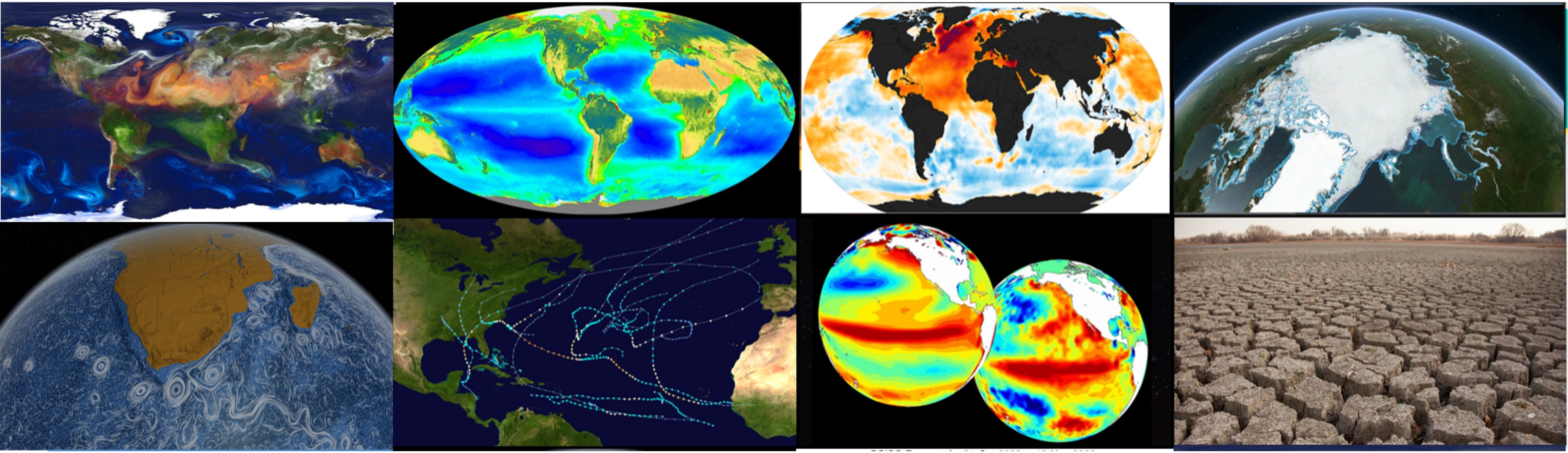


Updates on WGSIP Extremes, Ocean Prediction and Temperature Trends Projects

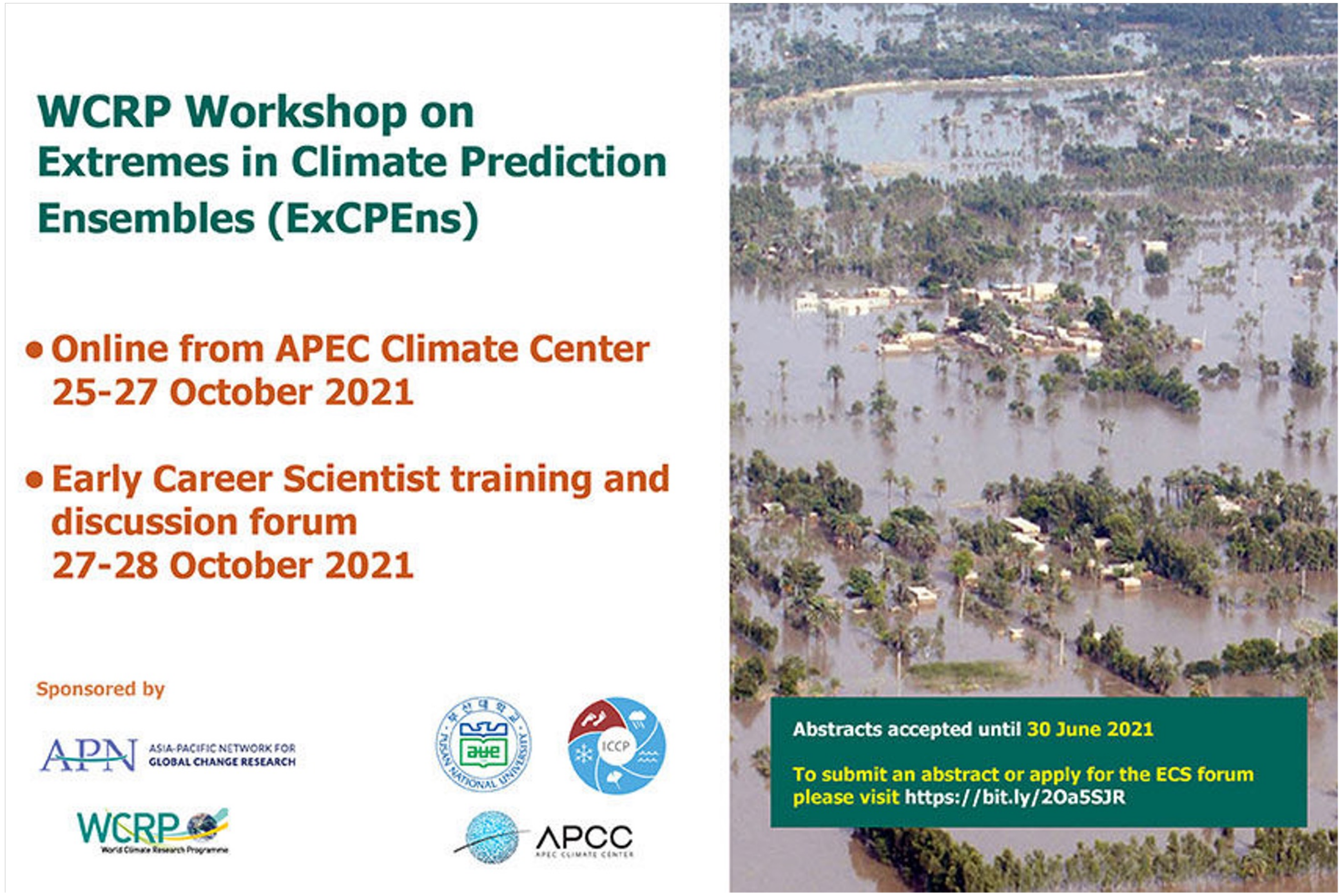
WGSIP 24
27-29 March 2023
ECMWF, Reading UK

WGSIP Extremes project

<u>Objectives</u>

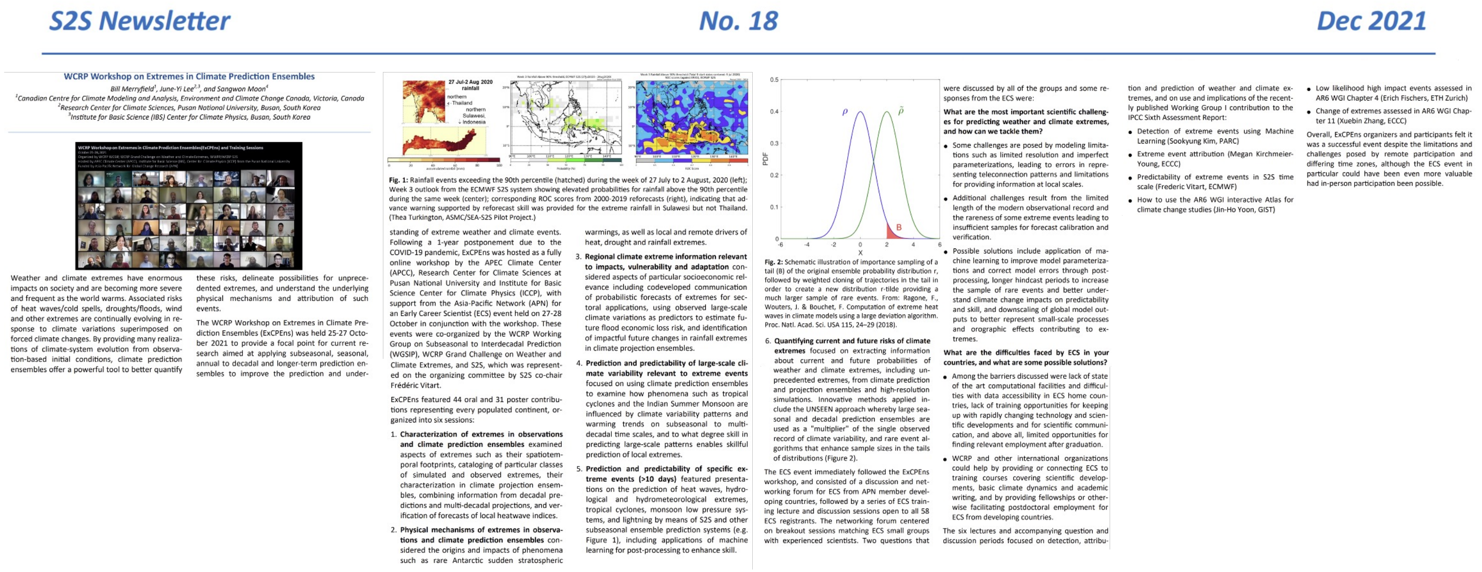
- To **quantify the risks of extremes** for a range of phenomena, over different regions and timescales, **using large ensembles of initialised climate model simulations**
- **Assess current capability** of climate models **to predict extreme events,** highlighting opportunities for operational prediction

…by exploiting CHFP and S2S databases, other sources including ESGF and C3S



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

APN ASIA-PACIFIC NETWORK FOR GLOBAL CHANGE RESEARCH

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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[d] APEC Climate Center, Centum 7ro, 48058, Haeundaegu, Busan, Republic of Korea
* Corresponding author. Email: bill.merryfield@ec.gc.ca.

- Special issue in APJAS

Volume 59, issue 1, February 2023

9 articles in this issue

EDITORIAL

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

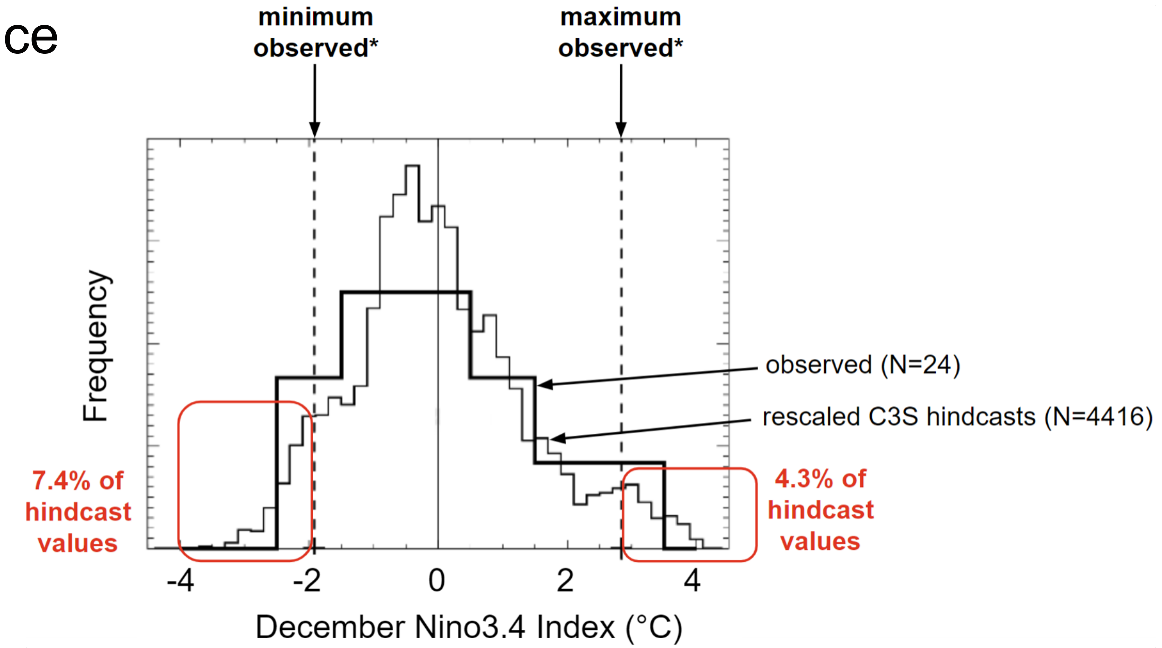
Christian L. E. Franzke[1,2] · June-Yi Lee[1,2,3] · Terence O'Kane[4] · William Merryfield[5] · Xuebin Zhang[6]

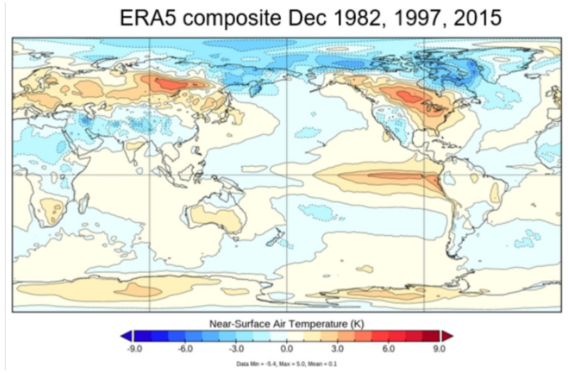
Published online: 14 February 2023

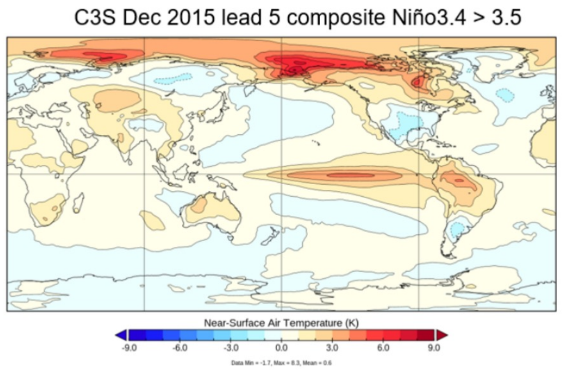
Extreme ENSO events in Copernicus seasonal hindcasts

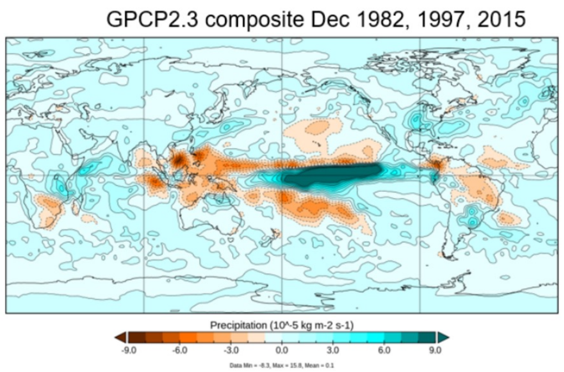
(Revised W. Merryfield & W.-S. Lee submission under review with APJAS)

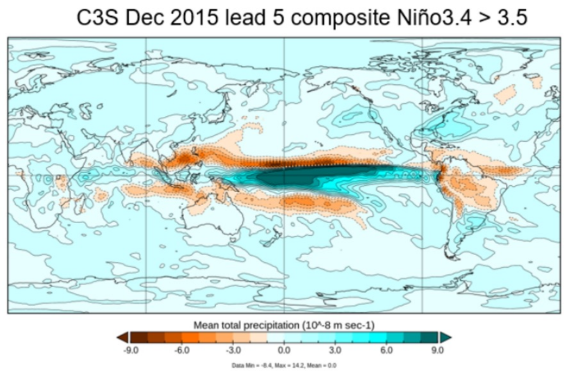
- 184 realizations of 1993-2016 ENSO variability at 0-5 month lead time
- Bias correct Niño3.4 for mean and interannual variance
- Key results:
  - Many of the 4416 simulated months at lead 5 exceed observed +/- Dec Niño3.4 extremes
  - Suggests possibility of unprecedented ENSO extremes, e.g. Niño3.4>3.5 every ~100 years ↓
  - ENSO amplitude biases vs model & lead time strongly correlated with cold tongue bias







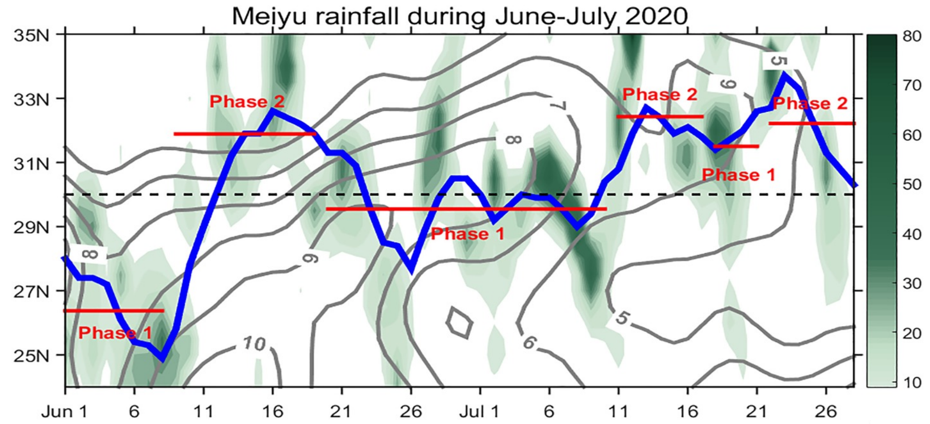


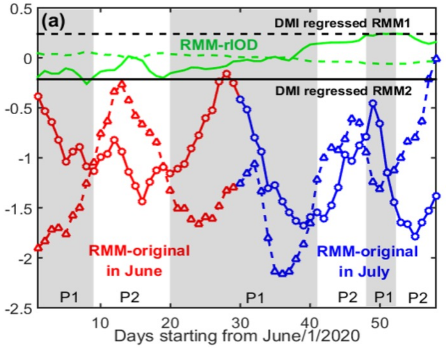


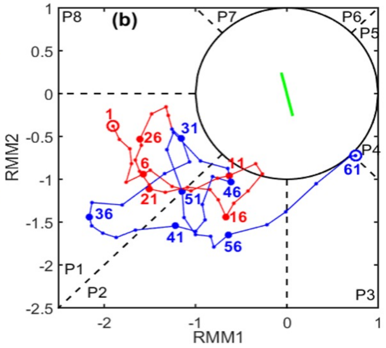
MJO Phase swings modulate the recurring latitudinal shifts of the 2020 extreme summer-monsoon rainfall around Yangtse

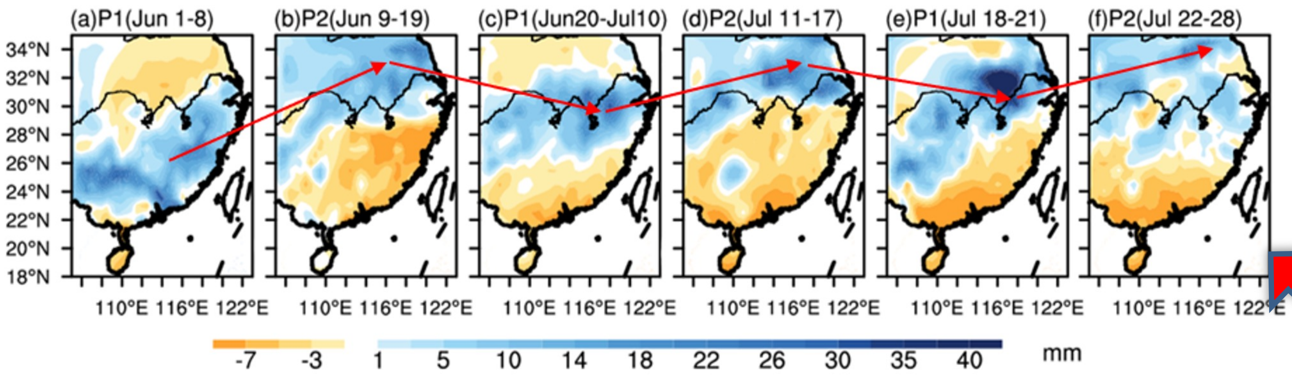
Wang, Y., **H.-L. Ren***, et al. 2022: *Journal of Geophysical Research: Atmospheres*, **127**(6), https://doi.org.10.1029/2021JD036011

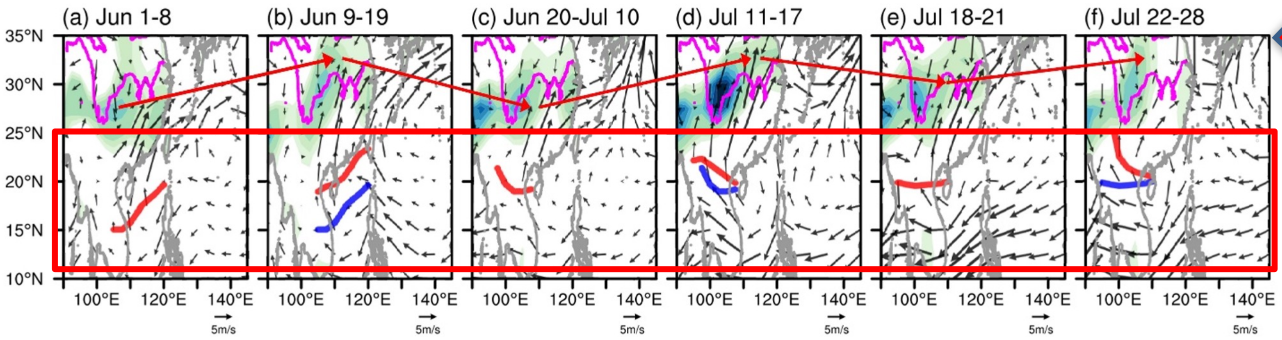
- The extreme rainfall episodes in June–July of 2020 manifest as recurring latitudinal shifts around Yangtse river;
- The north-south shifts of 2020 Meiyu rainfall shows a high correspondence with the recurring MJO Phase 1–2 swings;
- The MJO modulates the latitudinal shifts of Meiyu rainfall mainly through changing the westward extended ridge line of WNP anticyclone.











MJO phase variations between 1 and 2

WNP anticyclone ridges shift latitudinally

WGSIP Ocean Prediction project

Objectives

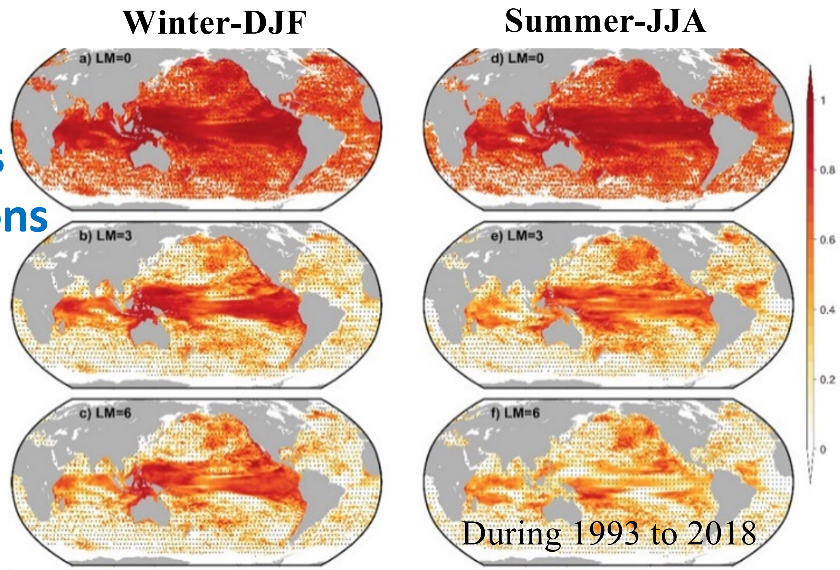
- Systematically **evaluate prediction capabilities for ocean variables besides** SST across time scales and for multiple climate prediction systems
- Assess **performance of individual prediction systems** in relation to their initialization, resolution, etc.
- Assess **multi-model performance gains**
- Assess **properties and suitability of different verification datasets**, utility of multi-product verification
- Assess **sources of predictability** and ability of models to represent them
- Facilitate useful **real-time forecasting of ocean properties** having societal impacts

Main focuses so far: sea surface height (SSH), mixed-layer depth (MLD)

Seasonal predictions of sea surface height in BCC-CSM1.1m and their modulation by tropical climate dominant modes

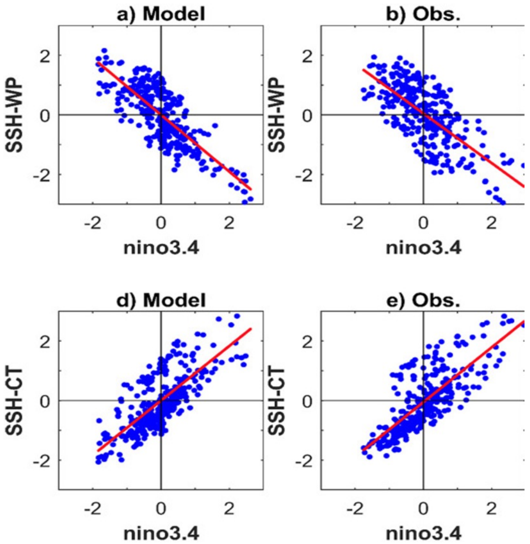
Wang, G.J., **H.-L. Ren***, et al. 2023: Atmospheric Research, 281:106466. https://doi.org/10.1016/j.atmosres.2022.106466

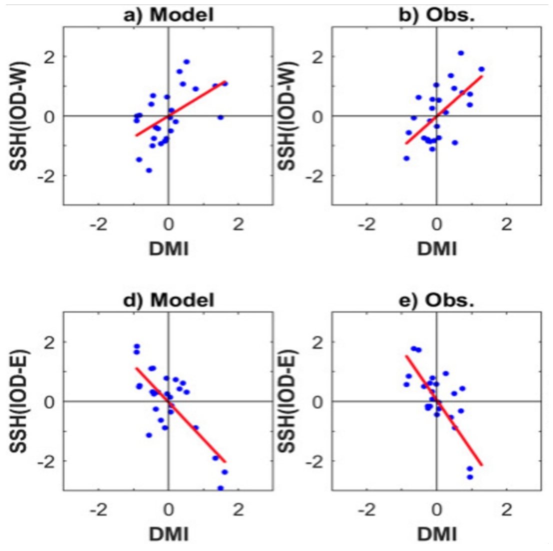
TCC scores distributions



- Prediction skills of SSH in BCC-CSM1.1m are overall higher during boreal winter than summer.
- ENSO/IOD is the main source of predictability for SSH over tropical Pacific/Indian Ocean.

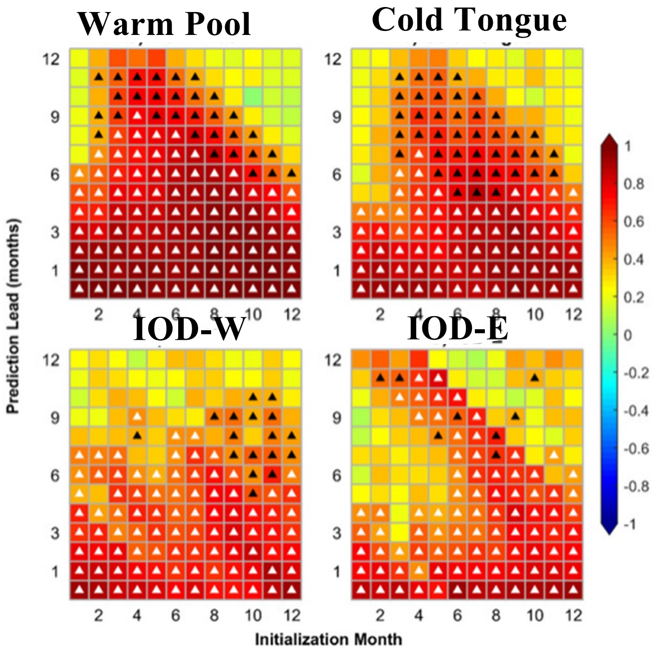
Relationship between regional SSH variations and ENSO and IOD →





Warm Pool (WP):
Cold Tongue (CT):
western IOD (IOD-W) :
eastern IOD (IOD-E) :

TCC scores as a function of initial month and prediction lead months →

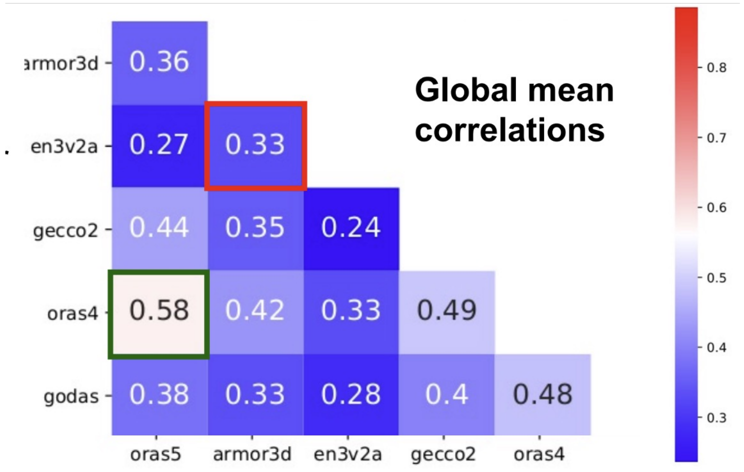


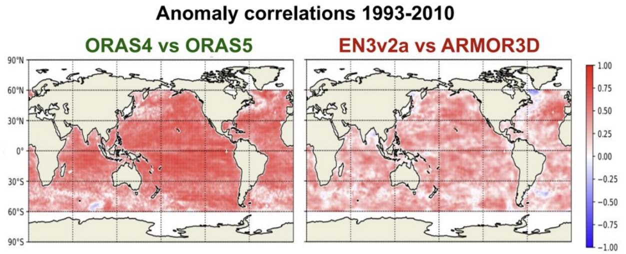
Ocean prediction poster cluster at OSC23

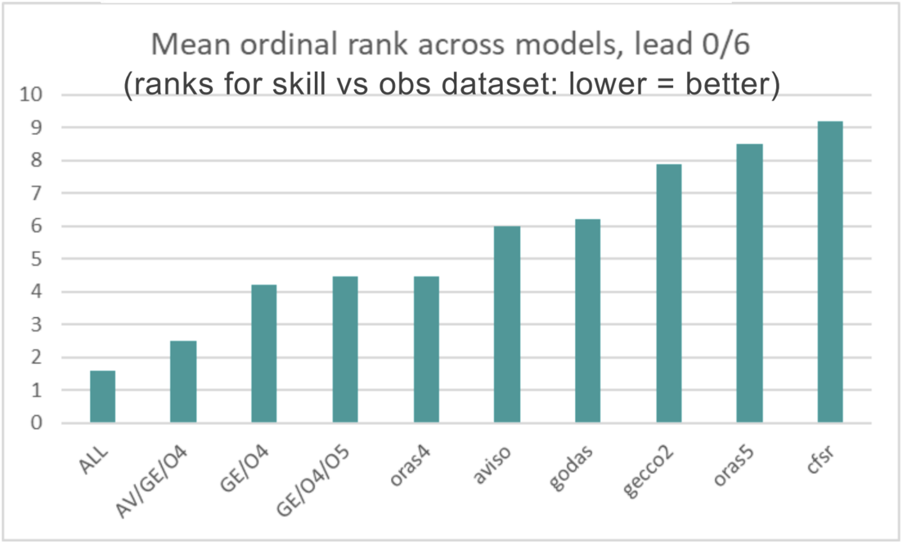
- 14 abstracts received, including W. Merryfield & W.-S. Lee, “Prospects for seasonal prediction of mixed-layer depth”

MLD prediction results & plans

- MLD is important for ecosystems, atmosphere-ocean interactions
- Intercompare multiple verification products (done) →
- Assess skill of 5 CHFP models & combinations thereof
- Assess utility of **multi-product verification**, as for SSH →
- Paper discussing skills, efficacy of verification datasets, potential utility of seasonal MLD predictions



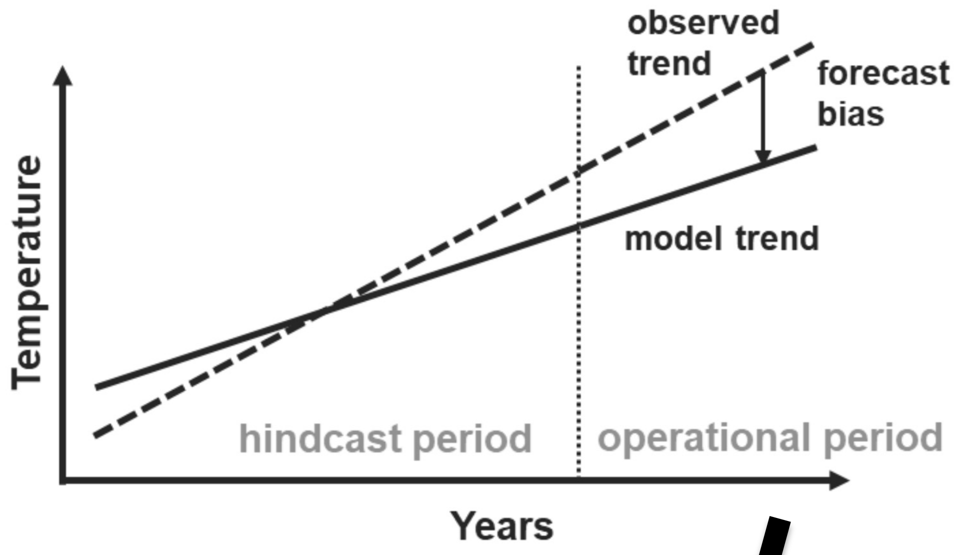


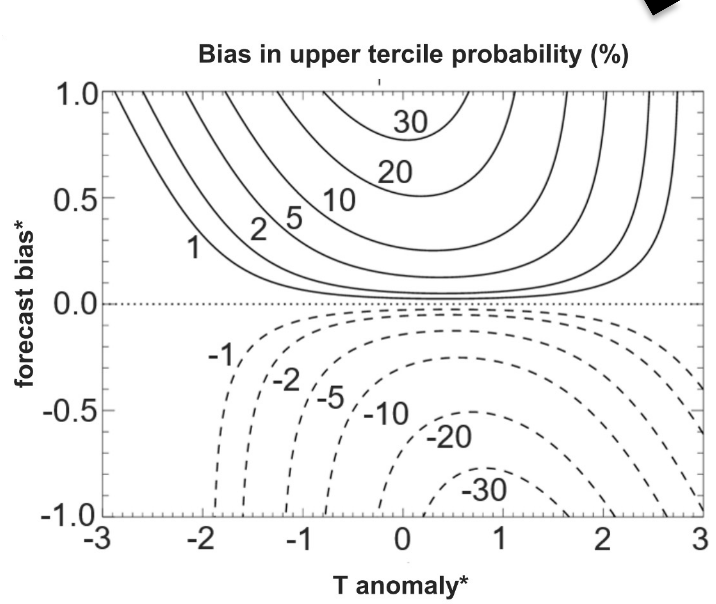


WGSIP Temperature Trends project

Objectives

- Assess long-term global and regional **temperature trend errors** as a function of lead time across many seasonal prediction systems
- Assess extent to which temperature trend errors **impact temperature prediction skill**
- Relate trend errors to radiative forcings and initialization methodologies
- Develop a **synthesis** of previous & new results for the community



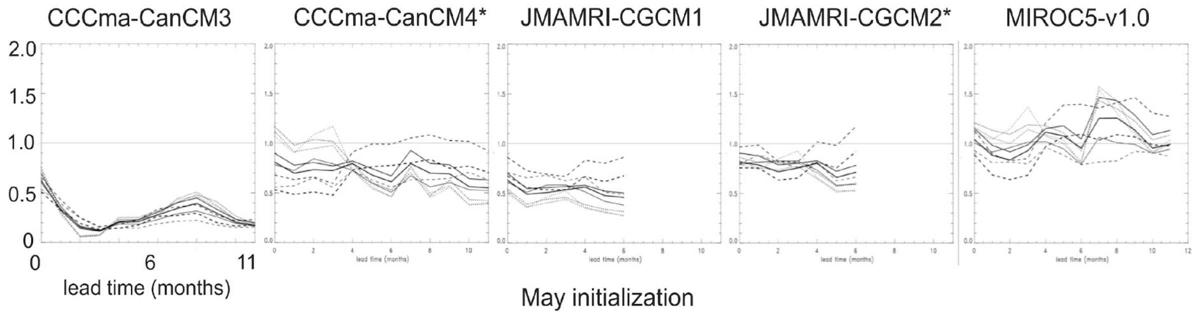


*in units of standard deviations of the forecast distribution

Results & community activity

- Temperature trend errors ~20 models have been assessed →
- The issue of how such errors can bias forecasts & skill measures is gaining traction in the community, though not in a coordinated manner ↓

- Trend ratios (model/obs)
- Consider common 1981-2010 hindcast period



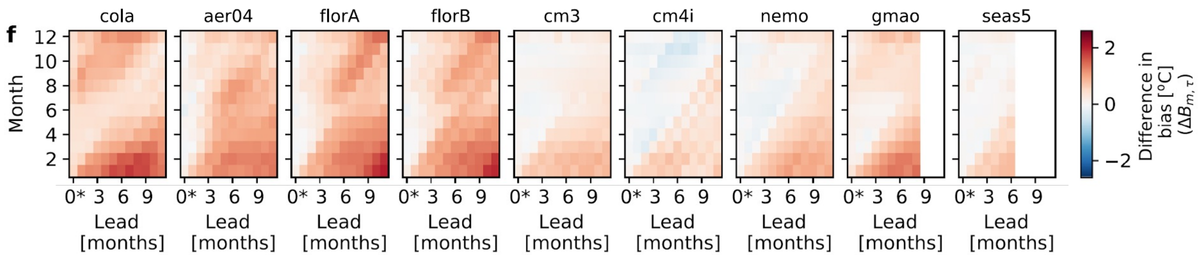
nature COMMUNICATIONS

https://doi.org/10.1038/s41467-021-23771-z OPEN

Standard assessments of climate forecast skill can be misleading

James S. Risbey[1,6✉], Dougal T. Squire[1,6], Amanda S. Black[1], Timothy DelSole[2], Chiara Lepore[3], Richard J. Matear[1], Didier P. Monselesan[1], Thomas S. Moore[1], Doug Richardson[1], Andrew Schepen[4], Michael K. Tippett[5] & Carly R. Tozer[1]

2021



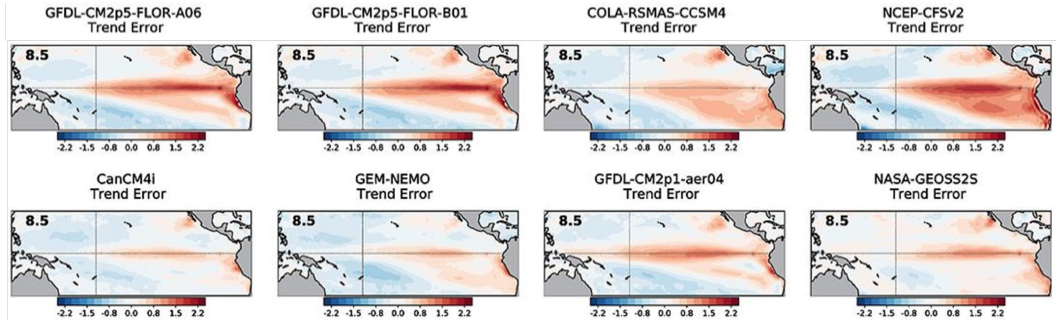
Δ(Eq Nino3.4 ST bias), (1999-2016)-(1982-1998)

frontiers | Climate

Prediction Challenges From Errors in Tropical Pacific Sea Surface Temperature Trends

Michelle L. L'Heureux[1*], Michael K. Tippett[2] and Wanqiu Wang[1]

2022



SST trend error at 8.5 month lead, 1982-2014

For discussion

Ideas and suggestions for

- Further engagement with other groups
- Additional WGSIP-driven or coordinated activities
- Promoting new approaches for research in this area
- …