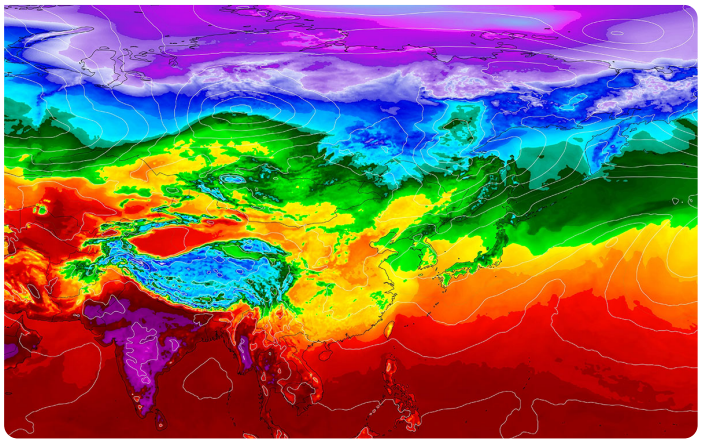
Three Finalists for the 2024 Gordon Bell Prize for Climate Modelling

OCTOBER 9, 2024

Program

Awards Gordon Bell Prize



By Barbara Chapman

The Association for Computing Machinery (ACM) introduced its inaugural ACM Gordon Bell Prize for Climate Modelling at SC23 in Denver. This new award, to be presented annually for the next decade, aims to recognize the vital contributions of climate scientists and software engineers in addressing climate change.

The award spotlights innovative parallel computing contributions based on performance and innovation in computational methods, as well as their impact on improving climate modeling and understanding Earth's climate system.

As John Taylor, the ACM Gordon Bell Prize for Climate Modelling Committee Chair, stated:

> "It is an incredible opportunity to review cutting edge papers in climate modeling and to be involved in the selection of the ACM Gordon Bell Prize for Climate Modelling. It is also a great honor and a tribute to the vision and enthusiasm of Gordon Bell who recognized the urgent need to make advances in climate modeling in order to address the global climate crisis. The finalist sessions are one of the best attended sessions in the technical program as the talks represent the

current best in their field. The papers offer a unique combination of the performance and innovation in their computational methods and their impressive contributions to advancing our understanding of the Earth's climate system."

This Year's Three Finalists

The three finalists for the 2024 Gordon Bell Climate Prize for Modelling are:

Boosting Earth System Model Outputs and Saving PetaBytes in Their Storage Using Exascale Climate Emulators

To advance our understanding of global climate change at the local scale there are both massive computational and data storage challenges. This work leverages the state-of-the-art in high-performance computing to develop a scalable implementation of an exascale climate emulator that illustrates the potential of supercomputers to address the challenges of climate modeling at ultra-high resolution.

They also demonstrate the potential for significant savings in the petabytes of storage required for storing and sharing climate simulations. Their approach uses the Spherical Harmonic Transform (SHT) for modeling spatio-temporal climate data that can accommodate climate data sourced from various spatial resolutions. The exascale climate emulator developed in this study holds significant potential for the climate community, advancing climate research and policy making by making high resolution climate data more readily available so that we can better address the threat of global climate change.

AUTHORS

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ORBIT: Oak Ridge Base Foundation Model for Earth System Predictability

The combination of rapidly advancing AI techniques and abundant simulation data from multi-model ensemble projects such as CMIP6 forms the basis for ORBIT the Oak Ridge Base Foundation Model for Earth System Predictability.

They designed ORBIT to scale up 113 billion parameters, the largest dense vision transformer to date, and were able to incorporate a record setting 91 channels of climate variables. ORBIT was pre-trained on 10 different CMIP6 datasets that included 1.2 million observation data points. ORBIT was able to achieve impressive performance during training delivering up to 1.6 exaFLOPS/684 PFLOPS for the 10/113 billion parameter models on 49,152 Frontier AMD GPUs using mixed

single BFLOAT16 precision using a novel Hybrid Sharded Tensor-Data Orthogonal Parallelism (Hybrid-STOP).

Importantly, this approach is not reliant on specialized HPC architectures, making it applicable on a broad range of HPC systems. Thus, ORBIT represents a significant step forward in advancing our Earth system modeling capabilities.

AUTHORS

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A Performance-Portable Kilometer-Scale Global Ocean Model on ORISE and New Sunway Heterogeneous Supercomputers

Oceans play a critical role in the climate system and in climate change by absorbing much of the additional heat (~90%) generated by increasing greenhouse gas levels. The heat uptake by the oceans is driven by widespread and energetic oceanic eddies which are difficult to resolve at lower model resolutions. Using 38,366,250 Sunway cores and 16,000 HIP-based GPUs, they were able to achieve 1.05 and 1.70 simulated-years per-day for their global ocean simulation model running at 1-km resolution that successfully reproduced sub-mesoscale processes.

The leap in ocean model resolution presented in this study will allow us to deepen our understanding of ocean dynamics, improve the accuracy of weather forecasts, and refine estimates of future climate change trajectories.

AUTHORS

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Groundbreaking Work

These finalists represent groundbreaking work in climate modeling, addressing challenges such as ultra-high resolution simulations, data storage optimization, and the integration of AI techniques with climate data. Their innovations promise to significantly advance our understanding of global climate change and improve our ability to make accurate predictions about future climate scenarios.

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