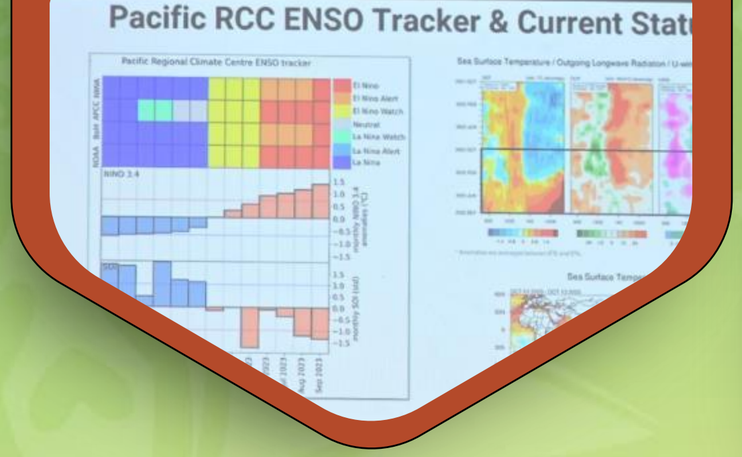


17th SESSION
PACIFIC ISLANDS CLIMATE OUTLOOK FORUM
(PICOF-17)

22 - 23 October, 2025

Port Vila, Vanuatu

WMO Global Annual to Decadal Climate Update 2025

Melissa Seabrook

PICOF-17

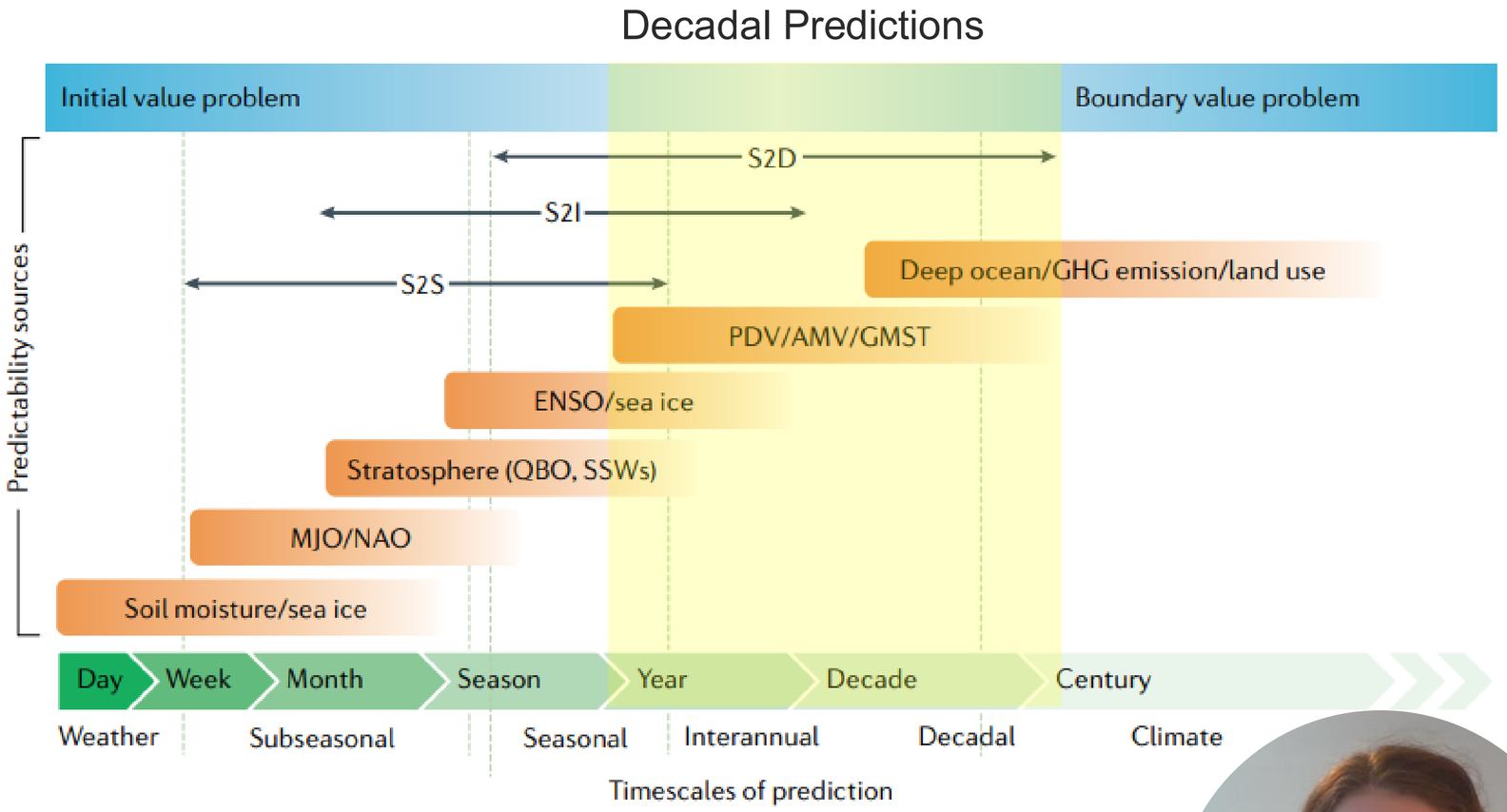
17/10/2025

Met Office
Hadley Centre

History of Decadal Prediction

What are Decadal Predictions?

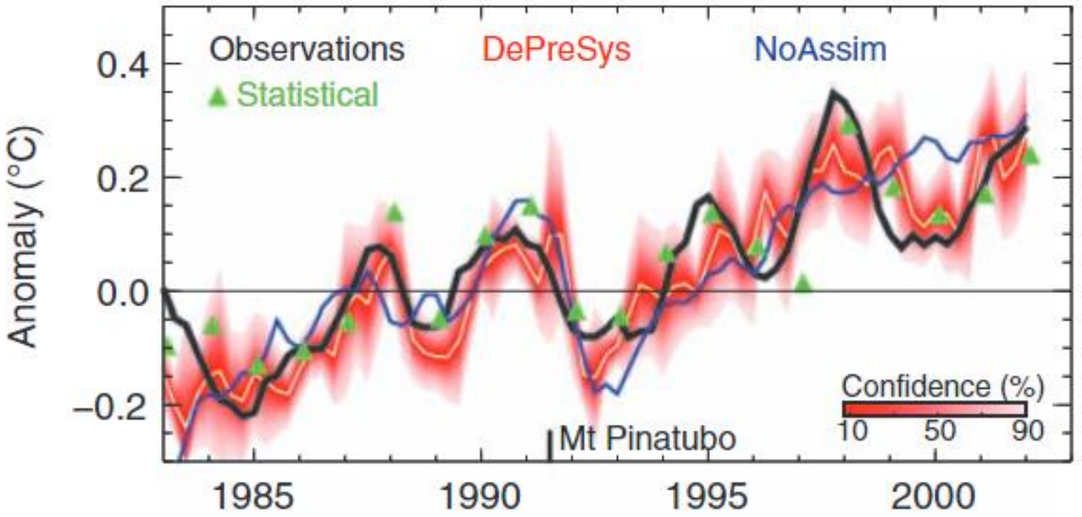
- Model runs for ~10 years
- Fairly recently developed (Smith et al 2007)
- Bridge the gap between seasonal and climate change projections, accounting for both **natural variations** AND **climate change** to give more skilful predictions



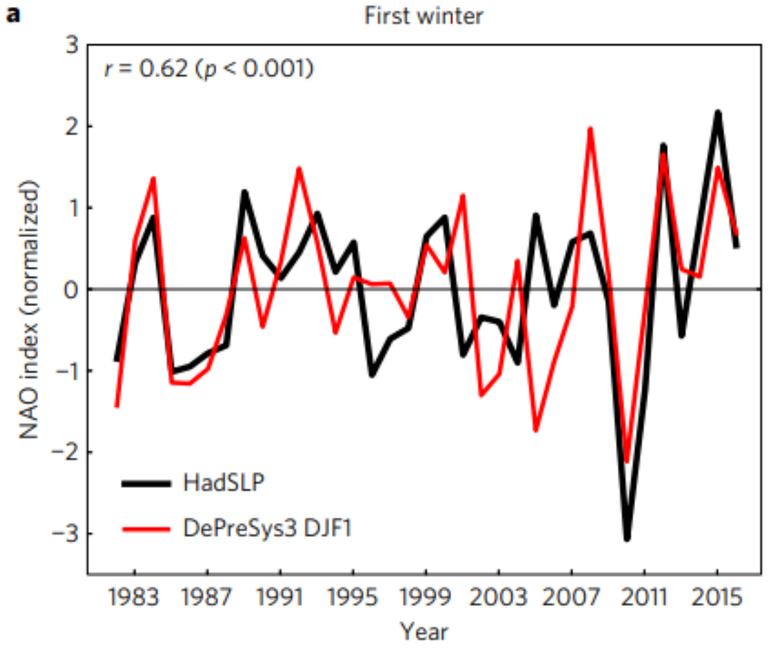
Timescales and sources of predictability: Meehl et al 2021, Nature

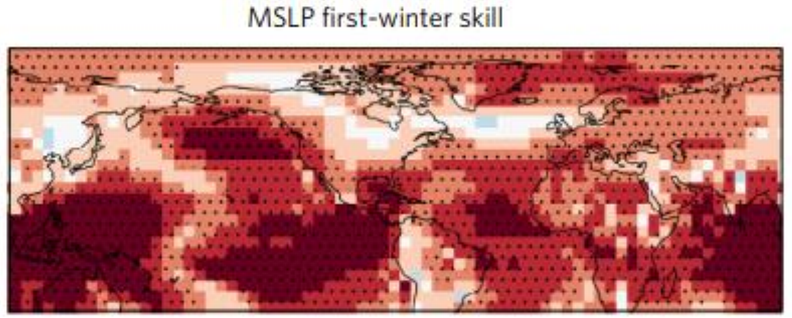
History of Decadal Prediction at Met Office

- Started off with DePreSys in 2007 showing improved temperature forecasts
- Decadal Predictions added to CMIP5 ~2010
- Many papers including on the NAO one year ahead, multiyear NAO, extremes, African rainfall, European rainfall, hurricanes, etc.



Global Temperature Anomaly for first year of hindcasts, Smith et al 2007, Science





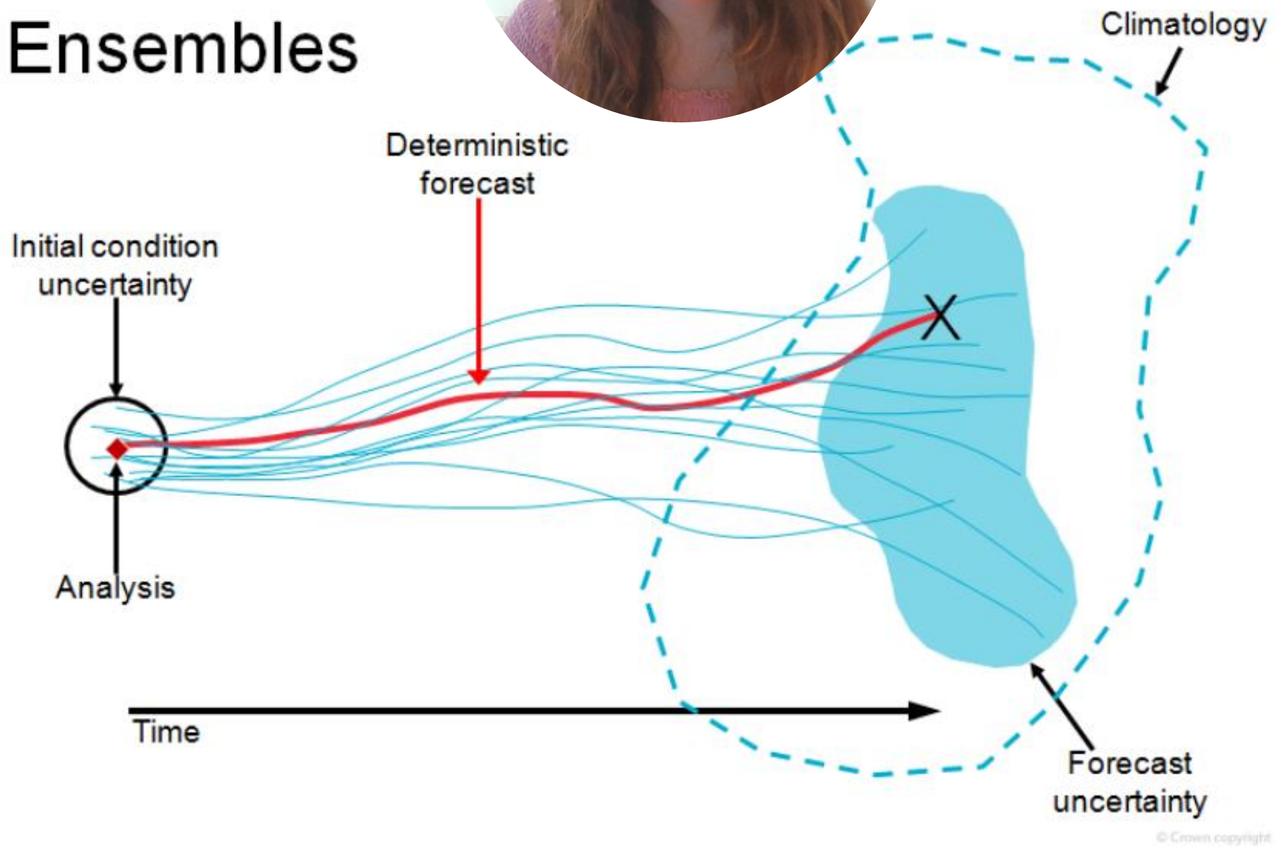
Timeseries of NAO and map of MSLP skill for first-winter in DePreSys3, Dunstone et al 2016, Nature.

Operational Use

DePreSys - 2010
DePreSys2 – 2012
DePreSys3 - 2014
DePreSys4 – 2021
DePreSys5 – 2026?

Large Ensembles

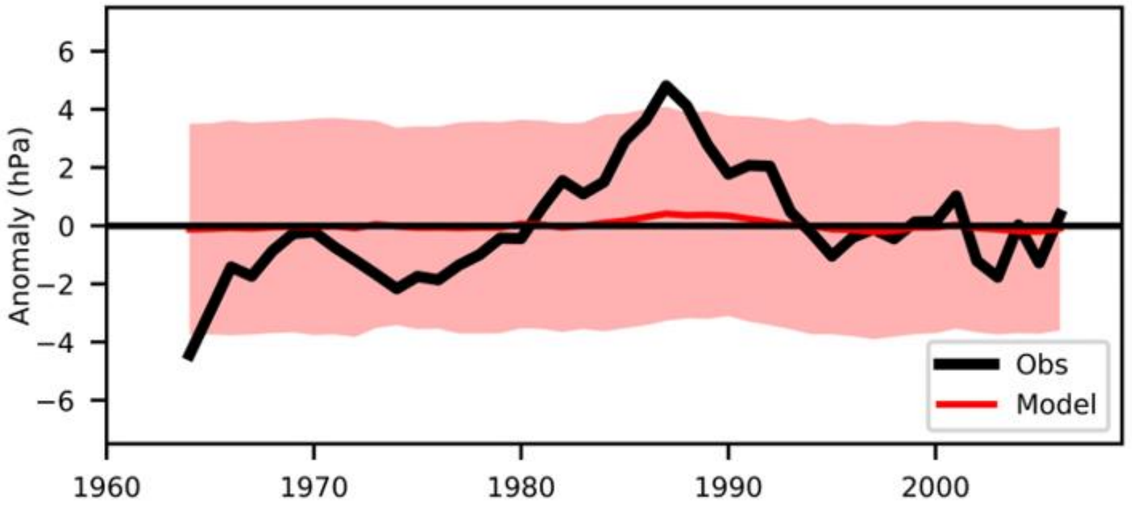
- The climate is a ***chaotic*** system; its evolution is highly dependent on small changes which can lead to drastic differences in the future.
- To quantify uncertainties an ***ensemble*** of many forecasts is created, differing by small perturbations, to estimate the future range of possibilities.
- We want our ensemble to be as large as possible in order to identify the range of possible outcomes, assess the model spread and therefore reduce uncertainties



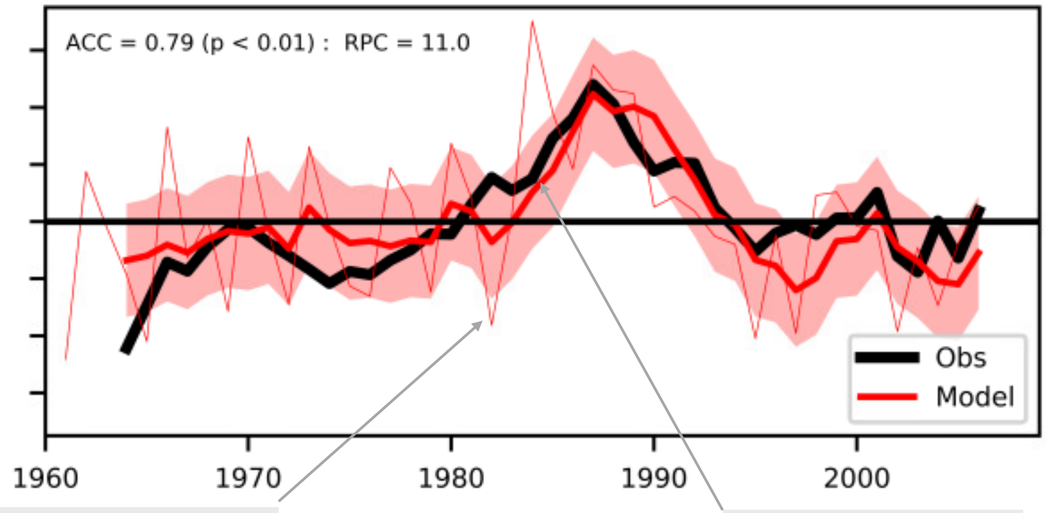
Forecast signal is MUCH too weak

NAO : Forecast years 2 to 9

Raw model output



Variance adjusted



169 member mean

676 member mean

Ratio of predictable components RPC = 11

Signal is an order of magnitude too weak in climate model ensemble

Need 100 times the number of ensemble members to extract the signal

Smith et al 2020

Doug Smith, Ec

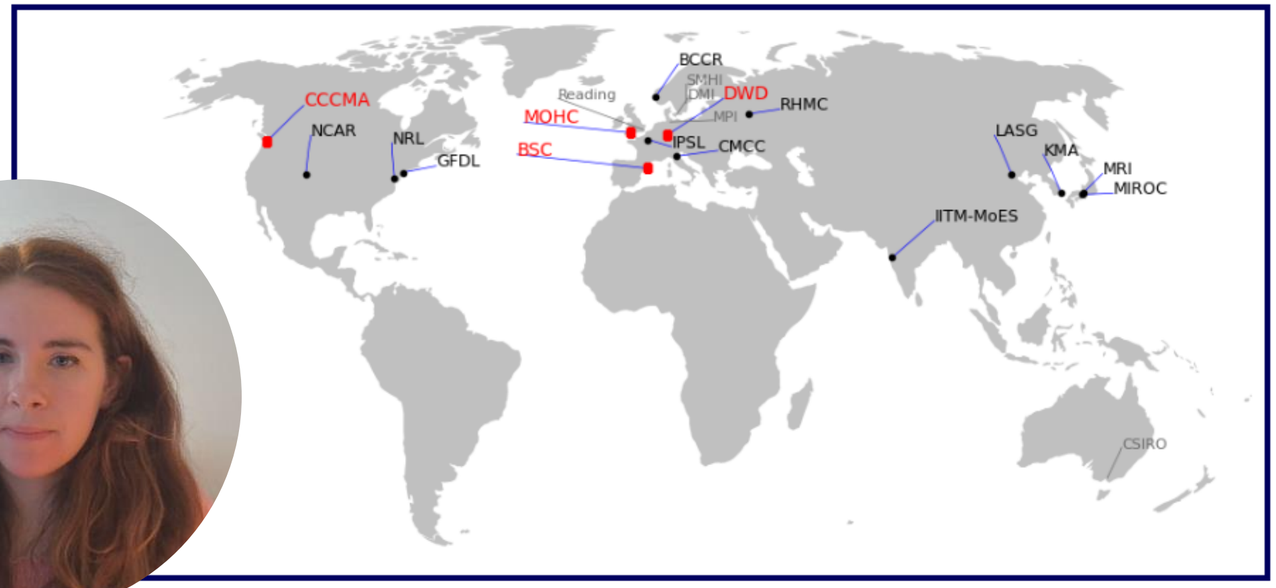
Met Office
Hadley Centre

WMO Lead Centre for Annual to Decadal Climate Prediction

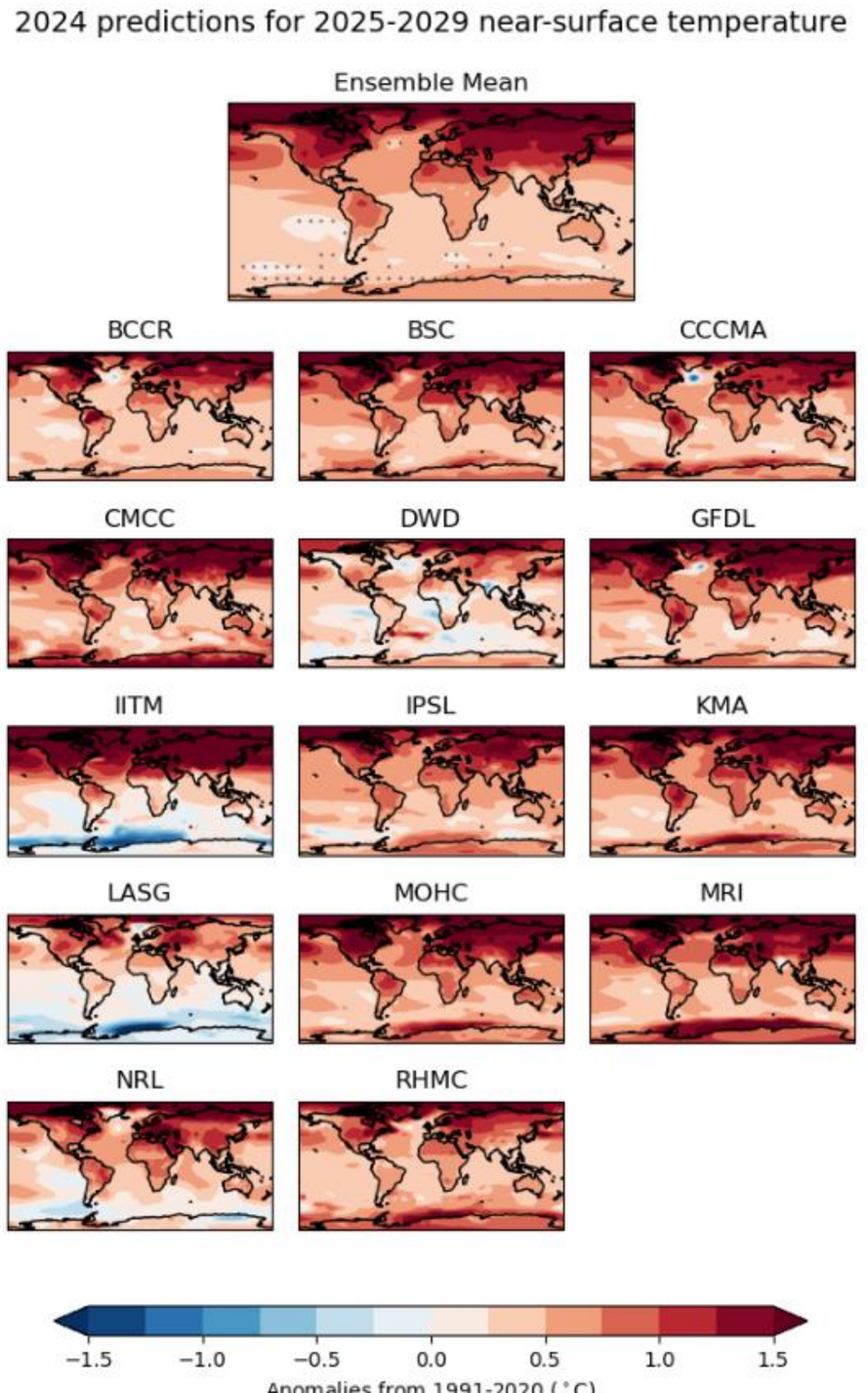
Operational Multi-Annual Predictions: WMOLC Website

WMO Lead Centre for Annual-to-Decadal Climate Prediction

The Lead Centre for Annual-to-Decadal Climate Prediction collects and provides hindcasts, forecasts and verification data from a number of contributing centres worldwide.

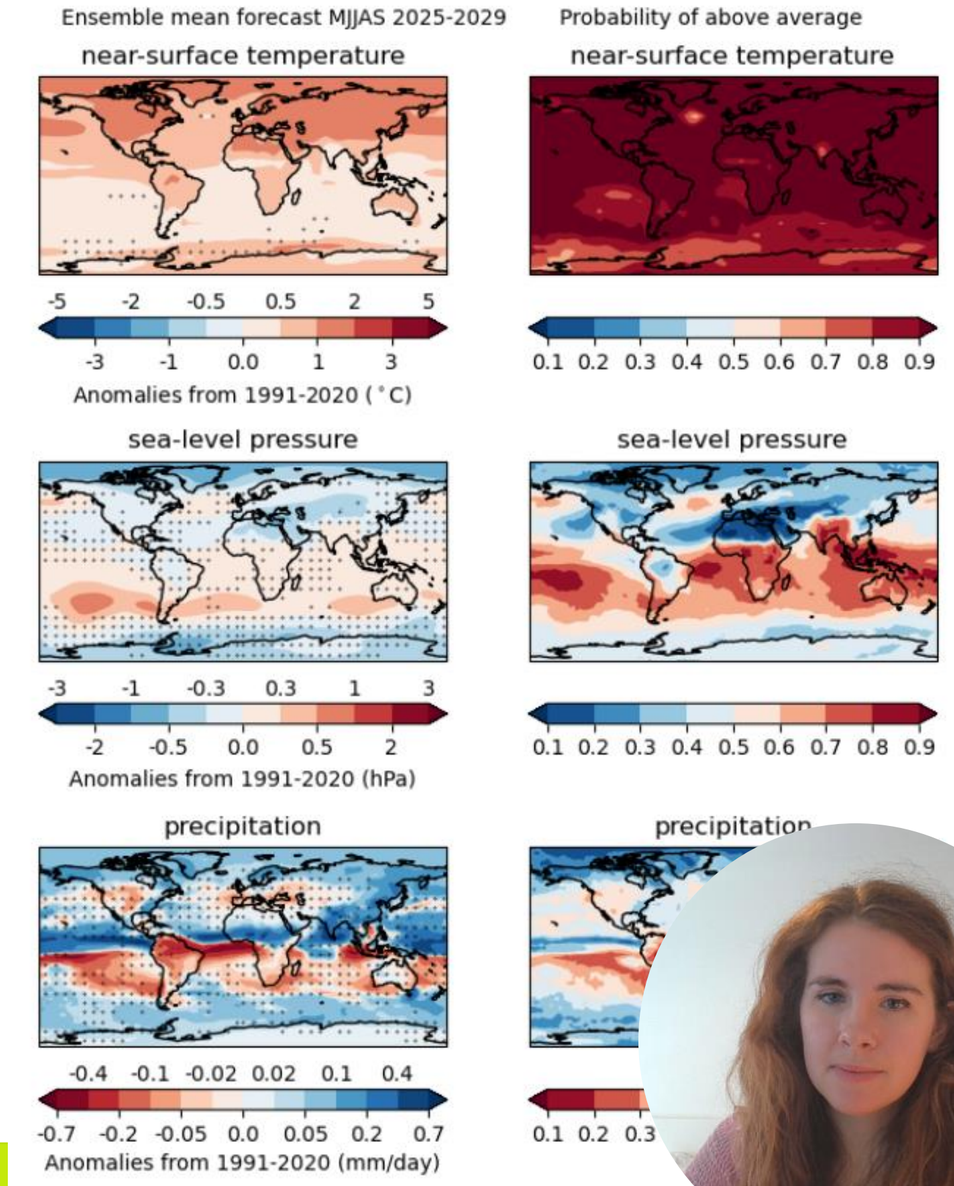


wmolc-adcp.org

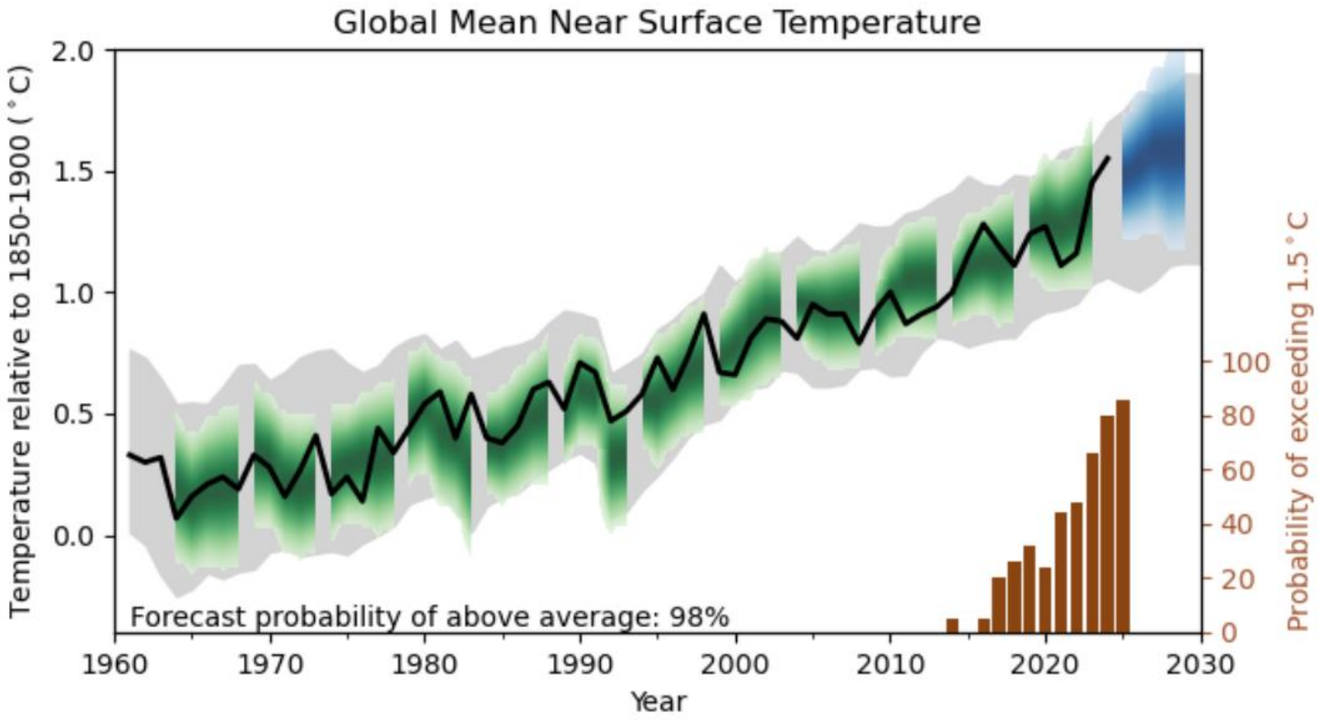


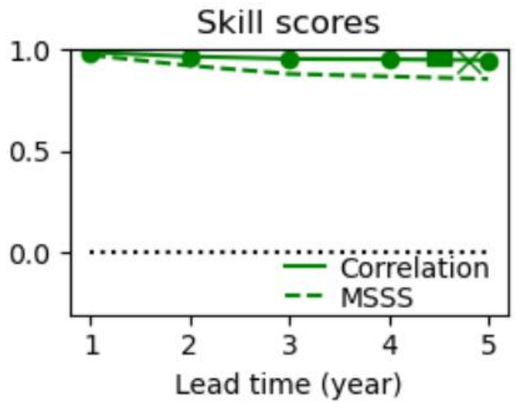
WMO Global Annual to Decadal Climate Update

- Issued annually by WMO Lead Centre for Annual to Decadal Climate Prediction, hosted by the Met Office
- This year there was international contributions from 14 different institutes from around the world
- Climate *predictions* for the next five years
- Considered one of the key annual reports of the WMO
- Key messages:
  - It is likely (86% chance) that global mean near-surface temperature will exceed 1.5°C for at least one year between 2025 and 2029.
  - It is also likely (70% chance) that the 2025-2029 five-year mean will exceed 1.5°C above the 1850-1900 average
- New Update out **every May** which was covered by many international news outlets.



Global temperatures likely to continue at record levels for 2025-2029





Forecast \ Observed	Above	Below
Above	16	1
Below	0	41

Hit rate: 100%
False alarm rate: 5%

- The annual mean global near-surface temperature for each year between 2025 and 2029 is predicted to be between 1.2°C to 1.9°C higher than pre-industrial levels
- The chance of at least one year exceeding the current warmest year, 2024, in the next five years is 80%
- Although exceptionally unlikely, there is a chance (1%) of at least one year in the next five exceeding 2 °C above pre-industrial levels

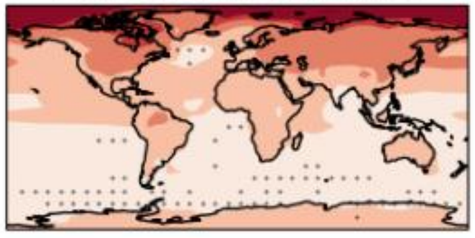
NDJFM 2025/26-2029/30 Forecasts

Baseline: 1991-2020

Met Office Hadley Centre

Ensemble mean forecast | NDJFM 2025/26-2029/30

near-surface temperature



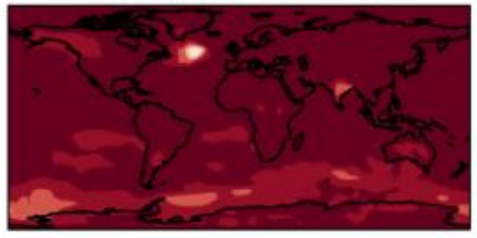
-5 -2 -0.5 0.5 2 5

-3 -1 0.0 1 3

Anomalies from 1991-2020 (°C)

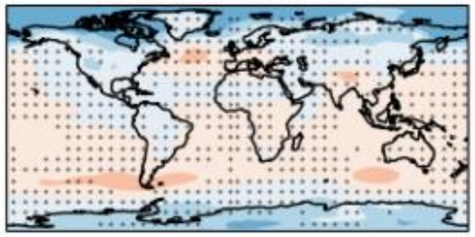
Probability of above average

near-surface temperature



0.1 0.2 0.3 0.4 0.5 0.6 0.7 0.8 0.9

sea-level pressure

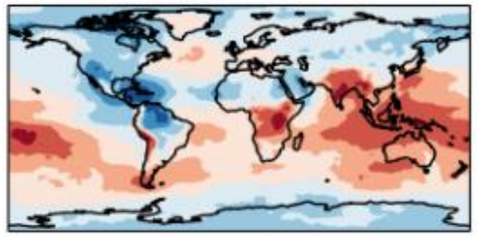


-3 -1 -0.3 0.3 1 3

-2 -0.5 0.0 0.5 2

Anomalies from 1991-2020 (hPa)

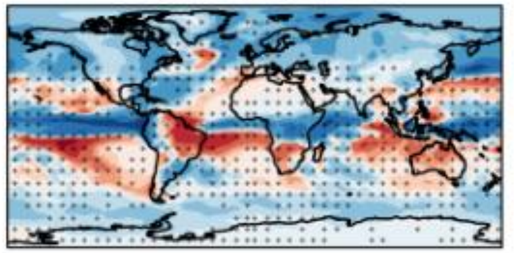
sea-level pressure



0.1 0.2 0.3 0.4 0.5 0.6 0.7 0.8 0.9

Ensemble mean forecast | NDJFM 2025/26-2029/30

precipitation



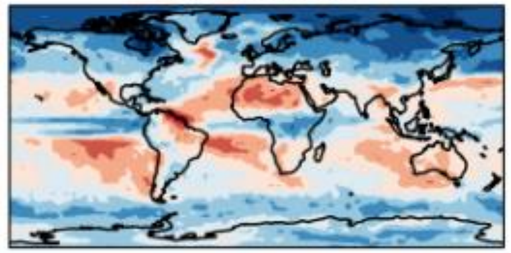
-0.4 -0.1 -0.02 0.02 0.1 0.4

-0.7 -0.2 -0.05 0.0 0.05 0.2 0.7

Anomalies from 1991-2020 (mm/day)

Probability of above average

precipitation



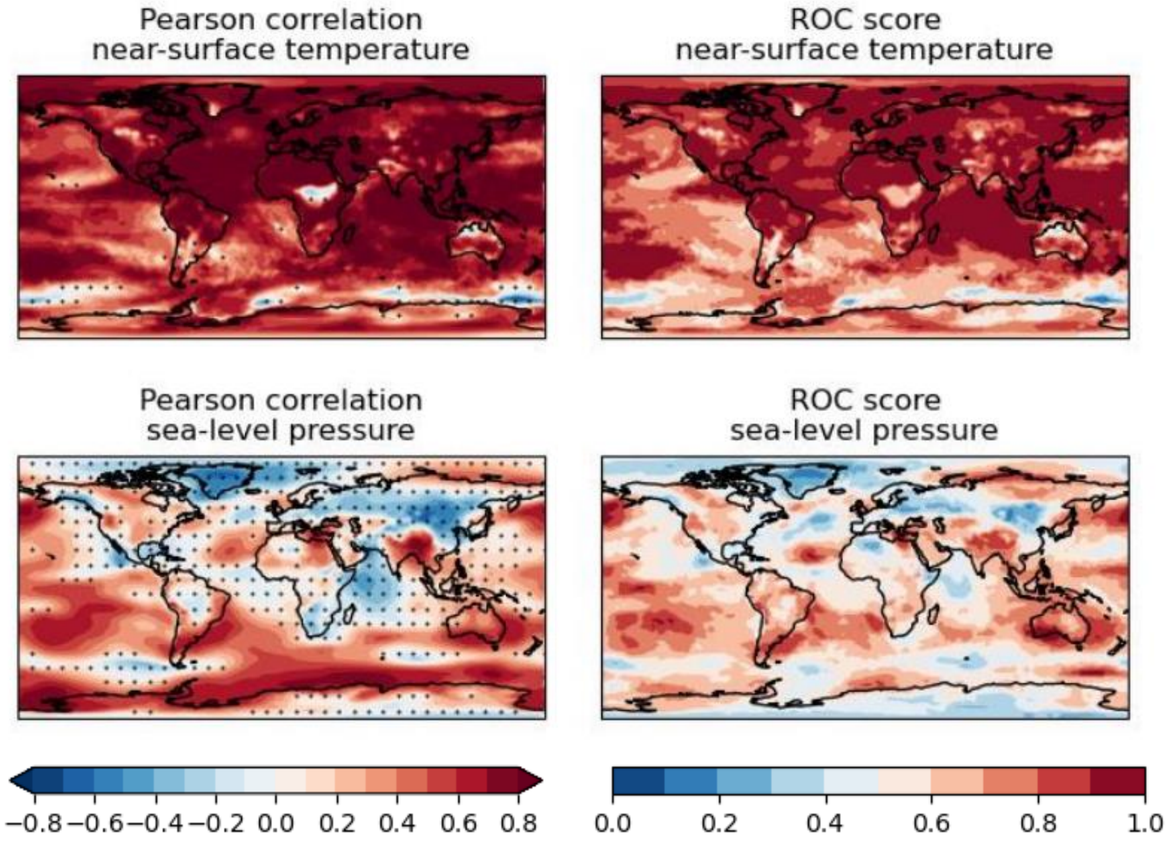
0.1 0.2 0.3 0.4 0.5 0.6 0.7 0.8 0.9

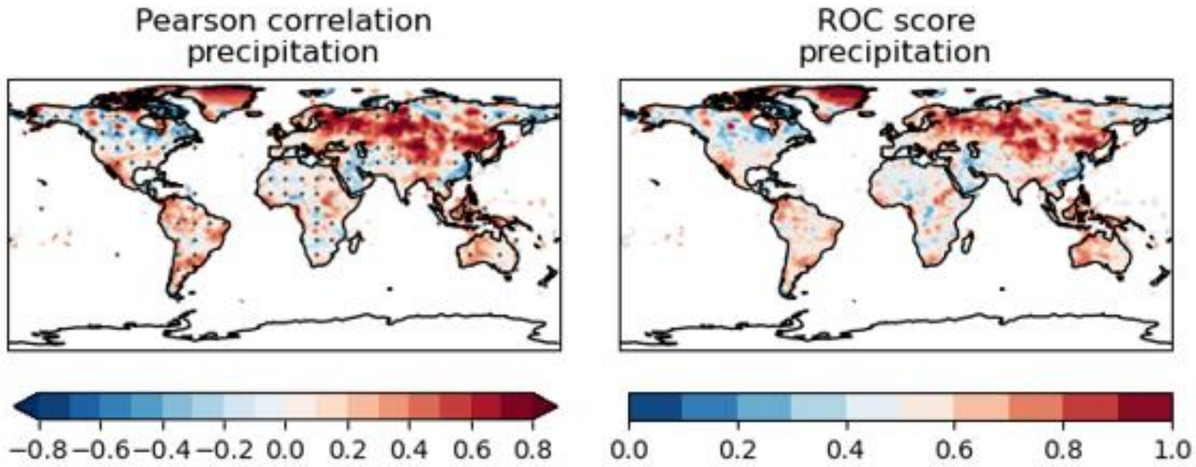
- Warm anomalies are likely almost everywhere, with larger anomalies over land than ocean. The Arctic anomaly is predicted to be 2.4°C, more than three and a half times as large as the global mean.
- The North Atlantic subpolar gyre, the so-called warming hole, which has been liked to a reduction in the AMOC, has large model disagreement on the sign of the anomaly
- There is an increased likelihood of a positive NAO in this period, although skill is low for this prediction
- The pattern of increased precipitation in the tropics and high latitudes and reduced precipitation in the subtropics is consistent with the climate warming.

Leon Hermanson

NDJFM 2022-2026 Skill Maps

Baseline: 1991-2020



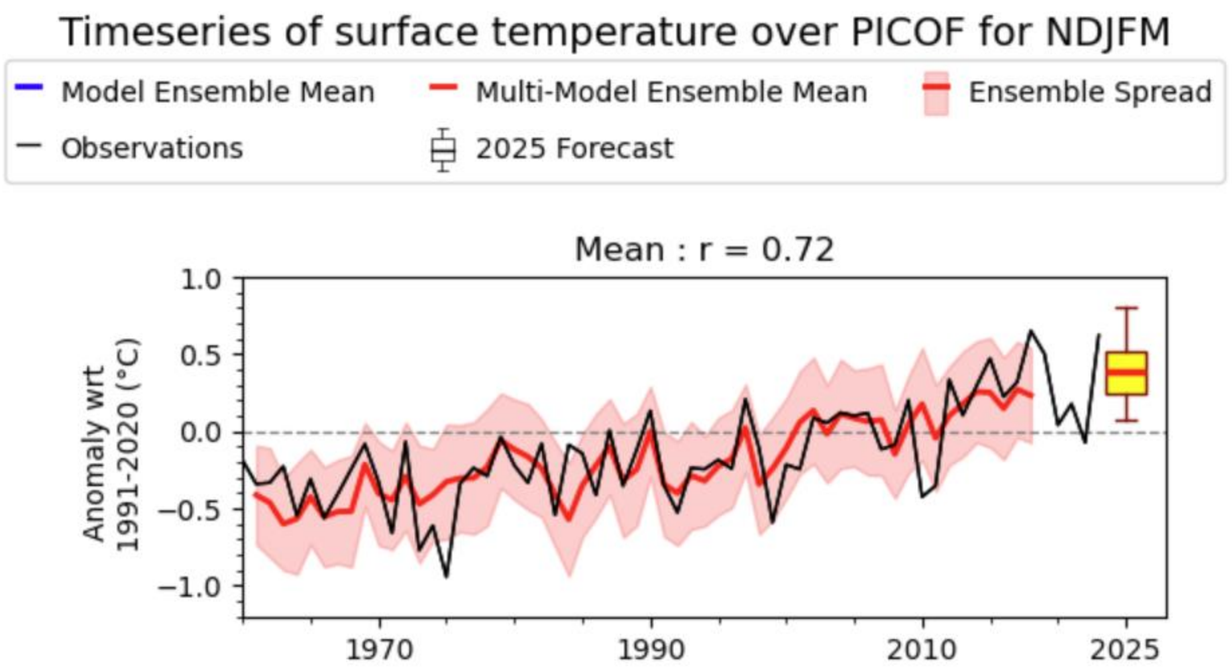


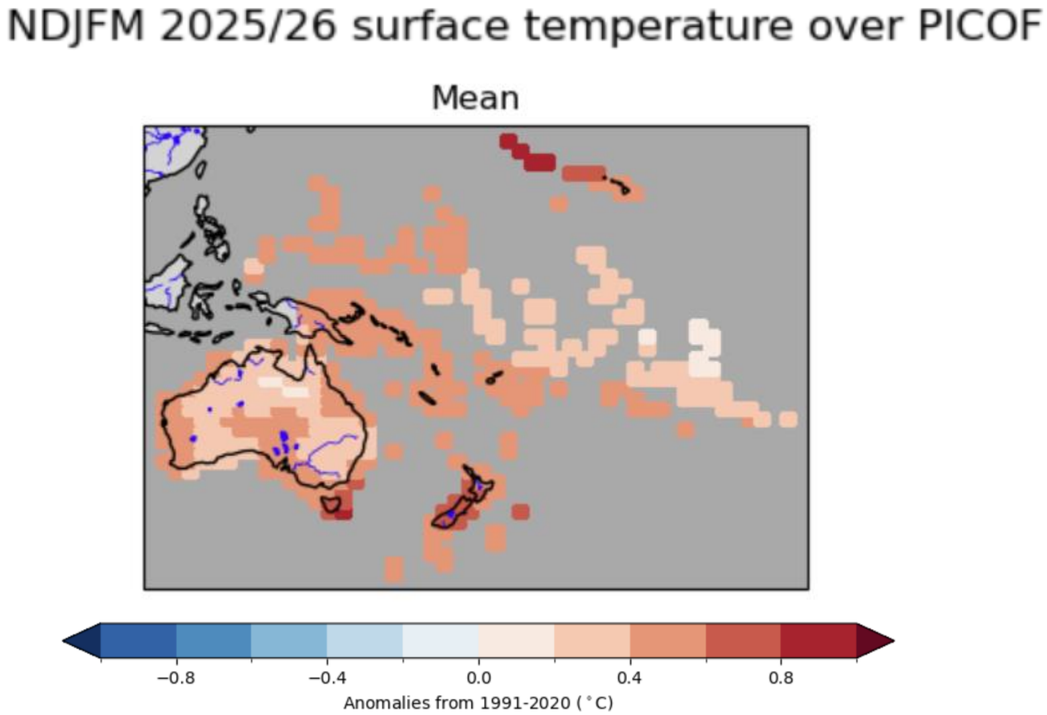
- Temperature skill is high in most regions apart from parts of the North Pacific and Asia, Australia, and the Southern Ocean, giving medium to high confidence.
- Sea level Pressure skill is medium over the eastern Pacific and Southern Ocean and Antarctica
- Precipitation skill is moderate over northern Eurasia, Greenland, and the Canadian Arctic Archipelago.

Stippling where positive correlation skill is not significant at the 5% level

Leon Hermanson

Temperature Forecast for PICOF for the coming season

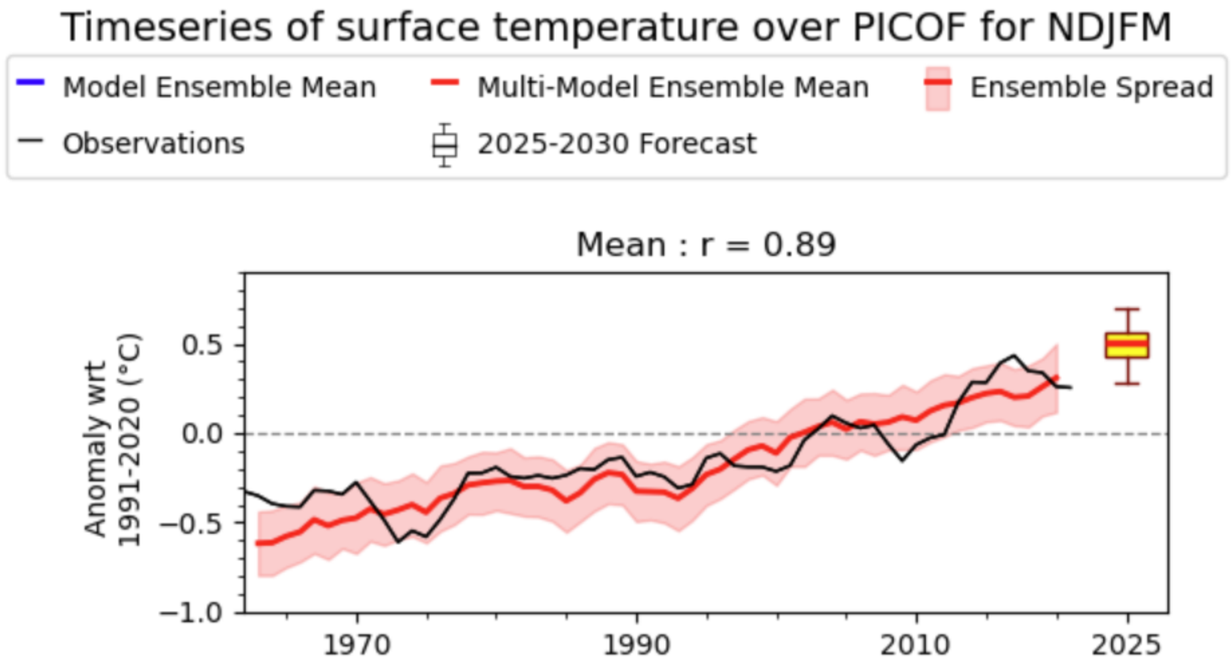


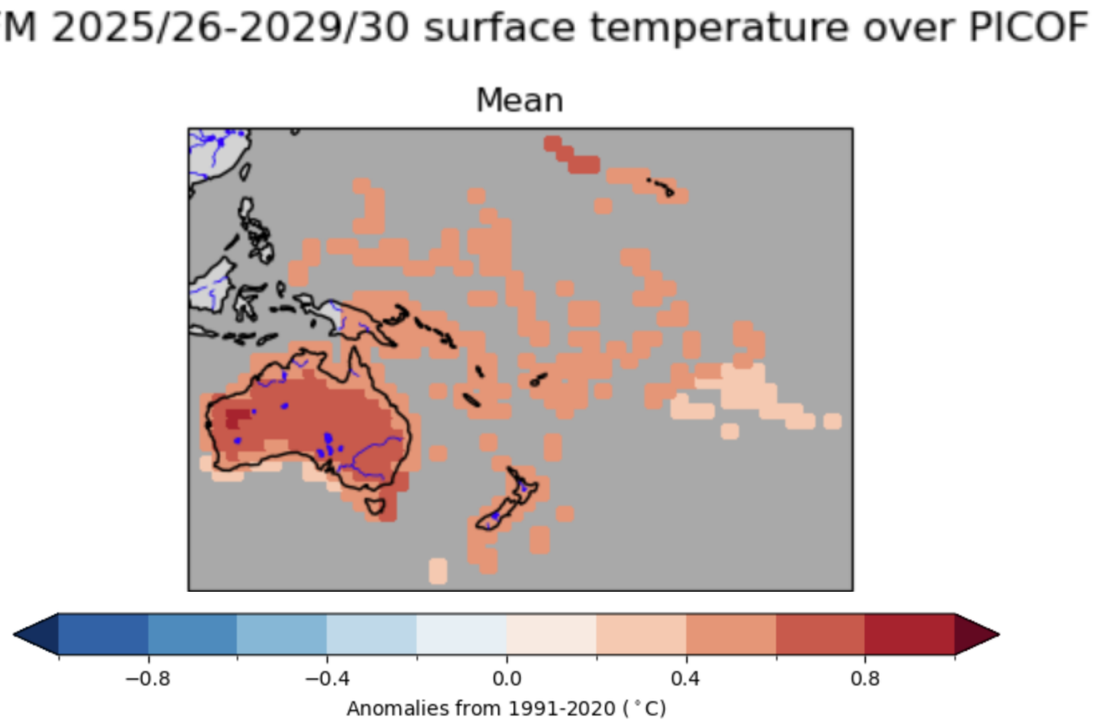


- Temperature forecast has good skill for the first winter of the forecast. Skill mainly comes from ENSO skill for the coming winter. We are predicting fairly neutral ENSO conditions for the coming summer

- Temperature forecast is above average, with increased warming over New Zealand and the tropical Pacific

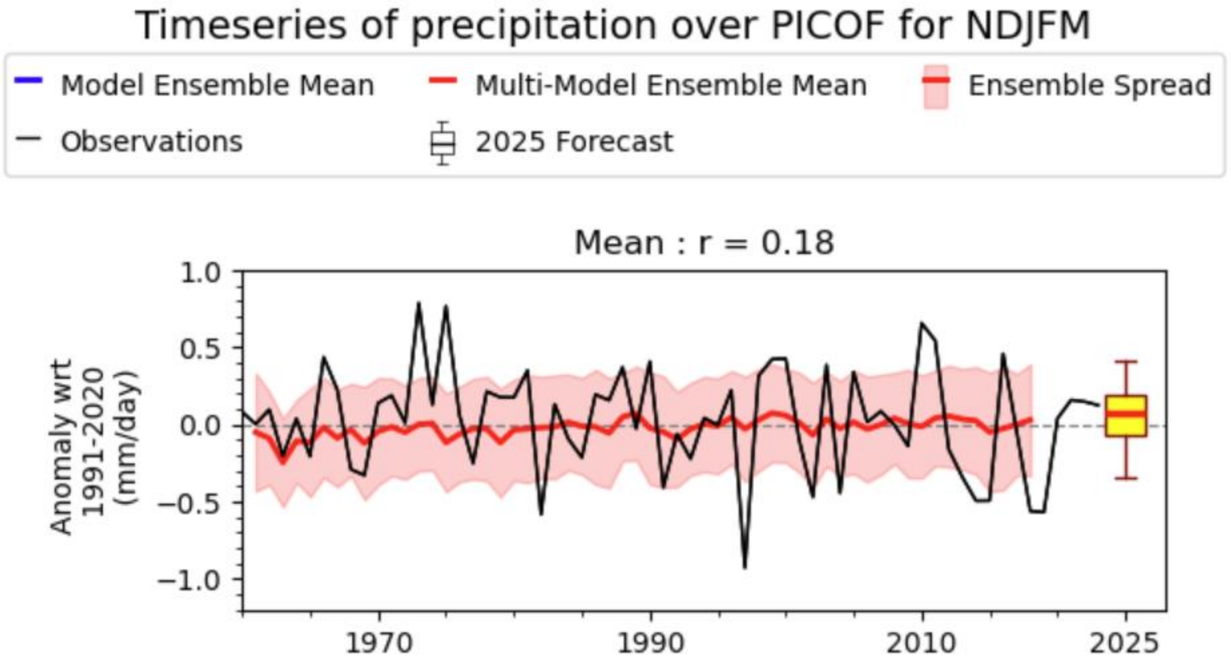
Temperature Forecast for PICOF for the next 5 years

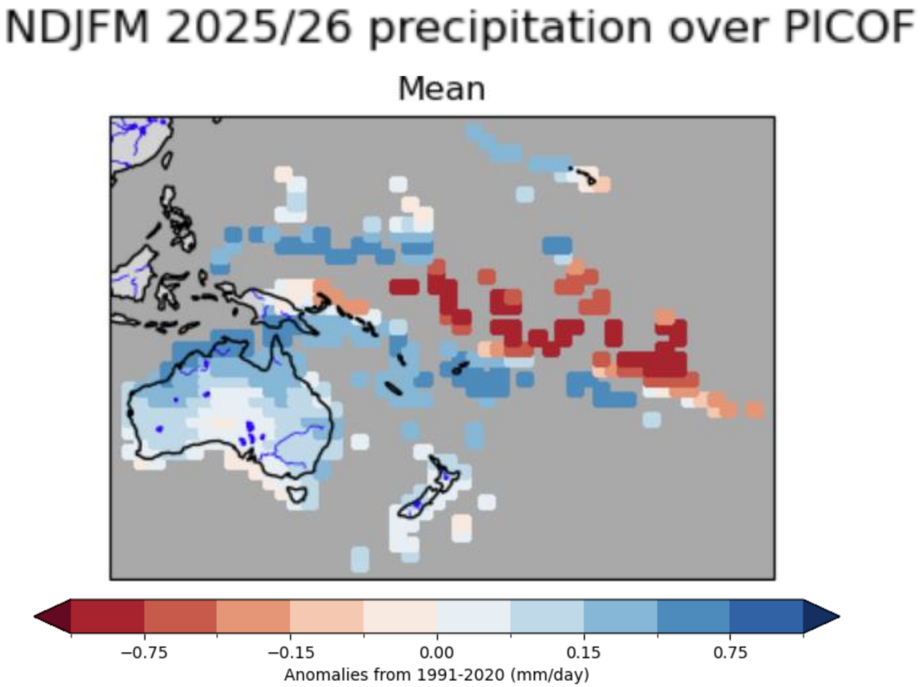




- Temperature for next 5 years is dominated by global warming trend, elevated temperature over land compared to oceans
- Similar results for MJJAS
- ENSO is difficult to predict beyond 1-2 years, historically not good at capturing decadal variability

In general, precipitation is poorly forecast for PICOF





- In general, our precipitation skill over PICOF is poor
- Models unable to capture the interannual to decadal variations present over this region
- Forecast shows slightly increased rainfall over land, decreased rainfall over ITCZ. This is consistent with the shift of the ITCZ under climate change

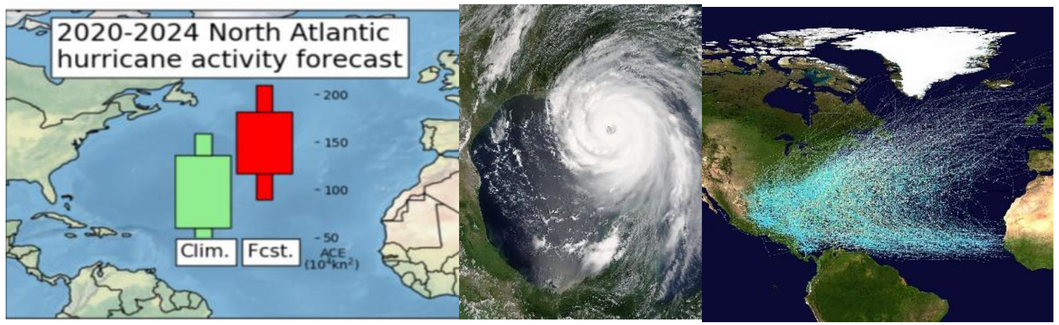
Met Office
Hadley Centre

Other Applications of Decadal Predictions

C3S North Atlantic Hurricane Prediction

Met Office was one of 4 centres involved in C3S Sectoral Applications of Decadal Climate Predictions – along with DWD, CMCC and BSC

Partnered with Willis Research Network/Willis Towers Watson to produce **y1-5** forecasts of North Atlantic hurricane activity



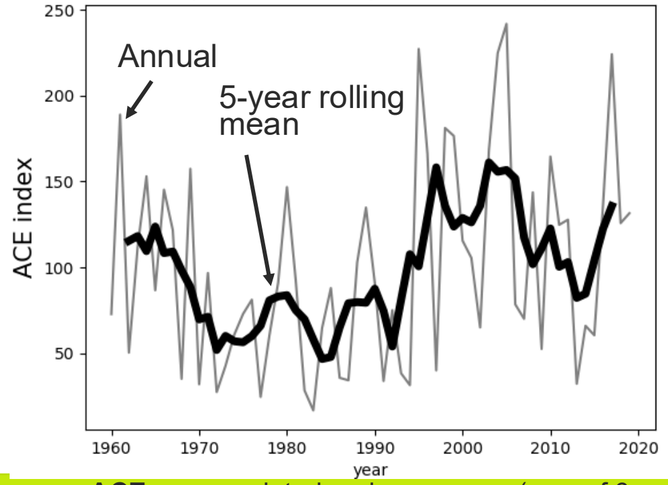
DWD: Infrastructure

BSC: Agriculture

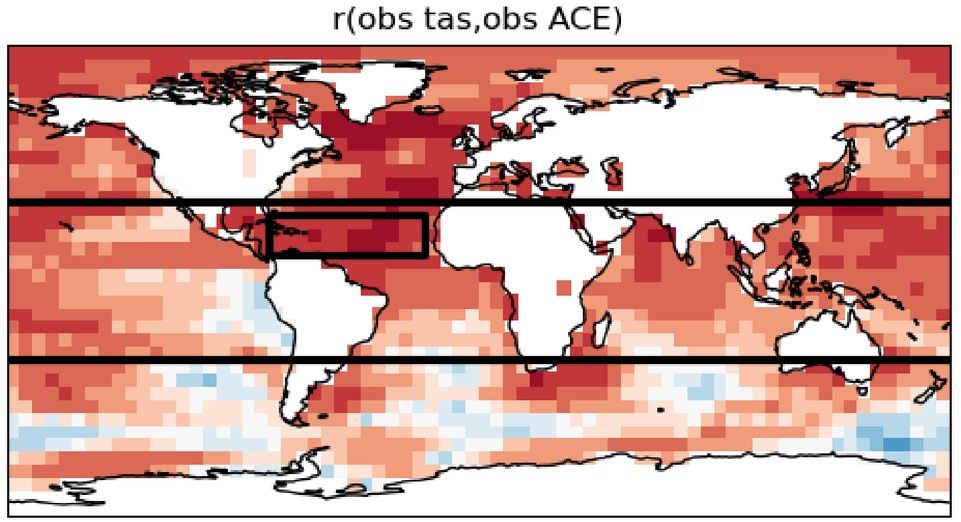
CMCC: Energy

Met Office: Insurance

Observed North Atlantic hurricane activity 1960-2019
(measured by ACE index)



ACE= accumulated cyclone energy (sum of 6 hrly max windspeed^2 over track for windspeeds >35kn)



Used relative temperature index from models to estimate hurricane activity (ACE)

Julia Lockwood

Decadal Predictions of Extremes

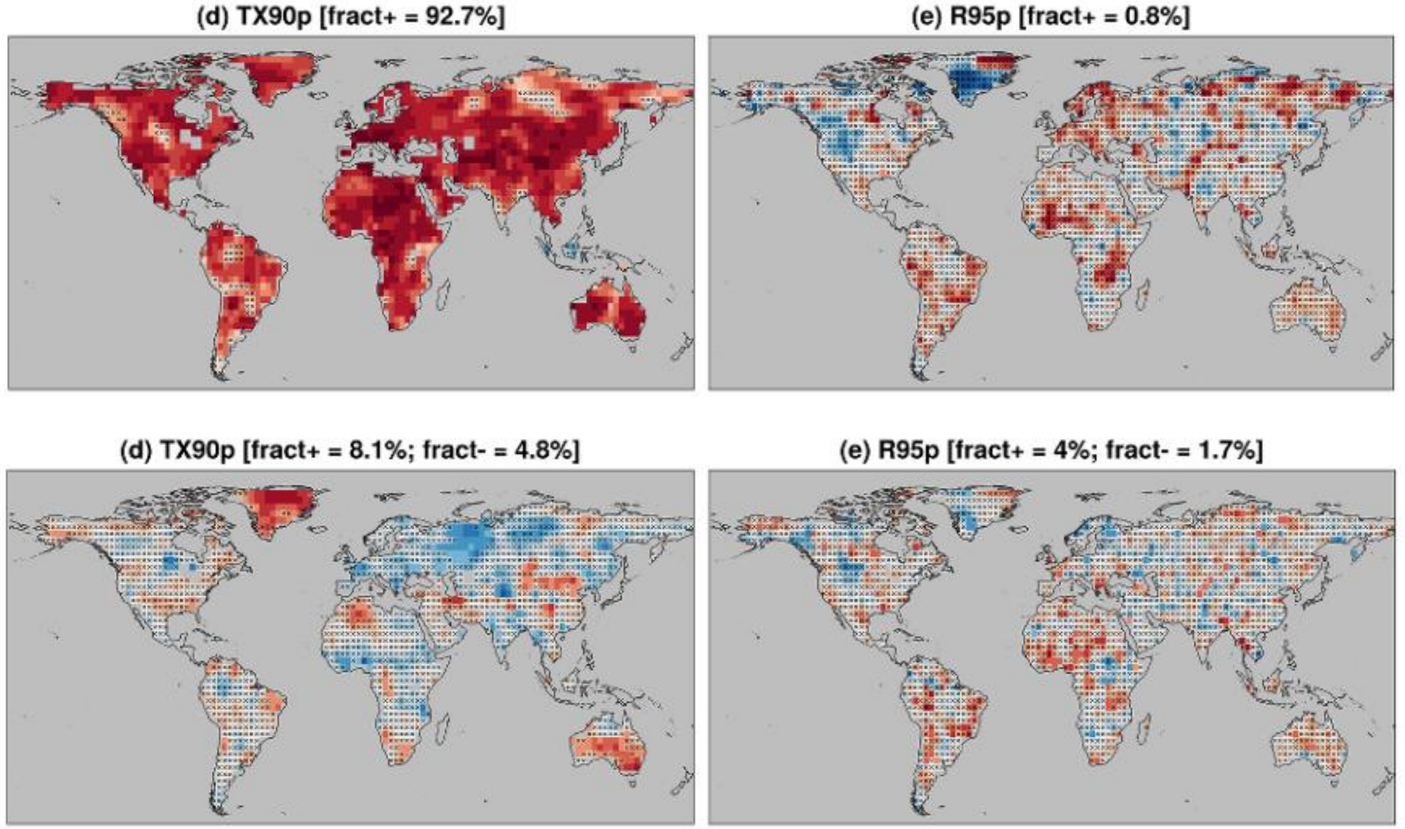
Multi-annual predictions of the frequency and intensity of daily temperature and precipitation extremes

Carlos Delgado-Torres[1,*], Markus G Donat[1,2], Albert Soret[1], Nube González-Reviriego[1], Pierre-Antoine Bretonnière[1], An-Chi Ho[1], Núria Pérez-Zanón[1], Margarida Samsó Cabré[1] and Francisco J Doblas-Reyes[1,2]

[1] Barcelona Supercomputing Center (BSC), Barcelona, Spain
[2] Institució Catalana de Recerca i Estudis Avançats (ICREA), Barcelona, Spain
[*] Author to whom any correspondence should be addressed.

E-mail: carlos.delgado@bsc.es

Delgado-Torres et al 2022 showed skill in predicting the number of extremes for decadal timescales



ACC (top) and residual from HIST (bottom) for DCPP multi-model ensemble for the years 1–5 (annual means) for TX90p (maximum temperature is above the 90th daily percentile) and R95p (daily PR exceeds the 95th percentile of daily precipitation)

Summary

- There still exists a gap between the producers of decadal climate predictions and the users
- The Lead Centre for Annual to Decadal Climate Predictions provides a global update and overview, tailored to give guidance for National Met Services and Regional Climate Outlook Forums (RCOFs)
- However, there are many other use cases for decadal predictions

- We would love to have some feedback from you. What kind of information you would find useful on these timescales? If you have any suggestions (e.g. metrics to be added, features you find interesting), please get in touch with me

THANK YOU!

melissa.seabrook@metoffice.gov.uk

wmolc-adcp.org

Met Office
Hadley Centre

Executive Summary

- There still exists a gap between the producers of decadal climate predictions and the users
- The Lead Centre for Annual to Decadal Climate Predictions provides a global update and overview, tailored to give guidance for National Met Services and Regional Climate Outlook Forums (RCOFs)
- However, there are many other use cases for decadal predictions
- Forecasts for the next 5 years show a continued increase in global temperatures, with enhanced warming over land
- Although precipitation skill is varied, there is evidence of a pattern of increased precipitation in the tropics and high latitudes and reduced precipitation in the subtropics is consistent with climate warming.
- We would love to have some feedback from you, on what kind of information you would find useful on these timescales? If you have any suggestions (e.g. metrics to be added, features you find interesting), please get in touch with me