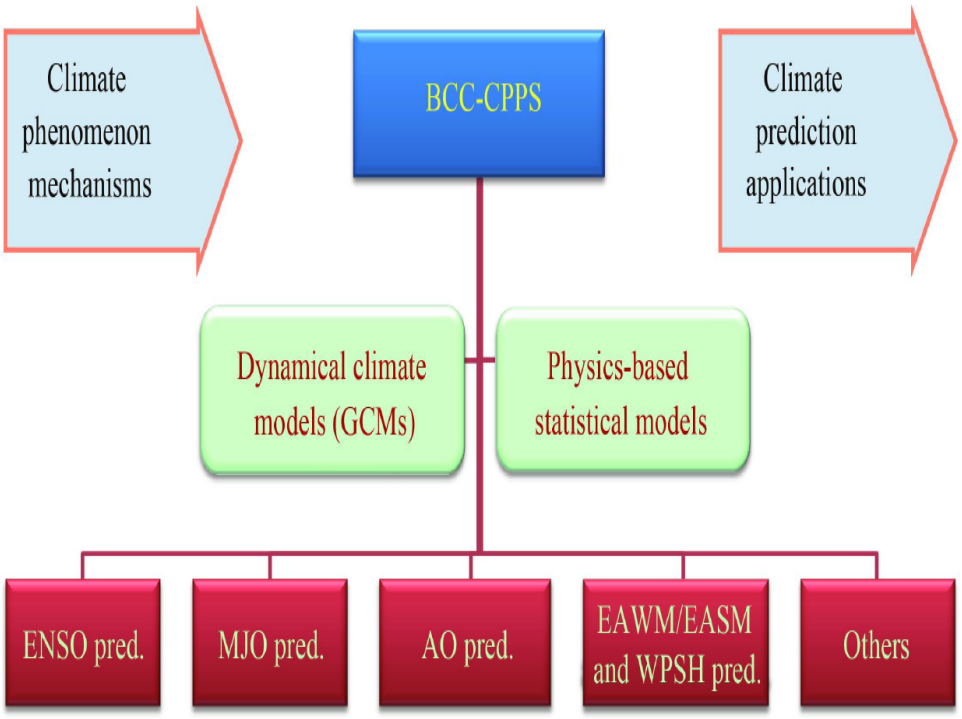
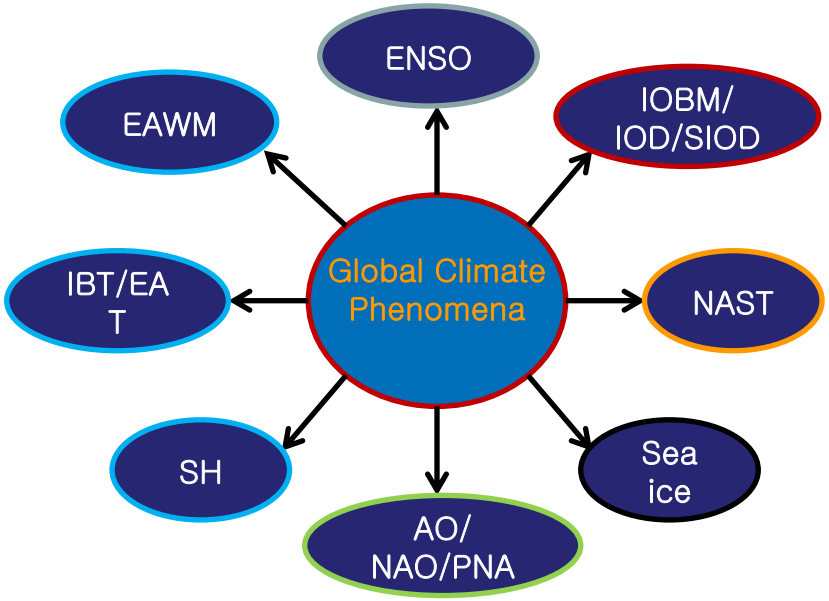
Climate phenomenon prediction system

--Support operational seasonal prediction

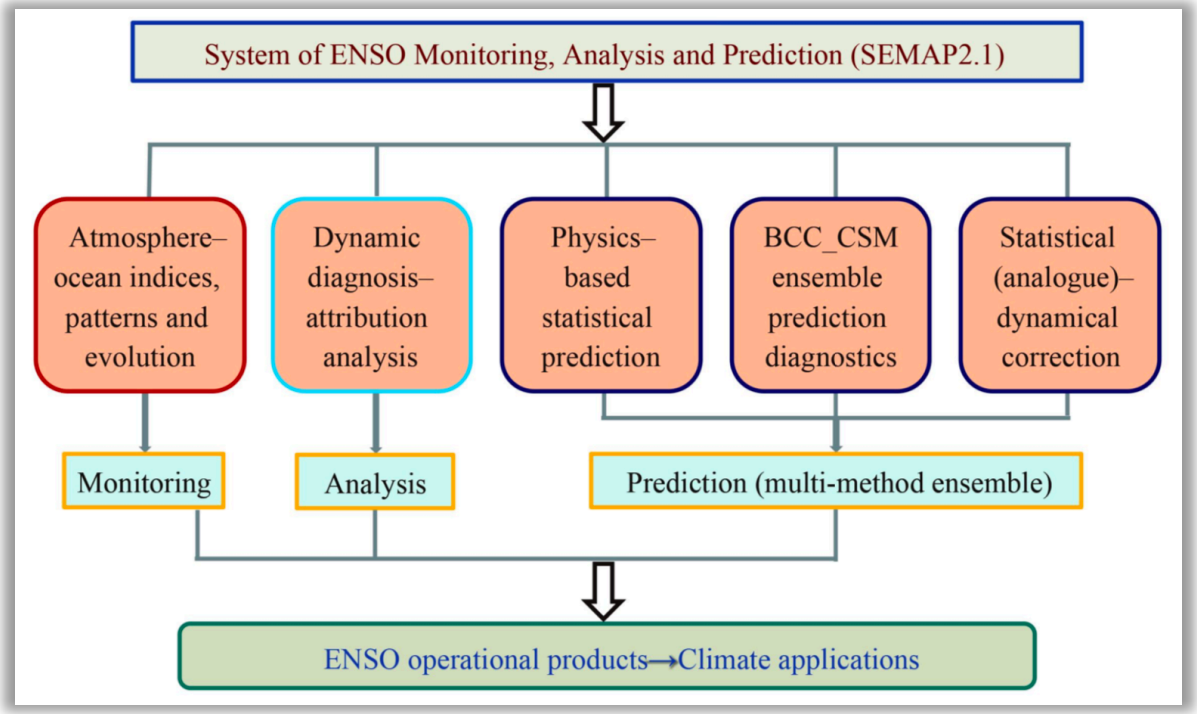




（Ren et al. 2017）

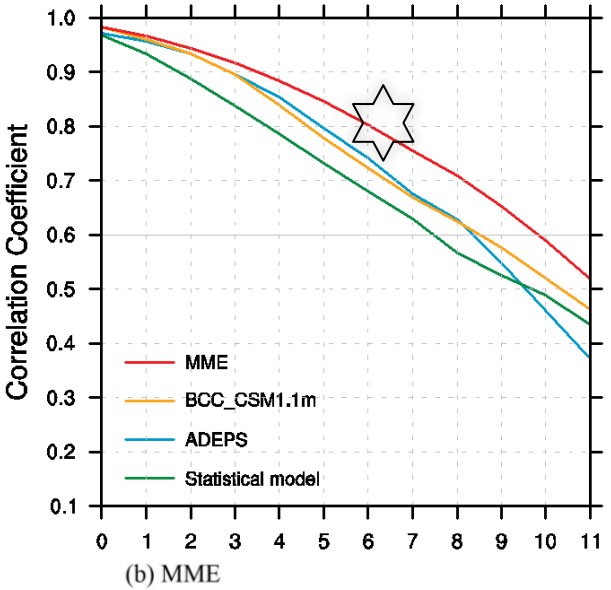
Prediction of primary Climate Phenomena/circulation patterns is of great significance for LRF and understanding Model behaviors

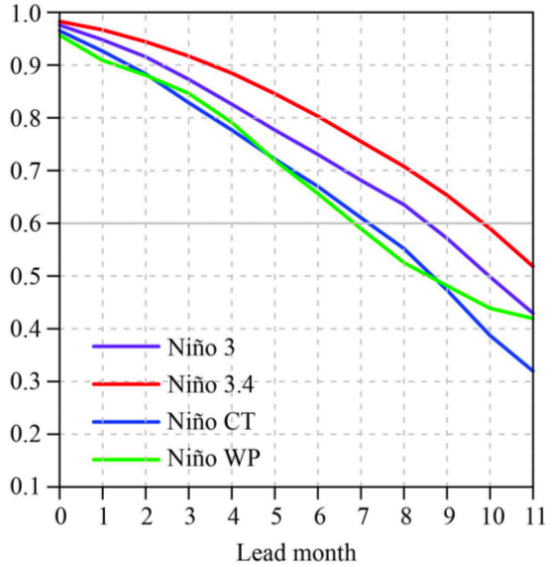
ENSO prediction



Multi-Method Ensemble (MME)

1996–2015 NINO3.4 独立样本检验





Statistical Method:

$$\text{Niño}(t) = \alpha\text{Niño}(t) + \beta\text{WWV}(t) + \gamma\text{ZWS}(t) + \delta\text{NTA}(t)$$

Dynamical model: **BCC-CSM1.1m** (24 members) — **LAF**, **SVD**

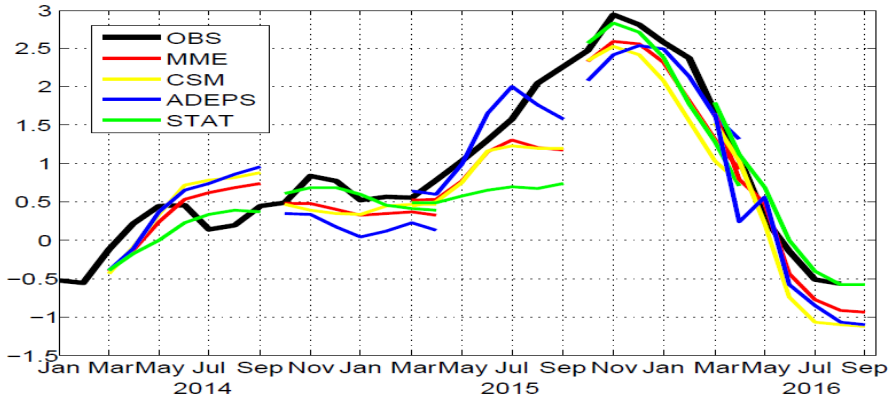
（Ren et al. 2014）

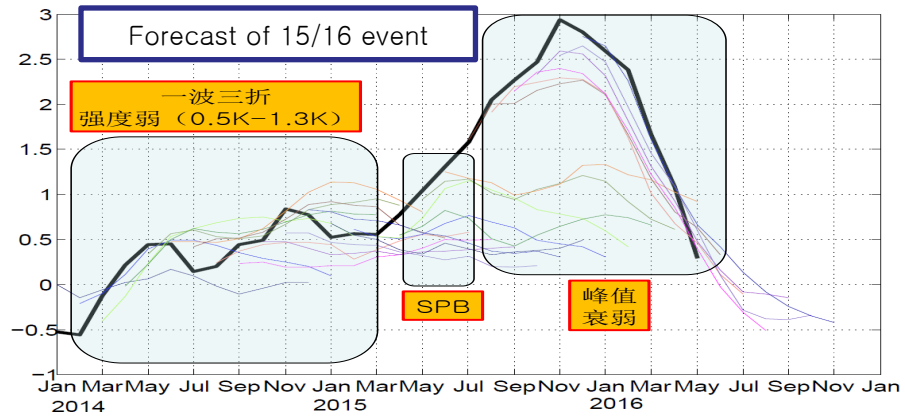
Analogue-dynamical ENSO prediction (ADEPS)

$$\hat{P}_{\mathrm{M}}(\psi_0) = P_{\mathrm{M}}(\psi_0) + \tilde{P}_{\mathrm{M}}(\tilde{\psi}_j) - P_{\mathrm{M}}(\tilde{\psi}_j)$$

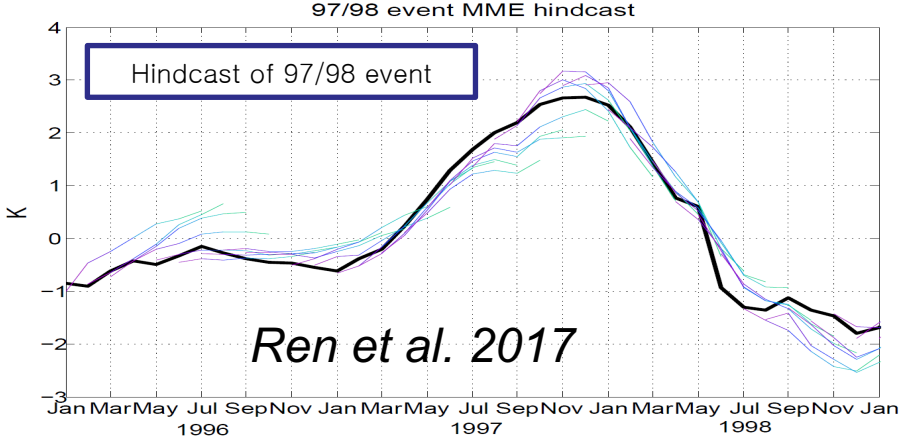
2014-2016

Nino3.4I

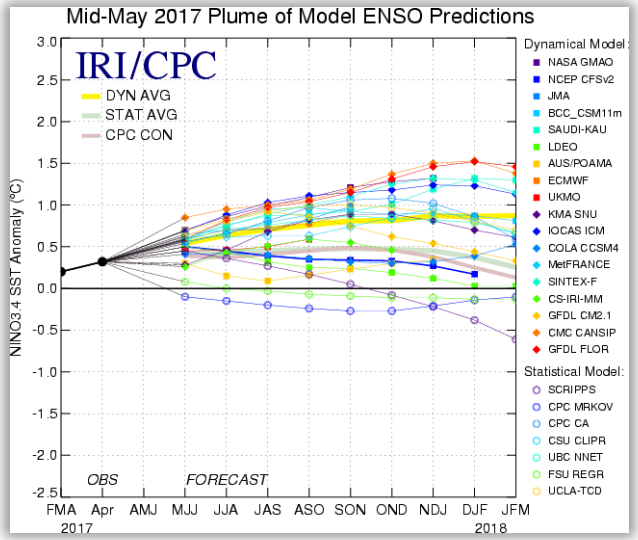




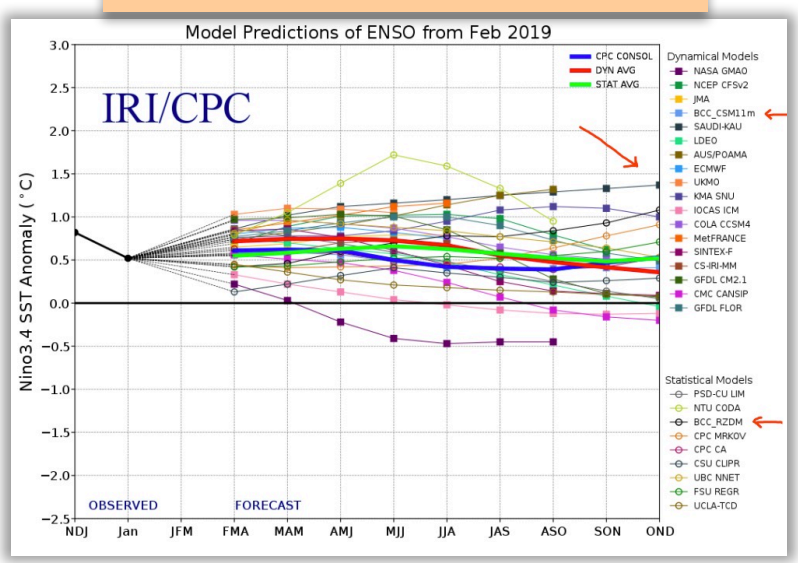
97/98 event MME hindcast



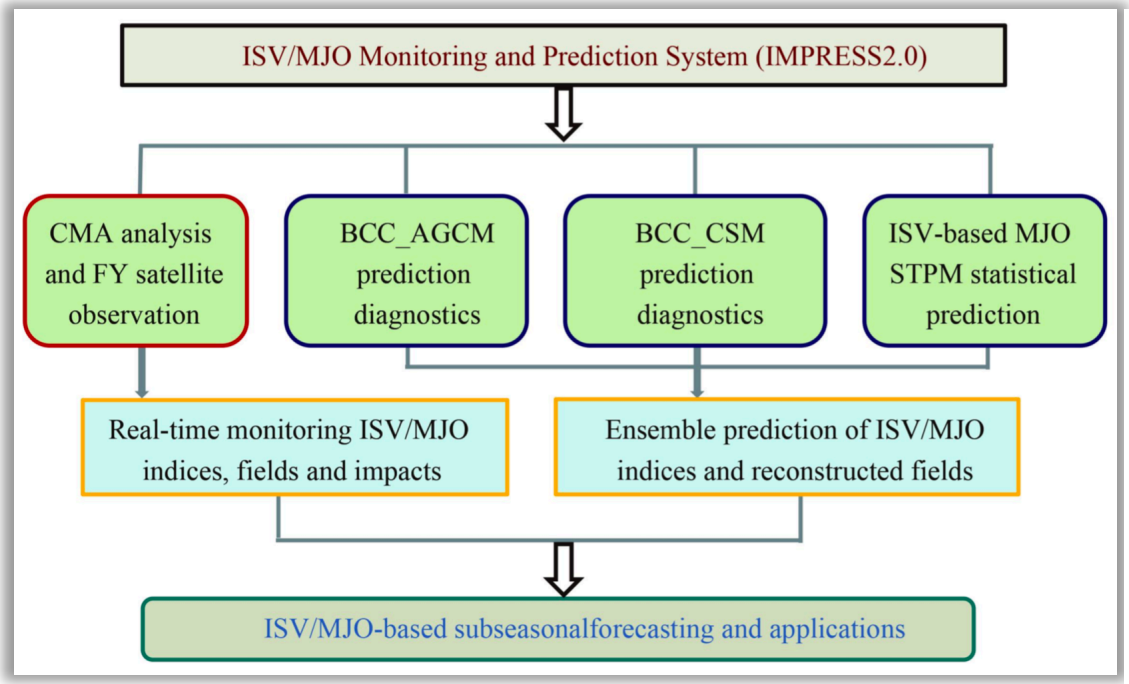
2017.05 ⇒ IRI/CPC



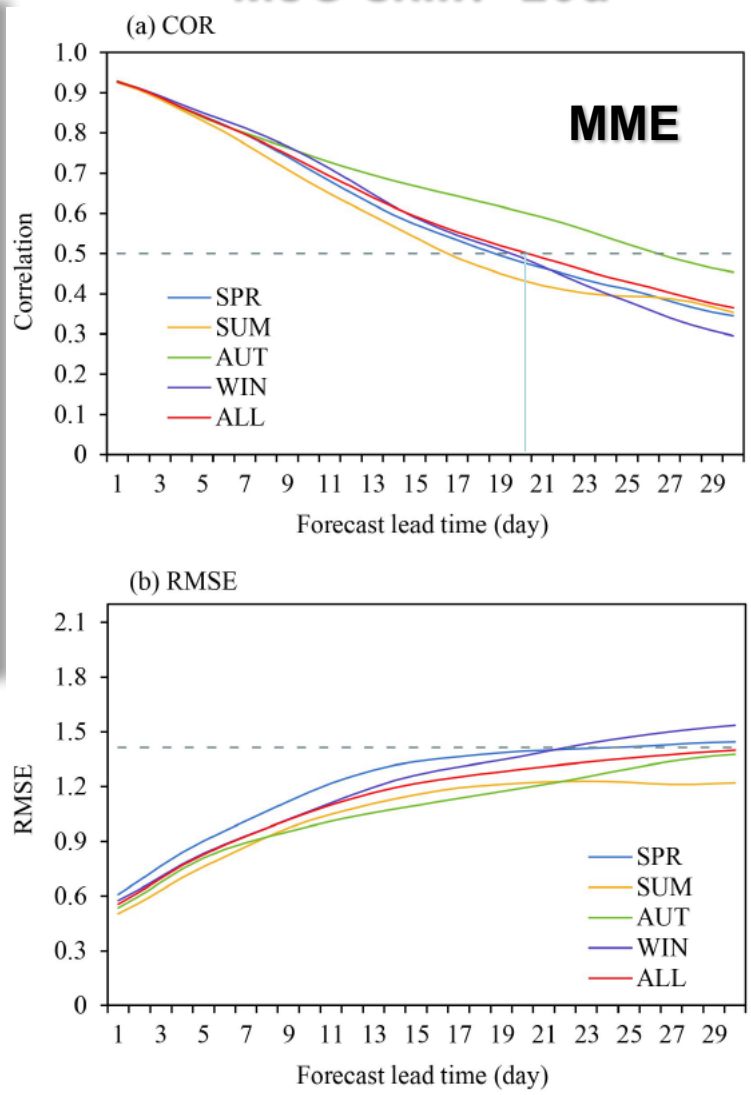
2019.01 ⇒ IRI/CPC



MJO prediction



MJO skill：20d



Multi-initial-value ensemble：

$$\mathrm{Ens_fcst}\ (t_0) = \frac{1}{6}\left[\sum_{i=t_0-2}^{t_0} \mathrm{Ens}_{\mathrm{BCC_AGCM2.2}}\,(i) + \sum_{i=t_0-2}^{t_0} \mathrm{Ens}_{\mathrm{BCC_CSM1.2}}\,(i)\right],$$

Ren et al. 2017 JMR

MJO monitoring and prediction

Framework of products

Categories	Datasets	Products
Monitoring	1）NCEP+NOAA_OLR 2）T639+FY3B_OLR	1）Up-to-now monitoring text of RMM indices（Oyear） 2）RMM phase diagram: recent 45d monitor（O45） 3）Up-to-now RMM indices/amplitude time series（Oyear）
Prediction	1) DERF2.0 2) S2S 3) T639 4) STPM	1）Prediction text of RMM indices（P50） 2）RMM phase diagram: Monitor & prediction（O30P30） 3）RMM indices/amplitude time series: M&P（OyearP50）
Impact	1) DERF2.0 2) S2S 3) T639 4) STPM	1）Time-Lon & -Lat evolutions: U850 & OLR（O120P50） 2）Reconstructed tropical wind850+PREC+OLR（O5P20） 3）Reconstructed T anom at 2400 stations（O5P25） 4）Reconstructed PREC anom at 2400 stations（O5P25）
Verification	1) DERF2.0 2) S2S 3) T639	1）RMM phase diagram: 45d M & P 10d ago（O45L10） 2）RMM phase diagram: 45d M & P 20d ago（O45L20）

BCC website for **real-time updated products**：
http://cmdp.ncc-cma.net/Monitoring/moni_mjo.php

MJO prediction products

Multi-data & models

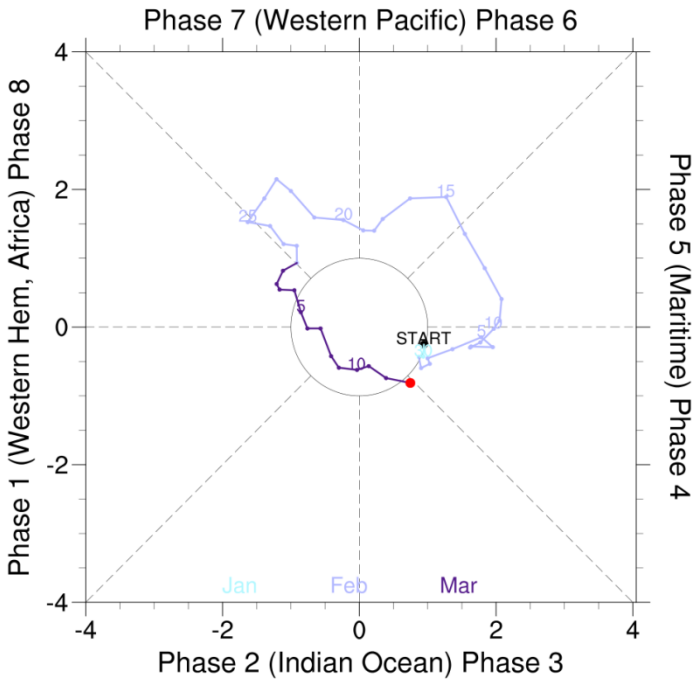
a) DERF2.0: prediction for future 50 days

b) BCCCSM1.2: future 60 days

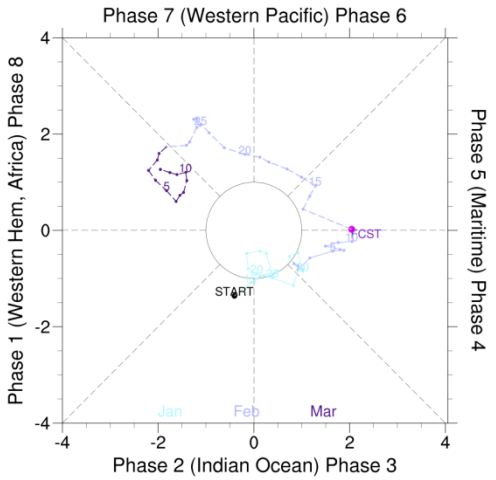
c) T639 model: ensemble of 15 days

d) STPM: future 30 days

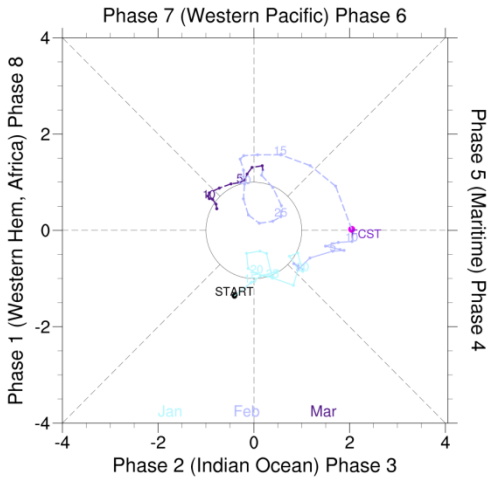
OBS



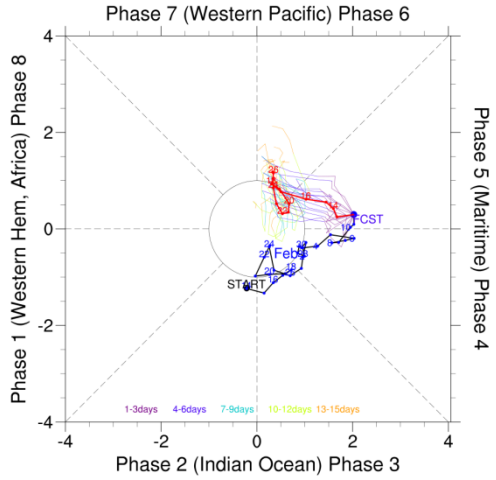
DERF2.0



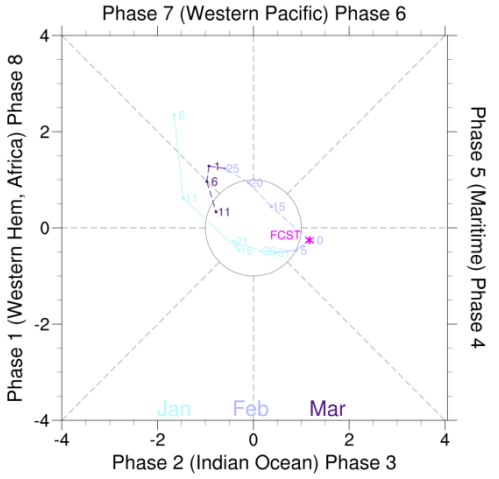
BCCCSM1.2



T639



STPM

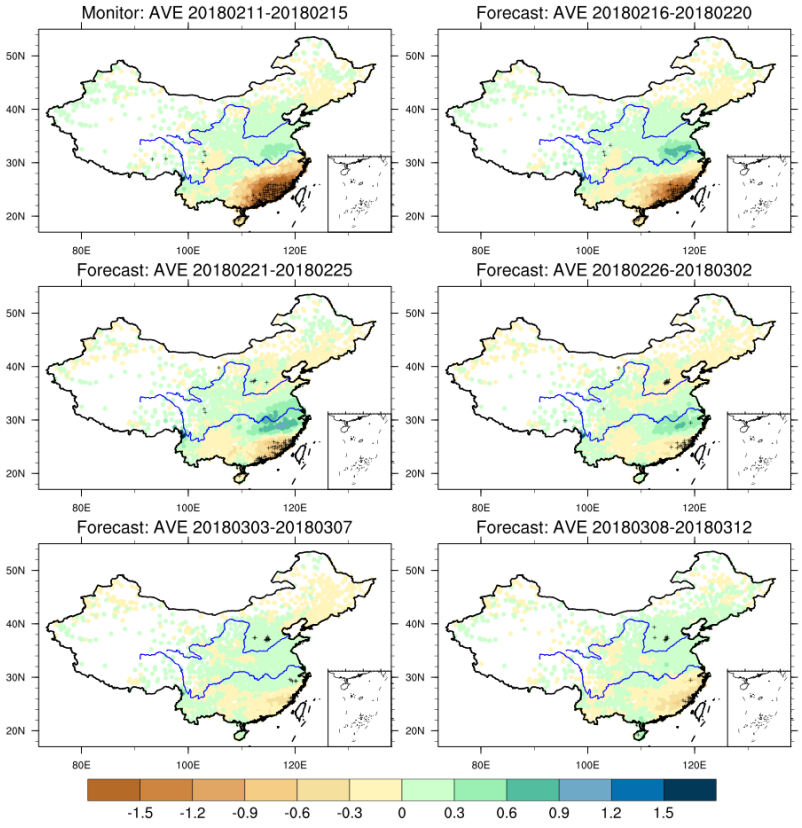


Extended-range forecasts

Pentad PRCP forecasts

RMMI Reconstructed Pentad-mean Precipitation Anomaly in China

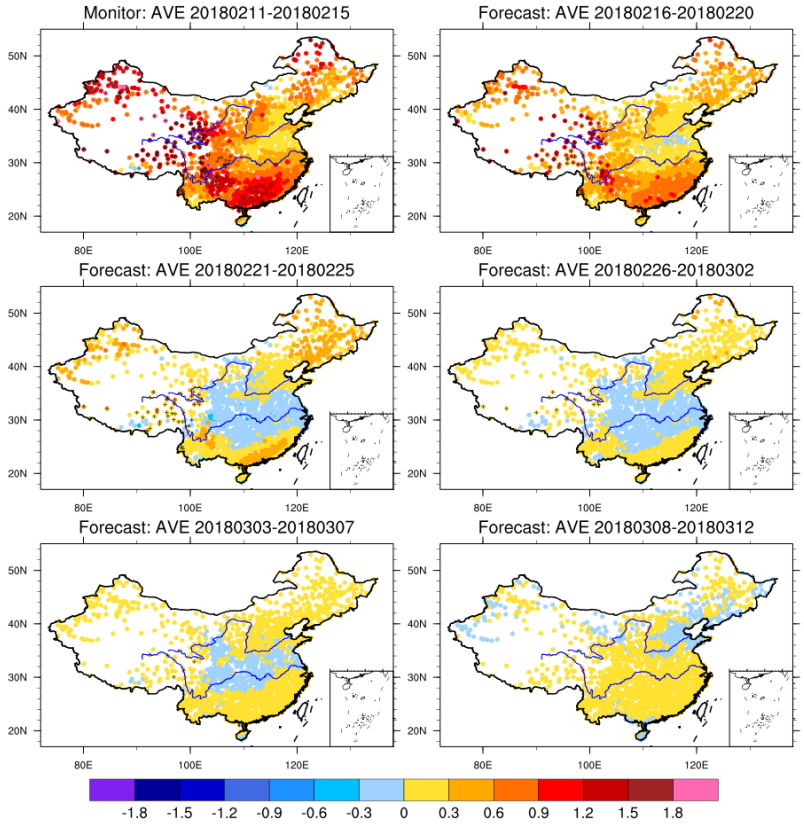
RMMI: Monitor(T639+FYB) Forecast(BCC_AGCM2.2)



Pentad T2m forecasts

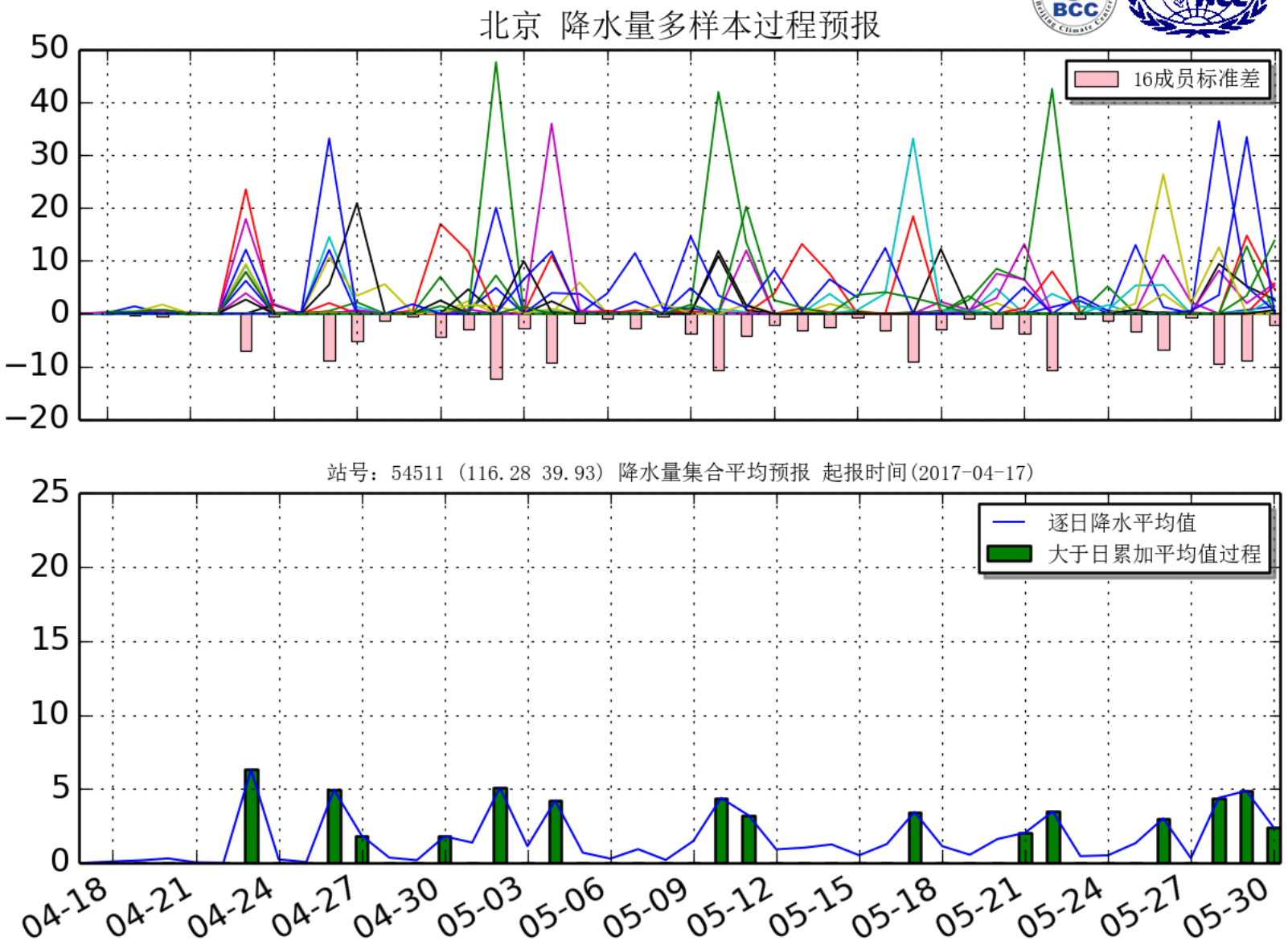
RMMI Reconstructed Pentad-mean 2m Temperature Anomaly in China

RMMI: Monitor(T639+FYB) Forecast(BCC_AGCM2.2)

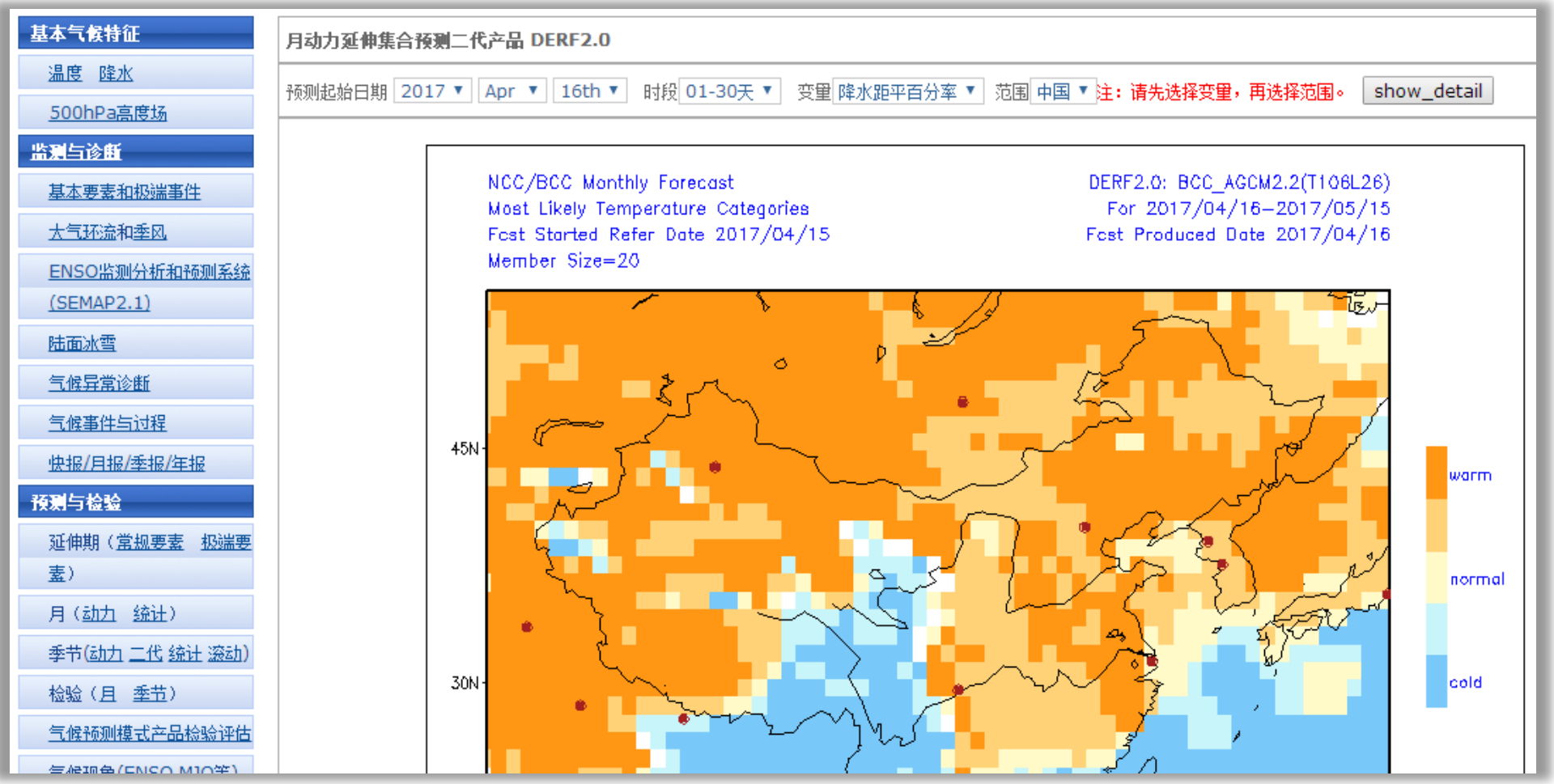


Rainfall process forecasts

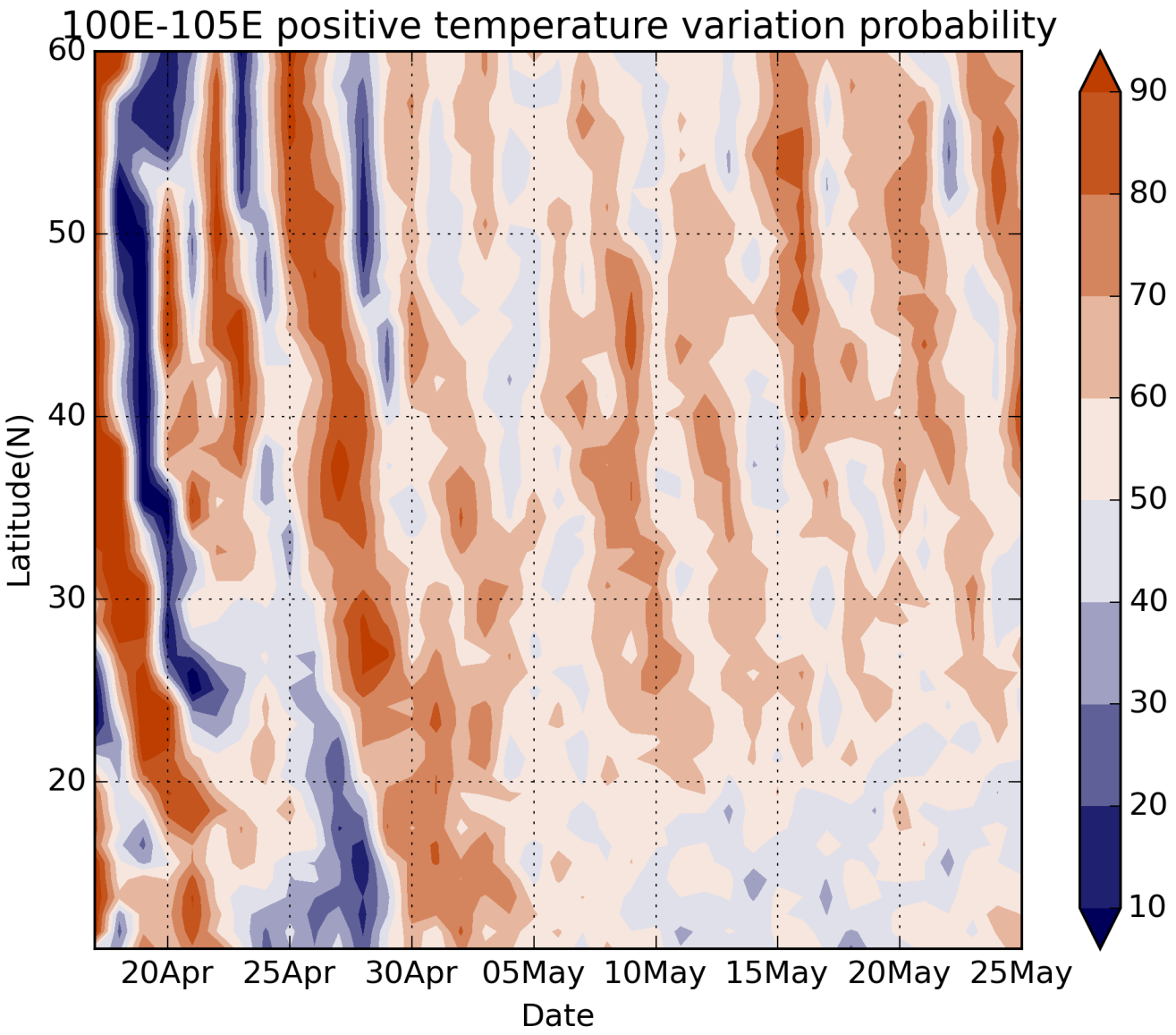
Beijing



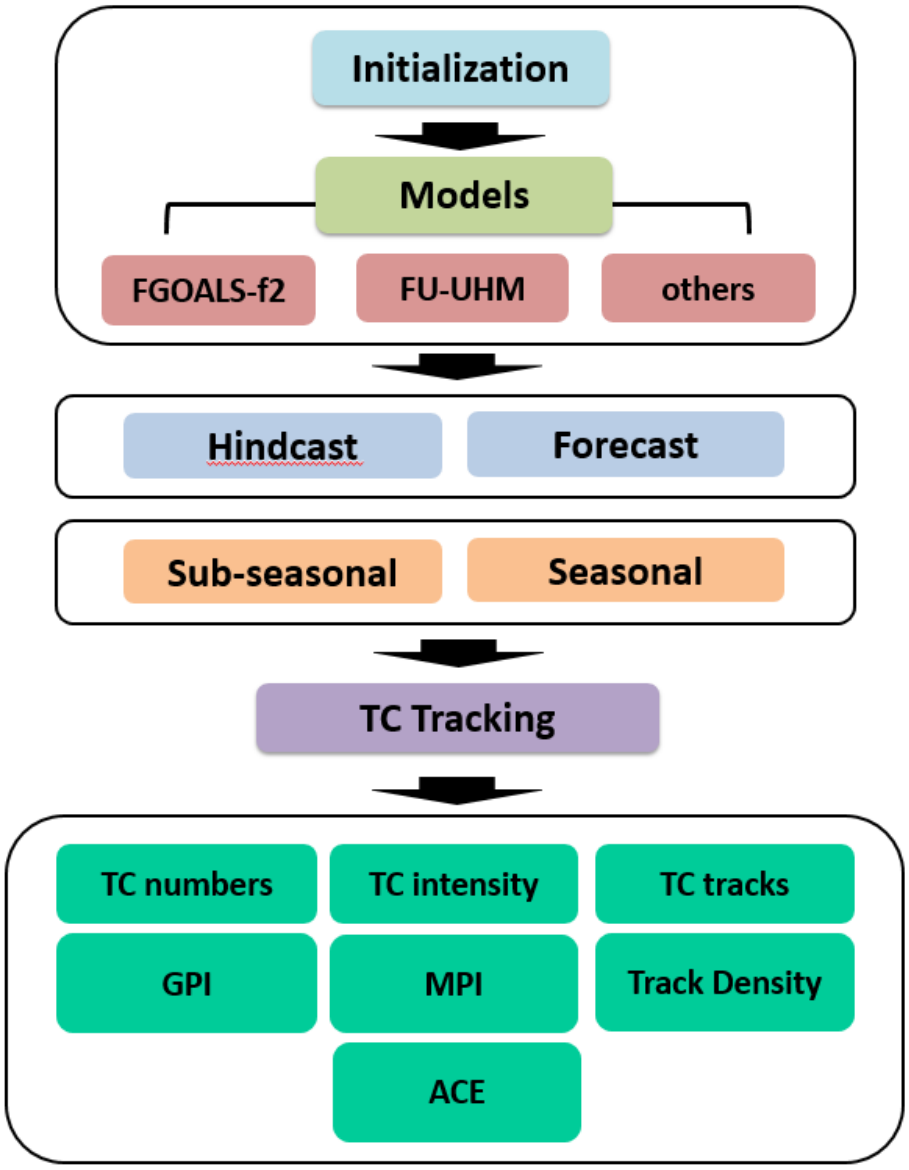
Probability forecasts



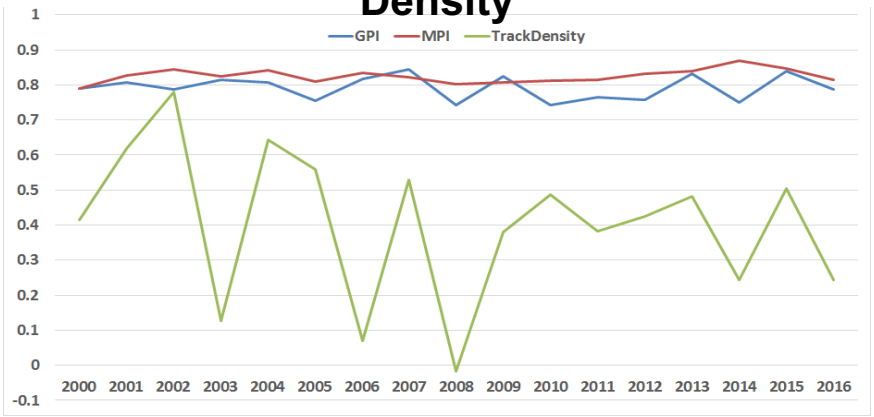
Probability forecasts

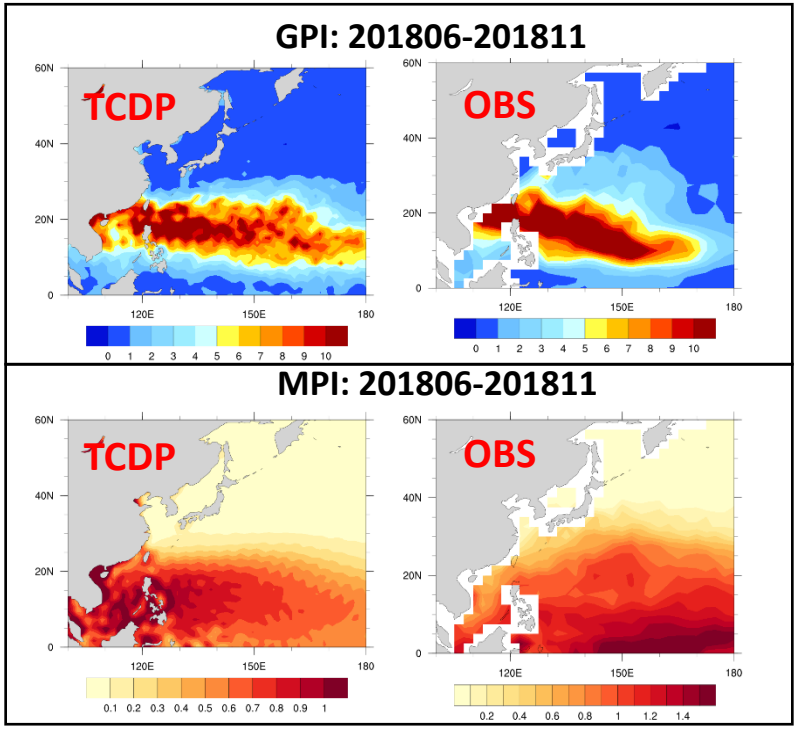


Tropical Cyclones Dynamical Prediction System 1.0 (TCDP1.0)

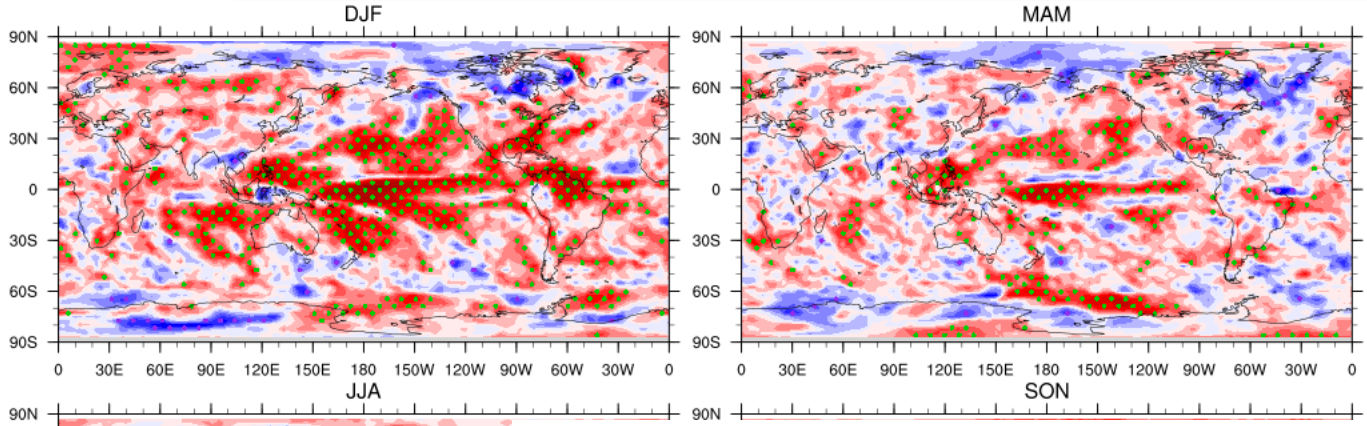


TCDP1.0: ACC skill of GPI, MPI, Track Density

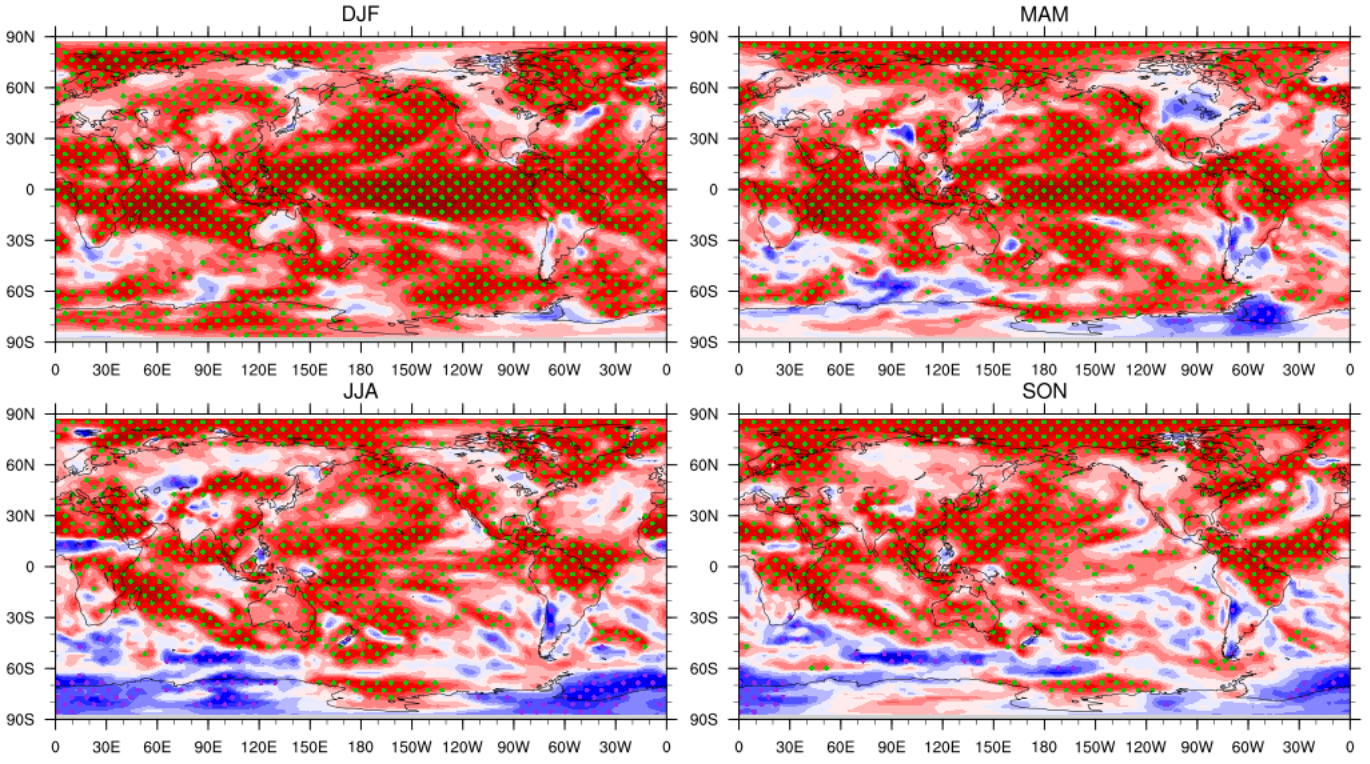




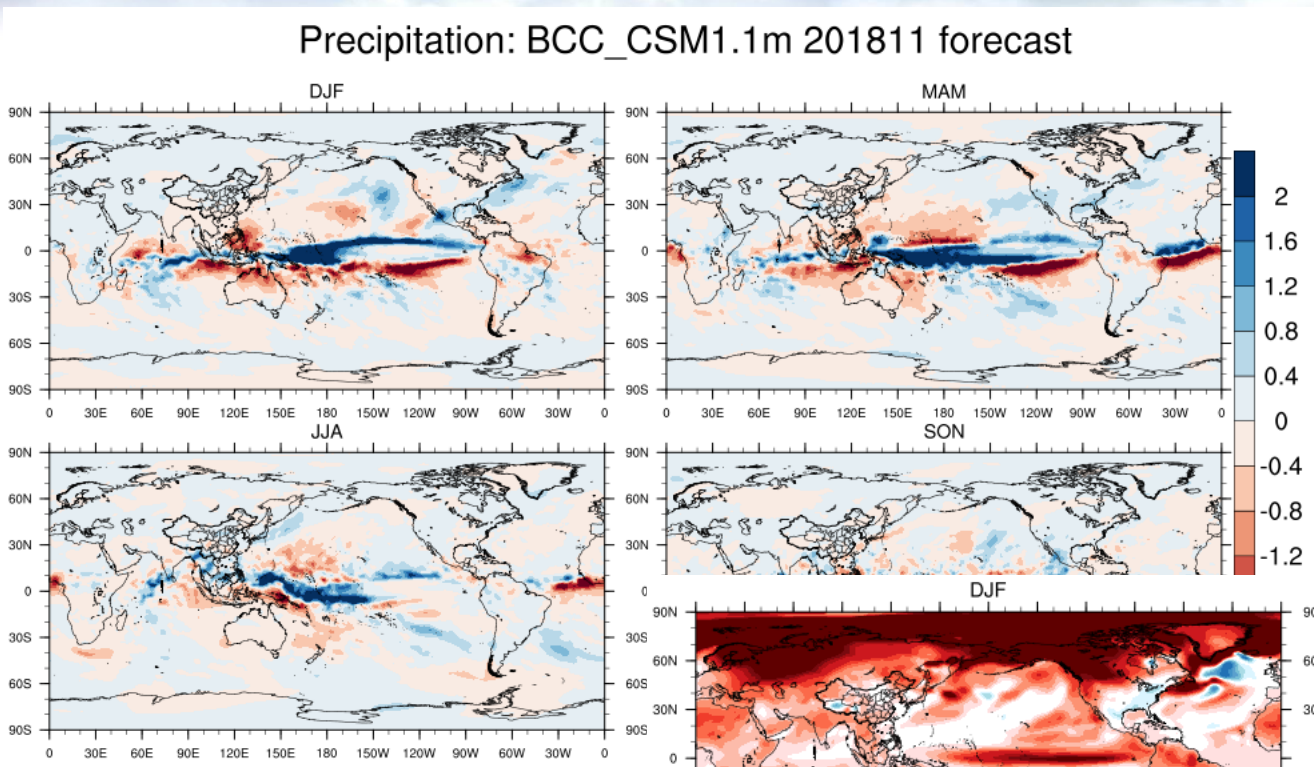
Seasonal-interannual prediction in BCC

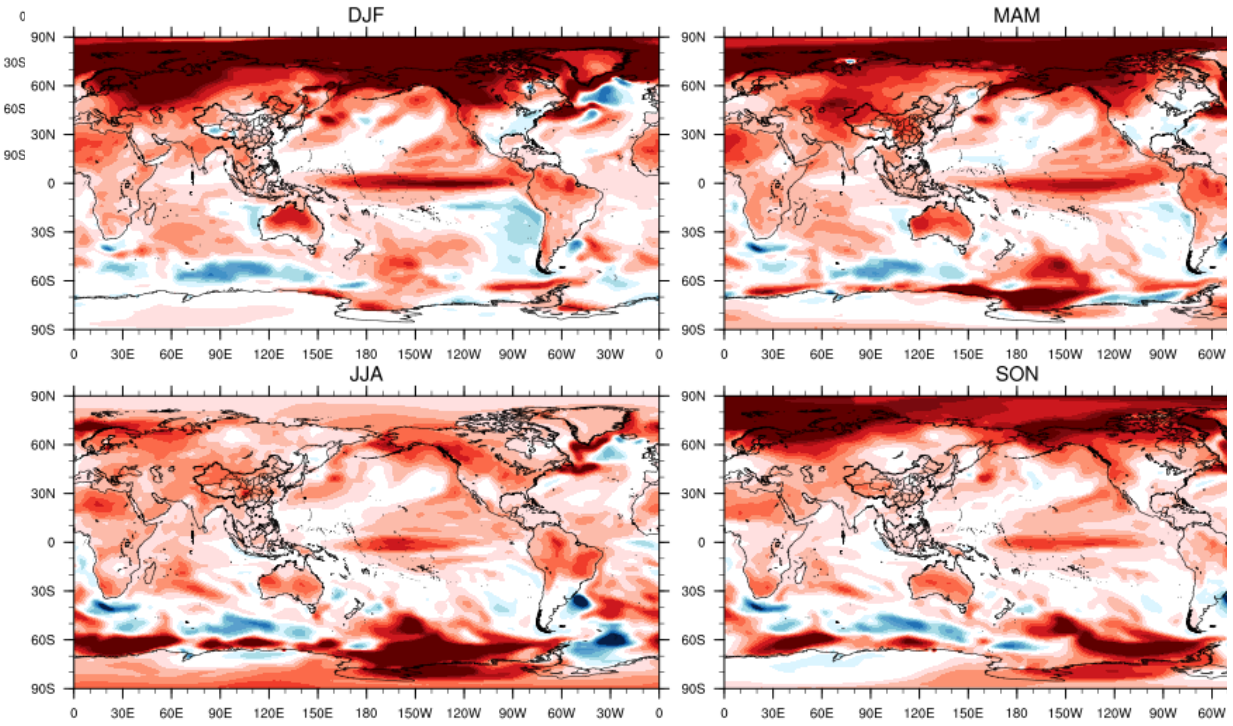


TCC skills:
4 season forecasts



2019: four season forecasts



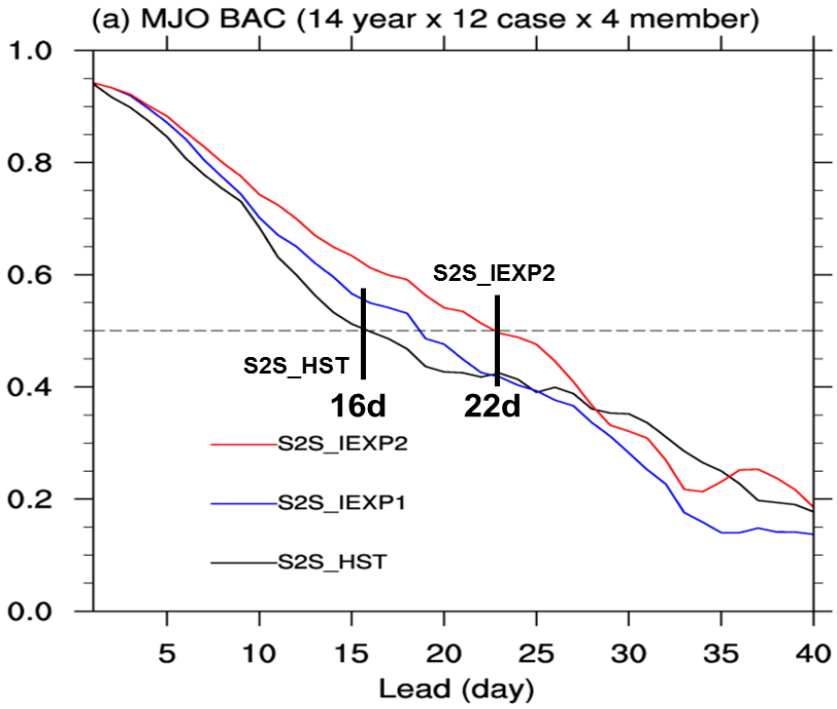


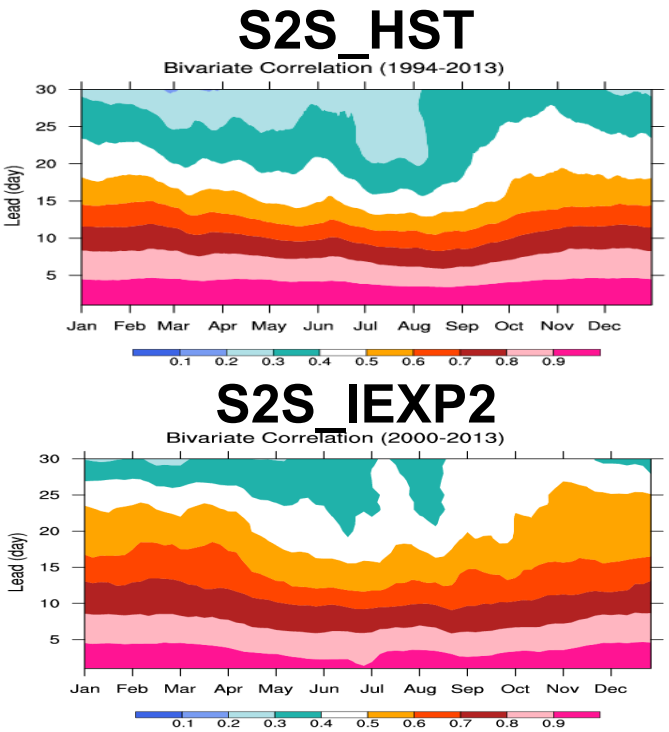
Outline

- Introduction
- Operational model system
- Climate prediction operation
- Climate prediction research
- Summary and outlook

Improved experiments of BCC S2S prediction

MJO prediction skill in BCC_CSM1.2





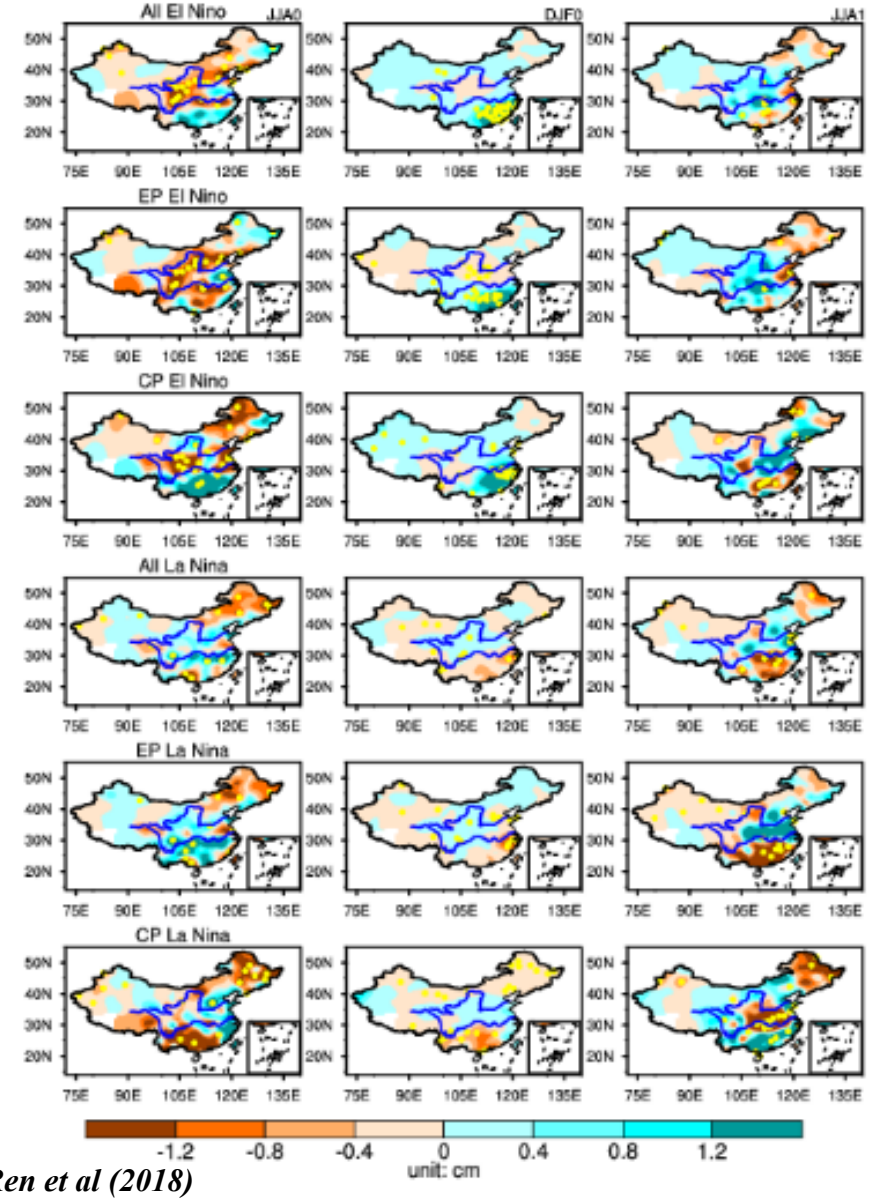
S2S_HST: ocean initials (BCC_GODAS)+atmosphere initials (NCEP R1)
S2S_IEXP1: ocean initials (BCC_GODAS) + atmosphere initials (NCEP FNL)
S2S_IEXP2: ocean initials (BCC_GODAS + OISST) + atmosphere initials (NCEP FNL)
Conducted on 1st , 6th, 11th, 16th, 21st, and 26th of each month in 2000–2013

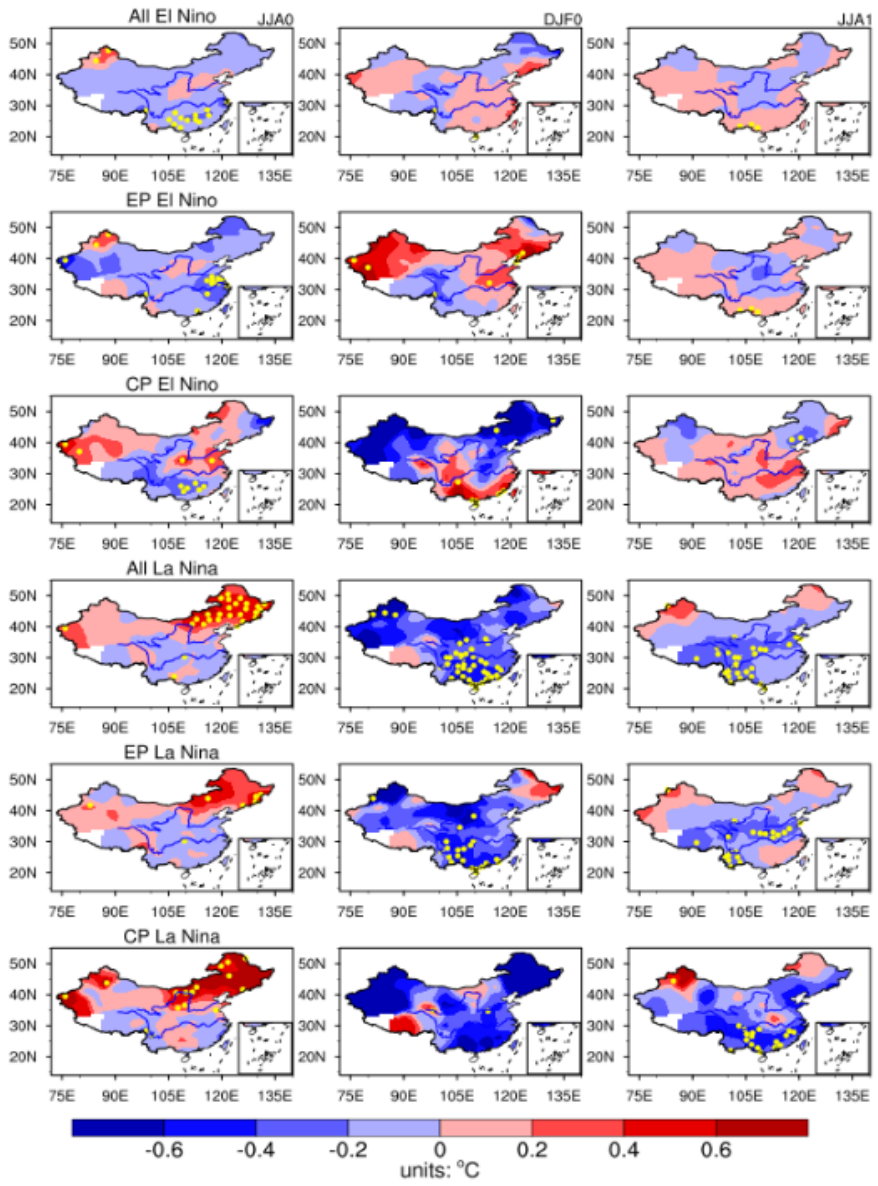
Further experiments using BCC model show that oceanic initial states largely impact on the East Asian summer monsoon and MJO forecast skill.

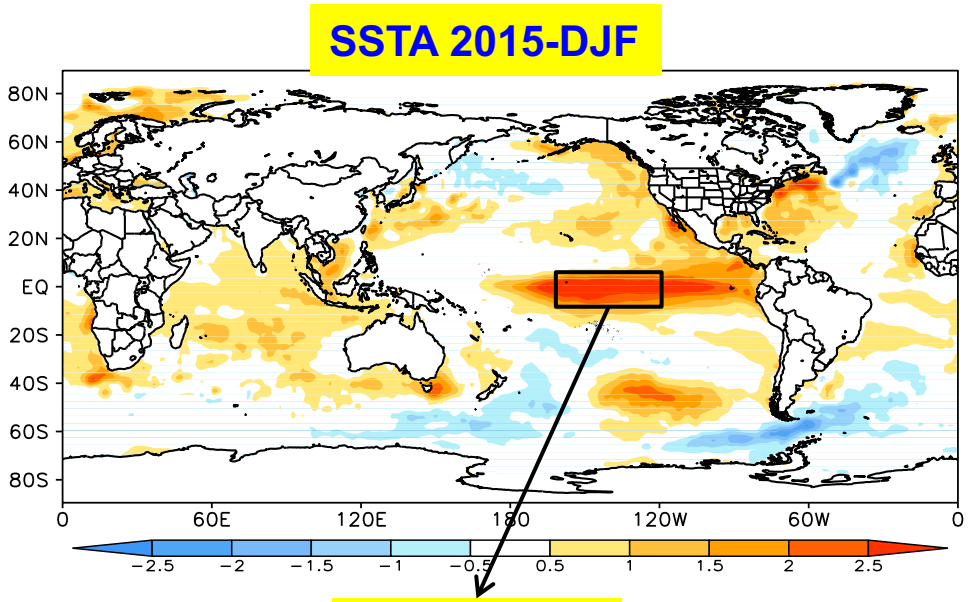
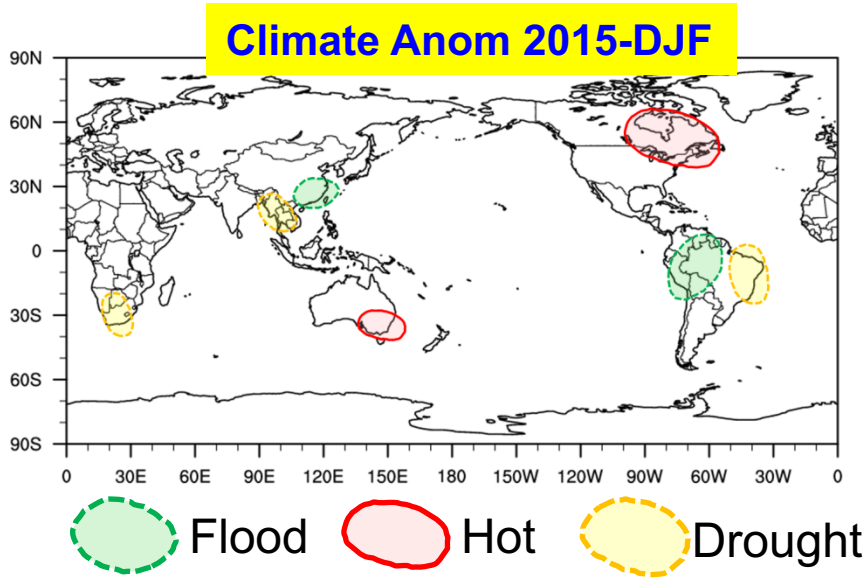
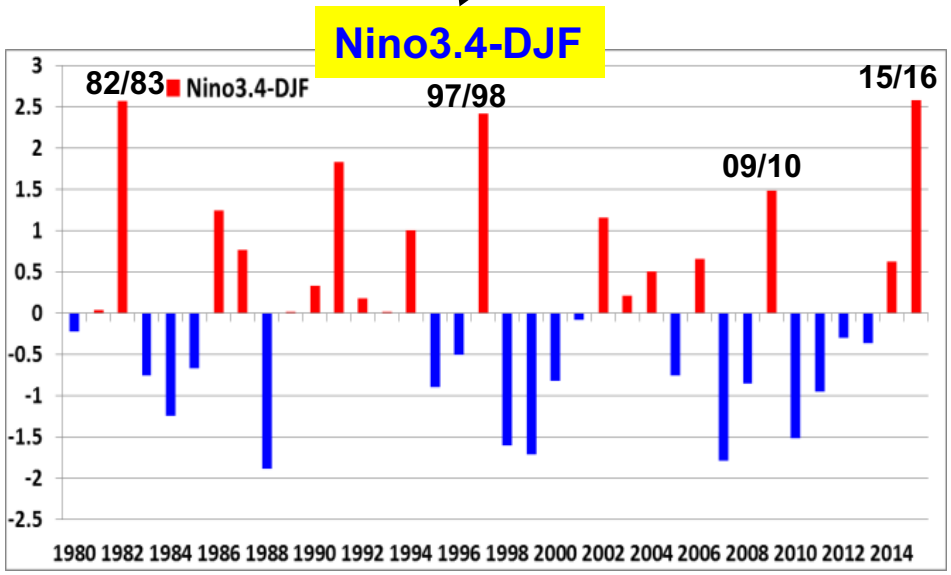
(Liu, Wu, Yang, et al. 2016: Cli. Dyn.)

Impacts: Two types of ENSO on China T2m & PRCP

PRCP patterns 1950～2016 T2m patterns





Ren et al (2018)

Example: Climate impacts of 2014-2016 super El Nino event