

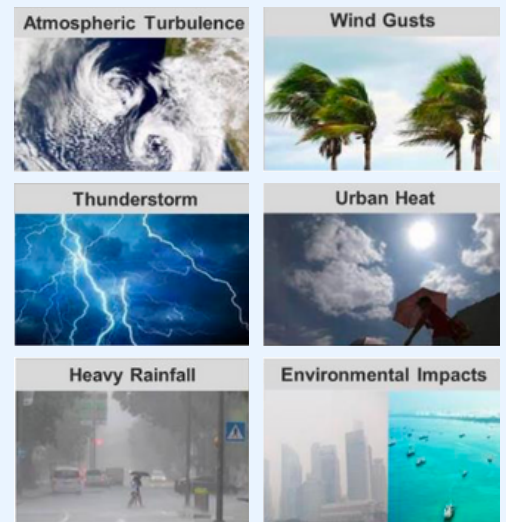
Climate and Weather Research Alliance Singapore (CAWRAS)

Advancing Tropical Climate and Weather Research
for Singapore and Southeast Asia



Motivations

Singapore, as a densely populated tropical city-state, faces increasingly severe weather challenges due to climate change, including intense rainfall, dry spells, and extreme heat. These weather events threaten critical sectors such as aviation, maritime operations, and water management. However, forecasting tropical urban weather remains challenging due to the complex nature of local weather e.g. thunderstorms and limited regional data. In recent years, Singapore has been at the forefront of advances in tropical weather/climate science through e.g. the Centre for Climate Research Singapore (CCRS). Singapore is uniquely positioned to extend its leadership through further fine-tuning of Numerical Weather Prediction (NWP) capabilities to strengthen national resilience and contribute to global understanding.



Impacts of Weather And Climate Change in Singapore



**Climate and Weather
Research Alliance Singapore**



 Watch our corporate video

Scan the QR code or go to:
<https://go.gov.sg/cawrass-video>

About CAWRAS

CAWRAS is a national research platform established by CCRS and local Institutes of Higher Learning (IHLs)/Research Institutes (RIs), aimed at expanding Singapore's weather and climate science capabilities. The model brings together researchers from CCRS and IHLs/RIs under a cohesive framework, with CCRS leading capability development.

CAWRAS will first focus on weather science research under the Research, Innovation and Enterprise 2025 (RIE2025) Weather Science Research Programme announced at the Committee of Supply 2025 (COS2025), before expanding to climate change research under RIE2030.

Impetus & Benefits



- Expanding opportunity space (extreme weather, climate change), technology developments (new observing systems, model, use of Artificial Intelligence (AI)/Machine Learning (ML), etc) present significant potential for coordinated development of next-generation national capabilities in weather and climate science research



- Expand capacity at the national level, not just within government, and build the local manpower pipeline
- Nurture local talent pipeline in weather and climate science



- Leverage existing expertise in CCRS' weather and climate science research, data and international partnerships
- Establish weather and climate science research capabilities in CAWRAS nodes
- Enhance national and international weather/climate collaborations

Weather Science Research Programme (WSRP)

WSRP focuses on four key areas: improving the use of weather observations, developing next-generation weather/climate models, performing a detailed historical weather re-analysis over recent decades for Southeast Asia (SEA), and enhancing weather prediction accuracy through advanced post-processing techniques

Research Cluster	Cluster 1: Observations	Cluster 2: Next-Generation Models	Cluster 3: Regional Reanalysis	Cluster 4: Post-Processing
Problem /Gap	Understanding and predicting local weather phenomena hampered by dearth of observations	Existing models will become legacy in next 5 years and not tailored for the tropics	Regional high-resolution datasets of past weather and climate (full state) do not exist for SEA	Model forecasts are not optimally used to extract valuable weather information
Solution	Explore use of novel observations (e.g. radar, satellite) through local data assimilation impact studies	Next-generation models tailored for the tropics can better represent local weather	Regional reanalysis provides a high-resolution reconstruction of the past weather and climate	New approaches can be explored to make best use of model forecasts to extract valuable weather information
Benefit	Improved understanding of local weather and potentially improved predictive capabilities	Next-generation models will be faster and scalable to enable improved tropical weather prediction	Supports understanding of historical extreme weather events and training of next-generation AI/ML models	Better usage of model forecasts will enable improved weather prediction
Research Scope	Exploration of novel data assimilation techniques and impact studies	Representation of local processes in next-generation models	Production of a historical regional reanalysis for past 50 years	Development of methods to better use model forecasts
Cross-Cutting Theme: AI For Weather/Climate Science				

Climate and Weather Research and Evaluation Testbed (CAWRET)

Accelerating pull-through of RI/IHL-led research into operational services through the provision/support of core enablers.



Observations: Collation, preprocessing and availability of a broad range of surface- and space-based weather/climate data for CAWRAS Research & Development (R&D) including process studies, data assimilation, reanalysis, etc.



Models: Implementing and sharing CCRS' next-generation weather/climate modelling systems, experimental setup and workflows, visualization software, evaluation packages etc. to facilitate CAWRAS R&D projects.



AI/ML: Providing a repository for the algorithms, workflows and training data sets (e.g. regional reanalysis, regional climate projections) required for real-world applications of AI/ML in Weather and Climate Science



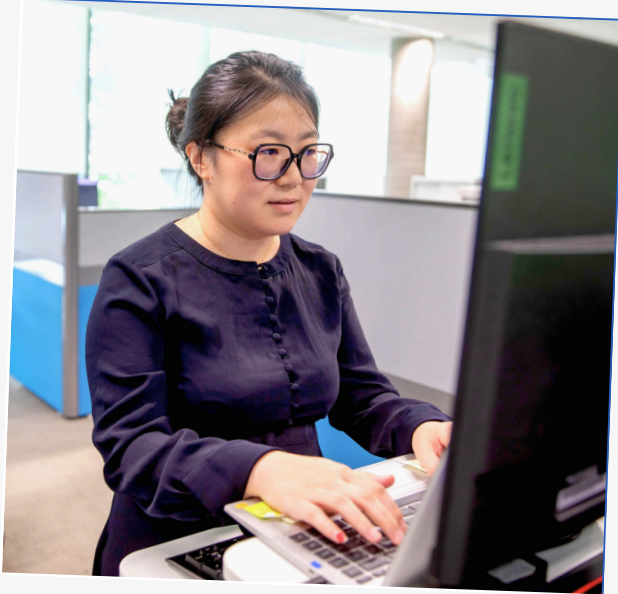
IT Infrastructure: Shared platform(s) providing High Performance Computing (HPC) resources, observations, modelling systems; HPC resource management and optimization; link to international partner testbeds



People & Partnerships: Dedicated user training and support for CAWRAS researchers use of observations, model, AI, HPC, etc; facilitating collaborations between CAWRAS Partner Institutes (PIs) and with international partners

Nodes Involved and Projects

Centre for Climate Research Singapore (CCRS)



Track Record and Capabilities:

CCRS has a track record of weather and climate modelling, exemplified by projects such as the V3 climate change projections. Collaborating with the UK Met Office, CCRS developed SINGV, a km-scale regional model for Singapore and the region, for both weather prediction and climate change research. These capabilities have led to impactful applications, e.g. rainfall nowcasting, and potential use cases in heat stress prediction, aviation weather warnings, etc. CCRS is recognised for its leadership in tropical urban climate modelling expertise, demonstrated by its core partner status in the multilateral Momentum Partnership, alongside ongoing collaborations with world-leading institutions such as the UK Met Office, Australian Bureau of Meteorology, US National Center for Atmospheric Research (NCAR), etc.

Role in CAWRAS:

CCRS steers the overall research agenda, aligning efforts with national priorities and operational needs. Through its partnerships with renowned institutions, CCRS provides CAWRAS partners with access to cutting-edge developments. CCRS also works with A*STAR to establish CAWRET.

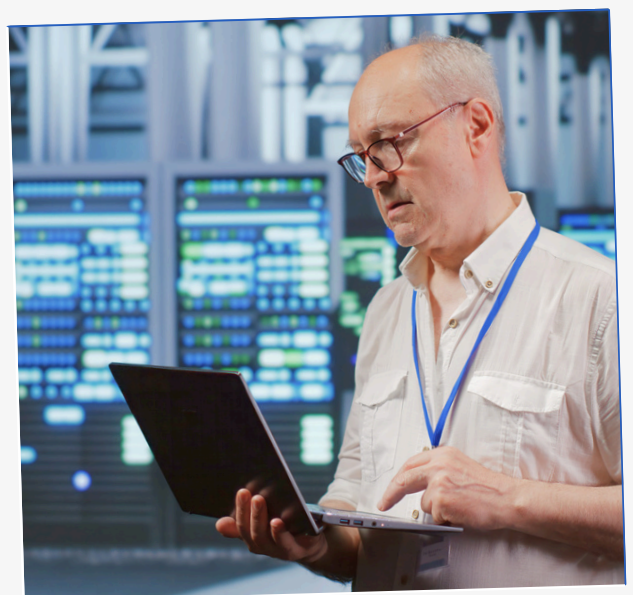
Agency for Science, Technology and Research (A*STAR)

Track Record and Capabilities:

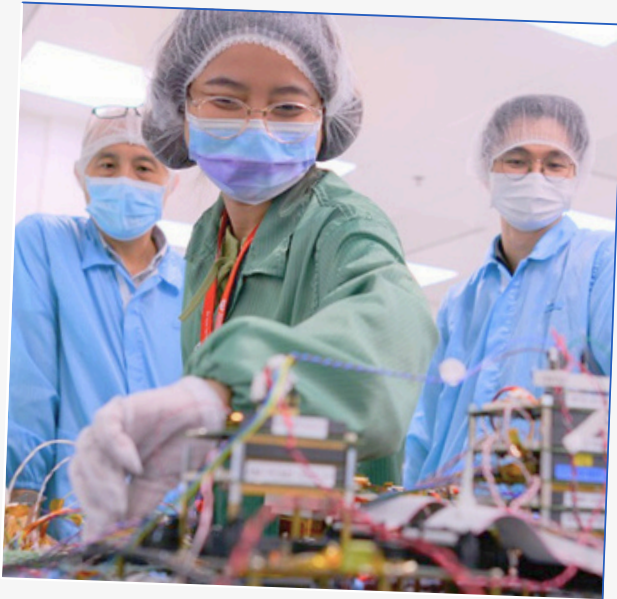
A*STAR serves as a vital bridge between research and operations, with proven success in translating complex weather science into practical solutions. Since 2023, it has actively supported public agency needs through the Aviation Meteorological Programme. A*STAR brings deep expertise in AI, with computational infrastructure including advanced GPU capabilities, to support AI model development and high-performance computing needs. A*STAR is building strategic partnerships with leading technology and research institutions, such as its potential collaboration with Nvidia and research partnerships with Taiwan's Institute of Oceanography and GPS Science and Application Research Center.

Role in CAWRAS:

A*STAR co-leads two WSRP Research Clusters, i.e. Regional Reanalysis and Post-Processing. It hosts CAWRET, establishing a vital national platform for weather and climate research. Through the A*STAR Graduate Academy (AGA), it actively promotes weather research opportunities and provides joint supervision with IHLs for PhD students, fostering knowledge transfer and capability building.



Nanyang Technological University, Singapore (NTU Singapore)



Track Record and Capabilities:

NTU brings significant observational science capabilities through its extensive data archives, including GPS base station data, long-term rainfall records, and radar reflectivity data. Through its Earth Observatory of Singapore (EOS) and Asian School of the Environment (ASE), NTU has spearheaded research on climate change impacts and tropical weather patterns. NTU has strong capabilities in GPS / Global Navigation Satellite System (GNSS) data processing, satellite systems applications, and AI/ML techniques for computational imaging and sensing. It maintains active collaborations with world-leading institutions including NASA, Jet Propulsion Laboratory (JPL), Caltech, NCAR, and Thales.

Role in CAWRAS:

As the lead for the Observations Cluster and co-lead for Regional Reanalysis Cluster, NTU builds on its existing strengths in AI, climate modelling, and observational science to advance weather prediction capabilities. It is building long-term capability through strategic faculty appointments and has developed a new MSc in Modelling, focusing on core skills in data science, predictive analytics, and computational methods for weather science.

Track Record and Capabilities:

NUS brings comprehensive research capabilities through its Department of Geography and centres of excellence, including the Technology Centre for Offshore and Marine, Singapore (TCOMS), Centre for Remote Imaging, Sensing and Processing (CRISP) and the Tropical Marine Science Institute (TMSI). NUS brings together diverse technical capabilities spanning AI/ML applications, computational fluid dynamics, and urban climate research. It maintains strategic partnerships with industry leaders like IBM for AI expertise in weather/climate research, as well as participates in the Eric and Wendy Schmidt AI in Science Postdoctoral Fellow programme to support the integration of AI techniques into natural sciences.

Role in CAWRAS:

As lead for the Next-Generation Models Cluster and co-lead for the Post-Processing Cluster, NUS advances capabilities in weather prediction and modelling, leveraging its strengths in AI/ML applications and environmental modelling. CAWRAS is established as a flagship programme of the NUS Sustainability Futures (NSF) platform, aligning weather and climate science research with broader sustainability initiatives to develop solutions for climate adaptation and mitigation.

National University of Singapore (NUS)



Scientific Advisory Panel (SAP)

The SAP provides high level guidance and expert advice to CAWRAS, advise on key trends, opportunities and challenges in weather and climate science, assess scientific merits of proposals for award and review progress.



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