CCRS Newsletter

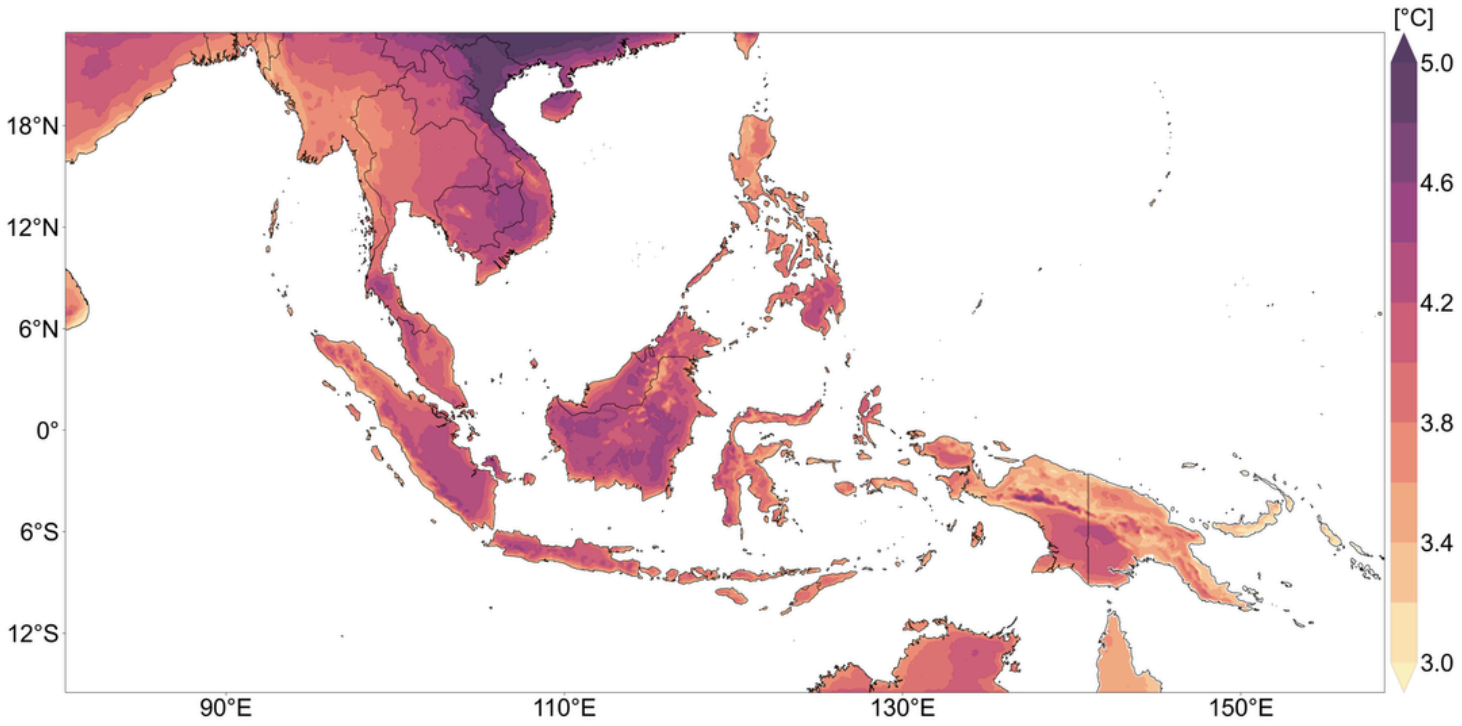
Issue 10, June 2026

Highlights in This Issue

CCRS Launches Advanced Rainfall Nowcasting System for Singapore

Southeast Asia's extreme temperature future: Insights from Singapore's Third National Climate Change Study

Shaping Singapore's Weather and Climate Research Priorities for RIE2030



Projected mean change in daily maximum temperature over Southeast Asia by end century under the high emissions scenario (SSP5-8.5; baseline period: 1995–2014)

Meteorological Service Singapore
Centre for Climate Research Singapore

A newsletter of the Centre for Climate Research Singapore

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Word from the Director

Welcome to the tenth edition of the CCRS Newsletter!

The first half of 2026 has been a productive and exciting period for CCRS, with significant progress across our activities: weather research, climate research, research masterplanning and supercomputing/operations.

On weather timescales, I am excited to announce that our rainfall nowcasting capabilities have taken a major step forward. Dr Jianyu Liang and Pluto Chui share below how we have successfully developed and set up in real time an enhanced Deep Generative Model of Rainfall (DGMR) for future use in Singapore's National Water Agency (PUB) and by MSS forecasters, delivering significantly improved rainfall nowcasts for the next 30–60 minutes for Singapore. The new system is on track to replace our current real-time 'RainNet' model by the end of 2026.

On climate change timescales, Dr Jianjun Yu shares the key findings from a recently published study on future extreme temperatures, heatwaves and heat exposure in Southeast Asia, drawing on high-resolution projections from Singapore's Third National Climate Change Study (V3). Results are sobering in terms of the potential impact on a highly populated, increasingly urbanised home to over 700 million people. At CCRS, we are committed to ensuring this information is based on best-available, robust science and shared with the relevant stakeholders to inform policy and planning.

Looking ahead to the next phase of Singapore's weather and climate research, CCRS has been actively engaging stakeholders across government agencies and the research community to shape priorities for a new Weather and Climate Science Research Programme (WCSRP) under the Research, Innovation and Enterprise 2030 (RIE2030). Ipein Chua shares how these engagements are helping to ensure that future research investments remain relevant, impactful and aligned with national needs.

It has also been a busy period for outreach and engagement. CCRS scientists contributed to a number of international events and partnerships, hosted distinguished visitors, and continued to build Singapore's national weather and climate research ecosystem through the Climate and Weather Research Alliance Singapore (CAWRAS). More details can be found in the 'Events' section.

As usual, we include a summary of CCRS' latest media highlights and staff spotlights – apologies if it's a little long, but it's an exciting time at CCRS and there seems so much to share! We hope you find this newsletter informative. Feel free to share it with your colleagues and friends, and do follow us on LinkedIn. Happy reading!



Professor Dale Barker
Director,
Centre for Climate Research Singapore

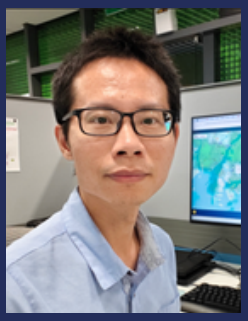


CCRS Launches Advanced Rainfall Nowcasting System for Singapore

Why nowcasting matters and why it is challenging

Rainfall profoundly impacts a variety of agency / industry operations, e.g. aviation, flood management, as well as the public's general outdoor activities across Singapore. Heavy, localised downpours are frequently accompanied by strong winds and lightning, posing significant threats to public safety and urban infrastructure.

To effectively mitigate these risks, accurate short-term rainfall nowcasting—predicting weather events 60–90 minutes in advance—is critical. However, achieving this precision is a formidable challenge in tropical regions like Singapore, where local weather is dominated by small-scale, rapidly evolving convective storms.



Dr Jianyu Liang is a Research Scientist in the Numerical Weather Prediction (NWP) Branch of CCRS' Department of Weather Research. His work focuses on radar quality control, radar rainfall estimation and nowcasting system development.



Pluto Chui is a Research Scientist in the NWP Branch. His work focuses on regional artificial intelligence (AI) based NWP system development and the research to operations (R2O) transition of CCRS' first AI-based rainfall nowcasting system.

Our current nowcasting system and its limitations

For several years, CCRS has been actively developing and refining its rainfall nowcasting capabilities. Our current system uses a U-Net-based machine learning (ML) model known as 'RainNet'. The system processes the past hour of Quantitative Precipitation Estimation (QPE) data (2D surface rainfall, derived from 3D radar reflectivity) to produce rainfall forecasts for the subsequent 90 minutes. While functional, RainNet's ability to capture the complex, dynamic nature of tropical storms indicated significant room for improvement, driving us to seek more sophisticated forecasting technologies.

A three-pronged approach to better nowcasting

To elevate the accuracy and reliability of our nowcasting system, we implemented three innovations.

Enhancing rainfall estimation



Accurate rainfall nowcasting begins with precise rainfall data. One of us (J.L.) recently undertook a collaborative exchange with the Bureau of Meteorology in Melbourne, Australia, working alongside international experts in the integration of dual-polarization (Dual-Pol) radar information. The Dual-Pol technique provides a more detailed understanding of cloud droplets such as shape, which significantly refines QPE accuracy, providing a better training dataset for our nowcasting system.

Integrating state-of-the-art machine learning



CCRS partnered with the National University of Singapore (NUS) to adapt and deploy a new predictive model based on Google's Deep Generative Model of Rainfall (DGMR). While the original DGMR relies solely on QPE inputs, our NUS collaborators successfully enhanced its predictive architecture by directly incorporating wind data and 3D radar reflectivity at varying atmospheric heights. This provides the model with a far deeper contextual understanding of developing storm structures, thus enabling physically more meaningful forecasts.

Ensuring operational resilience



Translating theoretical research into robust daily operations is a core priuority of CCRS. Both of us worked together to set up the newly enhanced DGMR model in real time for MSS forecasters, with formal operations planned for the near future. One critical hurdle in operational forecasting is the sudden, unpredictable loss of radar data, which typically causes ML models to fail. To engineer a highly resilient system to overcome this hurdle, we applied optical flow techniques[1] to seamlessly estimate and fill missing input data. This breakthrough ensures the continuous, uninterrupted availability of vital nowcasting products even under adverse conditions.

[1] In nowcasting, optical flow techniques are used to track the movement of a storm between radar images to predict where and how fast it could be heading next.

Putting the new system to the test

In May 2026, the Meteorological Service Singapore (MSS) launched a project to evaluate the new ML model in an active forecasting environment. The results were highly encouraging: the DGMR system dramatically outperforms our current RainNet model. Most notably, the DGMR model preserves the spatial sharpness of storm cells far better than its predecessor (Figure 1).

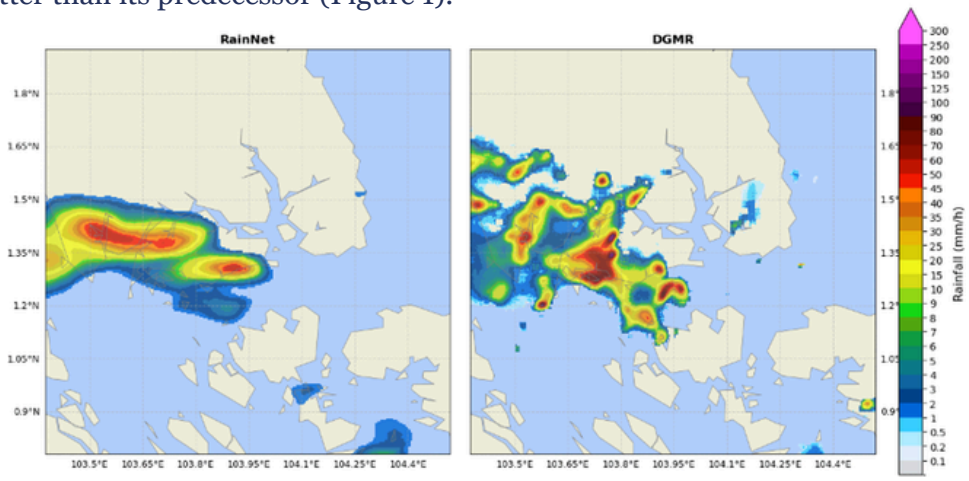


Figure 1. *Rainfall nowcasting for 35 minutes ahead. The newly implemented Deep Generative Model of Rain (DGMR) (right) preserves the spatial sharpness of storm cells far better than the current RainNet model (left).*

For heavy rainfall events, the new system demonstrates a significantly higher probability of detection[2] (POD) for lead times extending beyond 30 minutes (Figure 2).

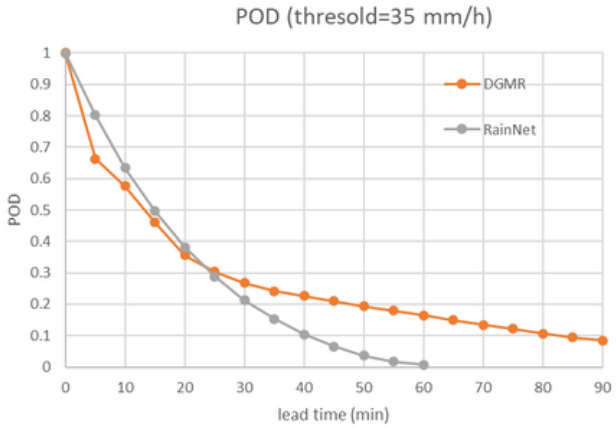


Figure 2. *Probability of detection (POD) for rainfall nowcasts from the Deep Generative Model of Rain (DGMR) and RainNet model. The DGMR model outperforms RainNet significantly after 30 minutes.*

What lies ahead beyond RainNet

Given these highly promising results, we are preparing to transition the DGMR into full operation, replacing the current RainNet system by the end of 2026. Supported by future investments, e.g. Singapore's National Research Foundation's (NRF) Research, Innovation and Enterprise (RIE) 2030 funding initiative, CCRS plans to foster expanded rainfall nowcasting collaborations with researchers and academic institutes across Singapore.

By systematically integrating state-of-the-art ML models into our operations, CCRS remains dedicated to advancing the nowcasting of rainfall, winds and lightning. These efforts continuously enhance the safety and resilience of Singapore while supporting CCRS' vision to be a leading centre in tropical climate and weather research focusing on Singapore and the Southeast Asia region.

[2] A verification metric commonly used to evaluate how well a weather prediction system can correctly predict events when they actually occur

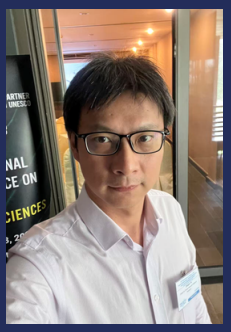
Southeast Asia's extreme temperature future: Insights from Singapore's Third National Climate Change Study

Extreme temperatures significantly elevated above climatological norms exert profound and wide-ranging impacts on human health, the environment and infrastructure. These impacts are amplified during heatwaves, when anomalously high temperatures persist for several days. The world has witnessed the unprecedented temperatures associated with the 2023–2024 El Niño event. Despite temporary cooling by La Niña, the 2023–2025 period represents three warmest years on record, with average temperatures 1.48°C above the pre-industrial era [1]. This reflects the influence of an ongoing and sustained long-term global warming trend.

According to the Intergovernmental Panel on Climate Change Sixth Assessment Report (IPCC AR6), the frequency of extreme temperature events has increased from once every 10 years during 1850–1900 to approximately 2.8 times at present, and is projected to occur 5.6 and 9.4 times at 2°C and 4°C global warming levels, respectively [2]. Southeast Asia (SEA)—home to 700 million people with a high concentration in urban areas—is highly vulnerable to extreme temperatures due to high population density, rapid urbanisation and a predominantly labour-intensive economy. High-resolution regional climate change projections for SEA are therefore necessary to enable granular analysis at the country and city level for local adaptation planning.

Methodology

This study used CCRS' 8-km high-resolution regional climate projections over SEA from Singapore's Third National Climate Change Study (V3), the first high-resolution regional dynamical downscaling effort over SEA based on the latest global climate models[1] (GCMs). It provides reginal climate change projections at 8-km resolution for SEA and 2-km resolution for the Maritime Continent, including Singapore, which are available through the V3 Data Sharing Portal, https:go.gov.sg/v3-dsp. The V3 dataset was generated by dynamically downscaling climate information from six GCMs under three Shared Socioeconomic Pathways (SSP) scenarios: SSP1-2.6 (aligned with limiting 2°C global warming), SSP2-4.5 (business-as-usual pathway), and SSP5-8.5 (high-emissions pathway).



Dr Jianjun Yu is a Senior Research Scientist in CCRS' Climate Change Impacts Branch. His research focuses on the analysis of climate extremes, with expertise in temperature extremes, heat stress, heavy rainfall and drought patterns across Singapore and the broader Southeast Asia region. His work further extends to examining climate change impacts on water resources, human health and infectious diseases.

We used a percentile-based method to define temperature extremes [3], setting the threshold at the 95th percentile of simulated daily maximum temperatures (T_{max}) during the historical baseline period (1995–2014), and apply this threshold to assess the projected changes in key heat-related metrics for the mid-century (2040–2059) and end-century (2080–2099).

Using this threshold, we assessed: (i) how often the hotter days with T_{max} above the threshold are projected to occur in the future; (ii) heatwaves, defined as three or more consecutive days with T_{max} above the threshold; and (iii) cumulative heat intensity (CHI)—defined as annual cumulative temperature above the threshold based on T_{max}, focusing on major cities across SEA. CHT captures the intensity of extreme heat exposure and serves as a proxy for potential impacts on human health and cooling energy demand.

[1] From the Coupled Model Intercomparison Project Phase 6 (CMIP6), an international effort among the climate modelling community aimed at coordinating climate change projections

While applying a percentile-based approach is common in climate research to assess large-scale climate changes, stakeholders should remain mindful of differences in local climatological conditions when interpreting the results for adaptation planning.

More frequent and intensive temperature extremes, particularly in the Maritime Continent

Our results indicate a substantial rise in daily maximum temperatures over land in SEA, with average increases of 1.0–2.1°C by mid-century and 1.1–4.0 °C by end-century depending on SSP scenarios. Southern Vietnam, eastern Sumatra and southern Borneo are identified as hotspots with pronounced temperature increases (Figure 3a). Mitigating emissions along a low-carbon pathway (i.e. SSP1-2.6) could bring substantial benefits for these regions in the second half of the century, potentially reducing additional warming by up to 3.0–3.6°C.

The background global warming is the primary driver of future increases in the frequency of hotter days, with changes in climate variability further amplifying the effect. Generally, countries in the Maritime Continent (i.e. Brunei, Indonesia, Malaysia, and Singapore) are expected to experience a higher frequency of hotter days in the future compared to the Indochina countries (i.e. Cambodia, Laos, Thailand, and Vietnam – see Figure 3b). In the mid-century, the number of hotter days in the Maritime Continent countries is projected to reach about 2–4 months per year, compared to 1–2 months in the Indochina countries, across the three SSP scenarios. By end-century, the Maritime Continent countries are anticipated to experience more hotter days (4–6 and 7–10 months under SSP2-4.5 and SSP5-8.5, respectively) than Indochina countries (2 and 3–5 months under SSP2-4.5 and SSP5-8.5, respectively).

Hotspots of more frequent and longer-lasting heatwaves are projected in eastern Sumatra, southern Borneo and northern Java. On average across SEA, the projected heatwave days and duration (i.e. the longest heatwave) are expected to double by around 2025 and 2040, respectively, compared to the historical baseline (1995–2014) (Figures 3c and 3d). Under the high-emissions scenario, the projected heatwave days and duration rise more than fivefold by around 2045 and 2070, respectively. This implies that while the effects of carbon mitigation may not be immediately visible, actions taken now are crucial to averting substantial temperature extremes by the end of the century.

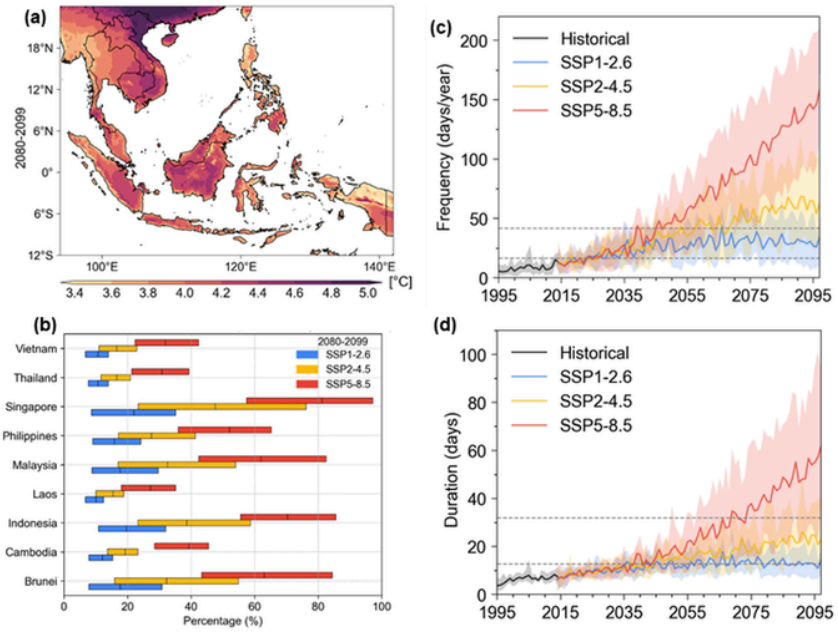


Figure 3. *Projected end-of-century changes under SSP5-8.5: (a) changes in daily maximum temperature; (b) proportion of future hotter days across SEA countries; time series of projected annual mean (solid line) and inter-model spread (shading) for heatwave days (c) and duration (i.e. the longest heatwave) (d). Dotted lines denote twofold and fivefold increases relative to the historical baseline.*

Cities along the Strait of Malacca and on Java face heightened heat exposure

Cities along the Strait of Malacca (e.g. George Town, Kuala Lumpur, Malacca, Singapore) and on Java (e.g. Jakarta, Bandung, Surabaya) are projected to experience heightened cumulative heat intensity. By mid-century, the CHI in these cities is expected to increase by 3–13 times compared to the past across the three scenarios, compared to 2–6 times in the Indochina Peninsula (e.g. Yangon, Bangkok, Ho Chi Minh City) and the Philippines (e.g. Manila and Cebu City) (Figure 4). By end-century, the CHI in these cities increases 10–20 times and 30–70 times under SSP2-4.5 and SSP5-8.5, respectively.

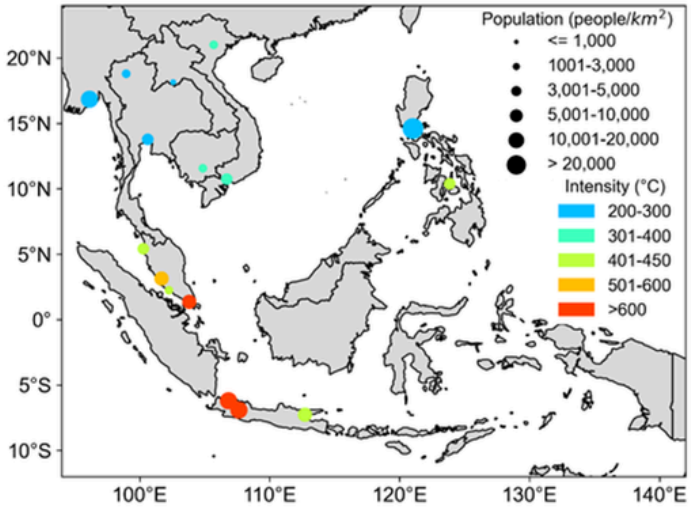


Figure 4. *Projected end-of-century changes in the cumulative heat intensity (CHI) in selected Southeast Asian cities under the high emissions scenario (SSP5-8.5).*

The results of this study imply a substantial increase in energy demand for cooling and potential reduction in labour productivity in the cities along the Strait of Malacca and on Java. Given their high population densities and ageing demographics, the risk of heat-related illness (e.g. cardiovascular and respiratory diseases) is expected to escalate.

Where CCRS can help

The full details of this study can be accessed at https://doi.org/10.1016/j.scitotenv.2025.179501. The V3 datasets offer a valuable foundation for climate change impact studies across key sectors—including environmental health, water resources, biodiversity, agriculture, energy and infrastructure—and support policy making, engineering design and climate finance.

References:
[1] WMO Press Release 14 January 2026. https://wmo.int/news/media-centre/wmo-confirms-2025-was-one-of warmest-years-record
[2] IPCC. (2021). Climate Change 2021: The Physical Science Basis. Contribution of Working Group I to the Sixth Assessment Report of the Intergovernmental Panel on Climate Change (V. Masson-Delmotte, P. Zhai, A. Pirani, S.L. Connors, C. Péan, S. Berger, N. Caud, et al., Eds.). Cambridge University Press. https://doi.org/10.1017/9781009157896
[3] IPCC. Managing the Risks of Extreme Events and Disasters to Advance Climate Change Adaptation. A Special Report of Working Groups I and II of the Intergovernmental Panel on Climate Change; Cambridge University Press: Cambridge, UK; New York, NY, USA, 2012; pp. 115–122.



Shaping Singapore's Weather and Climate Research Priorities for RIE2030

Singapore's weather and climate resilience is increasingly important in a world facing more frequent and intense extreme weather events, rising temperatures, and growing climate-related risks. At the same time, advances in artificial intelligence, high-resolution modelling, observational technologies and data analytics are creating new opportunities to improve weather prediction and climate projections.

To strengthen Singapore's capabilities and maintain its position as a leading hub for tropical weather and climate science, CCRS has been engaging stakeholders across government agencies, research institutions and operational users to shape priorities for the proposed Weather and Climate Science Research Programme (WCSRP) under the Research, Innovation and Enterprise 2030[1] (RIE2030).

Building on strong foundations

Singapore has established a strong foundation through the Weather Science Research Programme (WSRP) under RIE2025 and the launch of the Climate and Weather Research Alliance Singapore (CAWRAS) in September 2025.

Led by CCRS, CAWRAS brings together research performers from CCRS, the Agency for Science, Technology and Research (A*STAR), the National University of Singapore (NUS) and Nanyang Technological University Singapore (NTU Singapore) under a coordinated national framework. The alliance leverages complementary expertise across institutions to advance capabilities in weather and climate science, while strengthening the translation of research outcomes into operational products and services.

Through WSRP and CAWRAS, Singapore has developed a coordinated national ecosystem spanning next-generation modelling, artificial intelligence and machine learning applications, observations, data assimilation, post-processing and climate impact science. These efforts provide the foundation for the next phase of capability development under RIE2030.



Ms Ipein Chua is a Senior Assistant Director with CCRS' Department of Research Masterplanning. She helps drive the coordination of climate and weather science research across universities, research institutions and agencies in Singapore to strengthen weather and climate science capability locally while nurturing international partnerships and collaborations to enhance Singapore's global standing in weather and climate science.

[1] A five-year strategy that will strengthen Singapore's competitiveness and resilience, and better position Singapore to navigate the challenges and opportunities of the global landscape

Understanding whole-of-government needs

As part of the RIE2030 planning process, CCRS collaborated with A*STAR to organise an Operations and Technology Roadmap (OTR) workshop in January 2026.

The workshop brought together representatives from public sector agencies that rely on weather and climate information for operational decision-making and long-term planning. Participants shared current and emerging challenges, identified capability gaps, and highlighted future needs that could potentially be addressed through research and innovation.

The discussions covered a diverse range of operational requirements, including urban-scale weather prediction, coastal and marine applications, heat resilience planning, environmental monitoring, and decision-support tools. These inputs provided valuable insights into how future weather and climate research investments could generate meaningful impact for Singapore.



Operation & Technology Roadmap (OTR) workshop with public sector agencies across Singapore to gather whole-of-government user requirements for weather and climate science research

From user needs to research opportunities

Building on the OTR outcomes, CCRS organised a research brainstorming workshop in April 2026 involving researchers from universities and research institutes across Singapore.

The workshop brought together researchers from CCRS, A*STAR, NUS, NTU, Singapore University of Technology and Design (SUTD) and Singapore Management University (SMU). Participants were grouped according to thematic research interests and invited to explore potential research directions that could address the needs identified during the OTR exercise.

The brainstorming sessions encouraged interdisciplinary discussions and collaboration across institutions, allowing researchers to combine expertise from different domains to develop innovative approaches to weather and climate challenges. Potential research concepts generated during the workshop will help inform future discussions on capability development and research priorities under RIE2030.



Brainstorming workshop with researchers across Singapore to brainstorm on potential research projects to address the whole-of-government needs to respond to weather and climate risks

Strengthening national resilience through research

The stakeholder engagement activities represent an important step towards ensuring that Singapore's future investments in weather and climate science remain relevant, impactful and aligned with national needs.

By systematically engaging operational users, policymakers and researchers, CCRS is helping to strengthen the link between research and real-world applications. This whole-of-government and whole-of-ecosystem approach ensures that future research investments not only advance scientific excellence but also contribute directly to national resilience and decision-making.

Looking ahead

Building on the achievements of WSRP and CAWRAS, the proposed WCSRP under RIE2030 seeks to further strengthen Singapore's weather and climate science capabilities, nurture a strong research ecosystem, and establish regional leadership in tropical weather and climate research.

Through continued collaboration among government agencies, research institutions and international partners, Singapore aims to remain at the forefront of weather and climate science, delivering trusted knowledge, innovative solutions and impactful services that support national resilience and regional needs in an increasingly uncertain climate future.



Researchers across Singapore networking to ideate on solutions to address weather and climate challenges in Singapore



Science Publications

CCRS continues to contribute to the advancement of tropical weather and climate science through peer-reviewed publications. Selected papers published during the first half of 2026 are listed below, showcasing our work across various aspects of weather and climate R&D.

Wang, X., Chen, J., Yang, J. et al. CondensNet: enabling stable long-term climate simulations via hybrid deep learning models with adaptive physical constraints. npj Clim Atmos Sci 9, 7 (2026). https://doi.org/10.1038/s41612-025-01269-5

Delage, F., Narsey, S., **Lim, G.** et al. Regional downscaling increases projected changes of maritime continent large scale rainfall extremes. Sci Rep (2026). https://doi.org/10.1038/s41598-026-44563-9

Chen, I.-H., Patel, P., Furtado, K., Wang, W., Liu, Z., Barker, D., et al. (2026) Performance evaluation of regional weather predictions with the Model for Prediction Across Scales – Atmosphere (MPAS-A) over the Maritime Continent. Quarterly Journal of the Royal Meteorological Society, 152(777), e70129. https://doi.org/10.1002/qj.70129

Prasanna, V., Raghavan, S.V., Dipankar, A. et al. Convection-permitting climate simulations using SINGV-RCM and WRF over the Maritime Continent. Clim Dyn 64, 222 (2026). https://doi.org/10.1007/s00382-026-08193-1

K. Peddakapu, Dalila Mat Said, **Pavan Harika Raavi**, Energy conversion and emission trade-offs in hybrid marine microgrids: A CNN-LSTM forecasting approach, Energy Conversion and Management, Volume 350, 2026, 120967, ISSN 0196-8904, https://doi.org/10.1016/j.enconman.2025.120967

Peatman, S. C., and Coauthors, 2026: The Madden-Julian Oscillation and Equatorial Waves in Operational Forecasting. Bull. Amer. Meteor. Soc., BAMS-D-26-0034.1, https://doi.org/10.1175/BAMS-D-26-0034.1

Schwartz, C., Garfinkel, C. I., & Chen, W. (2026). Simulated tropical troposphere response to the QBO: Effect of vertical resolution, gravity waves parameterization, and boundary forcing. Geophysical Research Letters, 53, e2025GL120711. https://doi.org/10.1029/2025GL120711

Luo, F., Selten, F. & Coumou, D. The role of soil moisture on summer atmospheric circulation climatology in the Northern Hemisphere. npj Clim Atmos Sci 9, 42 (2026). https://doi.org/10.1038/s41612-025-01294-4

Luo, F., S. Sahany, A. Moise, F. Cruz, and F. Tangang, 2026: Capacity Building on the Use of High-Resolution Climate Change Projections for Impact Studies over Southeast Asia. Bull. Amer. Meteor. Soc., **107**, E796–E804, https://doi.org/10.1175/BAMS-D-25-0298.1

Findell, K. L., and Coauthors, 2026: Toward Improved Understanding and Attribution of Large-Scale Circulation Changes and Associated Extremes: Challenges and Opportunities. Bull. Amer. Meteor. Soc., 107, E778–E787, https://doi.org/10.1175/BAMS-D-26-0009.1

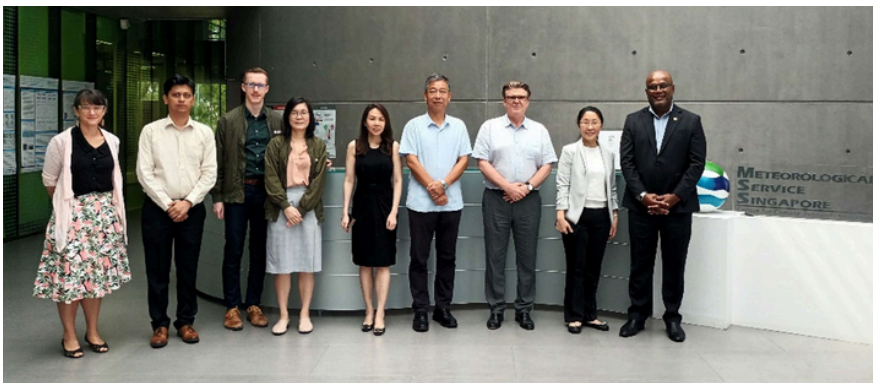
Events

Visit by Deputy Secretary-General (Strategic Policy & Programming) of the Pacific Islands Forum

On 21 January 2026, CCRS hosted Mr Esala Nayasi, Deputy Secretary-General (Strategic Policy & Programming) of the Pacific Islands Forum under the Ministry of Foreign Affairs' Distinguished Visitors' Programme.

Since both Singapore and the Pacific Islands navigate similar tropical environments, CCRS' expertise offers translatable insights to help understand these climate impacts and shape effective resilience planning. CCRS scientists showcased our tropical climate and weather research capabilities, including:

- Singapore's Third National Climate Change Study (V3), providing 8km resolution projections covering Southeast Asia
- Climate change impact research on food security and heat-related health risks
- Artificial intelligence-enabled weather prediction and rainfall nowcasting systems
- Research programmes funded under Singapore's Research, Innovation and Enterprise 2025 (RIE2025) plan, alongside the Climate and Weather Research Alliance Singapore (CAWRAS)



Ms Koh Li-Na (Director-General, MSS; second from right) hosted Mr Esala Nayasi [Deputy Secretary-General (Strategic Policy & Programming) of the Pacific Islands Forum; right] at CCRS on 21 January 2026.

Supercomputing/HPC Asia 2026 Conference

On 27 January 2026, CCRS Director Prof Dale Barker co-chaired a session on 'High-Performance Computing (HPC) for large-scale weather prediction and climate modelling' at the Supercomputing/HPC Asia 2026 Conference on 27 Jan 2026 in Osaka, Japan, alongside Dr Shigenori Otsuka from the RIKEN Center for Computational Science (R-CCS).



CCRS Director Prof Dale Barker (second from right) co-chaired a session on high-performance computing for large-scale weather prediction and climate modelling alongside Dr Shigenori Otsuka (right).

With a focus on the revolutionary impact of artificial intelligence (AI) and machine learning (ML) techniques in numerical weather prediction (NWP) and climate modelling, the session:

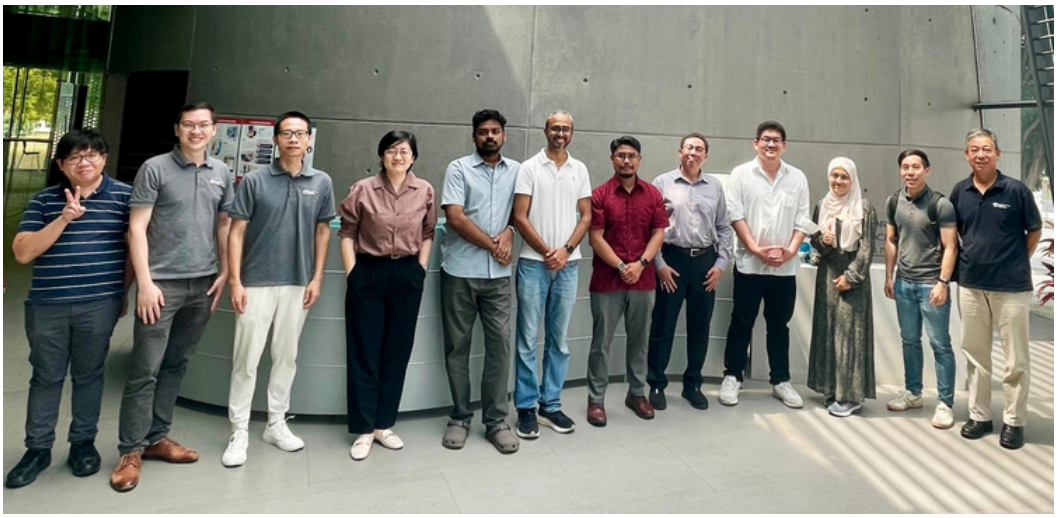
- Highlighted how AI is transforming every stage of the weather and climate data processing chain, from traditional physics-based approaches to cutting-edge hybrid models that combine physical and data-driven methods
- Explored a range of weather prediction/climate science applications on large-scale HPC—from nowcasting local rainfall in the next 30 minutes to simulating global climate systems under various climate change scenarios over the coming decades

ASMC Attachment Programme

In February 2026, CCRS hosted Mr Peeranat Longsombun from the Thai Meteorological Department, and Mr Noor Azam Shaari and Ms Wan Fariza Mustafah from the Malaysian Meteorological Department under the ASEAN Specialised Meteorological Centre (ASMC) Attachment Programme. The two-week visit focused on assessing the quality of satellite datasets and using them for evaluating the performance of numerical weather prediction (NWP) models in Southeast Asia.

Key highlights included:

- Exposure to the latest technologies in remote sensing and satellite data applications for forecast verification and model evaluations
- Developed comprehensive skills in satellite data application for weather forecast evaluations, including applying various verification metrics to assess model performance
- Conducted validation studies to better understand model performance, e.g. verifying CCRS' NWP model output against satellite observations and ground measurements
- Knowledge exchange in areas including air quality modelling and evaluation, monsoon monitoring, heat stress monitoring, and rainfall nowcasting



CCRS Scientists hosted Mr Peeranat Longsombun (fourth from right) from the Thai Meteorological Department, and Ms Wan Fariza Mustafah (third from right) and Mr Noor Azam Shaari (fifth from right) from the Malaysian Meteorological Department under the ASMC Attachment Programme.

Sharing session at CHIJ Katong Convent (Secondary)

CCRS Deputy Principal Research Scientist Dr Muhammad Eeqmal Hassim, PhD recently shared his passion for climate science with students at CHIJ Katong Convent (Secondary)'s 2026 Career Fair 'Navigating Tomorrow - Unlocking Future Opportunities' on 6 February 2026.

Dr Hassim spoke about career pathways in weather and climate research, sharing insights into his journey as a climate scientist and the meaningful work being done at CCRS to understand tropical weather and climate in Singapore and Southeast Asia.

The students found the session engaging and many expressing increased interest in science and research careers after learning about the diverse opportunities in environmental and climate science fields.



CCRS Deputy Principal Research Scientist Dr Muhammad Eeqmal Hassim sharing his passion for climate science with the students at CHIJ Katong Convent (Secondary).

National capability building efforts under the Climate and Weather Research Alliance Singapore

On 5 and 27 March 2026, CCRS co-organised the 'LFRic' training sessions alongside A*STAR Institute of High Performance Computing (A*STAR IHPC) and National Supercomputing Centre (NSCC) Singapore under the Climate and Weather Research Alliance Singapore (CAWRAS).

Developed by the Momentum Partnership (with MSS/CCRS as a core member), LFRic is a next-generation, highly scalable weather and climate modelling system adaptable for modern HPC hardware. The sessions aimed to involve local research institutes in the international co-development of modelling capabilities for Singapore and Southeast Asia.

Led by CCRS scientists Dr I-Han Chen, Dr Song Chen and Jerry Liu, the comprehensive training equipped participants with knowledge and first-hand experience in this next-generation modelling system, covering topics such as:

- LFRic fundamentals
- Workflow management
- Regional nesting capabilities
- Post-processing and evaluation techniques

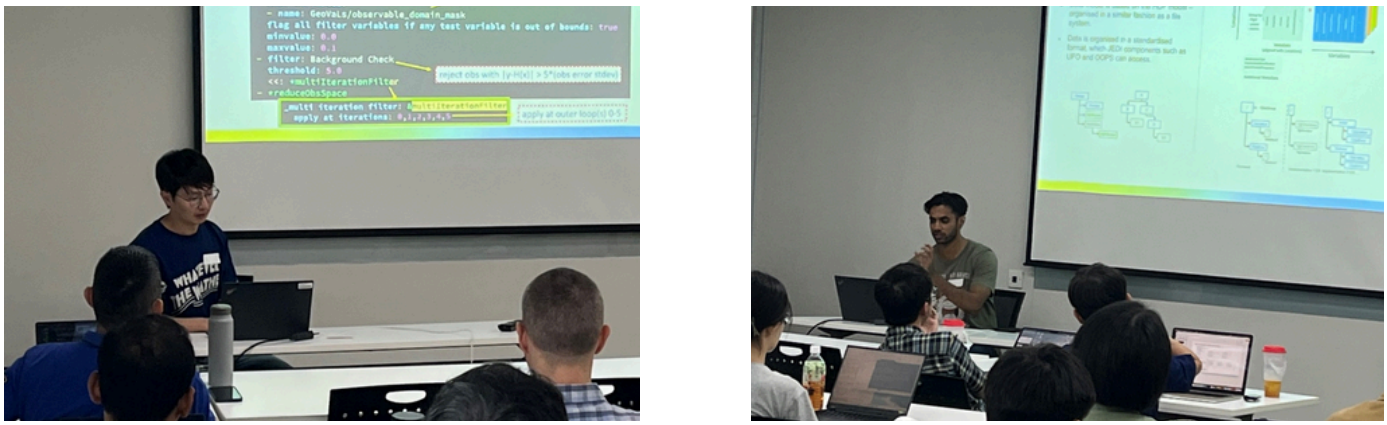


Participants of the 'LFRic' training sessions on 5 and 27 March 2026.

To enhance capabilities in data assimilation (DA) within CAWRAS, CCRS conducted the 'MPAS-JEDI' training session on 10 April 2026. Attended by around 25 researchers, the session focused on the Joint Effort for Data assimilation Integration (JEDI), an open-source, "model-agnostic" DA framework that can be used for collaborative DA research across a broad range of international research organisations, regardless of which environmental models they use.

Since 2024, CCRS has collaborated with the US National Centre for Atmospheric Research (NCAR) to develop an MPAS-JEDI system tuned for Southeast Asia. This system couples JEDI with NCARS's Model for Prediction Across Scales (MPAS), an advanced atmospheric model with flexible mesh capabilities. Through this training session, local CAWRAS researchers can now directly leverage this successful international collaboration for their own real-world DA research projects.

Led by CCRS scientists Dr Tao Sun, Dr Kashyapa Athreyas, Dr Chih-Chi Hu, Adam Clayton and Jerry Liu, with support from A*STAR, the session started with explanations of the JEDI framework and basic components, and proceeded to hands-on practical sessions, ending with exercises on advanced techniques such as radar assimilation and clear-sky radiance assimilation.



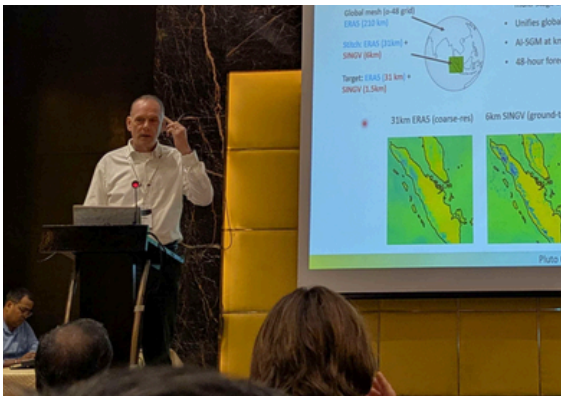
CCRS scientists Dr Chih-Chi Hu (left) and Dr Kashyapa Athreyas (right) delivered introductory presentations on the Joint Effort for Data assimilation Integration (JEDI) framework and basic components.

International Momentum Partners Meeting

On 23–27 March 2026, CCRS scientists participated in a two-day 'AI/ML Challenges and Opportunities' Workshop, followed by a celebration of the host's (the National Centre for Medium Range Weather Forecasting [NCMRWF]) foundation day, and a series of presentations and discussions involving both core and associate Momentum Partners.

CCRS Director Prof Dale Barker delivered two presentations during the week sharing CCRS' progress and strategic direction in advancing tropical weather and climate research for Singapore and Southeast Asia.

Our scientists Pluto Chui, Dr Chanh Kieu, Dr Pavan Harika Raavi and Dr Sandeep Sahany also participated in the workshop, contributing to key discussions on weather modelling, climate modelling and the broader ML landscape, helping to shape the strategic direction of AI/ML applications within the Partnership.



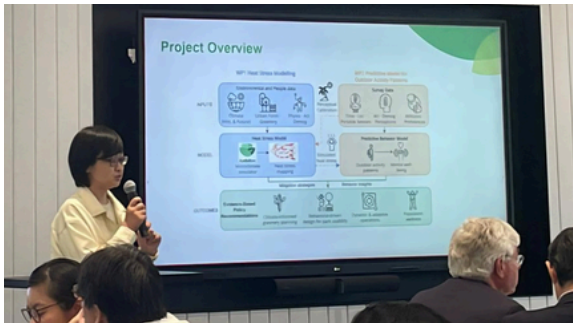
CCRS Director Prof Dale Barker shared CCRS' AI applications in its weather and climate research

These engagements enable CCRS to contribute to and benefit from global weather and climate research developments that serve not only Singapore but the broader global community. The discussions and knowledge exchange from these meetings will also support our ongoing efforts to build next-generation weather and climate research capabilities within the local research ecosystem under the Climate and Weather Research Alliance Singapore (CAWRAS).

Climate Impacts Science Research Programme Progress Meeting

The Climate and Weather Research Programme Office (CWRPO) held its half-yearly Climate Impact Science Research (CISR) Programme progress meeting on 4–5 May 2026 at Catapult @ Rochester, bringing together over 50 participants across two days, including leading local and international climate scientists of the Scientific Advisory Panel (SAP), CISR research teams, agency representatives and CCRS colleagues.

The meeting reviewed progress across 12 projects spanning human health, biodiversity, food security, energy, and science-to-policy translation. Notable achievements include the development of climate-driven dengue early warning tools, urban tree failure prediction models, projections of compound climate extremes affecting regional food security and heat stress models to support outdoor activity planning. The SAP highlighted the strong scientific quality of many projects while encouraging teams to accelerate stakeholder engagement with policymakers and strengthen the translation of research outputs into actionable policy recommendations.



*Principal Investigator Dr Liu Huizhe (A*STAR) shared the progress of her project titled 'Evaluating the Impact of Heat Stress on Outdoor Physical Activities and Mental Well-being in Urban Environments'.*

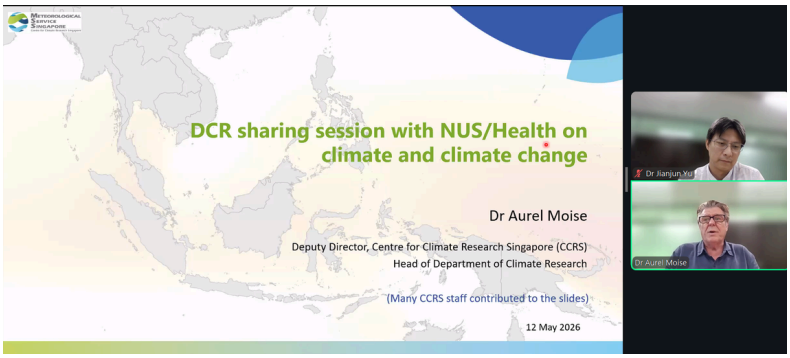
The meeting also featured a welcome dinner hosted by the CISR Strategic Committee Chair, Dr Benjamin Koh, Deputy Secretary (Sustainability)/Ministry of Sustainability and Environment, reflecting the programme's broader commitment to building the international networks needed to advance climate adaptation science for Singapore.

Asia Pacific Malaria Elimination Network (APMEN) Online Climate Training Workshop

CCRS contributed to the Online Climate Training Workshop organised by the Asia Pacific Malaria Elimination Network (APMEN) held on 12–14 May 2026.

Attended by over 600 online participants, the workshop brought together public health professionals from across the Asia Pacific region to strengthen their understanding of how climate information can support disease control and health planning. As climate change increasingly shapes the transmission and distribution of malaria and other vector-borne diseases, equipping public health practitioners with the ability to interpret and apply climate data is more important than ever.

CCRS Deputy Director Dr Aurel Moise and Senior Research Scientist Dr Jianjun Yu delivered presentations covering core concepts in climate science, climate change projections, and best practices for using climate data in health impact studies. These sessions provided participants with practical guidance on how to apply climate information to public health and disease control planning.

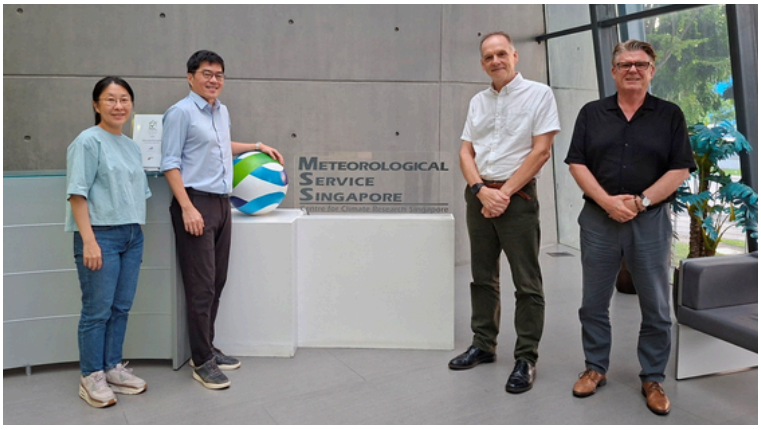


CCRS Deputy Director Dr Aurel Moise (bottom) and Senior Research Scientist Dr Jianjun Yu (top) shared climate science and projections at the Asia Pacific Malaria Elimination Network (APMEN) Online Climate Training Workshop on 12–14 May 2026.

Visit by the Permanent Secretary at Singapore's Ministry of Sustainability and the Environment

On 10 June 2026, CCRS hosted the Permanent Secretary at the Ministry of Sustainability and the Environment Mr Melvyn Ong.

We shared how CCRS' research and development (R&D) efforts benefit Singapore and the wider region—from our numerical weather prediction and AI-driven rainfall nowcasting systems that outperform global models for Singapore-relevant weather, to climate change projections that inform impact assessment and national adaptation planning. We also shared our ongoing efforts to build Singapore's national weather and climate research ecosystem through the Climate and Weather Research Alliance Singapore (CAWRAS) and the $25 million Weather Science Research Programme (WSRP).



(L–R) Ms Koh Li-Na (Director-General, MSS), Mr Melvyn Ong (Permanent Secretary for Sustainability and the Environment), Prof Dale Barker (Director, CCRS), and Dr Aurel Moise (Deputy Director, CCRS)

Media Highlights

In conjunction with World Meteorological Day, Head of CCRS' Seasonal and Subseasonal Prediction Branch Dr Thea Turkington shared her expertise with The Straits Times on Singapore's climate in 2025, including the record 35°C Wet Bulb Globe Temperature (WBGT) recorded at Palawan Green (Sentosa), the importance of expanding MSS' heat stress monitoring network, and how the El Niño – Southern Oscillation could influence Singapore's rainfall patterns under climate change.

Read the full article at https://www.straitstimes.com/singapore/environment/2025-a-year-of-weather-extremes-with-hottest-june-and-november-on-record-logged-met-report.



Head of CCRS' Seasonal and Subseasonal Prediction Branch Dr Thea Turkington shared insights on Singapore's 2025 weather extremes and climate trends in an interview with The Straits Times.

CCRS Senior Research Scientist Dr Jianjun Yu was featured on Channel 8 sharing insights on Singapore's expanded heat stress monitoring capabilities following the release of ACAR 2025. Dr Yu highlighted the expansion of Singapore's WBGT network to 20 operational stations across the island, as Singapore recorded its highest-ever heat stress reading of 35.0°C WBGT in 2025.

Find out more at https://www.youtube.com/watch?v=fxhS4ExbCGc.

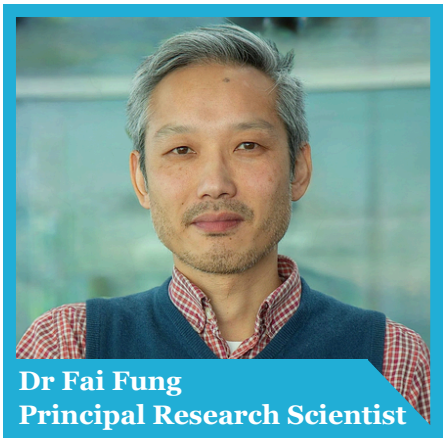


CCRS Senior Research Scientist Dr Jianjun Yu discussed Singapore's expanded heat stress monitoring capabilities in an interview with Channel 8, Singapore's news programme aired in Mandarin.

CCRS Director Prof Dale Barker spoke to MONEY FM 89.3's 'Singapore Unfiltered' programme on Singapore's long-term climate trends and the future of heat stress in the city-state. Prof Barker noted that while Singapore currently experiences around 10 to 15 high heat stress days a year, this could rise to 320 days annually if greenhouse gas emissions continue unabated. Listen to the full podcast at https://open.spotify.com/episode/0Pg07F8F9KPwdK9RhSQdVp.

Dr Turkington also spoke to CNA938 for 'Heat, Haze and El Niño: What Singapore Needs to Know', explaining how El Niño's impacts on Singapore are seasonal in nature, hitting hardest during the Southwest Monsoon season, and how El Niño interacts with long-term climate change to drive warming trends in the region. Learn more at https://open.spotify.com/episode/63Yzdpx147lMaK3NcpriGq.

Staff Spotlight



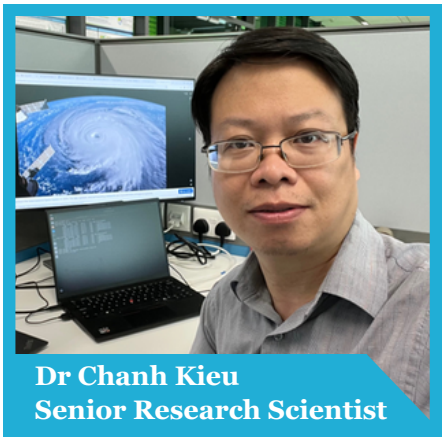
Dr Fai Fung
Principal Research Scientist

This January, I joined the Department of Climate Research to head the Climate Change Impacts Branch. My team translates climate model outputs from Singapore's Third National Climate Change Study (V3) into impacts, covering urban-scale climate modelling, sea-level projections, scientific support for the Department of Research Masterplanning, and climate change impacts studies across Southeast Asia.

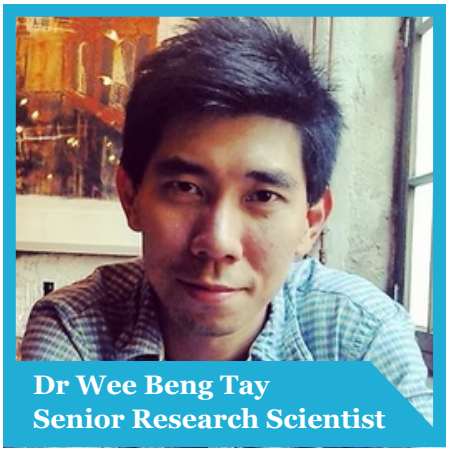
With over 20 years in academia (e.g. the University of Oxford, University of Bristol) and government (e.g. UK Met Office and Environment Agency), I have developed expertise across the climate services value chain—from analysing climate model projections to extract useful information to support decisions amid deep uncertainty, to co-producing and evaluating services that support climate change adaptation.

I joined the CCRS Core Modelling Development Branch in January 2026, where my primary focus is to advance the next generation of AI/ML-based regional weather and climate modelling for Singapore and the surrounding region.

Prior to joining CCRS, I was a faculty member at Indiana University Bloomington in the US, where I conducted research and taught courses on tropical cyclone intensity predictability, data assimilation, and AI/ML applications for high-impact weather and climate extremes. I have also served in different leadership roles for several collaborative research projects and American Meteorological Society (AMS) conferences. I currently serve as an Editor of the AMS Journal of the Atmospheric Sciences.



Dr Chanh Kieu
Senior Research Scientist

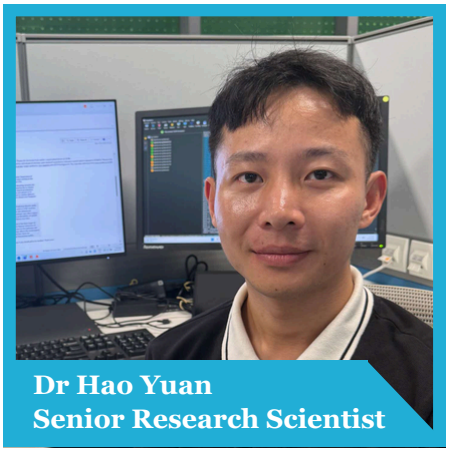


Dr Wee Beng Tay
Senior Research Scientist

I joined the Core Modelling and Development Branch, Department of Weather Research in April 2026. My work in the team is on urban model downscaling using machine learning. This involves taking coarse-resolution data and transforming it into finer, localized, high-resolution data using machine learning techniques.

Previously, I was working at Temasek Laboratories @ National University of Singapore, running computational fluid dynamics (CFD) simulations on different aerodynamic problems, such as flapping, morphing wing aerial vehicles. I also applied physics informed neural network (PINN) on airfoil's thrust, lift prediction and optimisation.

My work on increasing the resolution of urban data will help to resolve critical physical processes, such as convection which generates heavy rainfall in advance, to allow us to be better prepared.



Dr Hao Yuan
Senior Research Scientist

I joined the High Performance Computing Branch (HPCB) CCRS in February 2026. My current work focuses on managing and maintaining the core modelling systems, software tools, and operational numerical weather prediction (NWP) workflows running on HPC platforms. I also monitor and troubleshoot production systems to ensure stable and reliable forecasting operations.

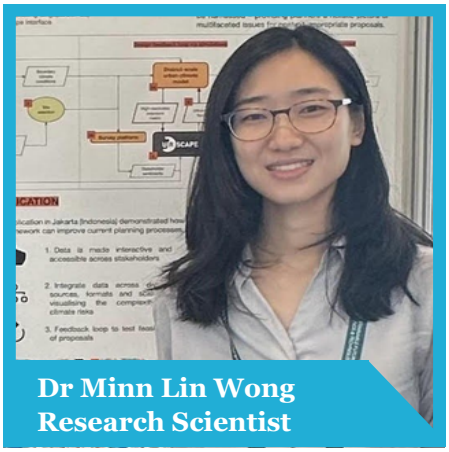
Before joining CCRS, I worked at Agency for Science, Technology and Research (A*STAR) as a research scientist in energy materials design. My research covered electrode materials, catalysts for CO_2 reduction, and hydrogen evolution reactions. Coming from a computational research background, I am interested in applying HPC and scientific computing to large-scale environmental and climate applications that are important for Singapore and the Southeast Asia region.



Dr Xiaoling Zhou
Senior Research Scientist

I joined the Climate Projections and Extremes Branch within the Department of Climate Research in March 2026, as part of the team working on the Fourth National Climate Change Study for Singapore (V4).

Previously, my work focused on AI model development and large-scale simulations using high-performance computing (HPC), where I had the opportunity to lead six research projects as a Principal Investigator. These skills and experiences directly support my role here at CCRS, where I am focusing on advancing AI for climate downscaling in Southeast Asia. My hope is that by incorporating AI's efficiency, we can truly enhance our climate change studies within V4. Ultimately, I believe this work can bring meaningful value to our projections, helping us better understand and prepare for climate change impacts over Singapore and the wider region.



Dr Minn Lin Wong
Research Scientist

I joined CCRS drawn to the opportunity to contribute to impactful work across Southeast Asia. I am currently part of the Climate Projections and Extremes Branch, where I will support the work on dynamical and AI downscaling of climate projections for Singapore's Fourth National Climate Change Study (V4).

My previous work employed atmospheric general circulation model (AGCM) experiments with hydroclimate proxies to explore how insolation and El Niño–Southern Oscillation (ENSO) variability influenced the South American Summer Monsoon. Following this, I also worked on assessing urban heat mitigation strategies in cities. In joining CCRS, I hope to deepen my understanding of new model developments and use that knowledge to support more meaningful work for the region.

Acknowledgements

Editorial Committee
Dale Barker, Aurel Moise, Shu Wei See, Hugh Zhang

Editor
Tammy Chin

Writers
Jianyu Liang, Pluto Chui — CCRS Launches Advanced Rainfall Nowcasting System for Singapore

Jianjun Yu — Southeast Asia's extreme temperature future: Insights from Singapore's Third National Climate Change Study

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The CCRS Newsletter highlights CCRS' latest news, activities and progress. The Newsletter also shares latest climate/ weather science developments that are relevant to CCRS' mission. For feedback and enquiry, please email NEA_CCRS_Engage@nea.gov.sg or fill up the form at go.gov.sg/ccrs-newsletter-feedback.



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