Solution Brief

High-Res Weather Forecasting

Skillful, high-resolution weather predictions with less energy and a smaller carbon footprint.

ICON prediction courtesy of MPI-M, DKRZ, and NVIDIA.

Introduction

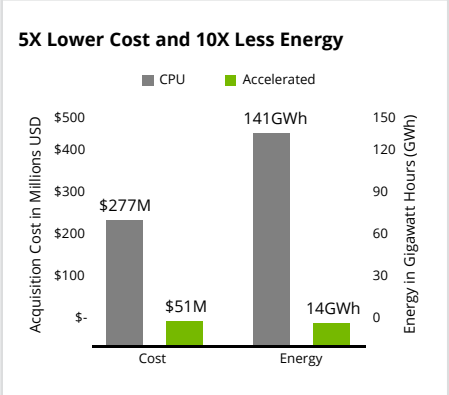
High-performance computing (HPC) efficiency with increased focus on performance-per-energy cost has become the overarching driver behind system design considerations for numerical weather prediction. Expected weather prediction skill is only possible with high-resolution models that are computationally intensive, which has led to an increase in the adoption of NVIDIA GPUs in recent years. Compared with CPU-based weather prediction, GPUs can perform numerical operations several factors faster and with much greater **energy efficiency**.

Key Points

- Over 100 accelerated applications
- Approximately 17 billion CPU hours consumed annually
- 24X performance speedup
- $225 million and 127 gigawatt hours (GWh) saved annually

Applications

NVIDIA GPUs have substantially accelerated several of the most widely used weather models today, including global models IFS from the European Centre for Medium-Range Weather Forecasts (ECMWF), ICON from the Max Planck Institute for Meteorology (MPI-M) and the German Meteorological Service (DWD), and MPAS from the National Center for Atmospheric Research (NCAR), as well as regional models COSMO and WRF. Major weather agencies that rely on TOP500-scale HPC centers to meet time-to-forecast requirements collaborate with NVIDIA to adopt GPUs for conventional numerical weather prediction models and machine learning applications in physics emulation and weather data post-processing.



Based on measured performance of the ICON model.
CPU: 2x AMD Milan. GPU: 4x NVIDIA H100 Tensor Core PCIe.

Use Cases

Weather predictions are commonplace, yet extreme conditions are increasing in all corners of the world. These include severe storms such as blizzards, hurricanes, tropical cyclones, tornadoes, and heavy downpours that lead to flooding, heatwaves that lead to wildfires, and air- and water-quality concerns from various pollutants. Delivery of reliable weather predictions enables safe evacuation from extreme conditions; transportation planning for operations and routing; and precision temperature, wind, and cloud cover forecasts for utilities, among other examples.

Accelerate, Reclaim, and Save

As the trend for skillful weather predictions increases with HPC resource demand, there's also pressure to reduce energy consumption and therefore the carbon footprint of weather predictions. With NVIDIA GPU deployments, performance increases of 24X are possible, while energy efficiency can be reduced by 127GWh annually, acquisition cost can be reduced by $225 million, and savings can be realized in rack space, floor space, and infrastructure over CPU-only systems.

> "To make reliable weather predictions and climate projections a reality within power budget limits, we rely on algorithmic improvements as well as hardware where NVIDIA GPUs are an alternative to CPUs."
>
> **Dr. Oliver Fuhrer**,
> Head of Numerical Prediction,
> MeteoSwiss

To learn more, visit: **nvidia.com/sustainable-computing**