CCRS Newsletter

Issue 6, October 2023

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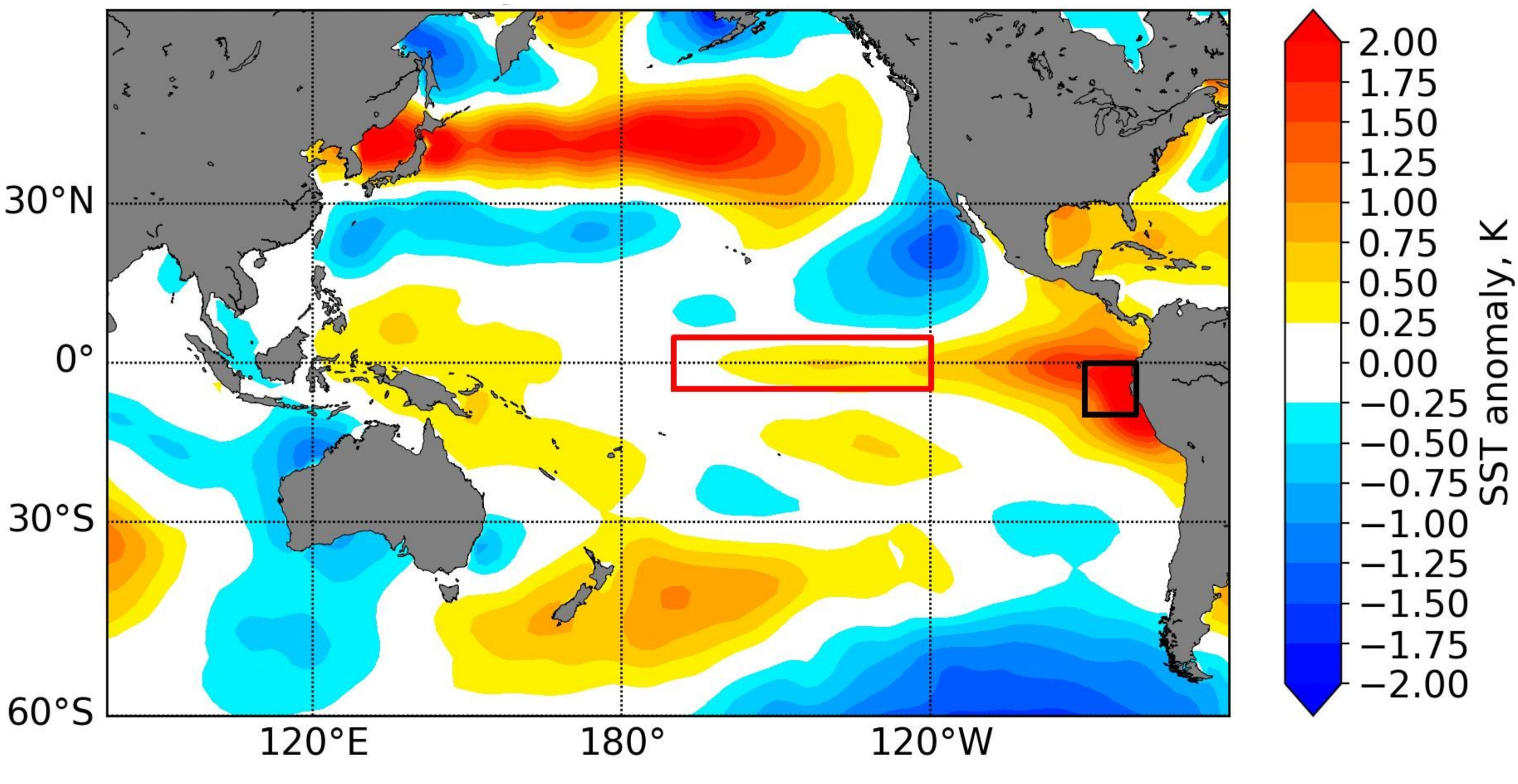

Sea surface temperatures (SSTs) in the Pacific in May 2023, with the background warming trend removed. The red and black boxes are the 'Nino 3.4' region and 'Nino 1+2' region, respectively, where SSTs are the key indicator used to monitor El Niño & La Niña.

Meteorological Service Singapore
Centre for Climate Research Singapore

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Published quarterly, 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.

Word from the Director

Welcome to the sixth issue of the CCRS Newsletter!

As we enter the fourth quarter of 2023, CCRS' preparations for the release of results from Singapore's Third National Climate Change Study (V3) are drawing to a close. The V3 project has been CCRS' largest project in recent years, using our own 'SINGV' regional climate model to "downscale" selected CMIP6 global climate projections to provide localised projections in support of local climate adaptation planning. The findings of the V3 project will be released at a symposium to be held at Singapore's Marina Bay Sands on 5 January 2024. For further publicity of this landmark event, follow us on our LinkedIn page.

On shorter timescales, CCRS' regional 'SINGV-DA' operational Numerical Weather Prediction (NWP) system will be upgraded in late 2023 to include improvements to the 'Regional Atmosphere and Land – RAL3' physics scheme (i.e. representation of sub-grid scale processes such as clouds, rainfall, etc.). Developed over several years in close collaboration with our international Unified Model (UM) partners, the upgraded system has demonstrated a significant improvement in forecasting rainfall, which is the primary consideration for weather forecasting in Singapore.

On 9–13 October, CCRS hosted about 35 members of the international UM Partnership for a series of meetings to discuss the scientific and technical challenges, as well as opportunities for the next generation of weather/climate models. As part of the deliberations, CCRS organised a half-day 'Celebration of Earth System Modelling' event on 11 October to facilitate knowledge exchange between the international modelling experts and local stakeholders. See page 5 for further details.

El Niño is back this year after about three years of La Niña conditions. In this issue, CCRS' Head of the Seasonal and Subseasonal Prediction branch Thea Turkington gives an overview of how CCRS monitors El Niño and La Niña, with a particular focus on the importance of accounting for background warming trend. Thea also shares how the prevalent El Niño conditions will likely impact the weather in Singapore and the region.

In another article, CCRS scientist Shipra Jain provides a summary of her paper on evaluating climate model performance, published in Nature earlier this year.

As usual, we include a summary of CCRS' latest science and media highlights, seminars and events. We hope you will find this issue informative and useful. Please let us know if there is something in particular you would like to hear about. I encourage you to share the newsletter with colleagues and friends – contact us to sign up. Happy reading!

Professor Dale Barker
Director,
Centre for Climate Research Singapore

El Niño Is Back – What Does It Mean?

El Niño has been making news in 2023. After three years dominated by La Niña conditions, there was a relatively quick switch (at the seasonal timescale) to discussions around El Niño.

As of 2022, 2016 was the warmest year on record globally in most datasets, associated with the background climate change trend as well as the strong El Niño condition. Locally, during the last strong El Niño in 2015/2016, Singapore also experienced warmer temperatures, extended dry periods and occasional transboundary haze. With these conditions in mind, thoughts turned to what to expect in 2023 and beyond.

Dr Thea Turkington is a deputy principal research scientist leading CCRS' Seasonal & Subseasonal Prediction Branch. Her work includes developing climate services for Singapore and Southeast Asia, particularly at the subseasonal and seasonal timescales, as well as underlying research in understanding the effects and impacts of relevant climate processes.

What is El Niño?

El Niño (or an El Niño event) is a naturally occurring climate pattern associated with changes in both the ocean and atmosphere. One of its most noticeable features includes the warming of the surface waters in the central and eastern equatorial Pacific Ocean (Figure 1). Other key features include the weakening of the trade winds and changes in rainfall (less in the west Pacific and more in the east).

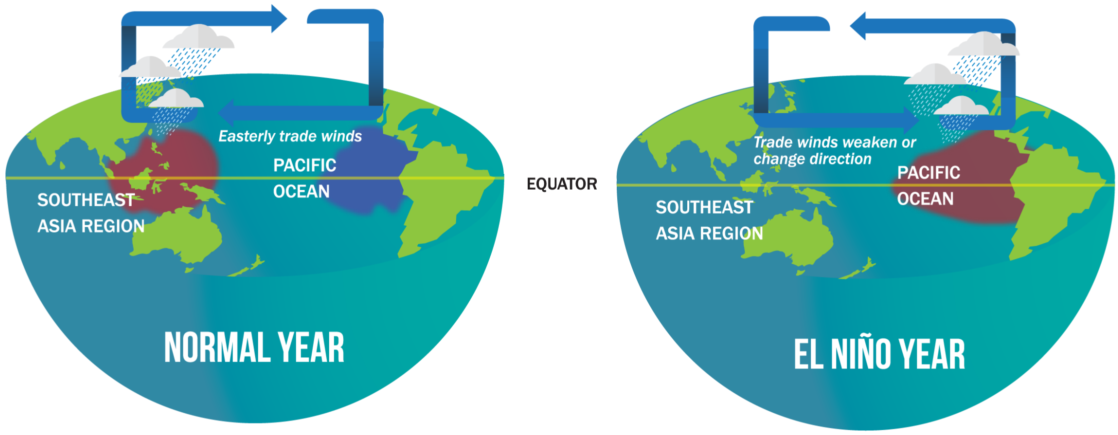


Figure 1 *Schematic showing the typical conditions in a normal year (left) and changes during an El Niño event (right)*

El Niño events are also seasonal phenomena (typically lasting 9–12 months) and often form around the middle of a year and end in the first half of the following year. El Niño is one extreme phase of the El Niño–Southern Oscillation (ENSO) – the opposite phase is called La Niña. While the key activity takes place in the tropical Pacific, El Niño events indirectly affect the climate across the globe.

How does CCRS monitor El Niño?

In 2018, under the Meteorological Service Singapore (MSS), CCRS developed a new monitoring system, or a set of criteria, to declare the ENSO state. There are five phases, ranging from La Niña to El Niño (Figure 2). "Neutral" indicates that neither El Niño or La Niña is present, while "Watch" indicates that conditions are close but not quite at either El Niño or La Niña states.

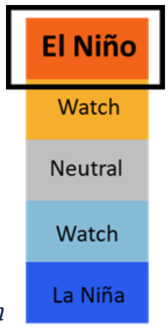


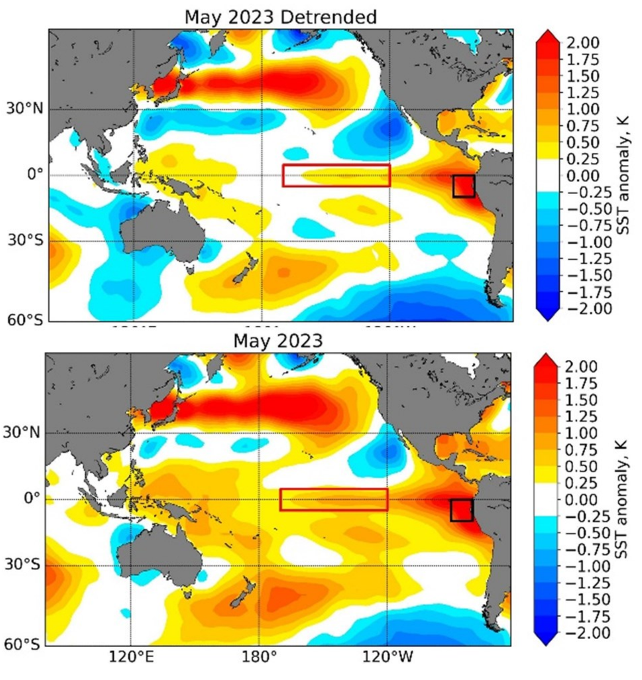
Figure 2 *The five phases in the Meteorological Service Singapore's ENSO monitoring system*

The ENSO states are based on observations and the ENSO outlook. Declaring El Niño conditions requires both observation-based ocean and atmospheric indicators to show signs of El Niño conditions, along with the duration of the conditions expected to be at least four months (which can be based on observations and the outlook).

How does CCRS account for background warming?

For sea surface temperatures (SSTs), as well as natural climate variability, CCRS also corrects for background warming. One of the most common SST indicators used to monitor ENSO is the Niño3.4 index (red box in Figure 3). The SSTs of the world's ocean have gradually increased over the last century under the influence of climate change. With this background trend, Niño3.4 will over time appear warmer than it should be. One way to account for this is to remove the long-term tropical warming trend from the observational data.

While removing the warming trend is only a small difference (up to around 0.3°C currently), it can be important in the developing phase of new El Niño/La Niña, or in weak/borderline cases. For example, in May 2023, SSTs were warm across the Pacific (Figure 3 lower). However, removing the background warming trend, the warming in the Niño3.4 is less pronounced and similar or less than in the western Pacific, which is not characteristic of El Niño (as shown in Figure 1). In the case of the eastern most part of the Pacific, SST anomalies are very warm in both upper and lower plots (indicative of what is termed "Coastal El Niño", which affects parts of South America).



There are often small differences between centres monitoring ENSO, as seen in 2023 with centres declaring El Niño conditions at different times of the year. These differences can be related to impacts (e.g. regions in the equatorial Pacific may be more sensitive to weak events) and the choice of datasets (observations and outlooks) and indices used. However, typically all centres agreed on the strong El Niño events (e.g. in 2015/2016)[2].

What does El Niño mean for Singapore and the region?

El Niño events are associated with drier and warmer conditions for Singapore. The biggest impact on Singapore's rainfall is typically during the Southwest monsoon season (June–September) as well as October, followed by the February–May period (often when El Niño events are weakening). During the November–January period, El Niño events have little impact on rainfall. As for temperature, El Niño events can bring warmer temperatures than usual at any time of the year, with warmest temperatures usually during the March–April period (a few months after the peak of the El Niño).

Looking forward, El Niño conditions are predicted to stick around until at least the start of 2024. After October 2023 though, El Niño is likely to have little effects on Singapore's rainfall until February 2024 (at which point it will depend on how long the El Niño conditions persist). Temperatures are likely to continue to be warmer than usual for any time of the year, with warmest temperatures likely after February 2024.

El Niño is not the only climate driver for rainfall across Singapore and the Southeast Asia (SEA) region[3]. Therefore, for the upcoming seasons, it is important to check out the seasonal outlook. CCRS produces a seasonal outlook for SEA via the SEA Regional Climate Centre -Network (https://www.mss-int.sg/sea-rcc-network/long-range-forecasting) and publishes a monthly El Nino update at http://www.weather.gov.sg/climate-el-la/. Week-to-week or day-to-day weather forecasts are available at http://www.weather.gov.sg.

Figure 3 *Sea surface temperatures (SSTs) in May – with the background warming trend removed (top) and without (lower). The red box shows the location of the Nino3.4 index, while the black box for the Nino1+2 index. Data: ERSSTv5*[1]

[1] The United States' National Oceanic and Atmospheric Administration (NOAA) Extended Reconstructed Sea Surface Temperature (SST) V5
[2] Read Dr Turkington's paper (doi.org/10.1002/joc.5864) for more details.
[3] Read MSS' Annual Climate Assessment Report 2021 (go.gov.sg/acar2021) for more details.

'Celebration of Earth System Modelling' Event

During the week of 9–13 October 2023, the Meteorological Service Singapore (MSS) hosted a series of meetings involving about 35 weather/climate modelling leaders from the international Unified Model[1] (UM) Partnership, together with CCRS' partners in Singapore's National Supercomputing Centre (NSCC). The early part of the week focused on the scientific and technical challenges, as well as opportunities for next-generation climate modelling (e.g. ultra-high resolution, coupled Earth System modelling, preparations for novel supercomputing infrastructures and the role of artificial intelligence in weather/ climate science). The latter part of the week focused on UM Partner Board's discussions on the future of the partnership as we move beyond the UM to next-generation modelling systems.

As the UM Partnership's newest core member, and to celebrate its 10th anniversary in 2023, CCRS organised a 'Celebration of Earth System Modelling' event on the morning of day 3 (11 October). Attended by about 100 participants from local universities, government agencies and international scientists, the event opened with a welcome address by MSS Director-General Wong Chin Ling. Following a scene-setting presentation by CCRS Director Prof Dale Barker, a series of insightful presentations from UM partnership leaders and Nvidia's Jeff Adie provided various views on the following topics:

- How national weather/climate services benefit from Earth system modelling
- The challenges and opportunities that lie ahead for Earth system Modelling, society and industry
- The importance of a coordinated, nation/multi-national approach to climate modelling

The event concluded with an insightful panel discussion moderated by CCRS Director Prof Dale Barker, followed by a networking session over lunch. CCRS will continue to catalyse exchange of ideas and insights among experts and practitioners locally, regionally and internationally.

Director-General of the Meteorological Service Singapore Ms Wong Chin Ling delivered the opening remark at the 'Celebration of Earth System Modelling' event on 11 October 2023.

Head of Science Partnerships of the UK Met Office Dr George Pankiewicz shared with audience about the Unified Model[1] Partnership, model applications, future challenges and next-generation modelling.

[1] One of the world's foremost climate/weather modelling systems, used in a range of weather/climate applications, including numerical weather prediction, seasonal prediction, and climate projections

Ignoring Internal Variability Can Lead to Misleading Conclusions on Model Performance

Dr Shipra Jain, Research Scientist
Seasonal and Subseasonal Prediction Branch,
Department of Climate Research

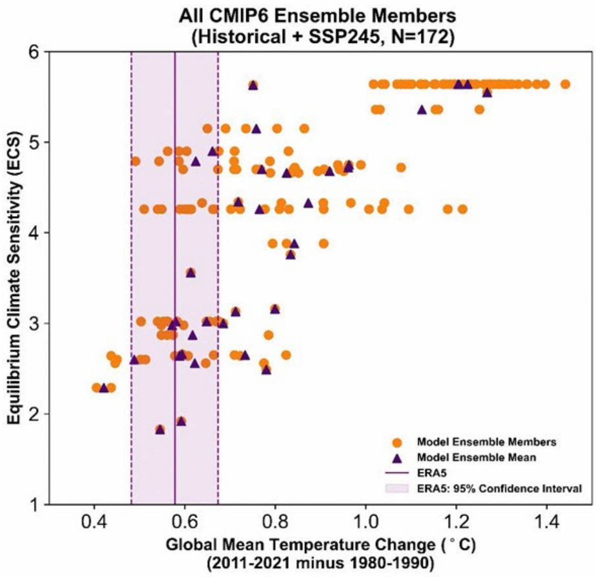
Prof Adam A. Scaife,
Principal Fellow and Head of Monthly to Decadal Prediction,
Met Office Hadley Centre, UK.
Professor, Faculty of Environment, Science and Economy,
University of Exeter, UK.

Climate models are built on fundamental laws of physics and mathematics. We can test their accuracy and gain confidence in model projections of the future by comparing model simulations with historical climate observations. This approach is also elemental to the further development and improvement of current climate models. However, if model simulated climate or trends do not match observations, should we necessarily conclude that our present models are deficient?

In this paper, using multiple illustrative examples, we emphasise that surprisingly basic features of observed climate can fail to match global climate model simulations simply due to the 'butterfly effect' – whereby a tiny change in the present weather conditions can drastically change the future outcome. We show that this can manifest as the inability of GCMs to simulate observed regional trends, extreme events, or changes in global teleconnections (e.g., El Niño-Southern Oscillation). One example is the recent global surface temperature trend in CMIP6[1] models. It has been argued that no global climate model with a climate sensitivity[2] greater than 3°C was consistent with observed trends since 1979 (Scafetta, 2022). However, this claim is based on comparing each model's ensemble mean change with an observational estimate (from 'ERA5'), without accounting for observational uncertainty or observational and model internal variability. When these elements are included and appropriate statistical tests are employed (Santer et al, 2008), most of the models with sufficiently large ensembles, even some of those with a climate sensitivity of 5°C, are consistent with observations (c.f. Schmidt et al. 2023).

Internal variability limits the power of the observation record as a test for climate models even when decades of observations are available. Internal variability has of course been explored as a reason for the discrepancies between modelled and observed climate for many important global-scale phenomena, but it is still often overlooked as an important cause of mismatch for regional features. While errors in GCMs certainly exist, we need to carefully compare observed climate with multiple realisations from models before concluding that even basic features of climate models are erroneous.

This paper was published by Jain et al. (2023) in Nature. Click here or visit https://doi.org/10.1038/s41612-023-00389-0 to read the full paper, including further details on the references quoted.



Global temperature change in climate models: Global surface temperature change (2011–2021 minus 1980–1990) from individual CMIP61 model simulations (n=172) (orange dots). Purple triangles show ensemble mean change from each model. The solid purple line shows the observed change (from ERA5) and the purple shaded region shows 95% uncertainty in observations. The distance of purple triangles from purple line shows the differences between modelled and observational temperature change. Figure adapted from Schmidt et al. (2023).

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

[2] Climate Sensitivity, typically, is the amount of global surface air temperature change, if the amount of carbon dioxide in the atmosphere is doubled as compared to the pre-industrial level.

Performance Evaluation of a Global Multi Wave Model Ensemble of Wave Climate Simulations

Dr Rajesh Kumar, Senior Research Scientist
Core Modelling Development Branch, Department of Weather Research

Ocean surface gravity waves, often simply called "waves", play a crucial role in the climate system as they interact with the atmosphere, sea ice and the underlying ocean. In conjunction with tides and storm surges, waves have a significant impact on coastal erosion, flooding and sediment transport. As a result, they can alter the shape of coastlines.

Satellite altimeter measurements indicate an increase in significant wave heights across the global ocean in recent years (Young et al., 2011). This upward trend is anticipated to persist under various greenhouse gas emission scenarios, impacting approximately 40% of the world's coastlines (Morim et al., 2019). As wave climate influences how high waves run up the coasts globally, it is advisable to incorporate wave setup considerations in studies that project coastal sea level. Thus, projections of changes in wave climatology are imperative in assessing the impact of climate change on both coastal regions and open seas. This knowledge is pivotal for mitigating the effects of climate change on maritime activities and offshore industries.

Despite recent advancements in the understanding and representation of waves in climate models, there remain uncertainties inherent to each wave model. Variations in the physics and parameterisations employed in different wave models provide a source of uncertainty when forecasting future wave climates. Surprisingly, the scientific literature has yet to address the uncertainty associated with different physics packages (that simulate physical processes in waves such as wave growth and decay due to wind, wave dissipation, wave scattering, etc.) in third-generation wave models like WAVEWATCH3 (WW3), WAM[1], and SWAN[2]. To address this gap, we conducted a study utilising a single forcing (EC-EARTH3) and a multi-wave model ensemble (WW3, WAM, and SWAN) to gain insight into intra-model uncertainties.

Collaborating with the IHE Delft Institute for Water Education in the Netherlands and the University of Lisbon in Portugal, we undertook a thorough evaluation of the uncertainty associated with the WW3 model. The uncertainties arising from the utilisation of various physics packages to model both current and projected future wave climates are detailed in the research conducted by Kumar et al. (2022). The WW3 model encompasses four ensemble members, each developed with distinct physics packages. Our primary objective was to gain insight into the ramifications of employing multiple source term parameterisations within the WW3 model for generating ensembles to project wave climates. Our findings revealed that the incorporation of diverse model physics in the wave model can introduce significant uncertainties within the wave climate ensemble. Furthermore, we expanded our ensemble through collaboration with the German Meteorological Service and Bursa Uludag University in Turkey. This collaborative effort involved the inclusion of one simulation from the WAM model and two additional simulations using the SWAN model, resulting in the development of a distinctive 7-member wave climate ensemble.

We conducted a comprehensive assessment of the dynamic wave climate simulations' accuracy in representing the current wave climate, involving a thorough comparison with long-term observational data and 'ERA5' reanalysis data, as detailed in the study by Lemos et al. (2023). We scrutinised various aspects, including the representation of extreme events and natural wave climate fluctuations, while also quantifying uncertainties between different model members.

The overall findings of this study suggested that the ensemble of simulations effectively captured the global wave climate. However, we emphasised the need for caution when incorporating multiple wave models and parameterisations within such ensembles, even when they were subject to the same forcing conditions. Notably, the study highlighted that ensemble spreads induced by model parameterisations during historical periods can be substantial, which posed challenges to the reliability of projected changes in wave characteristics as we looked ahead to the end of the 21st century, particularly in numerous regions across the global ocean.

Click here or visit https://doi.org/10.1016/j.ocemod.2023.102237 to access the full paper, including further details on the references quoted.

[1] WAM: Wave Model, a third-generation wave model developed by the Wave Model Development and Implementation Group
[2] SWAN: Simulating Waves Nearshore, a third-generation wave model developed by the Delft University of Technology

Seminar Series

CCRS hosts a regular seminar series to share research and development in areas of relevance to CCRS' activities, amongst our staff as well as with our collaborators. These seminars also serve to connect local and international researchers from the wider Earth system research community and provide avenues for discussions and collaborations on seminar topics. For more details of past and upcoming seminars, please visit http://ccrs.weather.gov.sg/ccrs-seminar-series/.

Previous seminars cover a broad range of topics, including sea-level research, climate change impact studies, air quality prediction, and urban impact on weather and climate. Below are some highlights of the seminars held in Q3 2023.

Title of seminar:
Urban climate downscaling: recent progress and challenges

Abstract:
Dr Doan Quang Van (University of Tsukuba, Japan) shared recent knowledge of urban climate change as well as urban climate prediction techniques with a particular focus on Asian megacities. He highlighted advancements in numerical modelling approaches with a land surface model-based downscaling method. He also shared the "paradigm" shift towards utilising big data technologies, data mining and artificial intelligence for urban climate prediction which enable better planning and policymaking to address the impacts of the global climate change crisis.

Title of seminar:
Building a climate-intelligent Singapore to withstand future hydrological extremes

Abstract:
Prof Xiaogang He (National University of Singapore) gave a talk to introduce the SgCALE (Singapore's Climate ArtificiaL intelligence Engine) platform to showcase how the power of artificial intelligence can be harnessed to improve our scientific understanding of Singapore's hydroclimate extremes, especially the drivers, risks and physical plausibility of very rare droughts (e.g. droughts that happen at a frequency of one in 10,000 years). The work is expected help Singapore boost its resilience to heightened drought and flood risks, mitigate their extreme impacts, and develop effective and actionable solutions towards sustainable development.

Events

NEA x AWS DeepRacer League 2023

On 7 July 2023, Team CCRS, comprising Dr Chen Chen, Dr Xin Rong Chua and Dr Jianjun Yu, emerged as the champion for the NEA x AWS DeepRacer League.

Organised by the National Environment Agency (NEA) and hosted by Amazon Web Services (AWS), the DeepRacer League is an autonomous vehicle competition for developers to showcase their machine learning skills by building and training autonomous driving models using reinforcement learning.

With an average time of 7.764 seconds, Team CCRS achieved top speeds that were comparable to larger global challenges.

CCRS scientists Dr Chen Chen (third from left), Dr Xin Rong Chua (middle) and Dr Jianjun Yu (third from right) won the NEA x AWS DeepRacer League with results that were comparable to larger global challenges. The award was presented by Mr Patrick Pang (Chief Technologist [ASEAN Public Sector] of the Amazon Web Services [AWS]; leftmost) and Ms Koh Li-Na (Assistant Chief Executive of the National Environment Agency [NEA]; second from left).

Symposium at the National University of Singapore

On 8 August 2023, the Meteorological Service Singapore (MSS) collaborated with the National University of Singapore (NUS) Department of Physics to organise the 'Why Study Climate Science?' symposium. MSS weather and climate experts presented on a number of topics, including what makes a good climate model and weather forecasting system, climate change over Singapore and Southeast Asia, and how it was like to be a meteorologist in Singapore.

The symposium ended with a panel discussion session where speakers answered questions on weather/climate science and shared opportunities for further student engagement with CCRS, which included internship and career opportunities. Contact us to find out more!

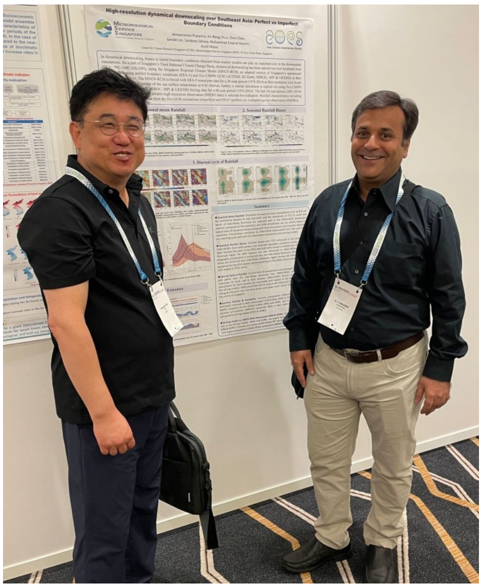
CCRS Senior Research Scientist Dr Song Chen giving a talk titled 'High-Resolution Urban Weather and Climate Modelling for Singapore' at the National University of Singapore.

Asia Oceania Geosciences Society 2023 Conference

On 31 July–4 August 2023, CCRS scientists convened four sessions and delivered 21 presentations at the Asia Oceania Geosciences Society (AOGS) conference held in Singapore. Held annually, the Conference provides opportunities for scientists to discuss and exchange scientific knowledge to address important geo-scientific issues in the Asia Oceania region.

Focusing on the Maritime Continent[1]-Southeast Asia (MC-SEA) region, CCRS scientists presented on a range of weather and climate research topics, including:

- Volcanic ash dispersion modelling system for SEA
- Vegetation fire and smoke pollution
- Numerical weather prediction for Singapore and the region: Evaluation of a new model science configuration, development of data assimilation methods, and forecast post-processing
- Representation of the urban boundary layer over Singapore in CCRS' ultra high-resolution 'uSINGV' urban model
- Regional weather and climate research e.g. sea-level trends at Southeast Asian coastal cities; linkage between rainfall changes to warming-induced Walker Circulation shifts and the Madden-Julian Oscillation; dynamical downscaling over SEA; and projections of cold surges from the latest global climate models
- Subseasonal to seasonal predictions for the region, such as evaluation of subseasonal predictions, and impacts of the Indian Ocean Dipole on SEA.



CCRS Senior Research Scientist Dr Prasanna Venkatraman presenting his work on high-resolution downscaling of climate projections over Southeast Asia at the Asia Oceania Geosciences Society (AOGS) 2023 Conference.

CCRS also welcomed participants of the AOGS Conference on 3 August for a tour of CCRS and the Meteorological Service Singapore's co-located Upper Air Observatory. The tour was followed by a sharing session about CCRS' tropical weather and climate research, and trends in Singapore's upper air vertical profile.

CCRS hosted participants of the AOGS 2023 Conference on 3 August 2023.

[1] The Maritime Continent covers the maritime portion of Southeast Asia, including Indonesia, Malaysia, Philippines and Singapore.

Capacity-building Programme in Subseasonal-to-Seasonal Prediction for Southeast Asia

On 22–24 August 2023, under the auspices of the ASEAN Specialised Meteorological Centre (ASMC), CCRS scientists organised the fourth workshop of the Capacity-building Programme in Subseasonal-to-Seasonal Prediction for Southeast Asia (S2S-SEA) held in Singapore. The opening and closing sessions were held virtually on 15 and 30 August, respectively.

The in-person S2S-SEA IV workshop was attended by 19 participants from nine ASEAN National Meteorological and Hydrological Services (NMHSs). Additional participants attended the virtual sessions.

ASEAN National Meteorological and Hydrological Services' representatives who attended the fourth workshop of the Capacity-building Programme in Subseasonal-to-Seasonal Prediction for Southeast Asia (S2S-SEA) in Singapore on 22–24 August 2023.

As the final workshop of the Programme, S2S-SEA IV workshop focused on product and service development on the S2S timescale (2 weeks to 2 months) with a particular focus on disaster risk reduction. The workshop also helped participants prepare subseasonal briefings using publicly available information, highlighting various ways to communicate effectively with end-users.

CCRS will continue to play its part in building S2S capacity and enhancing collaboration among the NMHSs in the SEA region.

CCRS Research Scientist Chen Schwartz delivering a talk titled 'Sources of Predictability on the Subseasonal-to-seasonal Timescales'.

A group discussion at the S2S-SEA IV workshop to enhance knowledge exchange, facilitated by CCRS Research Scientist Dr Shipra Jain (rightmost).

Media Highlights

In an interview with Meteorological Technology International, a UK magazine dedicated to covering technological advancements that help protect people and infrastructure from the worst effects of weather, Deputy Director of CCRS' Department of Climate Research Dr Aurel Moise shared how a multi-year Strategic Relationship Arrangement (SRA) between CCRS and Australia's Bureau of Meteorology (the Bureau) would provide a boost to tropical weather and climate research in the region.

Under the SRA, CCRS has initiated two projects with the Bureau—one aims to evaluate tropical processes and their relationships to extreme rainfall across Singapore, while the other focuses on developing an enhanced nowcasting system in the tropics.

Click here or visit https://www.ukimediaevents.com/publication/8cf6eceb/56 to find out more about the SRA and CCRS' other projects, such as the Third National Climate Change Study (V3).

Deputy Director of CCRS' Department of Climate Research Dr Aurel Moise, who was interviewed by Meteorological Technology International (a UK magazine), shared how the new Strategic Relationship Agreement between MSS and Australia's Bureau of Meteorology could provide a boost to weather/climate research in the region.

CCRS Deputy Principal Research Scientist Dr Muhammad Eeqmal Hassim was interviewed by Channel NewsAsia (CNA) in the CNA Insight programme 'Asia's Hottest Summer In 174 Years Of Records: Are We Prepared for More Heatwaves?'.

CCRS Deputy Principal Research Scientist Dr Muhammad Eeqmal Hassim shared with Channel NewsAsia (CNA) that the last eight years had been the hottest on record since 1850. The fact that 2021 and 2022, both under the influence of La Nina, were included in the top eight hottest years on record pointed to a larger underlying global warming trend. Dr Eeqmal further explained how the development of typhoons would be affected under a changing climate.

Click here or visit https://youtu.be/sESHxS-jxeQ to watch the full episode of CNA Insight programme 'Asia's Hottest Summer In 174 Years Of Records: Are We Prepared For More Heatwaves?'.

Staff Spotlight

Joshua Lee
Branch Head

As the Head of CCRS' Numerical Weather Prediction (NWP) Branch under the Department of Weather Research, I lead a team of research scientists to develop, deploy and maintain CCRS' in-house weather prediction configurations, including a real-time nowcasting system and an operational NWP system called 'SINGV-DA'. We also build and deliver tailored NWP products for stakeholders such as the Meteorological Service Singapore's (MSS) operational weather forecasters.

My research focuses on data assimilation, the process of combining observational information with prior information to get a best estimate of the starting point to begin a weather forecast. Apart from testing the use of new observations in SINGV-DA, I also implement advanced data assimilation methods which leverage multiple weather forecasts to provide better prior information. I am currently working with collaborators from the Data Assimilation Research Centre in the University of Reading to improve the mathematical formulation of an advanced data assimilation method and applying it over Southeast Asia. On the side, my team and I also dabble with machine learning to explore its potential for improving nowcasting and the creation of NWP products.

Before joining CCRS in September 2018, I was at the University of Reading for my postgraduate studies, focusing on a tropical weather phenomenon known as the Madden-Julian Oscillation. I was interested in whether it could help predict the weather conditions over Europe two weeks in advance.

Apart from research, I am involved in organising and lecturing for NWP training workshops for National Meteorological and Hydrological Services in the Southeast Asia region under the auspices of the ASEAN Specialised Meteorological Centre (ASMC). I also liaise with NWP model developers across an international consortium, the Unified Model Partnership, to collaborate and share best practices.

NWP is a challenging but exciting domain which has the potential to drive many downstream systems in Singapore and inform decision-making. Through engagement with stakeholders, my team and I hope to improve Singapore's weather forecasts and drive NWP use cases.

Dr Pavan Harika Raavi
Research Scientist

I joined CCRS' Climate Projections and Extreme (CPE) Branch under the Department of Climate Research as a Research Scientist in April 2023. I am now part of a team that is actively engaged in Singapore's Third National Climate Change Study (V3). The V3 study is significant as it focuses on exploring climate change trends in Singapore and aims to provide valuable insights for Singapore's future climate to inform adaptation planning and implementation.

As a member of the V3 team, I am primarily responsible for disseminating crucial research findings related to climate change projections in future climates and associated extreme weather events. My current role involves in-depth analysis of state-of-the-art high-resolution regional climate model simulations, specifically focusing on Singapore and various Southeast Asia nations.

In my previous research, I delved into the complex interplay between extreme weather events and climate change. I specifically focused on unravelling the intricate mechanisms that govern the formation of extreme events, such as tropical cyclones, and how the frequency and intensity of these events are impacted by changes in the global climate. This investigation encompassed a wide array of climate model simulations that covered various timeframes, including the past (paleoclimate), present and future climate scenarios.

My research findings contribute significantly to our understanding of how climate change influences extreme weather events. This knowledge is paramount for enhancing our ability to predict, adapt to and mitigate the effects of such events in an evolving climate.

For other staff profiles, please visit http://ccrs.weather.gov.sg/our-people/.

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