

出國報告（出國類別：開會）

# 參加「2023年季內及季節高峰會」 報告書

服務機關：交通部中央氣象局

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派赴國家/地區：英國/雷丁市

出國期間：112年7月1日至7月15日

報告日期：112年10月2日

## 摘要

聯合國世界氣象組織於2014年開始執行季內至季節預報計畫，以改進季內至季節的短期氣候預測，為回顧此計畫過去10年的成果並展望未來，今（112）年由雷丁大學主辦「2023年季內及季節高峰會」，會議聚焦在「可預報度之機制探討及處理」、「研究至作業開發」及「系集模式之發展與改進」3大主題。

本局於會中發表論文「臺灣地區2-3週降雨機率預報之類比後處理技術研發」。另外，淡江大學與本局合作的論文「利用氣象局開發之熱帶氣旋展期預報系統監測季內尺度下的全球熱帶氣旋活動」亦於會中發表。透過參與此會，與各國專家學者交流，更進一步瞭解國際最新科學技術的發展現況與未來趨勢，以及應用產品的開發與發布策略，同時提升臺灣的國際參與廣度和能見度。

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## 一、目的

聯合國世界氣象組織（World Meteorological Organization, WMO）之全球天氣研究計畫（World Weather Research Programme, WWRP）及全球氣候研究計畫（World Climate Research Programme, WCRP）自2014年啟動「季內至季節預報計畫（Subseasonal-to-Seasonal Prediction Project, S2S）」，致力提升季內至季節（時間尺度：兩週至一季）短期氣候的預報能力與機制探討，並透過多種增值預報產品的開發，推動預報資訊的應用，同時解決全球氣候服務的相關議題。

今（112）年適逢 S2S 計畫執行10週年，特地於英國雷丁市之雷丁大學（University of Reading）舉辦「2023年季內及季節高峰會（S2S Summit 2023）」，本次會議主要涵蓋3大主題：（一）可預報度之機制探討及處理、（二）研究至作業開發及（三）系集模式之發展與改進。3大主題再向下細分類別發表，促進各國學術界、研究機構及作業單位於會中互相交流討論。

中央氣象局由張惠玲科長帶領，與廖苡珊技佐於會中發表海報論文「Analog Post-processing of Week 2-3 Probabilistic Precipitation Forecasts over Taiwan」，中譯為「臺灣地區2-3週降雨機率預報之類比後處理技術研發」；另一個來自臺灣的團隊為氣象局委外案「強化熱帶氣旋預報及警報作業整合系統建置案(1/4)」合作之私立淡江大學水資源及環境工程系的蔡孝忠副教授，亦於會中發表海報「Monitoring Global Tropical Cyclone Activities on Subseasonal Timescale using the CWB TC Tracking System」，中譯為「利用氣象局開發之熱帶氣旋展期預報系統監測季內尺度下的全球熱帶氣旋活動」。

藉由參與本次會議，可以增進國際視野，瞭解目前國際上季內至季節預報的最新發展現況及未來規劃，知悉各國於該時間尺度下的預報產品發展，提升氣象

局對於短期氣候監測及預報發展與應用的量能，亦可提升氣象局於國際上在季內預報產品的能見度，並透過交流討論，促進與其他國際氣候預報作業單位合作的可能性。此外，也能夠增加氣象局對於舉辦國際型研討會議的作業方式與注意事項有更進一步的認識。

## 二、過程

「2023年季內及季節高峰會（後稱研討會）」為期5天（112年7月3日至7日），於英國雷丁市之雷丁大學學校舉辦。此次張員與廖員參與研討會的行程如下：

日期	工作摘要
7月1日	啟程，赴英國雷丁市
7月2日	準備研討會海報及講解內容
7月3日至7日	<ul style="list-style-type: none"><li>■ 參加研討會。完整議程如附錄1。</li><li>■ 此研討會除開幕演講、討論及海報發表外，會中將3大主題的口頭發表再細分為各類別，如下所示：<ul style="list-style-type: none"><li>（一）可預報度之機制探討及處理：<ul style="list-style-type: none"><li>1、季內振盪（MJO）及遙相關</li><li>2、陸地及氣膠</li><li>3、平流層</li><li>4、降水及熱帶波動</li><li>5、其他過程</li></ul></li><li>（二）研究至作業開發：<ul style="list-style-type: none"><li>1、極端事件</li><li>2、技術與校驗</li><li>3、後處理過程</li><li>4、氣候服務</li></ul></li><li>（三）系集模式之發展與改進：<ul style="list-style-type: none"><li>1、系集模式與過程</li><li>2、降尺度、機器學習與模式誤差</li></ul></li></ul></li><li>■ 海報發表：<ul style="list-style-type: none"><li>（一）張員及廖員：編號 B36（展示日期：7月5日至6日），題目：「Analog Post-processing of Week 2-3 Probabilistic Precipitation Forecasts over Taiwan」</li></ul></li></ul>

	(二) 蔡孝忠副教授：編號 A43 (展示日期：7月3日至4日)， 題目：「Monitoring Global Tropical Cyclone Activities on Subseasonal Timescale using the CWB TC Tracking System」
7月8日至15日	個人休假，並於7/14-7/15返回臺北

本次研討會於雷丁大學白騎士校區的活動場館 (Palmer Building) 舉辦，主要使用1間階梯式演講廳，依序進行演講與口頭發表，該廳可容納400人，實際與會人數約250人，座位空間隨著新冠肺炎疫情趨緩可屬合宜，惟空氣流通性較差；海報展示於門廊與走道，每個海報架間距約1公尺且可正反面分別張貼，此間距空間約可同時容納2-4人，與他國與會者交流與討論時尚屬方便。

會中，各國 (英國、美國、加拿大、德國、法國、瑞士、澳洲、印度、日本、中國、韓國、印尼、巴西、迦納、以色列及我國…等) 的學術單位、研究機構及作業單位分享其近10年參與 S2S 計畫及使用 S2S 資料庫進行季內至季節之短期氣候研究與開發的重要成果，內容包含：可預報度之機制探討及處理、研究至作業開發及系集模式之發展與改進，展示各國單位在這些議題上所做的努力與貢獻，並與他國與會人員相互交流討論，以得到多方的回饋及建議。

每天的議程除海報發表的時間固定外，其餘主題與討論大致交錯進行，增添會議內容的活潑度，於後就各部分說明學習情形與心得。

S2S 計畫設有網站 (<http://www.s2sprediction.net/>)，從此網站中可瞭解 S2S 的背景、研究議題、參與人員及單位、各子計畫及各區域活動的資訊及線上討論、計畫報告及發表的論文、開放使用的編程工具、產品及數據資料 (由歐洲中期天氣預報中心 (European Centre for Medium-Range Weather Forecasts, ECMWF) 及中國氣象局 (China Meteorological Administration, CMA) 管理) 等豐富訊息。

會議開場，WWRP 的 Dr. Chris Davis 說明 S2S 是 WWRP 的一項核心計畫，其中原因是因為季內至季節的時間尺度對於災害的預警或減少具重大意義，他也特別提到 WWRP 將於2024年至2027年以 S2S 成功的項目為基礎，應用至農業和環境，稱為 SAGE 計畫（S2S Applications for Agriculture and Environment），聚焦在全球農業、水資源、健康與再生能源議題上，預報極端天氣、傳達具不確定的情形下的合適作為、客製化產品及提供有效指標。澳洲氣象局的 Gilbert Brunet 也提及模式的預報能力取決於對於大氣環流的模擬及遙相關的掌握，且熱帶的強迫機制對於中緯度的氣候現象十分重要，必須重視聖嬰現象和海洋大陸在模式裡的表現。

## ■ 口頭發表

### （一） 可預報度之機制探討及處理：

Dr. Cristiana Stan 的研究顯示，S2S 預報系統可改進預報 MJO 的能力，其中說明模式可成功預報在大尺度環流下 MJO 的影響，也可以預報在 MJO 影響下的颱風活動，而前者的預報成效較後者好；對於對流層路徑預報較平流層路徑預報好；模式能反應不同的 MJO 相位對於地表溫度有明顯的關聯性。此外，他也建議探討大氣的遙相關在極端事件中所扮演的角色，也探討平流層與海洋的變化在大氣的遙相關中扮演什麼角色。

Dr. June-Yi Lee 提到北半球夏季季內振盪（Boreal Summer Intraseasonal Oscillation, BSISO）對於亞洲季風區及印度洋區域的極端降雨十分重要，海氣交互作用對於 BSISO 的傳播具重要角色，經向的海表面溫度梯度和水氣梯度是提供 BSISO 對流活動往北傳播的有利要素。此外，在西北太平洋，在聖嬰發展年的夏季，和 BSISO 相關的對流活動會比較強烈，且有時間尺度在30-60天往北傳播的特徵。自2013年夏季起，亞太經合會氣候中心（APEC Climate Center, APCC）對於



BSISO 有即時監測與預報，其中也包含使用氣象局的氣候模式，結果顯示對於兩種 BSISO (BSISO1及 BSISO2)，模式分別具有10-20天及7-15天的預報能力，而目前的 S2S 預報模式對於1-2週前預報極端事件的技術仍有限，部分原因是模式表現季內振盪和多重尺度系統的交互作用存在誤差。

Dr. Robert W. Lee 探討1979年至2018年冬半年的聖嬰、反聖嬰及正常年下 MJO 對於北大西洋振盪 (North Atlantic Oscillation, NAO) 的遙相關，顯示在聖嬰年，MJO 透過對流層裡強烈的羅士比波傳播加強正值的 NAO；在反聖嬰年，則透過平流層的強烈極渦加強負值的 NAO。

Dr. Xiangbo Feng 探討熱帶氣旋發生與加強的前兆，從氣候的再分析資料中發現，向西移動的赤道波可能有60-70%是形成熱帶氣旋的前兆，再進一步發現，當風暴與向西移動的赤道波同相位時，風暴增強的速率會增加，但若赤道波在其他相位時，風暴強度增加較慢，甚至會減弱。然而，與熱帶氣旋相關的波動最多可以在2週前被識別。

Dr. Kieran Mark Rainwater Hunt 研究 BSISO 對季風低壓系統 (Low Pressure Systems, LPS) 的非線性強化，研究區域為印度，透過再分析資料研究，BSISO 的相位與 LPS 降雨和傳播之間有顯著關係，例如：BSISO 在相位5時，印度北部的 LPS 產生的降雨量增加了51%，向西北傳播的速度也加快了20%。

## (二) 研究至作業開發：

Dr. Christopher J. White 提及透過 ECMWF 的 S2S 預報系統進行熱浪、寒潮、強降雨及熱帶與溫帶氣旋等個案極端事件研究，其中，在2018年7月於歐洲發生的熱浪，從4週、3週至2週前的模式預測，系集成員對於大於90百分位的溫度預測可自30%、60%進展至90%，研究也顯示熱浪是在季內尺度下最能夠預測的極端事件。

S2S 預報在許多使用者眼下仍算是新的領域，但 S2S 預報能對於災害決策制定提供額外的價值也越來越受到關注，雖然目前要到應用端仍然不是一件簡單的事，但近期有許多個案研究的論文，特別是對於極端事件的預測，都說明 S2S 預報有助於提供應用端有用的資訊。

Dr. Chia-Ying Lee 表示在熱帶及亞熱帶地區，熱帶氣旋降雨（Tropical Cyclone Precipitation, TCP）會對全年雨量帶來重要貢獻，也常造成極端降雨事件。其研究團隊評估了戈達德地球觀測系統-次季節至季節（Goddard Earth Observing System-Subseasonal to Seasonal, GEOS-S2S）第2版預報模式和 WMO S2S 模式在 TCP 總雨量上的表現，結果顯示與衛星降雨產品（CMORPH）比較，兩模式都可以合理的模擬 TCP 的空間分布型態，而在與觀測的相關性上，GEOS-S2S 的預報模式表現較 WMO S2S 模式還高，但兩者在1-4週前的 TCP 預報均在北太平洋有乾誤差，在東北和西北太平洋會有濕誤差。

Dr. Hélène Vérèmes 提到 PISSARO 計畫（網址：<http://en.pissaro.re>）是辦理西南印度洋在季內尺度下的天氣與海洋預報應用計畫，而為了開發預報熱帶氣旋災害及強降雨潛勢客製化產品，科學家、預報員及人道組織展開了合作。西南印度洋的有人居住區依據不同的預報等級區分成不同的權重區域，不同權重會有相對應的潛在行動，類型包括：加強監測、警告和準備行動。面化的預報產品每週提供1次，每次會為未來3週提供決策輔助地圖。

Dr. Andrew W. Robertson 介紹全球季內降水及溫度機率預報的多模式即時系統（網址：<http://iridl.ldeo.columbia.edu/maproom/Global/ForecastsS2S/index.html>）。這個系統使用 SubX（Subseasonal Experiment）資料庫，並基於3個 NOAA 的系集預報模式（GEFSv12、CFSv2及 ESRL-FIM）開發，在組合成多模式系集（Multi-Model

Ensemble, MME) 機率預報之前，會利用邏輯斯迴歸進行每週和每兩週的雨量 and 溫度系集平均校正，每星期五會出未來第1、2、3、4週、2-3週及3-4週的預報。

博士生 Miss Nina Horat 展示他們的團隊開發了將機器學習方法和氣象過程結合的機率後處理方法，用以改進 ECMWF 的季內預報。他們的研究是基於卷積神經網絡架構 (Convolutional Neural Network, CNN) 的後處理方法，此 CNN 模型利用多個氣象變數的全球預報場做為 CNN 模型的輸入，預報第3-4週及5-6週的平均氣溫和累積雨量的3分類機率，結果優於 ECMWF 的預報且能反映 ECMWF 過度信心的情形。

Dr. Chen Schwartz 提到 S2S 東南亞試驗計畫 (S2S Southeast Asia Pilot project, S2S-SEA) 目的在探索季節展望對該地區災害管理的適用性。在 S2S-SEA 下，開發的第1個產品是每兩週1次的展望指導文件，是東盟專業氣象中心 (ASMC) 每兩週向東盟災害管理人道主義援助協調中心 (AHA) 提供未來1-3週強降雨可能性增加的書面展望；第2個產品是為 AHA 的災害管理反應系統 (DMRS) 開發的災害監測工具，用於顯示當地災害的即時訊息，著重監測和觀測。

### (三) 系集模式之發展與改進：

Dr. Yukei Takaya 表示在季內的時間尺度下，預報的不確定性來自於初始場的不確定性及預報模式的誤差，S2S 的系集計畫需要評估和改進能夠代表初始條件不確定性的方法。為優化有限的電腦資源下的作業預報，S2S 系集預報系統的初始化策略是一個重要的領域，例如使用 lagged ensemble 初始化。

Dr. Tongwen Wu 介紹中國氣象局發展的 CMA-CPSv3 氣候預報系統，用於預報每週的季內至季節預報、每月的月度至年度預報，此系統是基於北京氣候中心的 BCC-CSM2-HR 氣候系統 (是大氣-海洋-陸地-海冰的耦合模式) 發展而來，大氣的

水平解析度約45公里、海洋的水平解析度是0.25\*0.25度、56層垂直層、最高可達0.092hPa。會中介紹 CMA-CPSv3系統在中國月、季的2米溫度及降雨的預報得分。

Dr. Frederic Vitart 表示 ECMWF 的展期預報，由過去每週2次（週一和週四 00 UTC）更新，由51個系集成員組成，可預報46天，水平解析度在15天內是18公里、15天後是36公里，於2023年升級至每天更新、由101個系集成員組成、預報46天、水平解析度均是36公里，與預報15天、由51個系集成員組成、水平解析度9公里的系統分開運行。會中也介紹於升級後，在季內尺度的 MJO 及颱風侵襲潛勢預報都有更好的表現。預計未來將朝200或300個系集成員邁進，預期可以對第3、4週有更好的預報技術。

Dr. Andrea Molod 提到美國國家航空暨太空總署的模式與同化辦公室用 GEOS-S2S 第2版及第3版（預計在2024年初發表）預報模式來進行可預報度的研究，重點1是關注在陸地及大氣耦合的可預報度，研究結果顯示當陸地邊界層（地表至行星邊界層）耦合（稱為 atmospheric leg）活躍的時候，可提升美東地區2-4週前的預報能力；重點2是關注在研究天氣至季內至季節的無縫隙可預報度，目前統計技術：平均預測時間（Average Predictability Time, APT）正在起步發展中。

## ■ 海報發表

張員及廖員於7月5日至6日發表海報論文，題目為「Analog Post-processing of Week 2-3 Probabilistic Precipitation Forecasts over Taiwan」，中譯為「臺灣地區2-3週降雨機率預報之類比後處理技術研發」，摘要如附錄2-1。此論文主要是利用類比統計後處理技術（Analog Postprocessing technique）解決臺灣地區產期極端降雨預報的困境，包括：（一）錯誤的降雨位置與量值，並且無法提供細尺度降雨特徵。（二）系集成員的離散度不足，限制了降雨預報的可用性。在這研究中，我們利

用簡單克利金方法（Simple Kriging Method）得到高解析（解析度為1公里）觀測降雨分析場，進而讓類比統計後處理過程不單是進行偏差修正，同時也將預報場降尺度到1公里的高解網格。長期的預報校正成效評估顯示：校正後的系集離散度可以合理地反映預報的不確定性，且讓系集降雨預報的頻率分佈更接近真實觀測。此外，相較於未校正的降雨機率預報，校正後的預報有較佳的可信度與區辨能力，並可讓更多的使用者得到更高的經濟效益。此研究成果已完成論文撰寫，並完成美國國家海洋暨大氣總署全球系統實驗室（NOAA/GSL）內部審查，即將投稿至國際期刊 Monthly Weather Review。

在研討會中，我們針對類比統計後處理技術的優點及限制，與各國科學家進行交流，包括：加拿大環境及氣候變遷部的 Dr. Hai Lin、美國哥倫比亞大學的 Dr. Chia-Ying Lee、德國卡爾斯魯爾理工學院的 Nina Horat、日本氣象廳的 Dr. Masashi Sumitomo、雷丁大學 Dr. Xiangbo Feng 等人，大家對此方法的展期降雨預報校正成效也都給予正面肯定。

另外，本局委外案「強化熱帶氣旋預報及警報作業整合系統建置案(1/4)」合作的蔡孝忠副教授，亦於7月3日至4日張貼海報發表，題目為「Monitoring Global Tropical Cyclone Activities on Subseasonal Timescale using the CWB TC Tracking System」，中譯為「利用氣象局開發之熱帶氣旋展期預報系統監測季內尺度下的全球熱帶氣旋活動」，摘要如附錄2-2。

蔡副教授主要介紹與氣象局合作開發的「熱帶氣旋展期預報系統（TC Tracker）」，網址：<https://tctracker.cwa.gov.tw/>，結合4種模式：歐洲的 ECMWF、美國的 NCEP GEFSv12、CFSv2、氣象局的 CWA1T1，分別自動化對於即時預報資料進行未來1-4週全球的熱帶氣旋活動的偵測與預報，並運用歷史再預報資料評估與

校驗預報技術，此外也介紹近期開發的颱風系集路徑群集分類及颱風季內侵襲潛勢預報產品。在研討會中蔡副教授與各國科學家交流討論，包括：WMO 的 Dr. Munehiko Yamaguchi、美國哥倫比亞大學的 Dr. Chia-Ying Lee、日本氣象廳的 Dr. Yuhei Takaya、印度氣象局的 Dr. D. R. Pattanaik、法國留尼旺大學的 Dr. Hélène Vèrèmes、美國亞利桑納大學的 Dr. Christopher Castro 等人，各國專家對於此系統可處理全球即時預報資料、提供重點資訊及歷史再預報的評估結果能和即時預報產品做連結給予很高的評價，同時也促進了本局和他國氣象單位合作的可能性。

## ■ 討論

會議最後，各國的科學家及專家學者在基於過去10年參與 S2S 計畫進行研究與開發的豐富經驗下，在可預報度探討與處理、研究至作業開發及模式發展等相關議題提出建議、需求及挑戰，整理列舉如下：

### ◎ 可預報度探討與處理

- 需要更加瞭解平流層可能帶來的影響
- 需要更加探討 MJO 的遙相關（非絕熱過程和波動及遙相關在模式中過弱）
- 預報極端事件的大小仍具挑戰
- 模式對於表示熱帶-溫帶的遙相關及對流層-平流層路徑能力仍有限
- 需要強化模式中的陸地、海洋、海氣交互作用、對流層-平流層交互作用、模式初始化等過程

### ◎ 研究至作業開發

- 應多思考即時資料的可用性
- 應彌合研究和作業預報間的差距，以及試驗計畫和真實世界的差距

- 應提高使用者在 S2S 的模式技術和預報不確定性的溝通
- 因應使用者需求客製化預報產品，但須注意作業中心可負荷的人力
- 作業化的預報產品應自動化產出，並加入技術可信度的訊息

◎ 模式發展

- 需要雲端計算設施來處理及共享數據並減少資料傳輸
- 應持續維護數據資料並思考開放即時資料存取的可能
- 應取捨模式的解析度及系集成員個數
- 整合無縫隙預報
- 接受機器學習：在可預報度研究、建模、後處理、降尺度上使用機器學習，但需要校驗、有動力或資料驅動的基礎、有足夠的歷史再預報資料進行訓練，重點應著重在具科學的基礎上進行機器學習（不落於如黑盒子般使用）

### 三、心得與建議

S2S 計畫在 WMO 的主持下自2014年啟動，過去10年匯集全球各地學術、研究及作業單位的科學家及專家學者，相互合作，積極使用 S2S 資料庫進行季內至季節的研究與開發，特別選在滿10週年的今年，在 WWRP 和 WCRP 的指導下，由英國雷丁大學主辦「2023年季內及季節高峰會」，會中將 S2S 計畫的各項子計畫融合於3大主題：(一) 可預報度之機制探討及處理、(二) 研究至作業開發及(三) 系集模式之發展與改進，進行發表與交流討論。

本次研討會以學術界參與的人數最多，其次是研究和作業單位，發表內容範疇廣泛，透過參與此會議，除了瞭解目前國際上短期氣候預報的發展現況外，更擴張對於 S2S 研究與開發的眼界，知曉國際各界以模式為出發點，探討與發展 S2S 模式的表現、改進、預報及應用…等，而氣象局在 S2S 的發展領域，除了長期預報員參與其中外，需要更多優秀的模式發展人員及科學研究人員一同投入參與。

經由參與本次研討會瞭解氣象局在進行 S2S 分析或預報時，除了長年持續關注臺灣周圍主要的大尺度系統、印度洋、海洋大陸、季內振盪、聖嬰現象的發展監測、預報及影響外，仍需強化增進瞭解熱帶-中緯度系統的遙相關、海氣交互作用及平流層可能帶來的影響、各模式的特性與誤差來源及預報技術，並增加與國際上的科學家及他國作業單位專家的交流討論的機會，相信對於氣象局的短期氣候預報有更好的判斷依據。

此外，研討會中表示對於模式發展需改進模式預報的不確定性及模式誤差，在科學架構下運用機器學習於建模、後處理方法及降尺度上，以及發展無縫隙預報等，也都是目前本局努力及未來挑戰的方向，可透由多與國際上的專家學者相互交流，提升我國發展的氣候模式預報的能力並與國際接軌。



研究至作業開發的部分，本次透過在會議中進行海報發表，提升本局發展季內預報的後處理方法及熱帶氣旋展期預報系統的能見度，會中得到許多正面的評價與回饋，瞭解氣象局所發展的方法與產品具有即時預報作業的可用性，同時也促進合作契機。另由於臺灣非聯合國的成員國，限縮臺灣科研人員參與國際官方氣象組織的活動或較不易得到口頭發表的機會，但仍建議多鼓勵氣象局人員參與國際會議，瞭解與學習國際上科研的現況與最新發展，以培訓及開拓人員的視野，並分享技術發展與應用成果，進一步爭取交流與合作互惠的機會。

綜整本次會議專家學者所提出的建議、需求及未來挑戰如頁11-12「討論」，會中也提醒在發展客製化產品時，應先評估所需資源和作業人力；產品開發時，應在作業單位、學術單位及使用者3方間建立橋樑並有效交流討論；產品發布後，應提高使用者在 S2S 的模式技術和預報不確定性的溝通。氣象局可善用這些有用訊息，檢視和規劃模式與科學研究的業務發展及預報產品的開發，另關注 WWRP 於明年開始推動的 SAGE 計畫，瞭解 WMO 推動 S2S 應用的方向及行動。

最後，英國致力2030年達到減碳目標，2050年達成淨零排放，於本次研討會中也有展現相關作為，雷丁大學校園各處設有宣傳標示，研討會相關資訊以網頁公告並以電子郵件通知與會者，不另外提供紙本手冊；會議中提供環保杯自行取用；主辦人多次在會中宣傳「Running Out of Time relay」（一項在英國民間關心氣候行動的大型接力活動），該活動於會議最後1天接力路跑至校園，歡迎大家響應，展現本次研討會不僅由各國專家學者發表 S2S 的科學進展，同時也展示英國在氣候變遷議題上具體落實國家政策，並透過民間活動加以倡議，此精神令人印象深刻，也值得我們效法。

# 附錄1、議程

## Program Overview

Monday 3 July		Tuesday 4 July		Wednesday 5 July		Thursday 6 July		Friday 7 July	
08:00–08:30	Registration								
08:30–09:00	Opening Session	Modelling: M1 Ensembles		Breakout Preparation		Predictability & Processes: P3 Stratosphere		Predictability & Processes: P5 Precipitation & Tropical Waves	
09:00–09:30									
09:30–10:00		Predictability & Processes: P1 MUO & Teleconnections		Morning Coffee		Breakout 1		R2O: R4 Climate Services	
10:00–10:30					Breakout 2				
10:30–11:00									
11:00–11:30			R2O: R2 Skill & Verification						
11:30–12:00									
12:00–12:30									
12:30–13:00									
13:00–13:30			(13:00: Group photo)		Lunch Break		(Running Out of Time relay)		
13:30–14:00									
14:00–14:30			Poster Session 2 (Block A)		Poster Session 3 (Block B)		Poster Session 4 (Block B)		
14:30–15:00	Poster Session 1 (Block A)						Modelling: M3 Downscaling, Machine Learning & Model Biases		
15:00–15:30									
15:30–16:00					Afternoon Coffee				
16:00–16:30	R2O: R1 Extremes		Predictability & Processes: P2 Land & Aerosols		R2O: R3 Post-Processing		Modelling: M2 Ensembles & Processes		
16:30–17:00							Breakout Reports & Closing Discussion		
17:00–17:30	Ice Breaker				ECR Event				
17:30–18:00									
18:00–18:30									
18:30–19:00									
19:00–19:30			Conference Dinner						
19:30–20:00									
20:00–20:30									
20:30–21:00									



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## Monday - 3 July 2023

<b>08:00–09:00 Registration</b>		
<b>09:00–10:30 Opening Session</b> Session Chair: Frederic Vitart (ECMWF)		
09:00–09:15		Welcome from the University of Reading, WCRP and S2S Project
09:15–09:30	Chris Davis (WWRP, NCAR)	WWRP: Welcome and Future Vision
09:30–10:00	Brian Hoskins (University of Reading)	Basic ideas on possible S2S predictive power
10:10–10:30	Gilbert Brunet (Bureau of Meteorology)	Subseasonal to Seasonal Prediction: a thirty-year journey
<b>10:30–11:00 Morning Coffee</b>		
<b>11:00–13:00 Predictability &amp; Processes: P1 MJO &amp; Teleconnections</b> Session Chair: Andrew Charlton-Perez (University of Reading)		
11:00–11:15	188 Cristiana Stan (George Mason University)	Advances in the prediction of MJO-Teleconnections in the S2S forecast systems
11:15–11:30	191 Hyemi Kim (Stony Brook University)	The Maritime Continent barrier effect on MJO predictability: perfect-model ensemble forecasts with the CESM2 aqua-planet
11:30–11:45	209 Kunio Yoneyama (JAMSTEC)	Some indications of key components for the MJO and relevant phenomena over the Maritime Continent from the recent field observations
11:45–12:00	198 Donaldi Permana (Center for Research and Development – Indonesia Agency for Meteorology Climatology and Geophysics (BMKG))	The impact of the BSISO on boreal summer rainfall anomalies in Indonesia
12:00–12:15	260 June-Yi Lee (Research Center for Climate Sciences, Pusan National University)	Boreal Summer Intraseasonal Oscillation: Propagation, Interannual Variability, and Impacts on Extremes
12:15–12:30	086 Robert W. Lee (University of Reading)	ENSO modulation of MJO teleconnections to the North Atlantic & Europe
12:30–12:45	211 Christian M. Grams (Institute of Meteorology and Climate Research (IMK-TRO), Karlsruhe Institute of Technology (KIT))	Predictability and windows of sub-seasonal forecast opportunity for North Atlantic-European weather regimes
12:45–13:00	237 David Martin Straus (George Mason University) <i>[This talk has been moved to the P4 Session at 12:00]</i>	Uncertainty in Diabatic Heating within MJO phases 3–4 and Consequences for Mid-Latitude Predictability: Large Ensemble Studies with the ECMWF Model
<b>13:00–14:00 Lunch Break</b>		
<b>14:00–15:30 Poster Session 1 (Block A)</b>		
<b>15:30–16:00 Afternoon Coffee</b>		
<b>16:00–17:30 R2O: R1 Extremes</b> Session Chair: Hai Lin (Environment and Climate Change Canada)		
16:00–16:15	192 Christopher J. White (Department of Civil and Environmental Engineering, University of Strathclyde)	Subseasonal-to-seasonal prediction case studies: extreme events and applications
16:15–16:30	060 James Carnuthers (Newcastle University)	Using sub-seasonal forecasting to predict temporally compounding extreme events



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16:30–16:45	149 Chia-Ying Lee (Lamont-Doherty Earth Observatory, Columbia University)	Subseasonal tropical cyclone precipitation prediction in GEOS-S2S and the WMO S2S models
16:45–17:00	152 Hélène Vermes (Laboratoire de l'Atmosphère et des Cyclones (LACy), CNRS, Université de La Réunion, Météo-France)	Using monthly forecast of extreme events in the southwest Indian Ocean for disaster risk management: co-creation of a decision support tool for tropical cyclone risk anticipation
17:00–17:15	035 Melanie Alayne Schroers (School of Meteorology, University of Oklahoma)	Prediction and Impacts of 14-day Extreme Precipitation Periods within the CONUS
17:15–17:30	100 Pauline Riviere (Institute of Earth Surface Dynamics, University of Lausanne)	Assessment of S2S ensemble extreme precipitation forecasts over Europe
<b>17:30–19:00 Ice Breaker</b>		



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## Tuesday – 4 July 2023

<b>09:00–10:30 Modeling: M1 Ensembles</b> Session Chair: Andrea Molod (NASA Global Modeling and Assimilation Office)		
09:00–09:15	072 Yuhei Takaya (Meteorological Research Institute, Japan Meteorological Agency)	Summary of S2S Ensemble Sub-project
09:15–09:30	246 Judith Berner (National Center for Atmospheric Research, U.S.A.)	Impact of Stochastic Parameterization on S2S Forecasts with CESM
09:30–09:45	050 Tongwen Wu (Earth System Modeling and Prediction Center, China Meteorological Administration)	CMA-CPSv3: A sub-seasonal to annual climate prediction system in China Meteorological Administration
09:45–10:00	095 Masashi Sumitomo (Japan Meteorological Agency)	New JMA forecast data for S2S Project based on a coupled model
10:00–10:15	029 Rae-Seol Park (Korea Institute of Atmospheric Prediction Systems)	Korean Integrated Model expansion of prediction target to extended range forecasts
10:15–10:30	069 William James Crawford (U. S. Naval Research Laboratory, Monterey)	The Navy Earth System Prediction Capability Version 2 Ensemble Forecast System
<b>10:30–11:00 Morning Coffee</b>		
<b>11:00–13:00 R2O: R2 Skill &amp; Verification</b> Session Chair: Arun Kumar (National Centers for Environmental Prediction)		
11:00–11:15	089 Caio Coelho (CPTEC/INPE)	The S2S sub-project on Research to Operations (R2O): forecast and verification products development
11:15–11:30	255 D R Pattanaik (India Meteorological Department)	Extended Range Forecast of Monsoon over India at Met-subdivision and Districts levels: Prospect of its applications in Agriculture
11:30–11:45	126 Felipe M. de Andrade (National Institute for Space Research)	Skill assessment and sources of predictability for sub-seasonal rainfall forecasts in Africa
11:45–12:00	044 Marisol Osman (Institute of Meteorology and Climate Research (IMK-TRO), Karlsruhe Institute of Technology (KIT))	Multi-model Assessment of the Sub-seasonal Predictive Skill for the Year-round Atlantic-European Weather Regimes
12:00–12:15	096 S. Abhik (School of Earth, Atmosphere, and Environment, Monash University, Australia)	The Indo-Pacific Maritime Continent Barrier Effect on MJO Prediction in Subseasonal-to-Seasonal Prediction Models
12:15–12:30	196 Philip Pegion (NOAA)	Coupled Model Diagnostic Tools for UFS Subseasonal to Seasonal Model Development
12:30–12:45	009 Claire Spillman (Bureau of Meteorology)	Predicting ocean extremes at subseasonal to seasonal timescales for operational decision support
12:45–13:00	245 Abigail Jaye (National Center for Atmospheric Research, U.S.A.)	State-dependent Forecast Skill in S2S Forecasts
<b>13:00–14:00 Lunch Break, including group photo outside the Palmer Building front entrance at 13:00</b>		
<b>14:00–15:30 Poster Session 2 (Block A)</b>		
<b>15:30–16:00 Afternoon Coffee</b>		
<b>16:00–17:30 Predictability &amp; Processes: P2 Land &amp; Aerosols</b> Session Chair: Magdalena Balmaseda (ECMWF)		
16:00–16:15	258 Yongkang Xue (University of California, Los Angeles (UCLA))	Progress Towards for better Understanding of the Sources of Global S2S Precipitation Prediction using Land Temperatures Anomaly over high mountains: A brief overview from the GEWEX/LS4P Initiative

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16:15–16:30	259 Julia Green (University of Arizona)	An Emergent Constraint to Improve the Representation of Biosphere-Atmosphere Feedbacks in Earth System Models
16:30–16:45	110 Bethan L. Harris (UK Centre for Ecology & Hydrology/National Centre for Earth Observation)	Global observations highlight regions where vegetation can enhance S2S predictability
16:45–17:00	107 Constantin Ardilouze (CNRM, Université de Toulouse, Météo France, CNRS)	Predicting the leaf area index in a dynamical S2S forecast system
17:00–17:15	157 Ariane Frassoni (INPE)	The Second Phase of the WGENE Aerosol Project: Evaluating the impact of aerosols on the Subseasonal Prediction
17:15–17:30	007 Joshua Talib (UK Centre for Ecology and Hydrology)	Surface drivers of sub-seasonal predictability across Africa
<b>18:30–21:00 Conference Dinner</b>		

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## Wednesday - 5 July 2023

<b>09:00–10:30 Breakout Preparation</b> Session Chair: Robert Lee (University of Reading)		
09:00–09:15	242 Dorothy Koch (NOAA OAR Weather Program Office) Presented by Mark Olsen (NOAA OAR Weather Program Office)	NOAA's S2S Program Plan and Project Highlights
09:15–09:30	081 Richard Mladek (ECMWF)	The technical development of the S2S database
09:30–09:45	049 Xing Hu (China Meteorological Administration)	Progress of CMA S2S Data Archive Centre
09:45–10:00	017 Paul Dirmeyer (George Mason University)	The Land Sub-project of S2S
10:00–10:15	261 Laura Ferranti (ECMWF) Presented by Matthieu Chevallier (ECMWF)	WMO infrastructure for operational subseasonal forecasting
10:15–10:30		Breakout instructions
<b>10:30–11:00 Morning Coffee</b>		
11:00–12:00	<b>Breakout 1</b> Breakout Group Chairs: 1. Christian Grams 2. Matt Newman 3. Christopher Roberts 4. Jason Furtado 5. Randy Koster 6. Felipe M. de Andrade 7. Dominik Büeler 8. Linda Hirons	
	<b>Breakout 2</b> Breakout Group Chairs: 1. Christian Grams 2. Matt Newman 3. Christopher Roberts 4. Jason Furtado 5. Randy Koster 6. Felipe M. de Andrade 7. Dominik Büeler 8. Linda Hirons	
<b>13:00–14:00 Lunch Break</b>		
<b>14:00–15:30 Poster Session 3 (Block B)</b>		
<b>15:30–16:00 Afternoon Coffee</b>		
<b>16:00–17:30 R2O: R3 Post-Processing</b> Session Chair: Caio Coelho (CPTEC/INPE)		
16:00–16:15	236 Andrew W. Robertson (IRI, Columbia University)	A multimodel real-time system for global probabilistic subseasonal forecasts of precipitation and temperature

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16:15–16:30	251 Marie Drouard (Institute of Geosciences (IGEO, CSIC-UCM), Madrid)	Sub-seasonal to seasonal prediction of summer heatwaves in the Iberian Peninsula using machine learning algorithms
16:30–16:45	046 Nina Horat (Karlsruhe Institute of Technology (KIT))	Deep learning for post-processing global probabilistic forecasts on sub-seasonal time-scales
16:45–17:00	116 Lucia Micaela Castro (Universidad de Buenos Aires, Facultad de Ciencias Exactas y Naturales, Departamento de Ciencias de la Atmósfera y los Océanos – Servicio Meteorológico Nacional)	Skill assessment of weekly temperature anomalies in the SubX Project for the extended austral summer in South America
17:00–17:15	225 Steven Woolnough (National Centre for Atmospheric Science, University of Reading)	The potential for using weather patterns to advance sub-seasonal forecasting in Southeast Asia
17:15–17:30	172 Camille Marie-Jeanne Laurence Le Coz (Laboratoire de Mé météorologie Dynamique-IPSL, Ecole Polytechnique, Institut Polytechnique de Paris, ENS, PSL Research University, Sorbonne Université, CNRS)	Multi-model sub-seasonal forecasts of 2m-temperature over Europe using Wasserstein barycentre
<b>17:30–19:00 Early Career Researcher Event</b>		

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## Thursday – 6 July 2023

<b>09:00–10:30</b>		
<b>Predictability &amp; Processes: P3 Stratosphere</b>		
Session Chair: Cristiana Stan (George Mason University)		
09:00–09:15	031	Chaim Garfinkel (Hebrew University)
		The Stratospheric Network for the Assessment of Predictability (SNAP): the role of stratosphere-troposphere coupling for S2S skill
09:15–09:30	233	Jason Furtado (School of Meteorology, University of Oklahoma)
		Representation and Predictability of Stratospheric Wave Reflection Events in Subseasonal Forecast Models
09:30–09:45	012	Bowen Liu (Nanjing University of Information Science and Technology)
		Precursory Signals in the Stratospheric Meridional Mass Circulation for Mid-Latitude Cold Air Outbreak Events of High and Low Sub-Seasonal Predictability
09:45–10:00	066	Rachel Wai-Ying Wu (ETH Zurich)
		Bimodality in the Predictability of Sudden Stratospheric Warming Events: A Case Study of the 2009 and 2018 Events
10:00–10:15	146	Andrew James Charlton-Perez (University of Reading)
		A Minimal Model to Diagnose the Contribution of the Stratosphere to Tropospheric Forecast Skill
10:15–10:30	067	Jonas Spaeth (University of Munich (LMU))
		Anomalies in tropospheric extended-range forecast uncertainty arising from stratosphere-troposphere coupling
<b>10:30–11:00</b>		
<b>Morning Coffee</b>		
<b>11:00–13:00</b>		
<b>Predictability &amp; Processes: P4 Other Processes</b>		
Session Chair: Hyemi Kim (Ewha Womans University)		
11:00–11:15	006	Hai Lin (Environment and Climate Change Canada)
		Subseasonal variability of the warm Arctic – cold North American pattern
11:15–11:30	230	John Methven (University of Reading)
		Relating the properties of quasi-stationary Rossby waves to the jet that they live on
11:30–11:45	123	Iago Perez Fernández (Universidad de la República)
		Predictability of Long-lived of Rossby Wave Packets during Southern Hemisphere Summer
11:45–12:00	022	Shreya Keshri (Earth and Climate Science, Indian Institute of Science Education and Research Pune)
		A survey of Mixed Rossby-Gravity waves and quantification of their association with extratropical disturbances
12:00–12:15	237	David Martin Straus (George Mason University)
		Uncertainty in Diabatic Heating within MJO phases 3-4 and Consequences for Mid-Latitude Predictability: Large Ensemble Studies with the ECMWF Model
12:15–12:30	164	Boris Dewitte (CEAZA/CECI)
		Forecast opportunity at subseasonal-to-seasonal timescales in the South Eastern Pacific
12:30–12:45	130	Jing Yang (Key Laboratory of Environmental Change and Natural Disaster/Faculty of Geographical Science, Beijing Normal University)
		Intraseasonal Melting of Northern Barents Sea Ice Forced by Circumpolar Clockwise-Propagating Atmospheric Waves during Early Summer
12:45–13:00	256	Elizabeth Barnes (Colorado State University)
		Interpretable Machine Learning for S2D Prediction and Discovery: data-driven approaches to the method of analogs
<b>13:00–14:00</b>		
<b>Lunch Break</b>		
<b>14:00–15:30</b>		
<b>Poster Session 4 (Block B)</b>		
<b>15:30–16:00</b>		
<b>Afternoon Coffee</b>		
<b>16:00–17:30</b>		
<b>Modeling: M2 Ensembles &amp; Processes</b>		
Session Chair: Yuhei Takaya (Meteorological Research Institute, Japan Meteorological Agency)		

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16:00–16:15	084	Magdalena Alonso Balmaseda (ECMWF)
		Towards consistent representation of the boundary forcing temporal variability in S2S reforecasts and real-time forecasts
16:15–16:30	001	Frederic Vitart (ECMWF)
		Sub-seasonal prediction at ECMWF
16:30–16:45	085	Andrea Molod (NASA Global Modeling and Assimilation Office)
		Prediction and Predictability Studies with NASA's GEOS-S2S Modeling and Assimilation System
16:45–17:00	137	Qing Bao (Chinese Academy of Sciences (CAS), Institute of Atmospheric Physics (IAP)) Presented by Yangke Liu (Chinese Academy of Sciences (CAS), Institute of Atmospheric Physics (IAP))
		Impacts of humidity initialization on MJO prediction: a study in an operational Sub-seasonal to seasonal system
17:00–17:15	019	Sumitha Joseph (Indian Institute of Tropical Meteorology, Pune)
		Development of a Multi-physics Multi-ensemble system for efficient subseasonal prediction
17:15–17:30	177	Matthew Newman (NOAA/Physical Sciences Laboratory)
		A Linear Inverse Model for Improved Model Guidance of CPC's Week 3-4 Operational Temperature Outlooks

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## Friday – 7 July 2023

<b>09:00–10:30</b>	<b>Predictability &amp; Processes: P5 Precipitation &amp; Tropical Waves</b> Session Chair: Susmitha Joseph (Indian Institute of Tropical Meteorology)	
09:00–09:15	062 Arun Kumar (Climate Prediction Center, NOAA)	Attribution of North American Subseasonal Precipitation Prediction Skill
09:15–09:30	148 Xiangbo Feng (National Centre for Atmospheric Science, University of Reading)	Equatorial waves: precursors to tropical cyclone occurrence and intensification
09:30–09:45	131 Vincent Owanda Otieno (Technical University of Kenya)	Characterization of Intra-Seasonal Variability during Extreme Dry Seasons over the Greater Horn of Africa (GHA): Implications for Climate Adaptation and Mitigation
09:45–10:00	193 Juliana Dias (NOAA Physical Sciences Laboratory)	Are equatorial waves a practical source of deterministic sub-seasonal predictive skill?
10:00–10:15	214 Philippe Peyrille (CNRM, Météo-France)	Multiple tropical waves occurrence drive extreme precipitation events in the central Sahel
10:15–10:30	160 Kieran Mark Rainwater Hunt (University of Reading)	Nonlinear intensification of monsoon low pressure systems by the BSISO
<b>10:30–11:00</b>	<b>Morning Coffee</b>	
<b>11:00–13:00</b>	<b>R2Q: R4 Climate Services</b> Session Chair: Andrew Robertson (IRI, Columbia University)	
11:00–11:15	097 Joanne Robbins (Met Office)	Exploring the challenges and opportunities of S2S forecast application development through the Subseasonal-to-Seasonal (S2S) Real Time Pilot (RTP) Initiative
11:15–11:30	257 Mike DeFlorio (Center for Western Weather and Water Extremes, Scripps Institution of Oceanography, University of California San Diego)	The transition from California's extreme drought to major flooding: Evaluating CW3E's S2S forecasts of the onslaught of landfalling atmospheric rivers and associated extreme precipitation in December 2022 – January 2023
11:30–11:45	057 Linda Hirons (NCAS, University of Reading)	Using a co-production approach to support effective application of S2S forecasts in Africa
11:45–12:00	174 Maslin Gudoshava (IGAD Climate Predictions and Applications Centre)	Application of real time S2S forecasts over Eastern Africa in the co-production of climate services
12:00–12:15	071 Randal Koster (Global Modeling and Assimilation Office, NASA/Goddard Space Flight Center)	The Subseasonal Forecasting of Hydrological Variables: Improvement Strategies Inferred from a Water Balance Model Analysis
12:15–12:30	166 Wee Leng Tan (Centre for Climate Research Singapore) <i>Presented by Chen Schwartz (Centre for Climate Research Singapore)</i>	Application of S2S for Disaster Management: Development of products for Southeast Asia
12:30–12:45	208 Emily Black (University of Reading and the National Centre for Atmospheric Science)	Application of sub-seasonal forecasts for farmer decision support in eastern and southern Africa
12:45–13:00	181 Erik W. Kolstad (NORCE, Bjerknes Centre for Climate Research)	Use of S2S forecasts in the Climate Futures centre for applied research
<b>13:00–14:00</b>	<b>Lunch Break, including Running Out of Time walking relay participation opportunity</b>	
<b>14:00–15:30</b>	<b>Modeling: M3 Downscaling, Machine Learning &amp; Model Biases</b> Session Chair: Anca Brookshaw (ECMWF)	
14:00–14:15	217 Hoteit Ibrahim (King Abdullah University of Science and Technology)	On the development of a S2S forecasting system for the Arabian Peninsula using convective-permitting ensemble dynamical downscaling

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14:15–14:30	243 Ty Dickinson (School of Meteorology, University of Oklahoma)	Forecasting Subseasonal Extreme Precipitation in the Contiguous United States Using a Convolutional Neural Network
14:30–14:45	104 Dominik Büeler (ETH Zürich)	Northern Hemisphere extratropical cyclone biases in ECMWF sub-seasonal forecasts
14:45–15:00	178 Kirsten Mayer (National Center for Atmospheric Research, U.S.A.) Matthew Widlansky (Cooperative Institute for Marine and Atmospheric Research, School of Ocean and Earth Science and Technology, University of Hawaii at Mānoa)	Identifying State-Dependent Subseasonal Predictability Bias with Explainable Neural Networks
15:00–15:15	090	Assessing opportunities for improved coastal data assimilation in ocean model analyses and forecasting systems
15:15–15:30	120 Steffen Tietsche (ECMWF)	Underestimation of Arctic warming trends in sub-seasonal forecasts
<b>15:30–16:00</b>	<b>Afternoon Coffee</b>	
<b>16:00–17:30</b>	<b>Breakout Reports &amp; Closing Discussion</b> Session Chair: Steve Woolnough (National Centre for Atmospheric Science, University of Reading)	

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## Posters Group A – Monday & Tuesday

### Session 1: Monday, 14:00-15:30 | Session 2: Tuesday, 14:00-15:30

Poster #	Author (Affiliation)	Title	Presenting Session
A1	Marcela Ulate (U.S. Naval Research Laboratory, UCAR)	Impact of Stochastic Kinetic Energy Backscatter Scheme on the Navy Earth System Prediction Capability prediction of the Madden-Julian Oscillation during 2017	1
A2	Yangke Liu (CAS-IAP)	Madden-Julian Oscillation prediction skill of CAS-IAP model	2
A3	Baoqiang Xiang (GFDL/NOAA, UCAR)	Subseasonal prediction of diverse MJO and BSISO events in GFDL SPEAR model	1
A4	Jing Yang (Beijing Normal University)	Boreal summer extratropical intraseasonal waves over the Eurasian continent and real-time monitoring metrics	2
A5	Lais Fernandes (Portland State University)	ENSO-MJO effects on the lifecycle of North Pacific Atmospheric Rivers	1
A6	Young-Kwon Lim (University of Maryland, Baltimore County, and NASA Goddard Space Flight Center, Global Modeling and Assimilation Office)	Prediction skill of the eastward propagating Madden-Julian Oscillation and associated dynamics in NASA's GEOS-S2S forecast system	2
A7	Jung-Eun Esther Kim (Ewha Womans University)	S2S predictability of Western North Pacific Subtropical High due to the decadal change in ENSO	1
A8	Laura Baker (NCAS, University of Reading)	Understanding the intermittency of the wintertime North Atlantic Oscillation and East Atlantic Pattern seasonal forecast skill in the Copernicus C3S multi-model ensemble	2
A9	Masuo Nakano (Japan Agency for Marine-Earth Science and Technology)	Impact of the Boreal Summer Intraseasonal Oscillation on Typhoon Tracks in the Western North Pacific and the Prediction Skill of the ECMWF Model	1
A10	Elena Saggioro (University of Reading)	Probabilistic causal network modelling of Southern Hemisphere jet stream long-range predictability in spring-to-summer	2
A11	Tao Zhu (Key Laboratory of Environmental Change and Natural Disaster/Faculty of Geographical Science, Beijing Normal University)	Two Types of Mid-High-Latitude Low-Frequency Intraseasonal Oscillations near the Ural Mountains during Boreal Summer	1
A12	Constantin Ardouze (CNRM, Université de Toulouse, Météo France, CNRS)	Flow dependence of wintertime subseasonal prediction skill over Europe	2
A13	Jeffrey B. Basara (School of Meteorology, School of Civil Engineering and Environmental Science, University of Oklahoma) Presented by Taylor Grace (OU) and Daniel Mesheke (OU)	Analysis of the 2022 Flash Drought Across the South-Central United States	1
A14	Marybeth Arcodia (Colorado State University)	Assessing Decadal Variability of Subseasonal Predictability using Explainable Machine Learning	2
A15	Danni Du (University of Colorado, Boulder)	Potential increase in MJO predictability under global warming	1
A16	Chaim Garfinkel (Hebrew University)	The winter North Pacific teleconnection in response to ENSO and the MJO in operational subseasonal forecasting models is too weak	2
A17	Christopher David Roberts (European Centre for Medium-Range Weather Forecasts)	Euro-Atlantic weather regimes and their modulation by tropospheric and stratospheric teleconnection pathways in ECMWF reforecasts	1
A18	Sasha Giamville (National Center for Atmospheric Research)	Subseasonal predictability from atmospheric, land, and ocean initial states	2
A19	Angela Benedetti (ECMWF) Presented by Frederic Vitart (ECMWF)	The impact of biomass burning emissions on seasonal prediction: a study using the ECMWF's coupled Ensemble Prediction System	1
A20	Daniel Mesheke (Department of Civil Engineering and Environmental Science – University of Oklahoma)	Interseasonal terrestrial-atmospheric drivers of flash drought over Europe	2
A21	Jing Yang (Beijing Normal University)	Subseasonal Warming of Surface Soil Enhances Precipitation Over the Eastern Tibetan Plateau in Early Summer	1
A22	Yuhei Takaya (MRI, JMA)	A submonthly scale causal relation between snow cover and surface air temperature on the autumnal Eurasian continent	2
A23	Shan Sun (NOAA Global Systems Laboratory)	Quantifying direct aerosol effect on subseasonal prediction: climatology versus interactive aerosols in the UFS model	1
A24	Jonny Day (European Centre for Medium Range Weather Forecasts)	Diagnostics for land-surface initial conditions and coupling	2

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A25	Monika Feldmann (Institute of Geography and Oeschger Centre for Climate Change Research, University of Bern)	Investigating the predictability of severe convective outbreaks in central Europe	1
A26	Raju Mandal (Indian Institute of Tropical Meteorology Pune) Presented by A. K. Sahai (IITM) and Susmitha Joseph (IITM)	Diagnostics and real-time extended range prediction of cold waves over India	2
A27	Benjamin Davis (University of Oklahoma)	Predictability of Wet Bulb Globe Temperature Heat Waves in the United States Plains	1
A28	Taylor Grace (School of Meteorology, University of Oklahoma)	A Comparison of Boreal Winter and Summer Heat Wave Characteristics in the US Southern Great Plains	2
A29	Jorge L. Garcia Franco (Columbia University) Presented by Chia-Ying Lee (Columbia University)	On the source of model biases for subseasonal tropical cyclone precipitation prediction	1
A30	Emmanuel Rouges (University of Reading)	Heatwaves over Europe: Improving the forecast on the sub-seasonal range	2
A31	Daniele Mastrangelo (Institute of Atmospheric Sciences and Climate, CNR-ISAC)	Subseasonal prediction of the 21-25 November 2016 heavy rainfall event over northwestern Italy	1
A32	Annika Oertel (Institute of Meteorology and Climate Research (IMK-TRO), Karlsruhe Institute of Technology (KIT))	Everything hits at once: how remote rainfall matters for the sub-seasonal prediction of the 2021 North American heat wave	2
A33	S. Abhik (School of Earth, Atmosphere, and Environment, Monash University, Australia)	Multiscale prediction and attribution of the Black Saturday heatwave event over southeast Australia	1
A34	Erwan Cornillault (CRNM)	Extreme rainfall events over the French tropical overseas territories: characteristics and atmospheric forcing provided by equatorial waves	2
A35	Dame Guey (Laboratory of Electronics, Computing, Telecommunications and Renewable Energies – University Gaston Berger)	Study of cyclogenesis in the eastern tropical Atlantic East Atlantic with the LMDz model	1
A36	Qiaoping Li (CMA Earth System Modeling and Prediction Centre, China Meteorological Administration)	Forecasting and evaluation of summer extreme precipitation and high temperature events in China based on S2S models	2
A37	Richard I. Cullather (Global Modeling and Assimilation Office, NASA Goddard Space Flight Center)	Inferred Sea Level Prediction in the NASA GMAO Seasonal Forecasting System	1
A38	Ryu Jihun (GIST)	Correlation between predictability in Sub-seasonal to Seasonal (S2S) timescales and performance of mean state	2
A39	Marisol Osman (KIT)	Factors influencing sub-seasonal forecast skill of Greenland Blockings	1
A40	Devin McAfee (University of Oklahoma School of Meteorology)	Evaluation of S2S Prediction Project Database Performance in Forecasting U.S. Extreme Precipitation Events	2
A41	Paromita Chakraborty (National Centre for Medium Range Weather Forecasting (NCMRWF))	Assessing skill of ensemble sub-seasonal to seasonal forecasting over South-east Asia	1
A42	Wayne Yuan-Huai Tsai (Department of Atmospheric Sciences, National Taiwan University) Presented by Hsiao-Chung Tsai (Tamkang University)	Intraseasonal oscillations and the subseasonal peak rainfall event in the eastern Philippines during 2017/18 winter and S2S prediction evaluation	2
A43	Hsiao-Chung Tsai (Department of Water Resources and Environmental Engineering, Tamkang University)	Monitoring Global Tropical Cyclone Activities on Subseasonal Timescale using the CWB TC Tracking System	1
A44	Cristiana Stan (George Mason University)	The Forecast Skill of the Northern Hemisphere Middle Latitudes Seasonal Oscillation and its impact on the surface air temperature	2
A45	Ranjeet Singh Bais Bais (PhD, IIT Kharagpur)	Reliability indices for S2S model for societal application	1
A46	Paul-Arthur Monerie (University of Reading)	Prediction of the seasonal variability of global summer monsoon precipitation	2
A47	Ignazio Giuntoli (CNR-ISAC)	A weather regimes approach for identifying increased predictability in the subseasonal prediction of European winters	1
A48	Silvia Terzago (National Research Council of Italy, Institute of Atmospheric Sciences and Climate (CNR-ISAC))	Seasonal forecasting of Alpine snow depth	2
A49	Maureen Abia Ahlataku (Ghana Meteorological Agency)	Impact of Users' Feedback on Weather Forecast Evaluation in Ghana, West Africa	1
A50	Supari Supari (Indonesia Agency for Meteorology, Climatology and Geophysics (BMKG))	The Performance of ECMWF S2S Model on Predicting the Wet Period at the end of 2022 in Java Island, Indonesia	2
A51	Zhao Li (NASA-GSFC-GMAO)	Summer Heatwave Forecast skills in GEOS5-S2S version 2	1
A52	Xiangwen Liu (Center for Earth System Modeling and Prediction of China Meteorological Administration)	Progress of MJO Prediction at CMA during phase I to phase II of Sub-seasonal to Seasonal Prediction Project	2

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	Presented by Weihua Jie (CMA)		
A53	Maria Gehne (CU Boulder CIRES)	Diagnostics of Tropical Variability in the Unified Forecast System	1
A54	Li Ren (NASA/GSFC, SSAI)	Evaluation of GEOS -S2S Version 3 Forecast System	2
S1	Hyung-Jin Kim (Head, Climate Prediction Department, APEC Climate Center)	A Decade of S2S ICO's Services and Collaborations for the Subseasonal to Seasonal Prediction Project	



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## Posters Group B – Wednesday & Thursday

### Session 3: Wednesday, 14:00-15:30 | Session 4: Thursday, 14:00-15:30

Poster #	Author (Affiliation)	Title	Presenting Session
B1	Eunjeong Lee (Korea Institute of Atmospheric Prediction Systems (KIAPS))	Impacts of an Atmosphere–Ocean Coupling in the Korean Integrated Model (KIM)	3
B2	Min Chu (CMA Earth System Modeling and Prediction Centre (CEMC))	Seasonal prediction of regional Arctic sea ice using the high-resolution climate prediction system CMA-CPSv3	4
B3	Aude Carreric (BSC-CNS)	Impacts of increased horizontal resolution on the seasonal predictability of Tropical Pacific variability	3
B4	Ian Simpson (University of Lincoln)	Probabilistic seasonal forecasts using complex systems modelling, comparisons with dynamical models and linking North Atlantic atmospheric circulation and jet stream variability to UK and northwest Europe surface weather conditions	4
B5	Benjamin Green (CU/CIRES and NOAA/Global Systems Laboratory)	Sensitivities of Subseasonal Coupled Earth System Model Simulations to Changes in Parameterizations of Convection, Cloud Microphysics, and Planetary Boundary Layer	3
B6	Prajwal P. Jadhav (Indian Institute of Science Education and Research Pune)	Subseasonal forecasting of temperature and precipitation over India using a machine learning approach	4
B7	Yalan Fan (Beijing Normal University)	Gain of one-month lead predicting spring rainfall over China: A comparison between FGOALS-f2 ensemble prediction system and its driving stretched-grid downscaling prediction system	3
B8	Bruno dos Santos Guimarães (Center for Weather Forecast and Climate Studies, National Institute for Space Research)	An inter-comparison performance assessment of a Brazilian global sub-seasonal prediction model against four Sub-seasonal to Seasonal (S2S) prediction project models	4
B9	Christopher Castro (The University of Arizona)	Mesoscale Convective Systems in the Arabian Peninsula: Subseasonal to Seasonal Forecast and Tracking Capability through High Resolution Regional Climate Modeling	3
B10	Dioumaor Faye (Ecole Supérieure Polytechnique de l'Université Cheikh Anta Diop de Dakar)	Sub-seasonal to seasonal forecast in Senegal: Machine Learning approach	4
B11	Sylvie Malardel (Laboratoire de l'Atmosphère et des Cyclones (LACy))	Monthly forecast exploratory experiment with a convection permitting model for the south-west Indian Ocean basin	3
B12	Bowen Liu (Nanjing University of Information Science and Technology)	Impact of the Initial Stratospheric Polar Vortex State on East Asian Spring Rainfall Prediction in Seasonal Forecast Models	4
B13	Xiyuan Ding (University of California, Los Angeles)	Causality between Extreme Stratospheric Wave Activity and Cold Extremes over North America	3
B14	Zachary Lawrence (CIRES / NOAA PSL) Presented by Chaim I. Garfinkel (Hebrew University of Jerusalem)	Stratosphere & Stratosphere-Troposphere Coupling Biases in Subseasonal-to-Seasonal Forecast Models: An International SNAP Community Effort	4
B15	Dvir Chwat (Fredy and Nadine Herrmann Institute of Earth Sciences, Hebrew University, Jerusalem) Presented by Chaim I. Garfinkel (Hebrew University of Jerusalem)	Which Sudden Stratospheric Warming Events Are Most Predictable?	3
B16	Chaim I. Garfinkel (Fredy and Nadine Herrmann Institute of Earth Sciences, Hebrew University of Jerusalem) Presented by Chen Schwartz (Hebrew University of Jerusalem)	Stationary wave biases and their effect on upward troposphere–stratosphere coupling in sub-seasonal prediction models	4
B17	Robert W. Lee (University of Reading)	Initial Conditions for Stratospheric Error Growth	3
B18	Philip Rupp (LMU Munich)	Predicting the coupled AO extremes and strong polar vortex conditions during early 2020	4
B19	Hilla Afargan-Gerstman (ETH Zürich)	Stratospheric influence on North Atlantic storm track predictability in subseasonal-to-seasonal reforecasts	3
B20	Alexey Karpechko (FMI) Presented by Frederic Vitart (ECMWF)	The tropical influence on sub-seasonal predictability of wintertime stratosphere and stratosphere-troposphere coupling	4
B21	Xiaocen Shen (Department of Meteorology, University of Reading)	The Dominant Intraseasonal Coupling Mode between the Stratosphere and Troposphere: the Stratosphere–Troposphere Oscillation	3
B22	Akshay Deoras (NCAS & Department of Meteorology, University of Reading)	The predictability and representation of Indian monsoon low-pressure systems in Subseasonal-	4



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		to-Seasonal prediction models	
B23	Tarvir Ahmed (Shahjalal University of Science and Technology, Sylhet, Bangladesh)	Processes associated with extremely heavy precipitation in the Meghalaya Plateau region: A case modelling study.	3
B24	Joshua Dorrington (Karlsruhe Institute of Technology)	Domino: A framework for improving extreme event predictability using flow precursors	4
B25	Oliver T. Millin (School of Meteorology, University of Oklahoma)	The Impact of Rossby Wave Breaking on the Subseasonal Forecast of the February 2021 Great Plains Cold Air Outbreak	3
B26	Timothy Higgins (University of Colorado – Boulder)	Assessing the Potential Predictability of North Pacific Winter IVT and Precipitation Extremes in ECMWF Subseasonal Forecasts	4
B27	Felipe M. de Andrade (National Institute for Space Research)	Evaluating the representation of South America precipitation variability patterns in sub-seasonal predictions of S2S project models	3
B28	Luong Thang (King Abdullah University of Science and Technology)	Predictability of Sub-seasonal Rainfall in the Arabian Peninsula	4
B29	David Martin Straus (George Mason University)	The Predictability of the South Asian Summer Monsoon Intra-Seasonal Variability (Active-Break Cycle) from re-forecasts of the ECMWF ensemble prediction system at three resolutions.	3
B30	Erik W. Kolstad (NORCE, Bjerknes Centre for Climate Research)	Drivers of S2S Forecast Errors of the East African Short Rains	4
B31	Weihua Jie (CMA Earth System Modeling and Prediction Center (CEMC))	How to Choose Credible Ensemble Members for the Sub-seasonal to Seasonal Prediction of Precipitation?	3
B32	Dominik Büeler (ETH Zurich)	Extended-range warnings for heatwaves in Switzerland (HEATaware)	4
B33	Amulya Chevuturi (UKCEH)	Improving global hydrological simulations through bias-correction and multi-model blending	3
B34	Nurdeka Hidayanto (Indonesian Agency for Meteorological, Climatological and Geophysics) <i>Presented by Donald Perdana (BMKG)</i>	Improving Sub-seasonal to Seasonal Model Performance in The Tropics Using a Machine Learning Approach	4
B35	Annie Y.-Y. Chang (ETH Zurich)	Sub-seasonal drought forecasting in the European Alps with EFAS data in a machine-learning-aided hybrid approach	3
B36	Hui-Ling Chang (Central Weather Bureau)	Analog Post-processing of Week 2-3 Probabilistic Precipitation Forecasts over Taiwan	4
B37	Sem Vijverberg (Vrije Universiteit, Institute for Environmental Studies)	Introducing the AI4S2S project: open-source python packages to make data-driven pipelines for S2S forecasting more efficient, transparent, and scalable	3
B38	Philippe Peyrille (CNRM, Meteo-France)	Added value of analysing tropical waves and precipitable water for subseasonal forecast in West Africa: the MISVA platform	4
B39	Diego A. Campos Diaz (Direccion Meteorologica de Chile)	On the next generation (NextGen) seasonal precipitation forecast in Chile	3
B40	Pascal Oettli (Center for Environmental Remote Sensing (CEReS), Chiba University)	The value of machine learning to improve seasonal forecasting in mid-latitudes: The example of surface air temperature in central Japan	4
B41	Zhou Yang (Nanjing University of Information Science and Technology)	How Can Quasi-Periodic Signals Privilege S2S Operational Forecast? From a Perspective of Deep Learning	3
B42	Joshua Talib (UKCEH)	Co-producing sub-seasonal warnings of meningitis outbreaks	3
B43	Kamoru Abiodun Lawal (African Centre of Meteorological Applications for Development (ACMAD))	Progress and Challenges of Demand-Led Co-Produced Sub-Seasonal-to-Seasonal (S2S) Climate Forecasts in Nigeria	3
B44	Fabian Mockert (Institute of Meteorology and Climate Research (IMK-TRO), Department Troposphere Research, Karlsruhe Institute of Technology (KIT))	Weather regimes: A window of sub-seasonal forecast opportunity for periods of low renewable electricity generation in Germany?	4
B45	Valentina Pavan (Arpaè-Simc)	Sub-seasonal ensemble irrigation forecasts in Emilia-Romagna	3
B46	Pauline Rivoire (Institute of Earth Surface Dynamics, University of Lausanne)	Forecasting hydrometeorological drivers of forest damage over Europe	4
B47	Victor Indasi (ACMAD)	The Need for sustained provision S2S forecast products: African Perspective.	3
B48	Mary Nyambur Kilavi (Kenya Meteorological Department)	Reflections on the development and use of S2S products in Kenya	4
B49	Yuxian Pan (Beijing Normal University)	Skillful seasonal prediction of summer wildfires over Central Asia	3
B50	Christoph Sping (Federal Office of Meteorology and Climatology, MeteoSwiss) <i>Presented by Adel Imamovic (MeteoSwiss)</i>	Towards an early warning system for droughts in Switzerland	4
B51	Patricia Nying'iro (Kenya Meteorological Department)	Use of S2S forecast products in Kenya: Application for NHMSs forecast producers & for the Energy Sector.	3
B52	Mark Rhodes-Smith (UK Centre for Ecology and Hydrology)	UK Hydrological Outlook: Operational river flow forecasting using spatially-distributed seasonal rainfall forecasts	4



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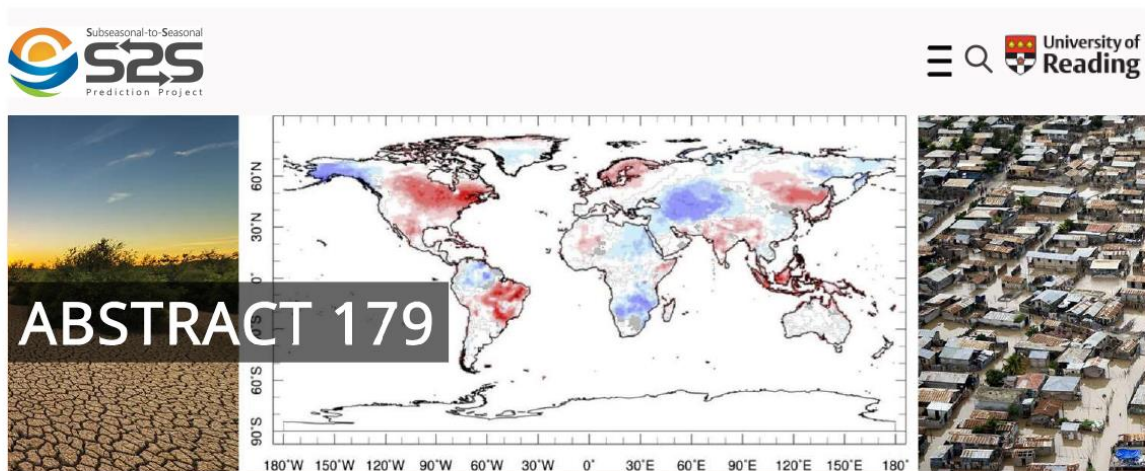
B53	Victoria L. Boulton (University of Reading)	S2S Forecasts for Biodiversity Conservation	3
B54	Sylvie Malardel (Laboratoire de l'Atmosphère et des Cyclones (LACy))	PISSARO: a collaborative and user-oriented project on the monthly forecasting of extreme events in the southwest Indian Ocean	4
B55	Neil Hart (University of Oxford)	When on-ground decision making shapes S2S prediction research pathways	3
S1	Hyung-Jin Kim (Head, Climate Prediction Department, APEC Climate Center)	A Decade of S2S ICO's Services and Collaborations for the Subseasonal to Seasonal Prediction Project	



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## 附錄2-1、本局發表之海報論文摘要



Abstract ID: 179

### Analog Post-processing of Week 2-3 Probabilistic Precipitation Forecasts over Taiwan

Lead Author: Hui-Ling Chang  
Central Weather Bureau, Taiwan (R.O.C.)

**Keywords:** probabilistic precipitation forecasts, Analog Post-processing, reliability, discrimination, potential economic value

**Abstract:** The predictability of precipitation is limited due to the important role finer-scale processes play. However, demand for extended-range (10-to-30 days) precipitation forecasts by users in agriculture and water resource management has grown significantly. Therefore, the goal of this study is to predict the conditional climatology of precipitation given the forecast of the large-scale circulation conditions, which still retain predictability in the extended range.

In this study, we focus on week 2-3 precipitation forecasts over Taiwan, and use Analog Post-processing (AP) to produce posterior ensembles with reasonable spread to effectively mitigate the problem of under-dispersion, which is very common for ensemble prediction systems. The AP forecast ensembles are derived from observed high-resolution precipitation patterns corresponding to historical forecast analogs that most resemble the current precipitation forecast. Frequency counting is then applied to the AP ensembles to produce well-calibrated and downscaled week 2-3 probabilistic precipitation forecasts.

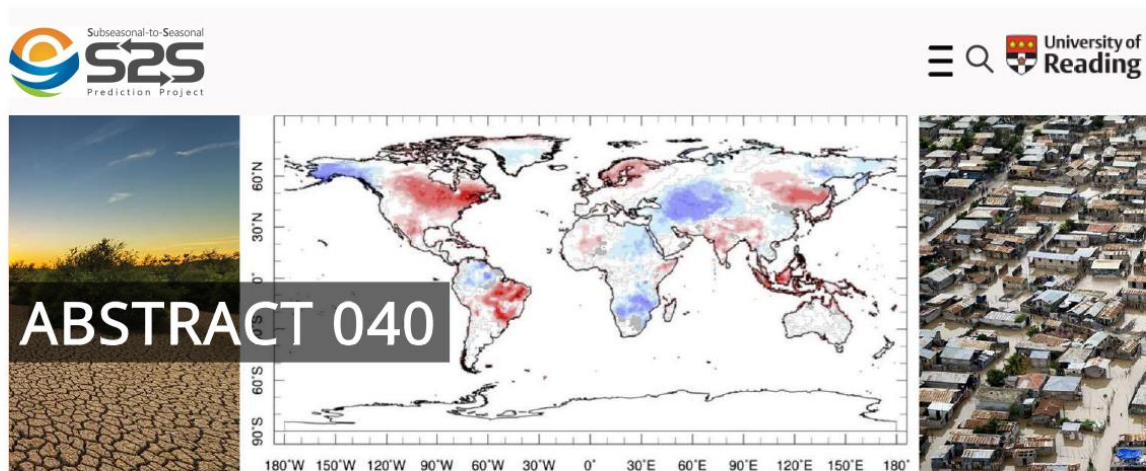
Forecast evaluation confirms that the raw ensemble is under-dispersive with an obvious wet bias. In contrast, the AP ensemble distribution is well calibrated with most of the bias removed. Compared to the raw forecasts, the AP-based probabilistic forecasts have better reliability and higher skill in discrimination in the winter and Mei-yu seasons. Evaluation of potential economic value demonstrates that users with a much wider spectrum of cost/loss ratio can benefit from the calibrated forecasts in decision making as compared to the raw forecast, with a significantly higher gain.

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## 附錄2-2、與本局合作發表之海報論文摘要



Abstract ID: 040

### Monitoring Global Tropical Cyclone Activities on Subseasonal Timescale using the CWB TC Tracking System

Lead Author: Hsiao-Chung Tsai

Department of Water Resources and Environmental Engineering, Tamkang University, Taiwan

**Keywords:** tropical cyclone, subseasonal forecast, global ensemble model

**Abstract:** A real-time tropical cyclone (TC) activity monitoring system has been developed at Central Weather Bureau (CWB) to objectively detect TCs in the 16-day NCEP GEFS (Global Ensemble Forecast System) since 2008. This system has been upgraded in 2020 by extending the forecast lead-time to four weeks. The new system, CWB TC Tracker 2.0, has integrated the forecasts from multiple global ensemble models. In addition to the NCEP GEFSv12, the real-time forecasts from the 46-day ECMWF ensemble (ENS), NCEP Climate Forecast System (CFSv2), and the CWB 1-tier climate forecast model (CWB1T1) are included. The forecasters from multiple forecast agencies are jointly using the CWB TC Tracker 2.0 as their TC forecasting tool in weeks 1-4. The development of the CWB TC Tracker 2.0 will be introduced. The weeks 1-4 TC forecast skills in the western North Pacific are also evaluated using the ENS and the GEFSv12. As shown in the preliminary verifications using the 20-year reforecasts, promising forecast skills can be found in both ensemble models, especially in the week-1 and week-2 forecasts. The impacts of large-scale environments on TC activity forecasts are further investigated (i.e., summer monsoon, MJO, and ENSO). A spatial-temporal ensemble track clustering algorithm (Tsai et al. 2019) is implemented to group similar ensemble vortex tracks for the track verifications and the false alarm detections. More details about the subseasonal TC forecast applications and verifications using the CWB TC Tracker 2.0 will be presented in the meeting.

**Co-authors:**

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Jui-Ling Kuo (Central Weather Bureau)

Han-Yu Hsu (Tamkang University)

### 附錄3、研討會相關照片

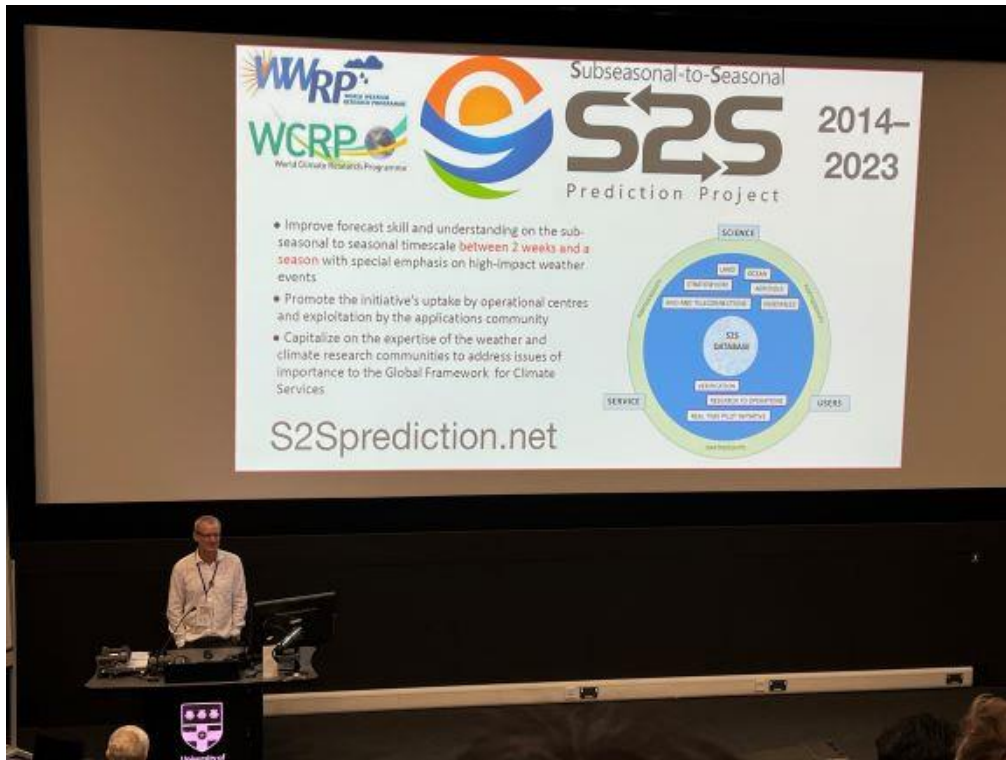


圖1、雷丁大學主辦人 Dr. Steven Woolnough 為研討會開啟序幕

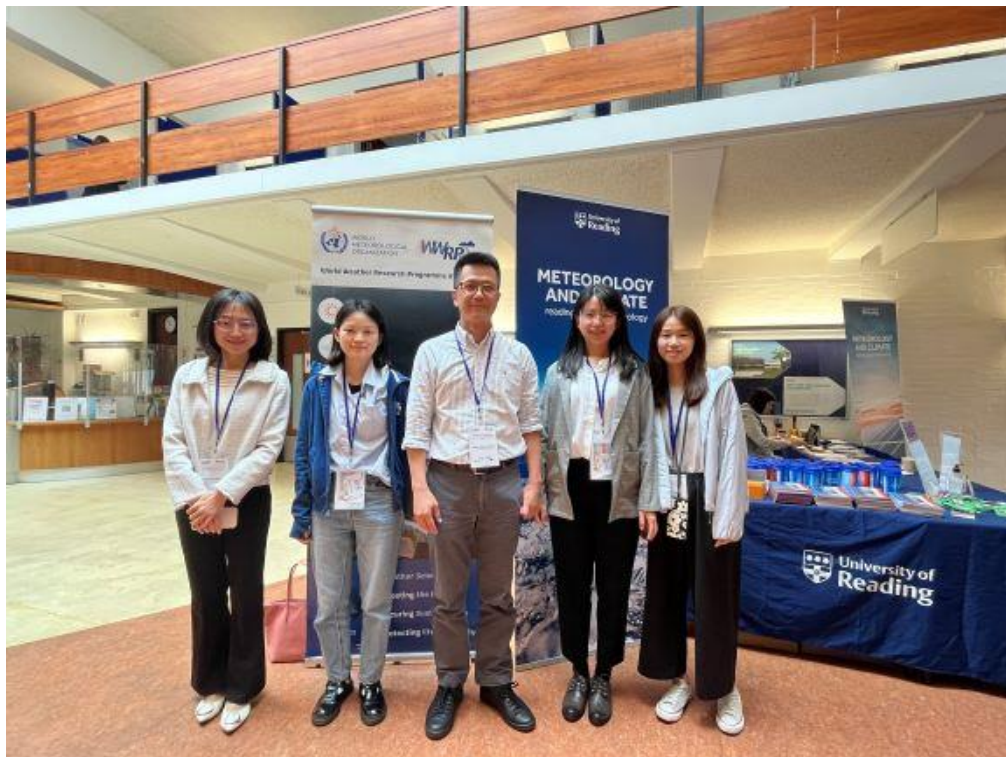


圖2、張惠玲科長(左1)、廖苡珊技佐(右2)、李亭萱助理研究員(右1)與淡江大學蔡孝忠副教授(中)於演講廳外合影。



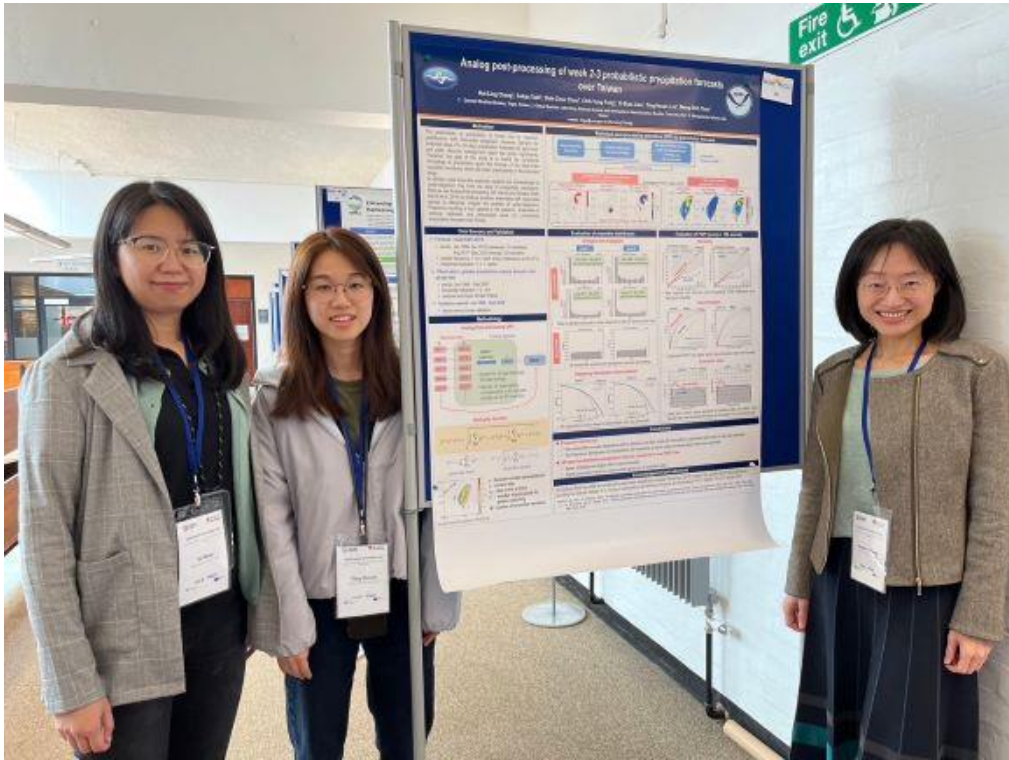


圖3、張惠玲科長(右起)、李亭萱助理研究員、廖苡珊技佐於論文海報前合影。

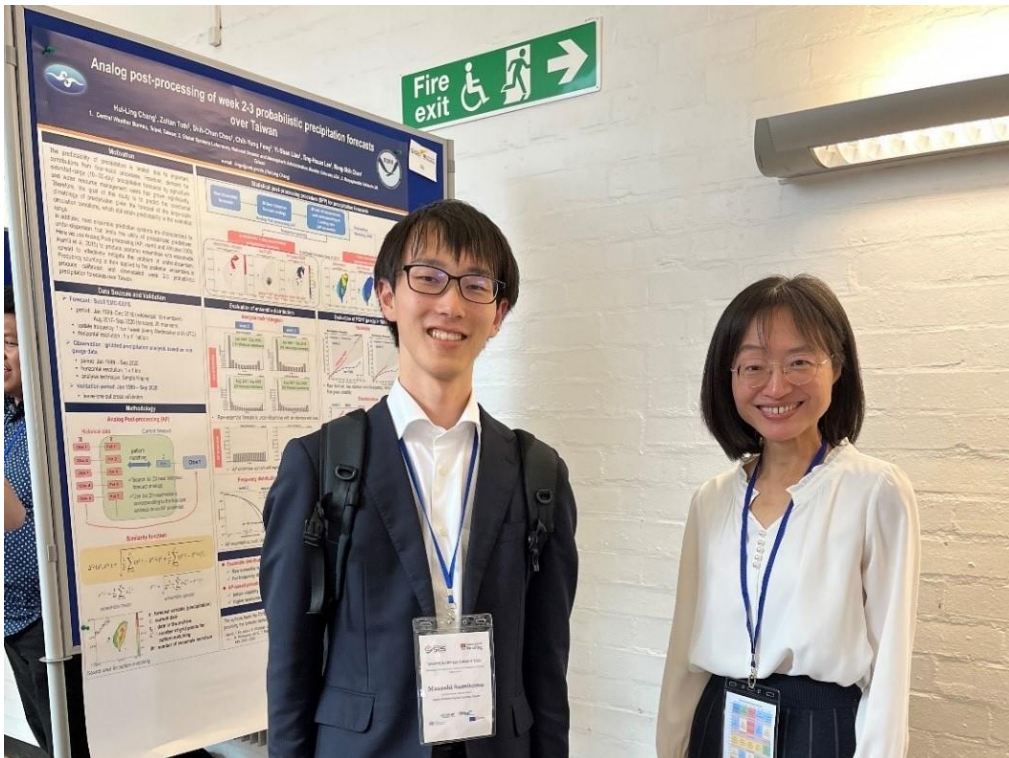


圖4、張惠玲科長與日本氣象廳（Japan Meteorological Agency）的 Dr. Masashi Sumitomo 於論文海報前合影。

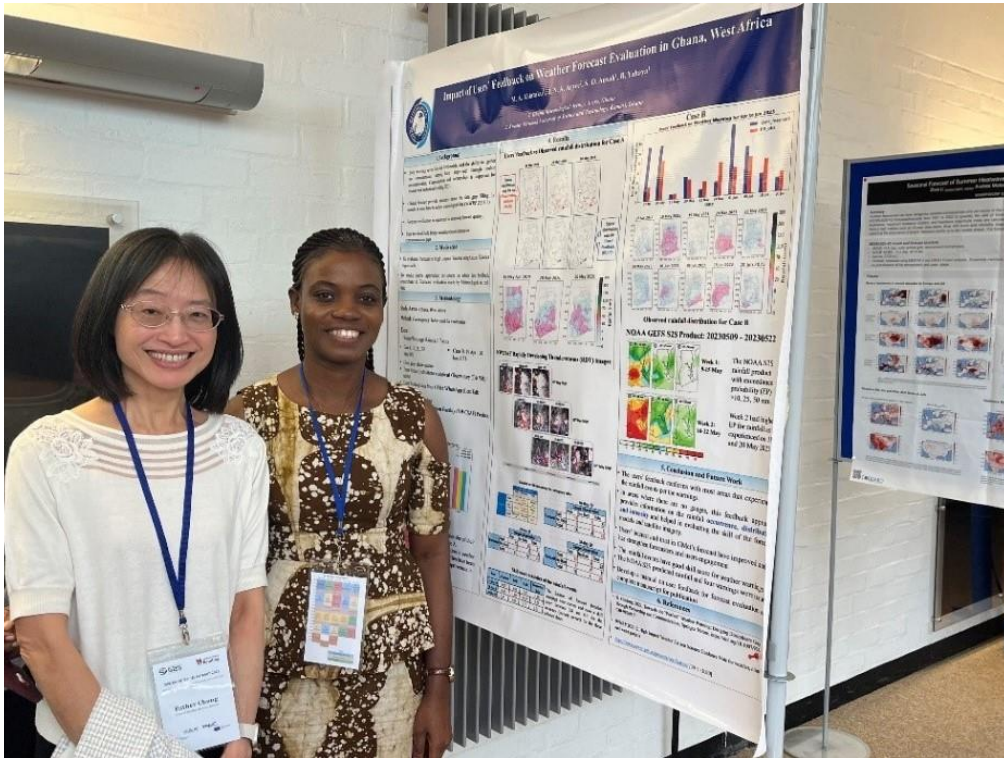


圖5、張惠玲科長與迦納共和國氣象廳（Ghana Meteorological Agency）的 Maureen Abia Ahiataku 於其論文海報前合影。

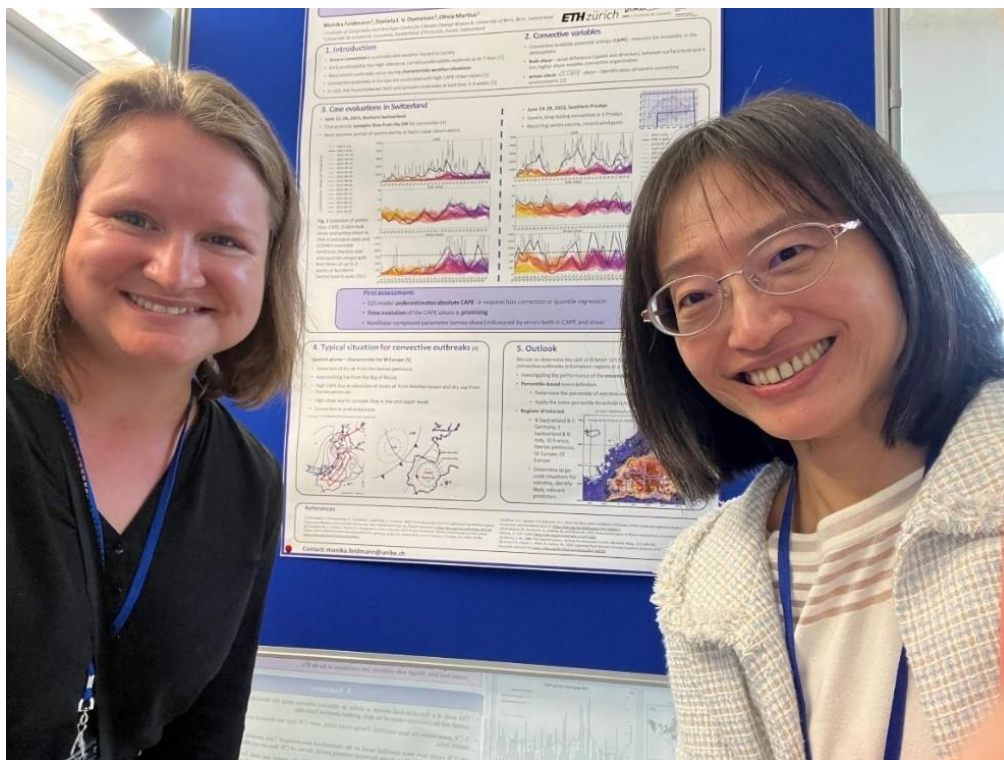


圖6、張惠玲科長與瑞士伯恩大學（University of Bern）的 Dr. Monika Feldmann 於其論文海報前合影。



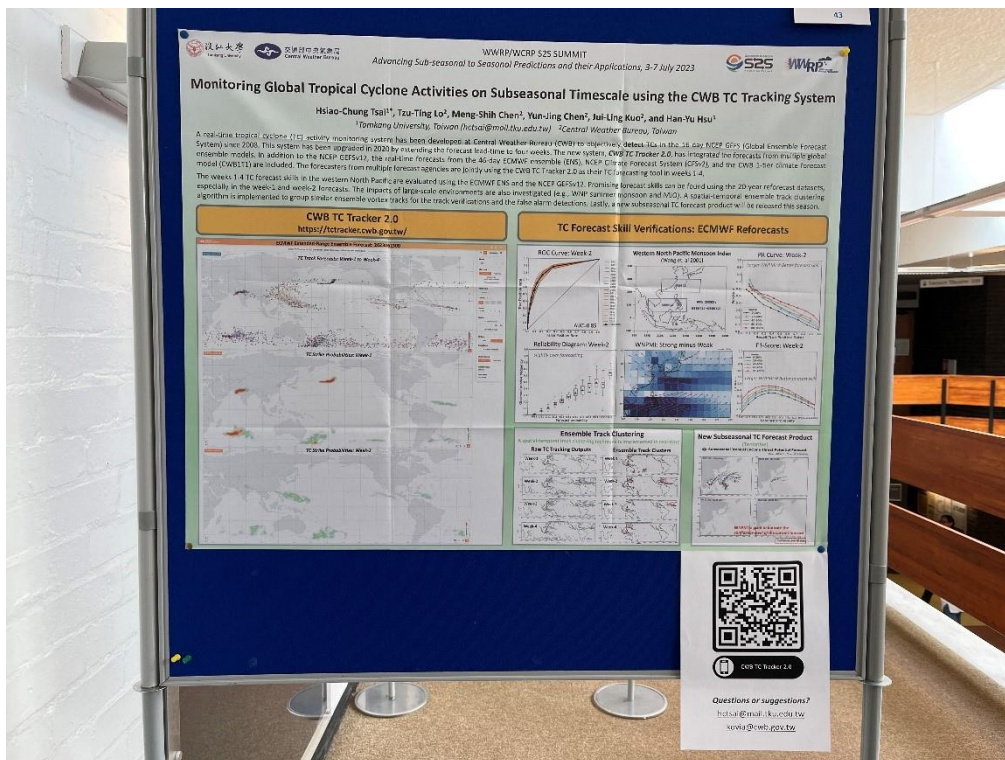


圖7、蔡孝忠副教授發表與本局合作的「熱帶氣旋展期預報系統」海報，並提供網址及 QR code 給與會科學家即時上網連結。

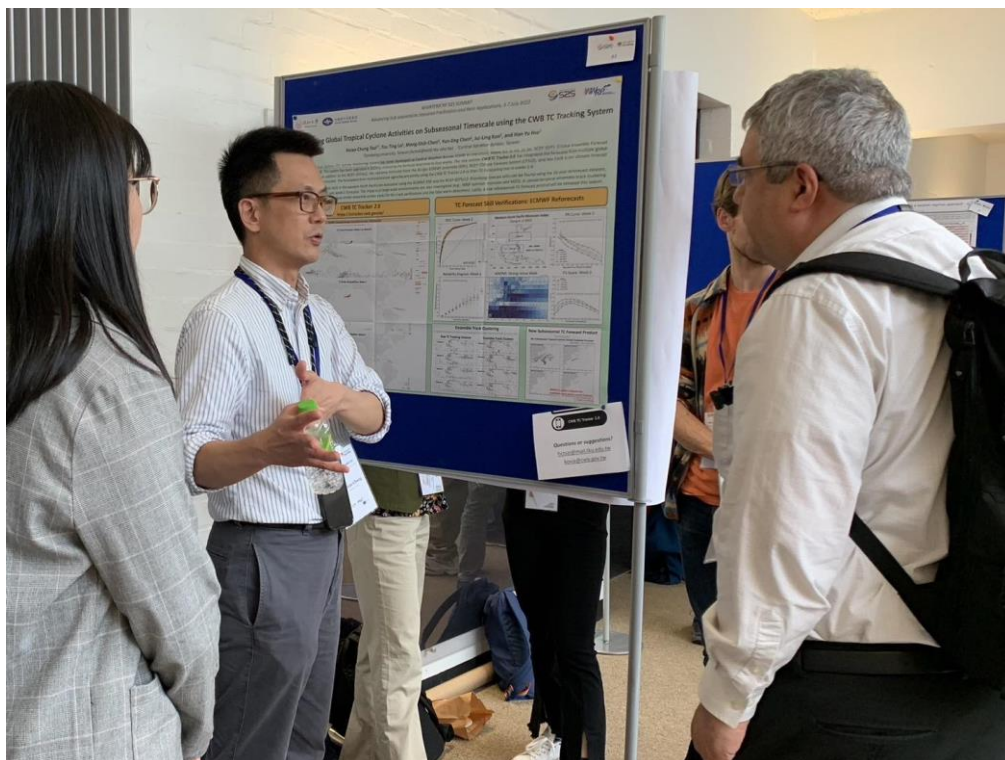


圖8、蔡孝忠副教授為美國亞利桑納大學（University of Arizona）的 Dr. Christopher Castro 講解與本局合作的「熱帶氣旋展期預報系統」。





圖9、廖苡珊技佐與美國哥倫比亞大學（Columbia University）Dr. Chia-Ying Lee 於活動會場合影。



圖10、雷丁大學主辦人 Dr. Steven Woolnough 在會議中宣傳「Running Out of Time relay」活動。