CALL FOR PAPERS

12TH HIGH PERFORMANCE COMPUTING SYMPOSIUM FOR

WEATHER, WATER, AND CLIMATE

The American Meteorological Society High Performance Computing Symposium for Weather, Water, and Climate is excited to announce it will hold its 12th meeting as a part of the 106th AMS Annual Meeting to be held in Houston, TX January 25-29, 2026. This year's symposium looks to host an array of sessions over both new and traditional HPC topics to continue to facilitate a strongly connected community of HPC users, administrators, maintainers, software library and application developers, and system and hardware vendors across the fields of weather, water, and climate. Proposed session topics include new and emerging hardware and algorithms, numerical weather prediction, artificial intelligence, GPU porting and development, urban and convective modeling, cloud-based HPC, industry trends and innovations, ecological forecasting, community modeling, and more. Of these topics, several joint sessions with relevant sister conferences are proposed to establish or maintain ties with the interdisciplinary needs for HPC across the atmospheric, oceanic, and hydrological sciences. We highly encourage those looking to submit abstracts to any of the proposed sessions to please review the topics, their descriptions, and whether or not they are proposed as joint sessions with relevant conferences to help ensure the best audience for your submission. Full proposed session topics and their descriptions are listed below. Abstract submissions are due by August 14, 2024. If you have any questions about the symposium or whether your abstract might be a good fit, please feel free to reach out to either of our symposium co-chairs Marc Cotnoir (marc.cotnoir@gmail.com) or Timothy Sliwinski (timothy.sliwinski@colostate.edu). We look forward to seeing you in Houston!

Proposed Session Topics (see full descriptions further below):

1.) Experiences Developing, Deploying, Evaluating, and Validating AI Weather and Climate Models on HPC Systems *(Joint with 26th Conference on Artificial Intelligence for Environmental Science)*
2.) High Performance Computing for Numerical Weather Prediction
3.) Utilization of Traditional and Emerging HPC Infrastructure for AI/data-driven Modeling for Weather, Water, and Climate
4.) GPU Accelerated Computing for Weather, Water, and Climate

5.) Artificial Intelligence, Numerical Weather Prediction, and HPC in a Data-driven Weather Future *(Joint with 26th Conference on Artificial Intelligence for Environmental Science)*
6.) Cloud-Based High-Performance Computing
7.) Challenges and Solutions for Running AI NWP Models in Traditional HPC Environments
8.) High Performance Computing and other Innovative Computing Approaches for Community Earth System Models (*Joint with the Fifth Symposium on Community Modeling and Innovation)*
9.) High Performance Computing and Other Technologies Supporting Ecological and Ecosystems Forecasting (*Joint with 14th Symposium on the Weather, Water, and Climate Enterprise and 4th Symposium on Environmental Security)*
10.) Novel/Innovative Computational Algorithms and Techniques for HPC Supporting Weather, Water, and Climate
11.) Urban and Convective Scale Modeling
12.) Innovative/Emerging Technologies, Products, and Services to Enable Future HPC for Weather, Water, and Climate
13.) Quantum Computing for Weather, Water, and Climate Applications
14.) Other Topics in High Performance Computing for Weather, Water, and Climate

Detailed Proposed Session Descriptions:

1.) Experiences Developing, Deploying, Evaluating, and Validating AI Weather and Climate Models on HPC Systems

Joint with 26th Conference on Artificial Intelligence for Environmental Science

Compared to traditional numerical models, AI-based weather and climate models have different needs in terms of datasets, data formatting, execution workflows, automation, storage methodologies, data access patterns, product generation, data archive and dissemination time scales, skill assessment, bias correction, and more. As more institutions begin to implement these models for operational forecasting, each of these factors will require attention and tools to help facilitate the most efficient solutions. In this session, we solicit papers that begin to address these aspects of AI weather and climate models in real-world environments, and the solutions (hardware configuration, software management, optimization methods, profiling, etc.) that have been put in place.

2.) **High Performance Computing for Numerical Weather Prediction**

This session will explore the use of high-performance computing to develop, run, enhance the performance of, and post-process output from numerical weather prediction models. Abstract topics may include (but are not limited to) improving computational performance and efficiency, improving scalability, approaches to parallelization, optimizing numerical weather models to benefit from the use of specialized hardware such as graphical processing units (GPUs) in HPC environments, workflow management, and many others.

3.) Utilization of traditional and emerging HPC Infrastructure for AI/data-driven modeling for weather, water, and climate

We invite researchers to present work on HPC-driven AI/ML for weather, water, and climate modeling, with a focus on large-scale training/inference and how emerging and traditional supercomputing systems are enabling scalable AI—from foundation models to operation forecasting. Contributions may cover: 1) Massive-scale AI training (e.g., climate LLMs, diffusion models) on HPC systems, 2) High-throughput inference for operational forecasting, 3) Optimized AI workflows (GPU/TPU acceleration, distributed computing), 4) Hybrid AI-physics approaches leveraging HPC parallelism, 5) Novel architectures (quantum, neuromorphic) for next-gen climate AI, 6) others.

4.) GPU Accelerated Computing for Weather, Water, and Climate

The use of GPUs as general purpose accelerators has continued to grow as data center class GPUs become more powerful, easier to access, and include larger available on-board memory to support larger problems. This session welcomes submissions of all types exploring or currently exploiting the additional power of GPUs for weather, water, and climate applications. Example topics of interest include, but are not limited to, the benefits, drawbacks, and challenges of developing new or porting existing libraries and applications to GPUs, profiling of applications on GPUs to realize peak performance, the adoption of performance portable frameworks and vendor-agnostic programming methods, new and innovative algorithms best suited for GPU architectures, and institutional or educational efforts to promote or expand the use of GPUs.

5.) Artificial Intelligence, Numerical Weather Prediction, and HPC in a Data-driven Weather Future

Joint with 26th Conference on Artificial Intelligence for Environmental Science

New weather prediction models based on artificial intelligence have rapidly grown in their ability to predict larger sets of complex variables, enabled substantial decreases in overall time-to-solution, and demonstrated similar or improved forecast skill when compared to their traditional numerically-driven predecessors. As these data-driven methods become more widely implemented, the overall future of weather prediction by computers seems poised to change. The future looks poised to realize larger ensembles, faster forecast revisions, the ability to bring in and utilize broader datasets beyond conventional meteorological variables, larger computational resources based on GPUs and faster storage systems, and overall software changes in how models are built, revised, stored, and shared for others to iterate upon. In this forward-looking session, we seek papers which examine aspects of the data-driven future of computational weather prediction, explore the potential innovations just over the horizon, and delve into the challenges and ramifications poised to occur in response to those innovations for the fields of weather prediction, artificial intelligence, and high-performance computing.

6.) Cloud-Based High-Performance Computing

Cloud computing has become pervasive across computational domains, including for providing HPC resources to the Weather, Water and Climate community. The cloud offers benefits in cost, ease of use, ease of access, and flexible provisioning, but there are challenges to gaining these benefits and the cloud will not be appropriate for all workloads. This session solicits papers presenting experiences in using HPC cloud resources as well as analyses addressing suitability of cloud platforms for delivering HPC to weather, water and climate applications. Abstracts are invited that address challenges and lessons learned from the experience, including issues of performance/optimization, availability, scalability, portability, data storage, data transfer and security and are also invited to address tools and techniques for HPC in the cloud.

7.) **Challenges and Solutions for Running AI NWP Models in Traditional HPC Environments**

AI forecasting models have quickly opened prospects for even greater forecasting capabilities than currently possible with traditional NWP models on many traditional HPC systems. However, these prospects also present potential challenges as HPC system refresh cycles are often much slower and users quickly begin shifting more compute requirements to accelerator-based designs and create new demands for managing, post-processing, and disseminating the much greater levels of input and output data expected in much shorter periods of time, potentially straining traditional HPC storage and data transport network systems. Therefore, this session seeks to explore efforts to implement AI NWP models in current HPC environments not designed with AI originally in mind and offer insight in how to achieve high-performance even with these systems.

8.) High Performance Computing and other Innovative Computing Approaches for Community Earth System Models

Joint with the Fifth Symposium on Community Modeling and Innovation

Community modeling has emerged as a major strategy for developing and exploiting earth system models. Initiatives such as NOAA's Earth Prediction Innovation Center strive to foster the development of tools and infrastructure to support and enable community modeling. This session solicits abstracts on innovative computing approaches that will further support both developers and users of community earth system models, including high performance computing, cloud computing, use of AI/ML, exploiting GPUs and other accelerators, software tools, and other new and emerging technologies.

9.) High Performance Computing and Other Technologies Supporting Ecological and Ecosystems Forecasting

Joint with 14th Symposium on the Weather, Water, and Climate Enterprise and 4th Symposium on Environmental Security

Ecological and Ecosystems Forecasting seeks to transform our understanding of nature's interactions with human lives, economies, and health, and empower communities to adapt and thrive amidst environmental challenges. This session invites abstracts on developments in ecosystems modeling and ecological forecasting that are enabled or facilitated by high performance computing and other technologies that enable these

applications to provide insight into changes in the natural environment and the impact of these changes on society. Abstracts are invited on topics such as infrastructure and computational support, development and use of digital twins, use of cloud computing resources, and software tools to facilitate development of these models, as well as other emerging tools and techniques.

10.) **Novel/Innovative Computational Techniques and Algorithms for HPC Supporting Weather, Water, and Climate**

This session will feature talks addressing advances in computational techniques that lead to advances in the state of the art for High Performance Computing applications in Weather, Water, and Climate. Benefits of emerging novel/innovative techniques may include increased performance, enhanced scalability, reduced cost and others. Approaches addressed could include exploiting mixed-precision arithmetic, new numerical or analytical solvers, novel architectures, etc. and the approaches can be hardware, software, or firmware solutions.

11.) **Urban and Convective Scale Modeling**

This session will focus on the development, enhancement, deployment, and refinement of high-resolution models used for urban and convective scale modeling that have become more computationally feasible as faster CPUs and GPU-related enhancements become more accessible. Topics may include — but not limited to — high resolution models for air pollution, aviation and drone flight guidance, boundary layers and turbulence, convective and severe storm dynamics, and other applications. Additionally, abstracts related to increasing the performance of high-resolution models using high performance computing resources to reduce communication overheads, enhance storage system performance, reduce overall runtimes, or other improvements at the code or system level.

12.) **Innovative/Emerging Technologies, Products, and Services to Enable Future HPC for Weather, Water, and Climate**

The computational resources required to perform global weather and climate modeling have always been demanding. Given the need for kilometer scale resolution,

enhanced physics, O(100) ensemble members, multiple forecast horizons (i.e. short-range, medium range and long-range) etc., this computational demand can be perceived as infinitely large. A multidisciplinary, cross-industry collaboration between software, silicon, system manufacturers, providers, academia etc. is required to meet ever increasing demand promptly and efficiently. This session invites abstracts on any innovative/emerging technology, innovation, service, etc. that will be useful in shaping and enabling the future of computing for weather, water, and climate modeling.

13.) **Quantum Computing for Weather, Water, and Climate Applications**

Quantum computing holds great promise for dramatic increases in computing speed for a wide range of applications. While this is still an emerging technology, progress is being demonstrated in many areas. This session invites papers on the application of quantum computing in weather, water, and climate applications. Papers are invited on specific applications as well as on foundational work in underlying algorithms and techniques.

14.) Other Topics in High-Performance Computing for Weather, Water, and Climate

This session is designed to allow researchers with innovative work utilizing High Performance Computing for Weather, Water, or Climate Research a place to showcase that work, even if it does not fit into any of the pre-defined sessions already listed. To truly grow our community, we need to see what that community has accomplished, what they are currently working on, or what they feel they want to discuss with the community for potential new research efforts related to building new or utilizing current HPC resources. Abstracts submitted under this general heading will be grouped – when possible – with submissions on similar topics during the review process.