German Research School
for Simulation Sciences

Enabling Climate Simulation at Extreme Scale - Performance Analysis and Modeling -

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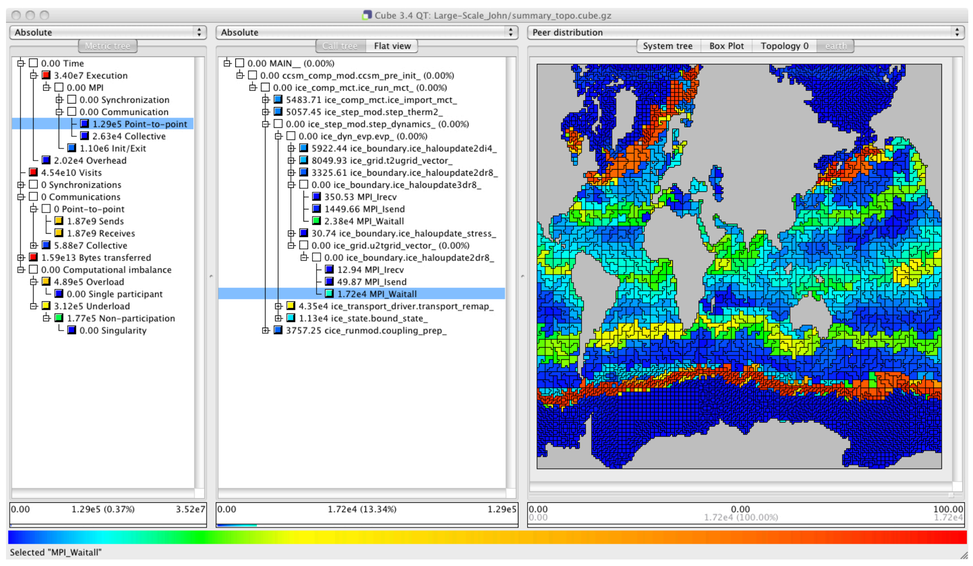
Performance Analysis

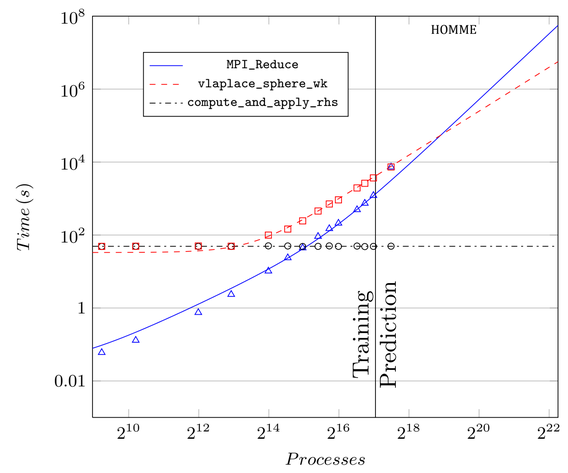
- Parallel efficiency and scalability crucial for climate simulations that run for months on high core counts
- Usage of performance analysis tools, e.g. Scalasca
- Identified computational load imbalance as root cause for poor scalability of some communication routines within the ocean and sea ice model



Scalasca performance analysis of a sea ice simulation run on Jugene using 23'404 cores. Communication time spent in function MPI_Waitall indicates long wait time at the border to sea ice regions. Courtesy: John M. Dennis (NCAR)

Automated Performance Modeling

- Applications may entail latent performance limitations, which would show only on larger scale
- Performance models enable sophisticated analysis and extrapolation of performance properties, but their manual generation is very laborious
- Tool developed to automate model-building process [1]
- Automated modeling revealed two scalability issues in HOMME, the dynamical core of the Community Atmospheric Model (CESM-CAM)

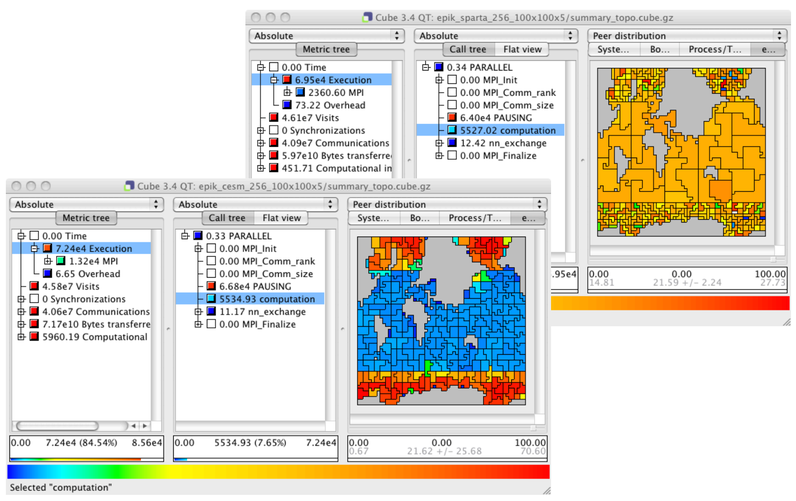


Automatically generated performance model of the atmospheric model reveals two latent scalability bottlenecks, one of them previously unknown. Experiments on Juqueen.

[1] Alexandru Calotoiu, Torsten Hoefler, Marius Poke, Felix Wolf: Using Automated Performance Modeling to Find Scalability Bugs in Complex Codes. In Proc. of the ACM/ IEEE Conference on Supercomputing (SC13), Denver, CO, USA, ACM, 11/2013.

Load-Balancing Simulator

- Implementation and test of different load balancing strategies usually not possible without major code surgery
- Development of a software engineering tool that facilitates comparison of different load-balancing strategies via simulation
- An initial simulation estimates that an alternative partitioning of sea ice would result in a speedup of 2.7



Initial partitioning of the sea ice model shows high load imbalance (front), while alternative partitioning improves load balance (back). Experiments on Juropa.

Project Funding

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