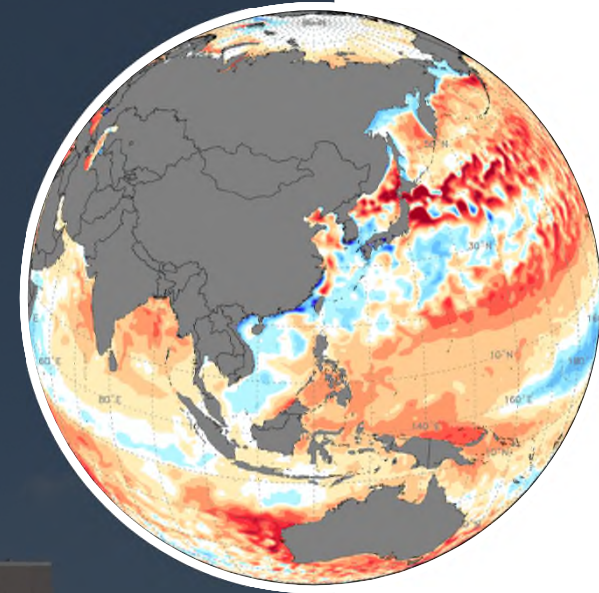




The Evaluation of CWA Seasonal Forecast Model

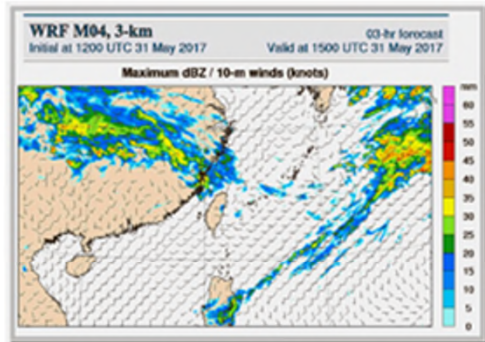


李澤邑、李清滕、羅資婷、胡志文、陳建河、洪景山
Marine Meteorology and Climate Division, CWA

Global and Regional Models in CWA



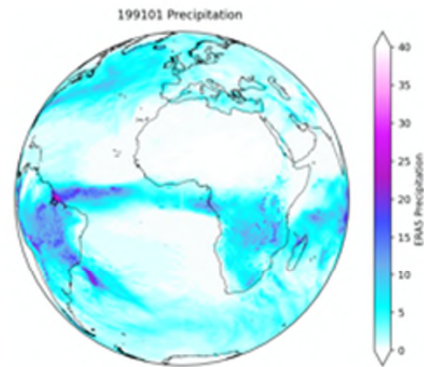
0~5day



Regional weather

- CWA RWRF (13 hours)
- CWA CEPS (13 hours)
- CWA WRFD (5 days)
- CWA TWRF (5 days)
- CWA WEPS (5 days)

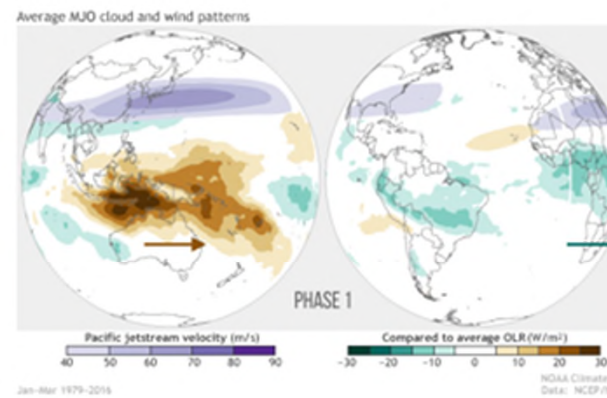
16day



Global weather

- CWA TGFS (16 days)
(Global-25km)

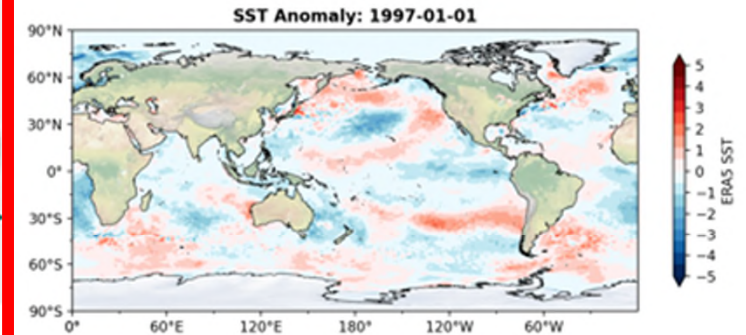
45day



Extended weather (S2S)

- CWA GEPSv2 (45 days)
(Global-28km + RSM-5km)
- 21 members

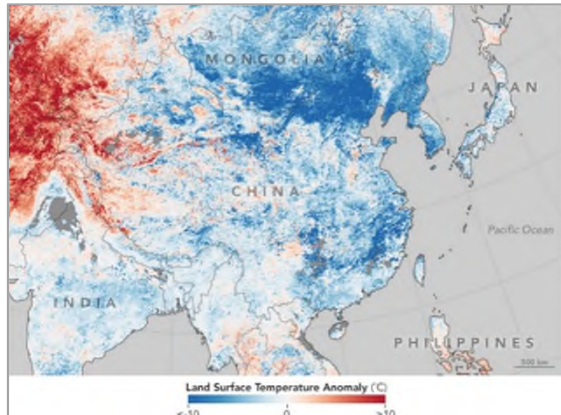
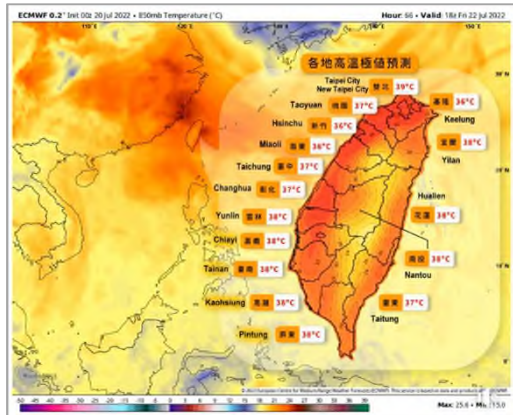
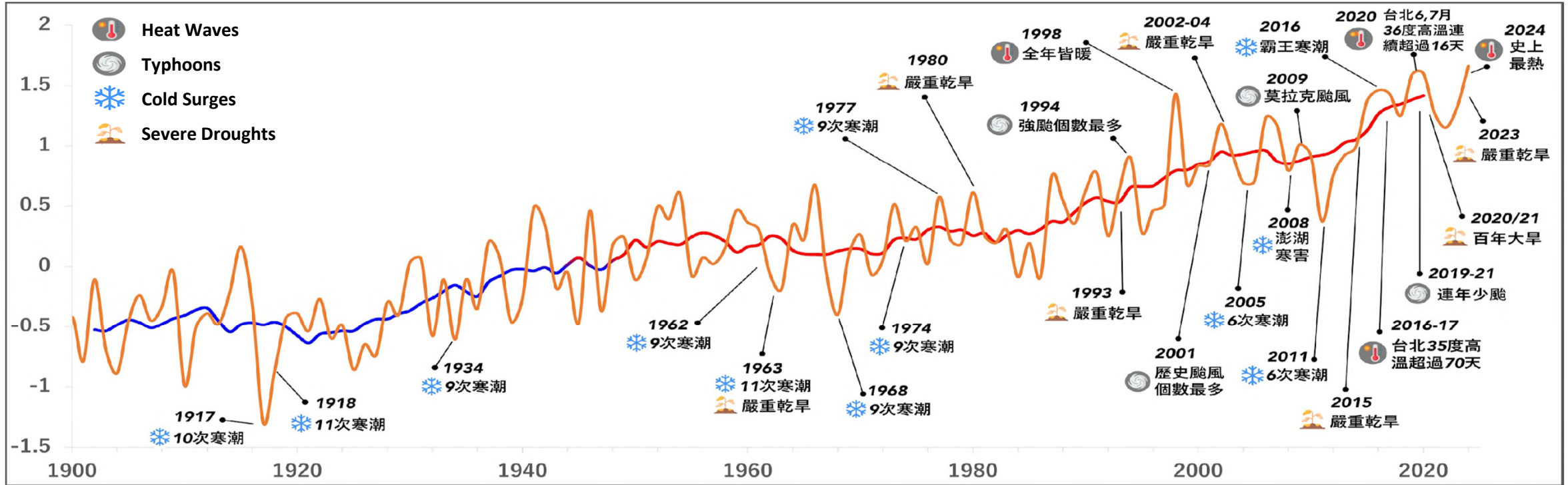
9month



Seasonal Forecast

- **CWACFSv2 (9 months)**
(Global-55km + RSM-12km)
- 30 members/month

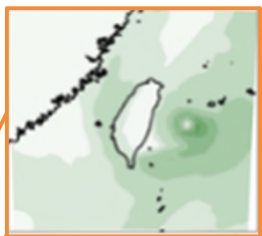
Surge of Extreme Events



Climate Service Operation [in development]



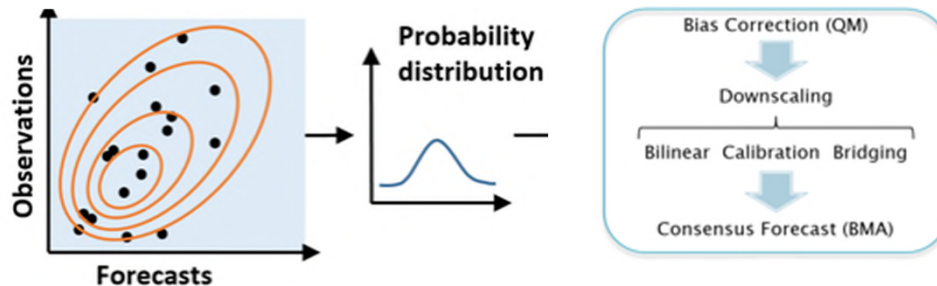
Global Forecasts



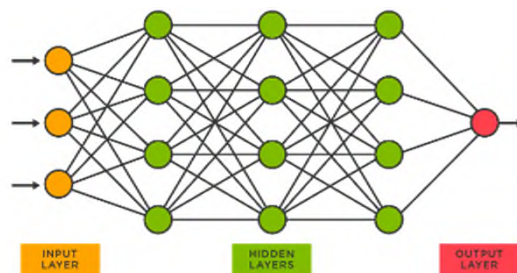
Multi-Model Ensemble



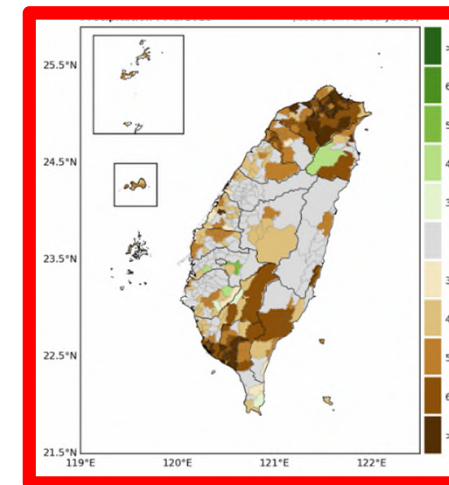
Statistic Post-Process Downscale/Bias Correction



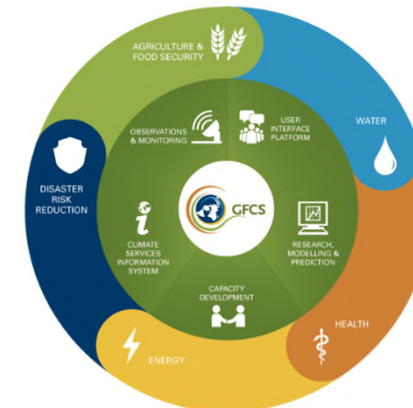
AI/ML Post-Process



Forecast Products



Cross-Domain Service



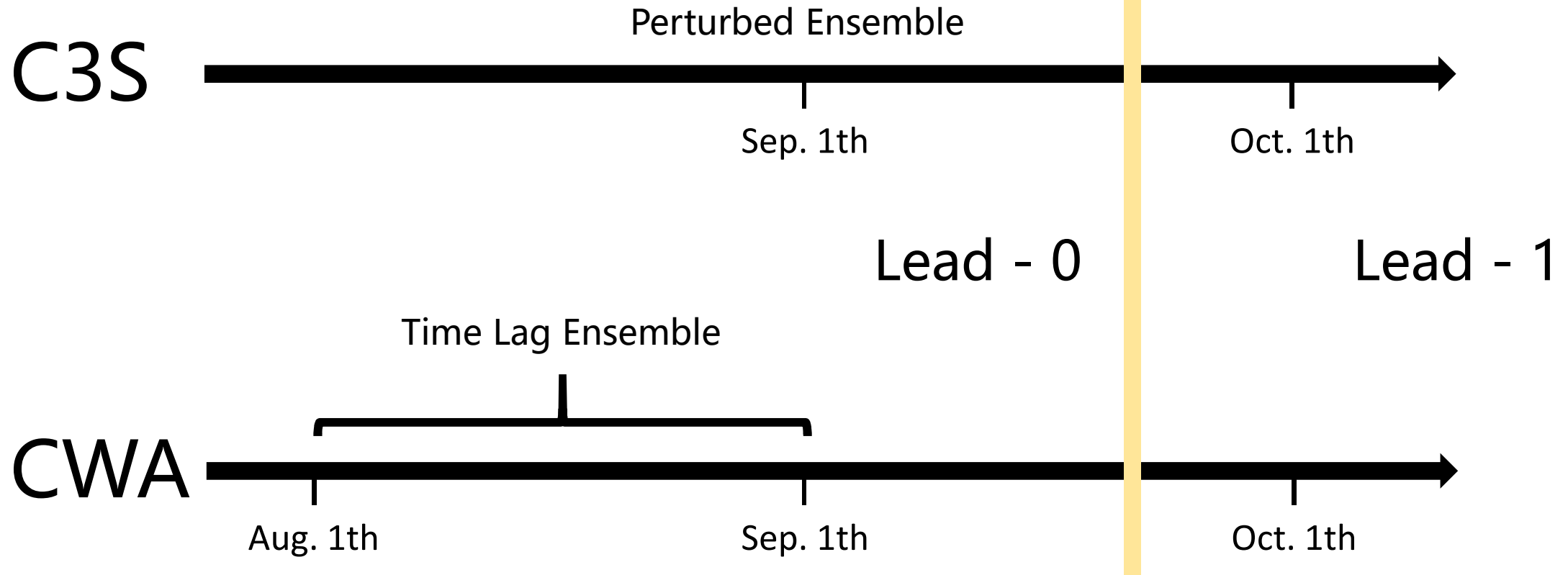


Hindcast: 1993-2016

	ENS Member	ATM model	OCN model	Initial Condition
ECMWF	25	IFS Cycle 43r1 / TCo319	NEMO3.4	ERA-Interim
JMA	10	JMA-GSM / TL319	MRI.COM v4.6	JRA-3Q
Meteo-FR	25	ARPEGE v6.4 / TL359	NEMO3.6	ERA5
NCEP	20	NCEP GFS / T128	MOM4	CFSR
CMCC	40	CAM5.3 / Cube Sphere	NEMO3.4	ECMWF ERA5, IFS
UKMO	28	GC 3.2 /	NEMO3.6	ERA-Interim
CWA	30	CWAGFS / TL359	MOM5	CDAS



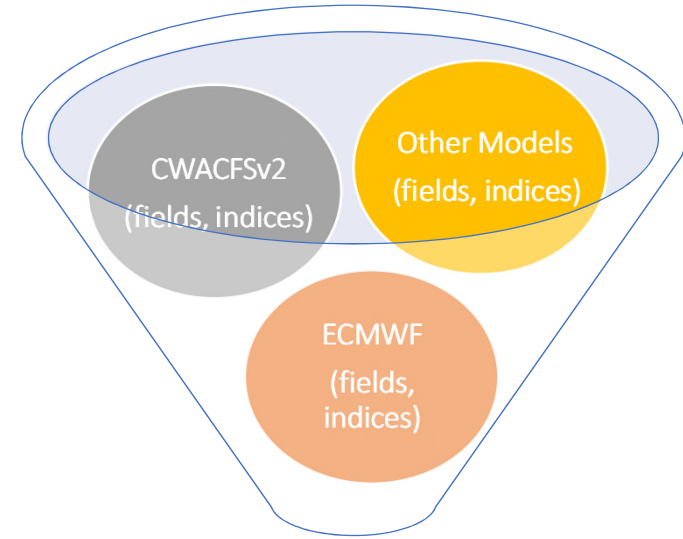
Seasonal Forecast Meeting



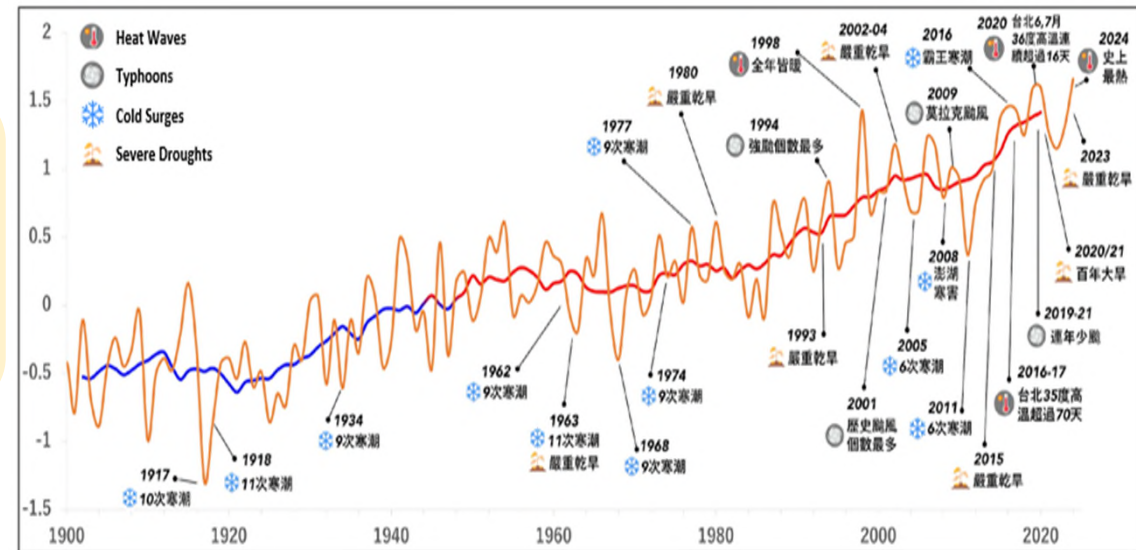
Motivation



1. Create a multi-model ensemble for seasonal forecast specifically for Taiwan



2. Improve extreme event predictability



Motivation

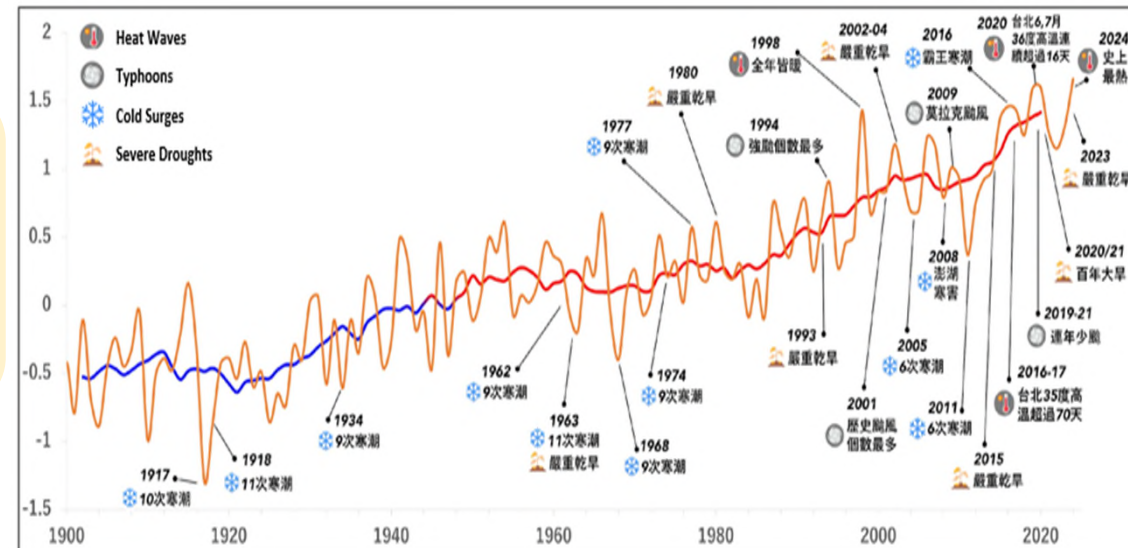


1. Create a multi-model ensemble for seasonal forecast specifically for Taiwan

2. Improve extreme event predictability

A. Compare Models General Performance

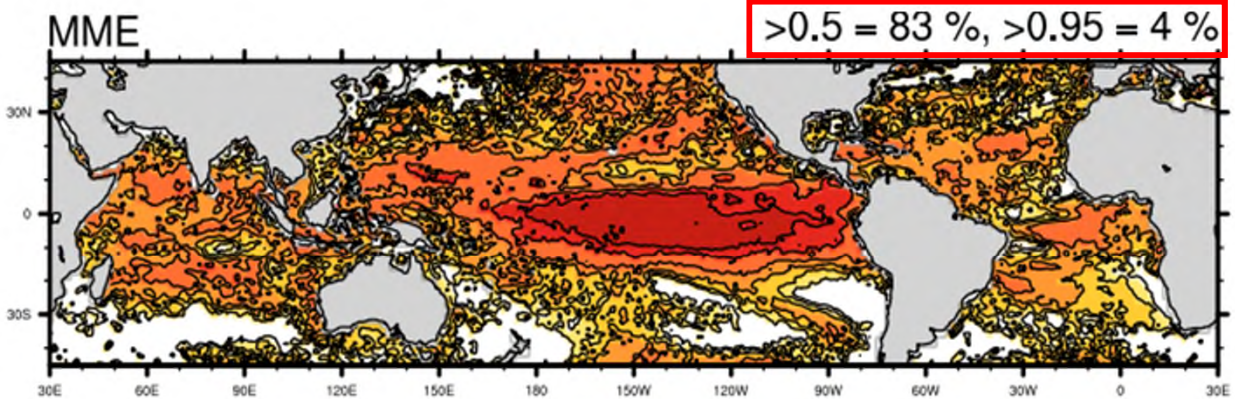
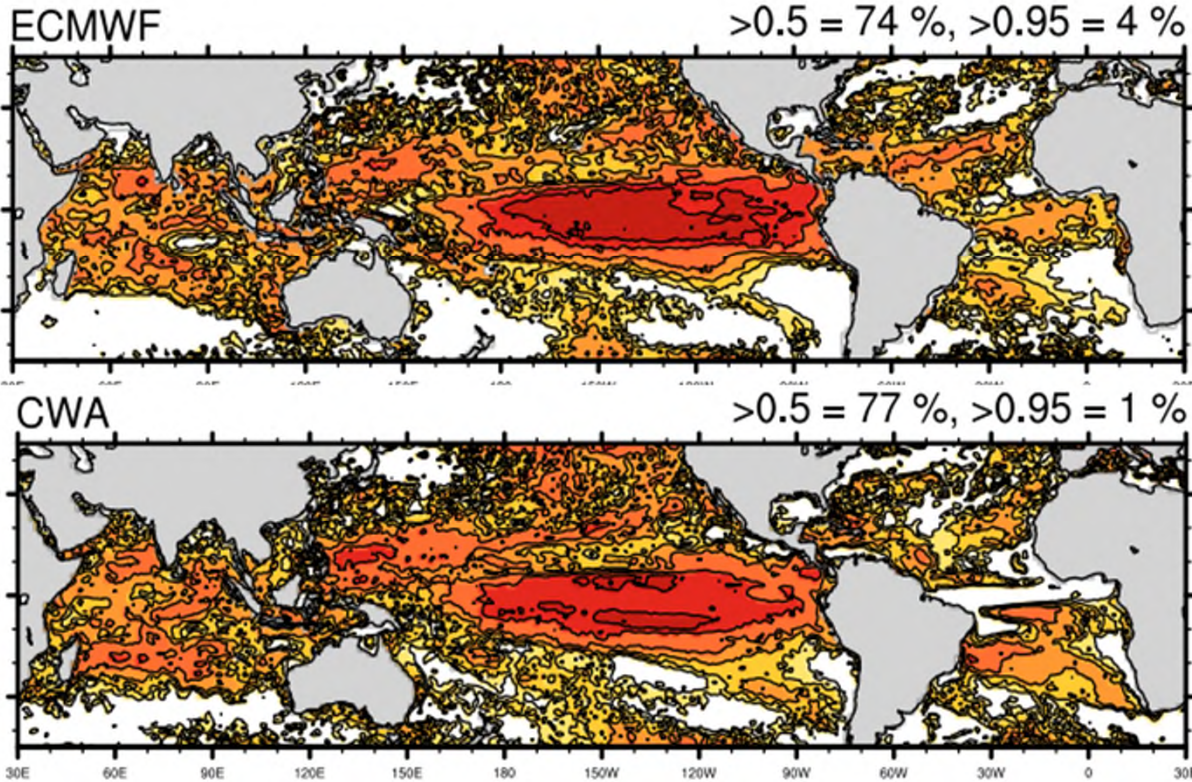
B. Compare Models Predictability in Different Levels of Extreme



Comparing Models General Performance



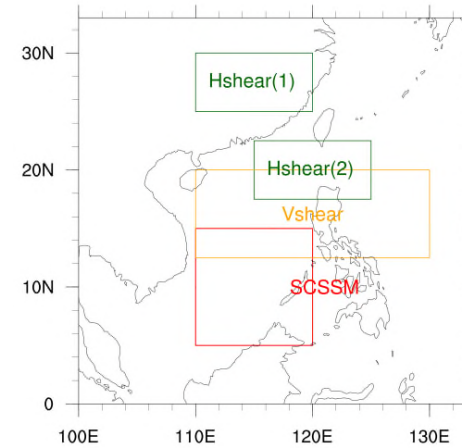
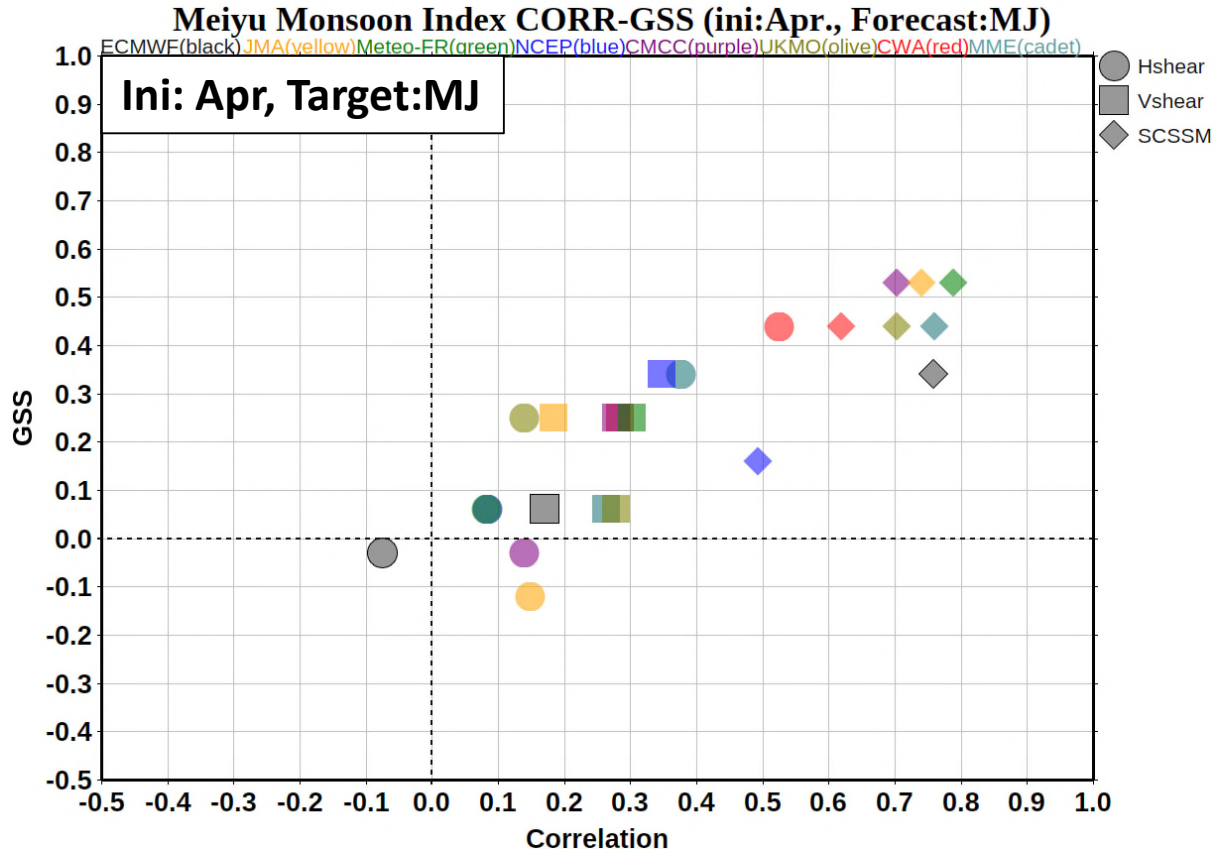
Correlation Map ini:Nov target:DJF with OISSTv2 DJF



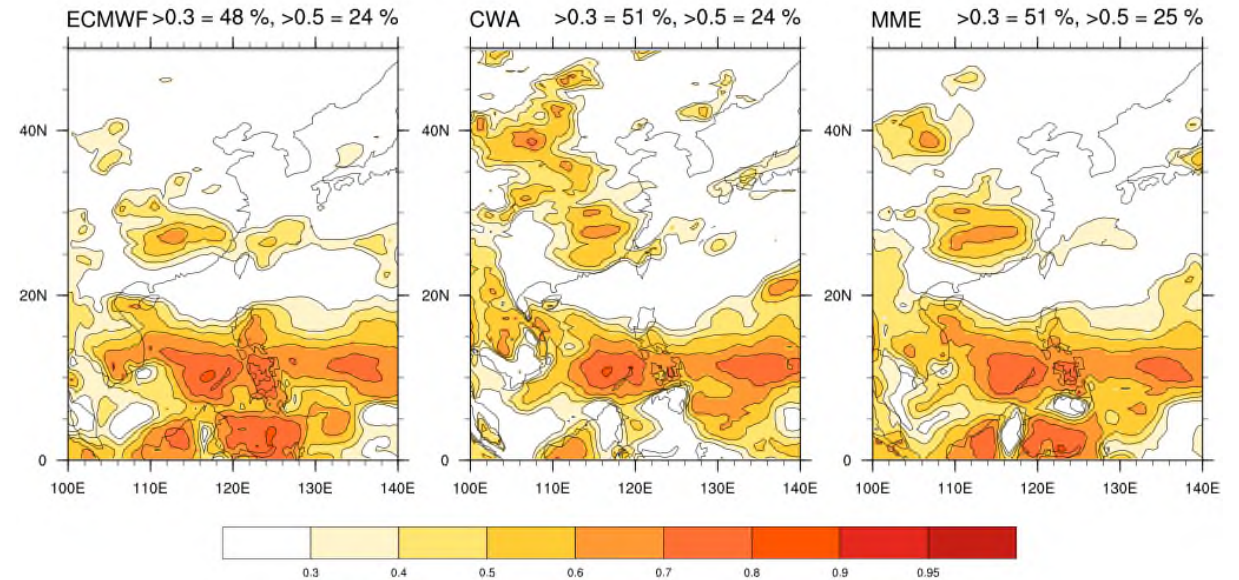
Most models have similar forecast performance for Tropical Ocean SST



Comparing Models General Performance

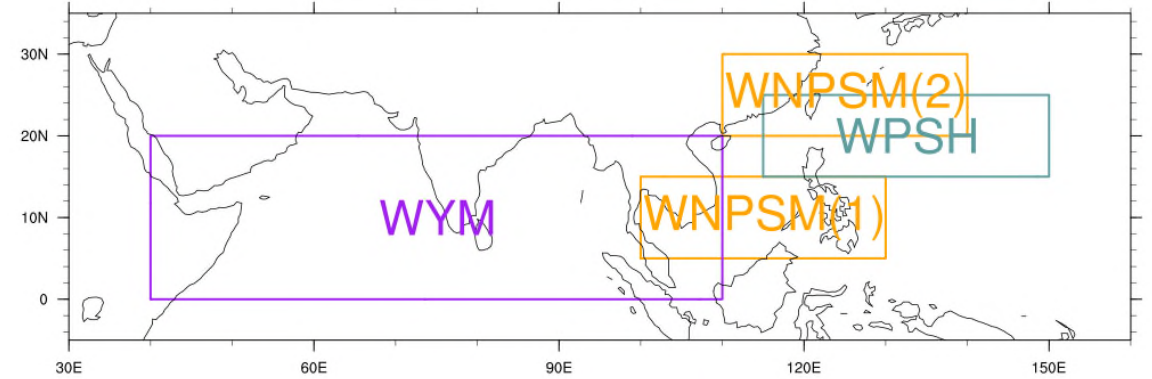
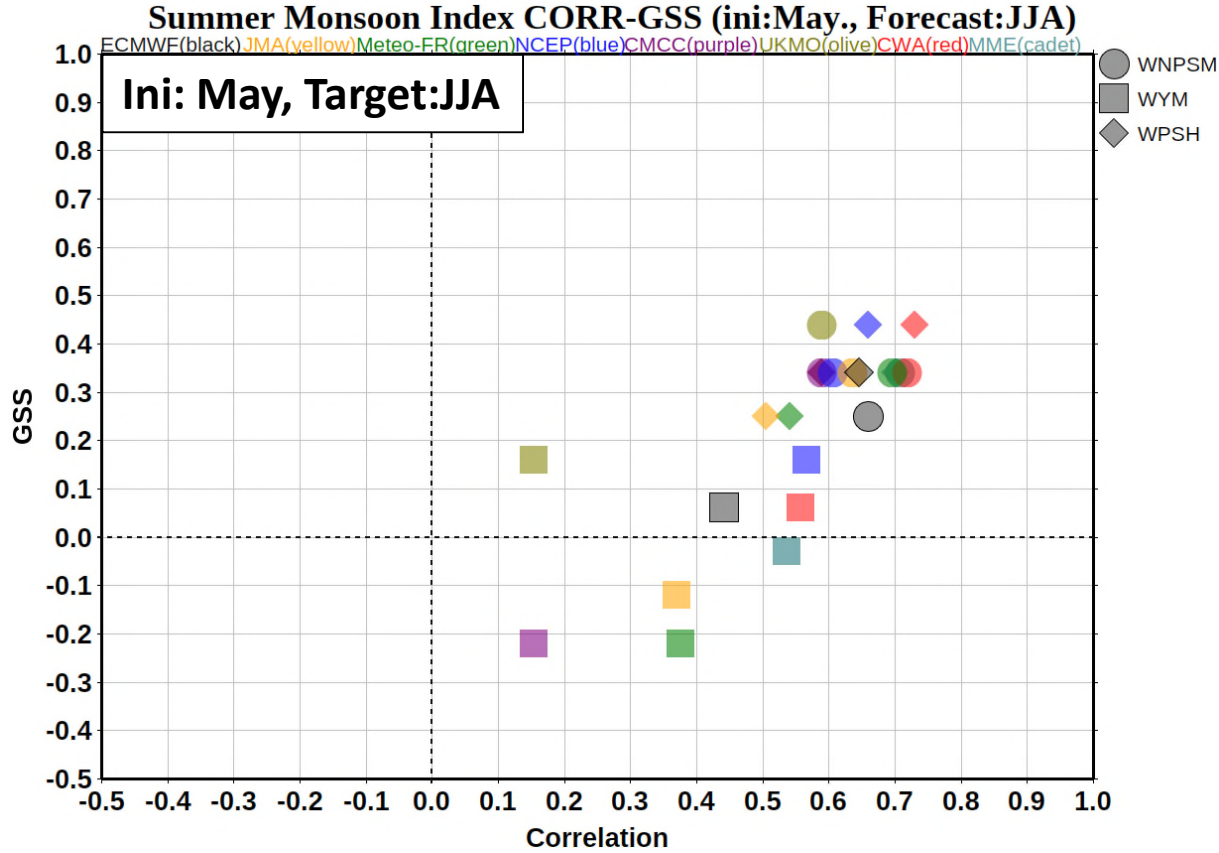


Models ini:Apr target: MJ correlation with GPCP Precip

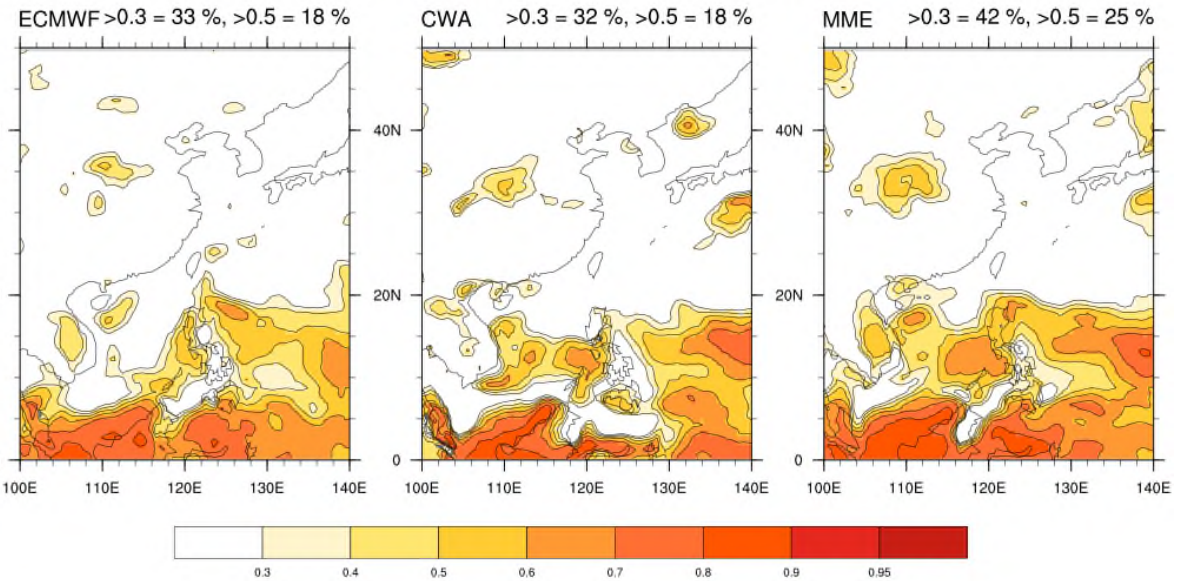


ECMWF **JMA** **Meteo-Fr** **NCEP**
CMCC **UKMO** **CWA** **MME**

Comparing Models General Performance

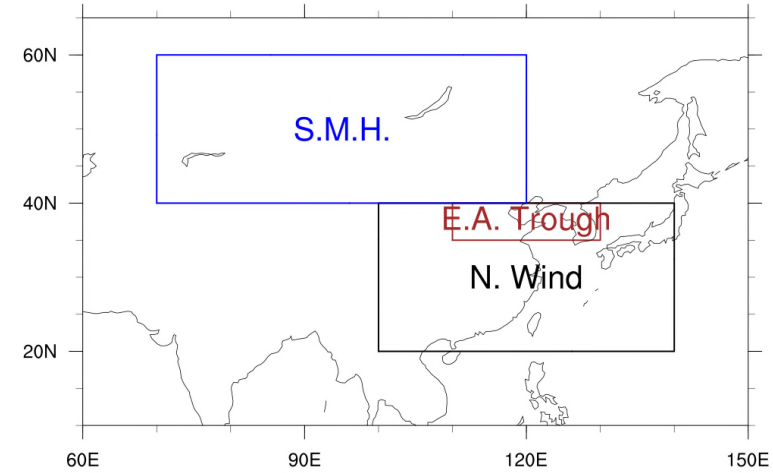
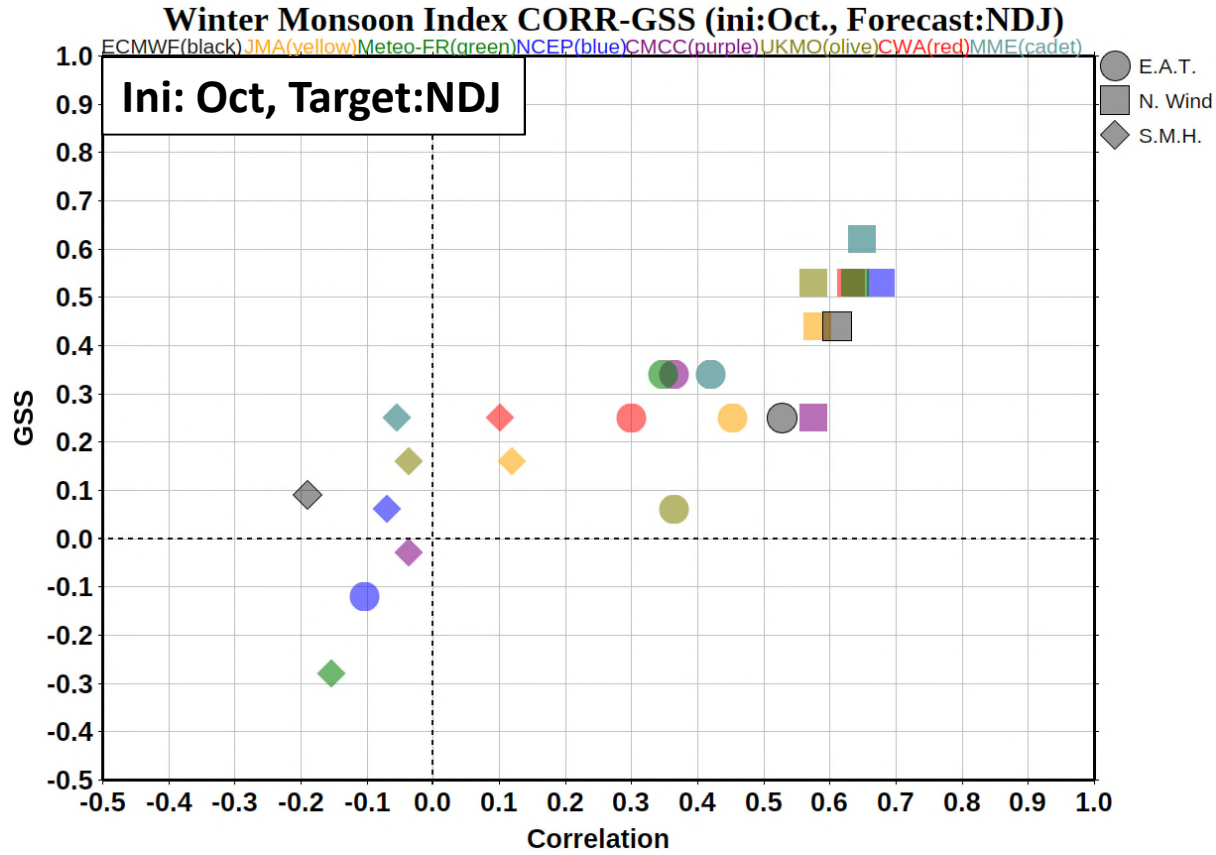


Models ini:May target:JJA correlation with GPCP Precip

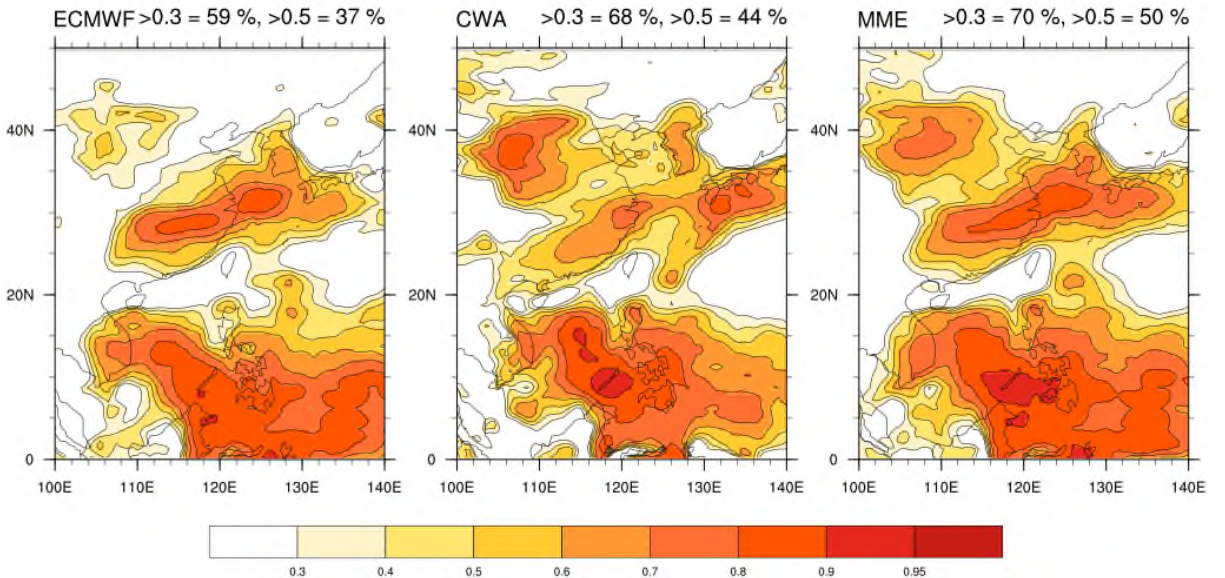


ECMWF **JMA** **Meteo-Fr** **NCEP**
CMCC **UKMO** **CWA** **MME**

Comparing Models General Performance



Models ini:Oct target:NDJ correlation with GPCP Precip

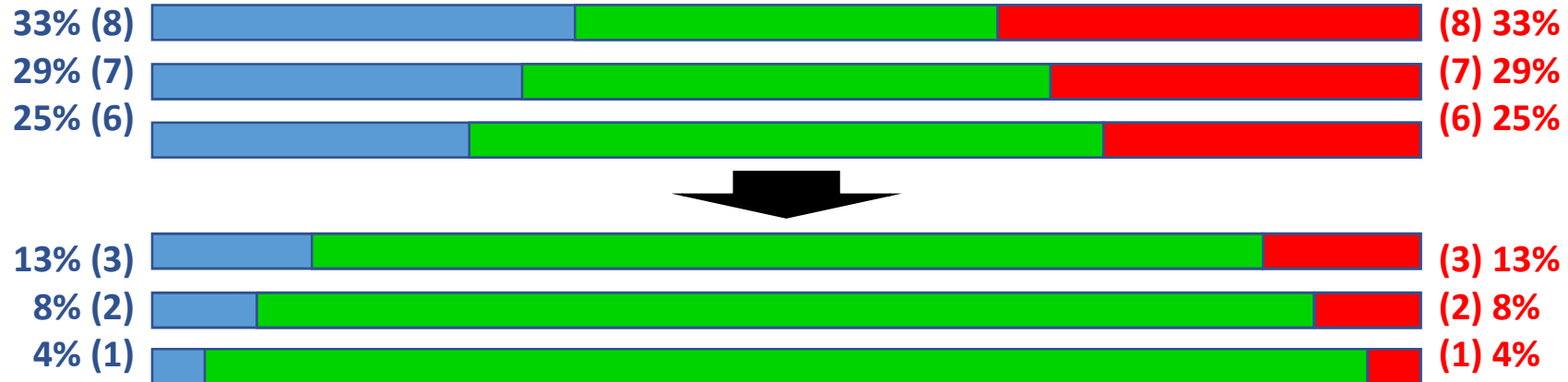


ECMWF JMA Meteo-Fr NCEP
 CMCC UKMO CWA MME

Comparing Models Extreme Event Performance



Tercile Based Categorization



Step 1

Brier Score (BS)

$$BS = \frac{1}{N} \sum_{i=1}^N (p_i - o_i)^2$$

p_i : The frequency of the forecasted event occurrence

o_i : The observed occurrence of the event

N : Sample size

BS ranges between 0 and 1

Step 2

BS_{ref} (Climatology)

$$BS_{ref} = \frac{1}{N} \sum_{i=1}^N (p_i - \bar{o})^2$$

\bar{o} : The average frequency of observed event occurrences

BSS ranges from $-\infty$ to 1

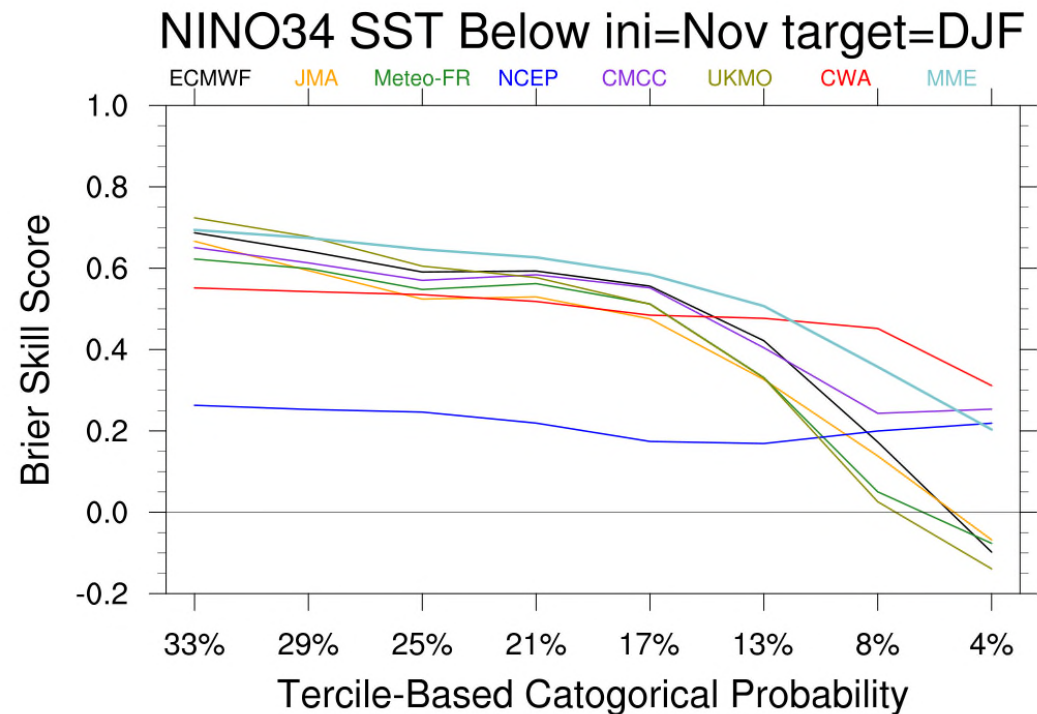
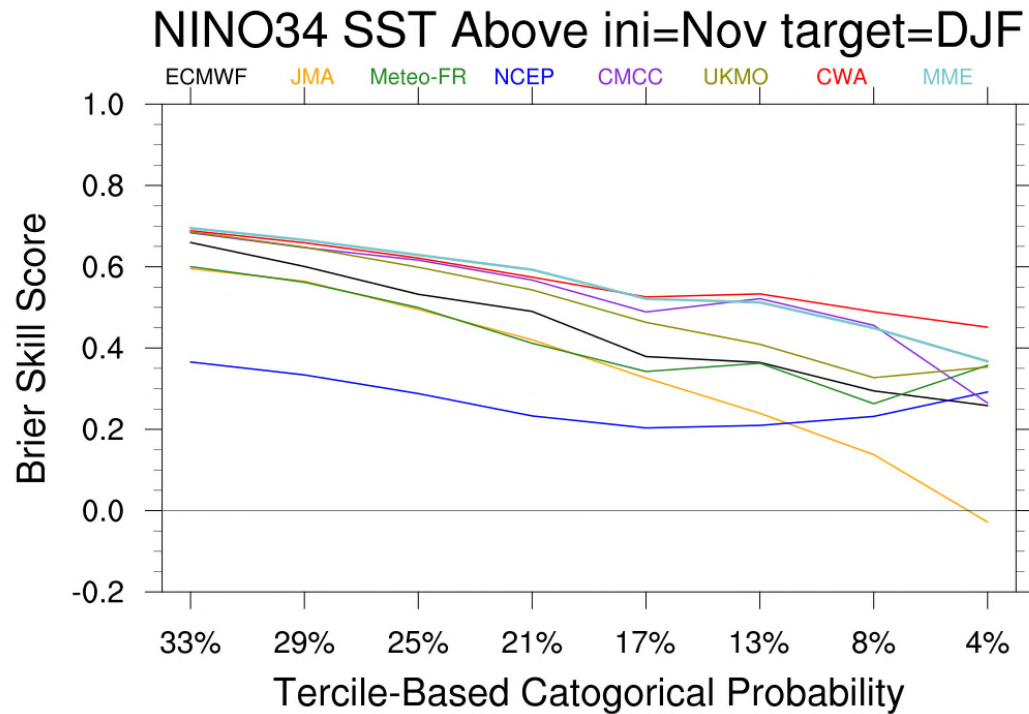
BSS = 1: Perfect Score

BSS = 0: No improvement in forecast skill relative to the climatological forecast

Brier Skill Score (BSS)

$$BSS = -\frac{BS - BS_{ref}}{BS_{ref}}$$

Comparing Models Extreme Event Performance

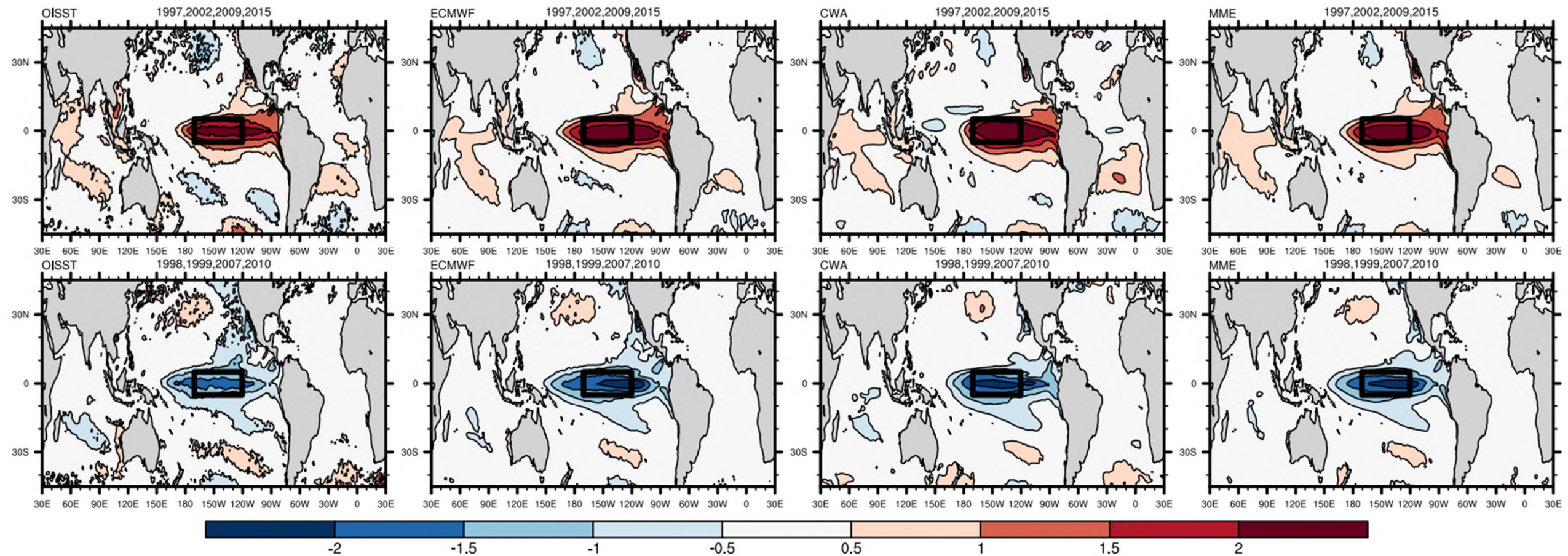


ABOVE: CWA shows overall higher BSS score

BELOW: All models have significant drop in BSS score after 17% (4), while CWA shows consistent results

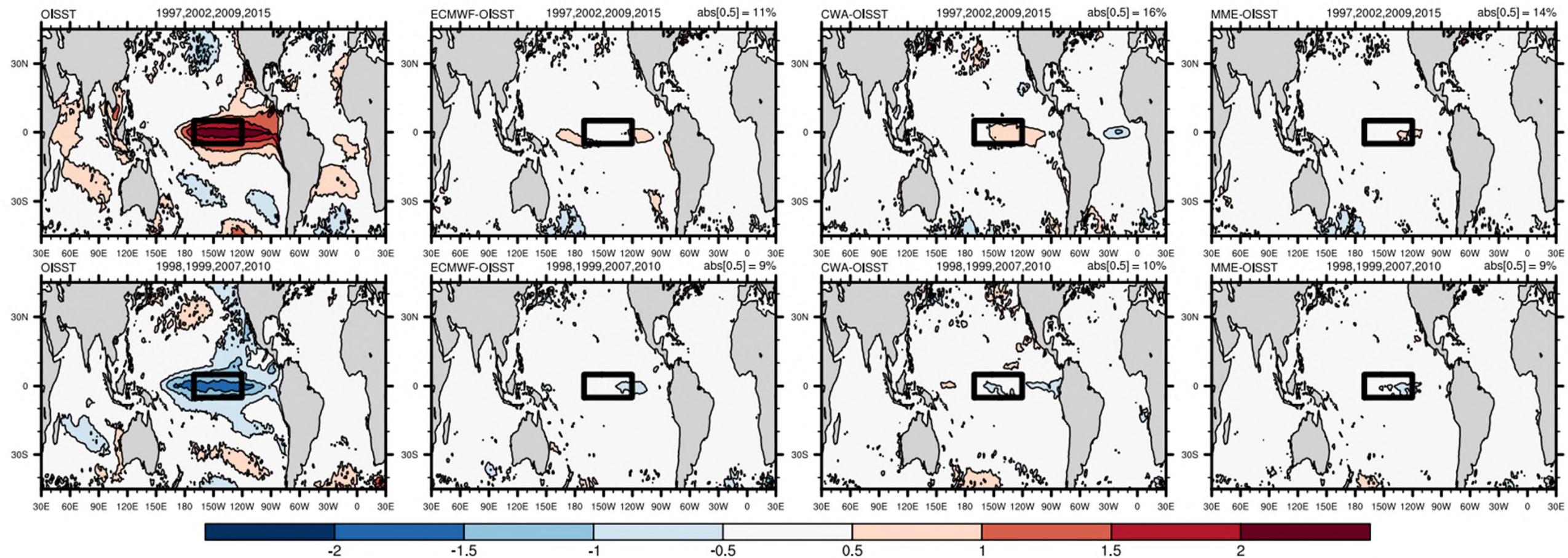
Comparing Models Extreme Event Performance

Models ini:Nov target:DJF NINO34 Warmest & Coldest 17%



Comparing Models Extreme Event Performance

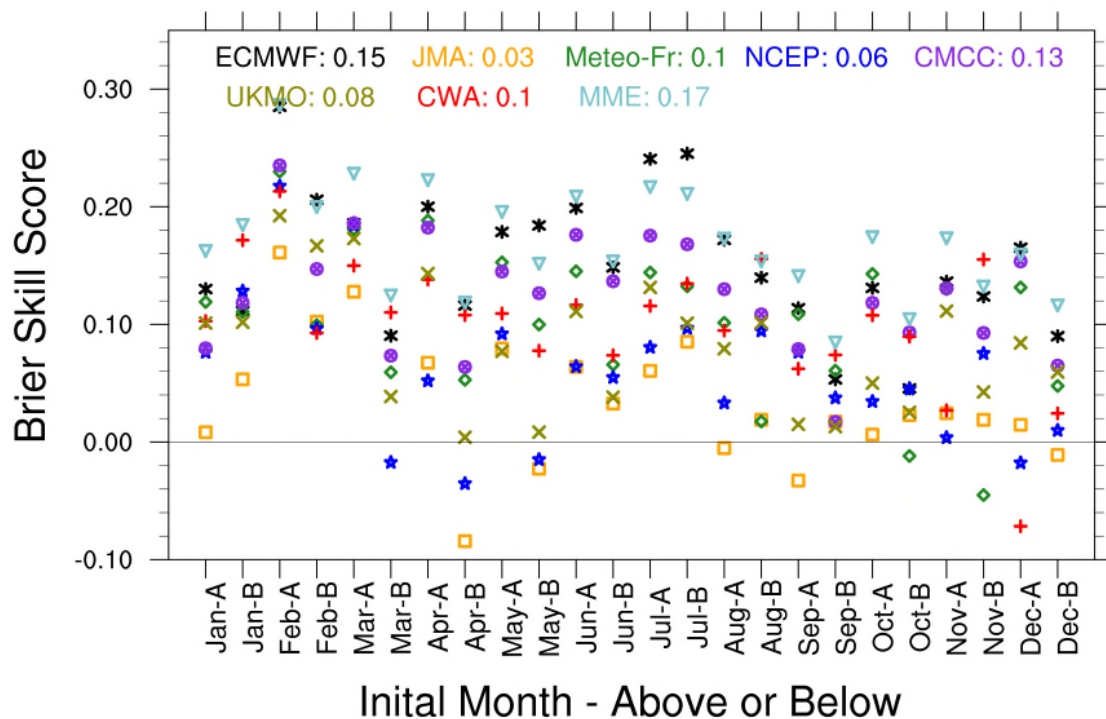
Models ini:Nov target:DJF NINO34 Warmest & Coldest 17% ; minus OISSTv2



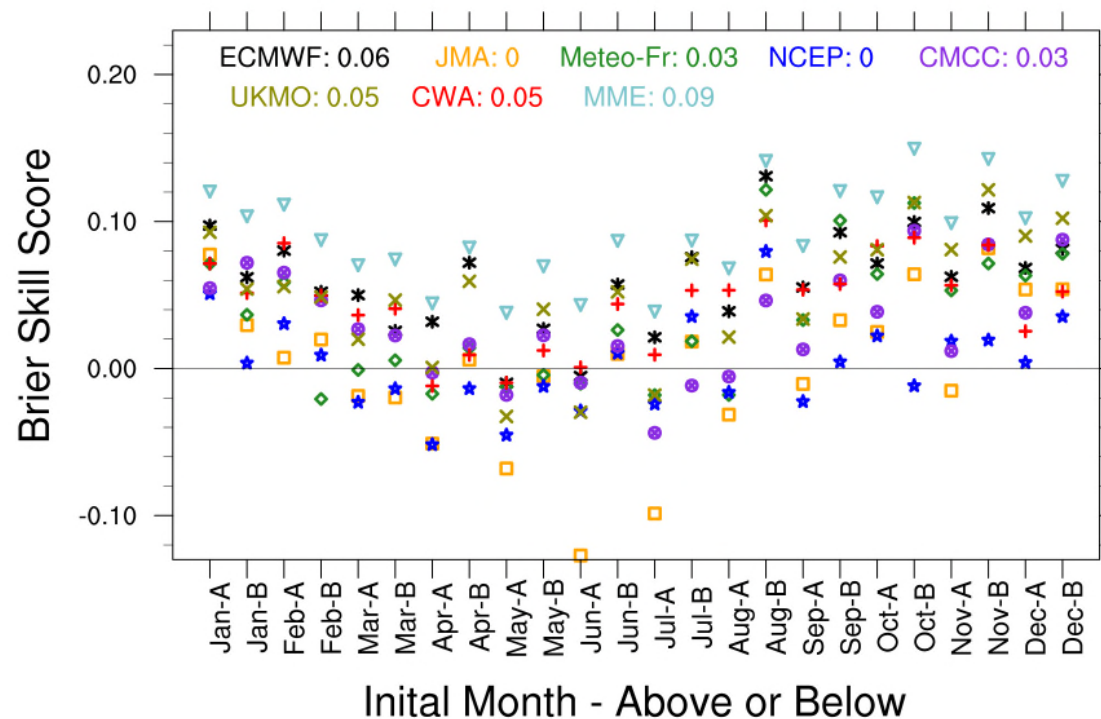
Comparing Models Extreme Event Performance



EAWP T2M BSS 17% leadtime=1 [3-month-mean]



EAWP Precip BSS 17% leadtime=1 [3-month-mean]



Simple MME method shows improvement in all seasons



- By comparing CWACFSv2 with most C3S models, we find that it performs competitively
- CWACFSv2 demonstrates strong skill in simulating summer EAWP circulation and the subtropical high
- ECMWF, Meteo-France, CMCC, UKMO, and CWA models will be used to construct the MME for Taiwan

Thank you for your attention.

➤ CWACFSv2 to 60 Members

- CWA uses a time-lagged ensemble approach, with all ensemble members currently initialized daily at 00Z. We plan to increase the number of ensemble members by also including initializations at 12Z each day.

➤ AI Downscaling

- Previous years, the CWA and NVIDIA collaborated to develop CorrDiff for weather forecasting. This year, we will focus on optimizing CorrDiff for use in climate services.

