2023 CCRS seminar summary

1. 18/1/2023 11AM-12PM

Presenter: Nandini Ramesh (CSIRO)
Title: Autumn Monsoons: A Newly Discovered Climate Type
Abstract: Over most tropical land areas, the annual peak in precipitation occurs during summer, associated with the local monsoon circulation. However, in some coastal regions in the tropics the bulk of annual precipitation occurs in autumn, after the low-level summer monsoon westerlies have abated. Examples include the Nordeste region of Brazil, southeastern India, parts of the Malay Peninsula, and coastal Tanzania. Unlike equatorial regions, they receive little rainfall during local spring. Such areas are present along the eastern coasts of nearly all continents, suggesting that they comprise a coherent yet previously unrecognized global phenomenon. In this talk, I will show that these regions, which have previously been treated as independent regional anomalies, display several common characteristics, and explore a few hypotheses to explain the emergence of this unique "autumn monsoon" seasonal cycle along eastern coastlines across the global tropics.

2. 22/2/2023 11AM-12PM

Presenter: Xiangzhong Luo (NUS)
Title: Climate change impacts on global photosynthesis: perspectives from cross scale observations
Abstract: Vegetation photosynthesis is the largest carbon flux in the global carbon cycle, removing CO2 from the atmosphere and contributing to climate change mitigation. Meanwhile, climate change, characterized by elevated CO2 concentration, rising temperature, and shifted rainfall, has caused considerable changes in global photosynthesis, though the magnitude - and even sometimes the direction - of the change are uncertain. In this talk, I will introduce our recent works in quantifying the response of vegetation photosynthesis to climatic drivers over short and long terms, using multiple observations across spatial scales (i.e., leaf traits, eddy covariance, remote sensing, atmospheric CO2 observation), as well as process-based land surface models and ecological theories.

3. 8/3/2023 11AM-12PM

Presenter: Keith Williams (UK Met Office)
Title: Met Office Research under WCSSP SE Asia
Abstract: The Weather and Climate Science for Services Partnership (WCSSP) is developing a global network of partnerships that harness the weather and climate scientific expertise of UK and partner countries to strengthen the weather and climate resilience of vulnerable communities around the world. The SE Asia project currently involves scientists in Malaysia, the Philippines, Indonesia and Vietnam undertaking collaborative research with scientists in the UK with the aim of advancing the ability to save lives and livelihoods. This presentation will summarise the work being undertaken at the Met Office under two of the project's work packages – "Understanding large scale processes" and "Development of modelling systems for use over SE Asia". The Met Office contribution is focussed around the Unified Model and recent work & plans evaluating large-scale processes for the SE Asia region, researching convective scale modelling for the tropics, developing parametrizations and exploring convective-scale model initialisation will be discussed.

4. 22/3/2023 11AM-12PM

Presenter: Jenny Weeks (UK Met Office)
Title: The Evolution of Sea-level Projections and Future Sea-level Rise in Southeast Asia
Abstract: The methods used to generate process-based global and local mean sea-level projections have evolved substantially over the last fifteen years, including improved process understanding,

advances in ice-sheet modelling, the use of emulators and further development of high-end scenarios. This talk will present an evolution of process-based local mean sea-level projections for the UK and for Southeast Asia, comparing projections and their methods generated using two approaches: (1) UK Climate Projections 2018 (UKCP18) (available to 2300), where projections are rooted in Coupled Model Intercomparison Project Phase 5 (CMIP5) models and in methods used in the Intergovernmental Panel on Climate Change (IPCC) Fifth Assessment Report (AR5); and (2) IPCC Sixth Assessment Report (AR6) (available to 2150), where projections are rooted in CMIP6 models. Understanding decadal-to-centennial future sea levels across Southeast Asia is important due to the region's densely populated and low-lying coastlines. Relative sea level change in Southeast Asia is complicated by tectonic activity and/or intensive groundwater extraction leading to Vertical Land Movement (VLM). Comparisons between the two approaches reveal the projections are broadly consistent, but the representation of VLM component in studies can lead to significant differences in projected relative sea-level at a given location (e.g. ~30cm at Sembawang, Singapore). Alongside scientific advancements in generating process-based sea-level projections, there has been an increasing need to improve the utility of projections in coastal adaptation planning and decision-making. This talk will also demonstrate a framework in which physically consistent high-end storylines can be generated for locations in Southeast Asia. This allows for a pragmatic approach to high-end sea-level rise where risk tolerances and decisions made in Southeast Asia may vary considerably over the coming centuries.

5. 5/4/2023 11AM-12PM

Presenter: Shilpa Manandhar (ASTAR)
Title: Precision Time Driven Solution for an Accurate Estimation of GNSS Signal Delays for Meteorological Applications
Abstract: Singapore is a tropical island which often experiences heavy convective rainfall events. There has been continued research on accurate estimation and prediction of rainfall events. Prediction of rising sea-levels is another interesting and challenging research area. Weather stations and Radars are few of the technologies that are currently used in gathering data for these purposes. However, Weather stations are limited by its spatial resolution and the Radars have poor vertical resolution and are also expensive solution to be implemented at multiple locations. To counter such challenges, our cutting-edge approach is to use GNSS signals, which has higher spatial coverage and is cheaper technology, to estimate the water vapor content of the atmosphere and hence use it in climatological applications like prediction of rainfall and sea-level heights. The approach has already shown to work well with more that 85% of true detection rate for rainfall prediction [1-2]. Here, the accuracy of the GNSS signal delays play an important role in determining the prediction results. Hence our focus at NMC, A*STAR is to better estimate the GNSS signal delays. We have identified, the GNSS receiver clock bias errors as one of the significant parameters in deteriorating the accuracy. The receiver clock bias error is related to the receiver clock stability. For a receiver with crystal oscillators (cheap), which have lower stability compared to atomic clocks (expensive), the clocks drift with temperature over a period of time, and hence the clock bias error increases. The increment in the clock bias results in an additional distance between the satellite and a receiver. This in turn affects the range and hence the GNSS signals. To improve this, our centre is conducting research to use the precision timing information from our time & frequency lab. The precision time is being generated by a highly maintained fountain of atomic clocks (Caesium clocks and Hydrogen Maser). The goal is to disseminate the precision timing information to the mobile GNSS receivers stationed at multiple locations and continuously monitor the GNSS signals to apply it for different meteorological applications. Moving forward, the precision timings will be based on optical clock standards, which is currently being developed in NMC. Optical clocks have better performance compared to the current atomic clocks, which will help to further improve prediction results.

6. 12/4/2023 2PM-3PM

Presenter: Takemasa Miyoshi (RIKEN)
Title: Big Data Assimilation Revolutionizing Numerical Weather Prediction Using Fugaku
Abstract: At RIKEN, we have been exploring a fusion of big data and big computation in numerical weather prediction (NWP), and now with AI and machine learning (ML). Our group in RIKEN has been pushing the limits of NWP through two orders of magnitude bigger computations using the previous Japan's flagship "K computer". The efforts include 100-m mesh, 30-second update "Big Data Assimilation" (BDA) fully exploiting the big data from a novel Phased Array Weather Radar. With the new Fugaku, we achieved a real-time BDA application to predict sudden downpours up to 30 minutes in advance during Tokyo Olympics and Paralympics. Moreover, Fugaku is designed to be efficient for both double-precision big simulations and reduced-precision ML applications, aiming to play a pivotal role in creating super-smart "Society 5.0." We have been exploring ideas for improving the predicting capabilities by fusing BDA and AI. The data produced by NWP models become bigger and moving the data to other computers for ML or even simply saving them may not be feasible. A next-generation computer like Fugaku may bring a breakthrough toward creating a new methodology of fusing data-driven (inductive) and process-driven (deductive) approaches in meteorology. This presentation will introduce the most recent results from BDA experiments, followed by perspectives toward DA-AI fusion and expanding new applications beyond meteorology.

7. 13/4/2023 11AM-12PM

Presenter: Ken Mylne (UK Met Office)
Title: Met Office current status and future plans for exploiting ensemble NWP and postprocessing
Abstract: The Met Office has been investing in the development of ensemble forecasting and the generation of calibrated probabilistic forecasts (e.g. using the IMPROVER post-processing system) for many years. Ensembles now use a large proportion of our investment in HPC (High Performance Computing). The science is well-proven and there is extensive evidence that the probabilistic forecasts from ensembles are more skilful than deterministic models, offering higher information content to support better decisions by users. As a result, the decision has been taken that at the next major NWP system upgrade on our new HPC system we will move to an Ensemble-only NWP system. Ensemble resolutions for both global and UK convective-scale forecasting will be increased to our current deterministic resolutions, and we will cease to run separate higher-resolution deterministic models. Despite this progress, the uptake of probabilistic forecasts in products and services is still relatively low. Recognising this, the Met Office has launched a corporate-wide "Strategic Action" on Ensemble Exploitation to focus priorities right across the organization, from model development through operational tools and into customer services, to ensure we pull through the benefits of the huge investment in HPC resources into better decisions which help people stay safe and thrive. In this talk I will outline some of the science capabilities and plans for future operations, but will focus mostly on the strategic action. We have identified six distinct use cases for ensemble forecasts, different ways in which ensembles can be used to aid decision-making. Alongside the "traditional" use of probabilities, research is investigating how the ensemble can be used to generate different scenarios or "story-lines" to communicate the forecast message, including tools to help the operational meteorologist. There is extensive research evidence that people can make good use of forecasts incorporating uncertainty information and make better decisions with them, but a major obstacle to exploitation remains the widely-held believed that "People don't understand probabilities". Another important strand of the strategic action is the development of training to help staff right across the organization understand the opportunities offered from ensembles, how to diagnose the best information from them and how to communicate this to their customers so that the benefits can be realised.

8. 24/4/2023 10AM-11AM

Presenter: Timothy Brown (AWS)

Title: Weather and Climate Modeling using AWS HPC Cloud
Abstract: The use of cloud computing technologies within HPC has grown considerably over the last few years coupled with the demand for higher resolution weather and climate modeling. This has created an exponentially higher demand for performant, elastic, flexible, and reliable distributed computing resources that AWS HPC is well positioned to serve. In this talk, we will present best practices for running weather and climate modeling on AWS, and show how new users can get started in an environment they're familiar with. We will conclude with experiences on scaling models from key customers. References: https://aws.amazon.com/blogs/hpc/best-price-performance-for-nwp-on-aws/

9. 10/5/2023 11AM-12PM

Presenter: Pavan Harika (CCRS)
Title: Simulating tropical cyclones: Past, present, and future climates
Abstract: A major uncertainty in future projections of tropical cyclone (TC) frequency is due to inadequate understanding of the atmospheric mechanisms leading to a reduction in the TC formation in warmer climates. Although the recently proposed "marsupial pouch theory," of TC formation indicates that a semi-enclosed recirculating region known as a "pouch" within large-scale disturbances provides necessary conditions for TC formation, it is important to link the frequency of the pouch environments to the evolving climate conditions. Therefore, in my PhD research work I have examined the changes in the marsupial pouch TC formation environments and their relationship to the large-scale environmental conditions in the current climate and idealized warmer climates using global climate model simulations (ACCESS 1.3). According to high-resolution climate model simulations, the intensity of the tropical cyclones (TCs) is expected to increase in response to greenhouse warming. However, how climate change will affect TC frequency, tracks and propagation speed is still under debate. To further elucidate the underlying sensitivities, in my postdoc I have studied the response of TCs to a variety of past and future climate forcing. Using a high-resolution TC-resolving global earth system model (CESM -1/4-degree atmosphere, 1/10-degree ocean resolution), we conducted a series of century-long paleo-snapshot and future greenhouse warming simulations targeting the last interglacial period (MIS5e, ~125 ka), glacial sub-stage (MIS5d, ~115ka), present-day, pre-industrial, CO2 doubling and quadrupling climate conditions. Changes in TC genesis and intensity during the past and future warm climates can be attributed to changes in tropospheric thermal and moisture structure. The presentation will also document the validity of the GPI index as an estimator of TC genesis changes under a wide range of climate conditions.

10. 17/5/2023 11AM-12PM

Presenter: Paromita CHAKRABORTY (CCRS)
Title: Assessment of the medium range weather forecasts using Unified model based global ensemble prediction system
Abstract: An ensemble forecast provides an estimate of the forecast probability distribution of model variables, given an estimate of the probability distribution of analysis errors. The ensemble prediction system (EPS) based on Met Office Global and Regional Prediction Systems (MOGREPS) at NCMRWF is assessed in this study. The global perturbation fields for wind, temperature, humidity and pressure are produced by the Ensemble Transform Kalman Filter method. The representativeness of the EPS is analyzed from the distribution of initial and forecast ensemble dispersion over different seasons. The number of members in an ensemble determines how well a probability distribution of a weather-related variable can be estimated by the ETKF. Increasing ensemble size is desirable but involves computational cost. Having a small ensemble size limits the cost and makes other improvements feasible, such as an increase in spatial resolution. The impact of ensemble size and resolution on forecast performance is examined for the global EPS. Rainfall forecasts during the Indian summer monsoon (ISM) are always of great interest because of their socioeconomic impact on the Indian

subcontinent. Verification metrics enables quantifying forecast uncertainty, necessary to build confidence in using probabilistic forecasts. The improvement of the ensemble mean to single control forecast is also examined during ISM using deterministic metrics along with a detailed verification of NEPS in a probabilistic framework.

11. 31/5/2023 11AM-12PM

Presenter: Hailin Yan (CCRS)
Title: Software Development Practices on HPC Systems: Progress and Challenges
Abstract: High performance computing (HPC) is the cohesive part of modelling for weather forecast and climate prediction. In this talk I will start with my working experiences on HPC systems at CSIRO and the Bureau of Meteorology of Australia. Portability and scalability of scientific modelling and simplifying the application to run the modelling system are the challenges to the scientific modelling systems on HPC. I will talk about the software components and tools for parallel computing on HPC and the cause of portability problem, and Rose/cylc utilities that aim to simplify developing and managing workflow of scientific application suites. Due to the cloud computing's high availability and scalability, HPC is expanding beyond the on-premises and into clouds. HPC in cloud is rapid developing, and various cloud HPC options are available. Portability is still a challenge to use HPC in clouds for scientific modelling. I will talk about the containerization on HPC in clouds to meet the requirement of portability and use JEDI as an example to show the portability of container without loss of computing performance. I will mention LFRic/Psyclone that is developed at Met Office for the next generation modelling system to have improved portability and scalability adaptable to the next generation HPC systems. Finally, I will touch on the code management tool Git, and some challenges we face in the hybrid HPC environments.

12. 12/6/2023 3PM-4PM

Presenter: Ted Shepherd (University of Reading)
Title: The storyline approach to the construction of climate information at the local scale
Abstract: The standard approach to the production of climate information is probabilistic in nature, with quantified uncertainties. There is a growing awareness of the limitations of this approach from the perspective of practical useability for decision-making, which has led to the emergence of more narrative-based or 'storyline' approaches. In this talk I will explain the rationale behind the storyline approach to the construction of climate information at the local scale, and discuss how it can be used to frame climate evidence in the context of adaptation.

13. 14/6/2023 11AM-12PM

Presenter: Kalli FURTADO (CCRS)
Title: Clouds, climate and monsoons
Abstract: The representation of cloud processes is fundamental to many of the systematic uncertainties and biases found in weather predictions and climate projections. In this talk, I will give some examples of recent advances in understanding the role of clouds in several areas including rainfall errors in numerical weather predictions, cloud-aerosol interactions, biases in the global-monsoon system, and the Earth's climate sensitivity. For each of these examples, I will demonstrate an approach to reducing biases or better constraining uncertainties by identifying influential cloud processes. The approaches used will encompass the development of new parametrizations, the use of Perturbed Parameter Ensembles, and the discovery of emergent constraints.

14. 21/7/2023 2PM-3PM

Presenter: Siwei Li (Wuhan University)
Title: Remote sensing of troposphere aerosols and ozone

Abstract: Using satellite observation data to retrieve atmospheric pollution parameters has become more important common and important in the field of air pollution in nowadays. With the increased spectra bands and resolution of satellite sensors, there are more atmospheric pollution parameters with better spatial, temporal resolution and higher accuracy can be obtained from satellites. This study introduces the new developed algorithms retrieving aerosols and ozone from satellites. The aerosol retrieval algorithms produce high spatial (highest is 30m) and temporal resolution of aerosol optical depth, PM2.5 for urban pollution investigation and moderate resolution of single scattering albedo for atmospheric optics and aerosol composition investigation. The ozone algorithm could obtain accurate spatially continuous surface ozone. Moreover, the new algorithm shows outstanding spatial transferability, which had been a critical challenge for machine-learning models on surface ozone estimation.

15. 26/7/2023 11AM-12PM

Presenter: Hanh Nguyen (BoM)
Title: Equatorial waves and Sumatra squall lines
Abstract: The weather and climate of the Maritime Continent, including Singapore, is influenced by a wide range of tropical climate drivers including the El-Niño Southern Oscillation (ENSO), the Indian Ocean Dipole (IOD), the Madden-Julian Oscillation (MJO), and equatorial wave activity. In Singapore the rainfall pattern is often characterised by episodes of short strong rainfall bursts which are dominated by mesoscale convective systems such as Sumatra squall lines, and often lead to local flash floods and strong wind bursts. Here we investigate the impact of equatorial tropical waves on the Sumatra squalls over Singapore. The NOAA Interpolated Outgoing Longwave Radiation (OLR) and GPM IMERG V06 precipitation dataset spanning from 2000-2020 is used to extract equatorial waves by filtering for the Wheeler and Kiladis (1999) wavenumber-frequency domains. Then, archives of the Sumatra squalls dataset will be assessed against the passage of equatorial waves over the region in order to identify their potential co-occurrence and interaction.

16. 26/7/2023 4PM-5PM

Presenter: Estelle De Coning (WMO)
Title: The next five years of the World Weather Research Programme (WWRP): Research Supporting Early Warnings for All
Abstract: As WWRP enters its twenty-fifth year, people all across our planet face unprecedented extremes and there is every reason to believe these events will continue to accelerate, affecting vulnerable populations. During the period of WWRP's previous Implementation Plan, 2016–2023, major advances have been achieved in science, community building, research capacity building and stakeholder engagement. Building on these success stories as well as on the guidance provided by the United Nations Sustainable Development Goals, the Sendai Framework, WMO Strategic Plan for 2024–2027, the call for Early Warnings for All by the UN Secretary-General, the WMO Regional Reform as well as the Research Board, the WWRP will embrace a versatile scientific portfolio integrated with the needs of actors representing diverse constituencies. The new Implementation Plan for 2024-2027 plan, WWRP will continue scientific threads from major projects that are ending, expand into new areas such as hydrology, and tighten the linkage between the working group expertise within WWRP as well as partner organizations across WMO, and external to WMO. These science areas will include polar regions, S2S predictions for agriculture, water management and energy, integrated hydrology and meteorology to address flooding, and interdisciplinary science to benefit urban communities. WWRP will have a stronger focus on social science in all new projects, to ensure that the needs of users are taken into account in the design of new projects. It is envisaged that each new project will have two co-chairs – one physical and one social scientist. WWRP will also work with our early career scientists to help ensure that the next generation of leading scientists is given all the tools and experience they need to continue this vital work.

17. 27/7/2023 2PM-3PM

Presenter: Yuriy Kuleshov (BoM)
Title: Climate Risk and Early Warning Systems (CREWS) for Pacific Island Nations
Abstract: This talk will briefly describe CREWS, with focus on developing drought Early Warning System for Papua New Guinea. The talk will also cover the WMO Space-based Weather and Climate Extremes Monitoring (SWCEM) East Asia and Western Pacific regional subproject, which is an important contributor to CREWS.

18. 1/8/2023 10AM-11AM

Presenter: Steven Sherwood (UNSW)
Title: Assessment of Equilibrium Climate Sensitivity in CMIP6 models
Abstract: I will briefly review the 2020 equilibrium climate sensitivity assessment that finally narrowed the range of likely ECS, explaining how this happened and what the issues are. I will then discuss some more recent studies claiming to change the distribution, and give an overall assessment of movement since then. Finally I will touch on issues related to using CMIP ensembles whose ECS sample distribution differs from the PDFs that have been obtained from observational constraints, noting topics like model selection/weighting, processes reportedly contributing to high ECS in some models. I will conclude with a discussion of what promise I think there is for further narrowing of the distribution.

19. 24/8/2023 3PM-4PM

Presenter: Doan Quang Van (University of Tsukuba)
Title: Urban climate downscaling: recent progress and challenges
Abstract: Cities, accommodating more than half of the world's population, have faced significant risks due to climate extremes, such as heat waves, flooding, and drought. The rising global average temperature has led to profound changes in weather and climate patterns worldwide, posing a major challenge and threat to humanity. As urbanization continues in many regions worldwide, it becomes imperative to base their development on relevant climate information to ensure resilience against climate hazards. This presentation will delve into recent knowledge of urban climate change as well as urban climate prediction techniques with a particular focus on Asian megacities. The talk will highlight advancements in numerical modeling approaches with a land surface model-based downscaling method, and the “paradigm” shift towards utilizing big data technologies, data mining, and artificial intelligence for urban climate prediction which enabling better planning and policymaking to address the impacts of the global climate change crisis.

20. 7/8/2023 11AM-12PM

Presenter: Anurag Dipankar(ETH)
Title: Visualizing Earth
Abstract: The modern exascale computing systems have given the climate and weather modeling community an opportunity for a step change in the simulation capabilities. One expects the resolution to be high enough to resolve the key atmospheric processes, provided the machine is utilized correctly. However, this is a non-trivial task. Given the complexities at various levels, from the hardware to the software (model), a close collaboration between computer scientists, software engineers, and domain experts is required to redesign the conventional model to fully utilize the exascale capabilities while keeping the model easy to use. Together with other European partners, EXCLAIM is developing a Python-based framework that allows users to write code, debug, run the model, and visualize from within the framework. Computations are largely handled by the embedded Domain Specific Language, GT4Py, whereas the driver code is envisioned to be in Python. This

approach decouples the hardware-specific implementation choices made for efficiency from the functional decisions by the domain experts. The framework is expected to allow for interoperability with software components developed in other programming languages or other frameworks. The talk will give an overview of the framework, the progress we have made in the last years, and the challenges we have encountered.

21. 8/8/2023 11AM-12PM

Presenter: Tsung-Lin Hsieh (Princeton Univ.)
Title: Tropical cyclone frequency in the future: the source of uncertainty and its connection with climate sensitivity in global climate models
Abstract: The future projection of tropical cyclone frequency is highly uncertain. Estimates derived from global climate models range from a 10% decrease to a 5% increase per Kelvin of mean surface warming. In this talk, I will discuss the crucial role of tropical cloud response in determining the model spread of tropical cyclone projections. To this end, I will introduce a downscaling formula known as the seed propensity index, which characterizes how tropical cyclone precursors change with the large-scale circulation. This index is derived from a combination of vorticity dynamics and energy balance theory. We validate the theory in a hierarchy of models from idealized aquaplanets to realistic climate model simulations and show that it applies across a wide range of climates and models. We then apply the theory to show that atmospheric radiation related to clouds can alter the tropical cyclone response using the radiation override technique. Lastly, we examine the relationship between tropical cyclone response and climate sensitivity in CMIP6 models, showing a negative correlation stemming from their interconnection with tropical cloud response.

22. 11/8/2023 10AM-11AM

Presenter: Zhiquan Liu (NCAR)
Title: Towards km-scale NWP using MPAS and MPAS-JEDI
Abstract: The Model for Prediction Across Scales – Atmosphere (MPAS-A) is NCAR/MMM's new-generation global-/regional-unified non-hydrostatic atmospheric model discretized on unstructured grids. MPAS-JEDI is MPAS-A's data assimilation system based upon the Joint Effort for Data assimilation Integration (JEDI) software framework. In this talk, I will firstly introduce the main features of MPAS-A as a standalone model and ongoing development activities, including MPAS-A's coupling with other earth system model's components through the Community Earth System Model (CESM) for climate applications. The rest of my talk will focus on MPAS-JEDI, beginning with the introduction of the implementation of deterministic and ensemble data assimilation schemes and the assimilation of various observations, including those from satellite platforms, and then followed by performance demonstration with global and regional cycling experiments, configured at different resolutions (up to convection-permitting setting). Challenges and opportunities for applying MPAS and MPAS-JEDI in km- and sub-km-scales will be discussed.

23. 16/8/2023 11AM-12PM

Presenter: Nathanael Wong (Harvard Univ.)
Title: Bridging the Gap between the Theory of the Weak Temperature Gradient and its Potential Applications to Modelling the Islands of Southeast Asia
Abstract: The weak-temperature gradient (WTG) approximation has been a popular method used to couple convection in limited-area domain simulations to the large-scale dynamics. Three major implementations that use the WTG approximation have gained popular use over the past two decades - the (1) Temperature Gradient Relaxation implementation, its (2) Spectral equivalent and the (3) Damped Gravity Wave implementation. A comparison of these different WTG implementations in an idealised framework result in different model behaviour, and further investigation shows that the ratio of the strengths of the baroclinic modes is important in determining if multiple-equilibria states are

obtained under different WTG implementations. I will also show how I plan to use the WTG approximation to investigate how islands interact with local climatology with parameterization of the large-scale circulation, along with some preliminary results.

24. 16/8/2023 4PM-5PM

Presenter: Adam Scaife (UK Met Office)
Title: Research Topics in Long Range Forecasting at the Met Office
Abstract: We show some recent highlights from the research and operational activities in long range forecasting at the UK Met Office. The Met Office Global Seasonal (GloSea) forecast system provides skilful forecasts of both the tropics and extratropic on seasonal timescales and we show some examples of real time climate services. We also show examples of our underpinning research on extratropical teleconnections to ENSO, the finding that prediction systems tend to underestimate the amplitude of extratropical forecast signals and emphasize the need for large ensembles in order to generate skilful extratropical forecasts.

25. 17/8/2023 11AM-12PM

Presenter: Ray Chew (Goethe University Frankfurt)
Title: Balanced data assimilation with a blended numerical model
Abstract: Physical imbalances introduced by local sequential Bayesian data assimilation pose a problem for numerical weather prediction. For example, fast-mode acoustic imbalances of the order of the relevant slower dynamics destroy solution quality. We introduce a novel dynamics-driven method that suppresses imbalances arising from data assimilation. Specifically, we employ a blended numerical model with seamless access to compressible, soundproof, and hydrostatic dynamics. After careful numerical and asymptotic analysis, we introduce a one-step blending strategy to switch between model regimes within a simulation run. Upon assimilation of data, the model configuration is switched for one timestep to the limit soundproof pseudo-incompressible or hydrostatic regime. After that, the model configuration is switched back to the compressible regime for the duration of the assimilation window. The switching between model regimes is repeated for each subsequent assimilation window. Idealised experiments involving the travelling vortex, buoyancy-driven rising thermals, and internal gravity wave pulses demonstrate that our method successfully eliminates imbalances from data assimilation, yielding up to two orders-of-magnitude improvements in the analysis fields. While our studies involved eliminating acoustic and hydrostatic imbalances, this novel dynamics-driven method of achieving balanced data assimilation can be extended to eliminate other undesired imbalances, with significant prospective applications in real-world weather prediction.

26. 25/8/2023 11AM-12PM

Presenter: Lewis Blunn and Jon Shonk (UK Met Office)
Title: Urban-scale Modelling Progress at the Met Office
Abstract: The Met Office has a strategic aim, as part of the Research and Innovation strategy, to develop atmosphere and land models with order 100m grid length, often referred to as “Urban-scale” or hectometric models. Many of the potential benefits of Urban-scale models will relate to improved representation of urban areas. To realise these benefits there is the requirement for development of new parametrisations, diagnostic tools (e.g., heat stress), and model evaluation techniques, and the inclusion of high-resolution input datasets (e.g., land cover) and optimisation of model configurations. Lewis Blunn and Jon Shonk are visiting Singapore on their way to the 11th International Conference on Urban Climate (in Sydney), where they will be presenting their Urban-scale modelling work. This seminar will be a preview with four short presentations titled: • Can machine learning models trained using crowdsourced observations and high-resolution land cover be used to downscale extreme heat forecasts in urban areas? •The importance of land cover in O(100 m) grid length numerical weather prediction – a Pearl River Delta urban mega-conglomeration heat wave case

study • Progress towards implementing a vertically distributed urban canopy in the Met Office Unified Model •Utility of thermal remote sensing for evaluation of a high-resolution weather model in a city

27. 25/8/2023 4PM-5PM

Presenter: Andrew Robertson (IRI)
Title: Some examples of IRI subseasonal to seasonal climate forecast products
Abstract: The talk will draw on examples from IRI's Seasonal and Subseasonal precipitation and temperature global forecast Maprooms, capacity building tools for NMHSs in the global south, along with a seamless S2S weather regime forecast tool for forecaster and water resources guidance over the western U.S.

28. 13/9/2023 11AM-12PM

Presenter: Youngil Kim (UNSW)
Title: Comprehensive bias correction of regional climate model boundary conditions for simulation of hydrologic extremes
Abstract: Extreme events, such as droughts and storms, typically arise from complex interactions among atmospheric variables across time and space, often spanning significant durations that directly affect water resource management. Although global climate models (GCMs) have demonstrated their ability to capture precipitation patterns at daily or longer time scales, their applicability is limited when it comes to regional or hydrological catchment scales due to their coarse spatial and temporal resolution. To address these limitations, regional climate models (RCMs) have been developed to downscale climate fields, utilising input boundary conditions derived from GCM datasets. However, substantial errors in the forcing fields raise doubts about the reliability of model simulations. Therefore, correcting such input fields necessitates alternative modelling techniques that can identify the need for correction. The primary focus of this research is to enhance the representation of high-impact hydrologic extremes through RCMs by utilising carefully designed and comprehensive bias-corrected boundary conditions. To bridge the scale gap and mitigate systematic biases even in short-term periods, a sophisticated alternative for bias correction has been developed. In summary, this research demonstrates substantial improvements in the simulation capabilities of regional climate models, thereby enhancing water security and enabling more accurate forecasting of extreme events under climate change.

29. 20/9/2023 11AM-12PM

Presenter: Neil Cliffe (QLD)
Title: Connecting forecasters with end users to improve the usefulness of climate information in decision making
Abstract: Neil Cliffe is the manager for the Drought and Climate Adaptation Program, Dept of Agriculture and Fisheries, Queensland Australia. He has thirty years experience working with farmers to improve their understanding and use of seasonal climate forecasts in on-farm and supply chain decision making. In this talk, he will talk about the work aiming to improve the capacity within the agriculture sector to manage drought, climate variability and adapt to climate change impacts.

30. 20/9/2023 4PM-5PM

Presenter: Alexandre Stegner (AMPHITRITE/CNRS)
Title: How AI computer vision on SST imagery combined to satellite altimetry can Improve the nowcast and forecast of oceanic currents?
Abstract: Real-time monitoring of the ocean circulation, particularly surface currents, consists of a complex inverse problem. To- day, real-time surface current observation maps are produced through the inhomogeneous measurement of Sea Surface Height (SSH) and spatiotemporal interpolation

through objective algorithms. However, these maps contain important uncertainties on regions not sampled by satellites as well as an underestimation of current intensity. The fusion of SSH maps with Sea Surface Temperature (SST) maps allows for the reconstruction of high-resolution and reliable maps of ocean circulation. To this end, we employ a Super Resolution pipeline through an encoder-decoder network with a multi-modal input and a multi-task output setup. Our results indicate improved reconstruction accuracy both in intensity and direction estimation compared with the baseline of available surface current products. Operationally, reliable surface current maps enable short-term optimal routing for any commercial vessel.

31. 27/9/2023 4PM-5PM

Presenter: Andrew Kruczkiewicz (IRI)
Title: Compound extremes in humanitarian contexts: Understanding, managing and preparing for current and future extreme climate and weather events
Abstract: Increasingly, we face compounding and interrelated environmental, socioeconomic, and political crises. Yet our approaches to these problems are often siloed, fragmented, and inadequate. We are at a critical juncture, faced with a need and responsibility to redesign institutions to be proactive, agile, and socially just when confronted with increasingly likely compound risks. However, new data and technology will not only solve these challenges and could in some cases be creating more challenges than benefit. Assuming the integration of new data improves the current state of decision making represents a privileged view of responsibility, mandates and accountability - elements that will be increasingly vague as humanitarian situations become more complex and protracted. This talk presents examples of these challenges, creating space for discussion on opportunities to improve the translation and integration of climate, social and environmental data within humanitarian operations.

32. 4/10/2023 11AM-12PM

Presenter: Xiaogang He (NUS)
Title: Building a Climate Intelligent Singapore to Withstand Future Hydrological Extremes
Abstract: Hydrological extremes, in the form of droughts and floods, have huge impacts on a wide range of sectors including, most prominently, water availability, food security, and energy production, among others. The expectation of heightened drought and flood risk in Singapore under climate change, coupled with economic development, poses unprecedented challenges for the nation to boost its resilience to these natural hazards, mitigate their extreme impact, and develop effective and actionable solutions towards sustainable development. In this seminar, I will introduce the SgCALE (Singapore's Climate ArtificiaL intelligence Engine) platform to showcase how we can harness the power of AI to improve our scientific understanding of Singapore's hydroclimate extremes, especially the drivers, risks, and physical plausibility of very rare droughts (for example, those with return periods over 10000 years).

33. 18/10/2023 11AM-12PM

Presenter: Guangxing Lin (IAP)
Title: Improving mesoscale convective systems in E3SM with a multi-scale modeling framework
Abstract: Large thunderstorms called mesoscale convective systems (MCSs) are significant contributors to heavy precipitation and flooding worldwide. They change climate not only by changing the Earth's water cycle but also by releasing large amounts of latent heat in the atmosphere to alter large-scale circulations. Thus, accurately representing MCSs is crucial for simulating the water and energy cycles in global climate models (GCMs). However, MCSs pose a great challenge for GCMs in no small part due to the multiscale nature of the physics and dynamics, confounding conventional convection parameterizations used in traditional GCMs. As a result, traditional GCMs, including E3SM, have a common long-standing issue of being unable to simulate midlatitude warm-season MCSs.

Usually, they show a persistent summer warm and dry bias over mid-latitudes. We thus use an alternative approach, known as the multi-scale modeling framework (MMF), or super-parameterization, to improve the MCS simulations in E3SM. In this talk, I will briefly describe the development of the MMF version of E3SM (E3SM-MMF) and its application to modeling MCSs. I will then demonstrate how and why it can improve the MCS simulations.

34. 25/10/2023 2PM-3PM

Presenter: Mark Curtis (BoM)
Title: Overview of Radar Research Activity at the Bureau of Meteorology, focusing on the Collaboration for Enhanced Nowcasting in the Tropics
Abstract: The Bureau of Meteorology operates a network of over 70 weather radars distributed throughout the Australian continent. The network is highly heterogenous comprising multiple wavelengths, core technologies, and manufacturers, while serving a range of downstream services such as NWP Data Assimilation, hydrology, severe weather, industrial, and public weather. This diversity of climates, radars, and applications necessitates a broad research portfolio to maximize impact and value for the Australian public. This seminar will provide an overview of weather radar related research activities currently being undertaken at the Bureau. Topics include fusion of satellite, radar and rain gauge observations for improved rainfall estimation, precipitation nowcasting, use of mobile radars for severe weather and wildfire monitoring, evaluation of solid-state radar technology, and the use of bistatic receivers for cost-effective multi-Doppler 3D-wind retrieval. Special focus will be given to the Collaboration for Enhanced Nowcasting in the Tropics project being undertaken jointly with CCRS/MSS. This project aims to develop radar composite merging MSS weather radars with PUB X-band, obtained by applying the Bureau radar signal processing and QC systems, thus to improve rainfall nowcasting over the Singapore region.

35. 27/10/2023 4PM-5PM

Presenter: Humphrey Lean (UK Met Office)
Title: Urban-scale modelling at the Met Office: progress towards 100m scale forecasting applications
Abstract: I will describe the Met Office project to develop an “Urban-scale” (100m scale) modelling capability. The project plan is currently being updated as we enter the second stage of the project and I will describe the main activities in the recent past and going forward. A key aspect is to develop the capability of the models to represent convection. We are developing a 300m grid length ensemble capability which uses variable resolution domains to mitigate spin up effects which can otherwise greatly reduce the benefits for convection of the high resolution. Early trials of these models indicate significant benefits in terms of better representation of convective organisation. The ensemble aspect is essential because, compared to in scale models, the scales of unpredictability are longer compared to the scales that we are forecasting for. An important consideration is that 100m scale models have the potential to resolve many more processes in convective clouds so it is important to tell if these are correctly represented. I will describe the WesCon field campaign which took place in southern England in summer 2023 which involved measuring, in particular, the dynamical processes in convective clouds. The observational data for this campaign will be used to understand some of the issues with comvection in 100m scale models and also to develop new parameterisation schemes, in particular a grey zone turbulence scheme. I will finally briefly describe the outputs of a workshop we held recently to describe the issues that need to be solved to make 100m scale models practical for operational use.

36. 31/10/2023 11AM-12PM

Presenter: James Done (NCAR)
Title: Event-Based Downscaling of High-Impact Weather in a Changing Climate
Abstract: High fidelity climate information is in demand by many sectors of society, as risk managers grapple to understand their susceptibility to high-impact weather in a changing climate. Yet

understanding the full range of weather events is challenging due to the small sample size provided by historical records, the non-stationary behavior of events, and the immense computing power needed to conduct event-resolving climate simulations. We present an approach to understand rare high-impact events using a multi-scale physical modeling system, while at the same time quantifying the likelihood of occurrence. This approach rapidly scans thousands of years of global climate model data for extreme events, and then restimulates events of interest using a km-scale numerical weather model. This approach removes the need for ill-constrained statistical fitting to short records and allows process-based models to describe tail events. The approach will be demonstrated for the case of US landfalling tropical cyclones. The general applicability of the approach to other high-impact weather and climate phenomena will be discussed. Finally, some thoughts will be provided on how this approach compares with other modeling approaches such as global variable mesh capability within the Model for Prediction Across Scales.

37. 8/11/2023 11AM-12PM

Presenter: FangYi Tan, Christabel Tan and Tanghua Li (EOS)
Title: High-resolution Late Holocene relative sea-level record from coral microatolls in Sentosa, Singapore –by Fangyi Tan
Abstract: Local to regional relative sea-level (RSL) records are needed to shed light on the drivers of RSL change to guide coastal planning and adaptation. However, current understanding of RSL changes in Singapore and the Sunda Shelf are hindered by a lack of high-resolution RSL records. Here, we present the first high-resolution Late Holocene RSL record from coral microatolls in Singapore, located in the middle of the Sunda Shelf. Coral microatolls are fixed biological indicators whose growth are controlled by RSL changes. We compared the relative elevations of fossil and living coral microatolls to produce sea-level index points (SLIPs) that indicate the RSL at a given time in the past. We produced twelve high-resolution SLIPs (<± 0.20 m and <± 26 yrs uncertainties, 2σ) and showed that RSL fell gradually (at rates between 0.2 ± 0.7 mm/yr and 0.1 ±0.3 mm/yr) since ~2800 yrs BP, with slight RSL fluctuations. More high-resolution RSL records are necessary to resolve discrepancies amongst RSL records from the Sunda Shelf and/or decipher spatially-distinct drivers of RSL change in the region.

Title: Constraining late Holocene sea level using mangroves – A case study from Singapore –by Christabel Tan
Abstract: The reconstruction of late Holocene relative sea level (RSL) is important to understand the drivers of sea level change and prepare for future sea-level rise. Here, we investigated mangrove environments in Pulau Ubin, Singapore to develop sea-level index points (SLIPs) and reconstruct late Holocene RSL changes. We surveyed vegetation zones to estimate the indicative meaning of mangroves relative to the mean tide level (MTL) and applied the indicative meaning to basal mangrove sediments collected from sediment cores in an upland-mangrove transition area. We used radiocarbon dating of wood, leaf tissue and organic sediment to establish the depositional chronology and applied an Errors-In-Variables Integrated Gaussian Process (EIV-IGP) model to reconstruct the magnitude and rate of RSL change. The indicative range of mangroves in Pulau Ubin is between 1.28 ± 0.01 m MTL and -0.02 ± 0.01 m MTL, which is ~20% reduction in vertical uncertainty than the approach used in previous mangrove-based studies in Singapore. We have produced 8 new SLIPs (>40% mangrove pollen) that show sea levels were slightly below present over the ~2,000 year to ~500 cal. yr BP.

Title: Glacial Isostatic Adjustment: Implications for sea-level and beyond, from past to future –by Tanghua Li
Abstract: Over 400 million people in Southeast Asia live in low elevation coastal zones and are susceptible to future relative sea-level (RSL) rise. Accurate projections of future RSL rely on a good understanding of its history and driving mechanisms such as Glacial Isostatic Adjustment (GIA). Here I will introduce GIA model and its application in Singapore and Southeast Asia through two case studies.

We revealed the earliest documented instance of forced human migration driven by rapid sea-level rise (e.g., WMPs) in Southeast Asia by integrating paleotopographic and population genomic analysis. We investigated the sensitivity of the mid-Holocene sea-level highstand to Earth and ice model parameters, revealing that Earth model variation affects the magnitude and ice model variation changes both the timing and magnitude of the highstand. Lastly, we produced a highstand "treasure map" to guide future highstand data collection efforts as the highstand is poorly constrained currently in Southeast Asia.

38. 15/11/2023 11AM-12PM

Presenter: Cheryl Tay (EOS)
Title: Land subsidence through the lens of InSAR
Abstract: Human-induced land subsidence has far-reaching implications on climate change: the over-extraction of groundwater in urban coastal areas causes land to sink and thus exacerbates sea-level rise; excessive soil drainage in vegetated peatlands causes peat to compact and release large amounts of stored carbon as carbon emissions. The severity of these impacts are not well understood given the limited amount of observations available globally, as land subsidence is challenging to map both extensively and with high accuracy. In this talk, I will introduce our project which aims to advance the monitoring of land subsidence by utilising the unique capabilities of Interferometric Synthetic Aperture Radar (InSAR). The project seeks to contribute to informed decision-making and mitigation strategies for sea-level rise and carbon emissions by providing a measurement solution that works over differing land covers.

39. 22/11/2023 11AM-12PM

Presenter: Utkarsh Prakash Bhautmage (NUS)
Title: Development and Evaluation of a New Urban Parameterization in the WRF Model
Abstract: In mesoscale Weather Research and Forecasting (WRF) model, several urban-modeling options exist, such as Single-layer Urban Canopy Model (UCM), Building Effect Parameterization (BEP), and Building Energy Model (BEM). However, these models have limitations in terms of the choice of land surface models (LSMs) and planetary boundary layer (PBL) schemes, the associated computational expenses, and other constraints. In this work, an attempt has been made to explicitly include the urban physics components such as momentum drag, thermal, and moisture aspects into the Pleim-Xiu (PX) LSM and coupled with the Asymmetric Convective Model version-2 (ACM2) PBL scheme in the WRF model. This new urban model (named UACM) incorporates diurnal variation in the street, walls, and roof surface temperatures, modeled using the two-layer force-restore algorithm. Simple radiation treatment is considered to account for shadowing on streets based on the solar zenith angle and building morphology. Heat and moisture flux evolution are considered explicitly on all urban surfaces. The advantages of this novel UACM are simple formulation, more efficient execution, and its requirement for only a few fundamental urban morphological parameters. The real urban data case WRF-UACM simulations are demonstrated over the Pearl River Delta (PRD) economic region in southern China and Delhi region in India. The computationally efficient UACM is expected to perform faster for operational forecasting runs.

40. 28/11/2023 11AM-12PM

Presenter: Hari Vishnu (NUS)
Title: Acoustic activity due to submarine melting at tidewater glaciers - an indicator of climate-change?
Abstract: A significant component of sea-level rise is attributed to melting glaciers and ice-sheets in polar regions. At marine-terminating glaciers in these regions, calving and submarine melting at the glacier-water interface accounts for a big chunk of the ice lost. Submarine melting leads to explosion of ice-trapped bubbles underwater which produces a distinct sound similar to 'frying chips' that travels over long distances underwater. This sound is a promising remote-sensing medium to characterize

ice-loss using relatively cheap equipment over long time-scales and large areas. To evaluate this possibility, we made acoustic measurements at glaciers in Svalbard in 2019 and 2023. Our preliminary results reveal that sound recordings provide many details on the ice-loss processes at the glaciers, and shows a correlation with the water temperature, indicating that acoustics shows promise as a possible method for melt-monitoring at glaciers. In order to understand the sound produced at the glacier terminus, we also deployed robots which sensed close to the glacier terminus using acoustic, temperature, salinity sensors and cameras, and provide insights on the ice-loss processes transpiring at the ice-ocean boundary.

41. 6/12/2023 4PM-5PM

Presenter: Frank Selten (KNMI)
Title: Constructing climate scenarios for the Netherlands
Abstract: Climate scenarios for the Netherlands provide a coherent picture of future changes in twelve climate variables, including temperature, wind, sea-level and precipitation. Not only changes in the mean climate, but also in extremes like for instance the coldest day in winter or the maximum hourly precipitation sum in a year. Changes are given for 2050 and 2100 with reference to the climate of 1991-2020. The range of the scenarios is based on outcomes of the global climate simulations of the CMIP6 project. Four scenarios are given, for a moderate and strong global warming signal, a scenario with and without a change in the regional atmospheric circulation is constructed. For each scenario a complete set of 3D climate data is constructed by sub-sampling from an ensemble of regionally down-scaled climate scenario simulations. The methodology and outcome are carefully explained. These climate scenarios guide the adaption measures being planned and implemented to make the Netherlands more resilient with respect to the impacts of climate changes.