Case Study

Climate Research Team Meets Strong Headwinds with Scalable Data-Tier Solution

Prominent weather research academy solves modeling issues.

Academia Sinica is a preeminent climate research institution in Taiwan. The institution's researchers predict that over the next four years, they will see a 16-fold increase in data, amounting to more than 10PB. As the data used for simulations expands, the team needs reliable data storage that will keep pace.

Their Story

International data exchange and collaboration helps climate research.

Reaching net zero by 2050 is an imminent global endeavor. In response to this goal, Taiwan is proactively promoting climate change-related legislation and restructuring its environmental departments as a move toward the net zero transition. The climate team from the Research Center for Environmental Changes (RCEC) of Academia Sinica, Taiwan's most prominent research academy, has participated by conducting relevant climate research by developing the Taiwan Earth System Model (TaiESM).

TaiESM has participated in the Coupled Model Intercomparison Project phase 6 (CIMP6), which is funded by the World Climate Research Programme (WCRP), and the model was cited in the Sixth Assessment Report (AR6) of the United Nations Intergovernmental Panel on Climate Change (IPCC) Working Group I (WGI). The simulation data of TaiESM are shared with research institutions in various countries via the data portal powered by Seagate storage systems. At present, the climate team of RCEC collaborates with many academic teams, including Institute of Oceanography, National Taiwan University (IONTU), to keep improving the physical and chemical processes in TaiESM.

Their Goal

Creating an independent model close to local needs.

The first phase of TaiESM allowed the climate team to successfully participate in international data exchanges, and even placed the team among the top-ranking countries in most evaluations of model performance. The current version of TaiESM is built on the basis of Community Earth System Model (CESM). Huang-Hsiung Hsu, CEO of Anthropogenic Climate Change Center, said, "Developing our own model encapsulates [our] own distinct features, specifications, technicalities, and success. Our next phase is to keep refining the first version of TaiESM with a goal to develop a fully independent climate prediction suite by a Taiwanese team—from core programs to internal modules—that is close to local needs and truly exclusive to Taiwan."

In addition to the basic development of the model, improving TaiESM also requires the collection of climate simulation data generated by other international meteorological units for comparison and analysis with TaiESM. Another goal of the team is to be a global presence through international collaborations that produce and disseminate credible climate projections and data usability. Such a presence would increase their reputation and recognition in Taiwan and across the globe, enhancing opportunities for global partnerships and data exchanges.

Their Problem

Climate data storage needs will increase by 10PB over the next four years.

The climate team of TaiESM needs over 10 petabytes (PB) data storage in the near future to maintain higher demand of data for modeling. Existing storage availability rates and limited server space no longer meet their application and workload requirements. The increasing frequency of data exchanges and additional data production means the team needs always-on availability, speed, and improved data protection.

In pursuit of the second phase of TaiESM, Environmental Change Research Center needs more data storage capacity to cater to stronger data analysis and higher visual resolutions while managing a structured data surge that is complicated by data growth and data sprawl.

The existing storage equipment space, performance, and availability rate no longer met the team's application and workload requirements. To future-proof and scale their storage so it can handle more research data and analysis reports, the storage equipment needs immediate expansion.

Research Center's data growth has far exceeded the capacity of a common research institute. The current research data capacity at the climate change research center is approximately **3PB**. The center predicted that over the next four years, the amount of climate data will grow by at least another **10PB**. The climate team generates at least **two to four terabytes (TB)** of data a day, and their requirements demand seamless climate data exchange, rather than siloed data.

Simultaneously, there is a dire need to improve the resolution of modeling. The current version of TaiESM offered resolution that are not ideal for research because of limited computing resources and storage. To accurately simulate landforms and weather phenomena such as typhoons, the team is looking to enhance their horizontal resolution by at least four times. This four-fold resolution increase would mean at least a 16-fold increase in the amount of data.

When it comes to replicating weather conditions more realistically and practically in the climate research lab, the team's needs only get more challenging. A significant roadblock is simulating the long-term average of weather conditions, as temperatures change from land to ocean. Technology has advanced storage drives capacity and computing accuracy, allowing more grids or earth-sectoring, and thus, improving model predictions. While processing more raw data leads to greater resource opportunities, processing also creates even more data.

To pursue a visual resolution of up to 25km, the team creates 32TB-64TB of data a day. The climate team at Academia Sinica must continuously adjust and calibrate model settings and compare data produced by each setting, which further generates data. Effective and reliable data storage is crucial for the team. Hard drive failures were a significant pain point, often requiring the costly replacement of four to ten faulty units a month.

Their Solution

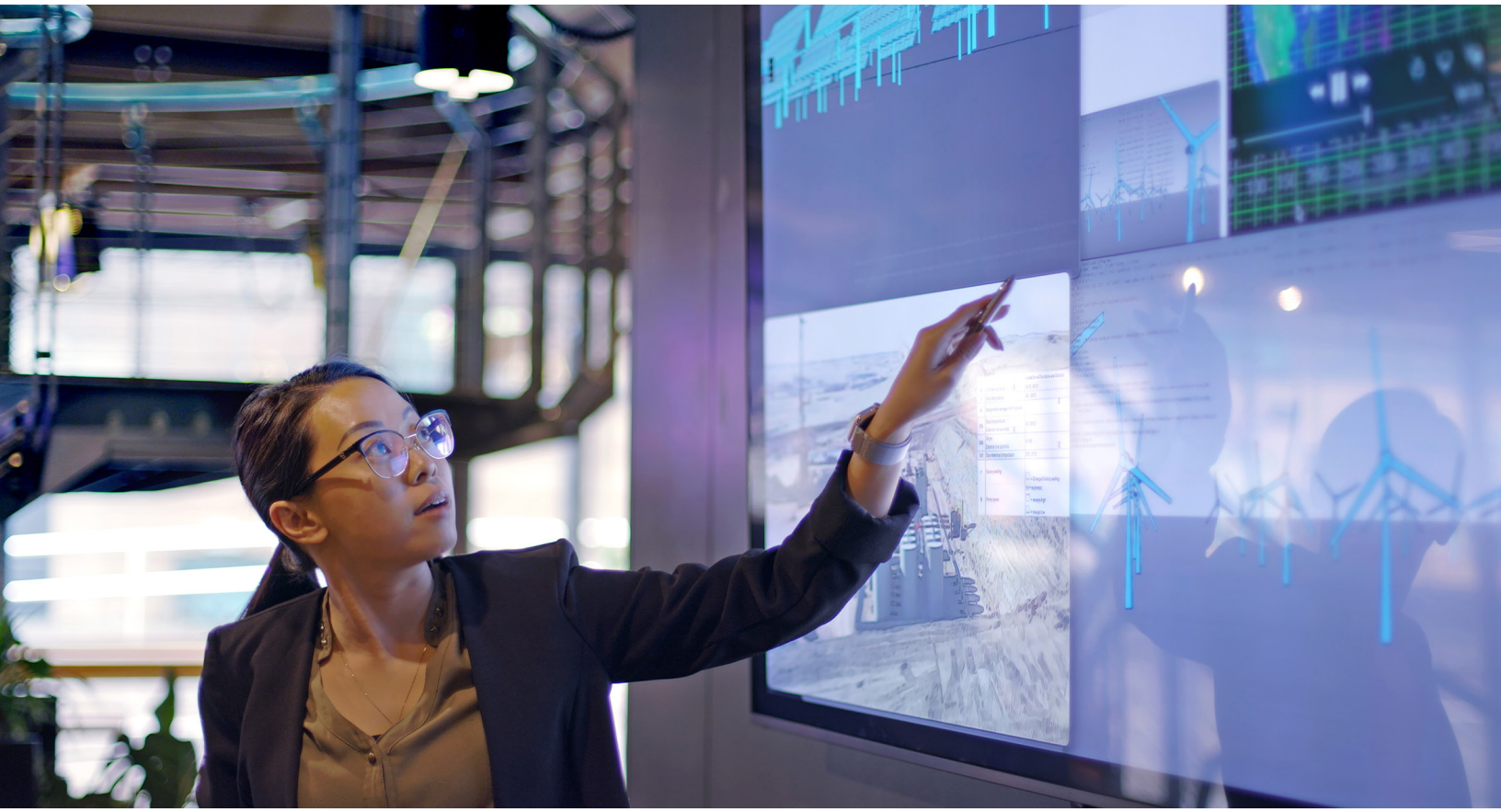
Efficient and high-performing data storage provides fast, reliable, and cost-effective data access.

To the climate research team, there is almost no cold data. The team requires a permanent storage solution for all climate data. Forecasts, analyses, rework of forecasts and analyses, and multi-model data is made available through dedicated data servers using a distributed file system.

As the sheer volume of data grows exponentially, the team must carefully consider requirements for data storage capacity, storage efficiency, storage performance, as well as less obvious factors, such as the hardware footprint and associated physical plant requirements.

Seagate's high-density data storage system, the Exos X Series 5U84, achieved sequential read and write performance of 7GB and 5.5GB at the current stage of the climate team's research. Seagate's ultra-dense intelligent solution also exceeded the team's expectations with a 75% reduction in the data center rack space and an 80% decrease in the total cost of ownership. Seagate's Advanced Distributed Autonomic Protection Technology (ADAPT) also helped the team reduce 93% of the storage rebuild time resulting from drive failure.

The climate research team looks to Seagate's versatile architecture to deploy a high-capacity, high-performance platform that addresses extreme data growth and efficiently manages hold and cold data with real-time data-tiering options. Seagate's solution allows Academia Sinica to scale their storage with data access freedom, while simplifying operations and optimizing costs.



Their Success

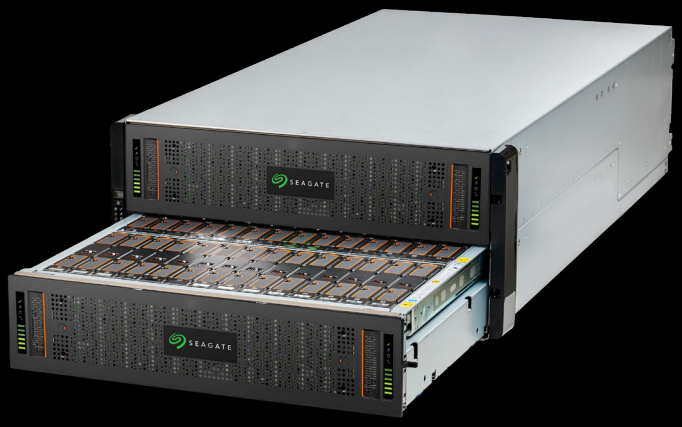
Dense solution reduces costs, improves performance.

Less downtime and lower maintenance and IT costs help TaiESM focus on climate prediction refinements and manage data without sacrificing performance.

Exos X 5U84's five nines availability (99.999%) has helped Academia Sinica deliver consistently high reliability. The maximum-density 5U chassis accommodates 84 drives and can expand to 336 drives for up to 8PBs of storage. It is tuned to maximize drive performance by protecting against vibrational and acoustic interference, heat, and power irregularities. With ADAPT, it distributes climate-research data across every drive, offers advanced data protection, and provides fast rebuilds without sacrificing performance, reducing downtime. And less downtime extends the product life cycle and reduces IT spend on repair or replacement.

With less downtime and lower IT cost, TaiESM can focus on refining their climate prediction model. Overall, the Exos X Series 5U84 helps the climate team efficiently manage mass data and reduce hefty maintenance expenses for storage equipment, allowing the team to contribute mission-critical climatology models to a growing international community.

Products Used



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