Long-Term Forecasting Technology at Beijing Climate Center

Технологии долгосрочного прогнозирования погоды в Климатическом центре Пекина

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Acknowledgements:

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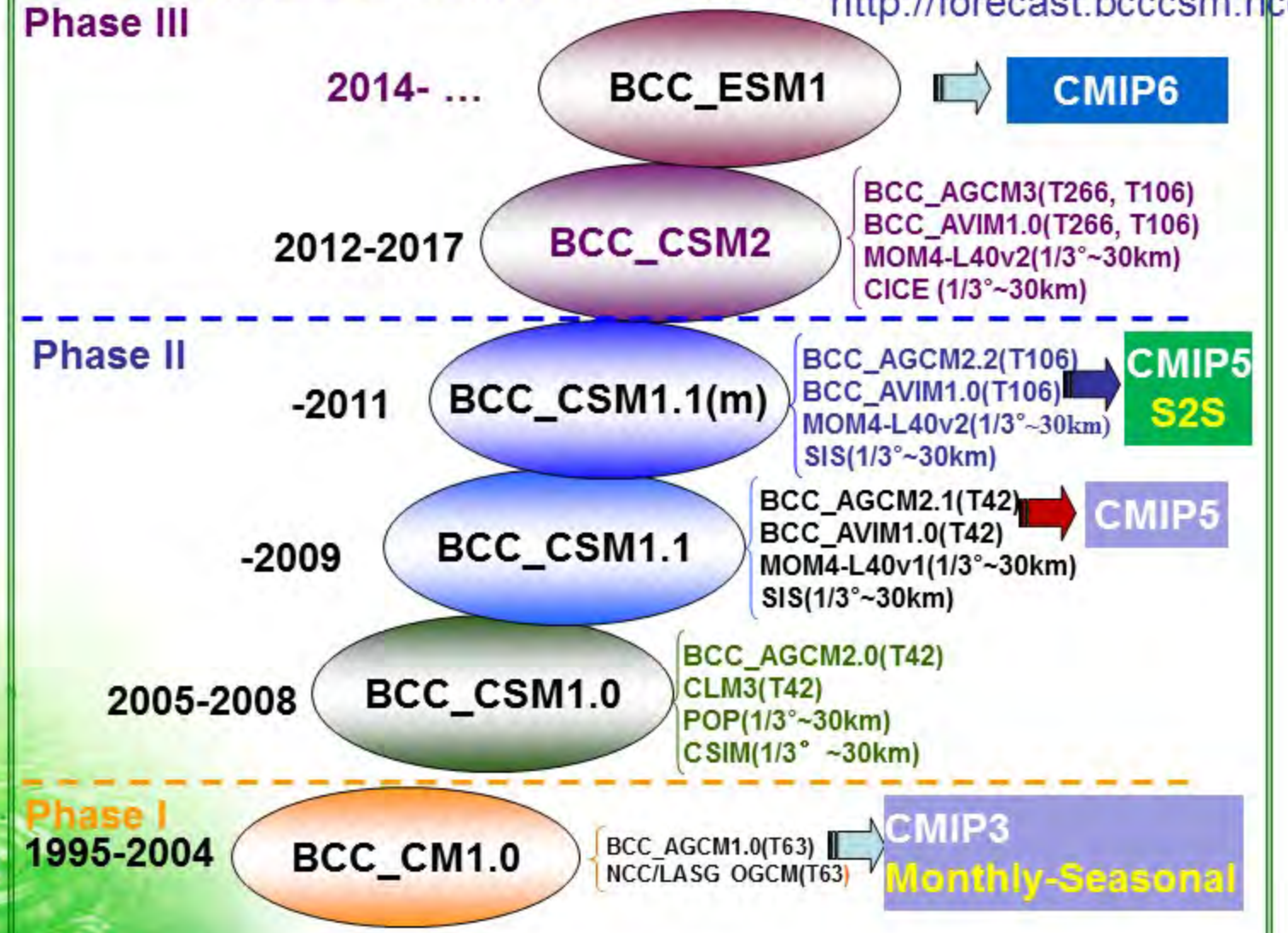
Outline
Содержание

- Model System Development Разработка системных моделей
- Forecast Technology Технологии прогнозирования
  - Climate Phenomena Prediction System (CPPS) Система прогнозирования климатических явлений
  - CMME
- Summary Заключение

Development Road of Climate Model System at BCC

Направления разработки системы климатического моделирования

http://forecast.bcccsm.ncc-cma.net/htm/



Operational seasonal prediction in BCC Оперативное прогнозирование на сезон в КЦП

BCC_AGCM2.2(T106 ~110 km, L26) Top: 2.19 hPa
BCC_AVIM1.0(T106)
MOM4-L40v2(1/3°~30km)
SIS(1/3°~30km)

Initialisation: Исходные данные

Atmos: NCEP daily reanalysis (Air Temp., winds, SLP, etc)

ежедневный реанализ атмосферы

Ocean: NCEP_GODAS monthly, Pentad reanalysis

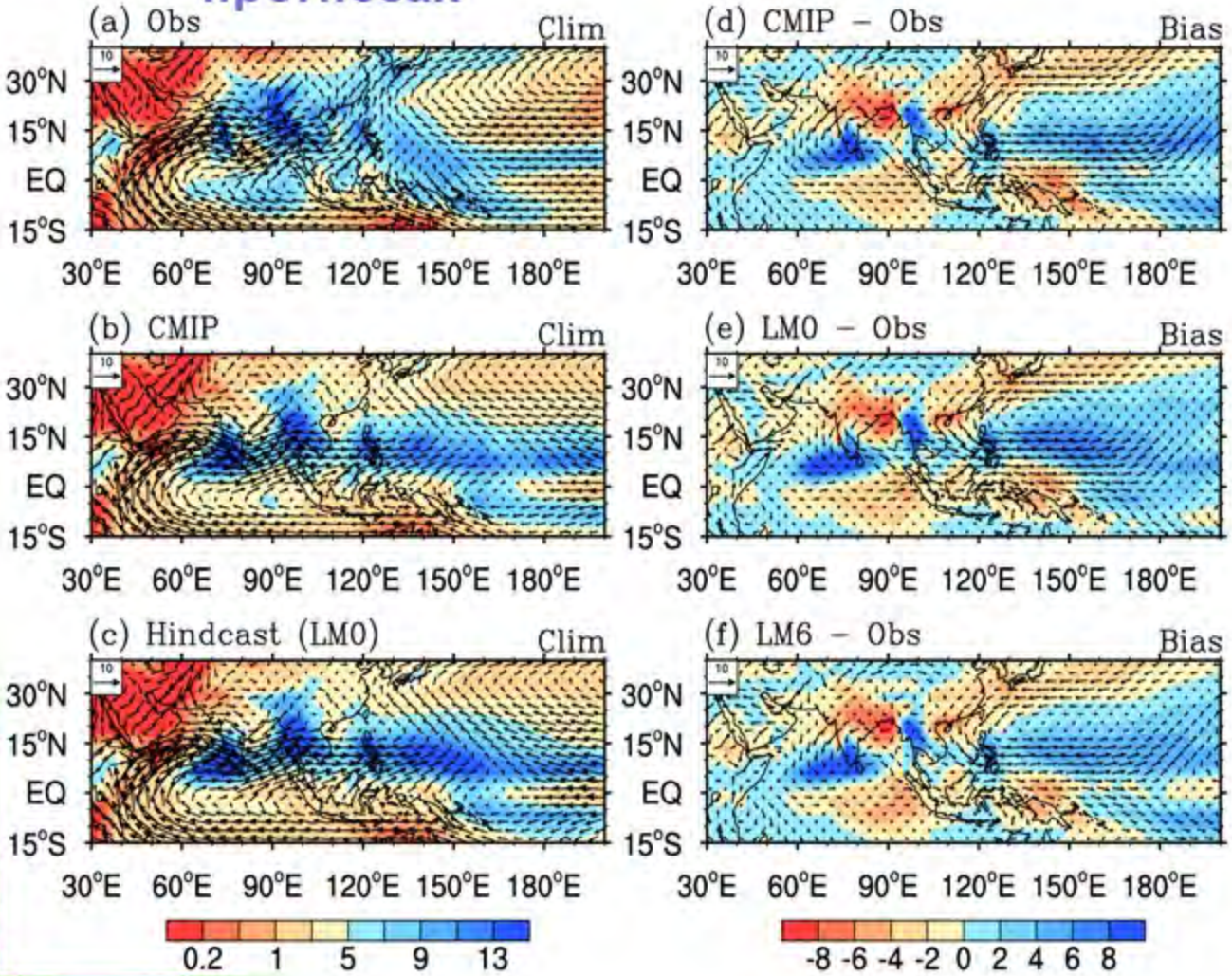
Ensemble members: 24 (15 LAF+9 SV) ансамблевые модели

Forecasts: 13 months (Operational running since Dec., 2014) прогнозы

Hindcasts: 1991~2014 (24 yrs) ретроспектива

Products: http://bcc.ncc-cma.net/channel.php?channelId=22 продукция

Climatology of U850 and PREC (JJA) in Hindcasts Климатология в ретроспективных прогнозах



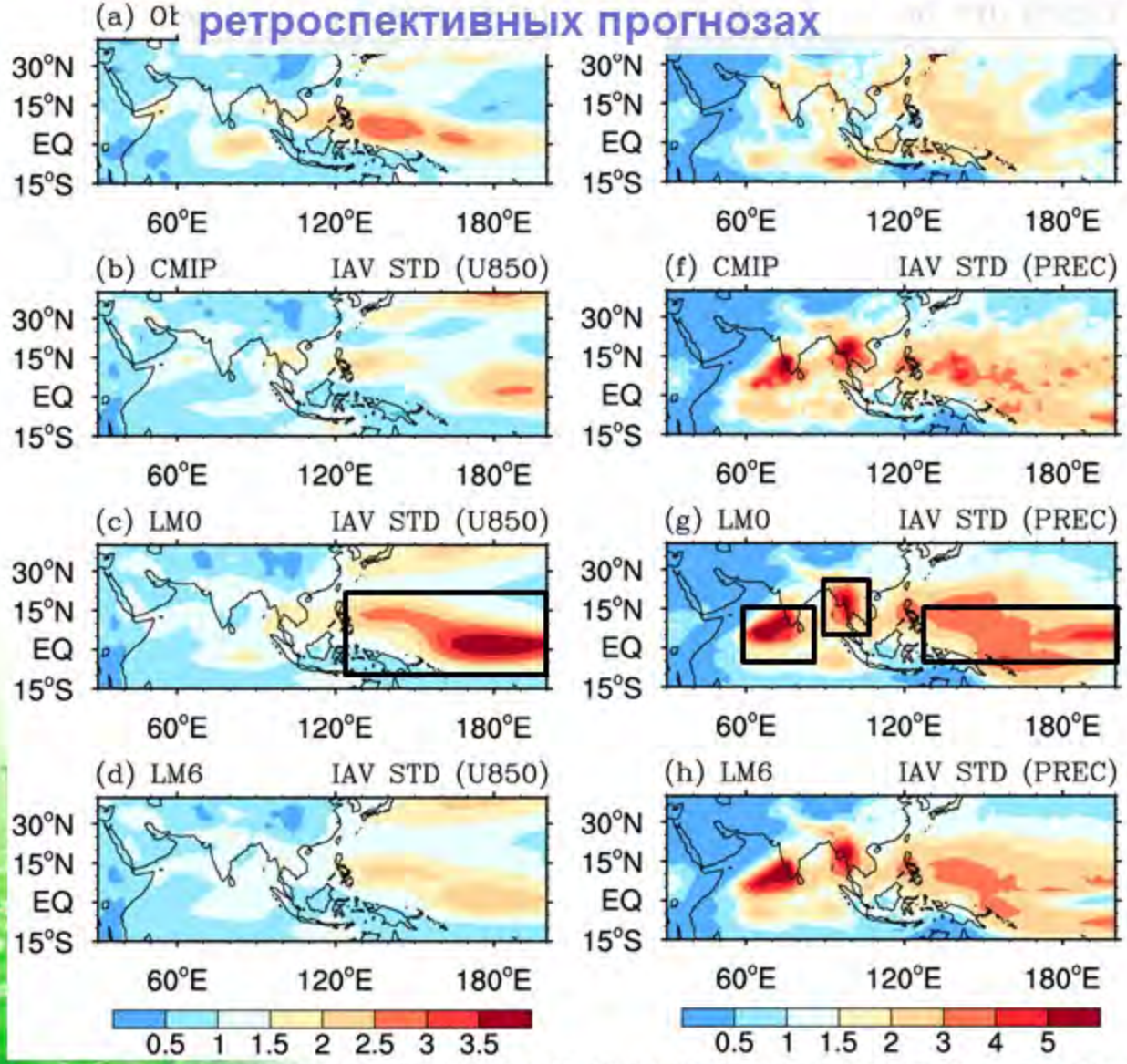
Wet biases over the Indian subcontinent, the western Indo-China Peninsula, and the tropical NWP.

Dry biases over the Bay of Bengal and the South China Sea and the cyclonic wind bias over NWP.

The biases show little increase from 0 to 6 months of lead.

(Liu X., et al., 2015: Adv. Atmos. Sci.)

Interannual Variability of U850 and PREC (JJA) in Hindcasts Внутригодовая изменчивость в ретроспективных прогнозах

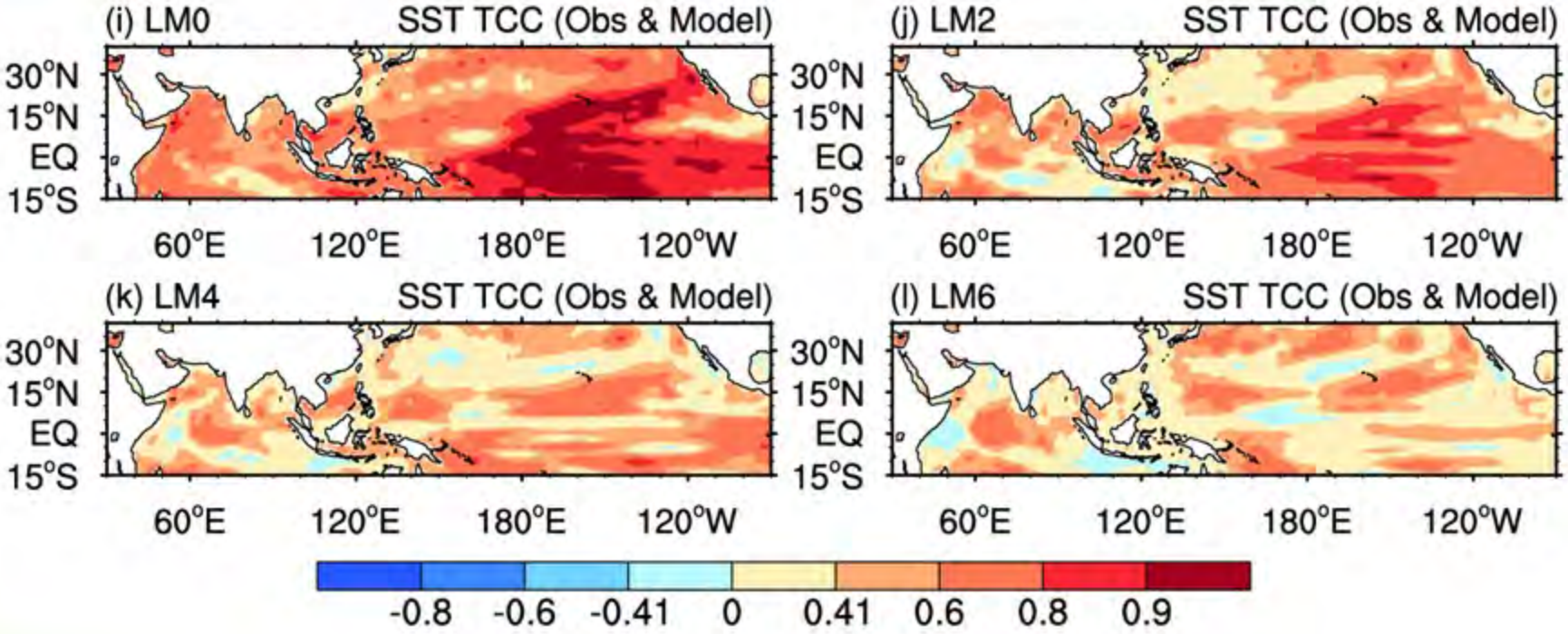


Strong interannual variability of U850 over the western tropical Pacific, with a maximum center near the Philippine Sea.

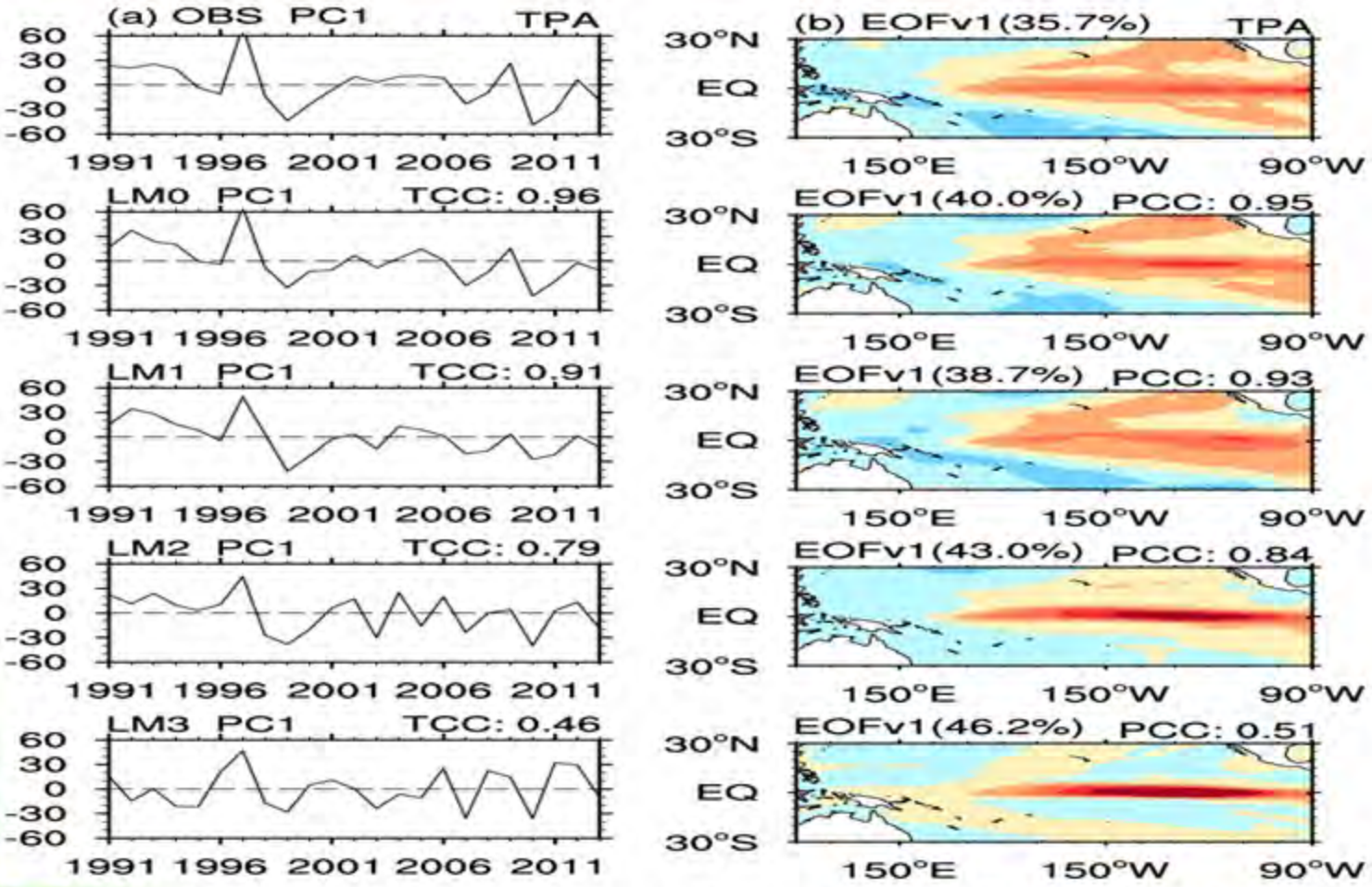
Remarkable overestimated the interannual variance of PRECIP over the SE Arabian Sea, western Indo-China Peninsula, and the western tropical Pacific.

(Liu, Wu, et al., 2015: Adv. Atmos. Sci.)

Forecast skills of SST (JJA) Успешность прогнозирования ТПО (лето)



Forecast skills of 1st EOF of SST Успешность прогнозирования



The extensive significant anomaly over the eastern Pacific is well captured by the 0- and 1-month lead forecasts, but the spatial range quickly reduces to a narrow band near the equator at the lead time of 2 and 3 months

S2S Prediction by BCC_CSM1.2

Прогнозирование на сезон-подсезон

BCC_AGCM2.2(T106 ~110 km, L40,Top: 0.5 hPa
BCC_AVIM1.0(T106)
MOM4-L40v2(1/3°~30km)
SIS(1/3°~30km)

Initialisation: Исходные данные

- Atmos: NCEP reanalysis 1 Реанализ
- Ocean: BCC Global Ocean Data Assimilation System (BCC_GODAS2.0)

Ensemble members: 20 ансамблевые модели

- 5 days LAF with each day 4 members initialied at 00 UTC of 1st forecast day and 18, 12 and 06 UTC of the previous day

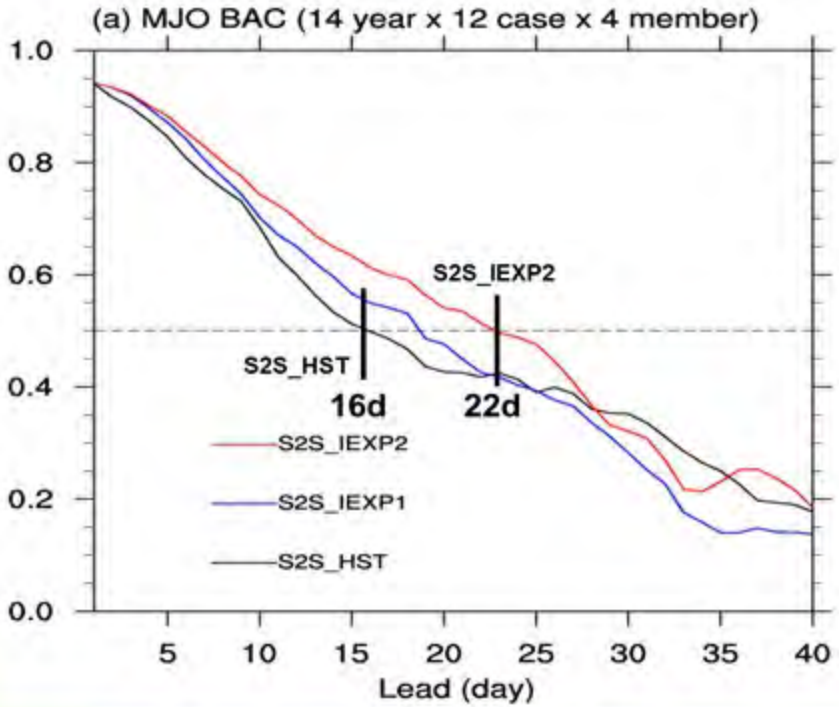
Forecasts: 60-day integrations

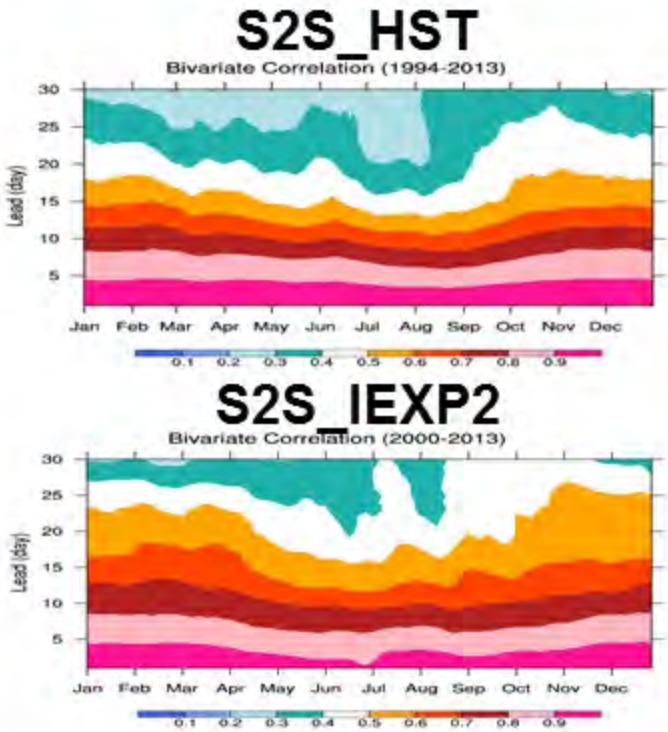
Hindcasts: Daily rolling forecasts from 1994/01/01-2014/04/30

Products: http://S2S.cma.cn

Improved experiments Эксперименты улучшенного качества

MJO prediction skill in BCC_CSM1.2





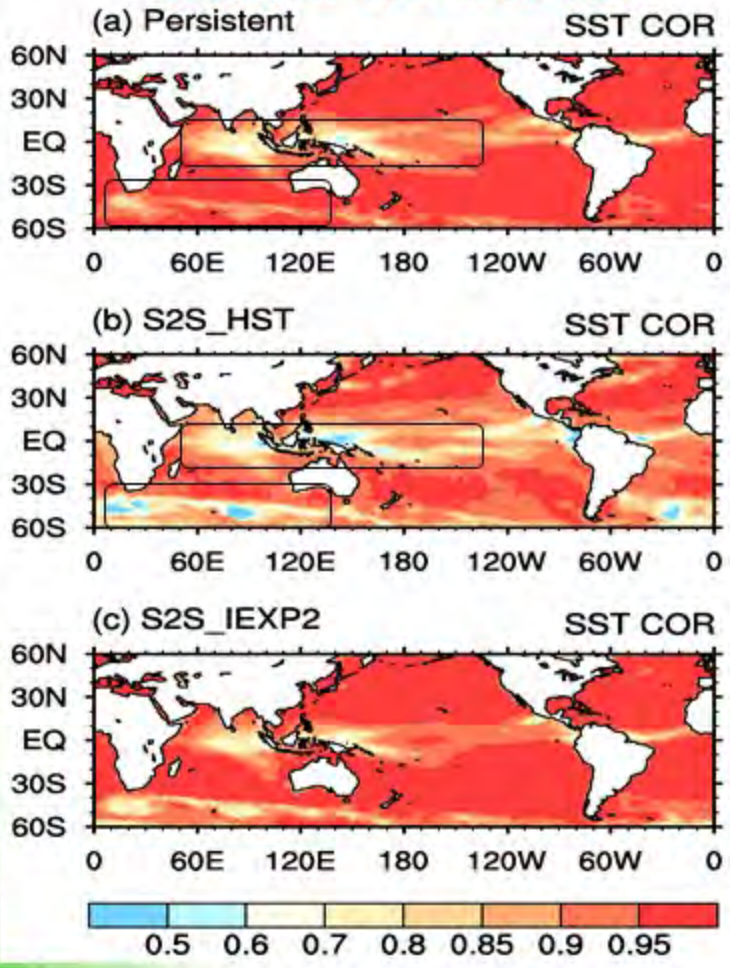
S2S_HST: ocean initials (BCC_GODAS)+atmosphere initials (NCEP R1)
S2S_IEXP1: ocean initials (BCC_GODAS) + atmosphere initials (NCEP FNL)
S2S_IEXP2: ocean initials (BCC_GODAS + OISST) + atmosphere initials (NCEP FNL)
Conducted on 1st , 6th, 11th, 16th, 21st, and 26th of each month during 2000-2013

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

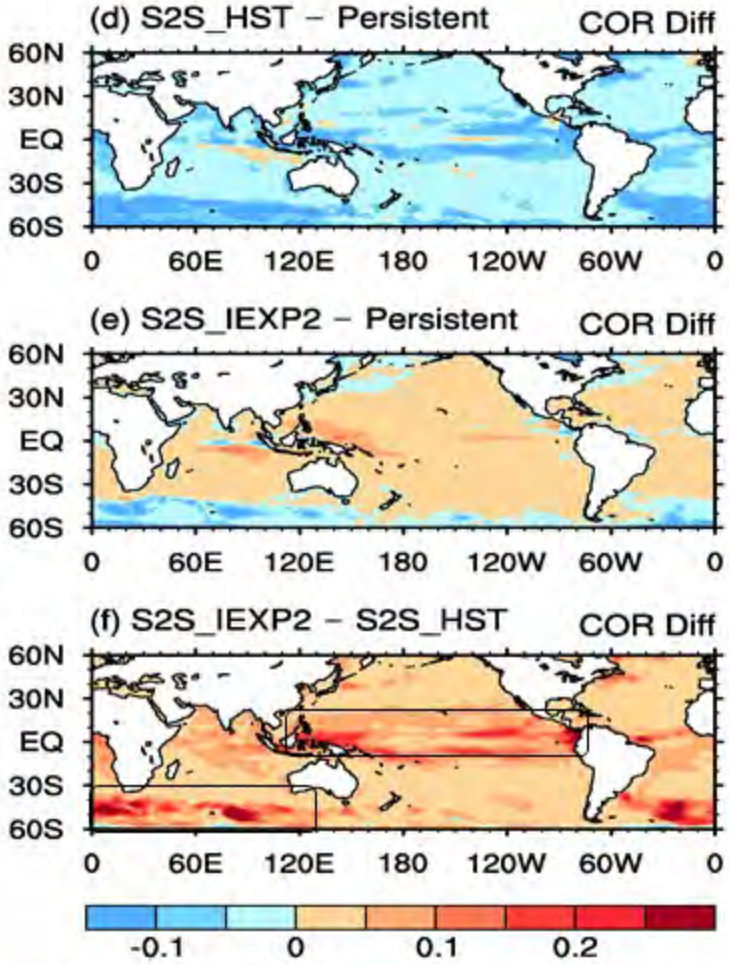
(Liu, Wu, Yang, et al. 2016: Cli. Dyn.)

Improvement of SST forecast Повышение качества прогнозирования

ACC of 20-day averaged SST between obsv and fcst

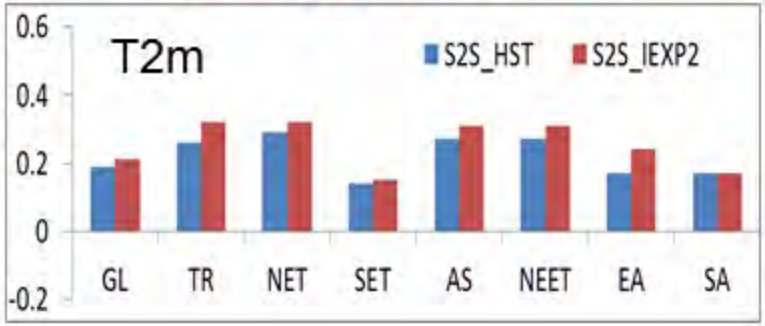


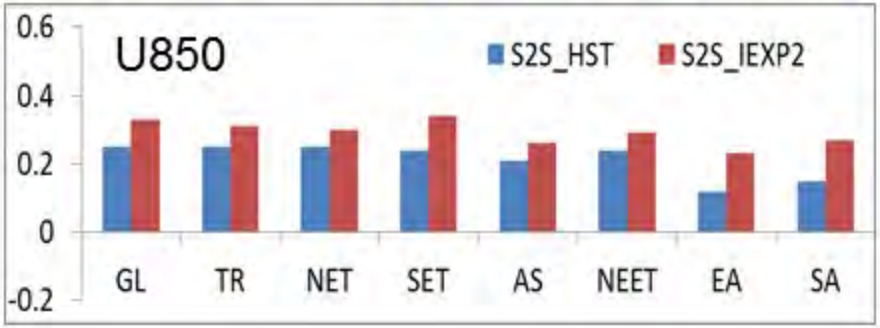
differences of SST fcst skill

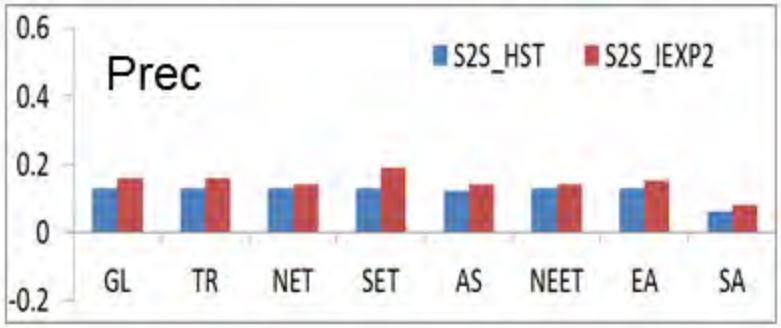


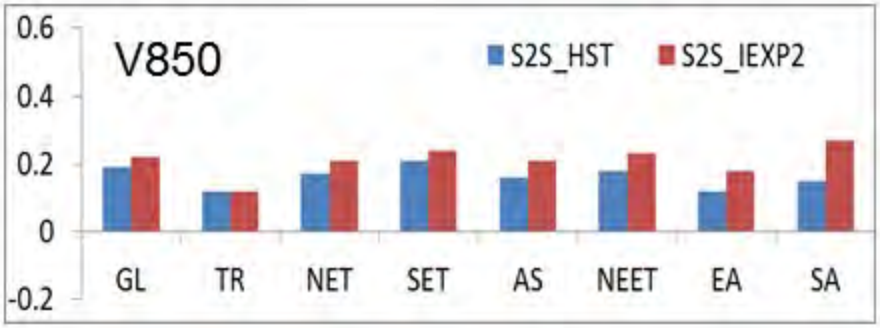
IEXP2 increased skills in most tropical and subtropical regions compared to the persistent forecasts.

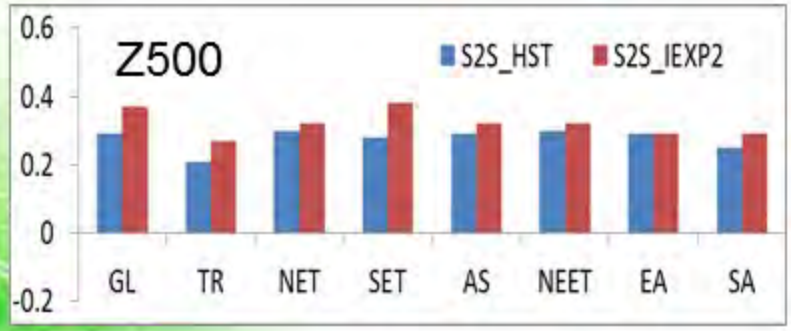
Improvement of monthly forecasts skill (July) Повышение качества месячных прогнозов (июль)











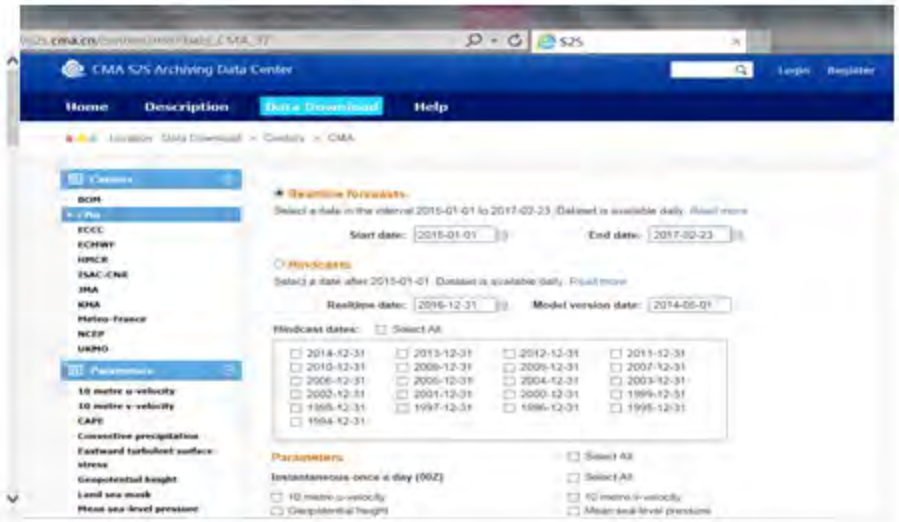
GL	0° -360° E, 90° S-90° N
TR	0° -360° E, 20° S-20° N
NET	0° -360° E, 20° N-90° N
SET	0° -360° E, 20° S-90° S
AS	30° -180° E, 20° N-90° N
NEET	0° -180° E, 20° N-90° N
EA	90° -150° E, 20° N-50° N

S2S activity of BCC Деятельность КЦП по прогнозированию на сезон-подсезон

Welcome to the S2S Museum
@University of Tsukuba, Japan

The Subseasonal to Seasonal Prediction (S2S) Project is a proposed WWRP/THORPEX/ WCRP joint research project.

The main goal of the S2S project is to improve forecast skill and understanding on the subseasonal to seasonal timescale, and promote its uptake by operational centres and exploitation by the applications community. Specific attention will be paid to the risk of extreme weather, including tropical cyclones, droughts, floods, heat waves and the waxing and waning of monsoon precipitation.



5-year project, started in Nov 2013.

CMA S2S database portal: *http://S2S.cma.cn*

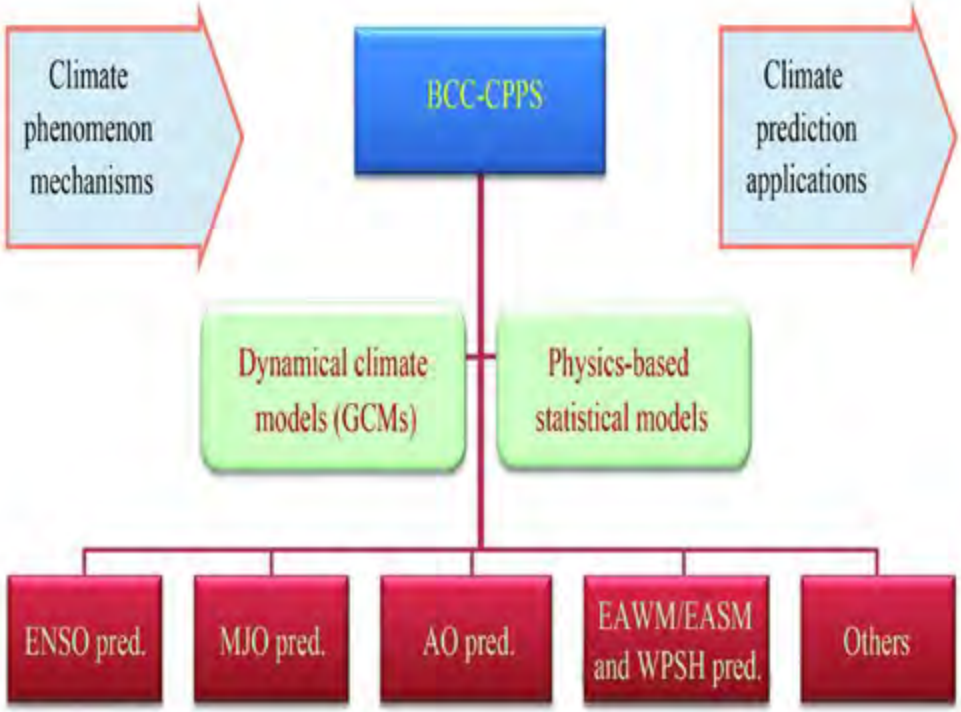
S2S project provides a good opportunity to evaluate models from different operational centers and further improve their numerical forecast skills on the S2S timescales.

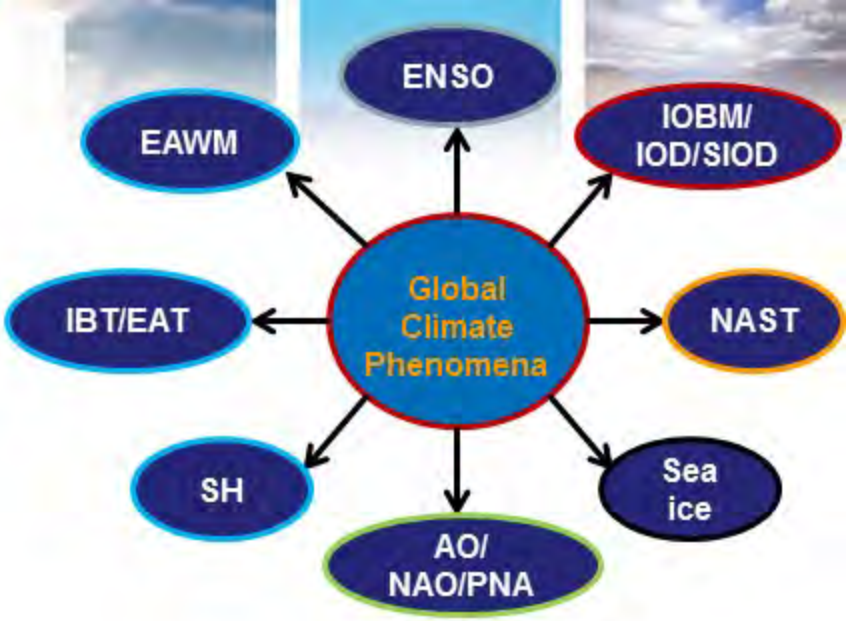
6 Topics: MJO, Monsoons, Africa, Extremes, Teleconnections, Verification

CPPS

Support operational seasonal prediction

Поддержка оперативного сезонного прогнозирования





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

CPPS-ENSO

Support operational seasonal prediction

Поддержка оперативного сезонного

Statistical Method:

$$\text{Nino}(t+\Delta t) = \alpha\text{Nino}(t) + \beta\tau(t) + \gamma\text{WWV}(t) + f\text{FORCING}(t) + c$$

Dynamical model:

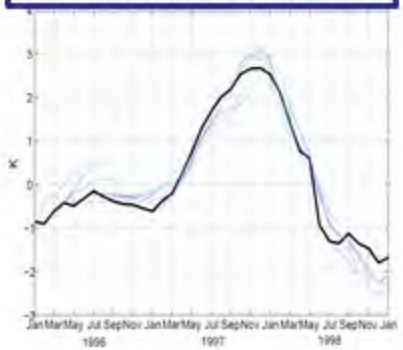
- **BCC-CSM1.1m**
  - 24 members
  - **LAF**
  - **SVD**

Analogue-dynamical ENSO prediction (ADEPS)

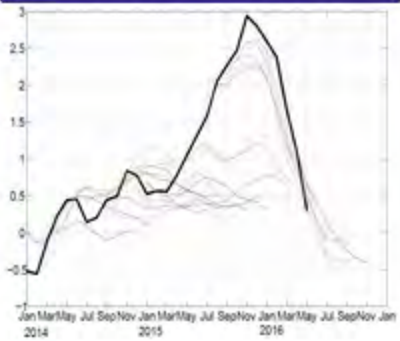
$$\hat{P}_{\mathrm{M}}(\psi_0) = P_{\mathrm{M}}(\psi_0) + \tilde{P}_{\mathrm{M}}(\tilde{\psi}_j) - P_{\mathrm{M}}(\tilde{\psi}_j)$$

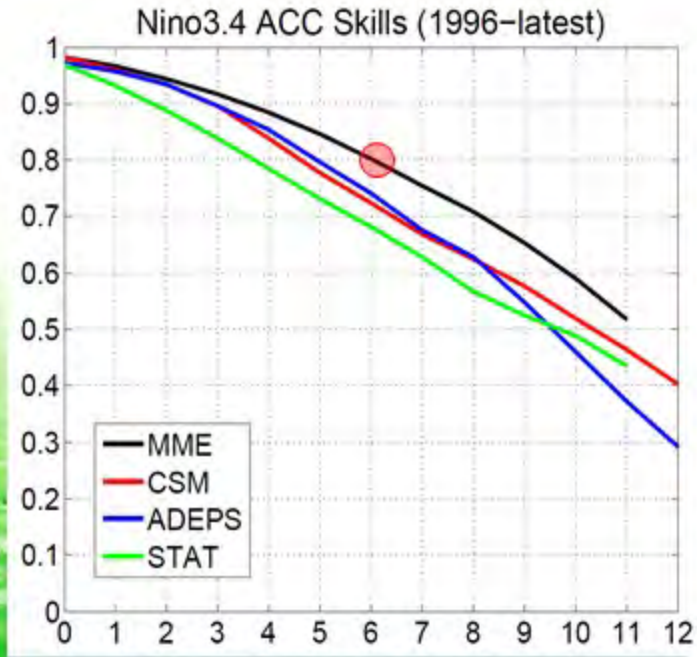
(Ren et al. 2014)

Hindcast of 97/98 events

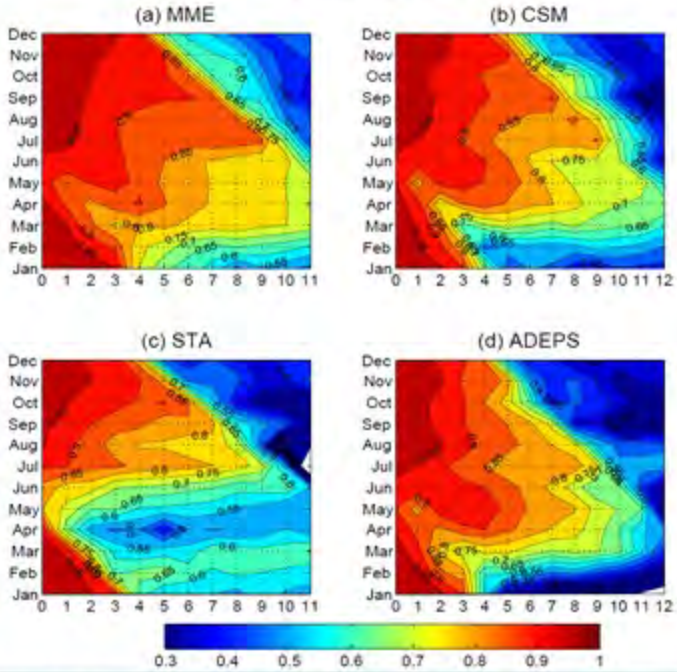


Forecast of 15/16 events





ACC skill (1996-2016)

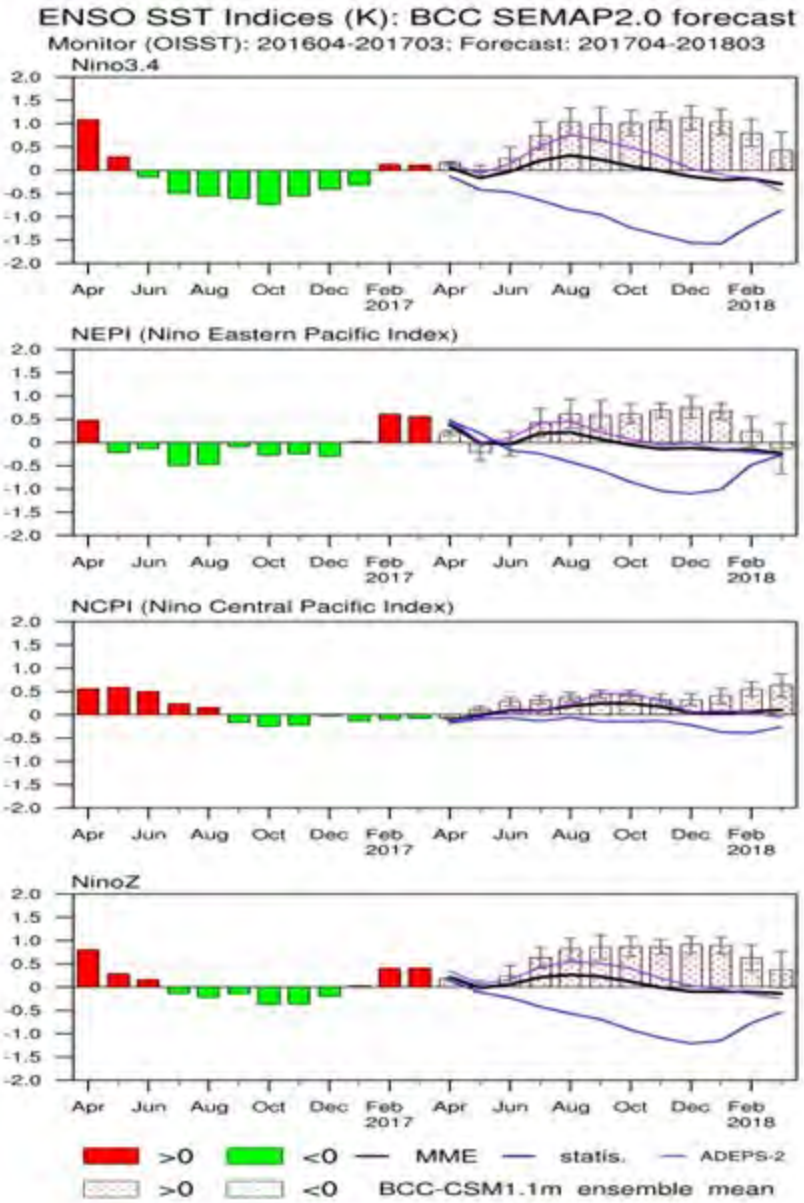


ACC skill initialized in different calendar months

CPPS-ENSO

Support operational seasonal prediction

Latest ENSO prediction by BCC



BCC dynamical model: moderate El Nino

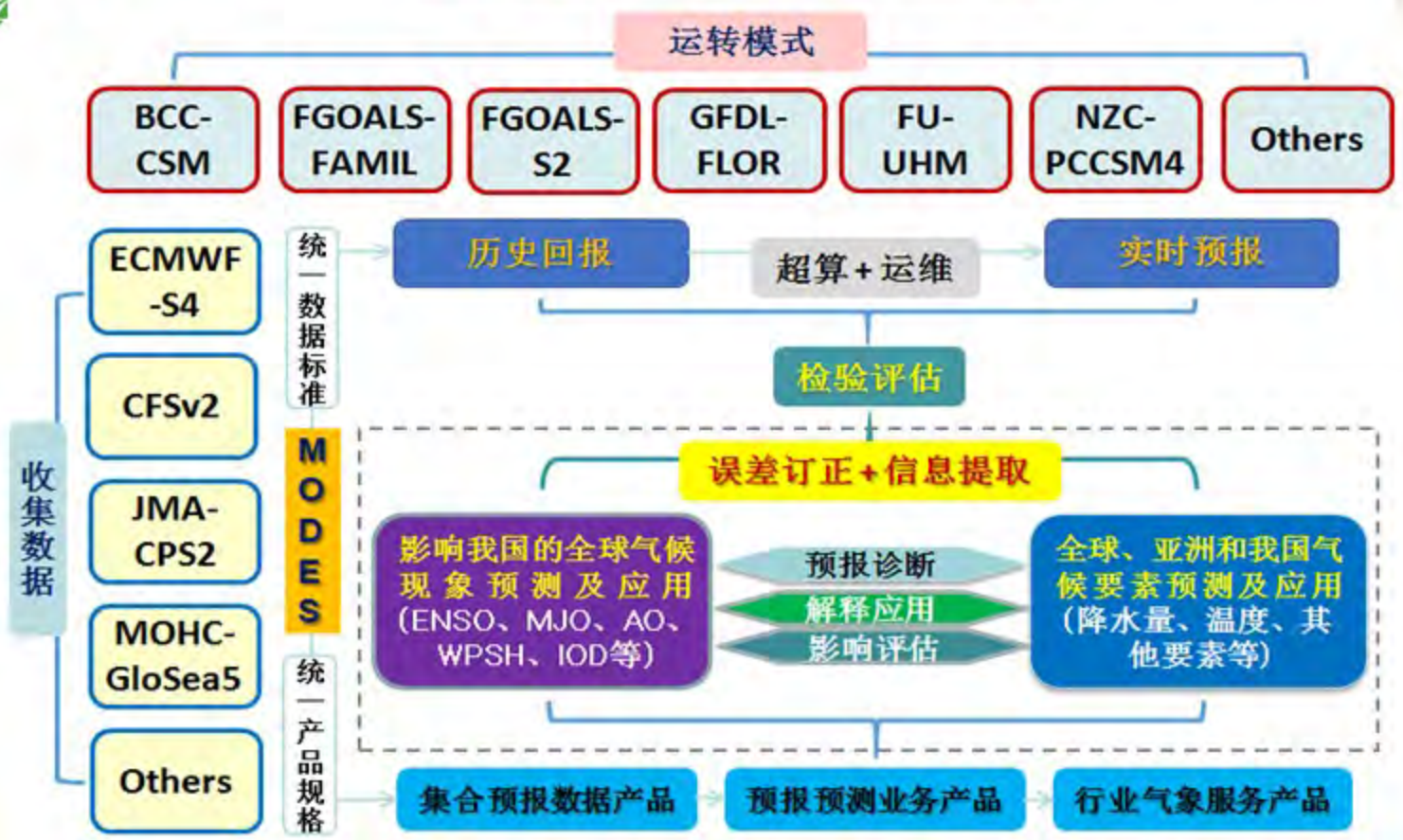
ADPES：remarkable correction in 2017 winter

Statistical model：La-Nina

MME：weak warm state in 2017 summer

CMME

中国多模式集合(CMME)



CMME

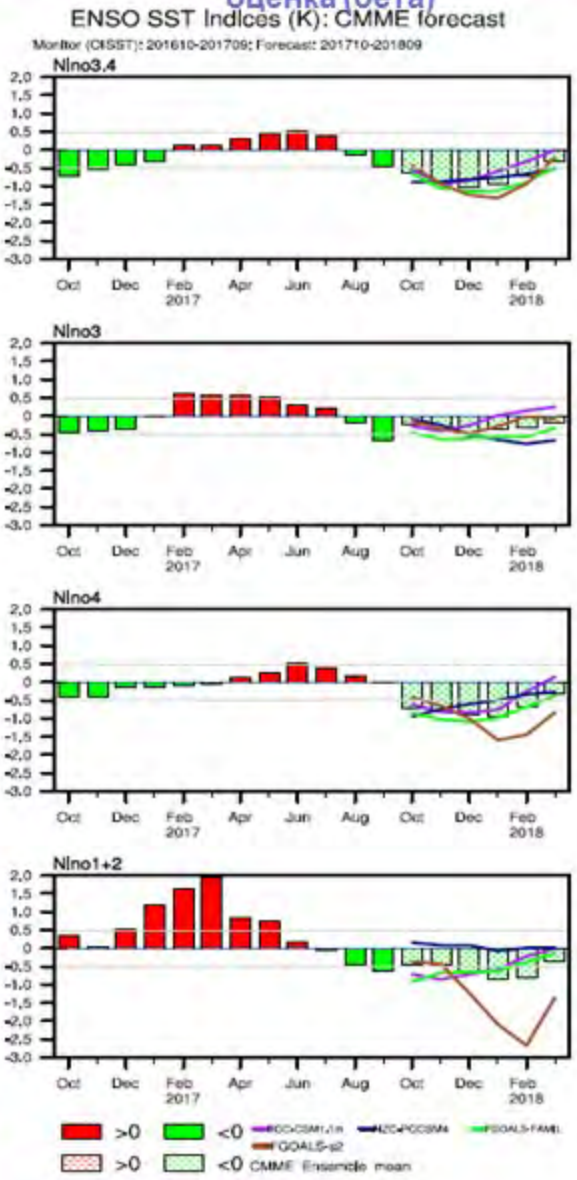
Test and Assessment (beta) Тестирование и оценка (бета)

Models	Ensemble Member	Run
BCC-CSM1.1m	24	BCC
FGOALS-s2	4	Tianjin
NZC-PCCSM4	4	Guangzhou
FGOALS-FAMIL	24	Guangzhou
GFDL-FLOR	4	Tianjin
UHM	10	Wuxi

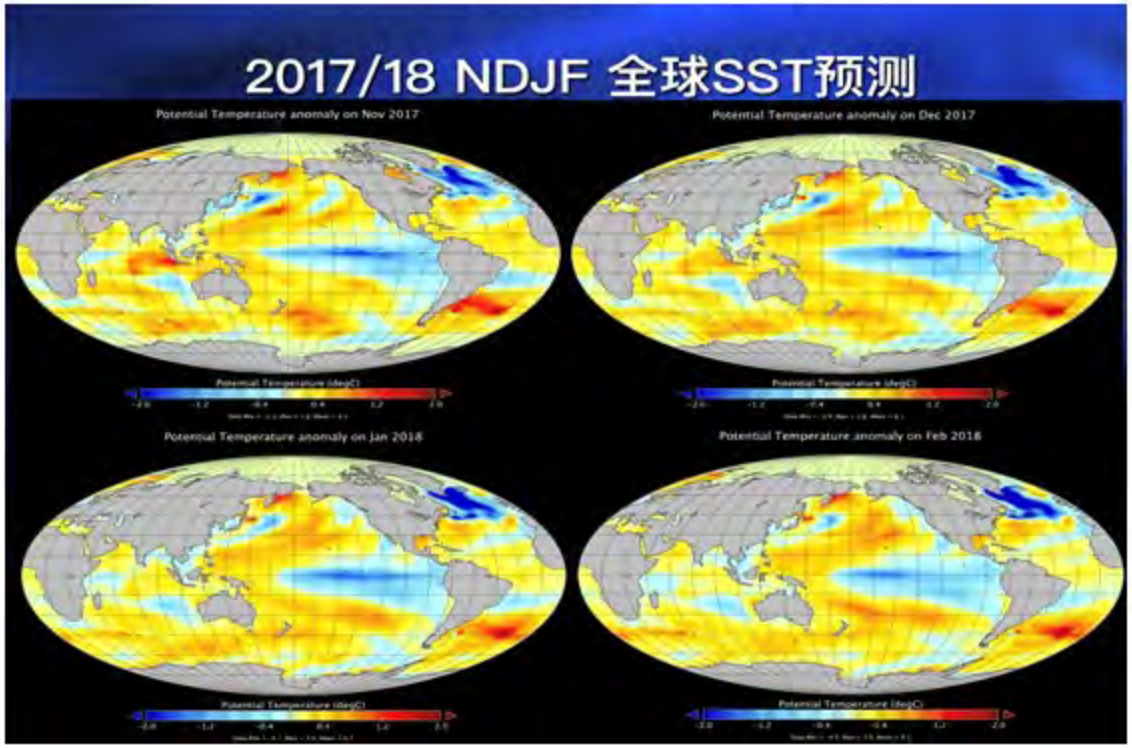
- Hindcasts: 1980-2016
- Forecasts: Realtime Experiments since 2017
  - Initial time: 20-21th Each month
  - Period of forecast: 6 months

CMME——ENSO

Test and Assessment (beta) Тестирование и оценка (бета)



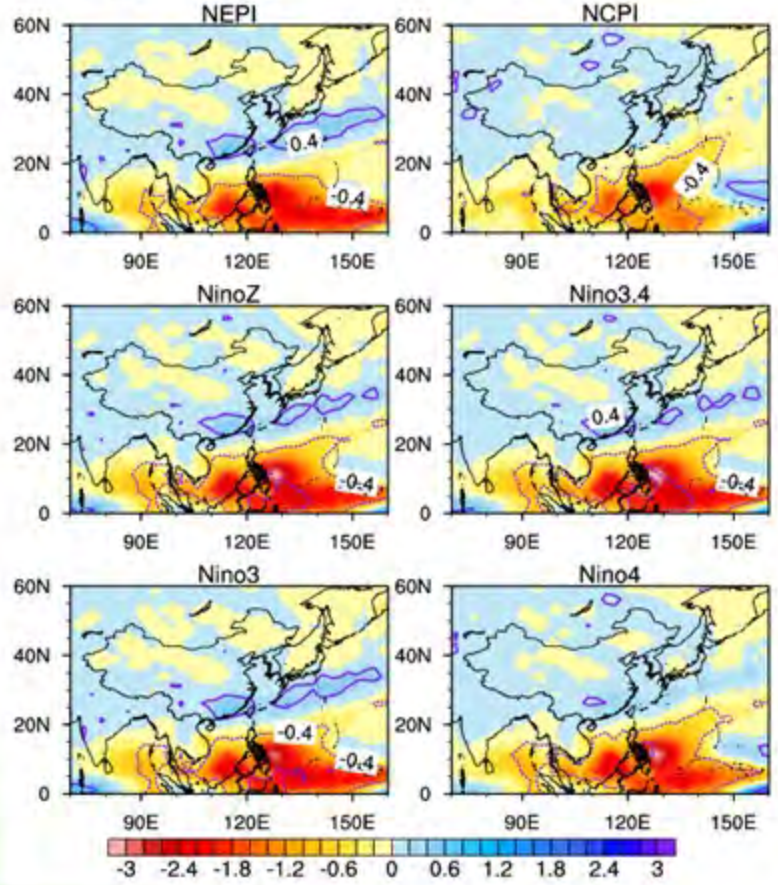
FGOALS-FAMIL



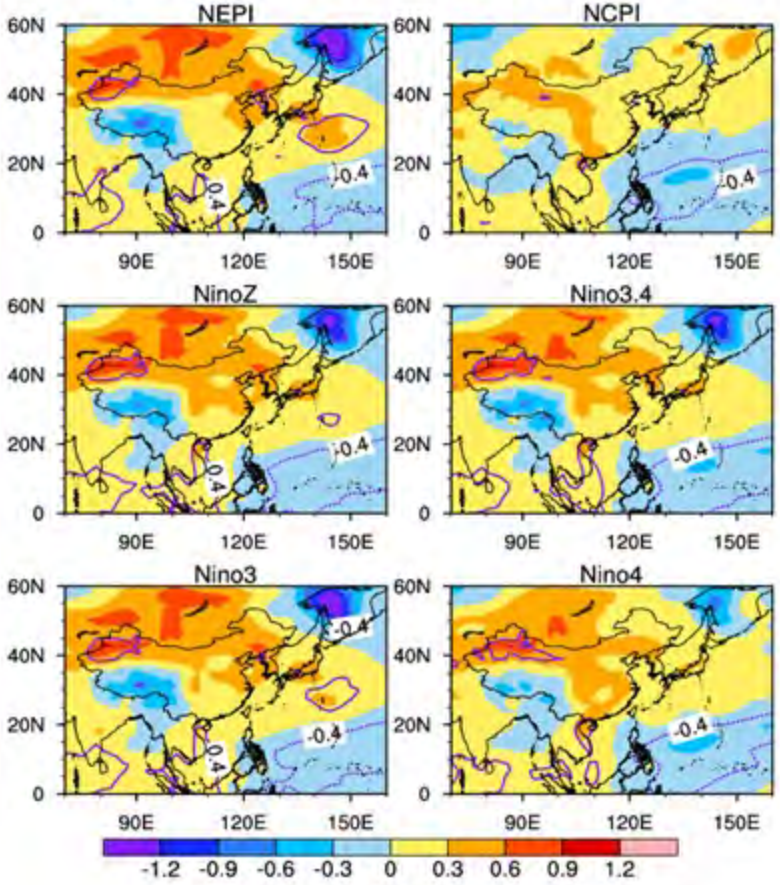
La nina will be expected by CMME in this winter

ENSO vs Precip/Temp in DJF

Regressed Precipitation of Nino Indices in DJF (mm/day)



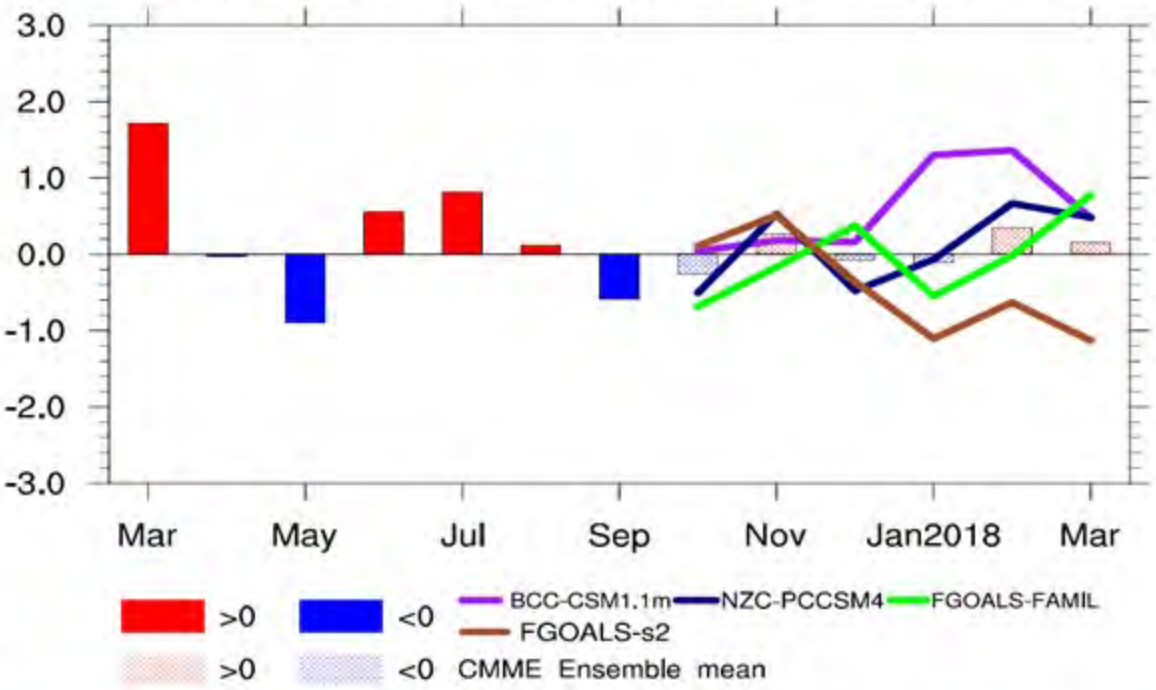
Regressed Temperature at 2m of Nino Indices in DJF (K)

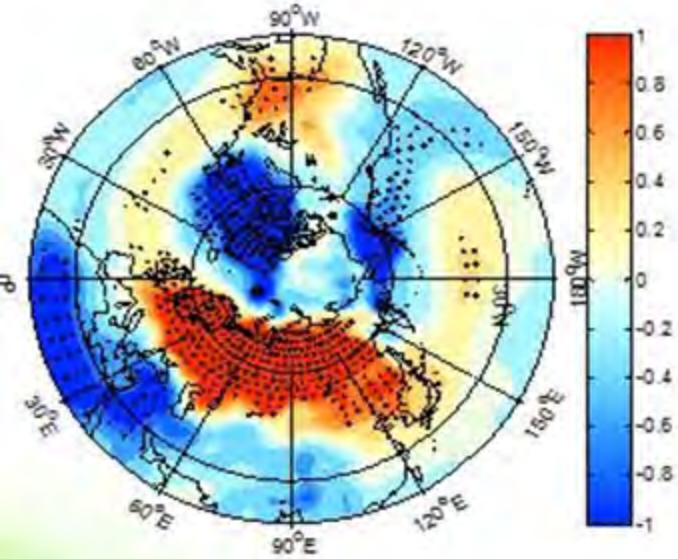


CMME——AO

Test and Assessment (beta) Тестирование и оценка (бета)

Monthly AO index: Observed & CMME Forecasts



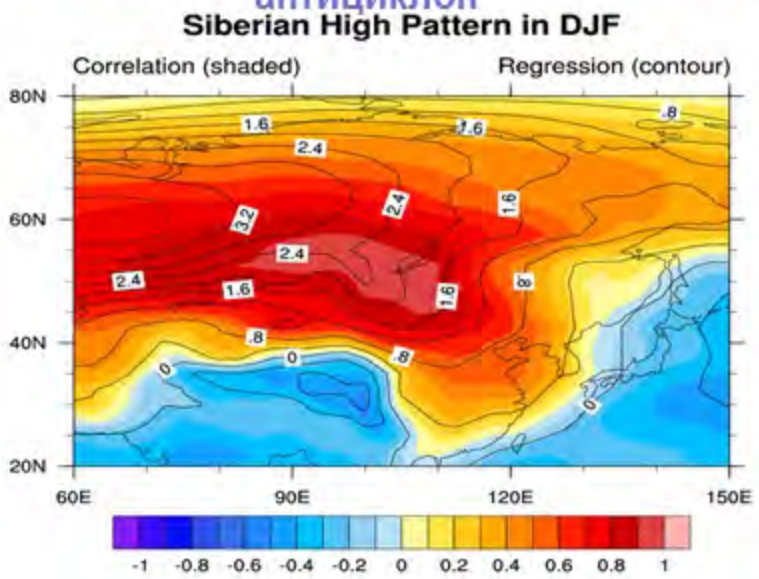


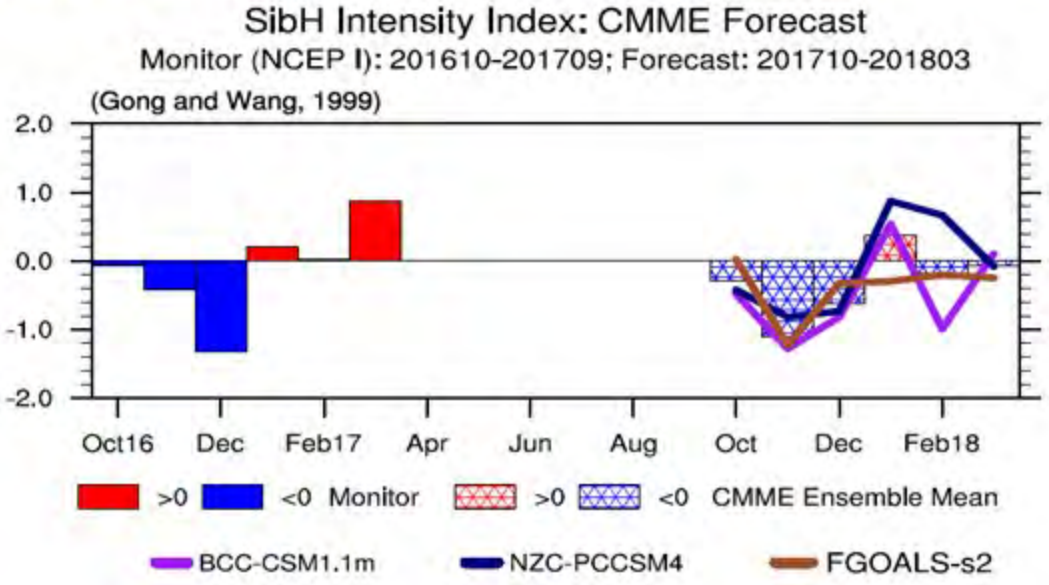
1983-2010年冬季AO对气温的回归图

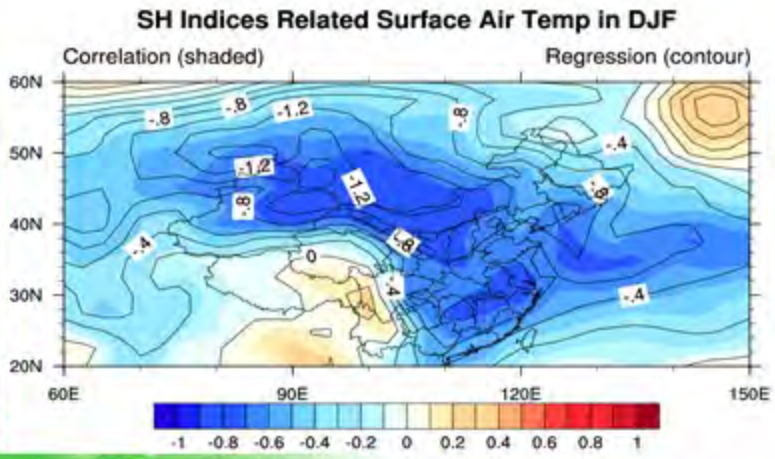
AO: from Negative to Positive during this winter

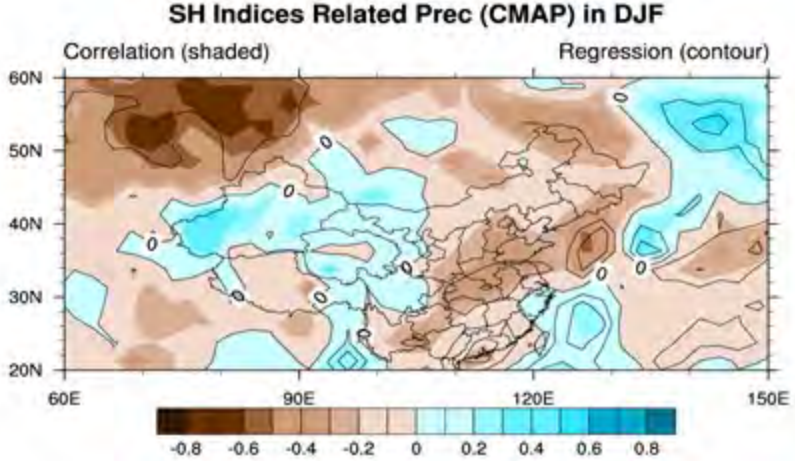
CMME——Siberian High

Test and Assessment (beta) Сибирский антициклон





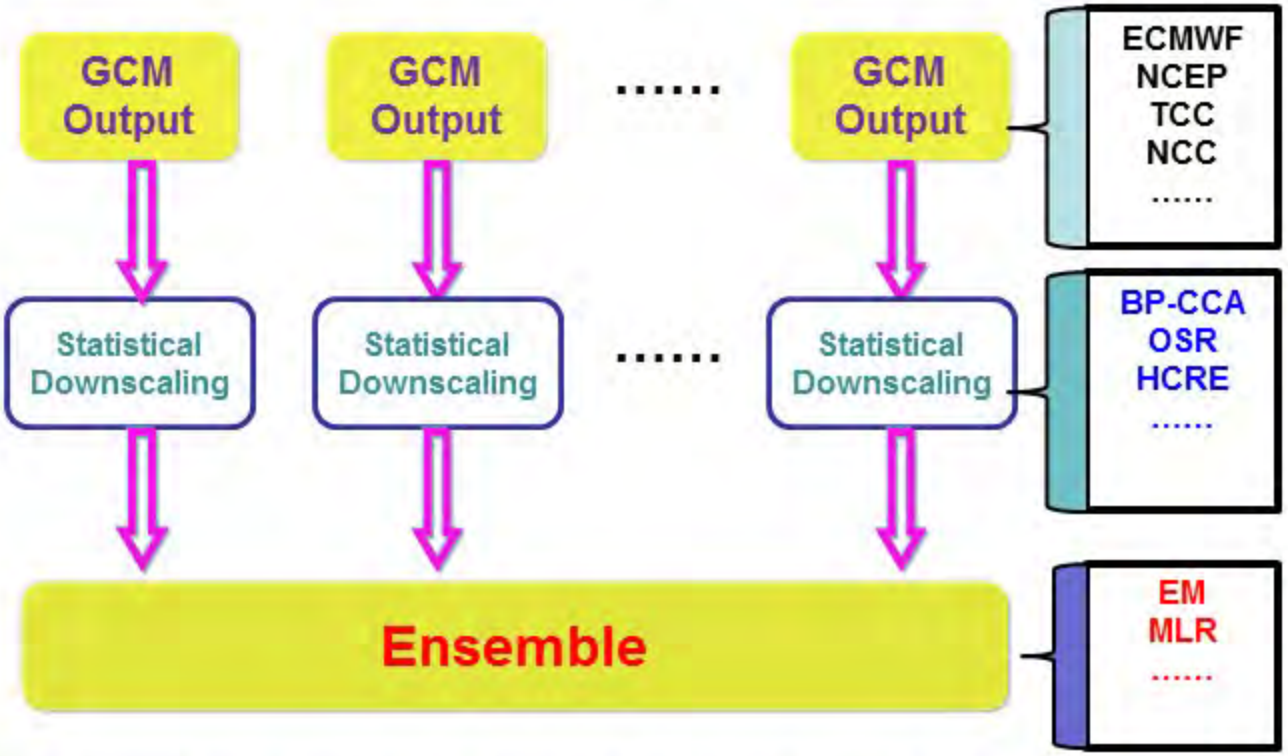




CMME——MODES

MODES

Multi-Model Downscaling Ensemble System



Previous study shows that forecast by downscaling and ensemble perform better than that by ensemble and downscaling.(Kang H. W. et al.,2009)

Summary Заключение

Climate Models:

- BCC CSM1.1m (T106L26) —>CSM1.2 (T106L40)
- BCC CSM2 (T266L56)

CPPS

- ENSO, AO, Siberian High
- MJO, EAWM

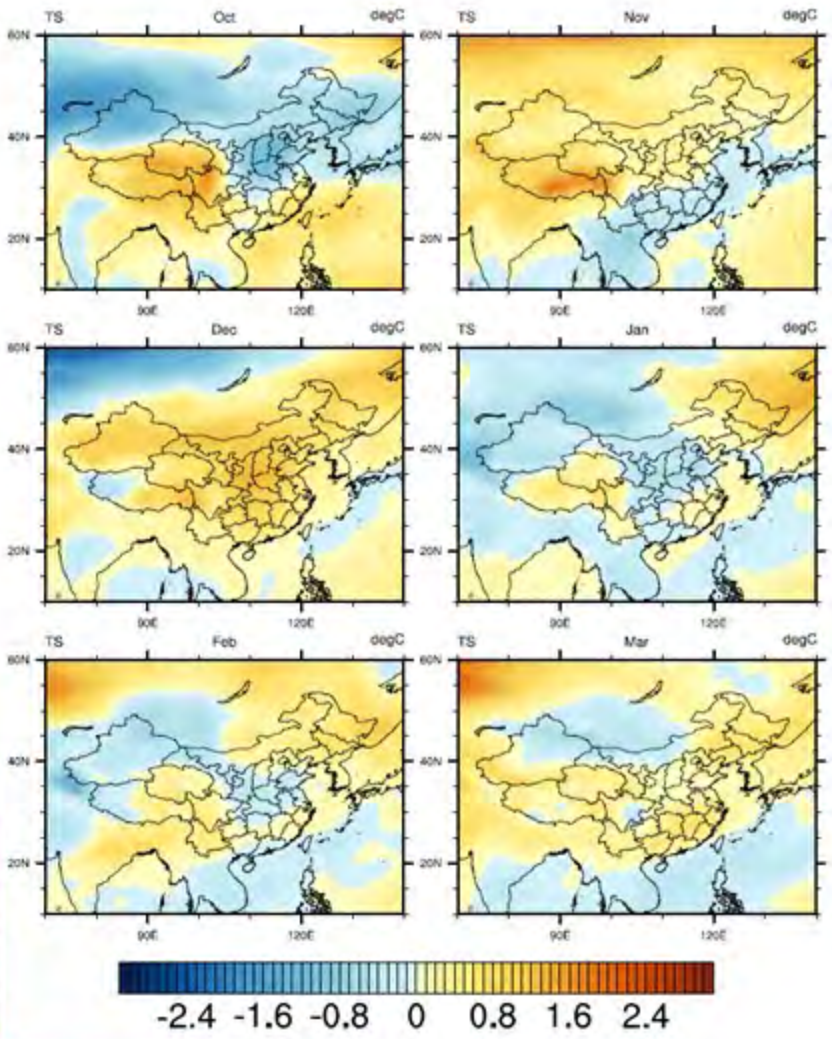
CMME

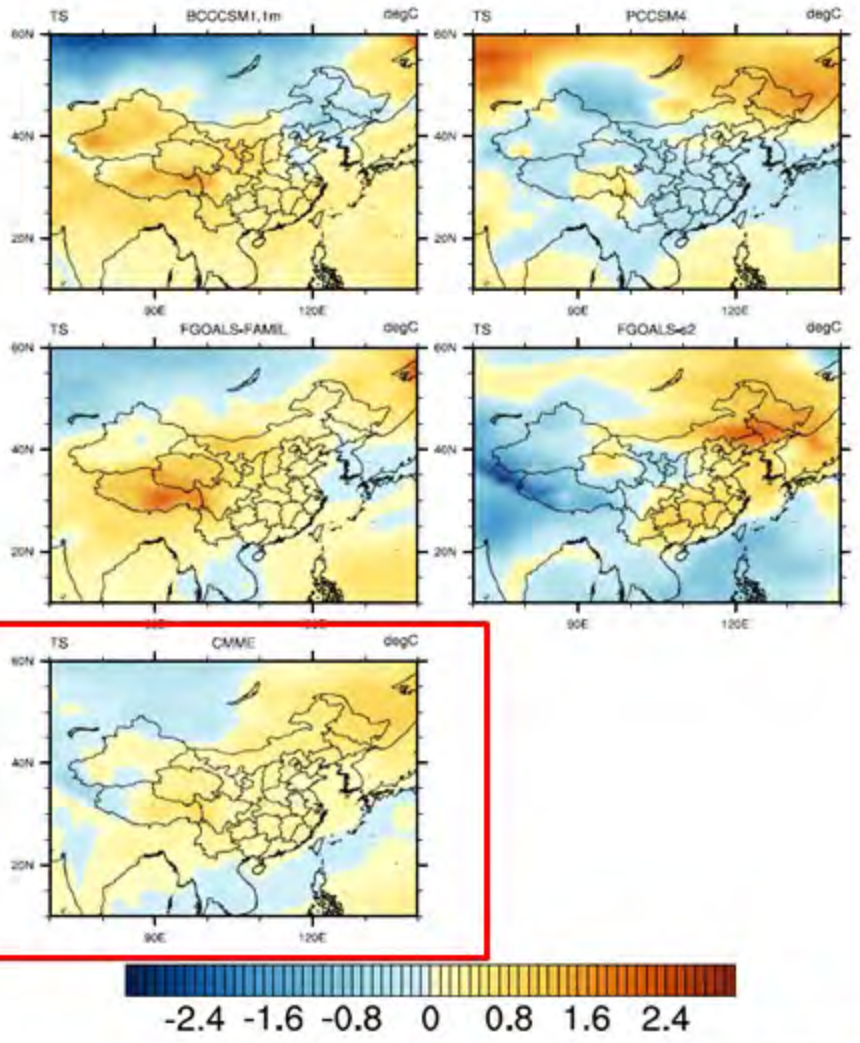
- More Models involve
- MODES

Thank You !

CMME——2017/18 DJF Temp

Test and Assessment (beta)





CMME——2017/18 DJF Precip

Test and Assessment (beta)