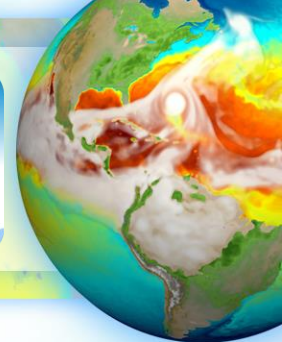


Performance Analytics for Computational Experiments



Sarat Sreepathi
Oak Ridge National Laboratory

E3SM All-Hands Webinar
June 4th, 2020

In collaboration with
Youngsung Kim, ORNL

Past Students:
Zachary Mitchell,
Pellissippi State Community College
Gaurab KC,
University of Tennessee Knoxville

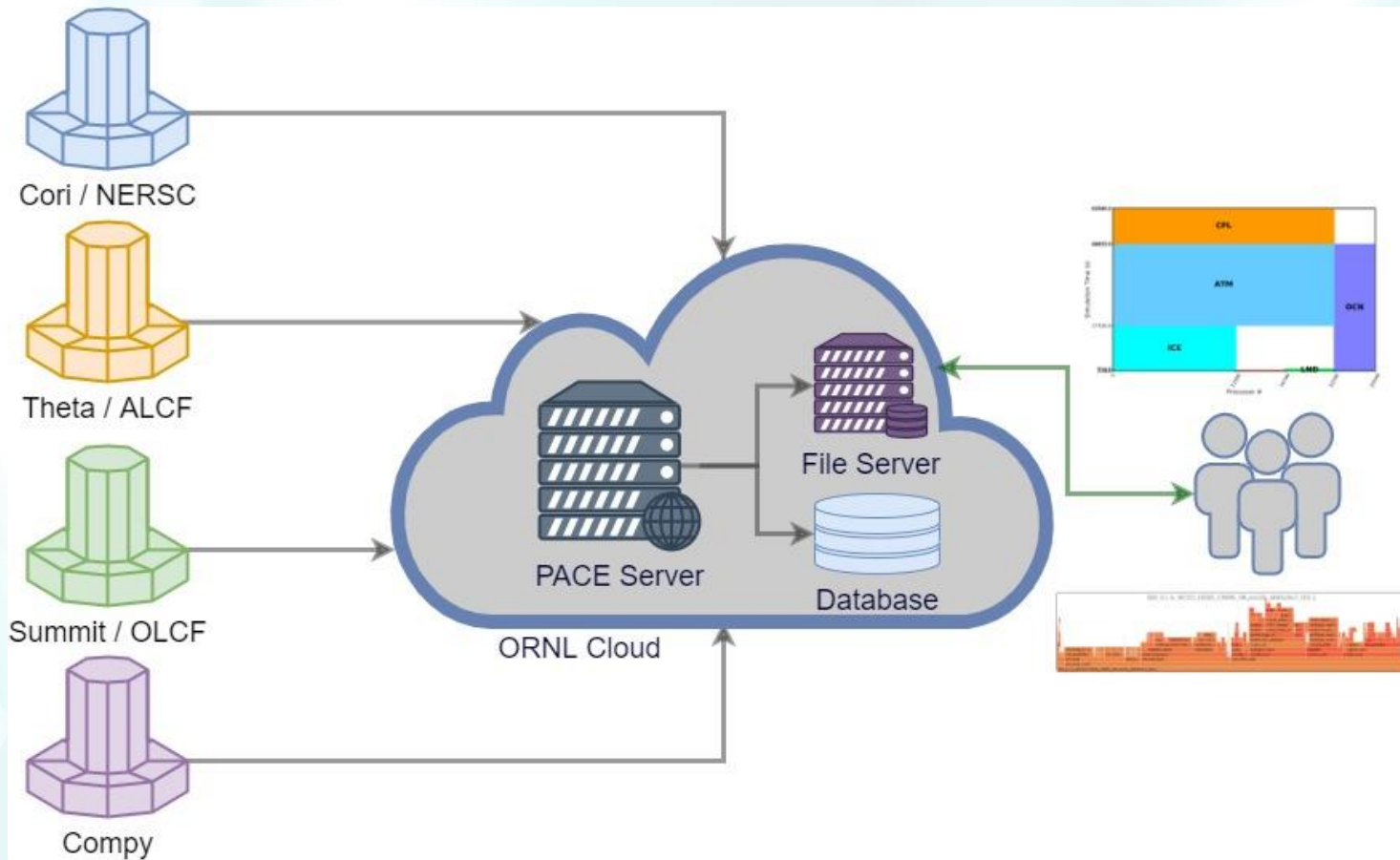
Goals

Provide executive summary of E3SM performance to stakeholders

Facilitate:

- Interactive analyses and deep-dives into experiments and application sub-regions, as desired,
- Tracking performance benchmarks and simulation campaigns of interest,
- Facilitating performance research on load balancing and process layouts,
- Identification of bottlenecks to inform targeted optimization efforts.

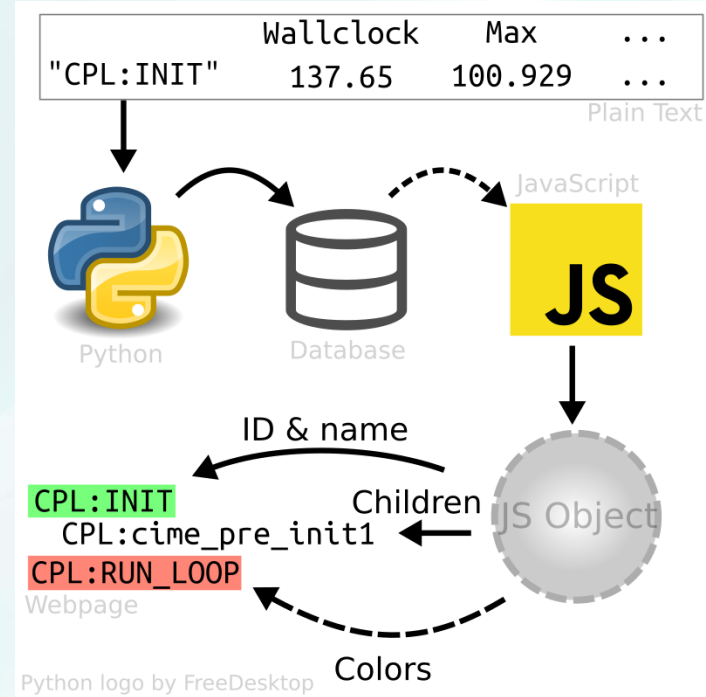
PACE Architecture



Technology Stack

- Infrastructure
 - ORNL Cloud (CADES)
 - OpenStack VM
- Nginx Web Server + Reverse Proxy
- Python-Flask middleware
 - Application Server
 - Process model inputs/timings
- Minio File Server
 - Object based storage for raw data
- MariaDB database
 - Structured and semi-structured data
 - Flexible Schema
- JavaScript
 - Frontend and visualization

Visualization Pipeline



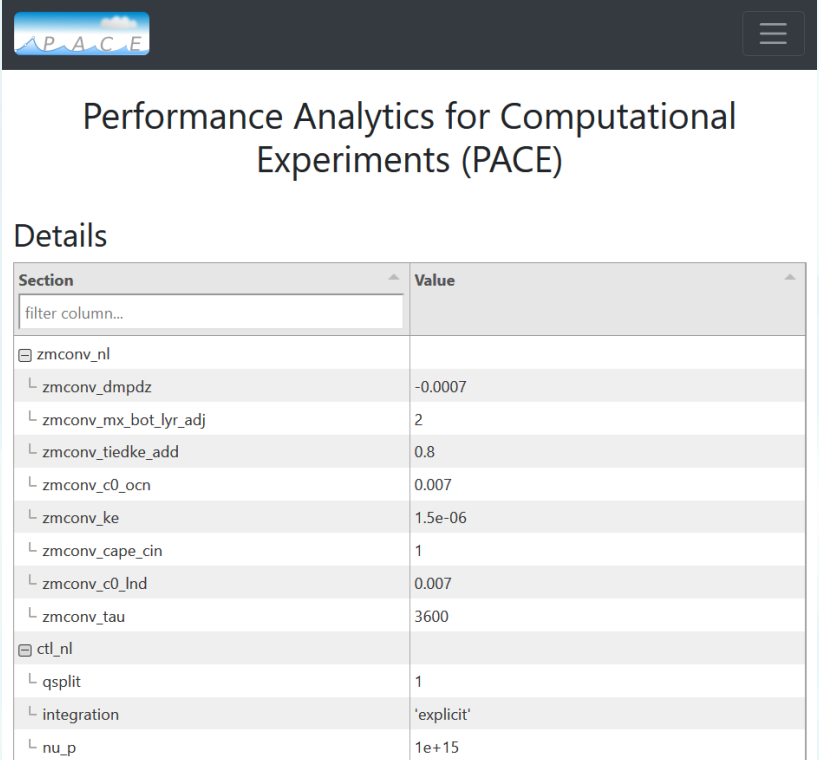
Last but definitely not least:
Cybersecurity compliance at a DOE lab

E3SM Performance Data

- Lightweight performance profiling by default
 - Utilizes General Purpose Timing Library (GPTL) timers
 - Mark start/stop at defined application phases
 - Aggregate statistics for parallel processes
 - Collect computation, communication and I/O performance data
- Performance Archiving
 - Archive performance data in project wide locations
 - Representative provenance data for context
 - System state and various logs
 - Hierarchical directory structure
 - user->case->job
 - Enabled on Anvil, Compy, ALCF, OLCF and NERSC.

New Capabilities

- Parse Model Inputs
 - XMLs: 187,682
 - Namelists: 440,374
 - RCs: 24,187
 - Raw data (.zip): 24,468
 - Total experiments: 24,468
- Automated nightly uploads
 - Using Jenkins
 - Deployed on Compy and Cori
 - Anvil, Theta – on the way



The screenshot shows the 'Performance Analytics for Computational Experiments (PACE)' interface. At the top, there is a logo for 'P A C E' and a menu icon. The main title is 'Performance Analytics for Computational Experiments (PACE)'. Below the title, the word 'Details' is displayed. A table with two columns, 'Section' and 'Value', is shown. The 'Section' column has a search box containing 'filter column...'. The table lists several parameters under two main sections: 'zmconv_nl' and 'ctl_nl'. The values range from -0.0007 to 3600.

Section	Value
filter column...	
zmconv_nl	
zmconv_dmpdz	-0.0007
zmconv_mx_bot_lyr_adj	2
zmconv_tiedke_add	0.8
zmconv_c0_ocn	0.007
zmconv_ke	1.5e-06
zmconv_cape_cin	1
zmconv_c0_lnd	0.007
zmconv_tau	3600
ctl_nl	
qsplitt	1
integration	'explicit'
nu_p	1e+15

View and filter namelists

PACE Statistics

- 151 users
- 10 platforms
- Performance Benchmarks
 - High-res Atmosphere
 - High-res Ocean
- Simulation Campaigns
 - DECK v1
 - High-res Water Cycle
 - MMF Early Science
 - BGC: BCRC, BCRD, BDRC, BDRD

- 24,468 experiments
- 652,243 model input files
- 59,560 timing files

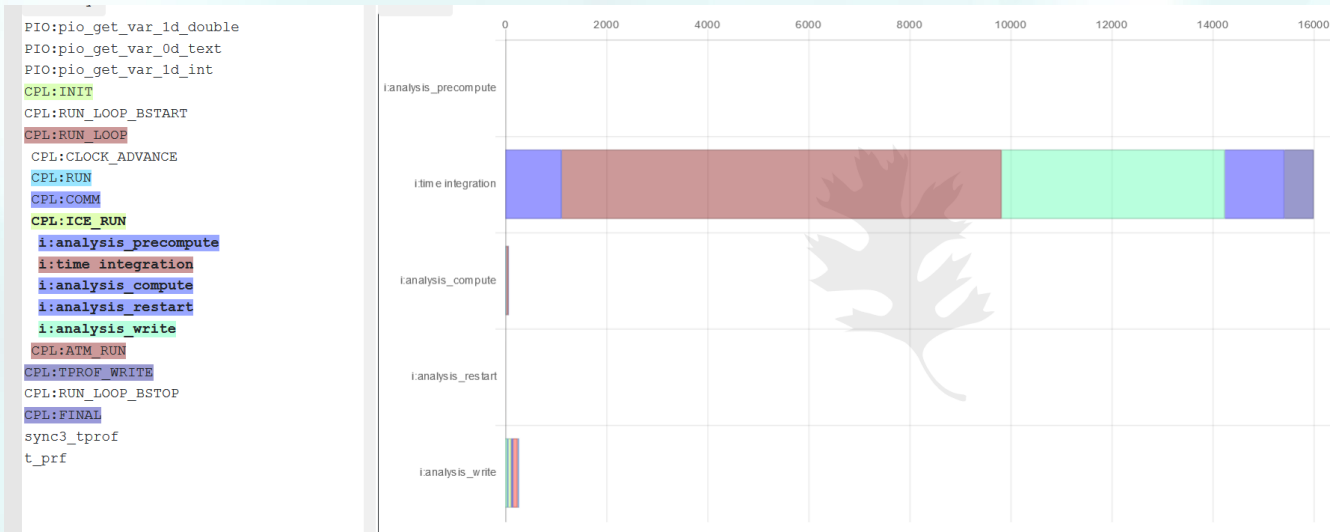
Aggregate statistics and reports can inform:

- INCITE and other compute allocation proposals
- Computing procurements

Tree Graph

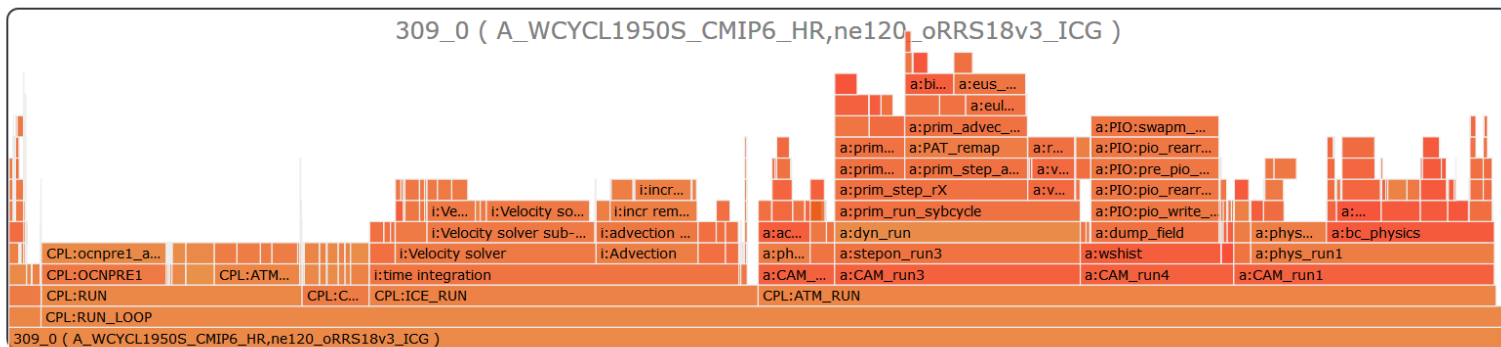
Summarize time taken by model components

Recursively explore time taken by model sub-regions



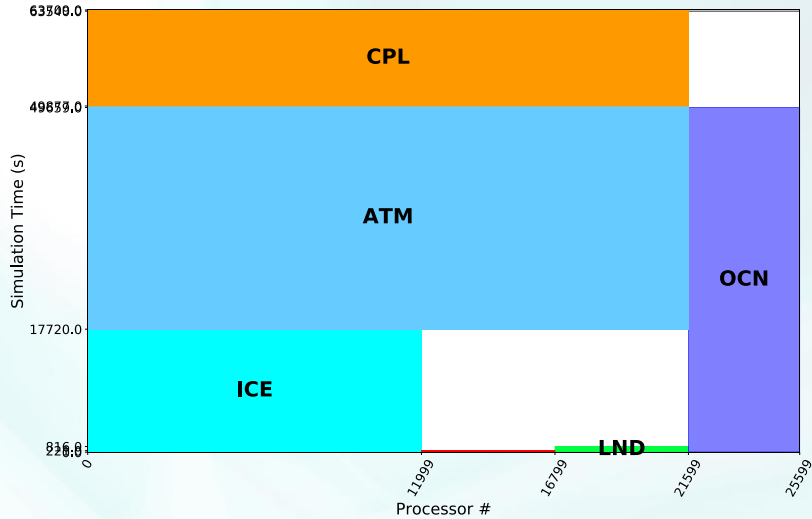
Flame Graph

High-level overview of a parallel process execution time



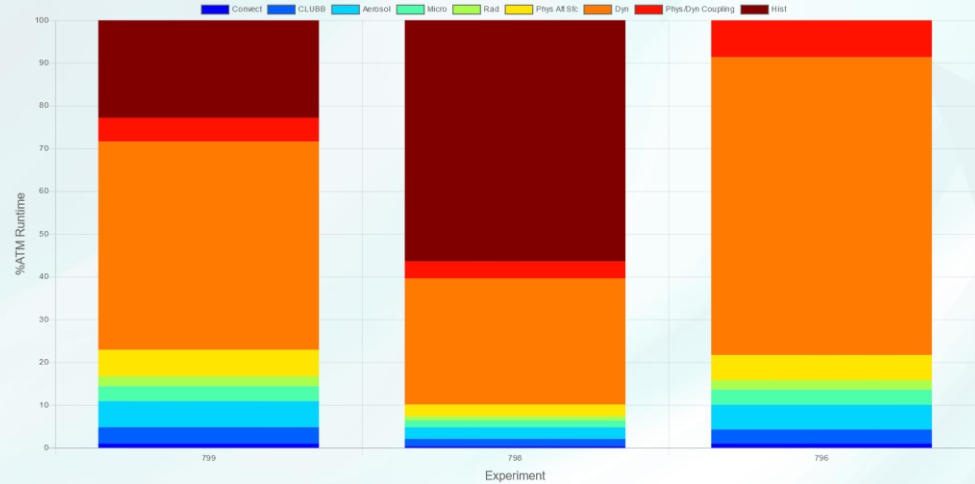
Performance Research Directions

Load Balancing



MPI Task Mapping

Optimization



Atmosphere model time distribution



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Acknowledgments



Links

- [BER Highlight](#)
- [PACE Portal](#)
- [Reference Page on E3SM.org](#)
- [Video - Web Portal Features](#)
- [Video - How to Upload Data](#)



<https://pace.ornl.gov>

Thanks!

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