

Tokyo Climate Center's Activity in Long-range Forecasting Development

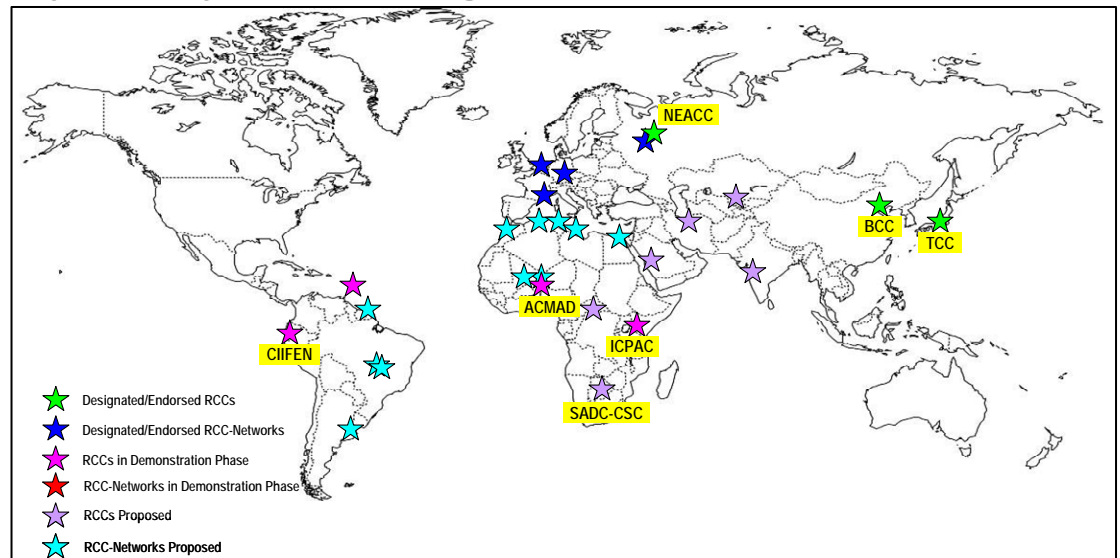
Shotaro TANAKA

Tokyo Climate Center (TCC)

Japan Meteorological Agency (JMA)

Tokyo Climate Center (TCC)

- Established in April 2002 at JMA to support climate services in the Asia-Pacific region.
- Designated as a **GPC** in 2007 and an **RCC (RAII)** in 2009.
- Major activities:
 - providing climate data and products to NMHSs through the website,
 - assisting with capacity building at NMHSs.



JMA's long-range forecast products

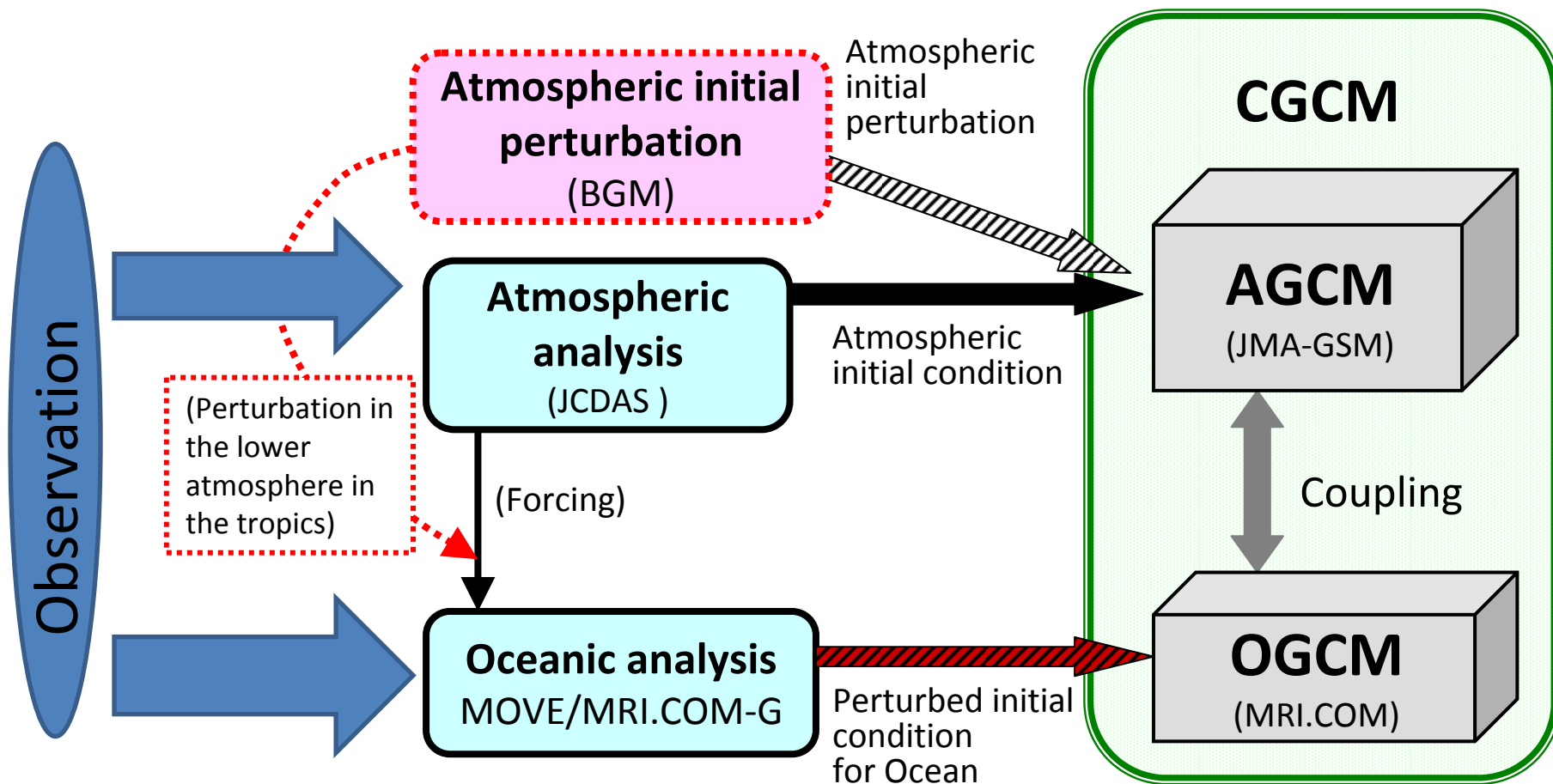
Forecast products	Date of issue
One-month Ensemble Prediction System (EPS) with Atmospheric Global Circulation Model (AGCM)	
One-month forecast	Every Friday
Seasonal Ensemble Prediction System (EPS) with Coupled Global Circulation Model (CGCM)	
Three-month forecast	Around 20th every month
Cold (DJF) /warm (JJA) season forecast	Around 20th of Feb., Mar. and Apr. (for JJA) Around 20th of Sep. and Oct. (for DJF)
El Niño Outlook	Around 15th every month

These products are provided at TCC website:

<http://ds.data.jma.go.jp/tcc/tcc/products/model/index.html>

JMA's Seasonal Prediction System

- Ensemble size: 51 members
- Ensemble method: BGM and LAF

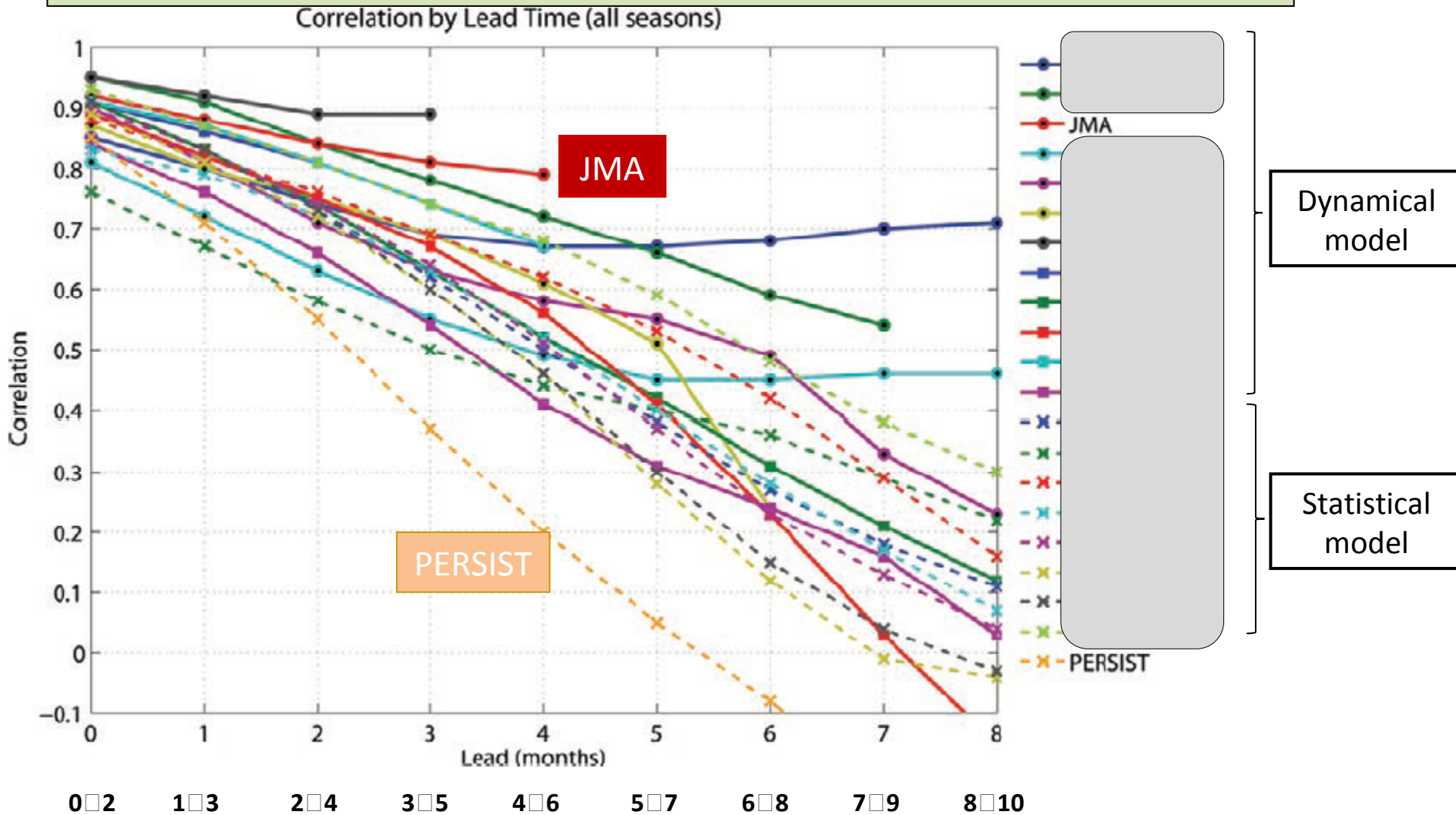


Coupled Global Circulation Model (CGCM)

AGCM	JMA/MRI Unified AGCM <ul style="list-style-type: none">• T_L95L40 (horizontal resolution ~ 180km)
OGCM	MRI.COM <p>Ishikawa <i>et al.</i> (2005)</p> <ul style="list-style-type: none">• 75S-75N, 0-360E (normal sea-ice conditions in the polar regions)• Horizontal resolution (lon: 1 deg, lat: 0.3-1 deg)• Vertical resolution : 50 levels (23 levels in the upper 200m)
Coupler	<ul style="list-style-type: none">• Coupling interval : 1 hour• Flux adjustment for heat and momentum flux

Prediction skill of CGCM (NINO3.4-SST)

- Verification by Barnston et al. 2012, BAMS, 93, 631-651.
- The time period for the verification: 2002-2011 (operational forecasts)



Verification (SVSLRF website)

- **Lead Centre for the Long-Range Forecast Verification System**
 - Australian Bureau of Meteorology (BOM)
 - Meteorological Service of Canada (MSC)
- URL: <http://www.bom.gov.au/wmo/lrfvs/>

Level1. Region scores

Exp. : ROC curves

Parameter : T2m

Season : DJF

Lead time : 1 month

Area : Tropics

Model : JMA

World Meteorological Organization
Lead Centre for the
Long Range Forecast Verification System

Home | Contact
[Disclaimer](#) | [Users Guide](#)
[Documentation](#) | [Verification Maps](#)

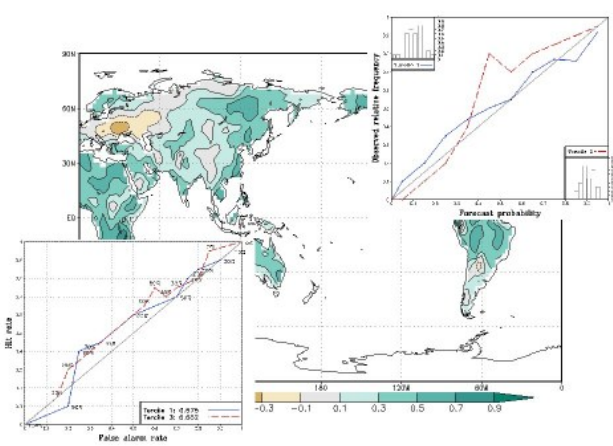
DISCLAIMER
DOCUMENTATION

Participating Met. Agencies.
Lead Centre role.
Documentation and software.
Verifying datasets.
Submitting data.
Glossary.

USERS GUIDE

Variables to be assessed.
Levels of assessment.
Diagnostic measures.
What the Lead Centre provides.
How to submit results.
Format for submitting results.
Model system details.

VERIFICATION MAPS



The Lead Centre provides access to verification datasets, verifying software, documentation of the system, broad technical support, access to the final verification data as well as graphing and display of results.

The [WMO](#) Lead Centre for the SVS-LRF is jointly managed by the [Australian Bureau of Meteorology](#) and the [Meteorological Service of Canada](#).

World Meteorological Organization
Lead Centre for the
Long Range Forecast Verification System

Home | Contact
[Disclaimer](#) | [Users Guide](#) | [Documentation](#) | [Verification Maps](#)

Model: JMA, Parameter: t2m, Area: t, Season: DJF, Lead: 1, Period: 1984-2005, Data: JRA-25

Model: JMA-NUM

Diagnostics
Diagrams

Parameter
Temp at 2m

Verification
ROC Curve

Season
DJF

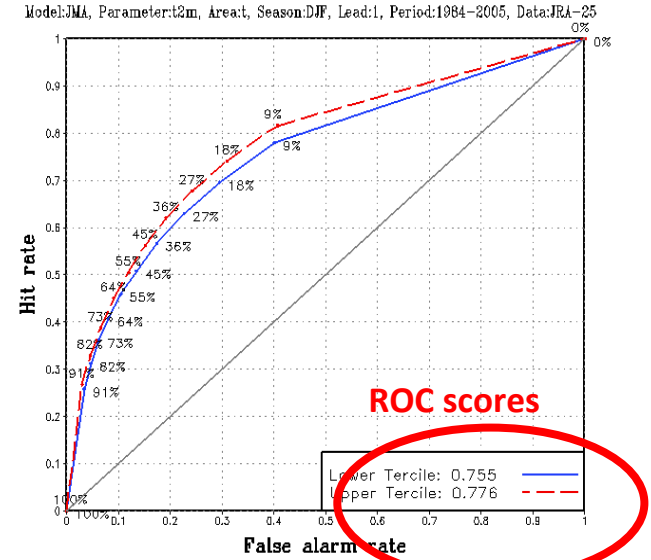
Lead Time
1 month

Area
Tropics

ENSO
All

Submit (Click on Submit if data not loaded)

[View data](#)
[View diagram](#)



ROC scores

Lower Tercile: 0.755
Upper Tercile: 0.776

TCC website

<http://ds.data.jma.go.jp/gmd/tcc/tcc/index.html>

The image shows a screenshot of the TCC website with several callouts pointing to specific sections:

- World climate**: Points to the 'World Climate' link in the top navigation bar.
- El Niño monitoring**: Points to the 'El Niño Monitoring' link in the top navigation bar.
- Training module**: Points to the 'Training Module' link in the top navigation bar.
- Climate system monitoring**: Points to the 'Climate System Monitoring' link in the top navigation bar.
- NWP model prediction (prediction maps, verification maps, GPV data)**: Points to the 'NWP Model Prediction' link in the top navigation bar.
- Climate in Japan**: Points to the 'Climate in Japan' link in the top navigation bar.
- Global warming**: Points to the 'Global Warming' link in the top navigation bar.
- TCC News (newsletter)**: Points to the 'TCC News' link in the bottom left corner.

The website content includes:

- Header**: Japan Meteorological Agency logo, 'Tokyo Global Information System Center', 'WMO Regional Climate Center in RA II (Asia)', and navigation links (TCC home, About TCC, Service Map, Contact us).
- Navigation Bar**: Home, World Climate, Climate System Monitoring, El Niño Monitoring, NWP Model Prediction, Global Warming, Climate in Japan, Training Module, Press release, Links.
- What's New**: RSS feed with updates from April 2013, including 'El Niño Outlook (April - October 2013)', 'Climate in Japan', and 'Climate System Monitoring'.
- Links**: Japan Meteorological Agency, Japanese 25-year ReAnalysis (JRA-25), JRA-25 Atlas, Monthly Climate Statistics for Japan, Tokyo Global Information System Center (GLIS), World Data Center for Greenhouse Gases (WDC), Satellite Imagery of MTSAT-2, Typhoon Center, etc.
- Operational Activities**: Long-range Forecasting, Climate Monitoring, Data Services, and Training.
- Main Products**: ClimatView, Introduction to ITACS, Interactive Tool for Analysis of the Climate System, Monthly Highlights on Climate System (latest issue), GPC Tokyo LRF products, TCC News, STRATALERT, and TCC News (newsletter).

NWP model products at the TCC website

<http://ds.data.jma.go.jp/gmd/tcc/tcc/products/model/index.html>

oyed to increase accuracy, and is applied to probabilistic forecasts. Ensemble prediction maps and verification maps for seasons prediction are available on this page. Experimental products of three-month probability forecast

Main Products

Latest Products

One-month Prediction

- ▶ One-month Prediction (20 Nov 2009)
- ▶ Z500, T850 & Psea (Northern Hemisphere) (20 Nov 2009)
- ▶ Stream function, Velocity potential & Surface air temperature (60N-60S) (20 Nov 2009)
- ▶ Verifications (22 Nov 2009)
- ▶ One month probabilistic forecasts at station points (experimental) (06 Jun 2008) **NEW**

Three-month Prediction

- ▶ Three-month Prediction (17 Nov 2009)
- ▶ Z500, T850 & Psea (Northern Hemisphere) (17 Nov 2009)
- ▶ Stream function, Velocity potential & Surface air temperature (60N-60S) (17 Nov 2009)
- ▶ Verification of recent predictions (06 Nov 2009)
- ▶ Verification of hindcasts
- ▶ Probabilistic Forecasts and Verifications (18 Nov 2009)

Warm/Cold Season Prediction

- ▶ Warm/Cold Season Prediction (18 Oct 2009)
- ▶ Z500, T850 & Psea (Northern Hemisphere) (18 Oct 2009)
- ▶ Stream function, Velocity potential & Surface air temperature (60N-60S) (18 Oct 2009)
- ▶ Verification of hindcasts

Model Descriptions

- ▶ Model Outlines
- ▶ Operations for Extended-range Forecast Model
- ▶ Operations for Long-range Forecast Model

Download GPC Long-range Forecast (LRF) Products

- ▶ Download Grid Point Value (GPV) File

Only registered NMHSs can access this page.

• When receiving an e-mail entitled "[JDDS] Your Password will expire in a few days" from JDDS_admin (JDDS_admin@data.jma.go.jp), you are kindly requested to change your password at <http://ds.data.jma.go.jp/changepasswd/>. Please note that the

Latest Products:

forecast maps,
probabilistic prediction maps,
verification maps.

One-month prediction

Three-month
prediction

Warm/cold season
prediction

Download gridded
data
(including hindcast)

Model
Descriptions
(Model outline)

Forecast maps (Ensemble mean)

forecast map

forecast period

3 months mean

initial date

2013.10.13.00Z

area

60N-60S

Asia

data

ensemble mean

forecast

ensemble mean

forecast (mask [mss < 0]
area)

mss : Mean Square Skill Score

spread and anomaly

corresponding verification

[forecast]

Contour show forecast,
and shaded pattern show
anomalies. Contour
interval

CHI200: $2 \times 1.0E6 m^2/s$

RAIN: 2mm/day

Z500: 60m/area: 60N-60S, 20m

(area: Asia)

TS: 4C

SST: 2C

PSI200: $16 \times 1.0E6 m^2/s$

(area: 60N-60S), $4 \times 1.0E6 m^2/s$

(area: Asia)

PSI850: $5 \times 1.0E6 m^2/s$ (area: 60N-

60S), $2 \times 1.0E6 m^2/s$ (area: Asia)

PSEA: 4hPa

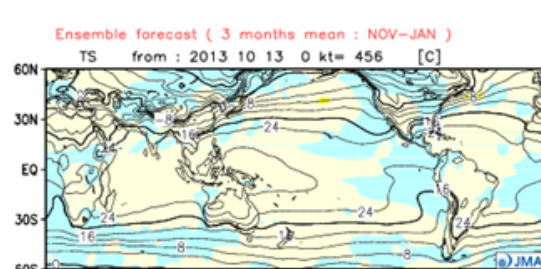
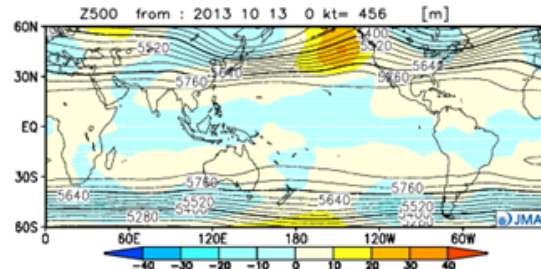
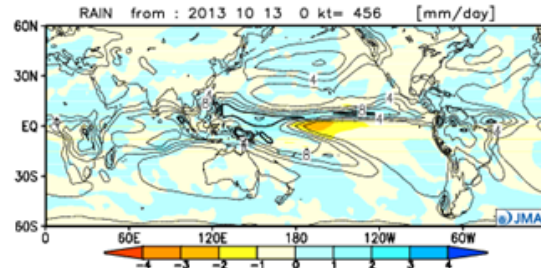
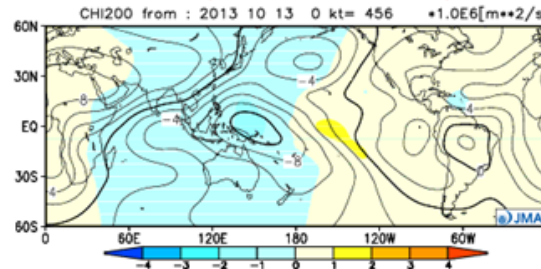
[spread]

Contour show spread, and
shaded pattern show
anomalies. Contour
interval

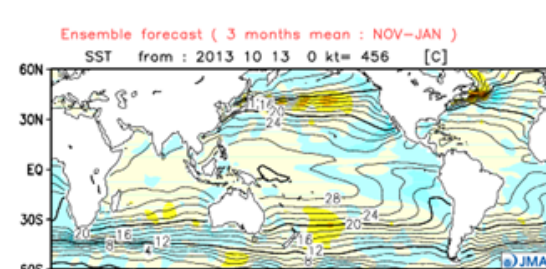
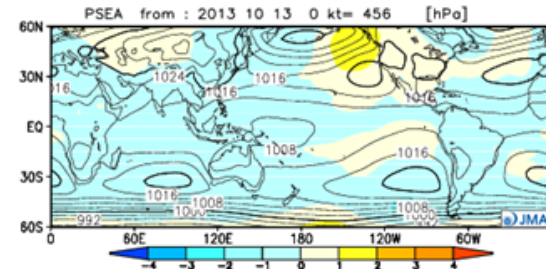
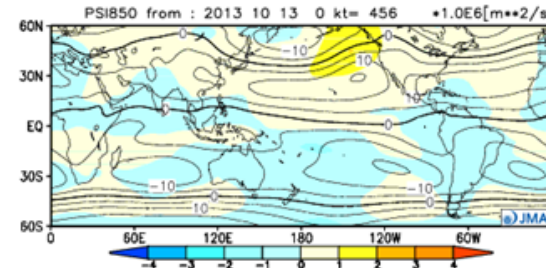
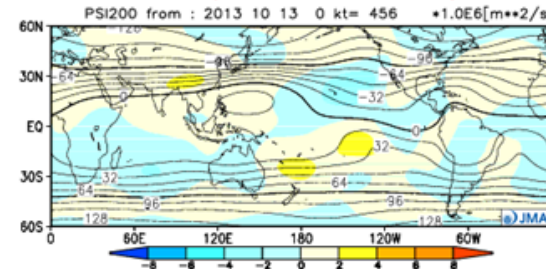
CHI200: $1 \times 1.0E6 m^2/s$

RAIN: 1mm/day

Ensemble forecast (3 months mean : NOV-JAN)



Ensemble forecast (3 months mean : NOV-JAN)



CHI200

RAIN

Z500

Tsurf

PSI200

PSI850

SLP

SST

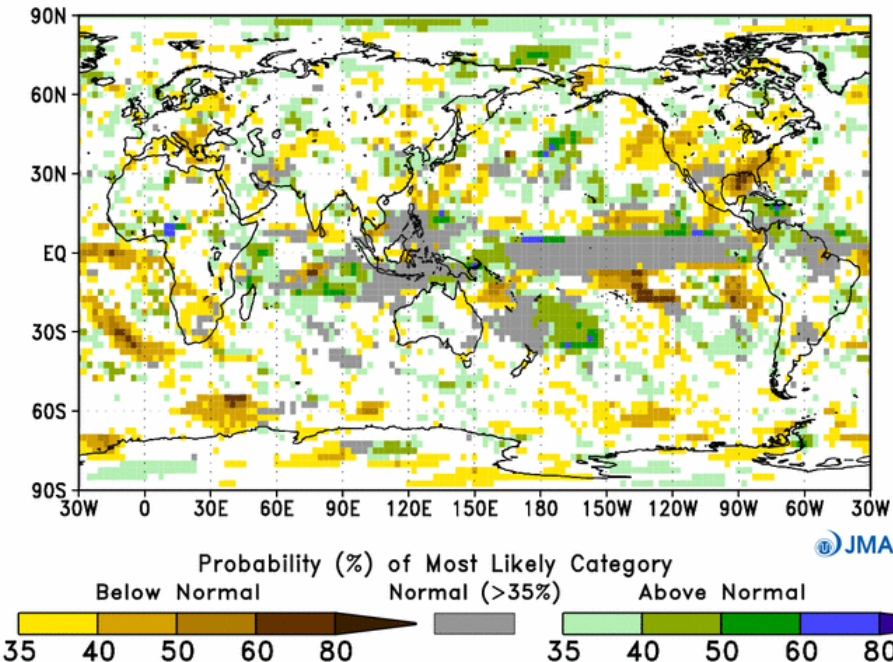
NDJ 2013/2014 (initial: October 2013)

Probabilistic prediction maps

- These maps show the probability of most likely category (tercile).

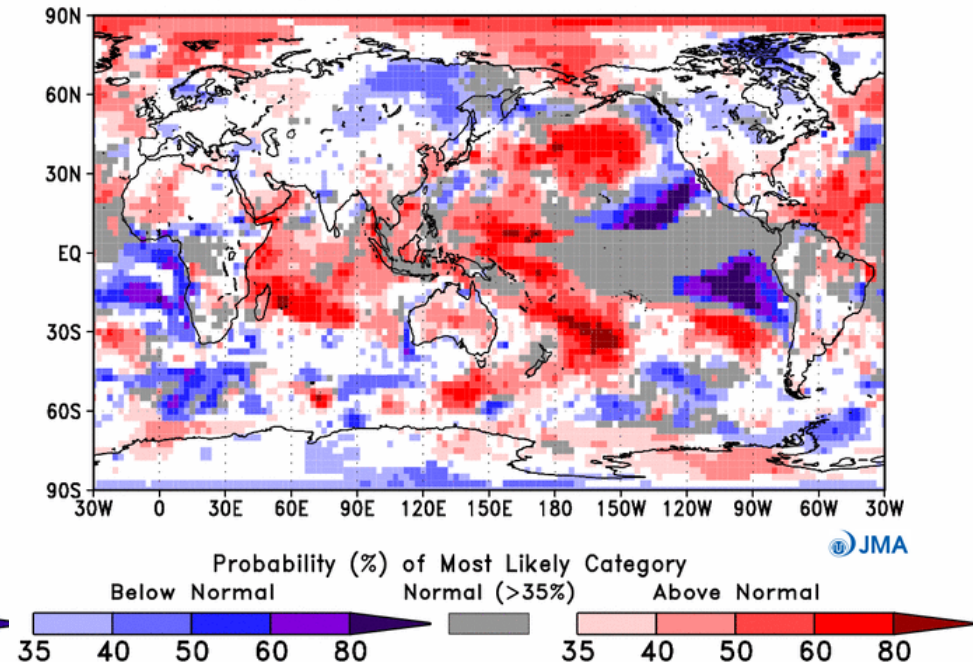
Precipitation

JMA Seasonal Forecast (Forecast initial date is 13 10 2013)
Most likely category of Precipitation for NDJ 2013



Surface temperature

JMA Seasonal Forecast (Forecast initial date is 13 10 2013)
Most likely category of Surface Temperature for NDJ 2013



NDJ 2013/2014 (initial: October 2013)

Verification maps

Verification map of the forecast

Analysis
(observation)

Forecast
(ensemble mean)

Error

forecast period

3 months mean

initial date

2012.10.13.00Z

element

stream function

velocity

potential

Z500,T850,PSEA

850hPa(top)

200hPa(middle)

precipitation

(bottom)
(Shaded patterns show anomalies in left and middle figures, and that show errors in right figures.)

[Contour interval]

PSI850: $5 \times 10^6 \text{ m}^2/\text{s}$

PSI200: $20 \times 10^6 \text{ m}^2/\text{s}$

CHI850: $2 \times 10^6 \text{ m}^2/\text{s}$

CHI200: $2 \times 10^6 \text{ m}^2/\text{s}$

PRECIP(RAIN):

4mm/day

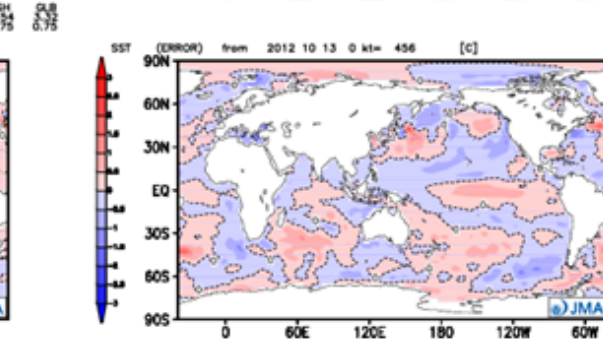
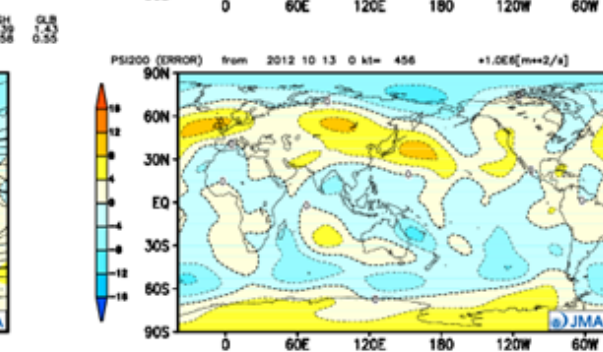
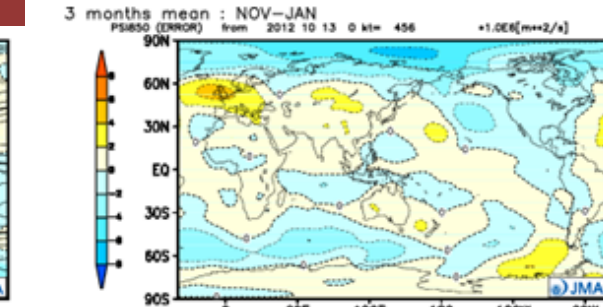
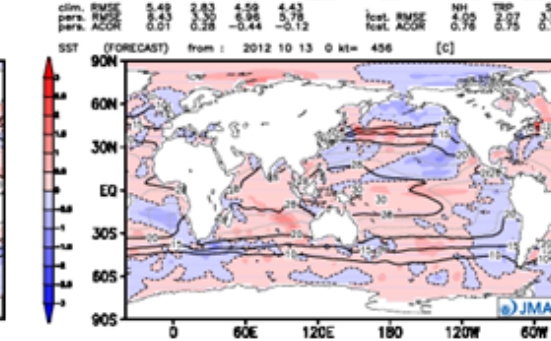
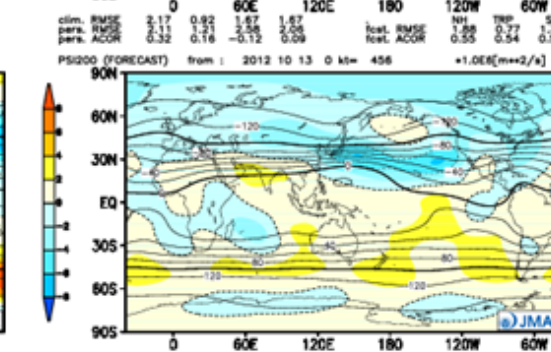
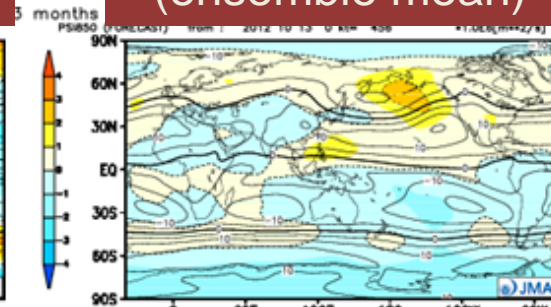
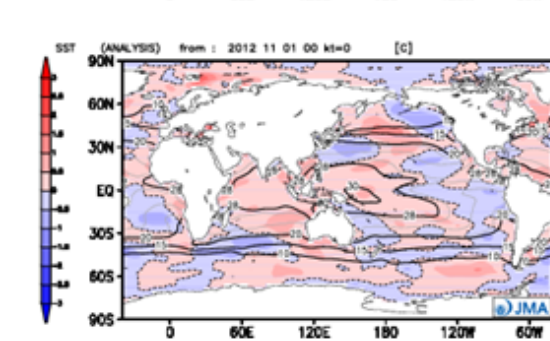
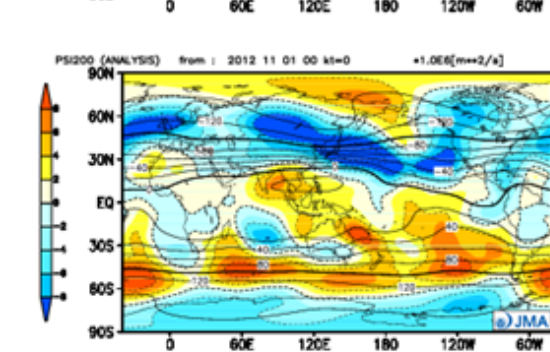
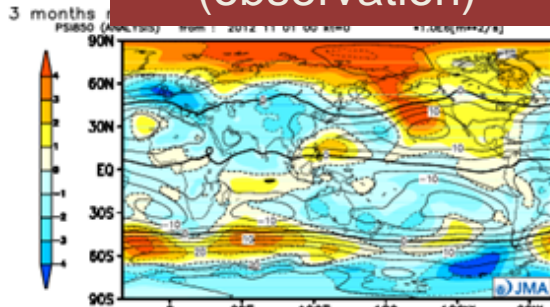
OLR: 20 W/m^2

Z500: 120m

T850: 4C

PSEA: 4hPa

kt : lead time(hour)



Future plan

The next version of CGCM are being developed to put it into operation in two years.

- Next version of CGCM

- AGCM:

- Higher resolution (TL95L40 -> TL159L60)
 - Improvement of model physics
 - Introduction of stochastic parameterization to improve perturbation for ensemble forecasting

- OGCM:

- Widening of target area (75N-75S -> the whole globe)
 - Improvement of model physics
 - Introduction of sea-ice model

Thank you!

Supplements

(seasonal forecast system)

Operational global NWP models at JMA

Prediction model and system	Main target	Horizontal resolution
Global Spectral Model (GSM)	• Short-range forecasting	20km Global
Typhoon EPS (TEPS)	• Typhoon forecasting	55km Global
One-week EPS (WEPS)	• One-week forecasting	60km Global
One-month Ensemble Prediction System (EPS) with Atmospheric Global Circulation Model (AGCM)	<ul style="list-style-type: none"> • Early warning Information on extreme events • One-month forecasting 	110km Global
Seasonal EPS with Coupled Global Circulation Model (CGCM)	<ul style="list-style-type: none"> • Seasonal forecasting • El Niño outlook 	180km Global

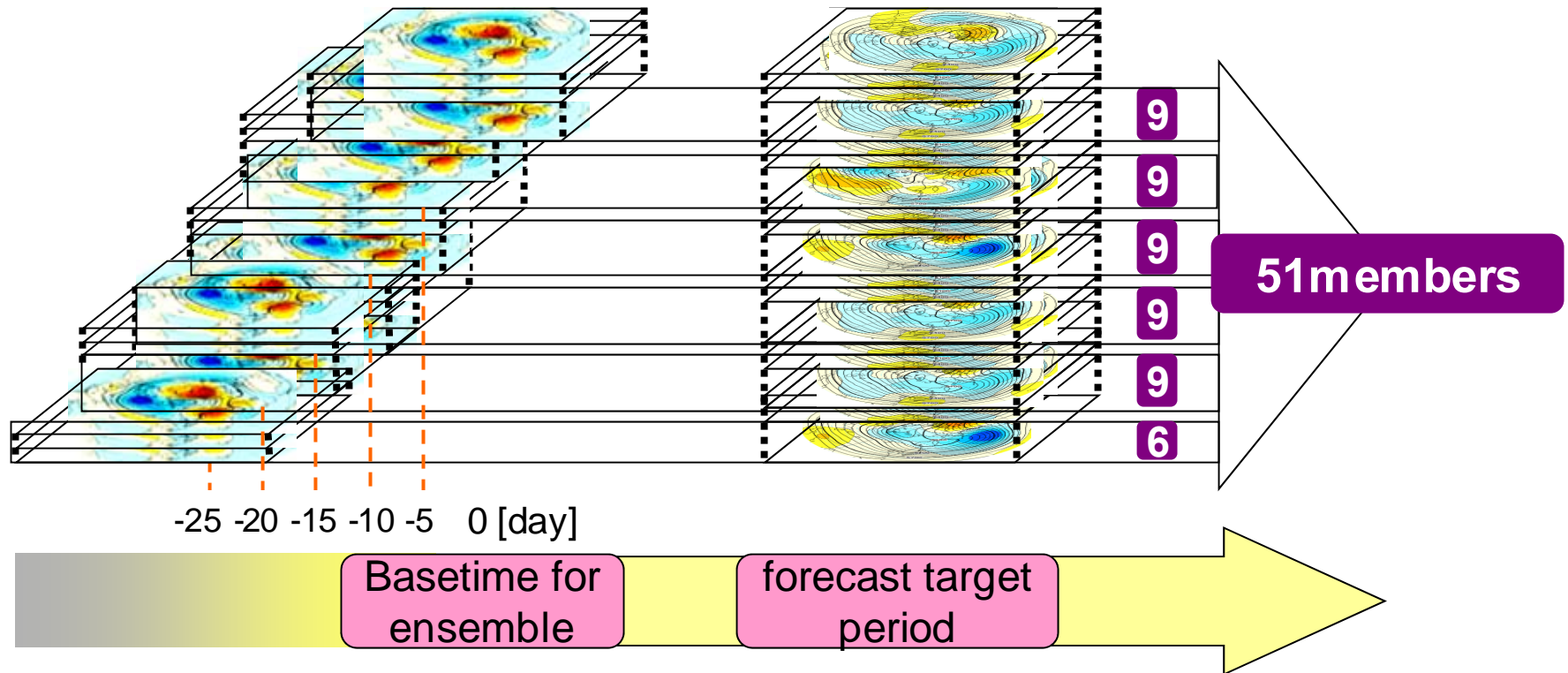
Ensemble prediction system (EPS) for seasonal forecasts

	One-month EPS	Seasonal EPS
Model	AGCM	CGCM
Resolution	Horizontal: approx. 110 km (TL159) Vertical: 60 levels (~0.1 hPa)	* Atmospheric component Horizontal: approx. 180 km (TL95) Vertical: 40 levels (~0.4hPa) * Oceanic component Horizontal: 1.0° longitude, 0.3–1.0° latitude (75°S – 75°N) Vertical: 50 levels
Forecast range	Up to 34 days	7-month (initial month of Sep., Oct., Feb., Mar., Apr) 4 months (other initial month)
SST	Persisted anomaly	Prognostic variable of CGCM
Sea ice	Climatology	
Ensemble method	Combination of Breeding of Growing Modes (BGM) and Lagged Average Forecast (LAF)	
Ensemble size	50 (25 BGMs & 2 days with 1-day LAF)	51 (9 BGMs & 6 days with 5-day LAF)
Frequency of operation	Every Wednesday and Thursday	Every 5 days
Frequency of model product creation	Once a week Every Friday	Once a month Around the 20 th of every month

Schema of aggregation for the ensemble members in the EPS for long-range forecasting of JMA

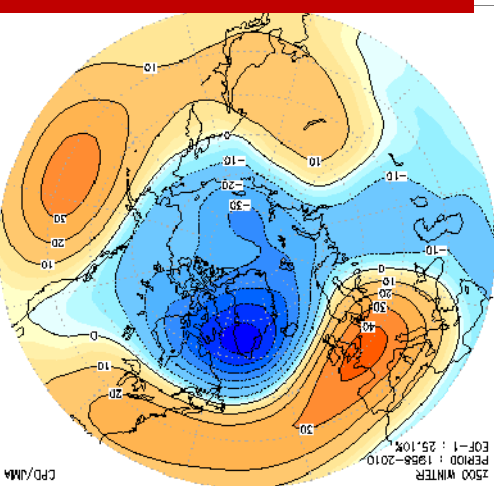
EPS adopts combination of the initial perturbation method and the Lagged Average Forecasting (LAF) method.

- to disperse computing resources
- to get ensemble spread

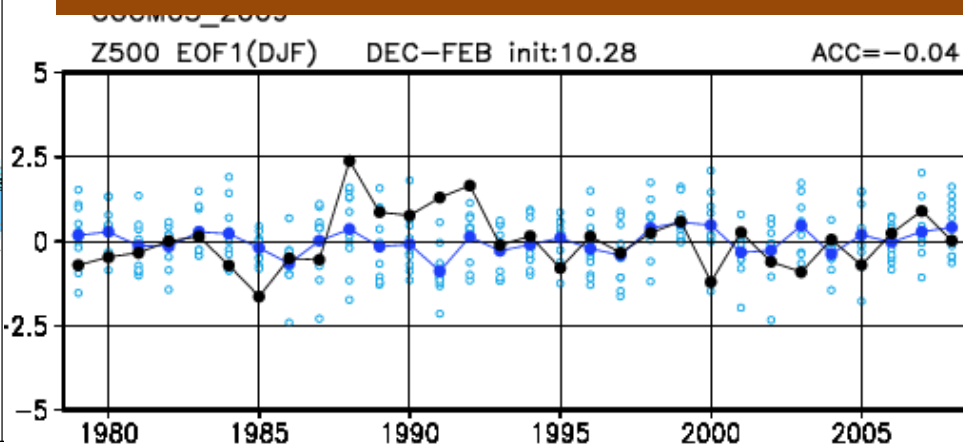


Prediction skill of CGCM (N.H. winter circulation)

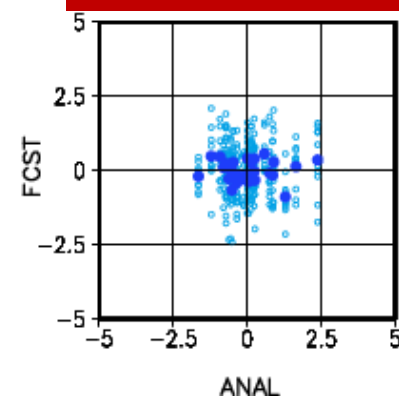
Z500 EOF-1 (DJF)



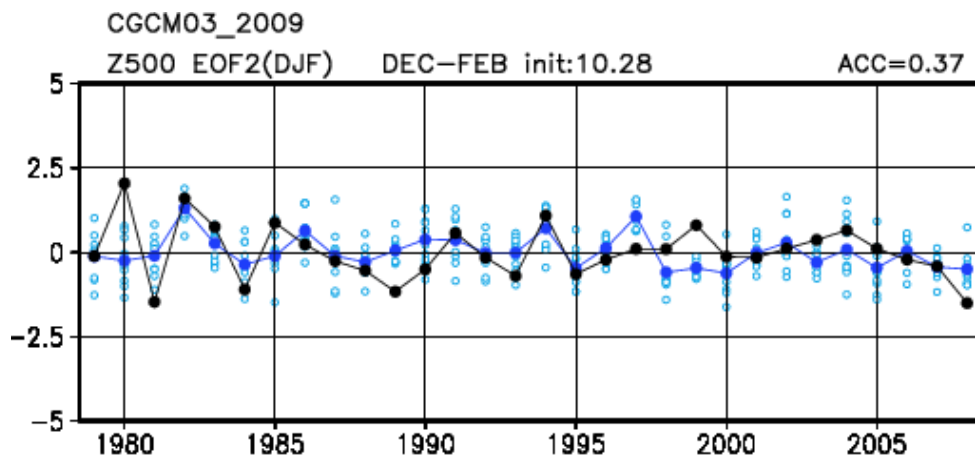
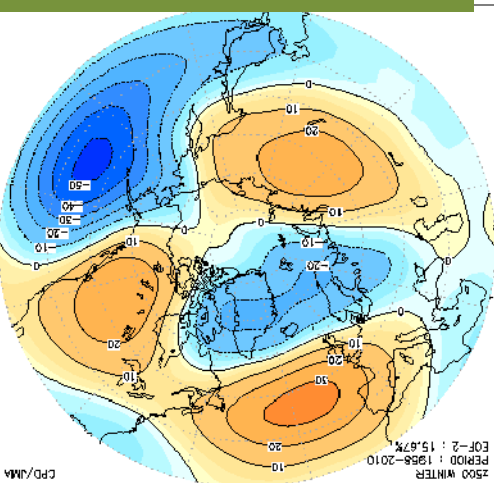
Anomaly Correlation Coefficient (ACC) between hindcast (1-month lead) and observation



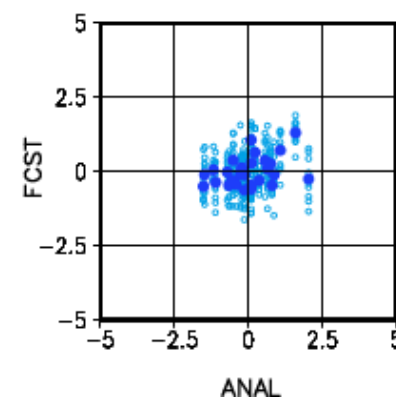
ACC: -0.04



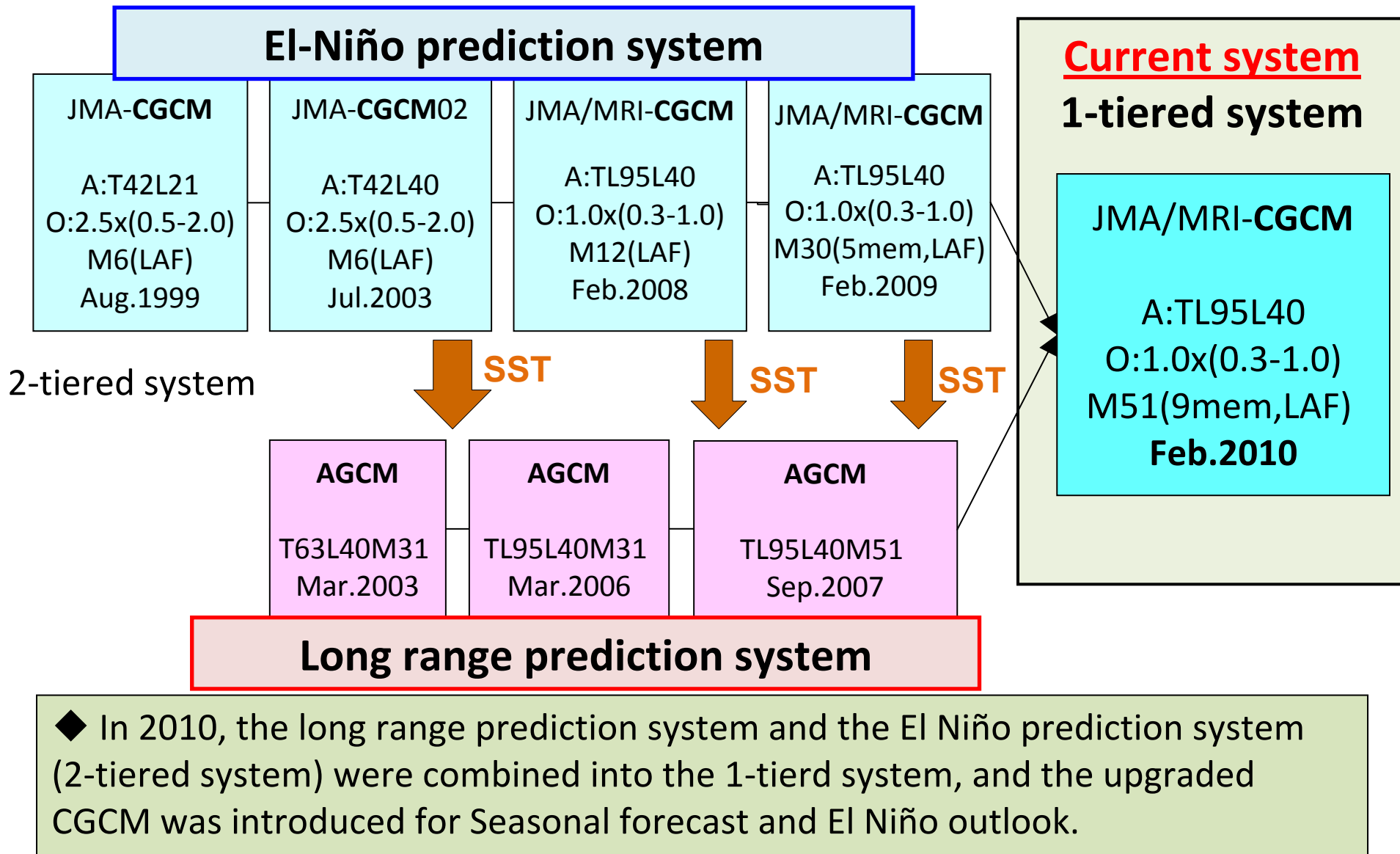
Z500 EOF-2 (DJF)



ACC: 0.37



History of JMA's models for seasonal and El Niño outlook



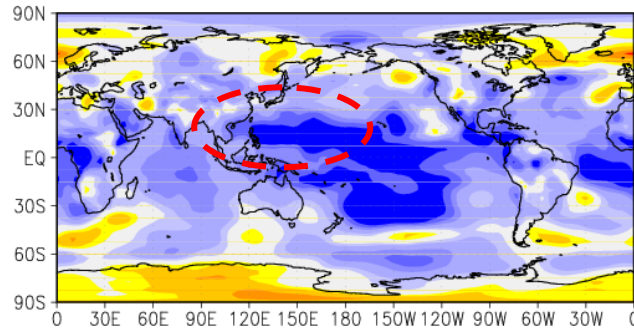
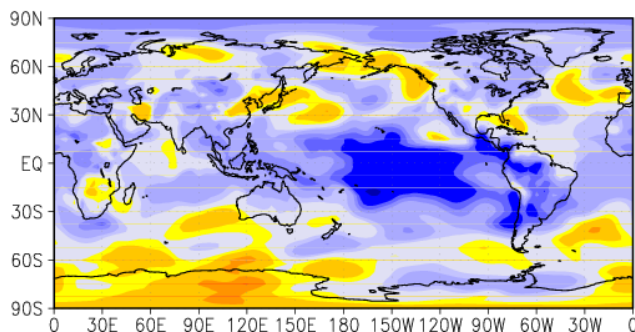
Improvement of prediction skill by introduction of CGCM

Anomaly Correlation Coefficient (ACC), JJA forecast (initial: February)

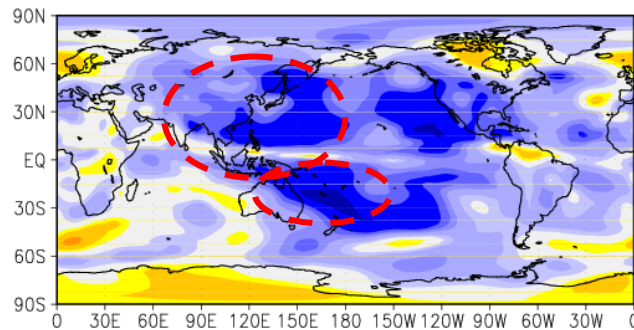
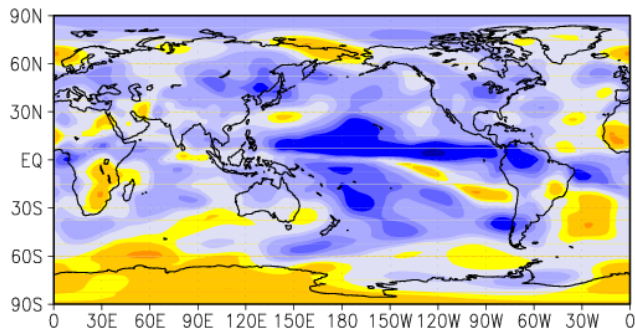
AGCM

CGCM

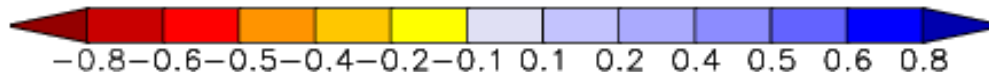
SLP



850hPa
stream
function



bad



good

◆ Improvement over Asian monsoon region and around SPCZ

Supplements

(prediction products on TCC website)

TCC website

<http://ds.data.jma.go.jp/gmd/tcc/tcc/index.html>

The image shows a screenshot of the TCC website with several callouts pointing to specific sections:

- world climate**: Points to the 'World Climate' link in the top navigation bar.
- El Niño monitoring**: Points to the 'El Niño Monitoring' link in the top navigation bar.
- climate system monitoring**: Points to the 'Climate System Monitoring' link in the top navigation bar.
- NWP model prediction**: Points to the 'NWP Model Prediction' link in the top navigation bar.
- climate in Japan**: Points to the 'Climate in Japan' link in the top navigation bar.
- global warming**: Points to the 'Global Warming' link in the top navigation bar.
- Download gridded data**: Points to the 'Download gridded data' link in the 'What's New' section.
- TCC News (newsletter)**: Points to the 'TCC News' link in the bottom left corner.

The website header includes the JMA logo, the text 'WMO Regional Climate Center in RA II (Asia)', and the WMO logo. The navigation bar contains links: Home, World Climate, Climate System Monitoring, El Niño Monitoring, NWP Model Prediction, Global Warming, Climate in Japan, Training Module, Press release, and Links. The main content area is divided into sections: What are WMO RCCs?, What's New (with RSS feed), Links, and Main Products. The 'What's New' section lists updates from April 2013, including information on El Niño Outlook, Climate in Japan, and Climate System Monitoring. The 'Main Products' section includes links to ClimatView, Introduction to ITACS, GPC Tokyo LRF products, and TCC News. The 'Links' section lists various regional and international organizations.

El Niño Monitoring & Outlook

JMA operates the Ocean Data Assimilation System and the El Niño Prediction System (an ocean-atmosphere coupled model) for monitoring and prediction of El Niño-Southern Oscillation (ENSO).

Monthly diagnosis reports, ENSO monitoring products, ENSO indices and El Niño outlooks are available on TCC website.

El Niño Outlook

(October 2013 - April 2014)

Last Updated: **10 October 2013**

- ENSO neutral conditions continued in the equatorial Pacific.
- It is likely that ENSO neutral conditions will continue in the northern hemisphere autumn and winter.

[El Niño / La Niña]

In September 2013, the NINO.3 SST was near normal with a deviation of -0.2°C ([Table](#) and [Fig.1](#)). SSTs were above normal in the western equatorial Pacific ([Fig.2](#) and [Fig.4](#)). Subsurface temperatures were above normal in the western equatorial Pacific ([Fig.3](#) and [Fig.5](#)). Easterly winds in the lower troposphere were stronger than normal in the central part ([Fig.7](#) and [Fig.8](#)). On the other hand, in the central and eastern equatorial Pacific, deviations from normals of SSTs and subsurface ocean temperatures were small. This means that conditions in the northern hemisphere summer, which were similar to those observed during the past La Niña events, became unclear, and ENSO neutral conditions continued in the equatorial Pacific.

The JMA's El Niño prediction model predicts that the NINO.3 SST will be near normal during the prediction period ([Fig.9](#)). Since subsurface ocean temperature anomalies in the central and eastern equatorial Pacific were small, it is considered that SSTs in the eastern part will not be affected significantly in the months ahead by the subsurface ocean conditions. In conclusion, it is likely that ENSO neutral conditions will continue in the northern hemisphere autumn and winter.

[Western Pacific and Indian Ocean]

The area-averaged SST in the tropical western Pacific (NINO.WEST) region was above normal in September ([Fig.1](#)). It is likely that the NINO.WEST SST will come closer to normal in the months ahead, and will be near normal during the northern hemisphere winter ([Fig.10](#)).

The area-averaged SST in the tropical Indian Ocean (IOBW) region was near normal in September ([Fig.1](#)). It is likely that the IOBW SST will be near normal or below normal during the northern hemisphere autumn and winter ([Fig.11](#)).

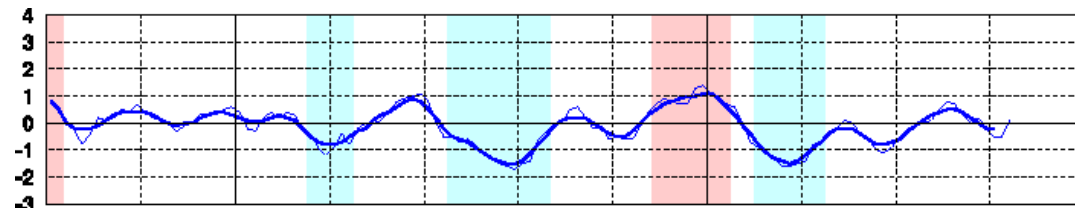
NEACOF-5, October 29 - November 1, 2013

El Niño Monitoring & Outlook

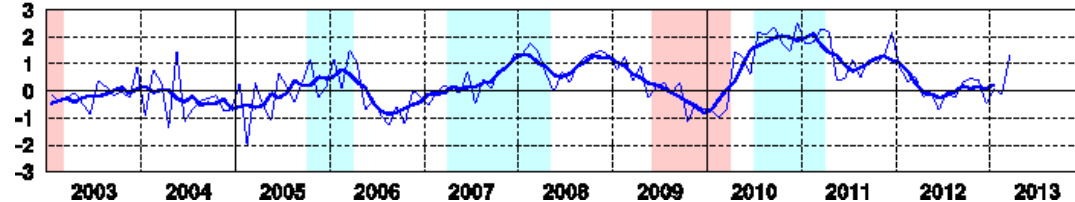
(2) El Niño Monitoring Indices



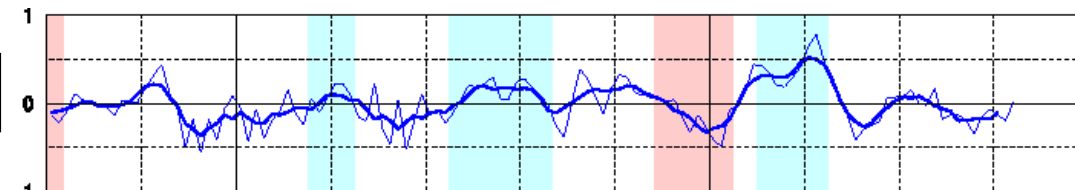
NINO.3



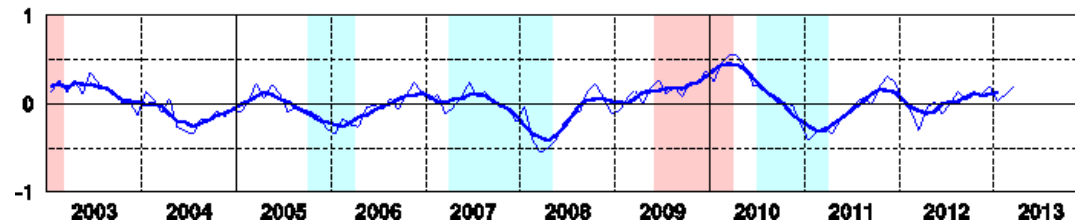
SOI



NINO.WEST



IOBW



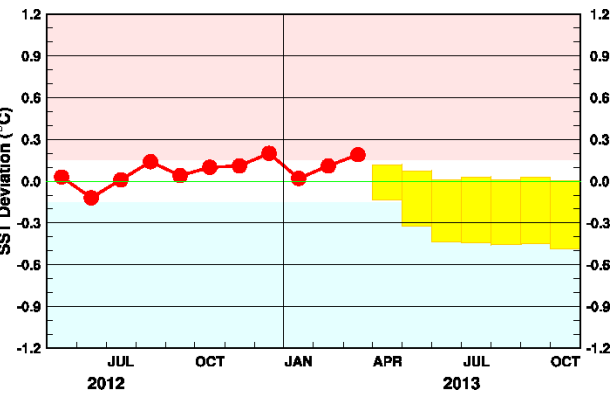
NEACOF-5, October 29 - November 1, 2013

El Niño Monitoring & Outlook

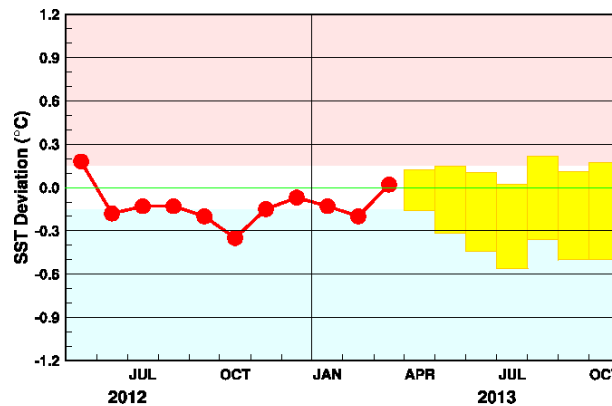
(3) Model forecast of SST anomalies for Niño regions



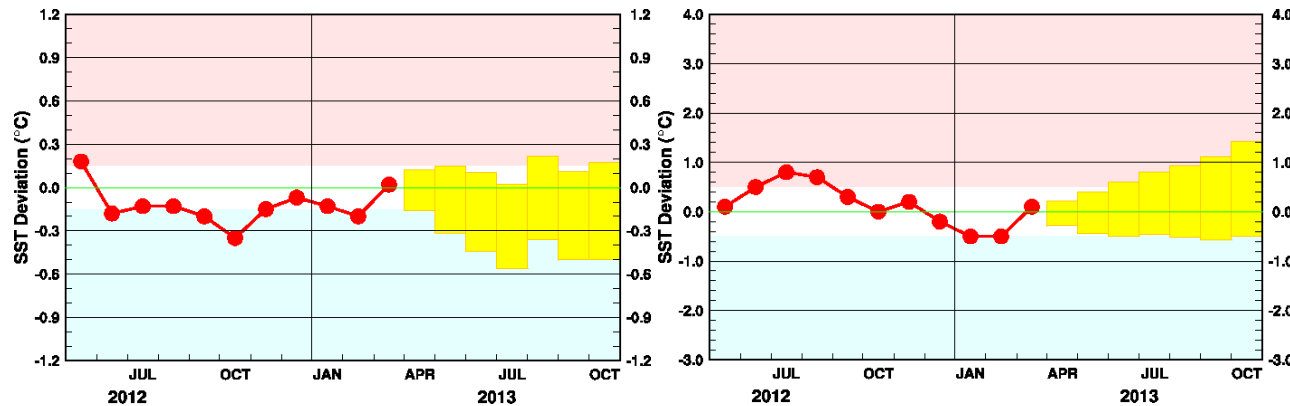
NINO.3



NINO.WEST



IOBW



Products available on TCC website

- **Maps**

- Ensemble mean forecast map
- Probabilistic forecast map
- Verification (near real-time, hindcast)

- **Gridded data (binary)**

- Operational run
- Hindcast
 - Ensemble statistics
 - All ensemble members

(Only registered NMHSs can access.)

If you have any questions about ID and/or password, please e-mail to:

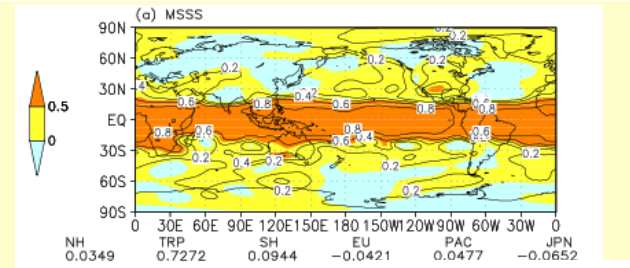
tcc@met.kishou.go.jp

Verification of hindcast

Verification of hindcast based on WMO Standard Verification System (SVS)

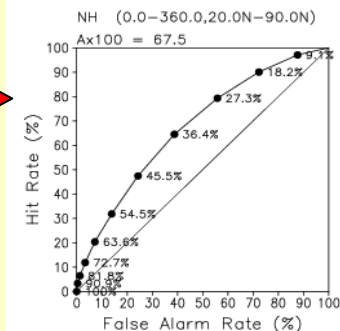
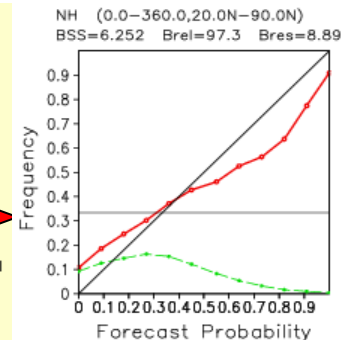
Verification of deterministic forecasts

- Mean Square Skill Score
[RAIN](#) | [T2m](#) | [PSEA](#) | [Z500](#) | [T850](#)
[Dependence of MSSS on Initial date](#)
- 3 by 3 contingency tables (in Japan)
 (Category : Below Normal, Near Normal, Above Normal)
[RAIN](#) | [T2m](#) | [PSEA](#) | [Z500](#) | [T850](#)



Verification of Probabilistic forecasts

- Reliability diagrams (Aggregated verification)
 (Anomaly > 0, Below Normal, Near Normal, Above Normal)
[RAIN](#) | [T2m](#) | [PSEA](#) | [Z500](#) | [T850](#)
- Relative Operating Characteristics
 - ROC curves, ROC areas (Aggregated verification)
 (Anomaly > 0, Below Normal, Near Normal, Above Normal)
[RAIN](#) | [T2m](#) | [PSEA](#) | [Z500](#) | [T850](#)
[Dependence of ROC areas on Initial date](#)
 - ROC areas (Grid point verification)
 (Anomaly > 0, Below Normal, Near Normal, Above Normal)
[RAIN](#) | [T2m](#) | [PSEA](#) | [Z500](#) | [T850](#)



Animation of one-month prediction

TCC provides animation of JMA one-month prediction on an experimental basis.

Animation of the JMA One-month EPS (7-days running mean)

NOTICE (Experimental Product)

This product is not identical with the formal products (e.g. Weekly forecast maps, gridded datasets (GPVs)).
Ensemble size for ensemble mean is half (=25 members) and only forecasts with the initial date on Thursday are used, while the formal products are produced using 50 members (25 members * 2 initial dates (Wednesday and Thursday)).

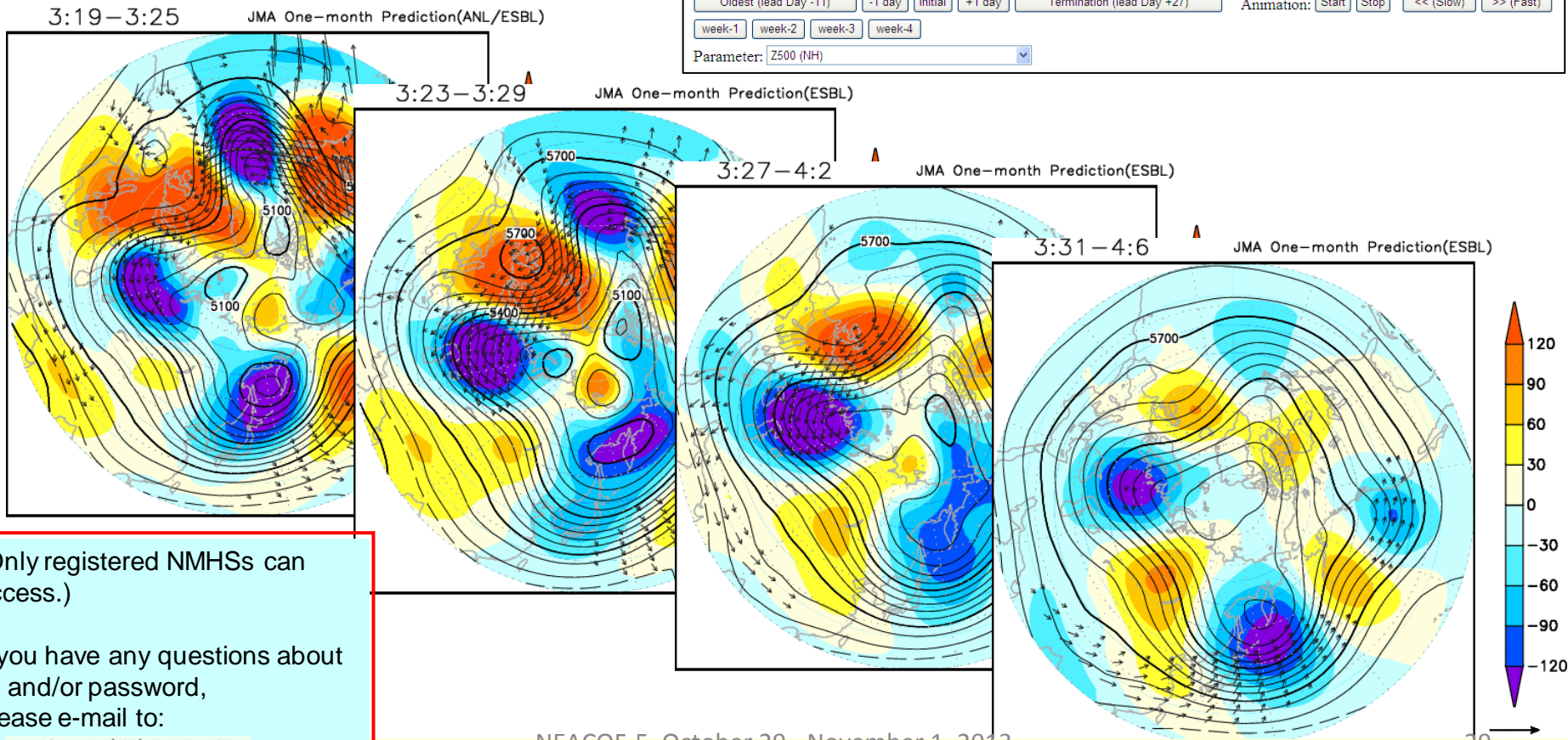
Initial date: 2012.03.22 Forecast lead time: Day -11

Setting for Animation

Oldest (lead Day -11) -1 day Initial +1 day Termination (lead Day +27) Animation: Start Stop << (Slow) >> (Fast)

week-1 week-2 week-3 week-4

Parameter: Z500 (NH)



NEACOF-5, October 29 - November 1, 2013

<http://ds.data.jma.go.jp/tcc/tcc/gpv/model/Anime.1mE.experiment/anime.e.php>

Binary gridded data (GPV)

(GPV: Grid Point Value)

Grid point value products of Three month Outlook in GRIB2 format (All ensemble members)
WMO Regional Climate Center in RA II (Asia)

• **download** Grid point value (GPV) data.

• Each file is located in a time. Each file name is r...

• Data description

Index of /model/gpv/4mE/MGPV

Index of /model/gpv/4mE/MGPV/201210

Name	Size
Parent	
201210/	
201207/	
201208/	
201207/	
201206/	
201205/	
201204/	
201203/	
201202/	
Parmbt Directory	
h2_Patt_mb.201210	3.1M
h2_Ptt_mb.201210	3.1M
p100_Pahh_mb.201210	3.1M
p100_Phh_mb.201210	3.1M
p200_Pahh_mb.201210	3.1M
p200_Patt_mb.201210	3.1M
p200_Pawu_mb.201210	3.1M
p200_Pawv_mb.201210	3.1M
p200_Phh_mb.201210	3.1M
p200_Ptt_mb.201210	3.1M
p200_Pwu_mb.201210	3.1M
p200_Pwv_mb.201210	3.1M
p300_Pahh_mb.201210	3.1M
p300_Phh_mb.201210	3.1M

Download Gridded Data files

Notice

- The update of the weekly data (ensemble mean) was terminated in December 2011.
- Animation of One-month Model Prediction is experimental and not identical with the formal products (e.g. Weekly forecast maps, gridded datasets).
- TCC starts providing daily Gridded data (ensemble mean) of One-month

Main Products

NWP Model Prediction

1-month (09 Nov 2012)

- Daily Statistics
- All Members
- Weekly Statistics (until D

3-month (18 Oct 2012)

- Statistics
- **All Members**

7-month (18 Oct 2012)

- Statistics
- All Members

NECOF-5, October 29 - November 1, 2013

Each files are available to download on your computer.
(Need to register)

<http://ds.data.jma.go.jp/tcc/tcc/gpv/index.html>

GPV data of 3-month forecast

Parameters	<ul style="list-style-type: none">● Ensemble mean: U200, V200, Z500, U850, V850, T850, mean sea level pressure, precipitation, 2m temperature● SST used as boundary conditions
Temporal resolution	1-month and 3-month mean
Spatial coverage and resolution	global, $2.5^{\circ} \times 2.5^{\circ}$
Lead time	<ul style="list-style-type: none">● Monthly mean forecast : about 0.5, 1.5, and 2.5 months● Three-month mean forecast : about 0.5 month
Issuance day	Around 20th of every month
Data format	GRIB2
Calibration	Model normals based on hindcast from 1984 to 2005

GPV data of Cold/warm season forecast

Parameters	<ul style="list-style-type: none"> ●Ensemble mean: U200,V200,Z500,U850,V850,T850, mean sea level pressure, precipitation, 2m temperature ●Ensemble members: Z100,Z200,U200,V200,T200,Z300,Z500,U500,V500,T500,Z850,U850,V850,T850,RH850,Q850, mean sea level pressure, precipitation, 2m temperature ●SST used as boundary conditions
Temporal resolution	<ul style="list-style-type: none"> ●Ensemble mean: 1-month and 3-month mean ●Ensemble members: 1-month mean
Spatial coverage and resolution	global, $2.5^{\circ} \times 2.5^{\circ}$
Lead time	<ul style="list-style-type: none"> ●Ensemble mean: between about 1.5 and 3.5 months ●Ensemble members: between about 0.5 and 5.5 months
Issuance day	Around 20th in Sep., Oct., Feb., Mar., and Apr.
Data format	GRIB2
Calibration	Model normals based on hindcast from 1984 to 2005