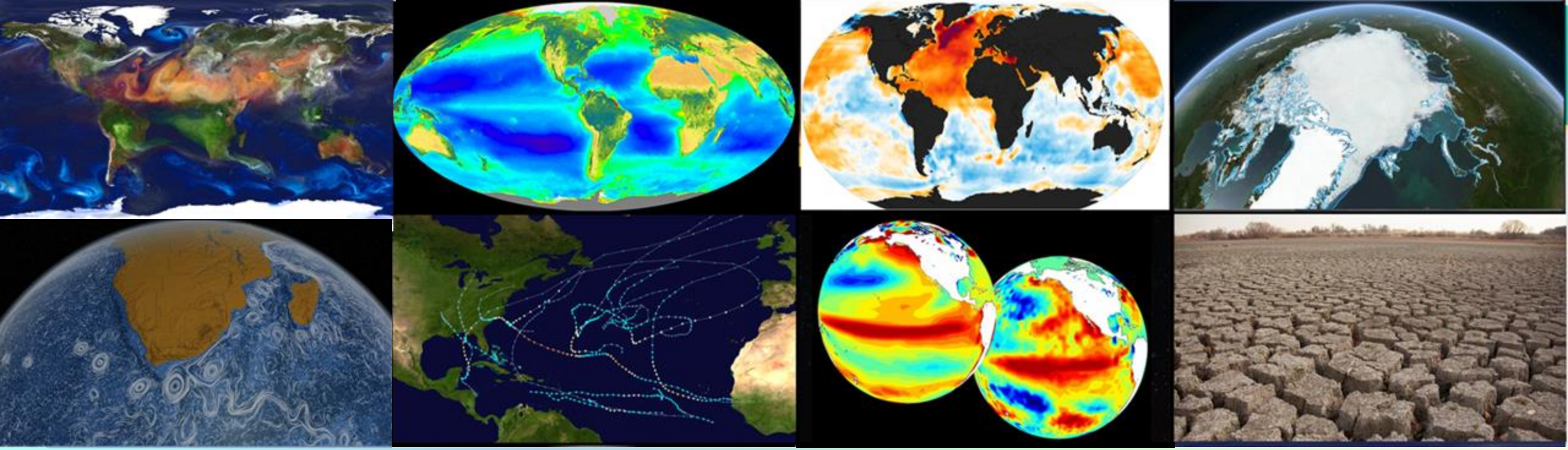
Current cycle of WGSIP projects (2019-2024):

- Prediction Capabilities
  - Monsoons
  - Ocean prediction
  - Temperature trends
- Extremes
- Information for Decision-Makers (I4D)

- Cyclical framework was implemented at WGSIP 21 in 2019
- Will be renewed at this meeting
- Some 2019-2024 activities may continue at initiative of leads
- We may wish to consider whether to label these as “projects” (as before), “activities”, “research focuses” (like CLIVAR), or…



WGSIP Extremes project

WGSIP 25/WGNE 39

4-8 November 2024

Toulouse, France

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Objectives/expected outcomes

- **Quantify the probabilities/risks of extremes,** including **unprecedented extremes,** for a range of phenomena over different regions and timescales **using large ensembles of initialised climate model simulations ("hindcasts")**

- **Assess current capability** of prediction systems **to predict extreme events**

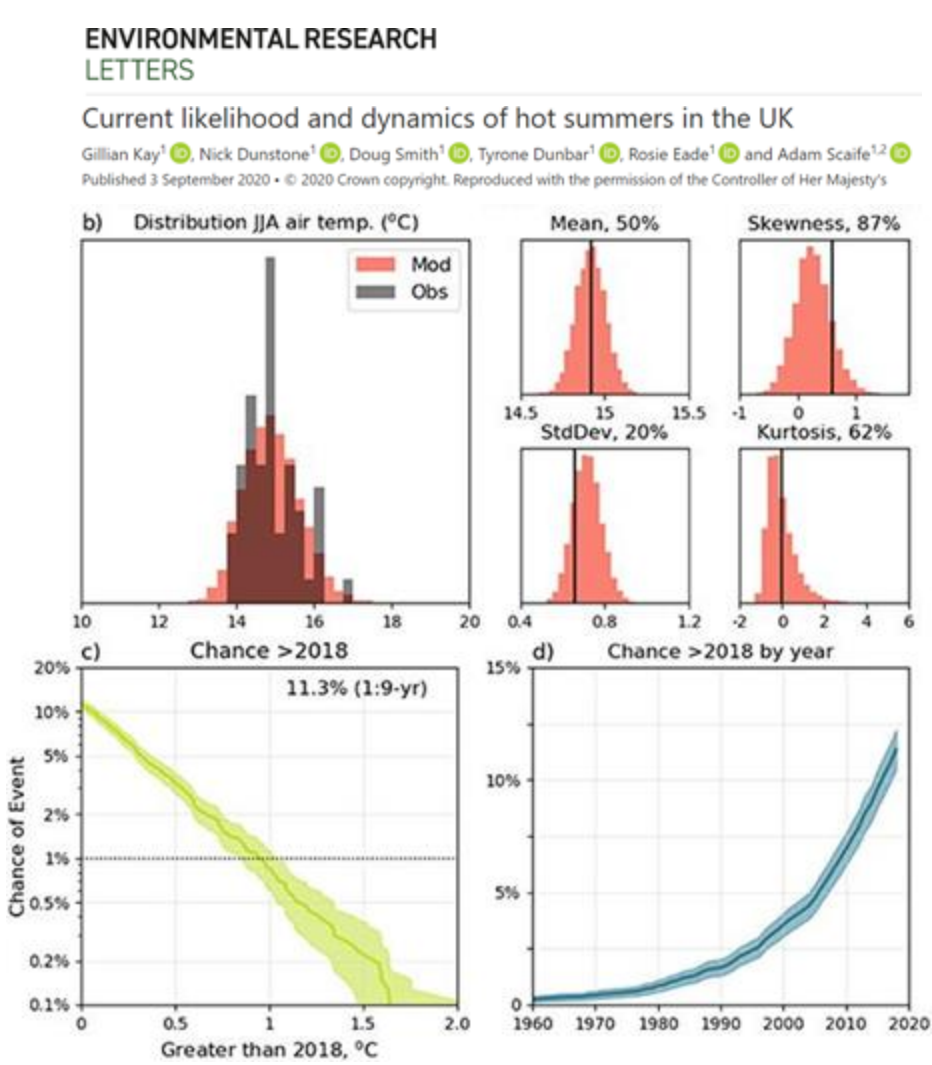
  …by exploiting hindcast databases of CHFP, S2S, C3S…

- Facilitate communication of advances in these areas

- Contribute to capacity building for Early Career Researchers in the Global South

Quantifying the probabilities of extremes

- Exploit “UNSEEN” methodology developed at Met Office:
  - assemble large volume of hindcasts
  - validate simulation quality for phenomenon of interest
  - assess tail of distribution to determine probability of unprecedented extremes



Assessment of probabilities of exceeding record hot UK summer of 2018 based on HadGEM3-GC2 decadal hindcasts

2021 Extremes Workshop

Supported and facilitated by

- Asia-Pacific Network for Global Change Research (APN)
- APEC Climate Center (APCC)

WCRP Workshop on Extremes in Climate Prediction Ensembles (ExCPEns)

- **Online from APEC Climate Center 25-27 October 2021**
- **Early Career Scientist training and discussion forum 27-28 October 2021**

Sponsored by

APN ASIA-PACIFIC NETWORK FOR GLOBAL CHANGE RESEARCH

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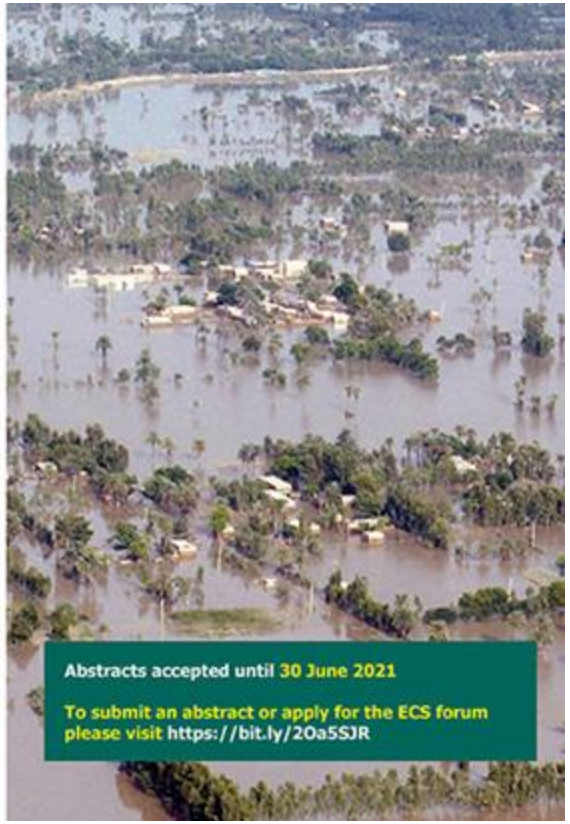
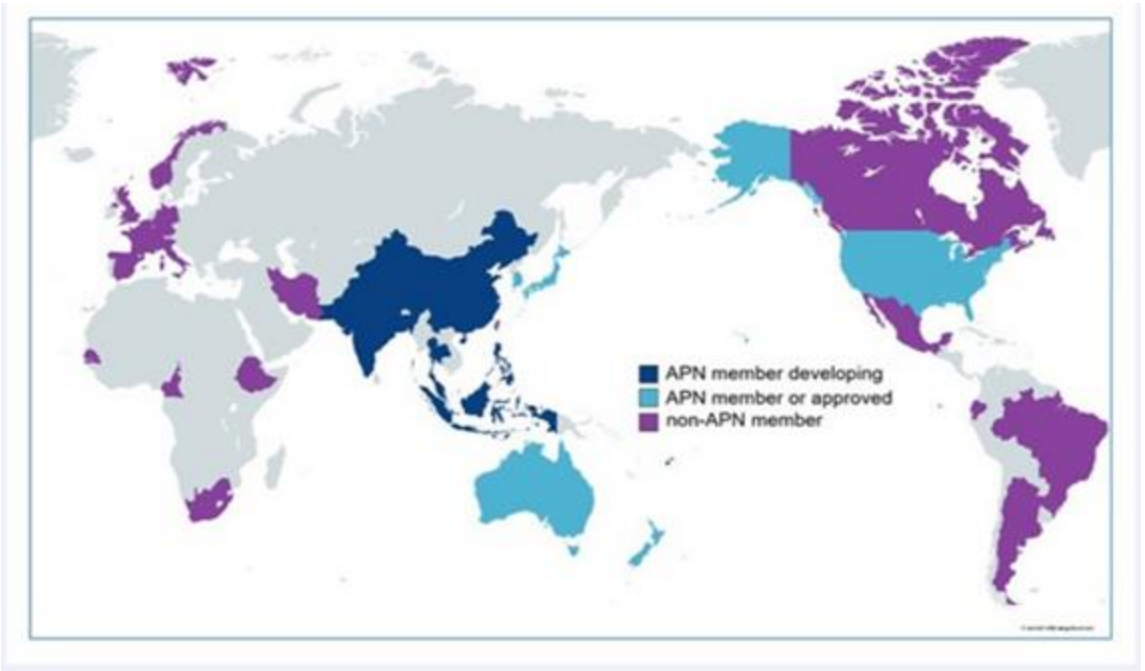
APCC APEC CLIMATE CENTER





Countries represented by Workshop and Early Career Scientist Training Session registrants.

2021 Extremes Workshop

Workshop sessions:

1. Identification of extremes in observations and climate prediction ensembles
2. Physical mechanisms of extremes in observations and climate prediction ensembles
3. Regional climate extreme information relevant to impacts, vulnerability and adaptation
4. Prediction and predictability of large-scale climate variability relevant to extreme events
5. Prediction and predictability of specific extreme events (>10 days)
6. Quantifying current and future risks of climate extremes

Scientific Organizing Committee

June-Yi Lee (PNU/ICCP, Co-chair of WCRP/WGSIP)
William Merryfield (ECCC, Co-chair of WCRP/WGSIP)
Doug Smith (UK Met Office, WCRP/EPESC)
Frédéric Vitart (ECMWF, Co-chair of WCRP/WWRP/S2S)
Xuebin Zhang (ECCC, Co-chair of WCRP/GC-Extremes)
Arun Kumar (NOAA, WCRP/WWRP/S2S)
Hongli Ren (CMA, WCRP/WGSIP)
Catherine Michaut (IPSL/UVSQ, WCRP)
Yun-Young Lee (APCC)

Local Organizing Committee

Jin-Ho Yoo (APCC)
Sangwon Moon (APCC)
June-Yi Lee (PNU/RCCS & ICCP, WCRP/WGSIP & WCRP/EPESC)

Presentation files:

https://trello.com/b/0h9RHCb4/wcrp-excpens-workshop-2021

Recorded presentations:

https://www.youtube.com/playlist?list=PLGUa1D7J0MXbFLqO3O4OMOGcDoAko9iY2

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Extremes Workshop follow up

- Meeting report in S2S Newsletter

- Summary article in APN Science Bulletin
https://doi.org/10.30852/sb.2022.1977

APN Science Bulletin
2022, Volume 12, Issue 1, 141-153, e-ISSN 2522-7971

Supporting regional and international cooperation in research on extremes in climate prediction and projection ensembles: Workshop summary

June-Yi Lee[a,b], William J. Merryfield[c *], Sangwon Moon[d], Suhee Han[d]

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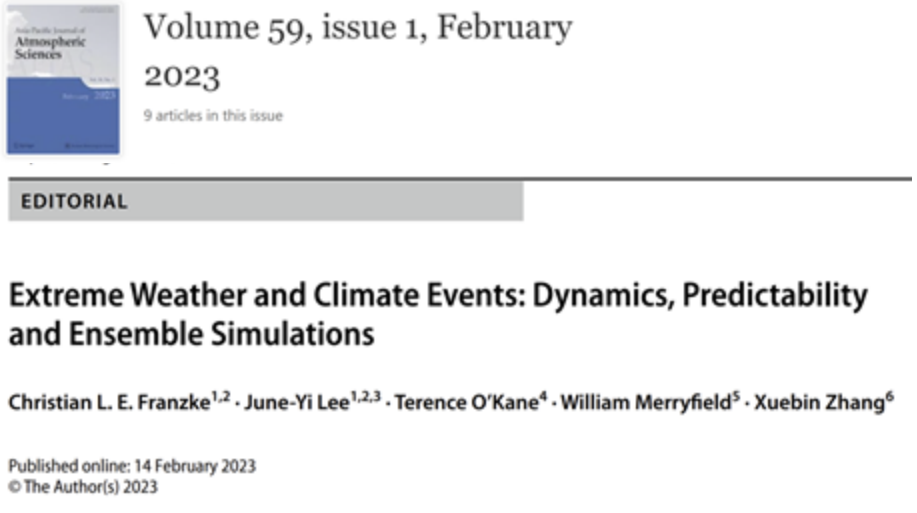
[c] Canadian Centre for Climate Modelling and Analysis, Environment and Climate Change Canada, 2472 Arbutus Rd, Victoria, V8N 1V8, BC, Canada
[d] APEC Climate Center, Centum 7ro, 48058, Haeundaegu, Busan, Republic of Korea
[*] *Corresponding author. Email: bill.merryfield@ec.gc.ca.*

- Special issue in APJAS
https://doi.org/10.30852/sb.2022.1977



Volume 59, issue 1, February 2023
9 articles in this issue

EDITORIAL

Extreme Weather and Climate Events: Dynamics, Predictability and Ensemble Simulations

Christian L. E. Franzke[1,2] · June-Yi Lee[1,2,3] · Terence O'Kane[4] · William Merryfield[5] · Xuebin Zhang[6]

Published online: 14 February 2023
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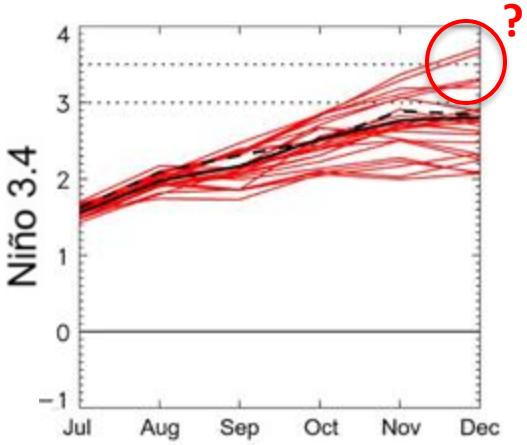
Home › Asia-Pacific Journal of Atmospheric Sciences › Article

Estimating Probabilities of Extreme ENSO Events from Copernicus Seasonal Hindcasts

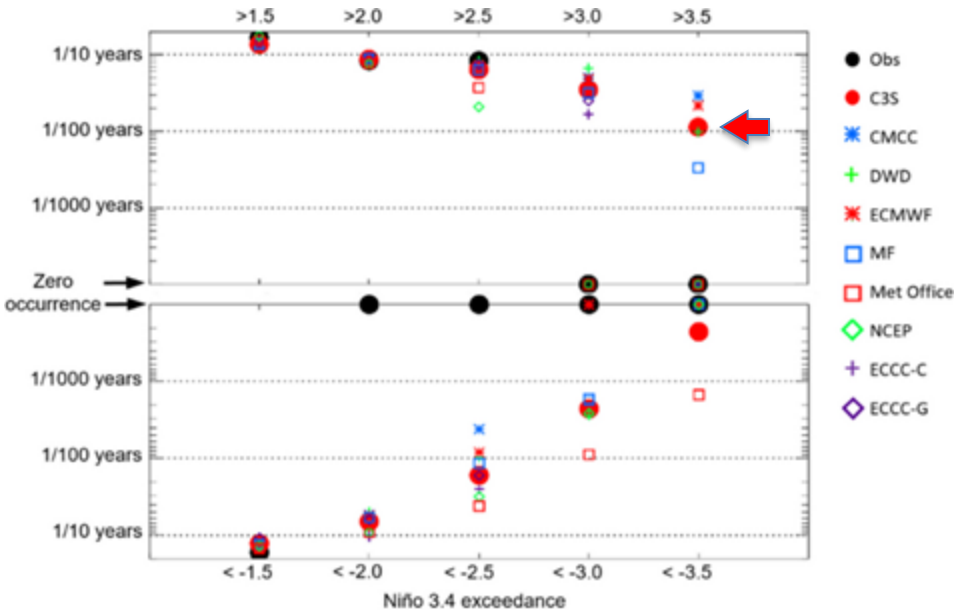
Original Article | Open access | Published: 04 May 2023
https://doi.org/10.1007/s13143-023-00328-2
Volume 59, pages 479–493, (2023) Cite this article

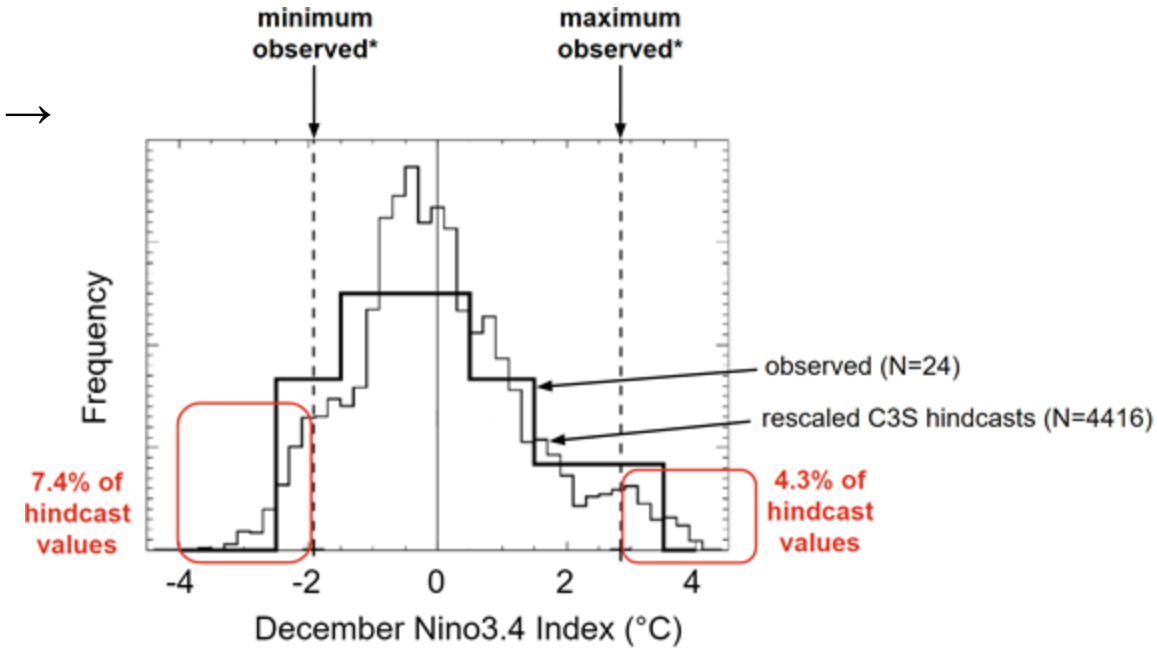
William J. Merryfield & Woo-Sung Lee



Amplitude-rescaled ECMWF SEAS5 from Jul 2015

- 184 realizations of 1993-2016 ENSO variability
- Bias correct Niño3.4 for mean and interannual variance
- Many simulated Decembers exceed obs Niño3.4 extremes →
- Implied return period ~100 years for Niño3.4>3.5°C





Also: Wang, Y., **H.-L. Ren***, et al. 2022: *JGRA,* MJO Phase Swings Modulate the Recurring Latitudinal Shifts of the 2020 Extreme Summer-Monsoon Rainfall Around Yangtse, https://doi.org.10.1029/2021JD036011

Multi-year Prediction of Statistics of Marine and Terrestrial Heatwaves

Alexia Karwat[1], June-Yi Lee[1,2], Christian L. E. Franzke[2], and Yong-Yub Kim[2], Eun-Young Kwon[2], Robert C. Garrett[3], and Sun-Seon Lee[2]

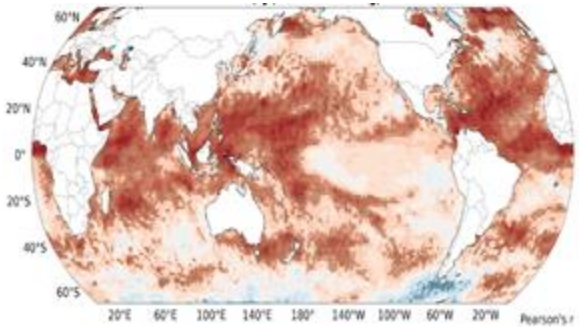
[1] Research Center for Climate Sciences, Pusan National University, Busan, Republic of Korea
[2] IBS Center for Climate Physics, Busan, Republic of Korea
[3] Department of Statistics, University of Illinois at Urbana-Champaign, Urbana, IL, USA

- Data Period: 1981 - 2020
- Observation: ERA5 and NOAA SST
- Model Experiments: 50-member **CESM2-LE**, 20-member Ocean assimilation (**ASSM**), 20-member hindcast initiated from Jan 1 (**HIND**)
- Marine Heat Wave (**MHW**) = 5 consecutive days ≥ 90th percentile of SST (e.g., Holbrook et al., 2020; Amaya et al. 2023)
- Terrestrial Heat Wave (**THW**) = 3 consecutive days ≥ 90th percentile of 2mT

Anomaly Correlation Coefficient Skill from Forcing
CESM2-LE vs Obs

Frequency of MHWs

DJF



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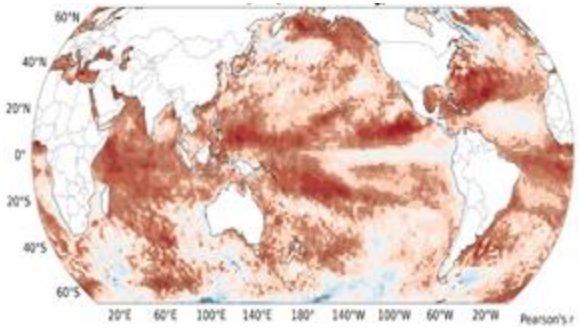
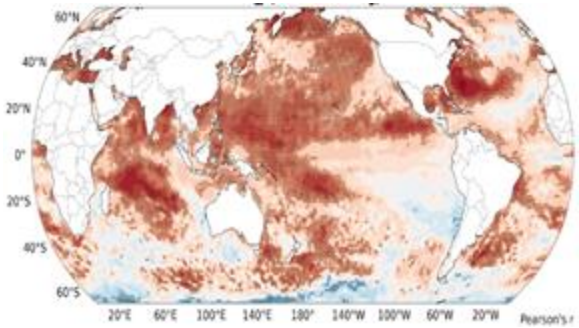


JJA



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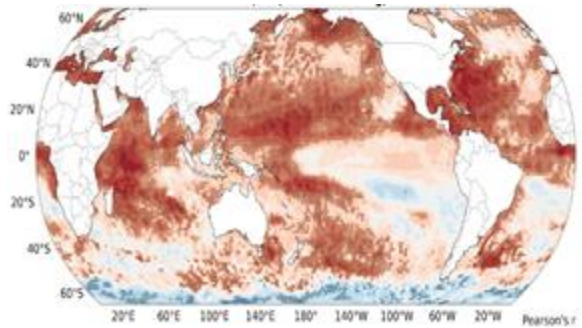
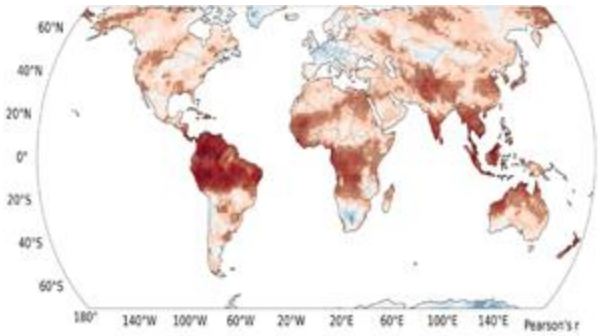


Frequency of THWs

DJF



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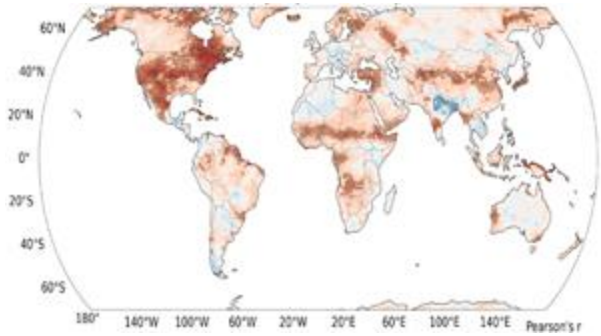

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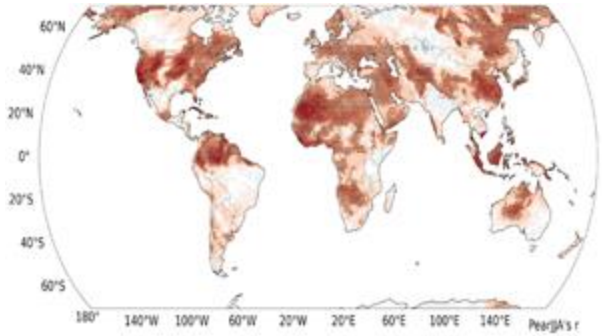

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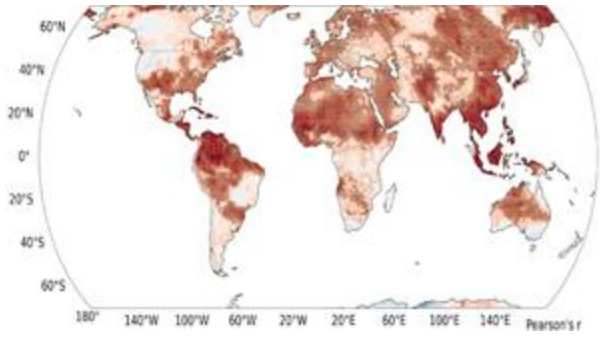
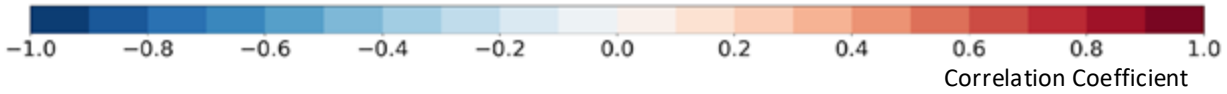
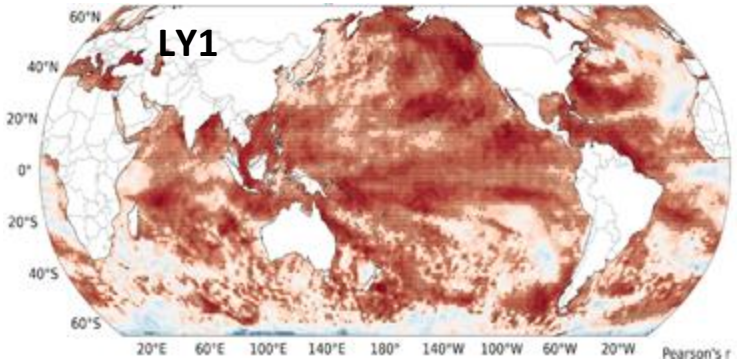




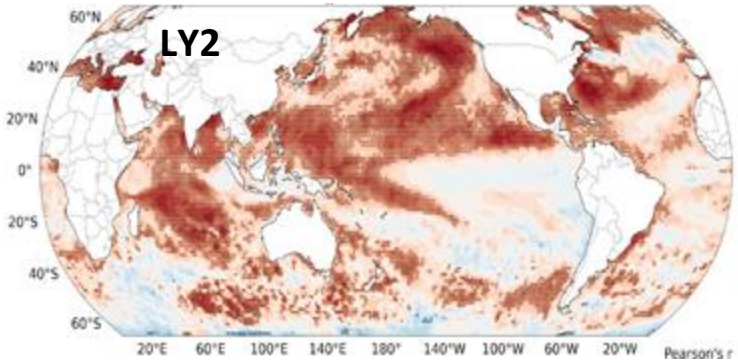
- High skill over many region due to the increasing trend of MHWs and THWs under GHG warming

Anomaly Correlation Coefficient Skill for JJA MHWs (Total Skill)

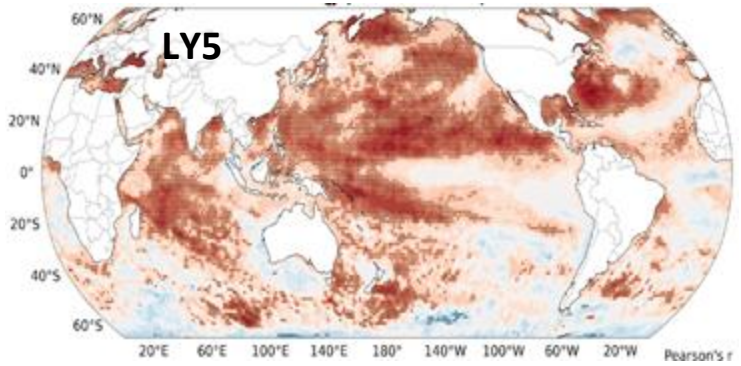
5-month Lead



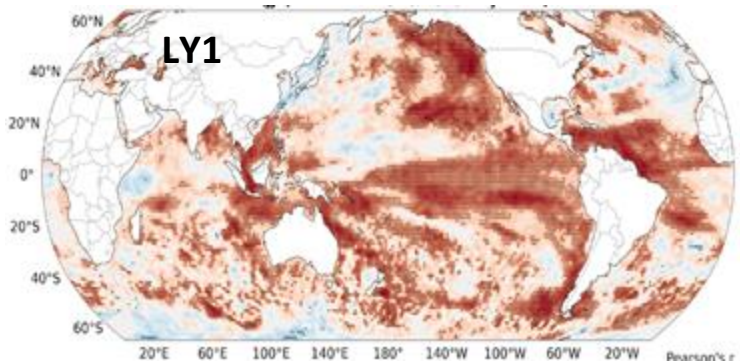
17-month Lead

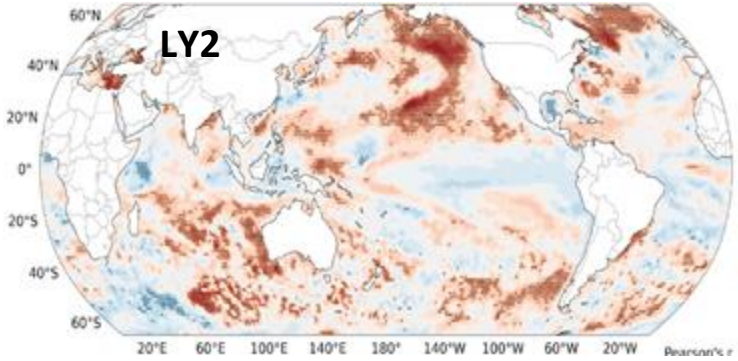


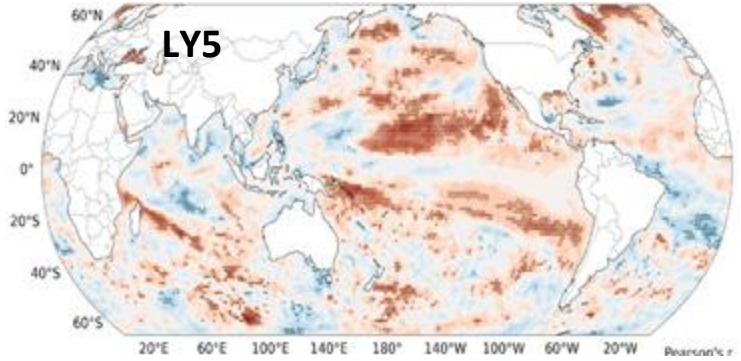
53-month Lead

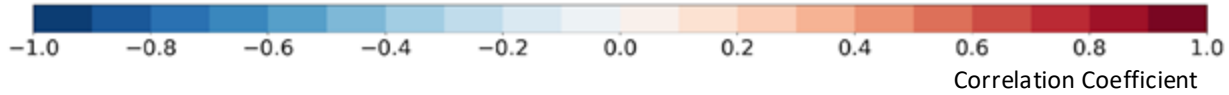


Anomaly Correlation Coefficient Skill for JJA MHWs from Internal Variability









- Multi-year skills are mainly due to the increasing trend. However, internal modes of variability also contribute to multi-year prediction skills for MHWs and THWs depending on region and season.

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For discussion

- Is there an impetus for extremes activity to continue?
- Would need updated plan, subgroup to take ownership
- Should we consider to coordinate activities with EPESC WGIII?

EPESC WGIII

Priority Hazards

1. Tropical Cyclones
2. Extreme precipitation & droughts
3. Heatwaves
4. Compound extremes

- **Objectives**:
  1. Quantifying the current likelihood of specific weather and climate hazards
  2. Quantifying changes in weather and climate hazards on multi-annual to decadal timescales
  3. Understanding the processes connecting changes in hazards to natural and anthropogenic drivers of climate variability and change
  4. **Advancing capabilities to predict and project changes in hazards**

➢ *Extreme event & hazard attribution on **A2D scale***

➢ *Links between hazards & large-scale circulation*