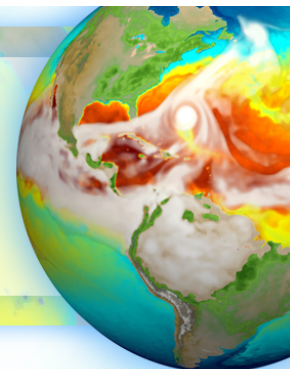# Performance Update

E3SM 2019 March Madness Edition

Phil Jones, Sarat Sreepathi on behalf of Performance Group:

Oksana Guba, Mathias Jacquelin, Noel Keen, Jayesh Krishna, Azamat Mametjanov, Henry Moncada, Hongzhang Shan, Mark Taylor, Pat Worley, Min Xu

E3SM — Energy Exascale Earth System Model

U.S. DEPARTMENT OF ENERGY

Goals

- Maximize throughput for science sims

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    - Summit (P9/GPU)
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    - A21 (newly announced Intel Xeon SP with Xe GPU, Shasta/slingshot, memory innov)
    - Trend?

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- Monitor/measure performance
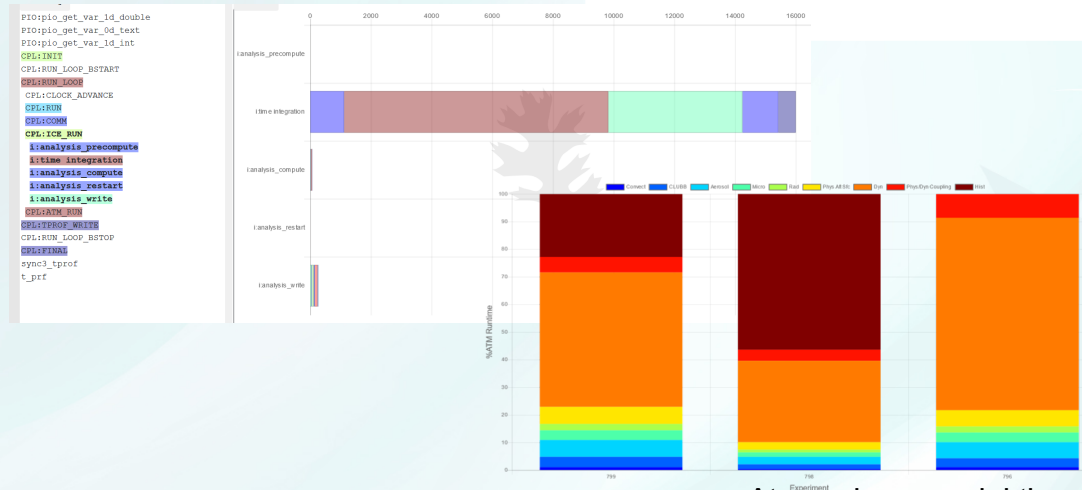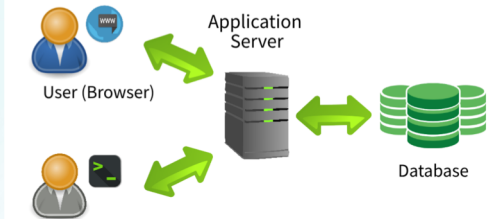 - Standard benchmarks
  - Performance tools

Performance Analytics for Climate Experiments

https://pace.ornl.gov

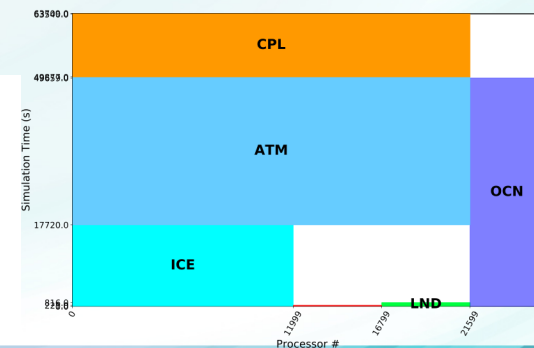Infrastructure to provide executive summary of experiments performance.
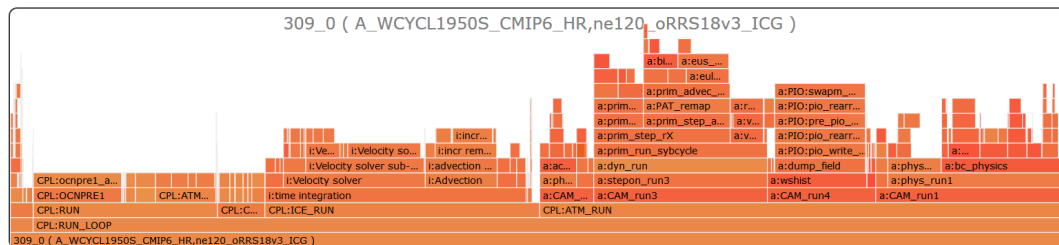
- Harvest/collect performance of all sims
  - Also collateral data to sell
- Central hub of performance data
- Interactively deep-dive as desired
- Facilitate performance research
- User input, existing scripts

Atmosphere model time distribution

Load Balance:
MPI Task Mapping

Summary Performance Graphs

309_0 (A_WCYCL1950S_CMIP6_HR,ne120_oRRS18v3_ICG)

Status

- Phase 2 Baseline Benchmarks
  - E3SM metric to track over time
  - How best to present/utilize this data?
- Ongoing work high-res
  - MPAS, RRTMG
  - Threading (MPAS)
- Initial profiles/optimization of BGC configuration
  - I/O bound
- I/O
  - PIO2, ADIOS
  - Substantially better performance
- KNL dead to us
  - Well, maybe some vector/thread improvements still needed

Cori-KNL

nodes	cores	Best SYPD ATM
85	68 per node	0.41
169		0.79
338		1.5
675		2.66
1350		3.94
2700		5.2

nodes	git hash: 1b2b515 10/2017	Master 12/2018	Maint-1.0 12/2018
85	0.41	0.40	0.35
169	0.79	0.75	0.65
338	1.50	1.42	1.27
675	2.66	2.46	2.14
1350	3.94	3.71	3.08

Latest update: 2019-02-17 (Collected by @Patrick Worley). Code: v1 maintenance

nodes	cores	OCN SYPD	ICE SYPD	CPL SYPD	hyperthreading
64	4096	0.59	1.53	2.37	yes (2-way, 4096x2)
75	4800	0.67	1.73	1.60	yes (2-way, 4800x2)
100	6400	0.82	1.95	2.38	yes (2-way, 6400x2)
128	8192	1.02	2.54	3.20	yes (2-way, 8192x2)
150	9600	1.10	2.80	1.30	yes (2-way, 9600x2)
200	12800	1.30	3.27	2.40	yes (2-way, 12800x2)
300	19200	1.67	3.90	1.21	yes (2-way, 19200x2)
400	25600	1.26	4.35	1.70	no (25600x1)
500	32000	2.21	4.81	1.57	no (32000x1)
750	48000	2.61	4.98	1.72	no (48000x1)
1000	64000	3.13	4.53	0.71	no (64000x1)

Summit – no GPU

Summit

High-res F case without I/O

Latest update: 2019-02-04.   Code: v1 maintenance branch.   Compiler: PGI/18.10

| Nodes	Cores	Threads	smt	SYPD ATM	SYPD LND
100	8400	1	2	0.37	183.41
200	16800	1	2	0.78	256.02
400	33600	1	2	1.38	473.05
515	43200	1	2	1.74	407.70

Summit

High-res G case without I/O

Latest update: 2019-02-04. Code: v1 maintenance branch. Compiler: PGI/18.10

nodes	cores (cpl,ice,ocn)	cores (others)	threads	smt	SYPD OCN	SYPD ICE	SYPD CPL
115	9600	9600	1	2	1.41	4.17	6.91
191	16000	16000	1	2	2.01	6.22	9.42
572	48000	16000	1	2	4.14	10.40	2.48

GPU Strategy

- Short term: 737-MAX model
  - Not a different model
    - No need for additional training
    - Porting exercise
  - Software to hide details
    - Kokkos
    - OpenACC/OpenMP
  - Issues
    - How much to port (eg v1 physics)

- Longer term
  - Utilize GPU differently
  - Subgrid models (SAM, ocean ML)
  - Task parallelism to split work across devices
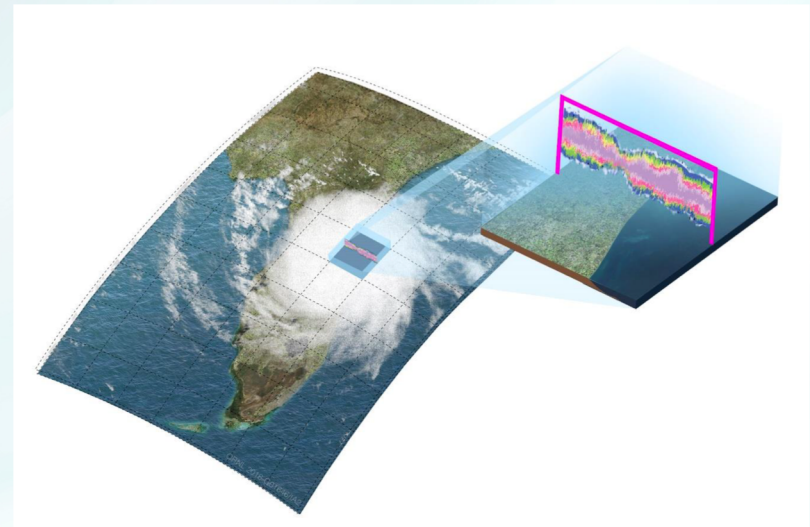
Related sessions

- Performance breakouts (3p today, 10a tomorrow)
  - Input on how to best use/present perf data
  - Input on v1 physics
- Discussions in SCREAM, Algorithm NGD

- Remember Deep Dives 4:30 tomorrow