

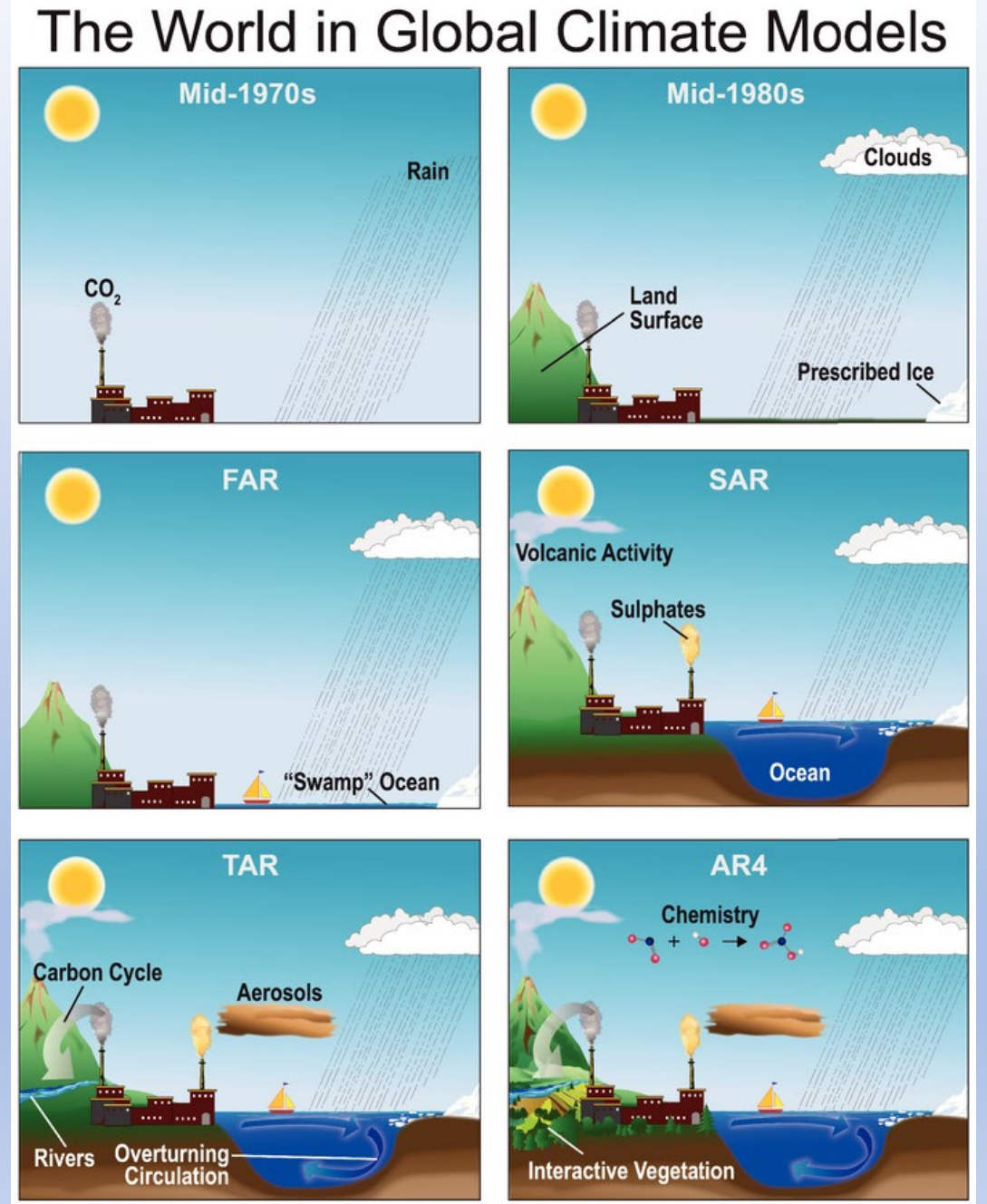
An underwater photograph of a surfer riding a wave. The surfer is positioned in the lower center of the frame, lying on their back on a white surfboard. They are wearing dark shorts and a watch on their left wrist. The water is a deep blue, and the surface of the wave is visible above, showing white foam and ripples. The lighting is natural, coming from above, creating a sense of depth and movement.

MOM6 – Parallel I/O

Matt Watwood – HPSC Final Poject

Global Coupled Climate Models - Reminder

- Atmosphere, Ocean, Land, and Sea Ice components
- MOM6 –
The Modular Ocean Model version 6
- To be used in NCAR's Community Earth Systems Model (CESM).



Community Contribution Follow-up

- Github wiki's do not currently support a fork and PR workflow
- As a contributor of a project, then the wiki can be edited smoothly
- Wiki's can be pulled, but cannot be pushed to by non-contributors



github.com/NCAR/MOM6-cases/wiki/Getting-Started#downloading-ncar-mom6-cases

qsub script_name

On CU Boulder - Summit

This process is similar to the two above.

1. First, compile FMS and MOM6. (see above)
2. Navigate to the folder of the example you want to run. Double gyre is small enough to run on a single core.
3. Create a batch script to submit the job.
 - For more details on submitting jobs on Summit, see <https://curc.readthedocs.io/en/latest/running-jobs/batch-jobs.html>

```
#!/bin/bash

#SBATCH --nodes=1
#SBATCH --ntasks=16
#SBATCH --time=00:10:00
#SBATCH --partition=shas-testing
#SBATCH --output=sample-%j.out

module purge

module load intel/17.4 impi netcdf
echo "== This is the scripting step! =="
### Run the executable
mpirun -np 16 ~/path/to/MOM6-cases/build/intel/ocean_only/repro/MOM6
echo "== End of Job =="
```

4. Submit your job

Motivation to Investigate Parallel I/O

<https://doi.org/10.5194/gmd-2019-257>
Preprint. Discussion started: 11 October 2019
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- Collaboration from ANU
- Recent Investigation on the previous version of MOM

Parallel I/O in FMS and MOM5

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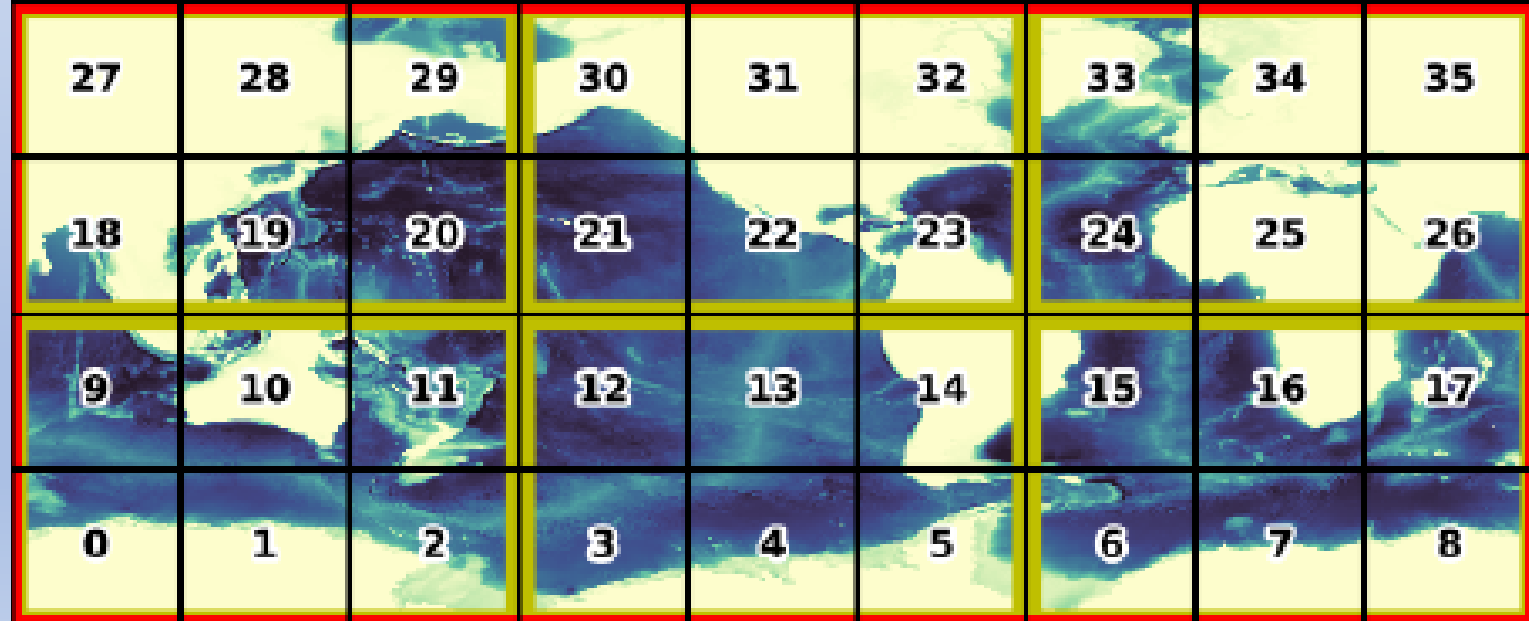
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Abstract. We present an implementation of parallel I/O in the Modular Ocean Model (MOM), a numerical ocean model used for climate forecasting, and determine its optimal performance over a range of tuning parameters. Our implementation

uses the parallel API of the netCDF library, and we investigate the potential bottlenecks associated with the model

Results of That Paper

- Up to 60x speed up in I/O when using 1440 Processing Element's and a 0.1° high-resolution model
- Optimal results used topics from class!
 - Coordinate and send output per node not per CPU
 - On a lustre system using striping



Measures of Note

- Top Tuned performance order was: PnetCDF, HDF5 1.10, HDF5 1.08
- On MOM5 in High-Resolution, 85% of compute time is spent on I/O
- On MOM6 in my experiments use about ~60% for the largest I/O in medium resolution
- Still major room for significant improvement!

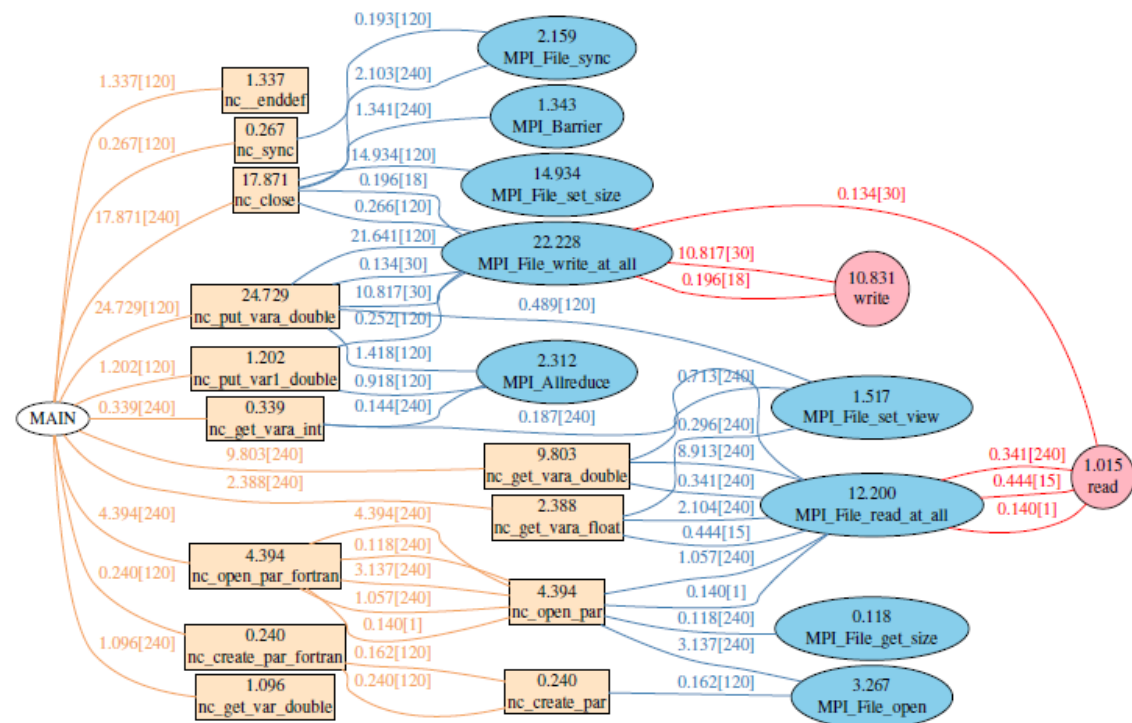
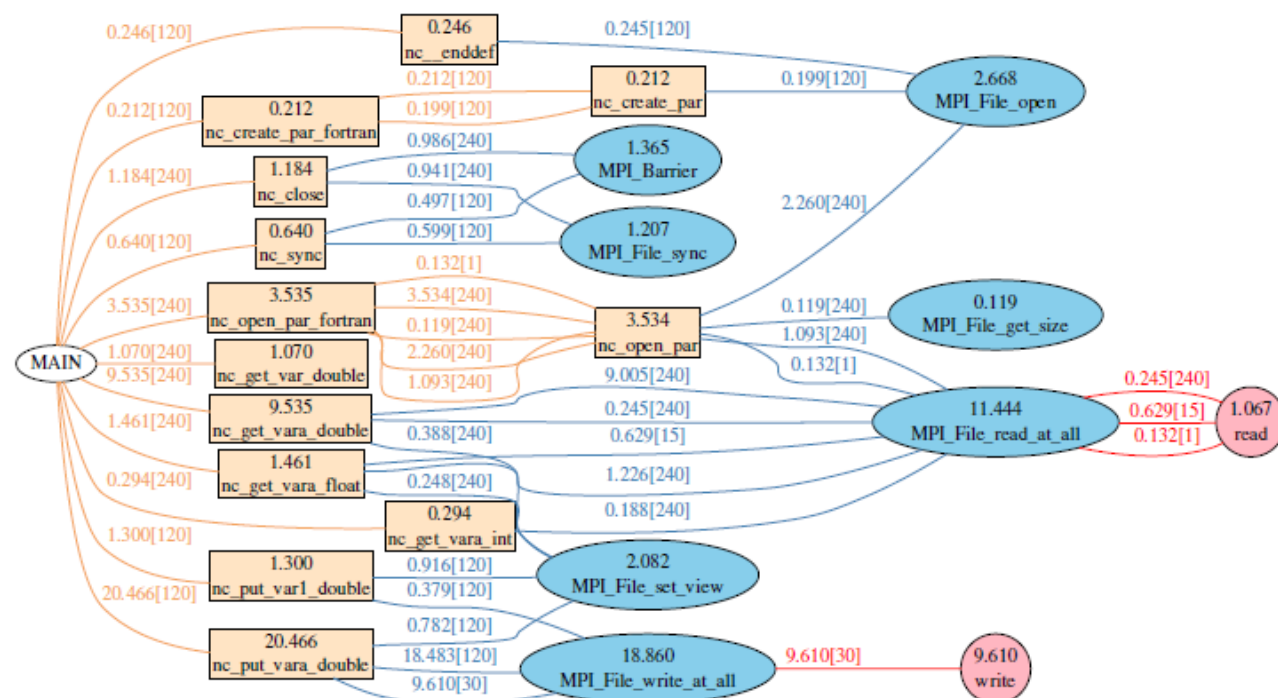


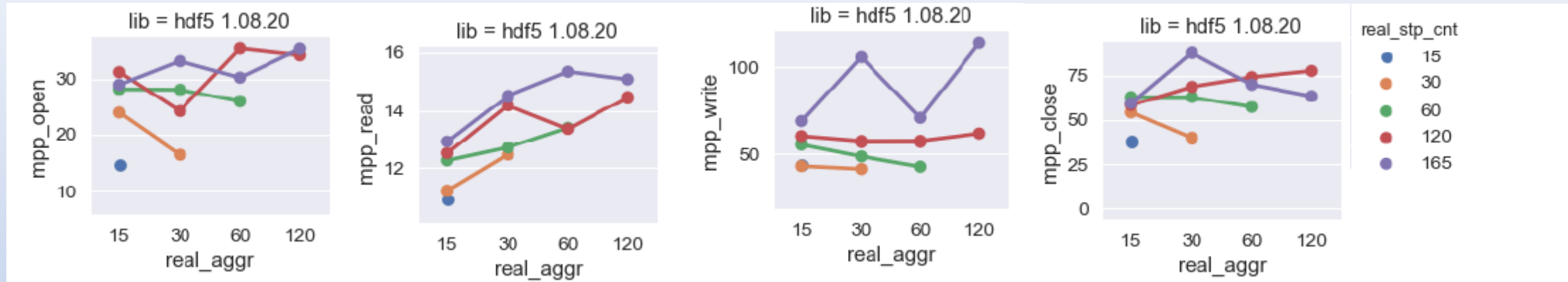
Figure 11. The call path flow of tuned 240-PE benchmark with HDF5 1.10.2/netCDF-4.



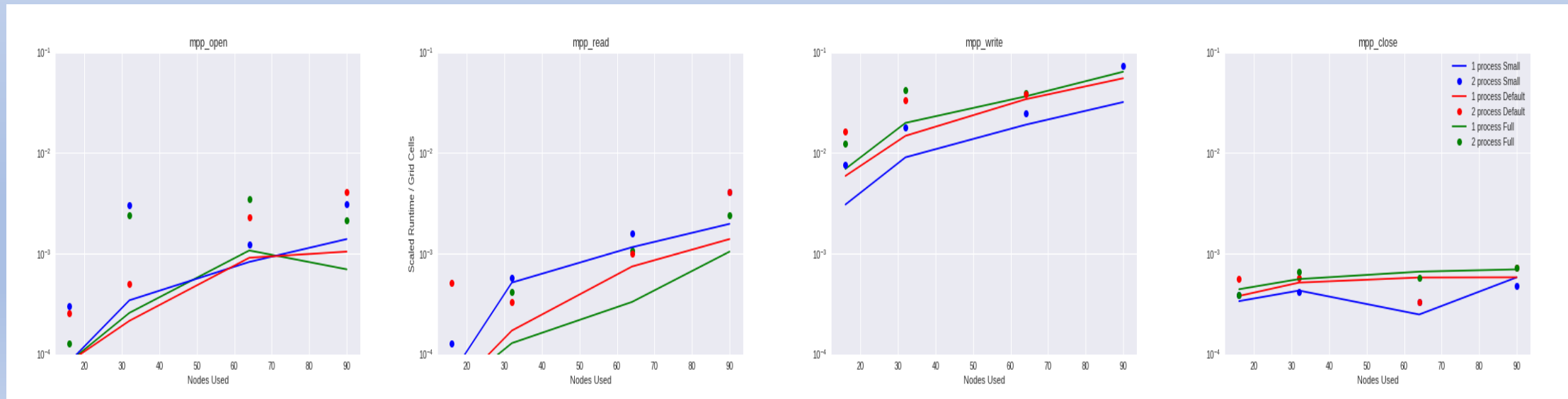
My Results and The Reality of Collaboration

- Collaborator working on the implementation of PnetCDF got pulled to another part of the project
- The PnetCDF is not yet integrated, and HDF5/netCDF is used only for serial output
- Primary experiment was to change the I/O load and measure serial performance
- Results are scaled to the size of the partition

MOM5 – HDF5 1.08

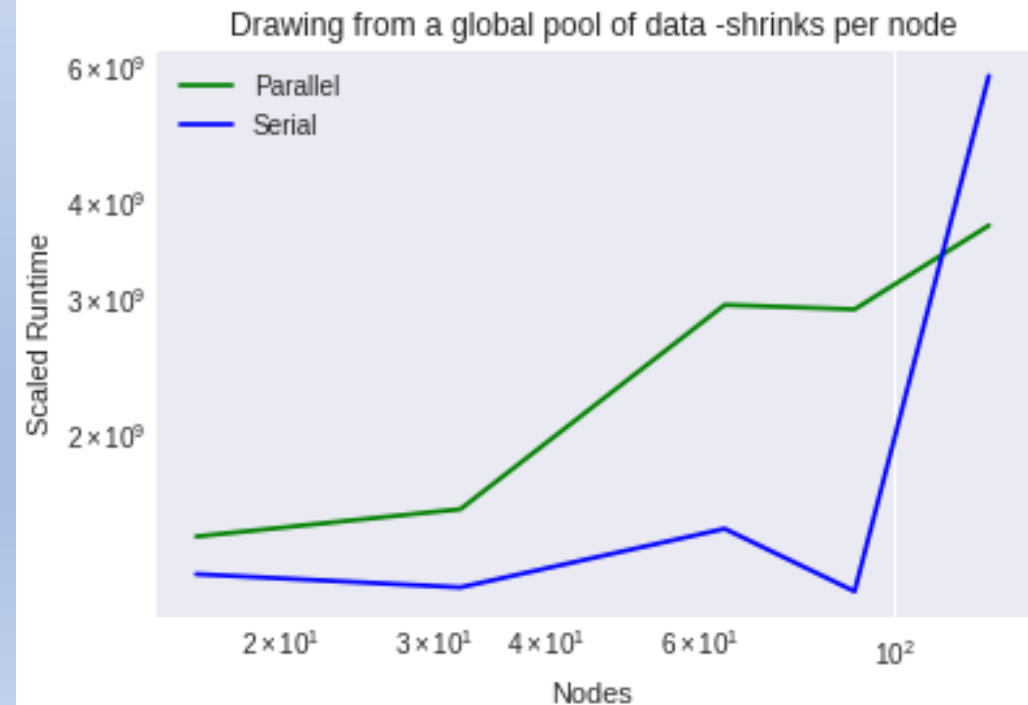
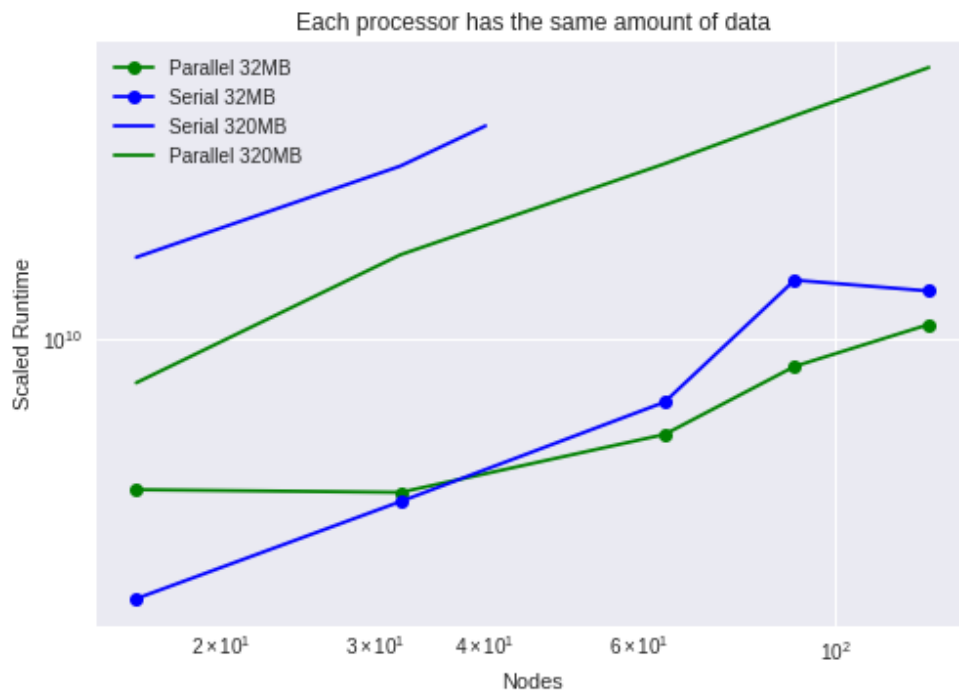


MOM6 - Serial



Last Minute PnetCDF Experiments

- Install and Run PnetCDF on Summit.
- Tested shared data writing and independent vs a serial comparison



Questions?