
```

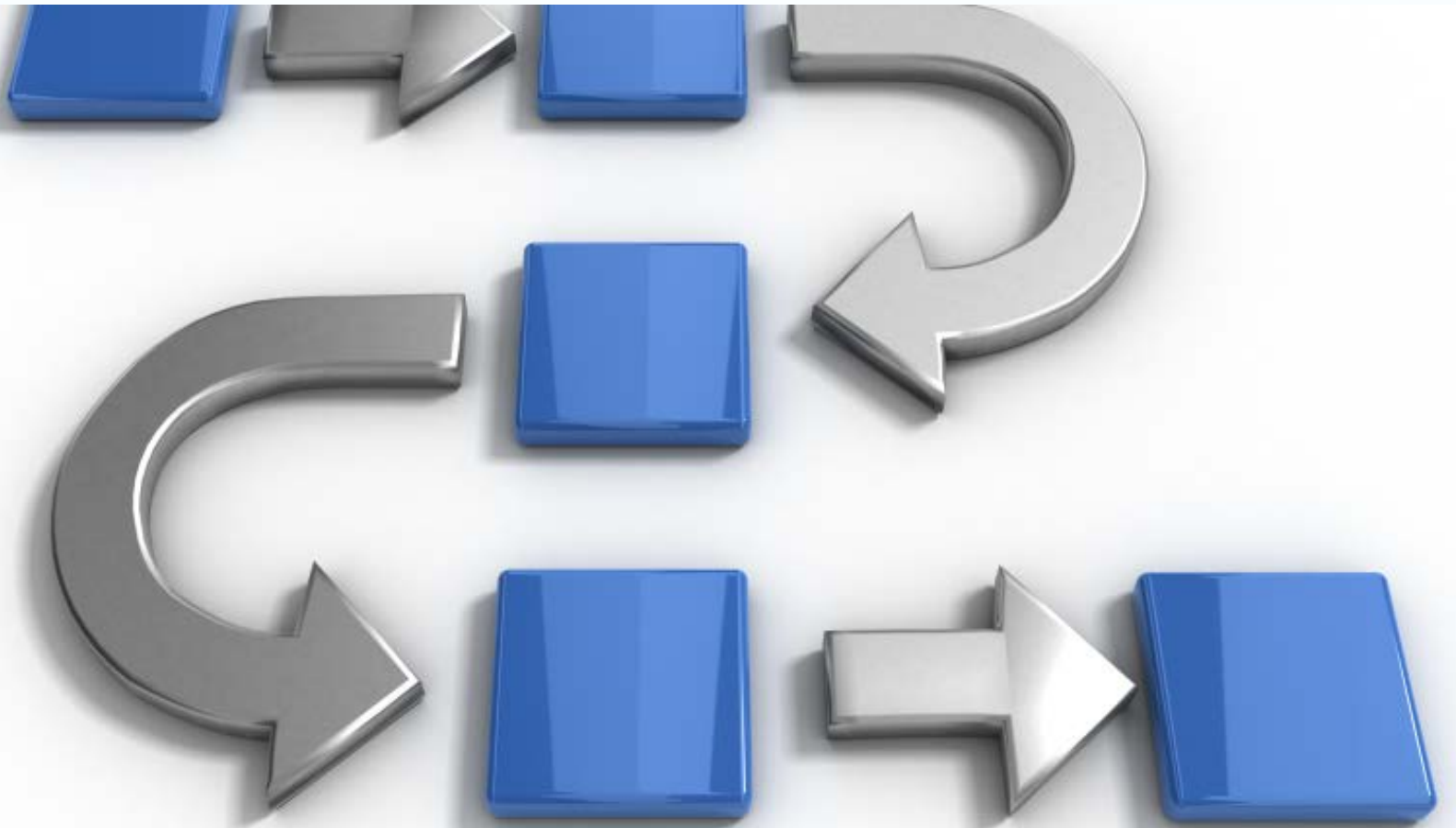
mycase

```
create_postprocess -caseroot mycase
```

mycase/
postprocess



Workflow



CMIP6 CESM Workflows Using Cylc

Provides an interface and workflow manager where users can run an entire CESM experiment suite and post process data automatically with only a couple of clicks.

- CESM2.0 support:
 - Cylc is installed on both yellowstone and cheyenne.
 - For CESM 2.0 will provide users with tools that automatically generate basic Cylc suites that users can run on yellowstone and cheyenne.
 - More general support for non-NCAR platforms will follow in subsequent release updates.

https://github.com/NCAR/CESM_WF


The ability to automate the postprocessing, via cylc, while performing the runs has enabled us to complete 1,240 out of 1,860 total runs
~750 TB timeslice output - in about 1 month. Identifying and restarting failed submissions was trivial.

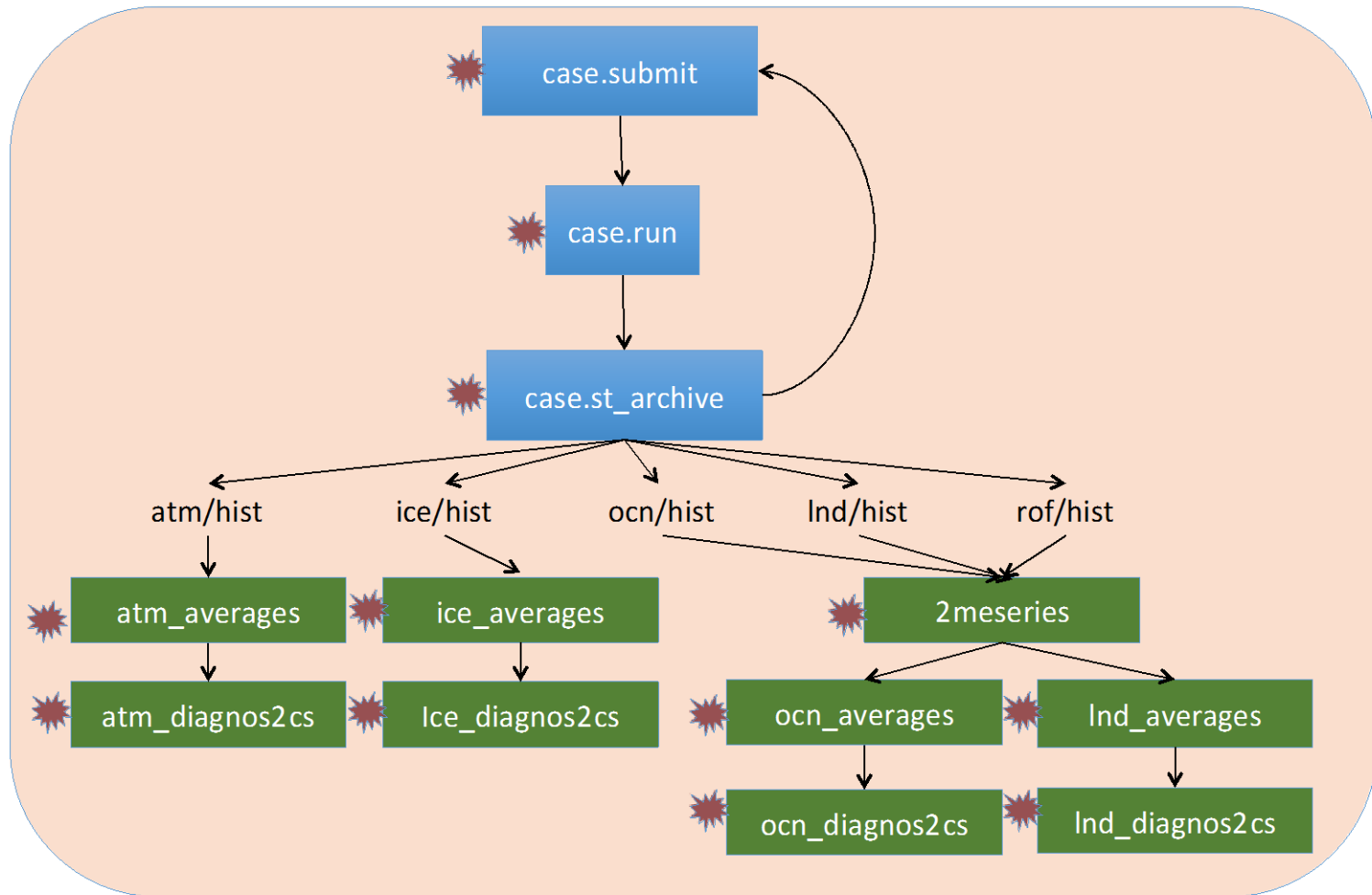
Cylc workflow manager

mycase

mycase/
postprocess

mycase/cylc

 Cylc sends
Automa2c
Email status
updates



Acknowledgements

- CIME
 - DOE: Jim Foucar, Rob Jacob, Jason Sarich, Andy Salinger, Andreas Wilke, Michael Deakin
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- Performance Optimization
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