Long-Range Forecasts of Monsoons (LRFM) WGSIP Prediction Capability Project

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Participants: Lauriane Batté (MetéoFrance, France), Asmerom Beraki (CSIR, SouthAfrica), June-Yi Lee (Pusan Univ., South Korea),Yvan Orsolini (NILU, Norway), Ramiro Saurral (CIMA, Universidad de Buenos Aires, Argentina), Adrian Tompkins (Abdus Salam International Center for Theoretical Physics, Italy)

Aims of Monsoons (LRFM)

Monsoons (LRFM)

Asian monsoon

Evaluating the reproducibility and prediction skills of key features/modes.

Better understanding of processes and mechanisms responsible for the seasonal predictability of the Asian monsoon.

Global Monsoons

Evaluating the performance of dynamical models in the seasonal prediction of the GM index and GM precipitation patterns.

Better understanding of main mechanism aspects responsible for the seasonal predictability of the GM index or GM precipitation.

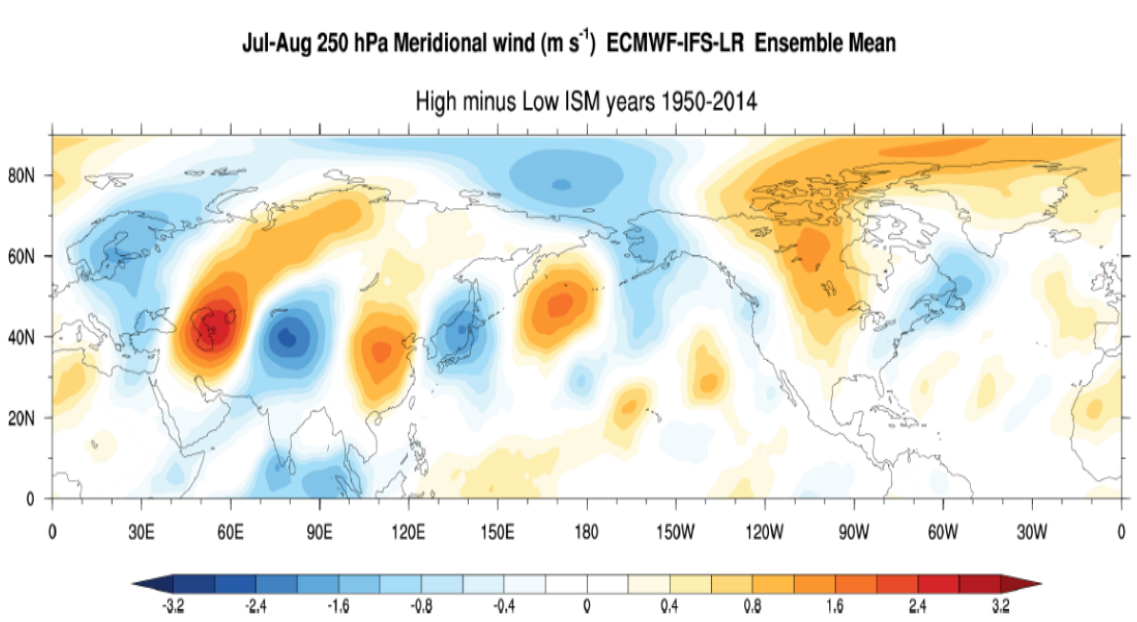
Some reports from recent on-going studies

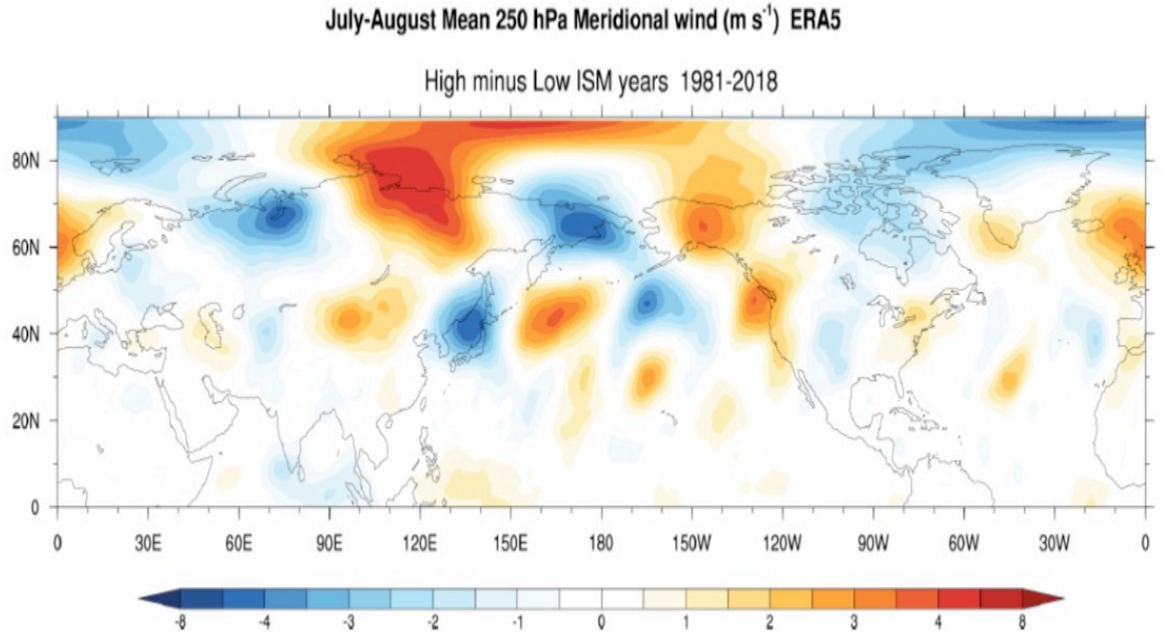
- Preliminary evaluation of the seasonal prediction of Asian summer monsoon (simultaneous and delayed influence of ENSO) – initiated
- Roles of the north tropical Atlantic on the Asian summer monsoon. – paper under review
- Studies on the 2020 flooding events in China and Japan
  -- paper under review
- Evaluation of PRIMAVERA (ECMWF) simulations

Evaluation of Indian Summer Monsoon and Silk-Road pattern in PRIMAVERA simulations

Contribution: Y. Orsolini (NILU, Norway), R. Senan and F. Molteni (ECMWF)

Composite analysis based on an index of ISM rainfall

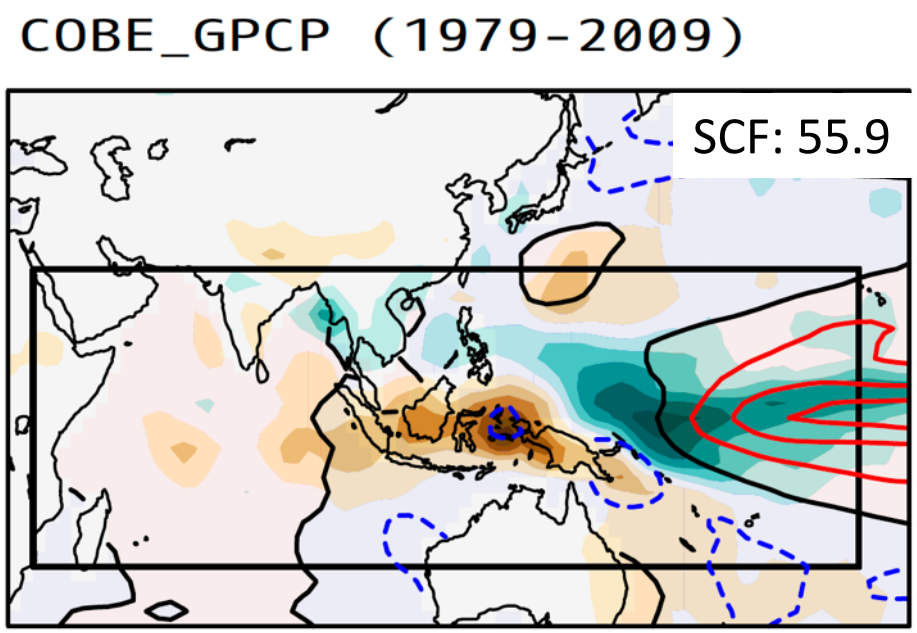




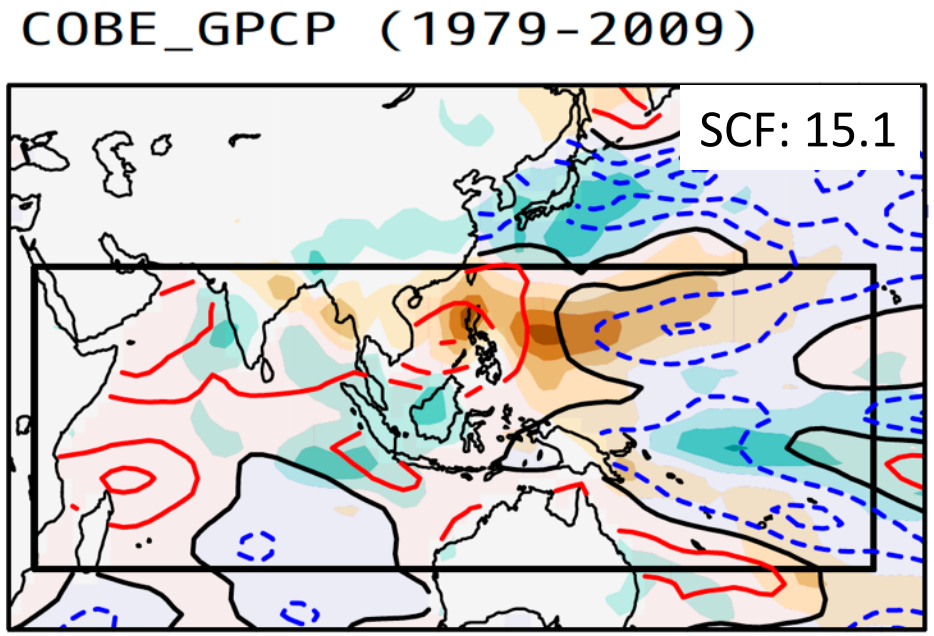
- Indian Summer Monsoon (ISM) as contributing the forcing of the circumglobal teleconnection (CGT) and the Silk-Road pattern (SRP)
- Representation of the CGT / SRP in the "PRIMAVERA" climate simulations (1950-2014) with the ECMWF coupled model
- Comparisons with the ERA5 reanalyses ; impact of model resolution

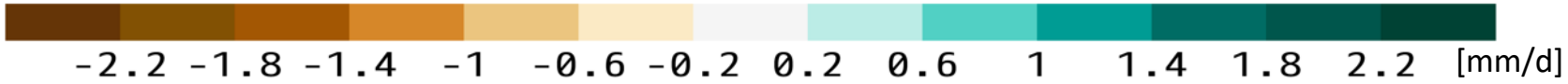
Simultaneous/delayed ENSO influence on ASM

ENSO mode



IPOC mode





color： precipitation
contour: SST (CI:0.2 [K])

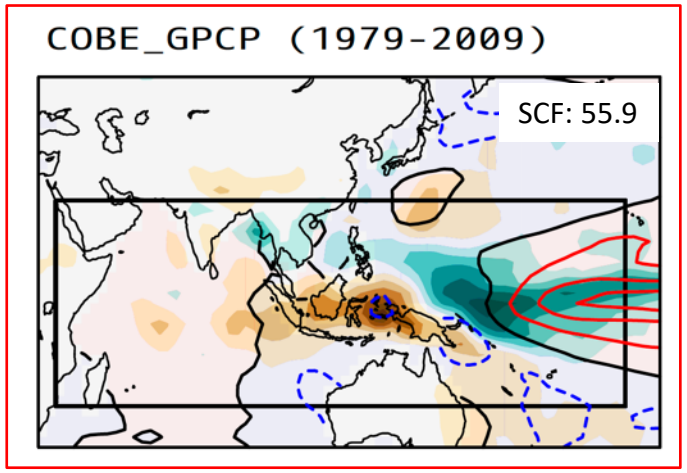
Heterogeneous regression maps of SVD analysis for SST and precipitation in JJA

Both modes seem to have relatively high predictability, being a key for Asian summer rainfall prediction. How well do models represent these mode? How does it relates to the skill?

Takaya et al. in prep.

Reproducibility of the SST-precipitation coherent modes

ENSO mode (obs)



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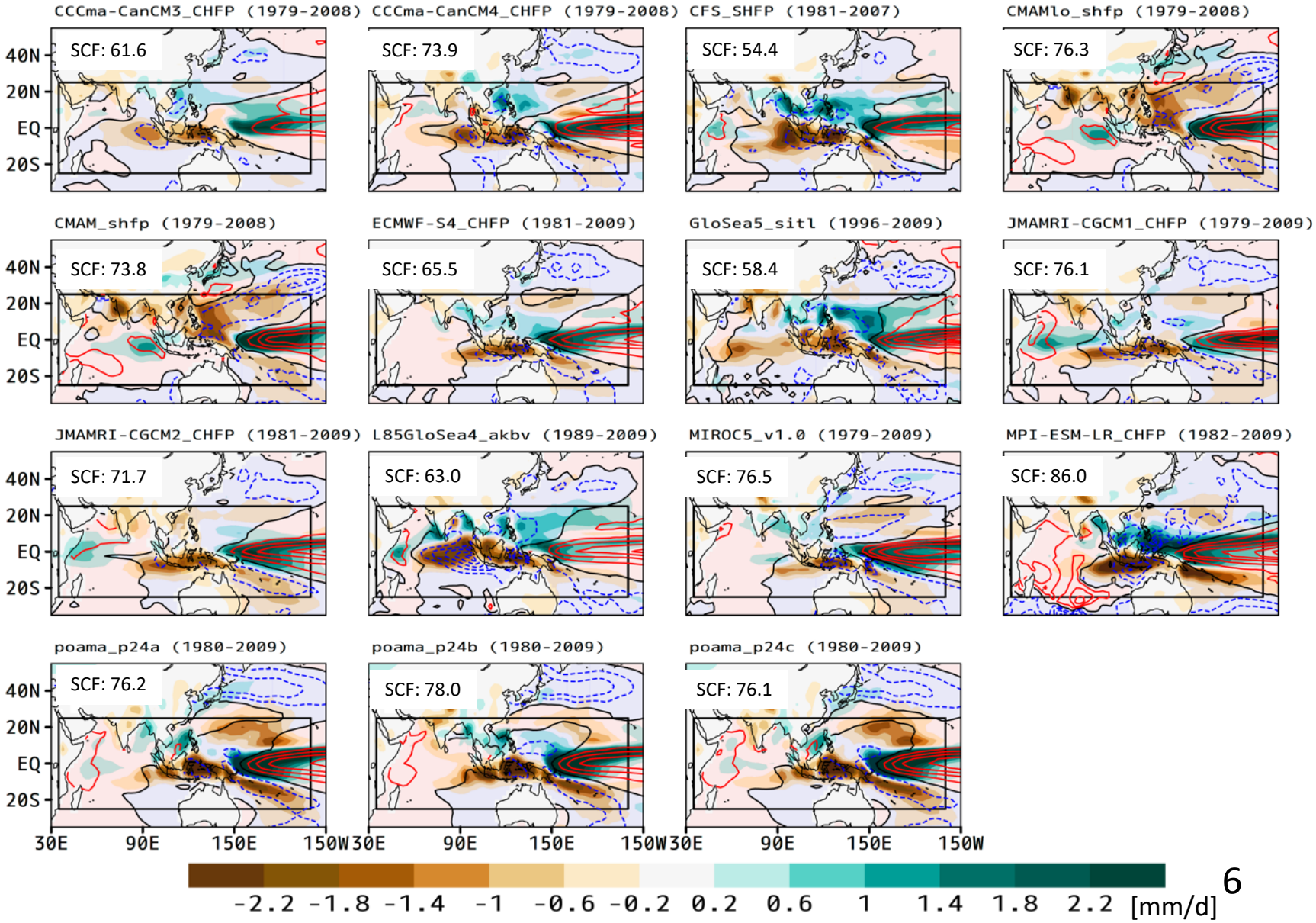
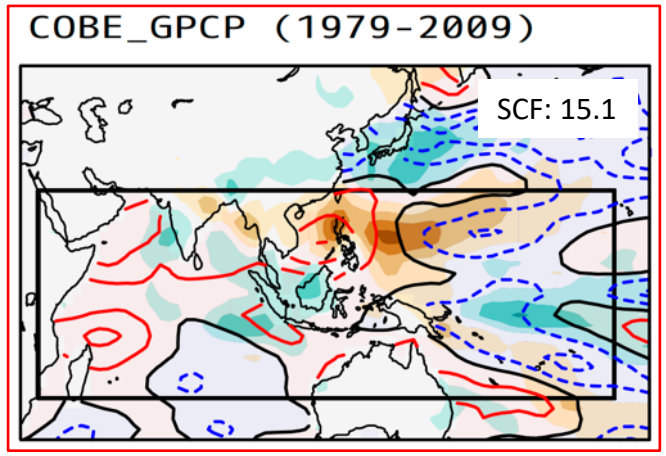
Results of SVD analysis for SST and precipitation in black box. heterogeneous regression maps



Reproducibility of the SST-precipitation coherent modes

IPOC mode (obs)



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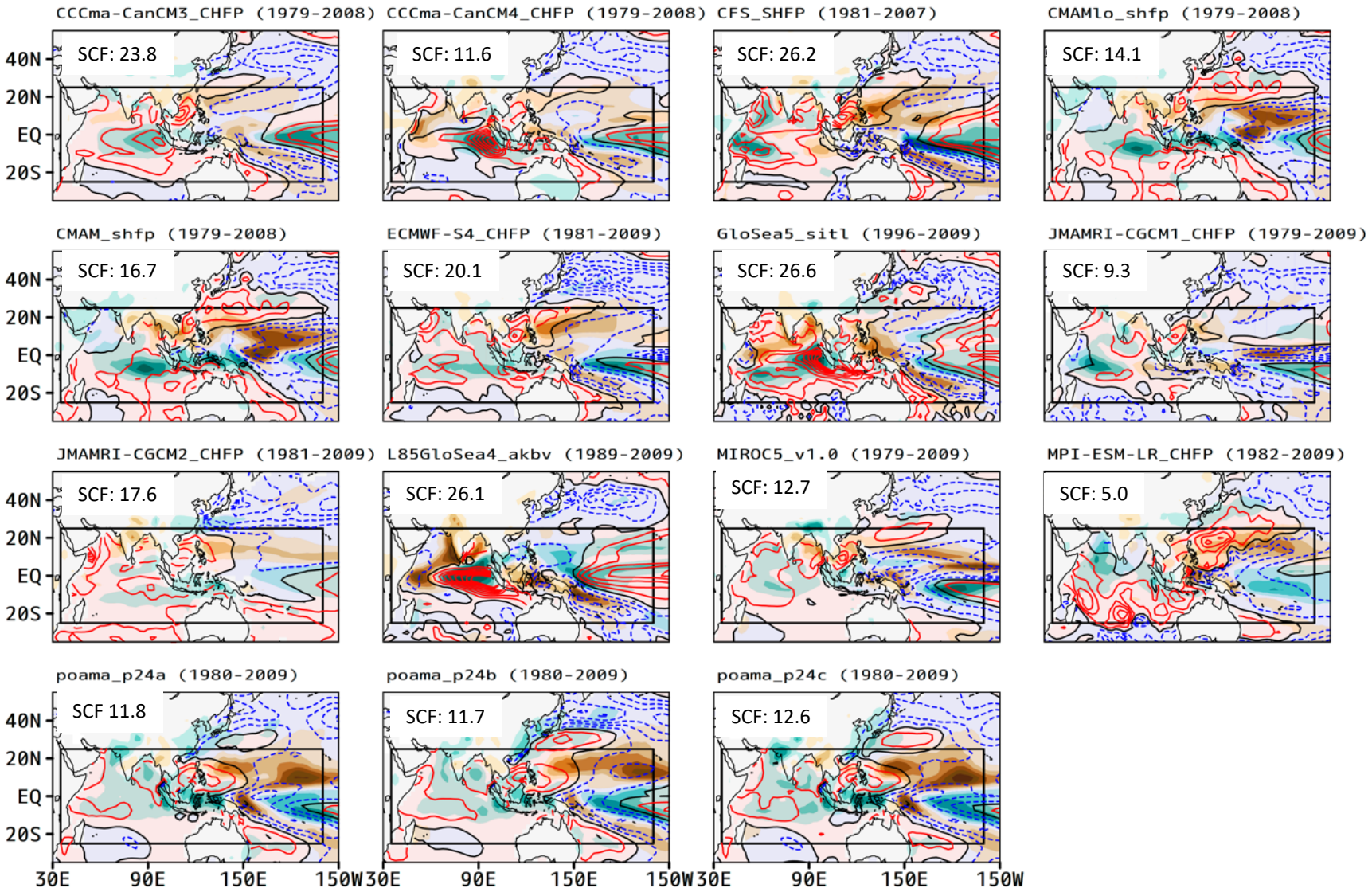
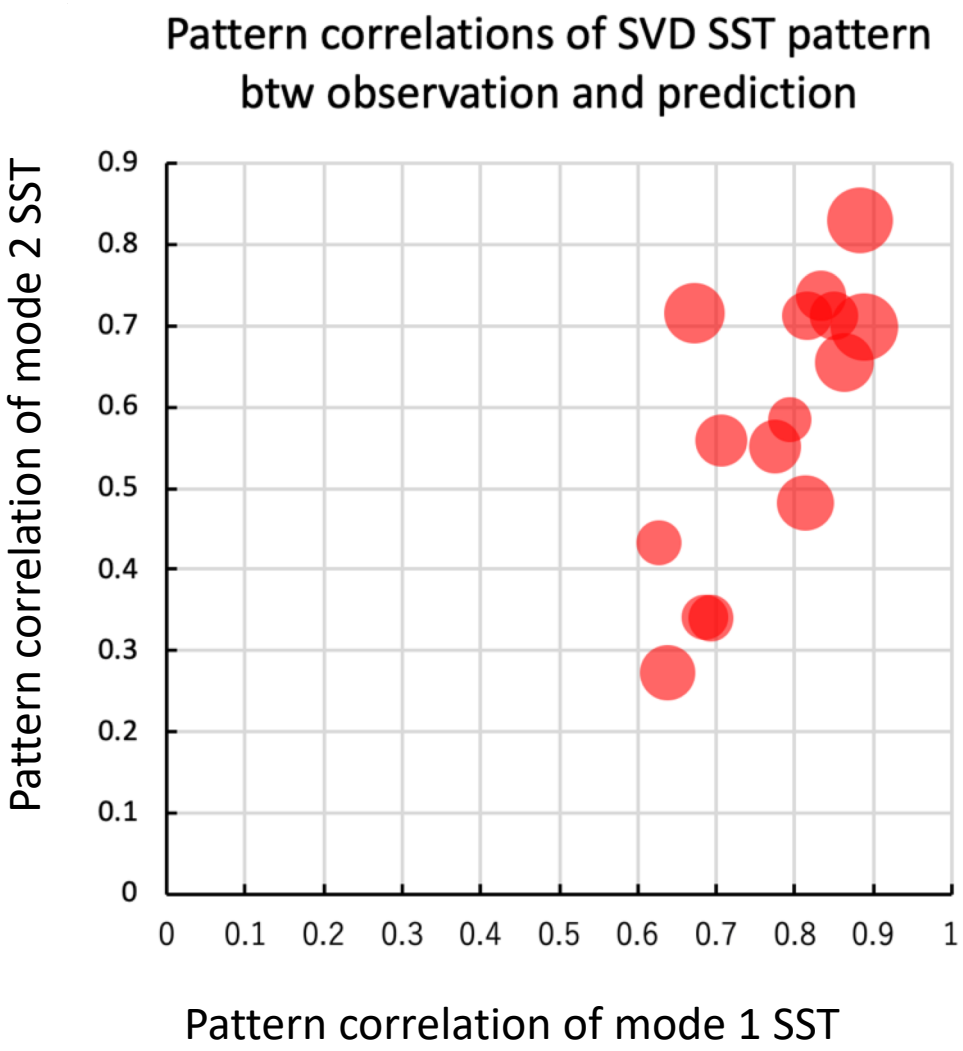


Precipitation prediction skill and reproducibility of ENSO/IPOC modes

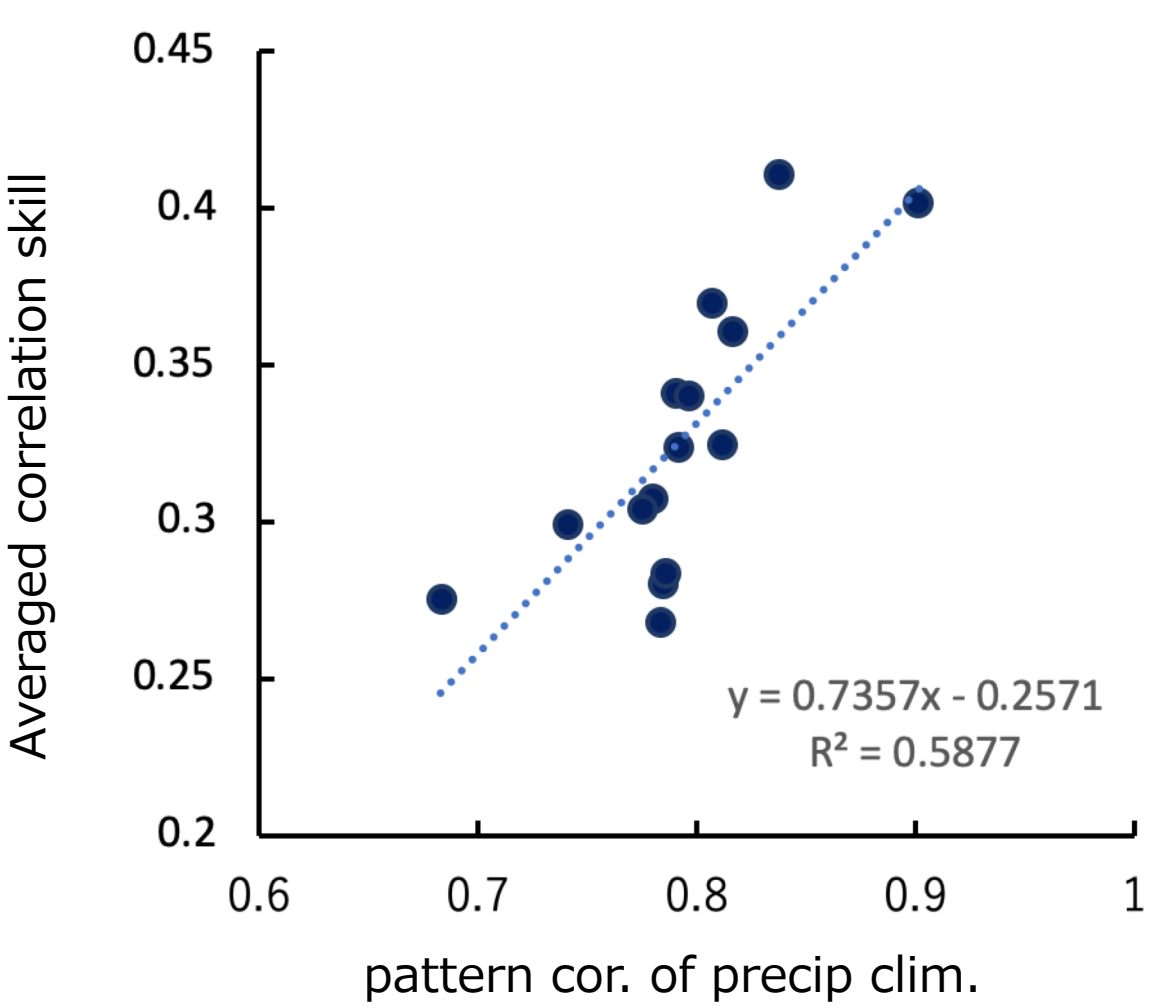


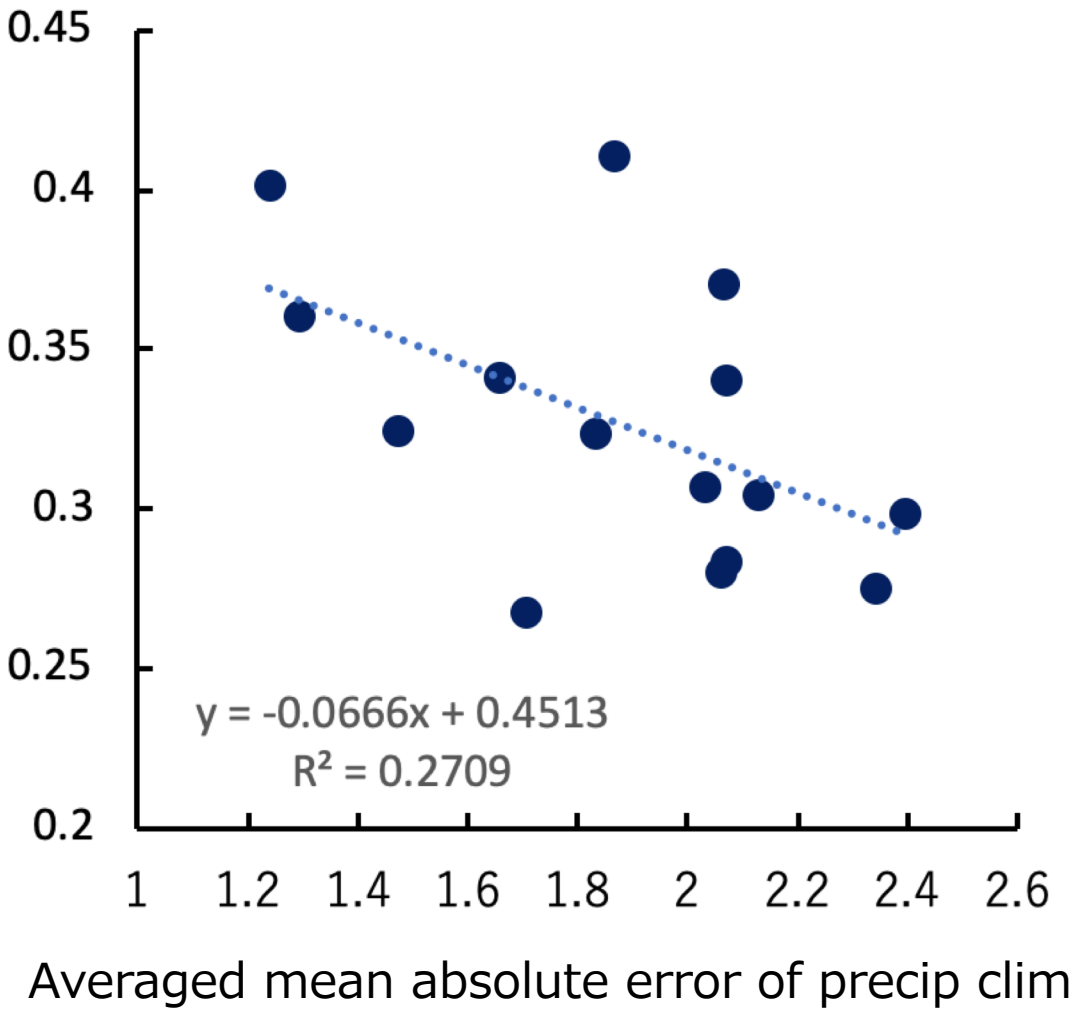
Pattern correlations of SVD heterogeneous regression maps of **SST** of mode 1 (x-axis), mode 2 (y-axis) and averaged correlation scores (circle size). Colors and circle size indicate averaged correlation scores for precipitation.

Models with better representation of the coherent modes tend to have higher skill.

Note that the causality can not be inferred by this analysis, but this result implies the direction of model development.

Relation btw prediction skill - bias & pattern cor





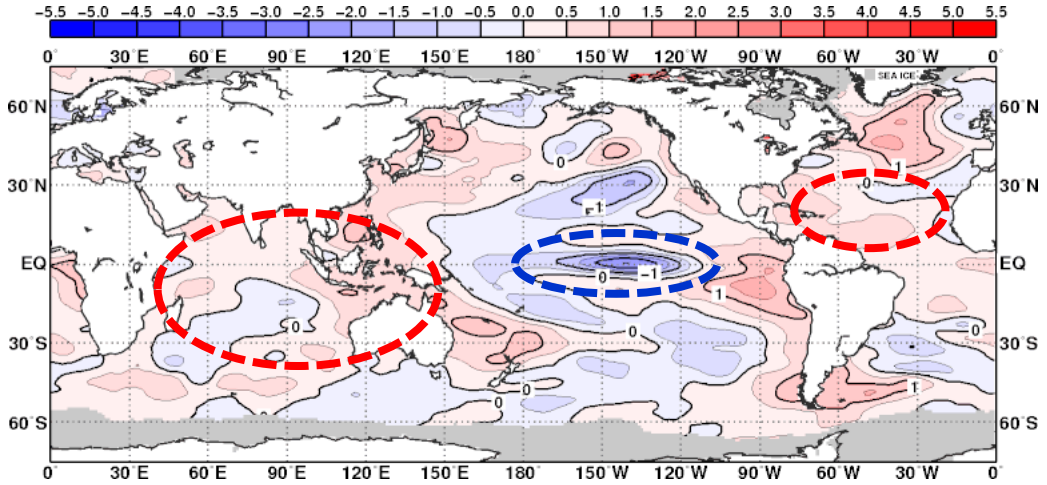
Note that the causality can not be inferred by this analysis, but this result implies the direction of model development.

North Tropical Atlantic (NTA) warming after El Nino

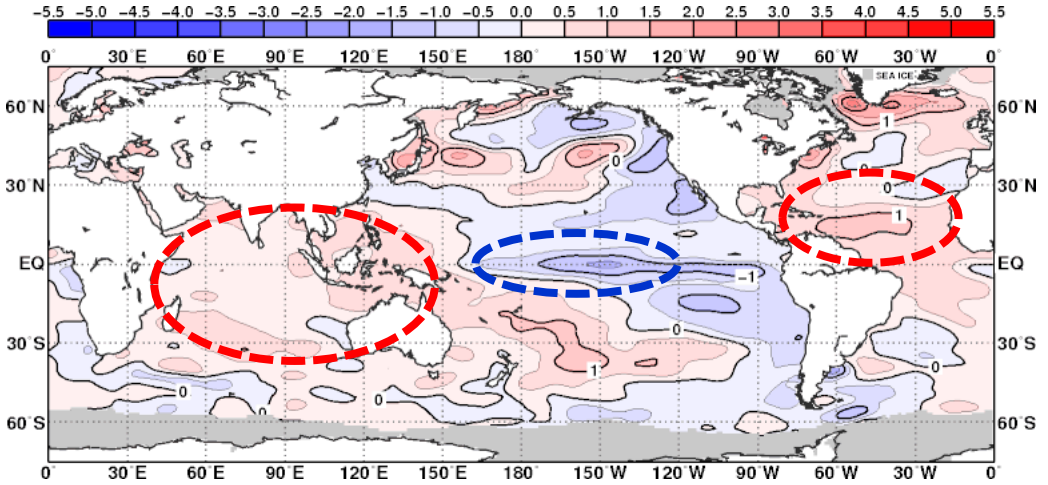
Takaya et al. under review, *J. Clim.*
“Two Tropical Routes for the Remote Influence of the Northern Tropical Atlantic on the western Indo-Pacific Summer Climate”

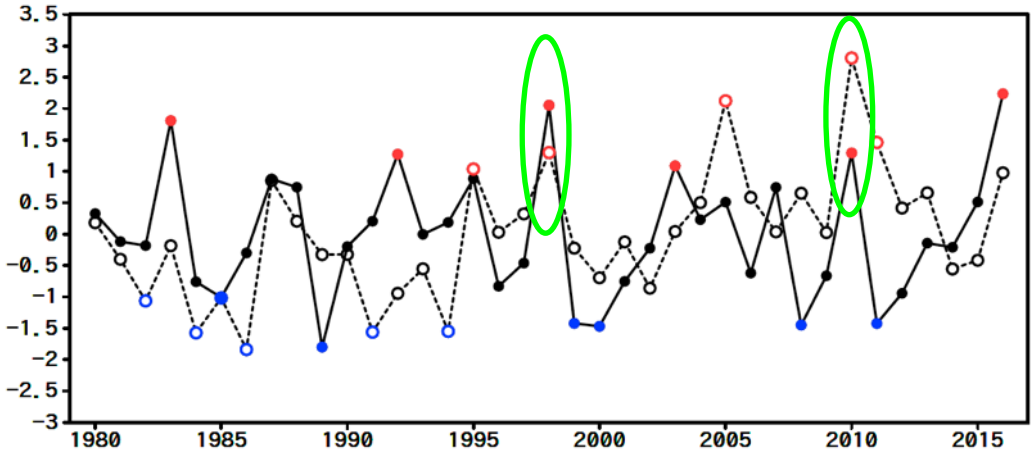
North Tropical Atlantic (NTA) warming after El Nino

SSTA (JJA 1998)



SSTA (JJA 2010)





NTA (JJA(1), dash) and NINO3.4 (NDJ(0) solid) SSTs normalized by the standard deviation.

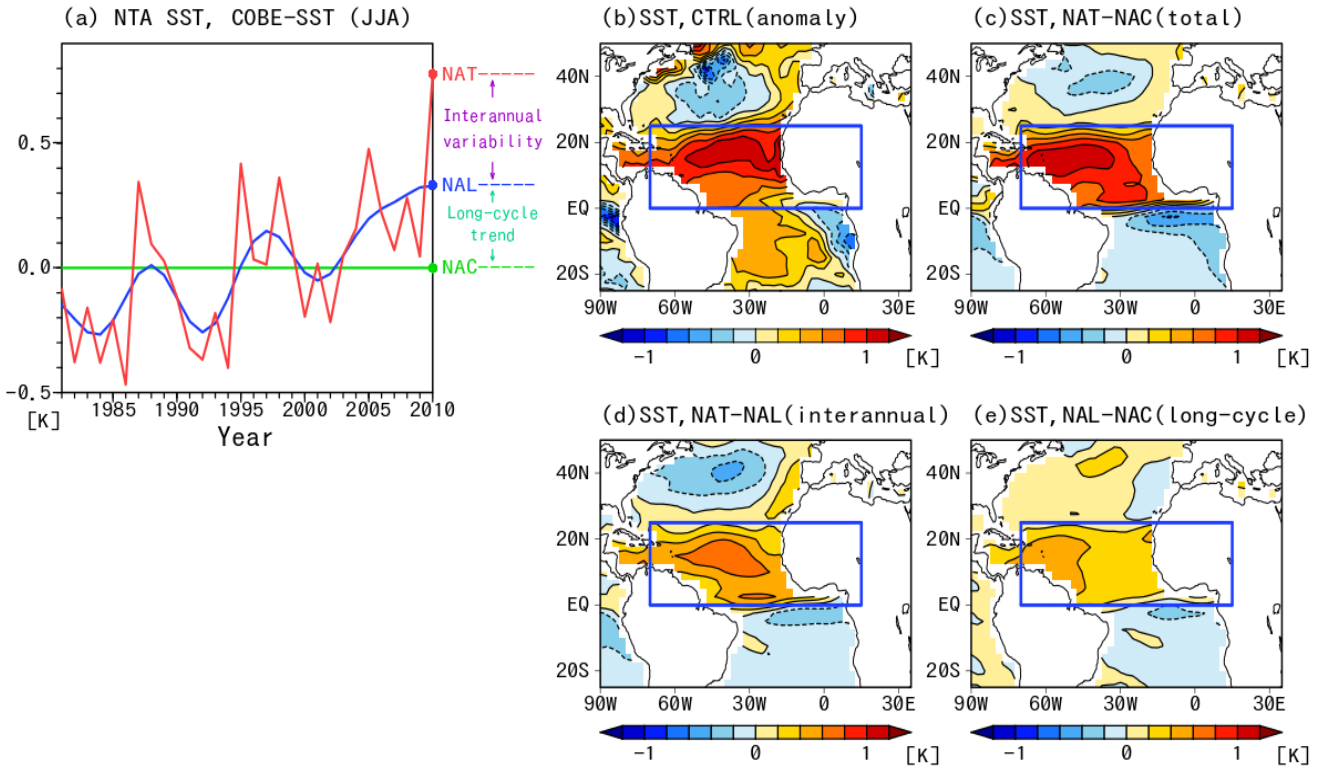
In these years, the El Nino events in preceding winter decayed rapidly, and turned to the La Nina phase. This characteristics are typical for strong El Nino events and warmed IO and NTA could enhance the ENSO transition.

Sensitivity experiments

NAT Exp: SST in NTA region relaxed to observed SST anomalies plus model climatology

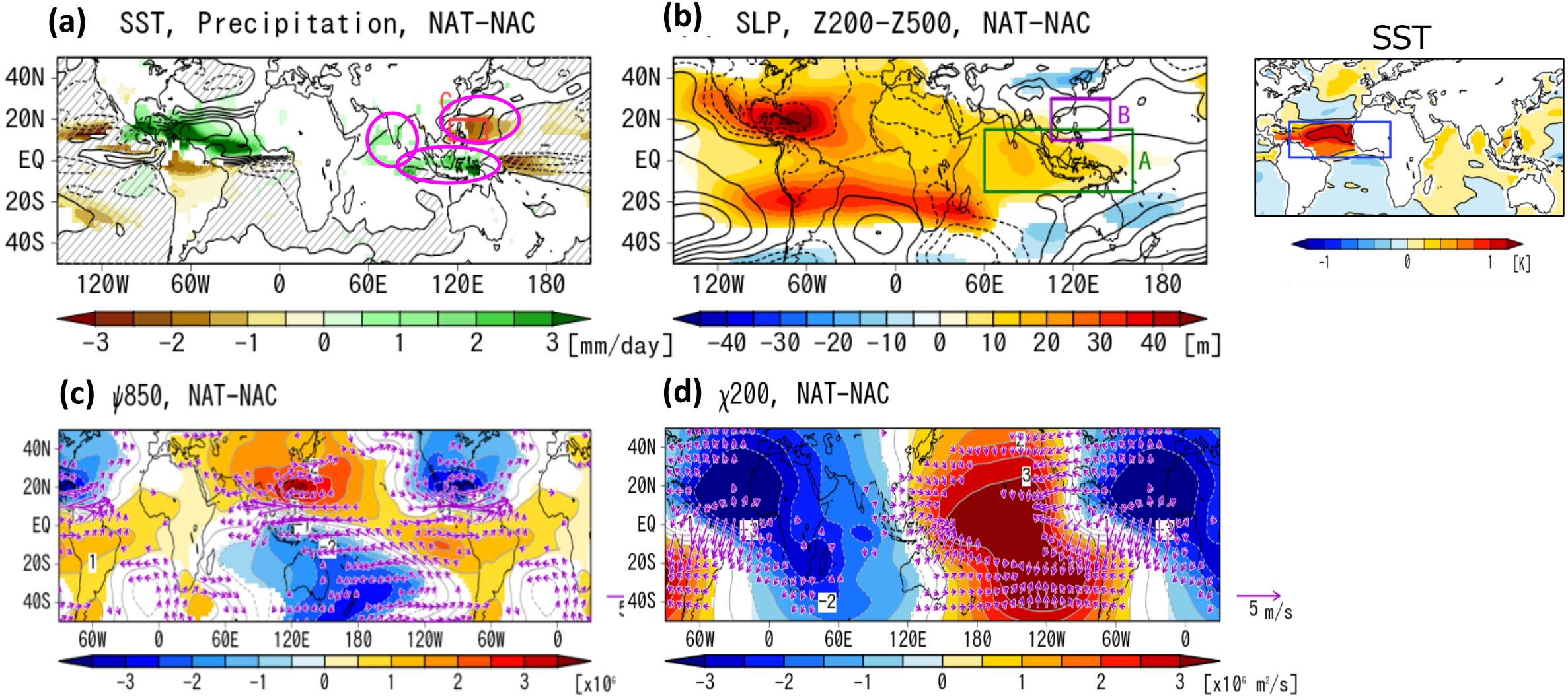
NAC Exp: SST in NTA region relaxed to the model SST climatology

30-member ensemble simulations from the end of April in 2010



Takaya et al. under review

Results of NTA SST sensitivity experiments



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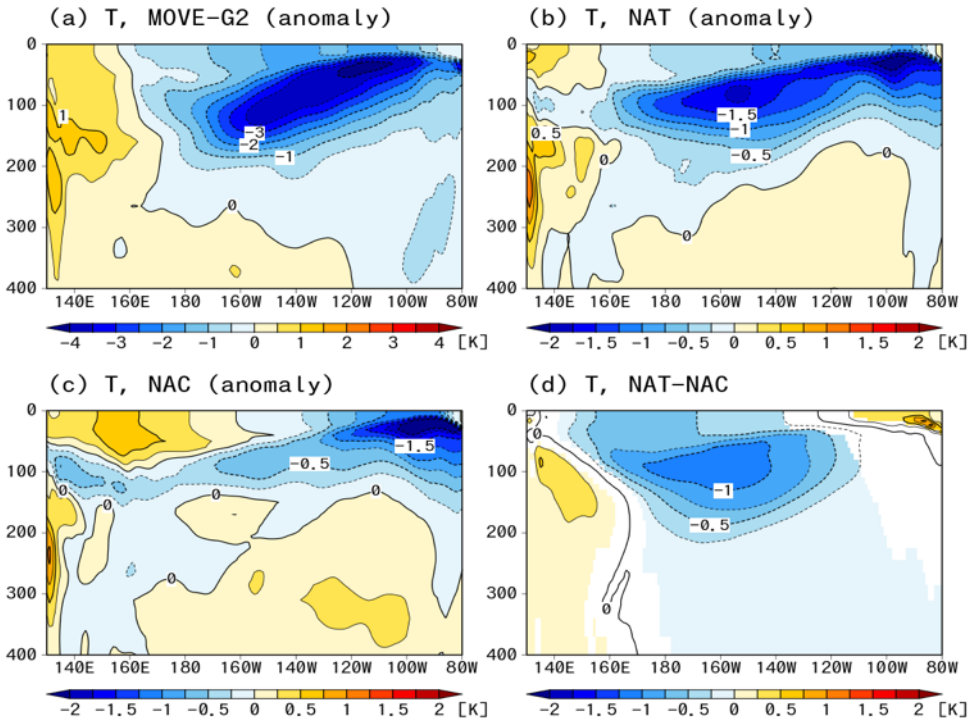
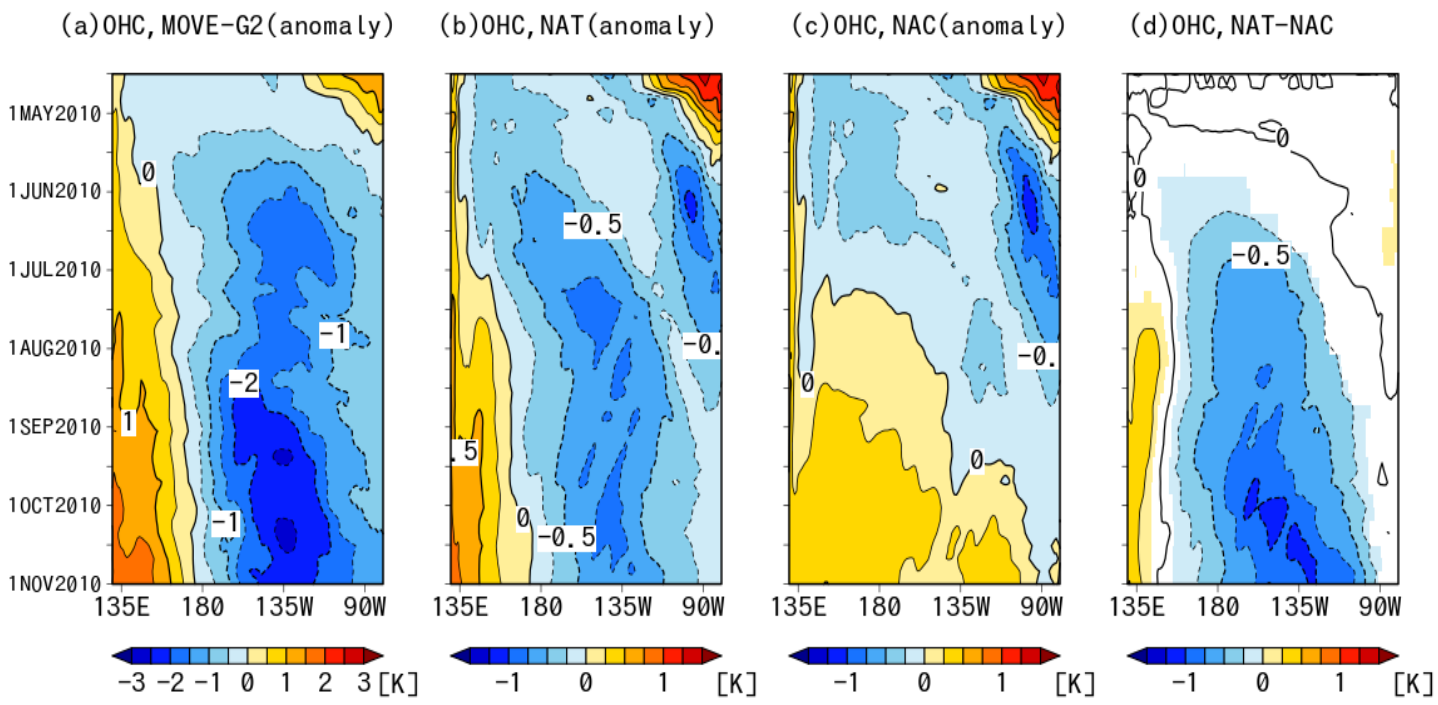
Warm NTA SST can strengthen the IPOC-like response (eastbound route),
and modulate the Walker circulation, and trigger the La Nina (next slide, westbound route)

Warm NTA SST facilitates the El Nino-La Nina transition

Subsurface temperature anomalies at the EQ (2010 JJA)



Hovmöller diagram of ocean heat content anomalies (T averaged in upper 300m) (2010 JJA)



Resultant La Nina-like conditions further enhance the WNP response in addition to the influence of Indian Ocean.

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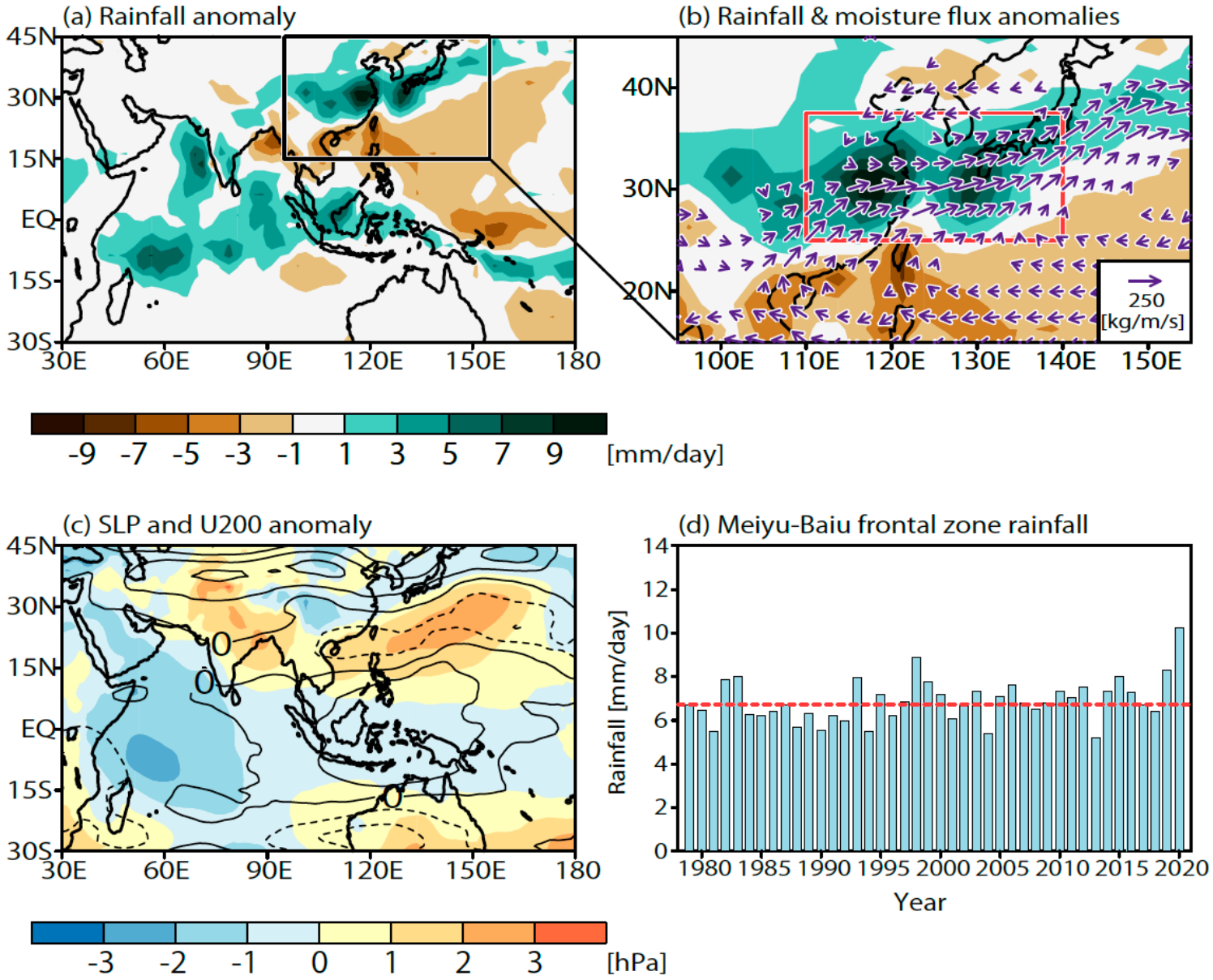
Studies on the 2020 flooding events in China and Japan



During the early summer this year, torrential rainfall in China and Japan caused devastating floods and landslides. These rainfall extremes are part of the large anomalous Asian monsoon condition like the well-known IPOC (Indo-western Pacific Ocean Capacitor) mode.

The JMA model (and other models) predicted well the enhanced Meiyu-Baiu rainfall during June-July from May (one month lead).

Sensitivity experiments further suggest that the warm Indian Ocean condition is one of the causes of the enhanced Meiyu-Baiu rainfall.

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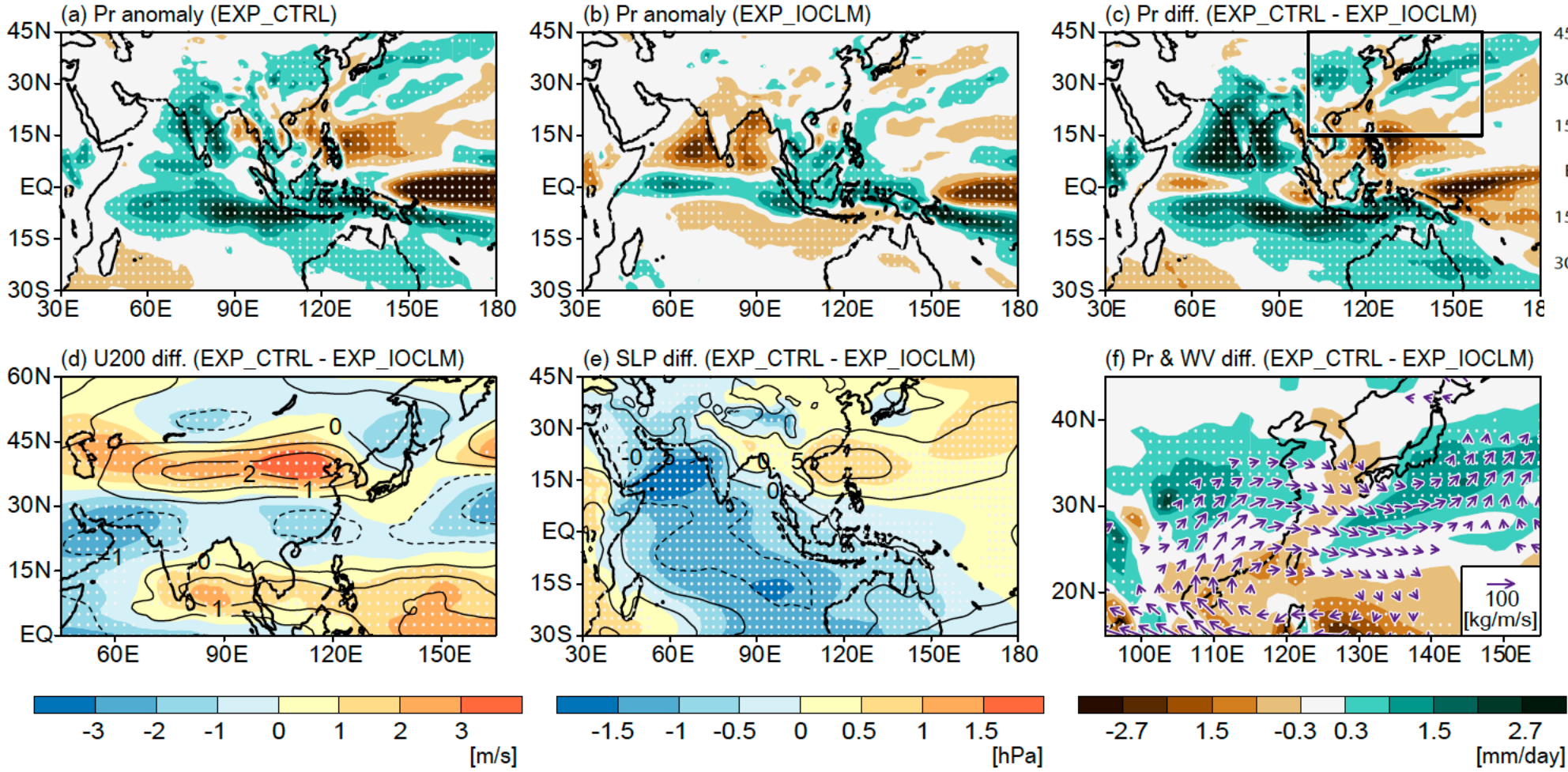
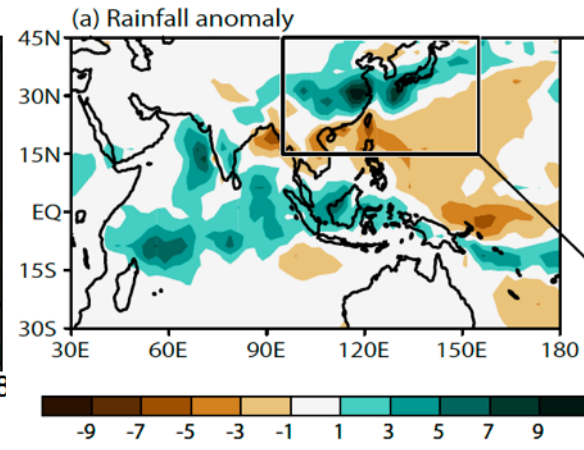
Seasonal prediction (JMA/MRI-CPS2)



Observation



Initial: 26 Apr. 2020

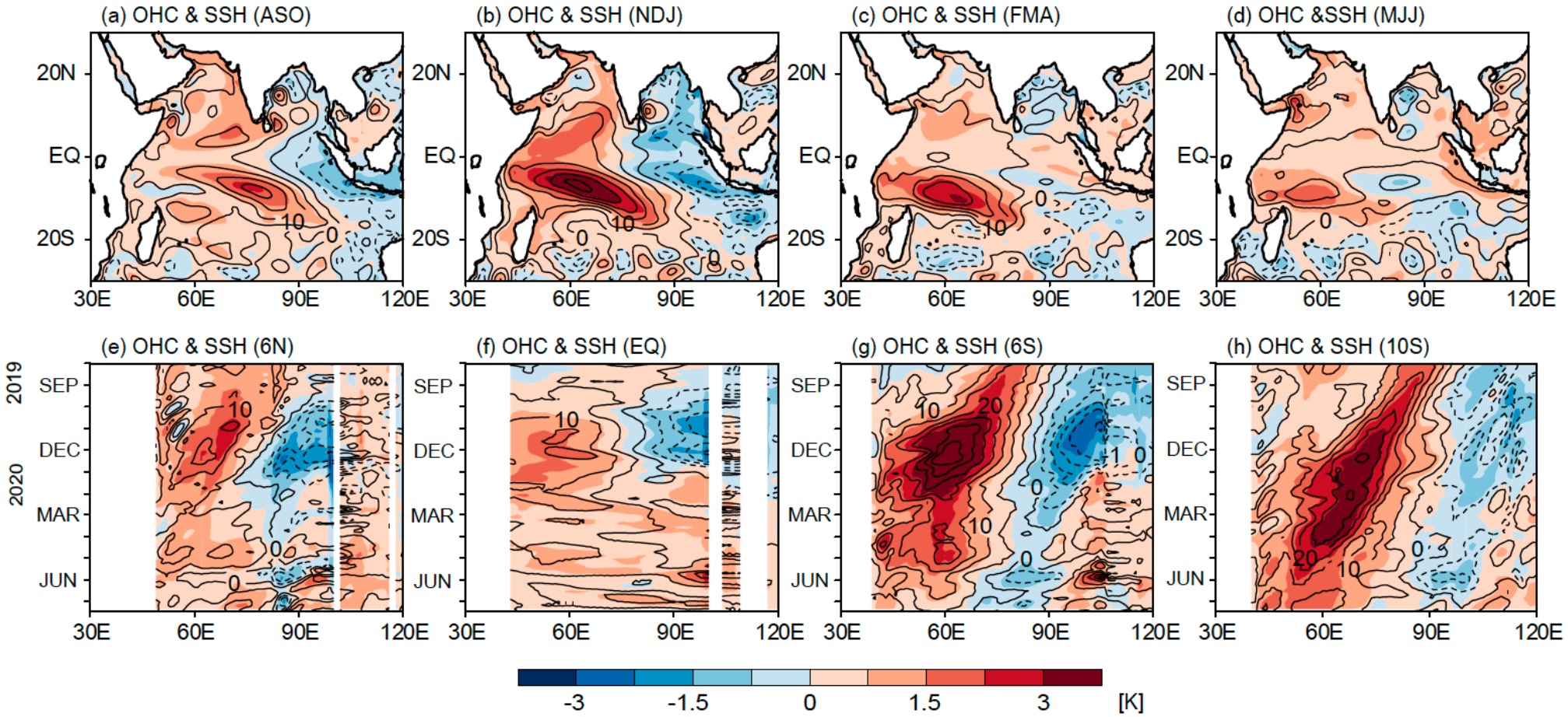
Takaya et al. under review

Linkages btw other projects/communities

- **CLIVAR/GEWEX Monsoon Panel**
  - The Seventh WMO International Workshop on Monsoons (IWM-VII) postponed to 2022
  - Contacted to CLIVAR/GEWEX Monsoons Panel (Rupa Kumar Kolli)
- GEWEX Regional Hydrological Project
  Initiating and Prospective RHPs **:**
  - **AsianPEX**: Asian Precipitation Experiment, A follow-on activity to the Monsoon Asian Hydro-Atmosphere Scientific Research and Prediction Initiative (MAHASRI) to understand Asian land precipitation over diverse hydroclimatological conditions
  - **TPE**: Study of the Third Pole Environment, the region centered on the Tibetan Plateau (Some prediction studies under way, e.g., LS4P with GEWEX-TPE-S2S)
- **Global Monsoons Model Inter-comparison Project(GMMIP)**

Questions?

Record strong Rossby wave and IO warming



The IPOC-like condition is associated with the warm SST condition in the Indian Ocean, which was formed by the strong IOD and record strong oceanic Rossby waves in the south Indian Ocean.

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