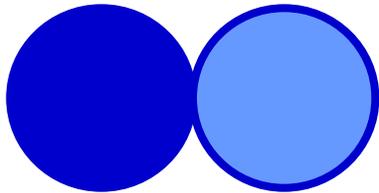
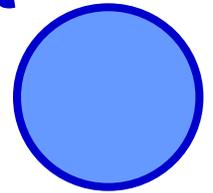




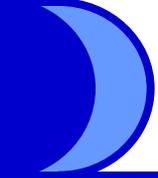
JMA's Coupled Ensemble Prediction System for seasonal forecast



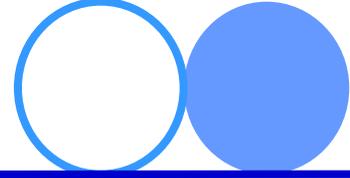
Akira Ito

Climate Prediction Division
Global Environment and Marine Department
Japan Meteorological Agency

Thanks to Shuhei Maeda, Yuhei Takaya, Masayuki Hirai,
Shoichiro Miyawaki, Yuji Akasaka and Masashi Ujiie



Contents

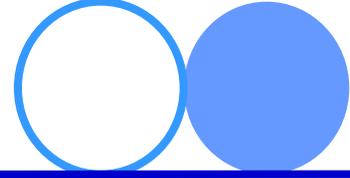
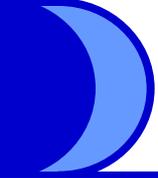


- The operational seasonal forecast system at JMA
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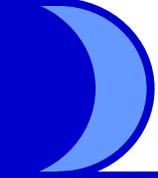
JMA Headquarters



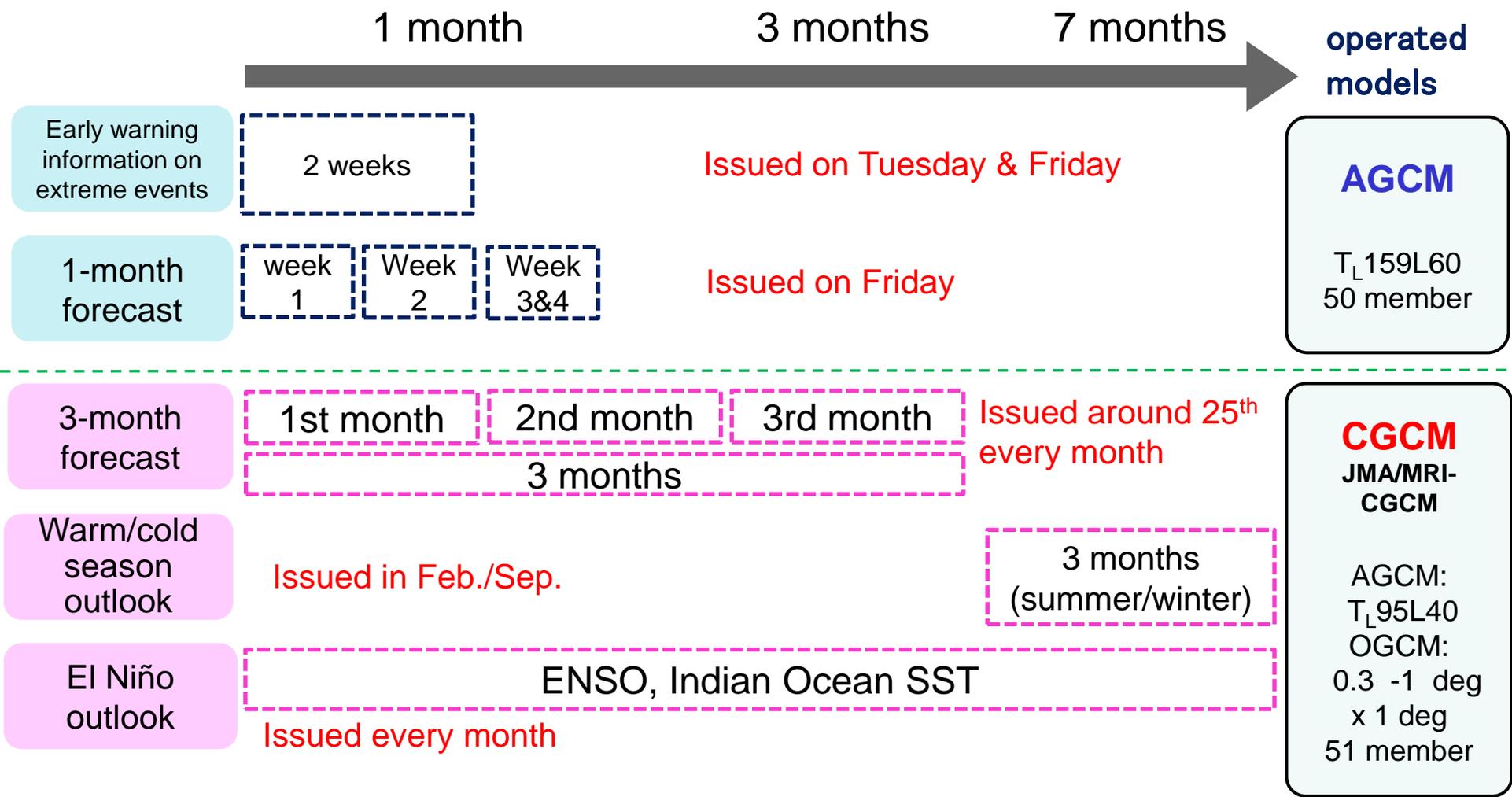
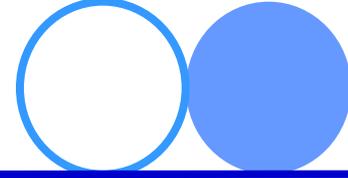


- The operational seasonal forecast system at JMA
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Current JMA Medium-range to Seasonal Prediction Systems



Operational timetable on JMA's HPC

Computer Resources



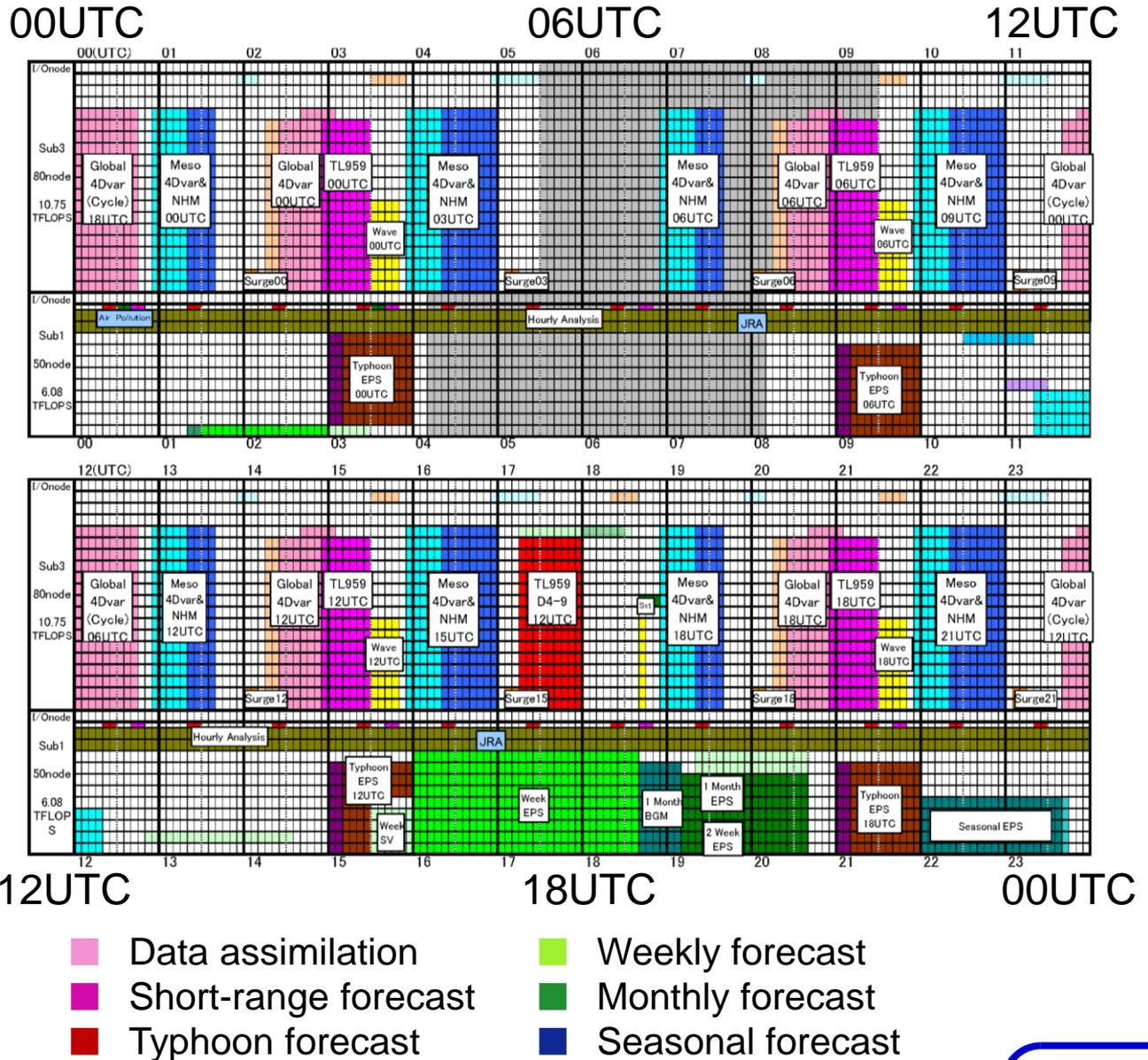
HITACHI SR11000



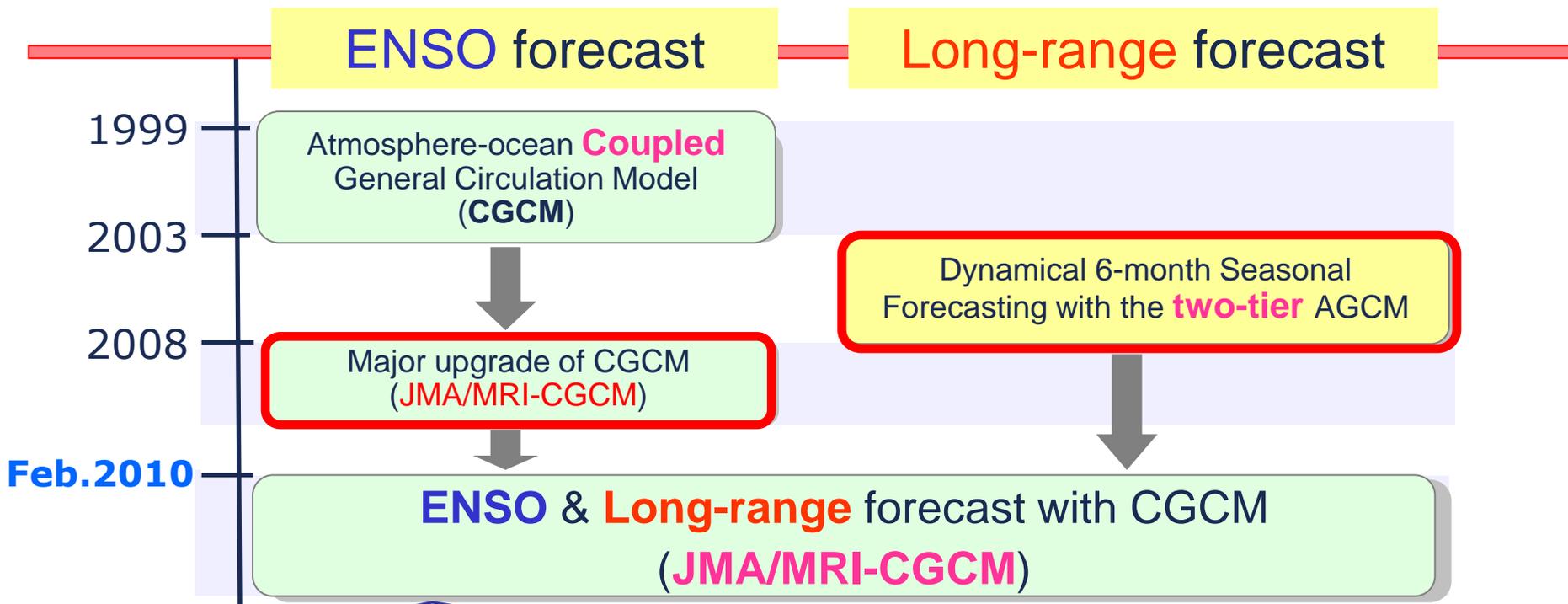
Replace in
June 2012



HITACHI SR16000

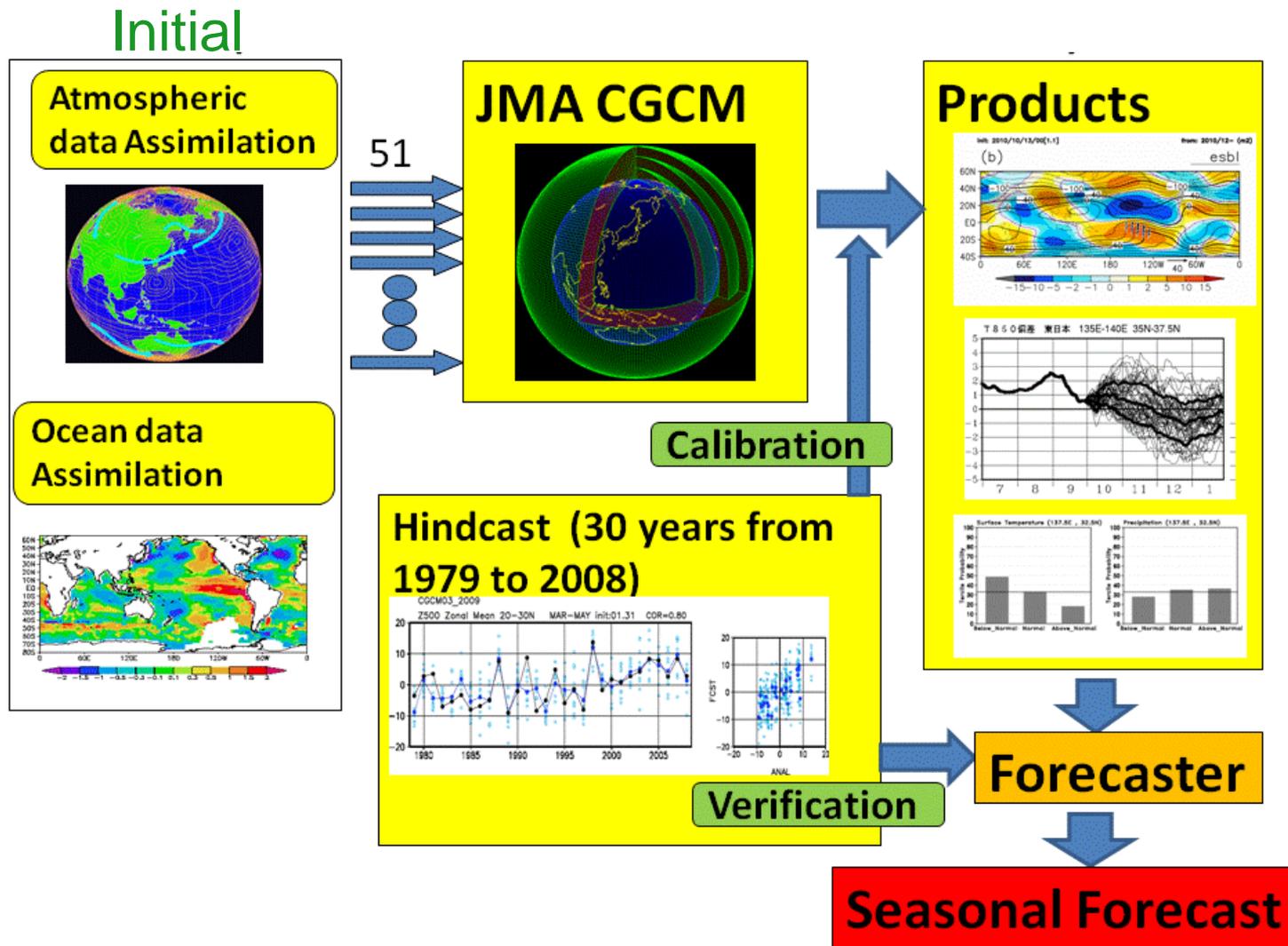


Operational changes



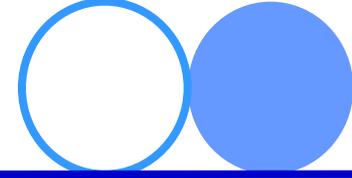
In 1999, JMA introduced the use of atmosphere-ocean coupled GCM in the ENSO forecasting service. In 2003, a two-tier dynamical ensemble prediction system was introduced in long-range forecasting services. Through a major upgrade of the CGCM in 2008, we finally **introduced this coupled system** for long-range forecasting in February 2010.

JMA Operational Seasonal Forecast System

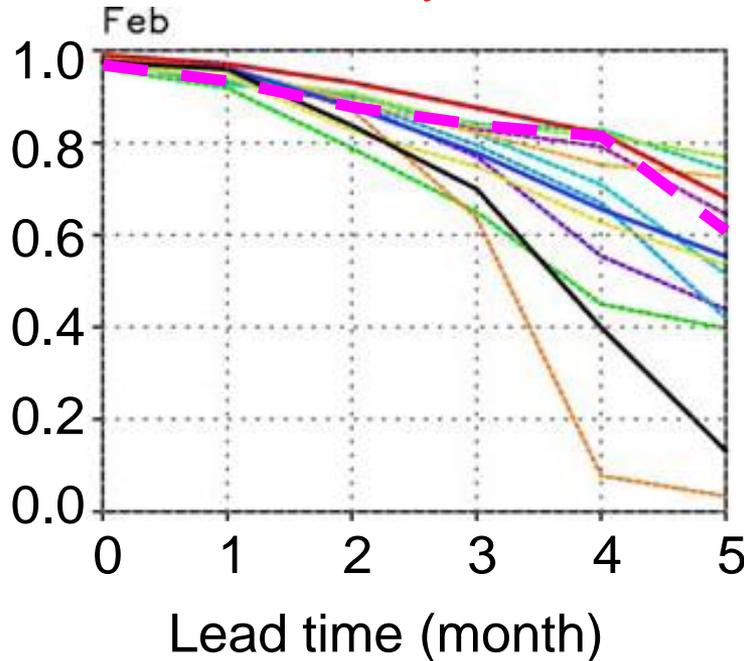


For 3-month, cold season and warm season forecast

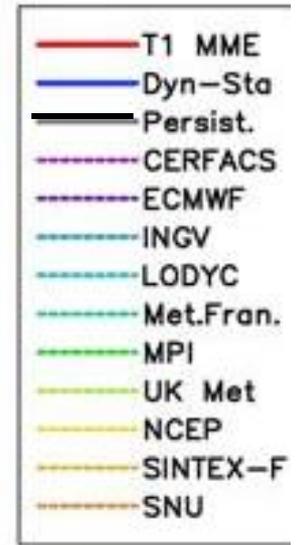
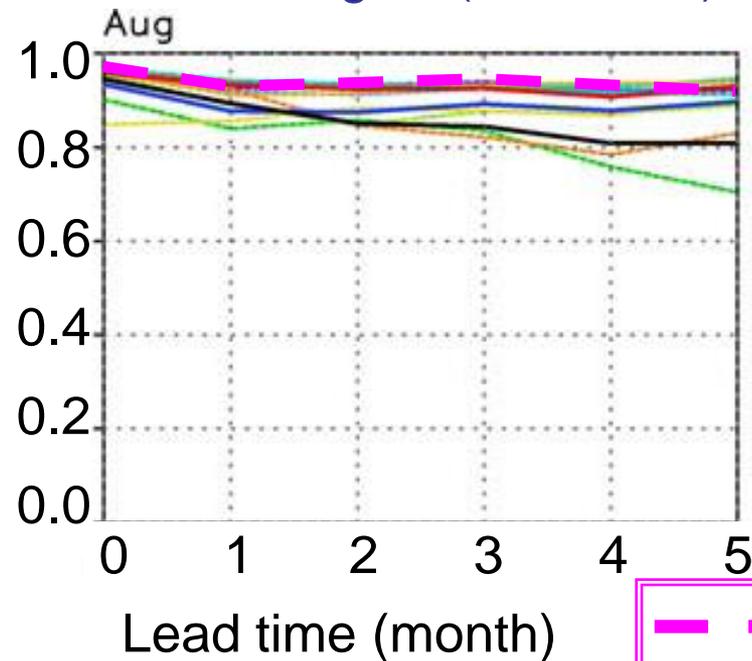
Skill of NINO3.4 SST



Initial: February (1980-2001)



Initial: August (1980-2001)

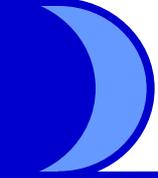


(JMA/MRI-CGCM)

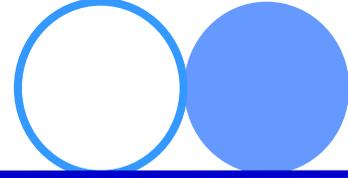
NINO3.4 region: 120W-170W, 5S- 5N

(quote from Fig. 8 of Jin et al. 2008)





Contents



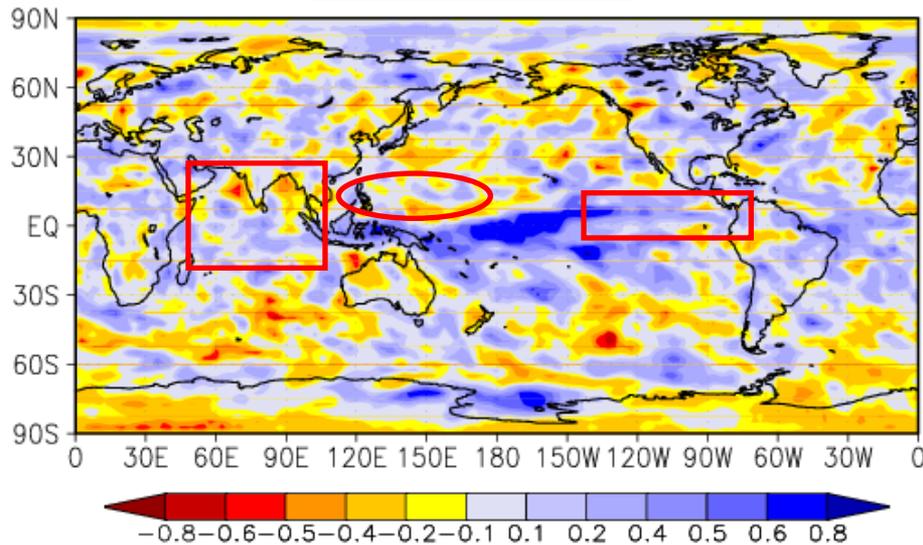
- The operational seasonal forecast system at JMA
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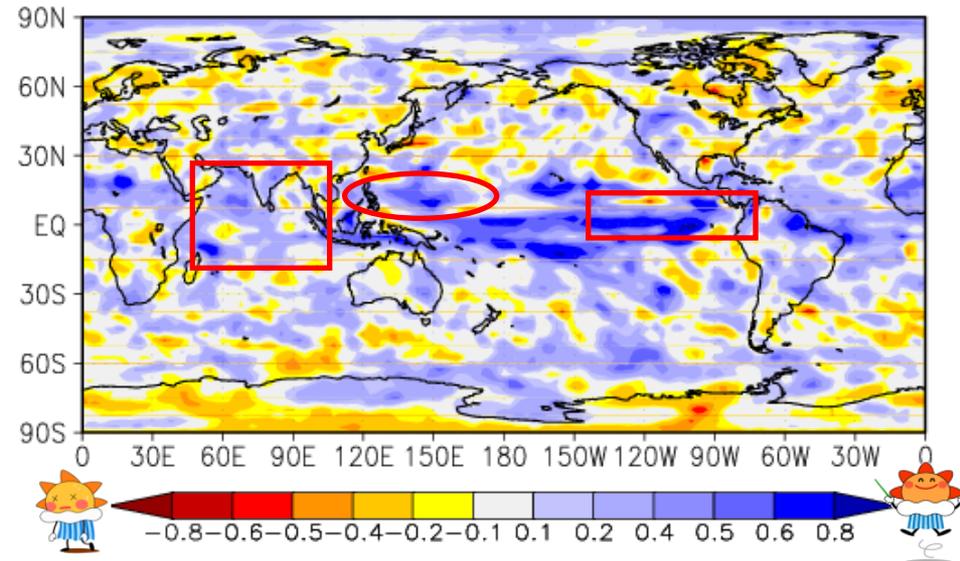
Improvement of precipitation

Anomaly correlation of JJA precipitation (1984 - 2005)

AGCM



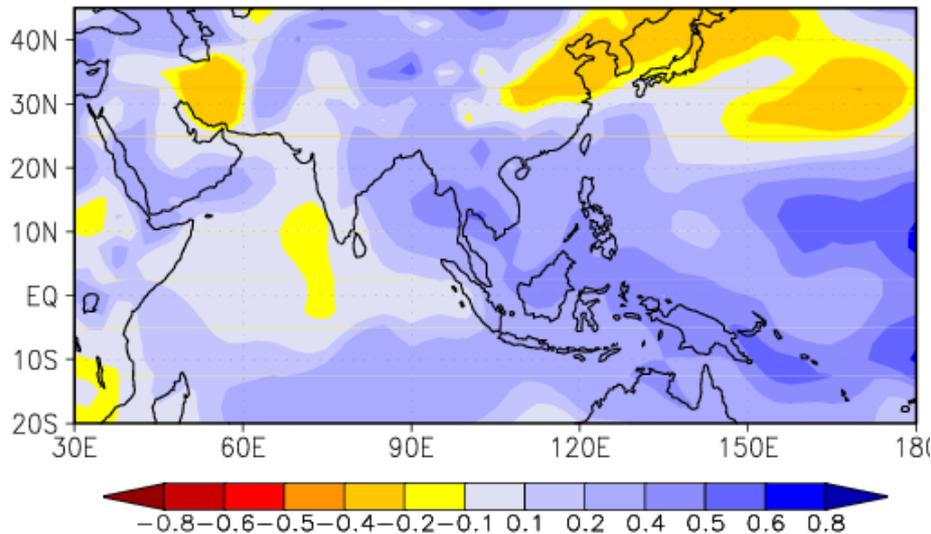
CGCM



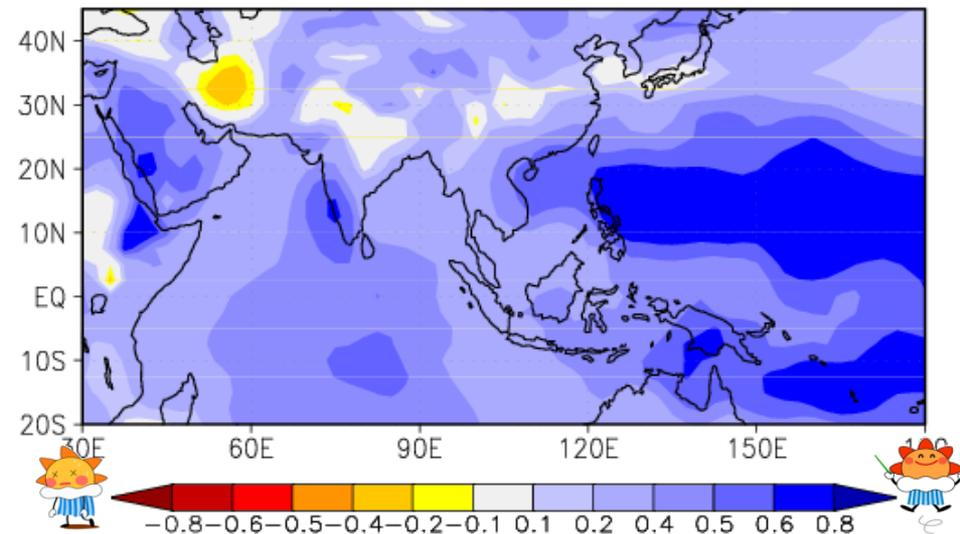
Improvement of sea level pressure

Anomaly correlation of JJA sea level pressure (1984 - 2005)

AGCM

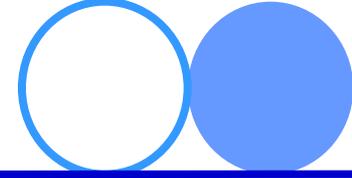


CGCM

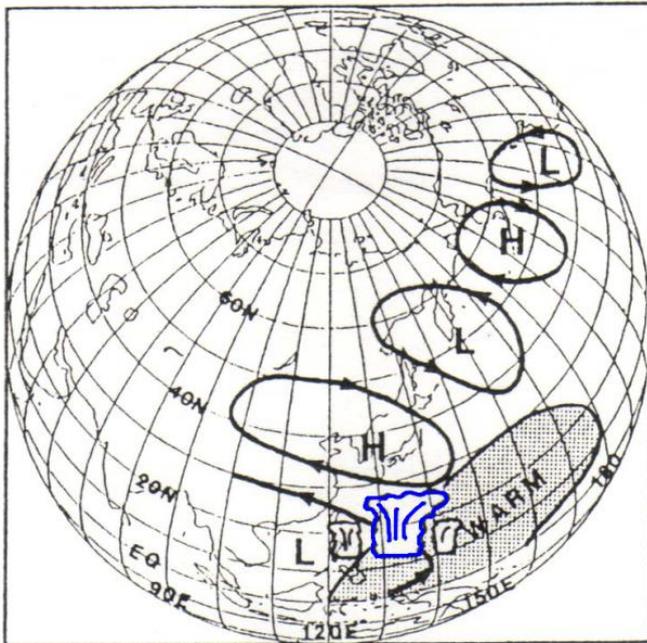


Corresponding to the improvements of precipitation in tropical regions, the skills of SLP are also improved, especially over the Western North Pacific region.

Pacific-Japan pattern

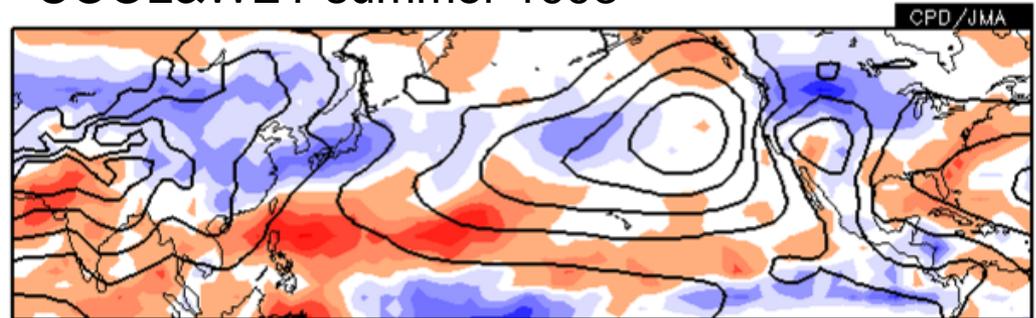


Contour: SLP
Shade: OLR anomaly

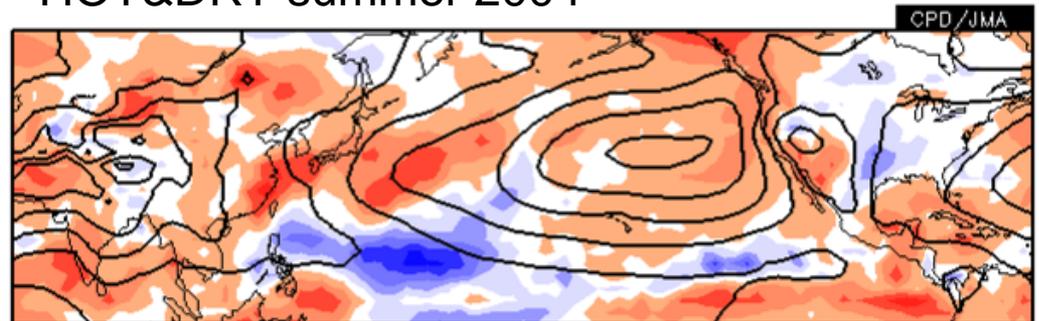


(Nitta, 1987)

COOL&WET summer 1993



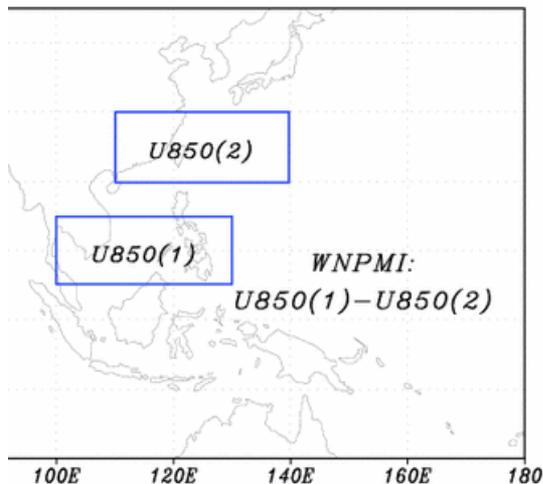
HOT&DRY summer 2004



The summer climate of East Asia is known to be deep relation with the convective activity around Philippines through the propagation of the Rossby wave.

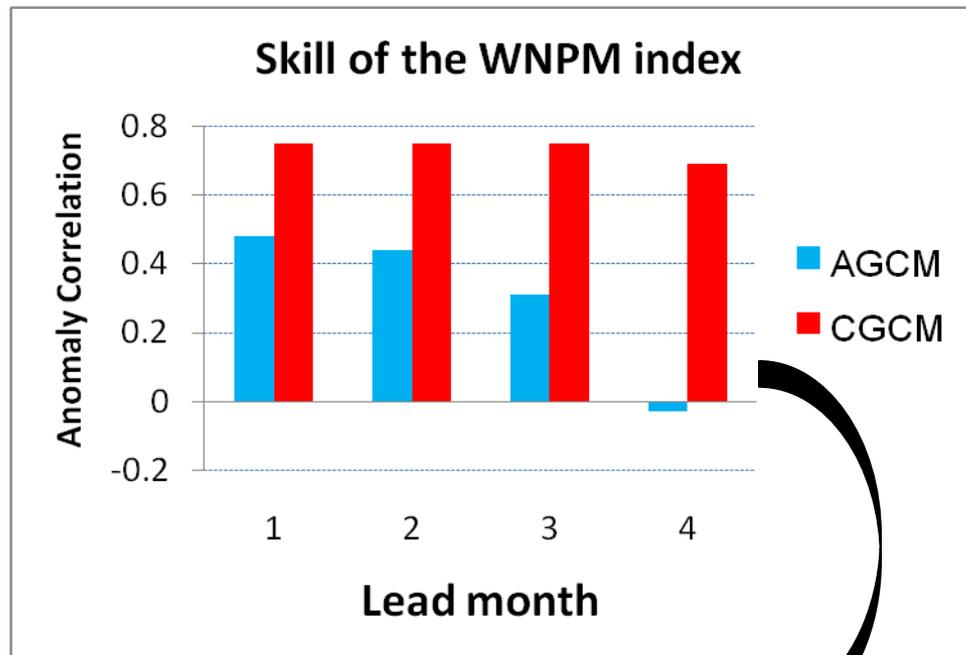


Improvement of the WNPM index



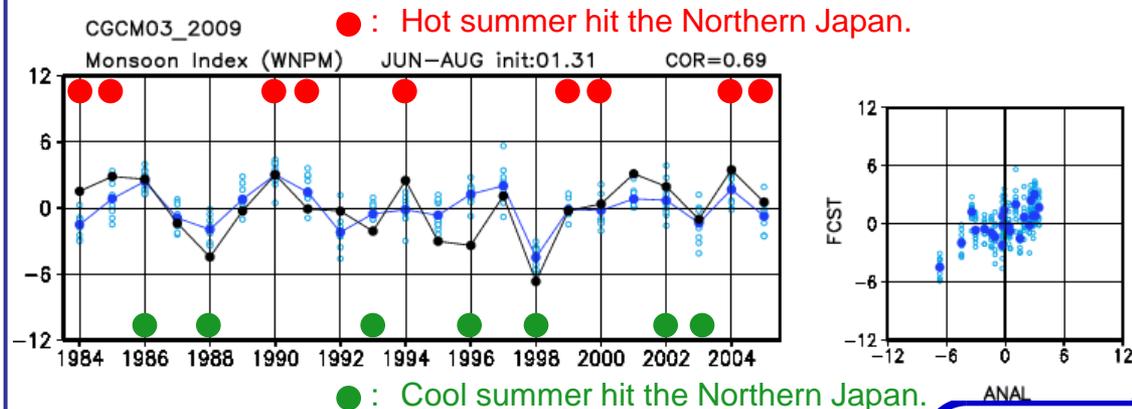
(Wang et al., 2001)

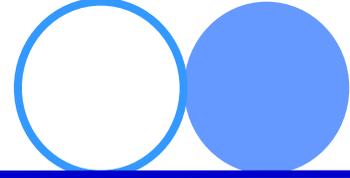
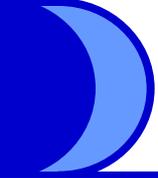
WNPM Index = $U850(100E-130E, 5N-15N) - U850(110E-140E, 20N-30N)$



Initial month: May Apr. Mar. Feb.

- When the convective activity around Philippines is enhanced (the index +), it tends to become hot summer over the Northern Japan.
- It is expected that improvement of the WNPM index will lead to breakthroughs for the summer outlook over Japan and East Asia.

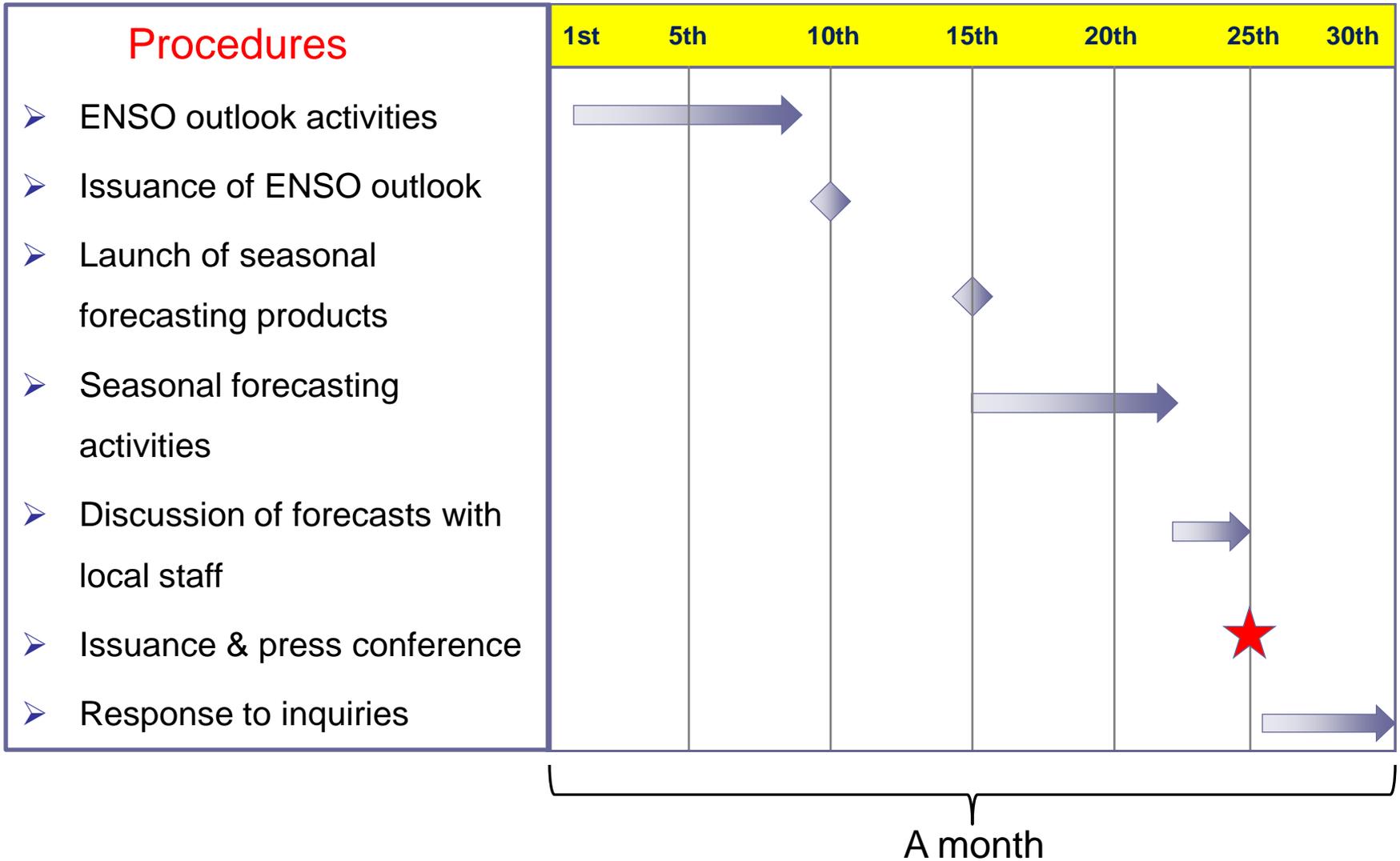
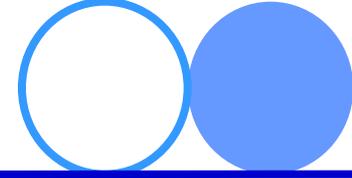




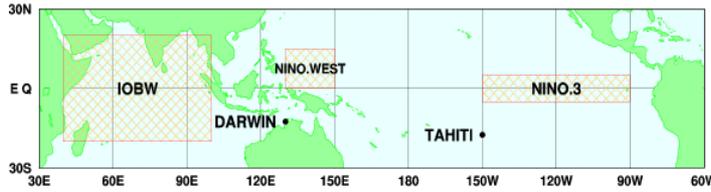
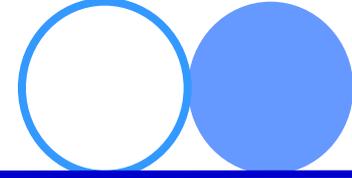
- The operational seasonal forecast system at JMA
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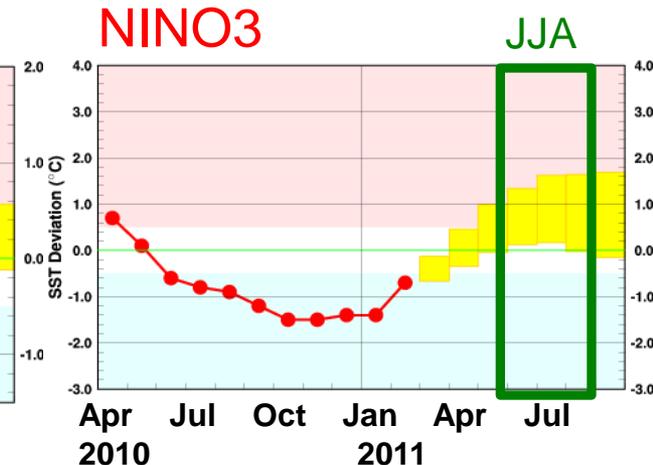
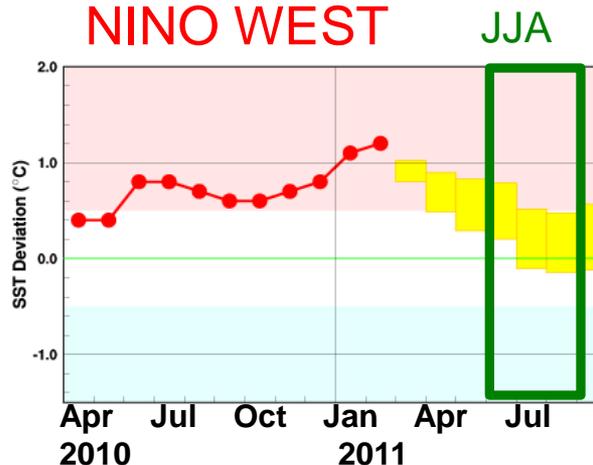
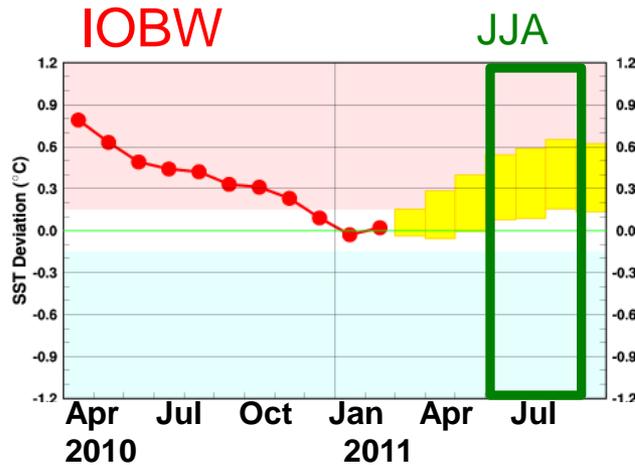
Operational schedule of seasonal forecasting activities



SST forecast



initial date: 2 March 2011



➤ Tropical Indian Ocean (IOBW) region SST would be near or above normal.

➤ NINO WEST SST would close to neutral conditions.

➤ Negative conditions of NINO3 SST were likely to decay in this spring and would be near or above normal in this summer.

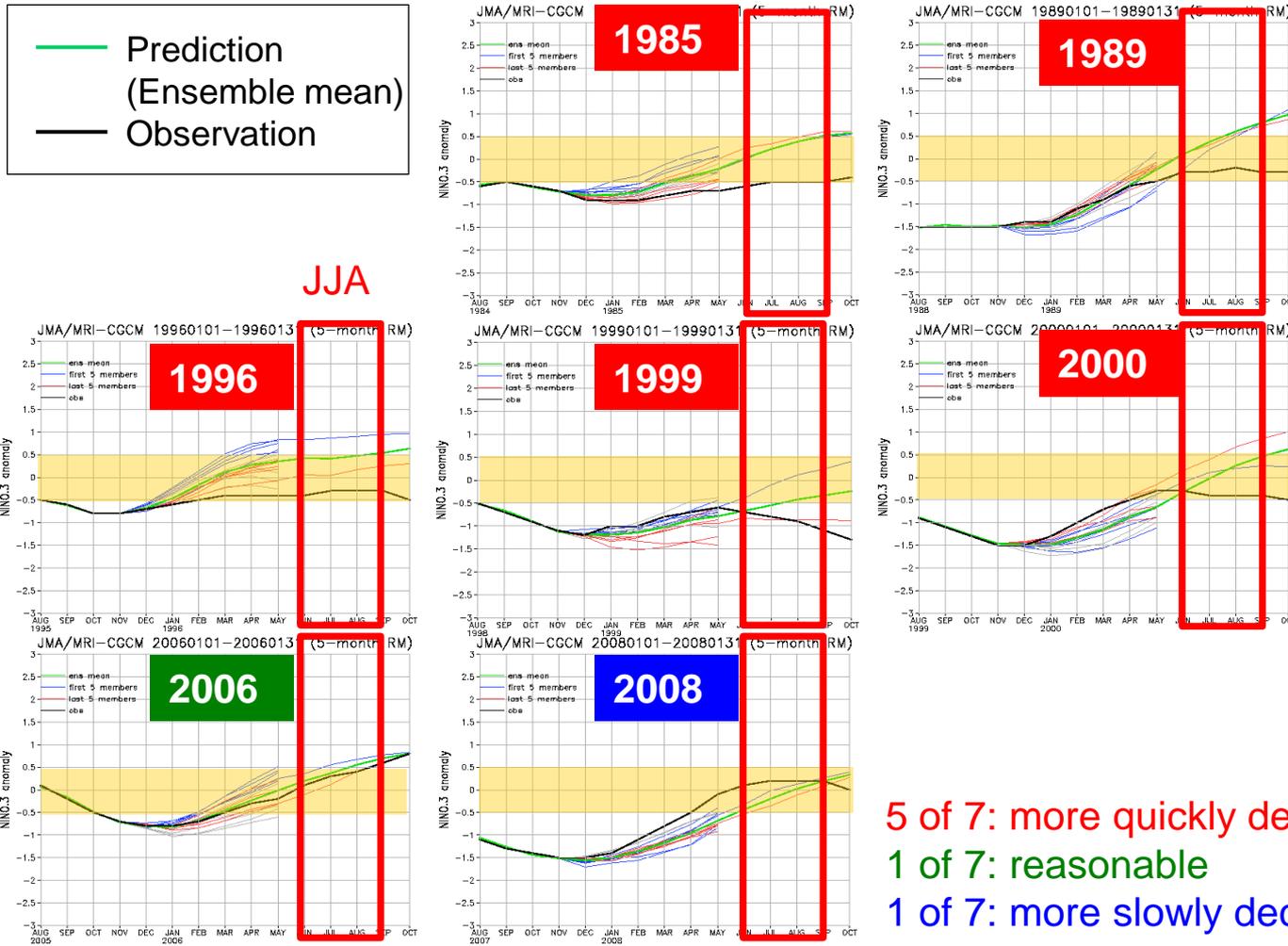
Uncertainty of the latter half of the prediction was large.



Hindcast (prediction of NINO3 SST)

In case of La Niña in spring (end stage of La Niña)

— Prediction (Ensemble mean)
— Observation



- Prediction skill of El Niño/La Niña condition is relatively low at the end stage of La Niña conditions in spring.
- JMA's model tends to decay La Niña conditions more quickly than observations.

5 of 7: more quickly decay La Niña than actual
 1 of 7: reasonable
 1 of 7: more slowly decay La Niña than actual

➔ Uncertainty in the prediction should be considered.

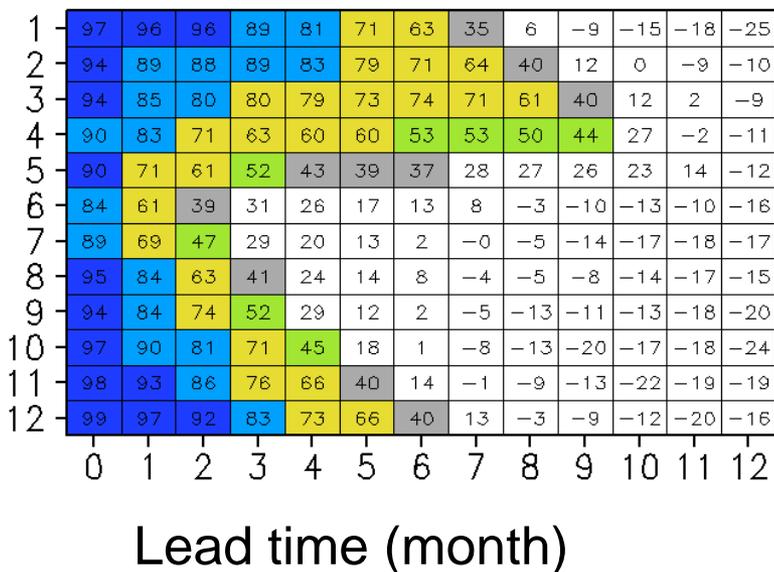
Skill for NINO3.4 SST

Prediction skill has target month dependency.

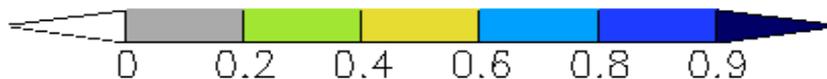
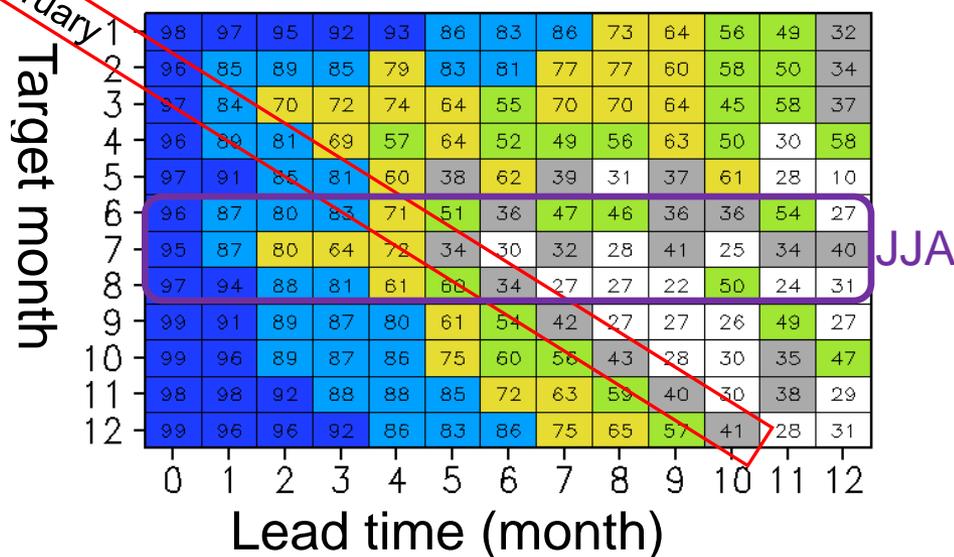
- Persistence barrier from spring to summer
- Anomaly correlation is small from spring to summer.

= **“spring barrier”** ; common issues for all numerical model

Persisted Anomaly



CGCM

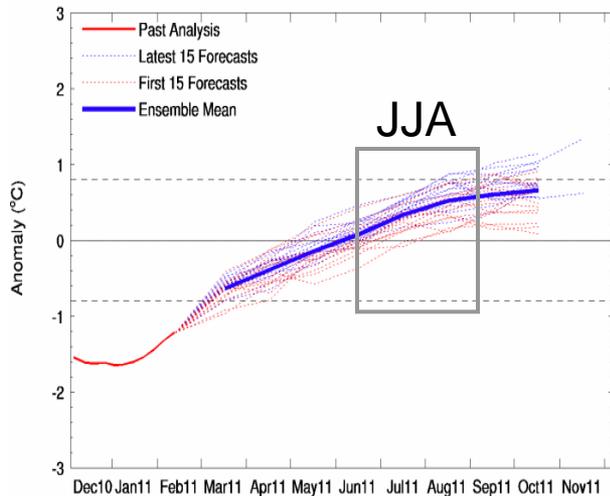


hindcast: 1979~2007

NINO3 SST predictions of other centres

Nino3 SST plumes from POAMA Forecasts 1 Feb 2011 - 2 Mar 2011

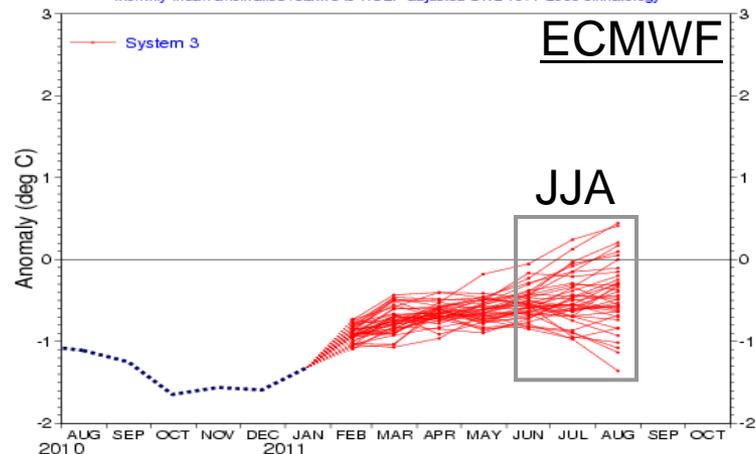
BOM



NINO3 SST anomaly plume
ECMWF forecast from 1 Feb 2011

Monthly mean anomalies relative to NCEP adjusted Olv2 1971-2000 climatology

ECMWF



NWS/NCEP/CPC

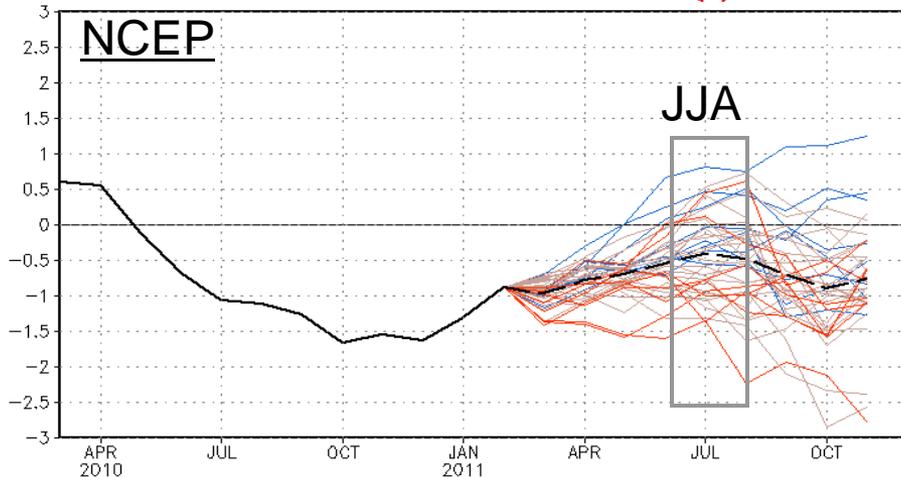
Last update: Thu Mar 3 2011
Initial conditions: 21Feb2011-2Mar2011

Forecast Issue date: 15 Feb 2011



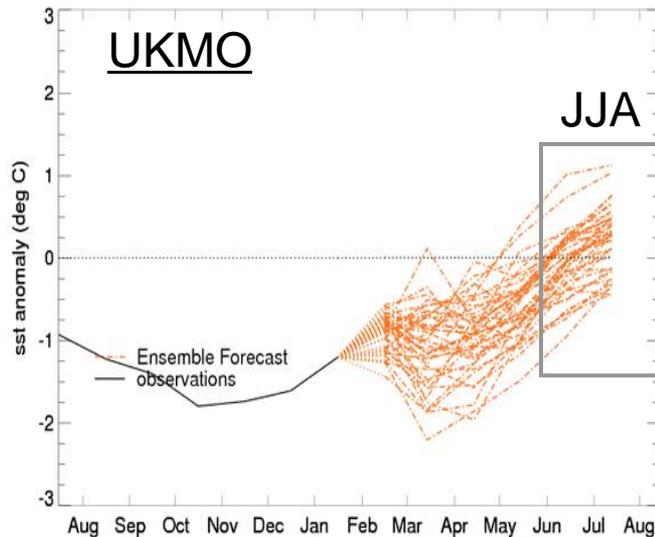
CFS forecast Nino3 SST anomalies (K)

NCEP



— Latest 8 forecast members
— Earliest 8 forecast members
— Other forecast members
— Forecast ensemble mean
— Olv2 observation

UKMO

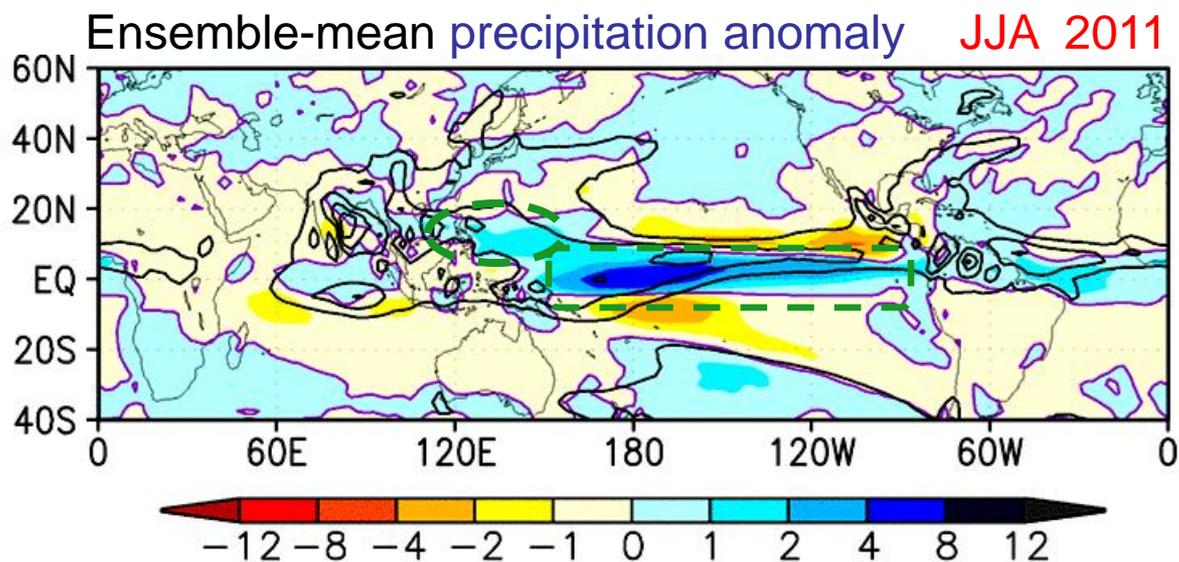
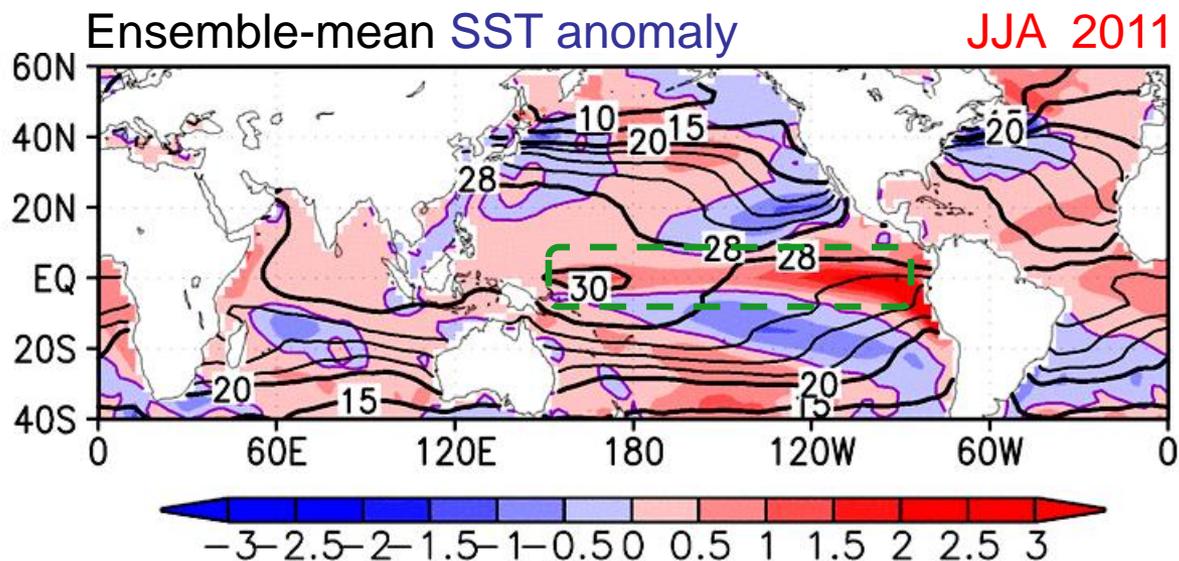
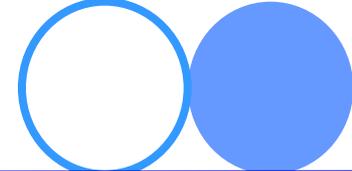


Statement of ENSO outlook

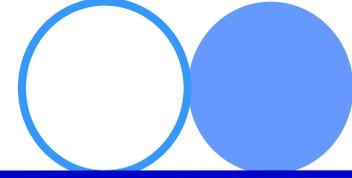
- The La Niña conditions that have persisted since last boreal summer are likely to decay by the end of boreal spring.
- Subsequent neutral conditions are likely to continue in boreal summer.

Issued in 10 March 2011

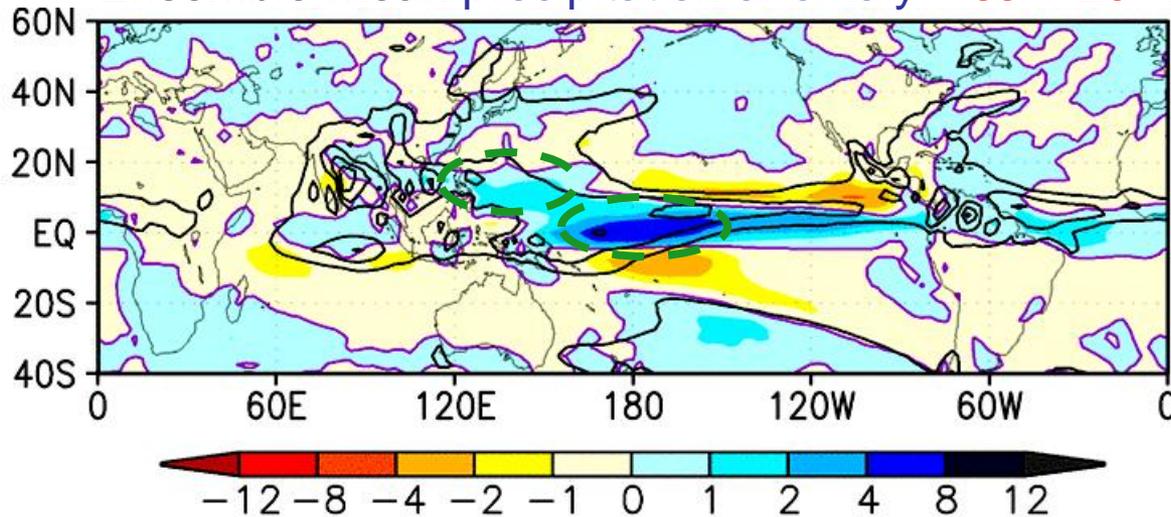
JMA seasonal forecast SST & Precipitation



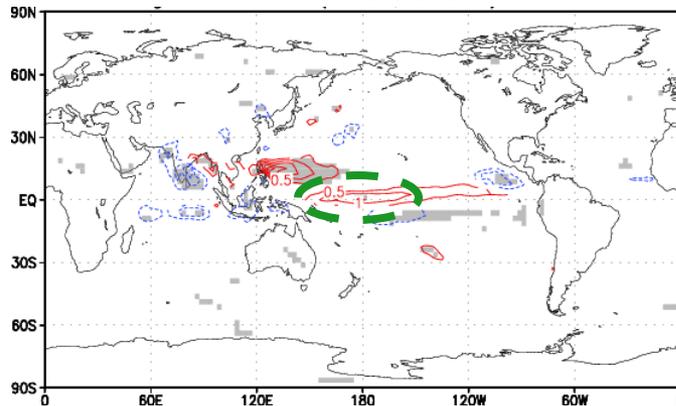
Statistical thinking



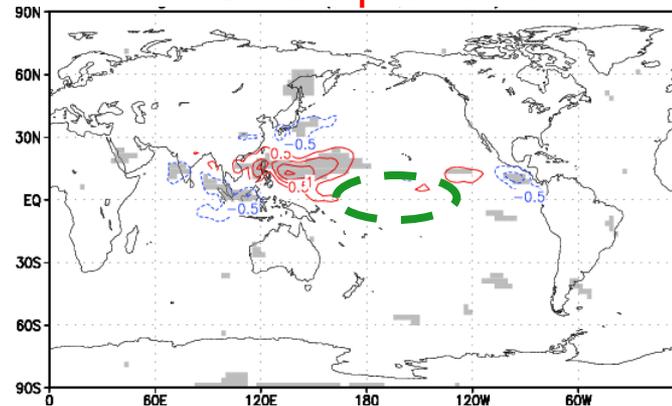
Ensemble-mean precipitation anomaly JJA 2011



Hindcast



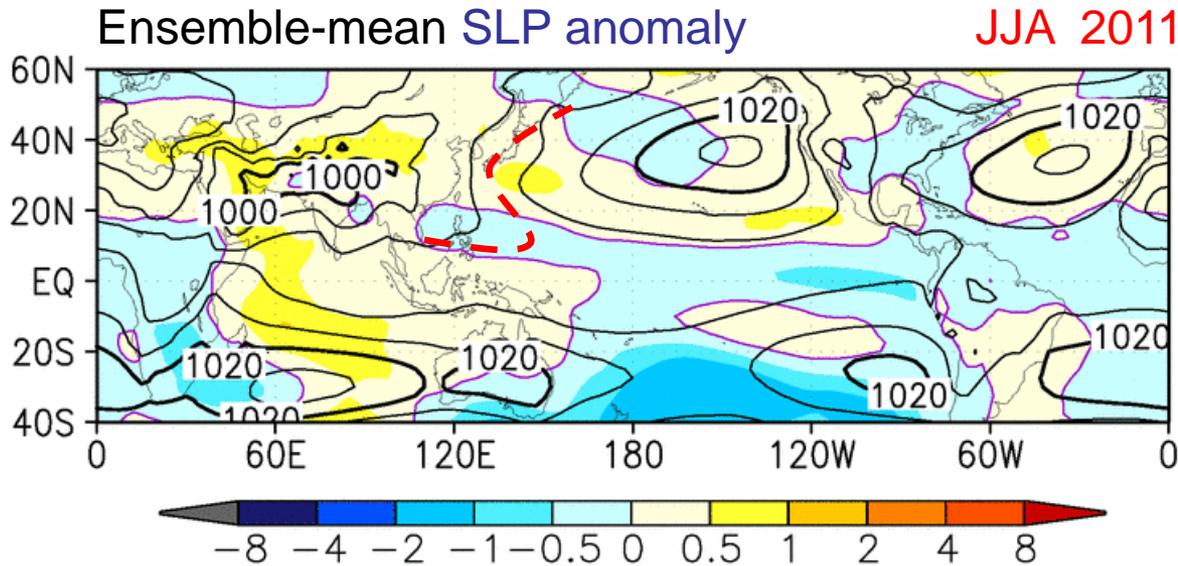
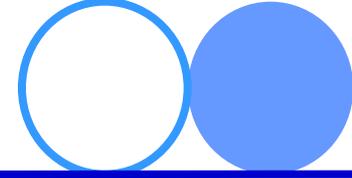
GPCP products



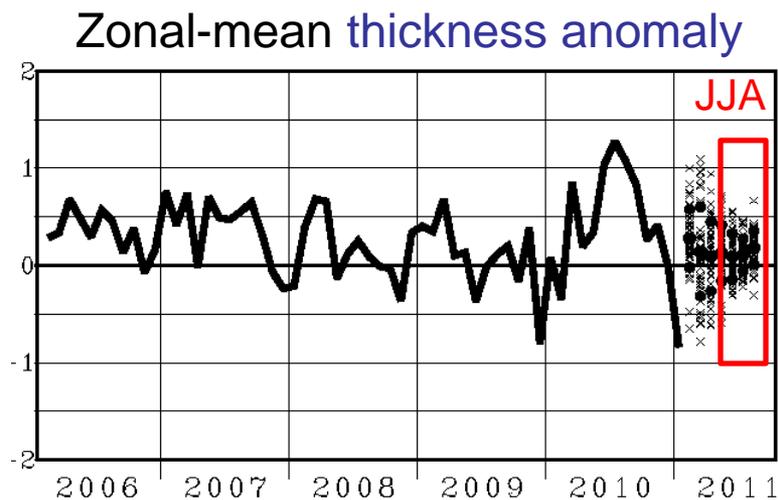
Results of regressing the hindcast precipitation fields and GPCP products against the area averaged precipitation around Philippines, respectively.



JMA seasonal forecast SLP & Thickness



The North Pacific High would strongly cover Japan.



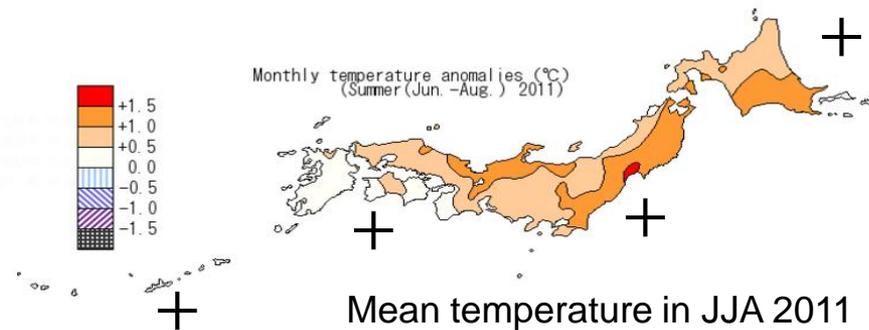
The zonal mean thickness at mid-latitude would be relatively above normal.



Outlook summary

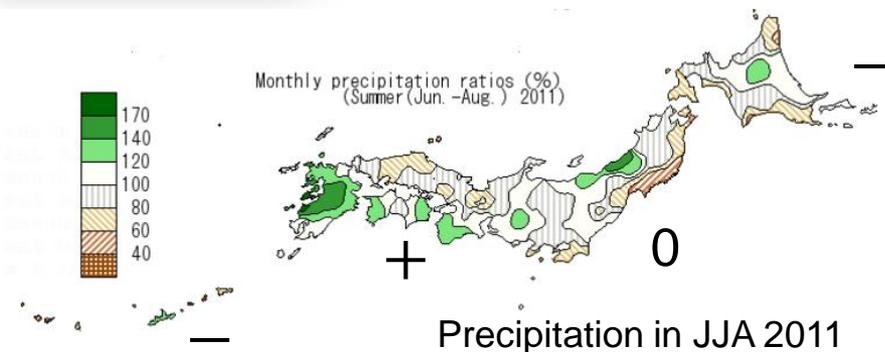
Mean temperature

Category	-	0	+
Northern Japan	30	30	40
Eastern Japan	20	30	50
Western Japan	20	30	50
Okinawa and Amami	20	30	50

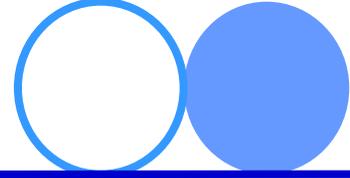
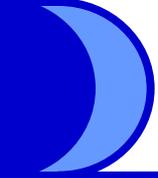


Precipitation

Category	-	0	+
Northern Japan	30	30	40
Eastern Japan	30	40	30
Western Japan	30	40	30
Okinawa and Amami	30	40	30



(Category - : below-normal, 0 : near-normal, + : above-normal, Unit : %)



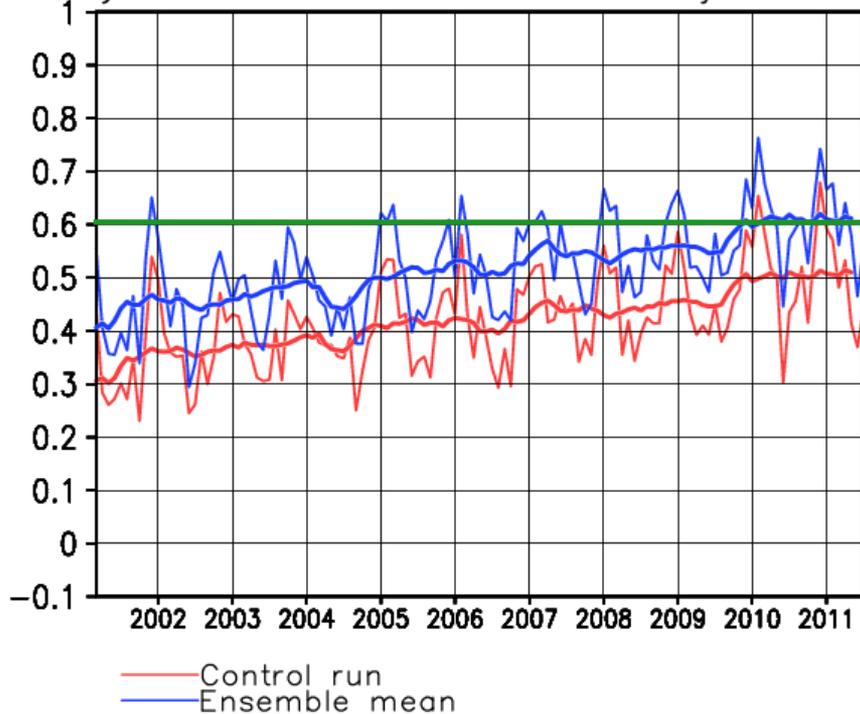
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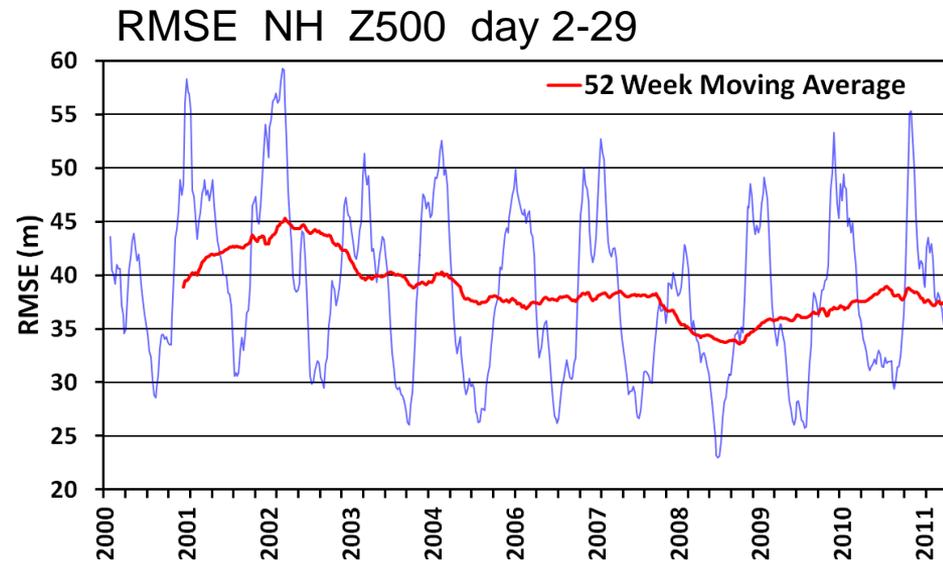
Z500 ACC, RMSE, N. Hem.

Weekly forecast

Monthly mean ACC NH Z500 mar2001 to jul2011 FT=216



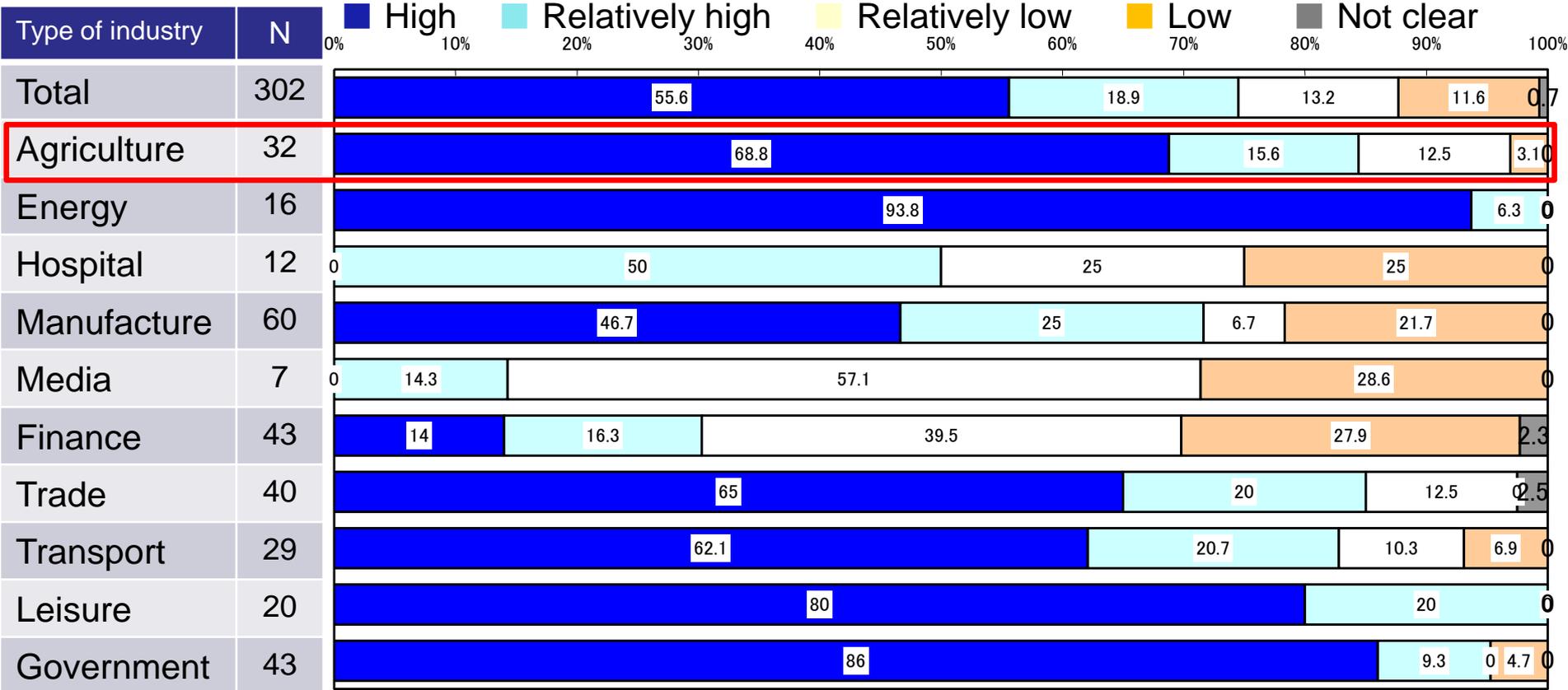
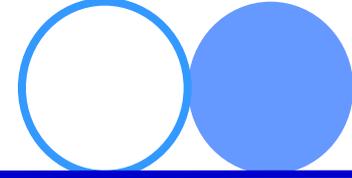
Monthly forecast



The level of skill in JMA's weekly/monthly predictions has gradually increased over the past decade.

However, it is widely recognized that the exploration of using climate information remains a long-term area to be addressed.

Effects of climate on business



【High impact】

Agriculture (69%), Energy (94%), Trade (65%),
Transport (62%), Leisure (80%), Government (86%)

【Relatively low impact】 Hospital, Media, Finance

【Polarity】 Manufacture

Joint Research with the National Agricultural Research Center for Tohoku Region (NARCT)

- Producing useful information for the prevention of cold/heat-related damage in rice production -

NARCT
Climate normal
(1-km scale)

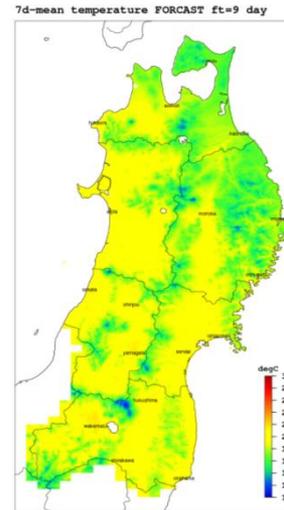
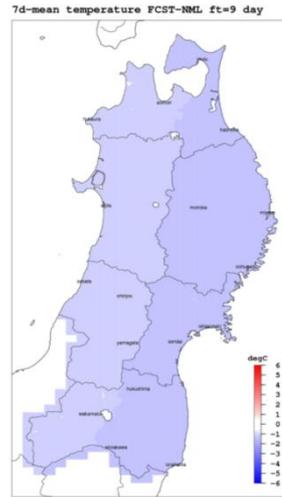
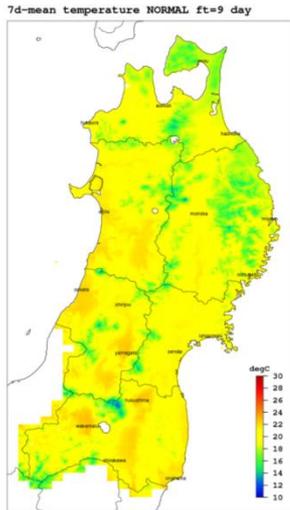


JMA Prediction of
temperature anomalies
(7-day average, regional scale)



**Predicted
temperature**
(1-km scale, 2 weeks ahead)

NARCT
Early warning information
on cold damage in
rice production



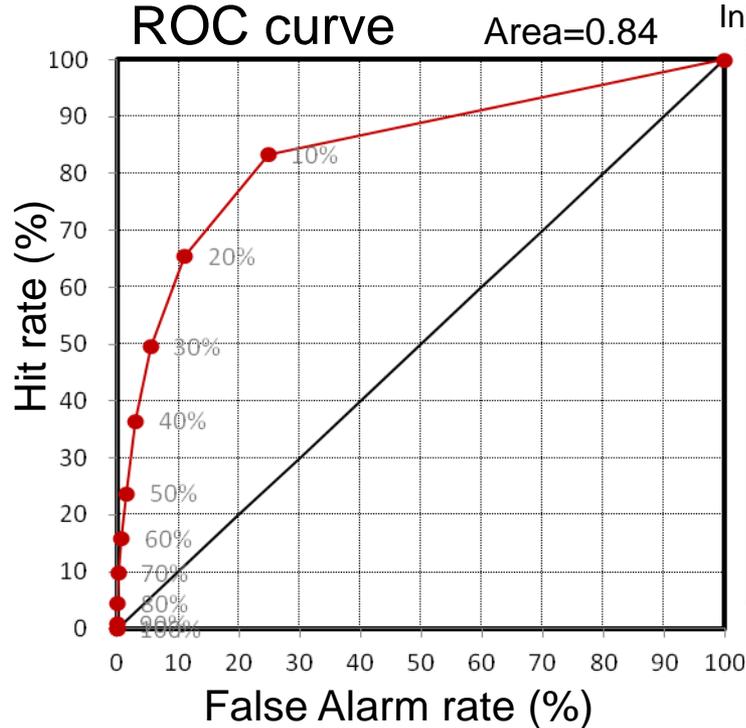
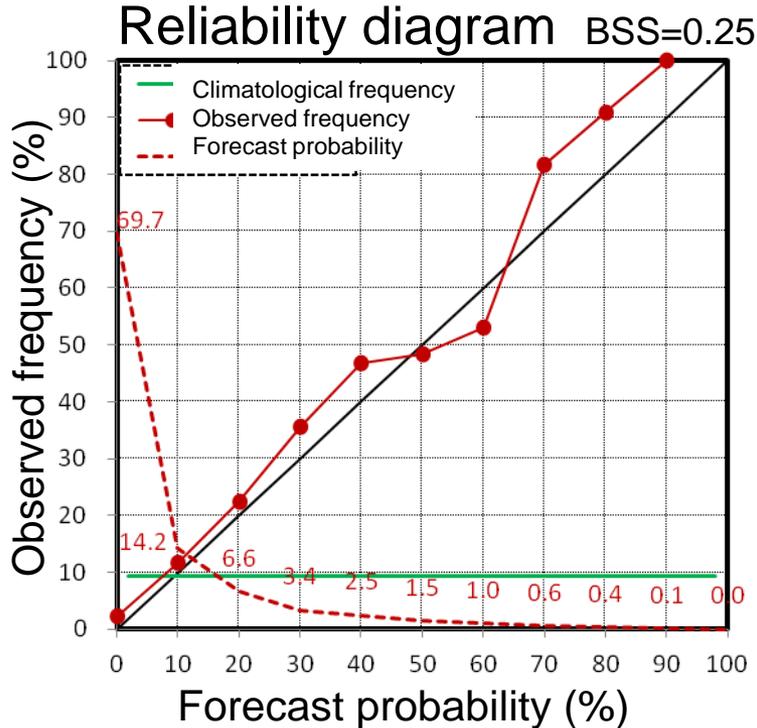
Statistical downscaling

Conversion to user-friendly information

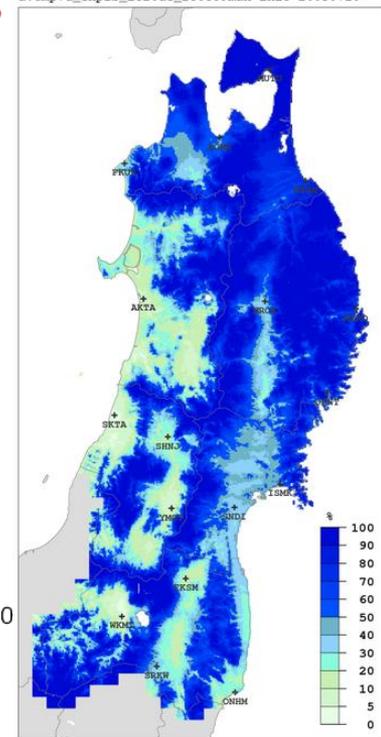
Necessity of management
(to avoid cold damage)

Skill for extreme temperature events

Events: 7-day mean temperature below 20 deg C. (normal: 23 – 25 deg C.)
 Target: 2nd – week (day 9-15)
 Region: The Northern Japan (17 stations)
 Period: From mid-July to early August (1981 – 2010)

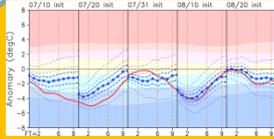


Prob. for below 20 deg C.
 Init. 10 July, 2003



N = 6120

Key Processes in the joint research



@ 2nd-week temperature prediction data
 @ Prediction skill information based on hindcast results

JMA

Dialogue

NARCT

@ Knowledge of climatic impacts on agriculture
 @ User needs

@ Trial provision of early warning information by WEB
 @ Information briefing

@ Requests for improvement

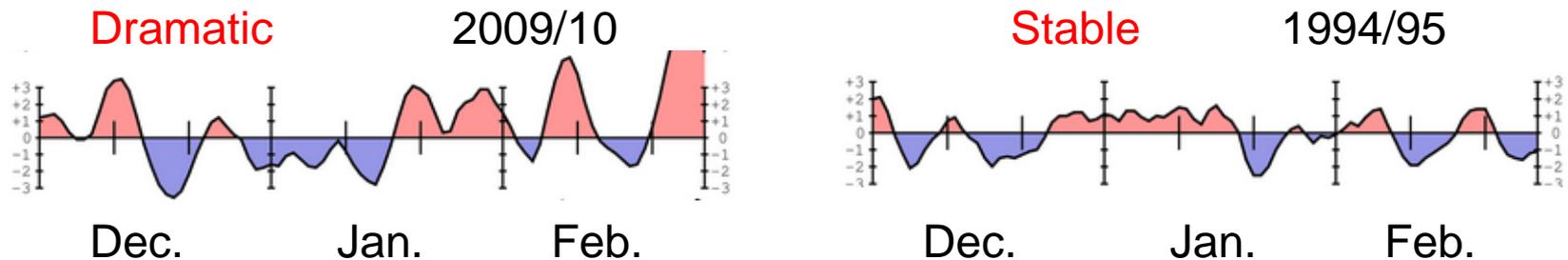
Dialogue

Users



➤ Variability of temperature

- Social impact is huge when the variability of temperature is dramatic, even when mean-temperature is almost the same.



Time series of 5-day running mean temperature anomaly

➤ Extreme Forecast Index (EFI)

- Surface temperature and precipitation

➤ Weekly EPS

- TL479L100 (~40 km) in 2013

➤ Monthly EPS

- TL319L100 (~60 km) in 2013
- Development of integrated Weekly EPS and Monthly EPS (**Seamless system**) is planned.

➤ Seasonal EPS

- AGCM: TL159L60 (80?) (~110 km) in 2014
- OGCM: Tripolar grid, 1deg x 0.3-0.5 deg. 53 levels.

Summary

- JMA introduced the CGCM for operational long-range forecasting in February 2010.
- Its introduction would improve forecast performance, **especially with longer lead times and over the tropical region**, compared to that of the previous AGCM system.
- A characteristic point of JMA's forecasting activities is the forecasters' use of a wide variety of prediction maps in addition to **the statistical results and verifications of the massive hindcast**.
- JMA has started joint research with the national agricultural center **to promote the use of 2nd -week temperature forecasts**.