Diagnosis of the atmospheric circulation in winter 2008/2009 Using newly developed software, Interactive Tool for Analysis of the Climate System (ITACS) and LRF data on the TCC Website

HAYASHI Kumi
林　久美

Tokyo Climate Center, Climate Prediction Division,
Japan Meteorological Agency (TCC/JMA)

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

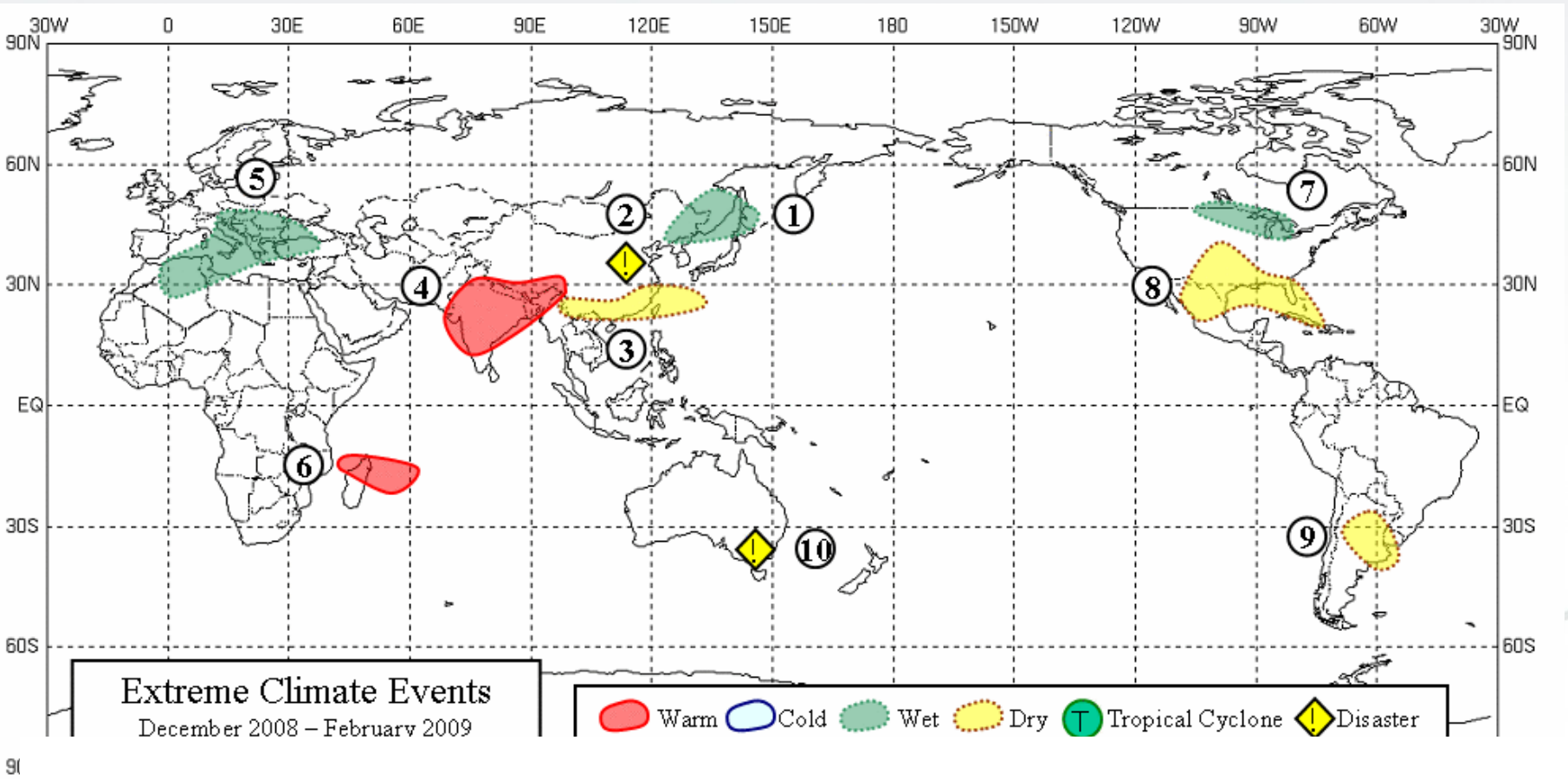
Outline

1. Climate in 2008/09 winter
2. Predictability of cold surges over east Asia in January
3. Diagnosis of the atmospheric circulation for the warm condition in February using ITACS
4. Summary

Appendix: Preliminaries to JMA's new coupled seasonal model

1. Climate in 2008/09 winter

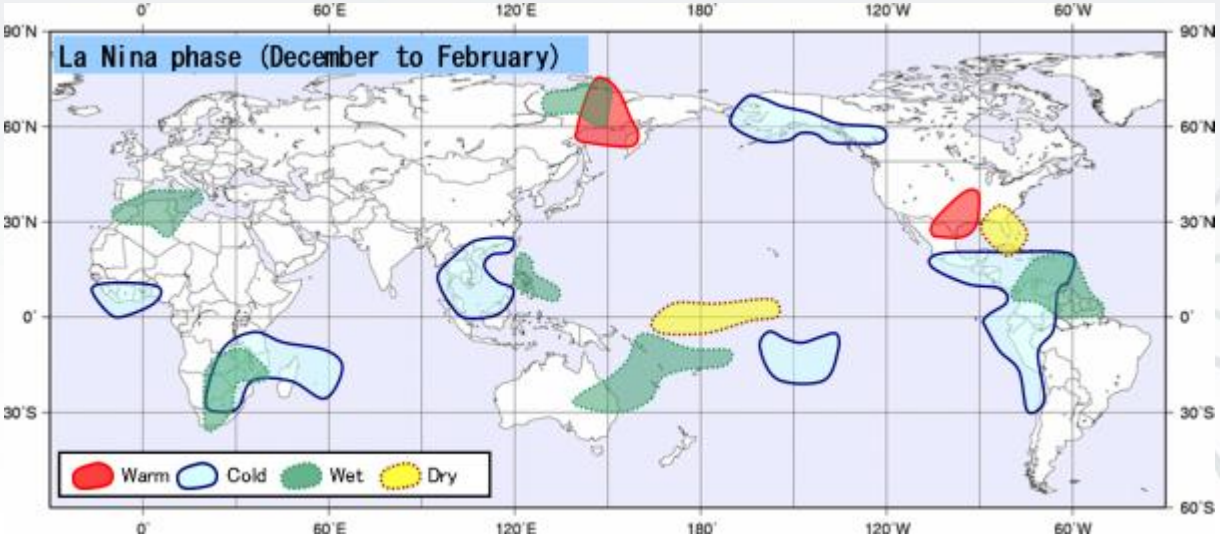
Extreme Climate Events in 2008/9 Winter (World)

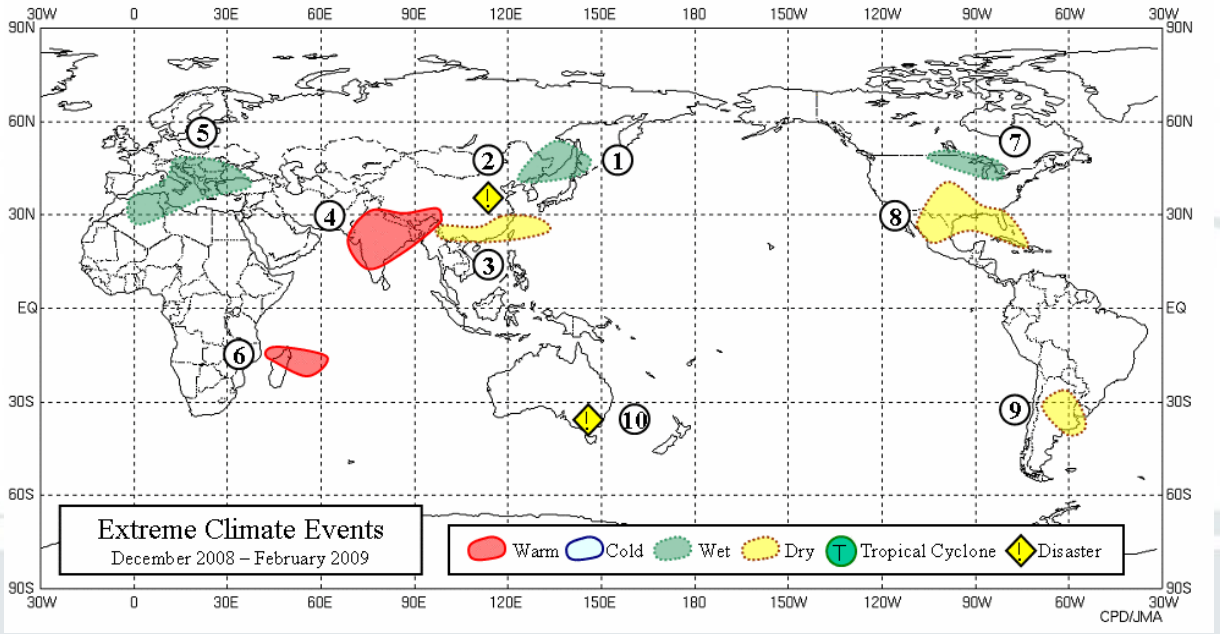


1. Heavy precipitation around southeastern Siberia
2. Drought in eastern China
3. Light precipitation from Okinawa to southern China
4. High temperature around India
5. Heavy precipitation from western Turkey to northern Algeria
6. High temperature around Madagascar
7. Heavy precipitation in the northern USA
8. Light precipitation around the southern USA
9. Light precipitation in northeastern Argentina
10. Bush fire in southeastern Australia

http://ds.data.jma.go.jp/tcc/tcc/products/climate/seasonal.html

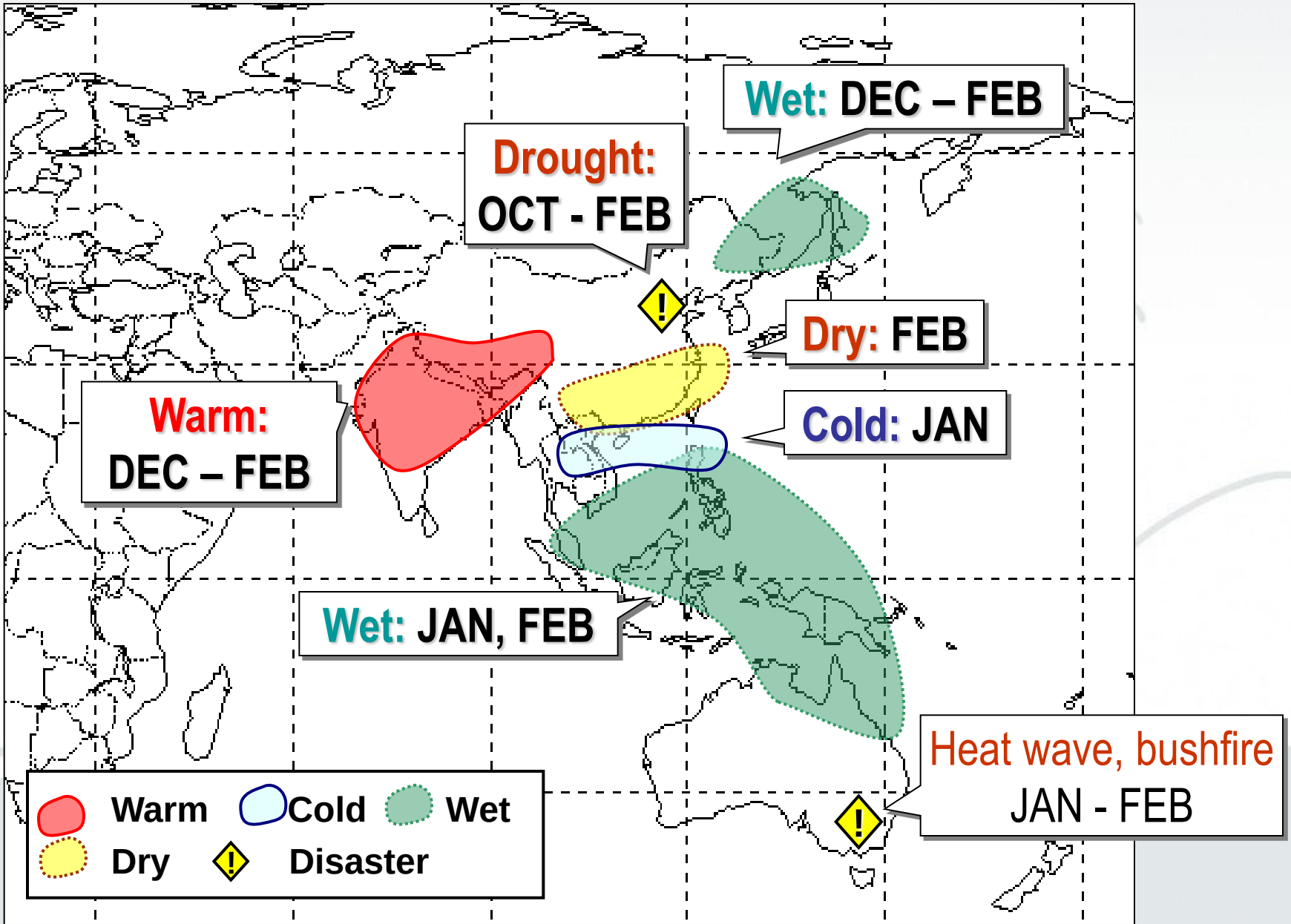
Climate Tendencies in La Nina Phase



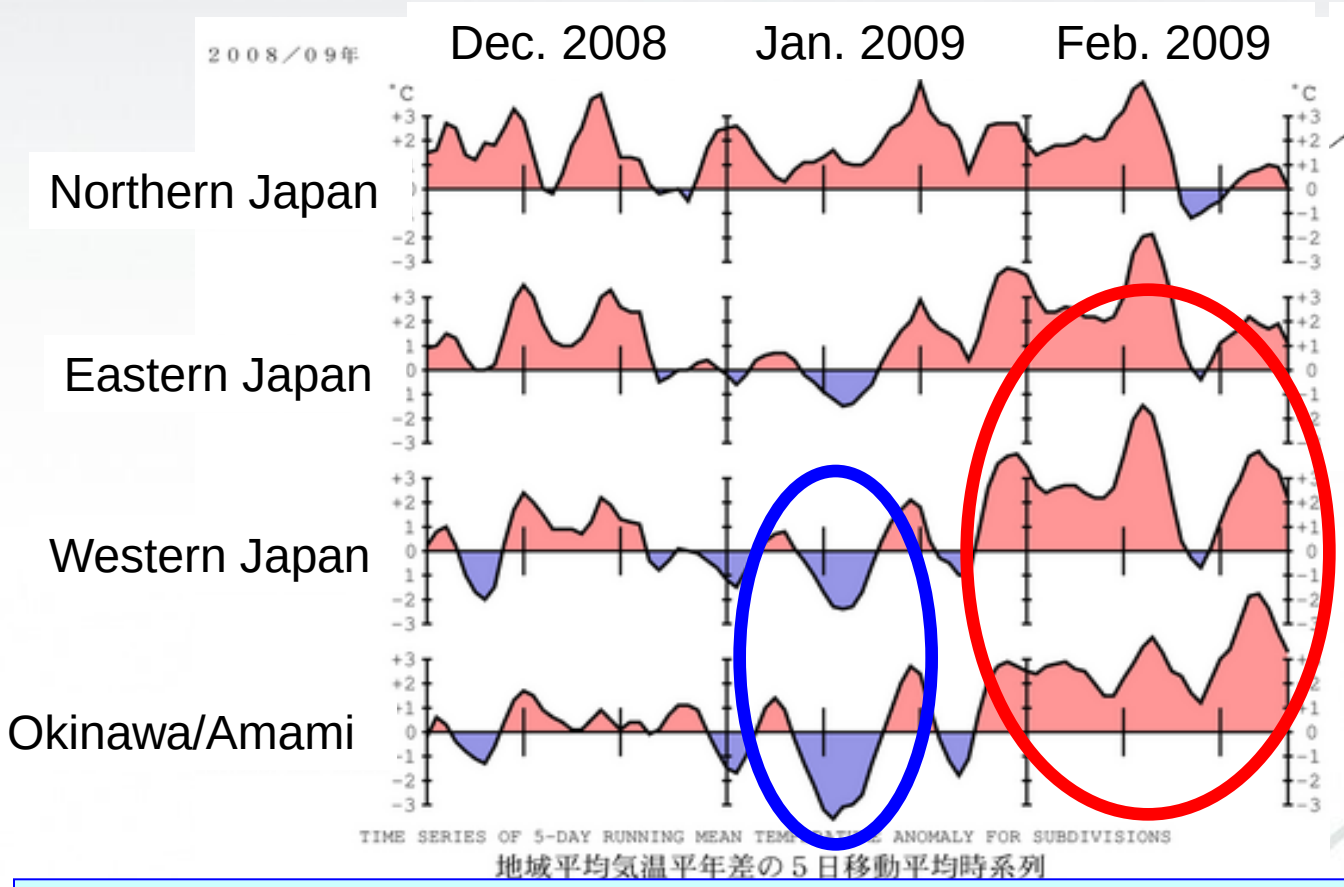


http://ds.data.jma.go.jp/tcc/tcc/products/climate/ENSO/shade/shadela.html

Extreme Climate Events in 2008/9 Winter (Asian region)



Temperature anomalies in Japan

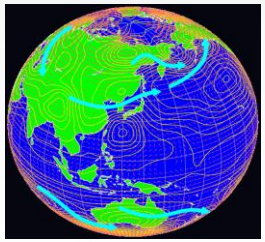


- Seasonal mean temperatures were significantly above normal in Northern Japan, Eastern Japan and Okinawa/Amami.
- Okinawa/Amami experienced the warmest monthly temperature for February since 1946.
- Cold surges occurred in January.

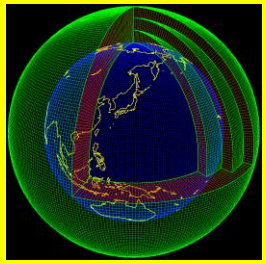
2. Predictability of cold surges over East Asia in January 2009

The JMA's EPS for 1-month Forecast Outlook

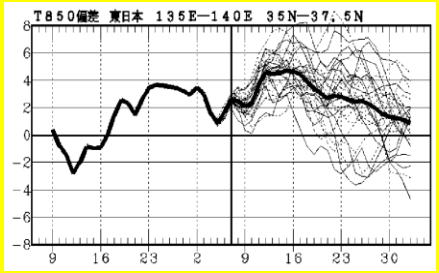
4D-VAR Assimilation



JMA Global Atmospheric Model



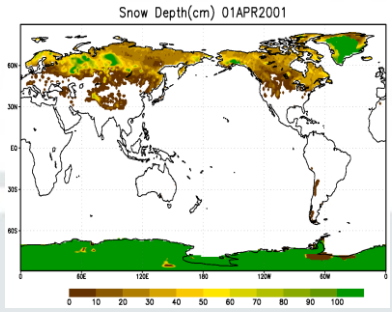
Ensemble Products



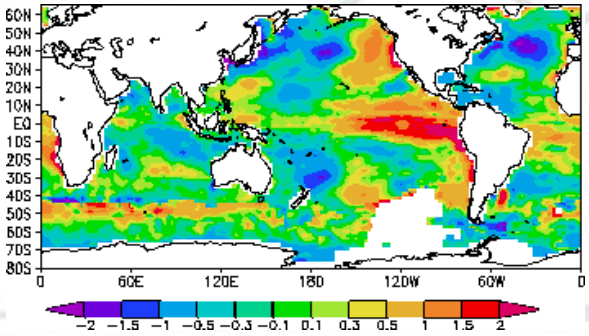
Calibration

Verification

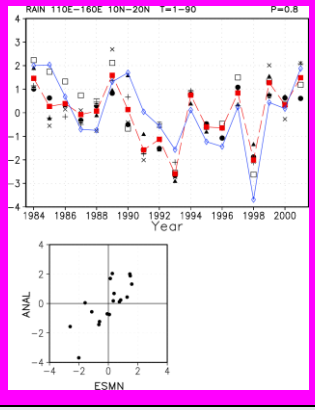
Land-Surface Assimilation



SST: Boundary condition



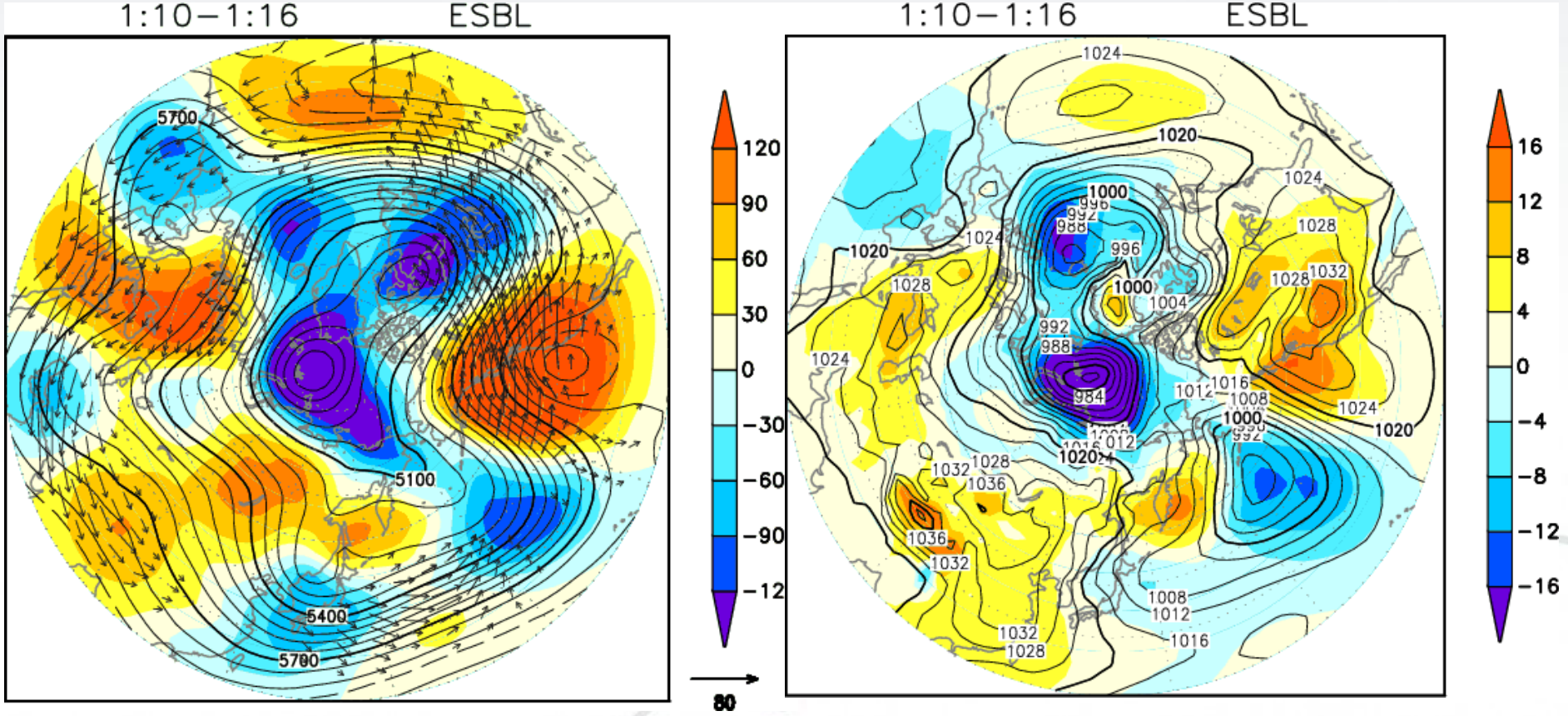
Hindcast



Specifications of the NWP model for 1-month forecast

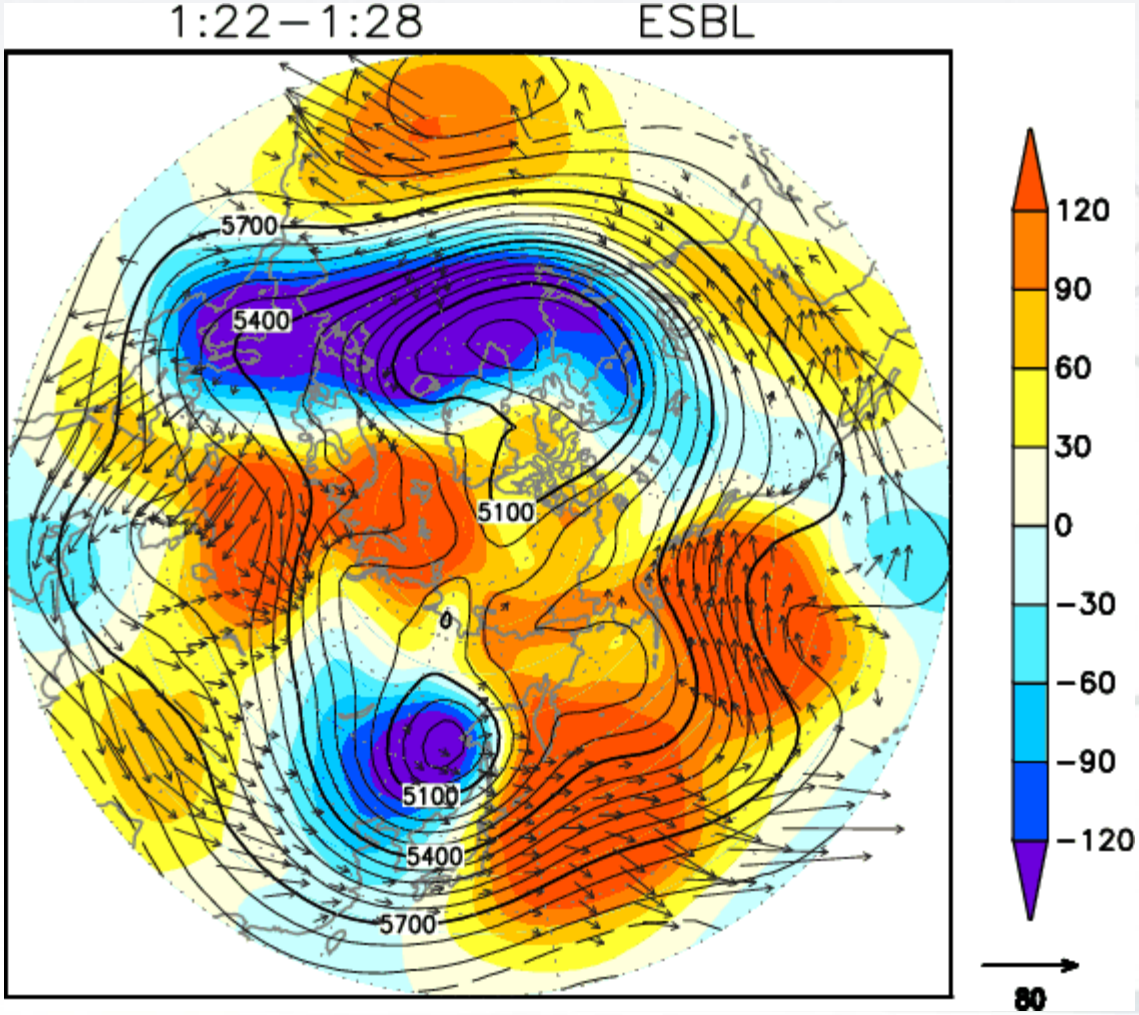
Horizontal resolution	TL159 (about 1.125º Gaussian grid ~110km)
Vertical Layers	60 (Top Layer Pressure:0.1hPa)
Time integration range	34 days
Executing frequency	Once a week
Ensemble size	50 members
Perturbation method	Breeding Growing Mode (BGM) & Lagged Average Forecast (LAF) method
SST	Persisted anomaly
Land surface Parameters	Initial conditions of land parameters are provided by a land surface analysis system. Observation of snow depth reported in SYNOP is assimilated.

Analysis


1:10−1:16 ESBL
5700
5100
5400
5700
120
90
60
30
0
−30
−60
−90
−12
80
1:10−1:16 ESBL
1024
1020
1000
996
988
1028
1032
1004
992
984
1016
1012
1008
1036
16
12
8
4
0
−4
−8
−12
−16

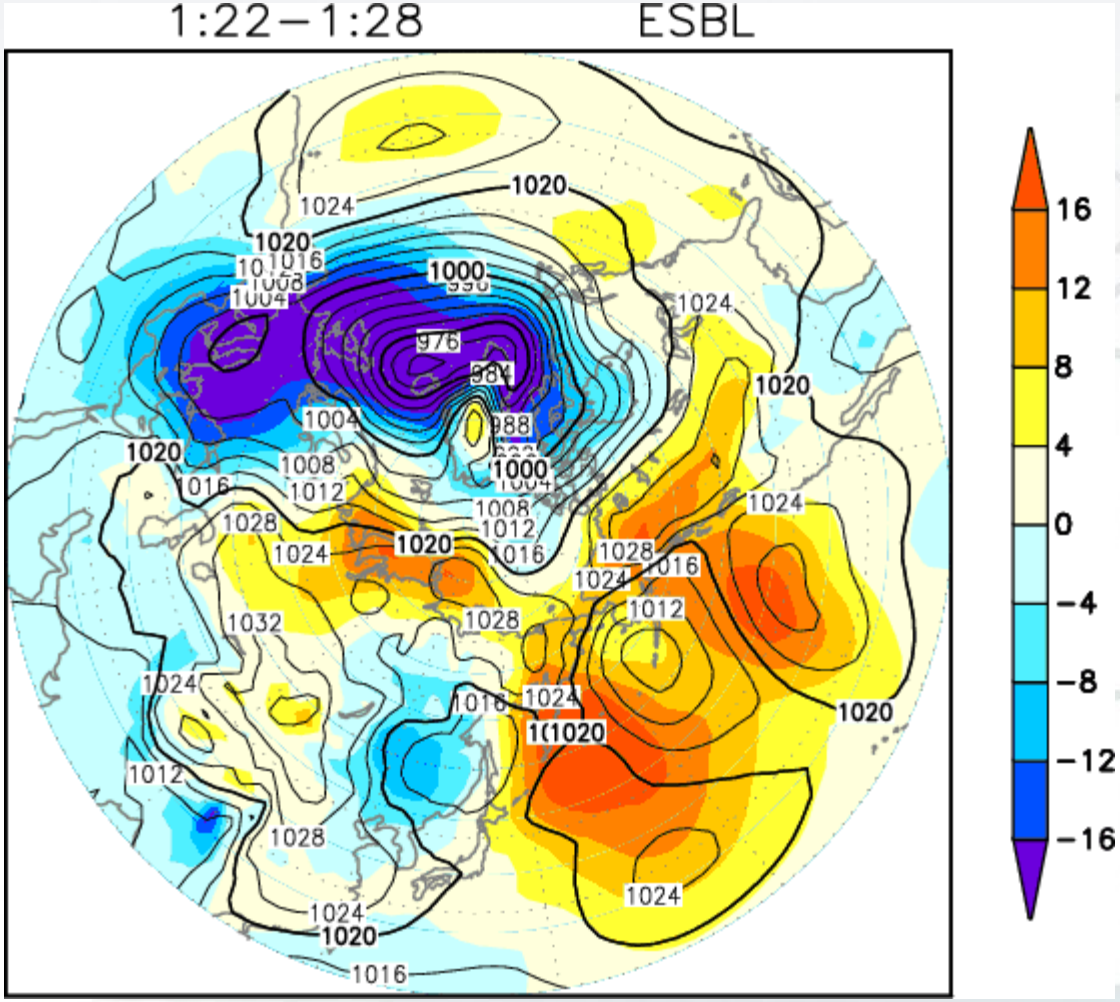
500hPa geopotential height

Analysis

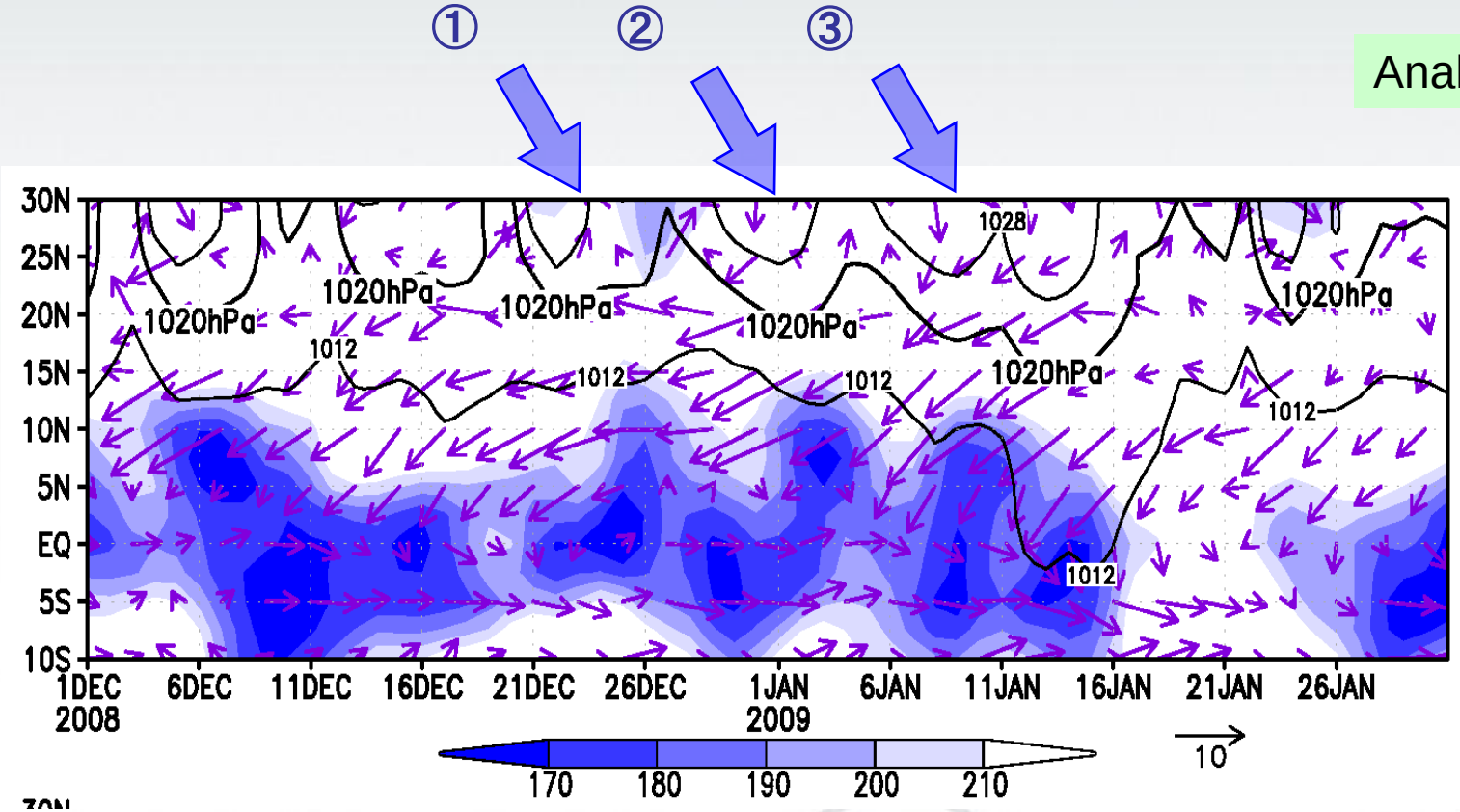


Sea level pressure

Analysis



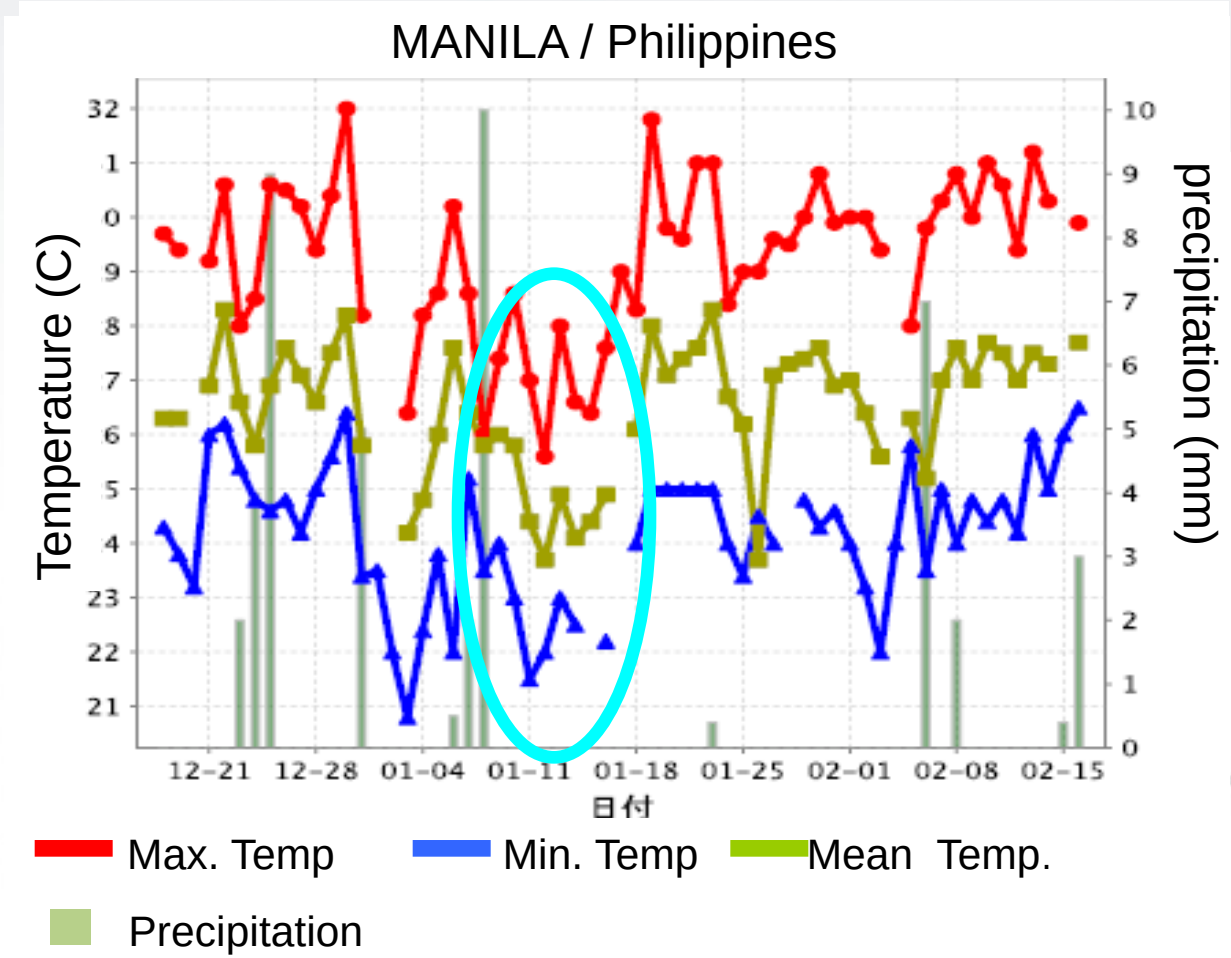
Analysis



Time-latitude cross section chart (averaged over 105E to 120E)

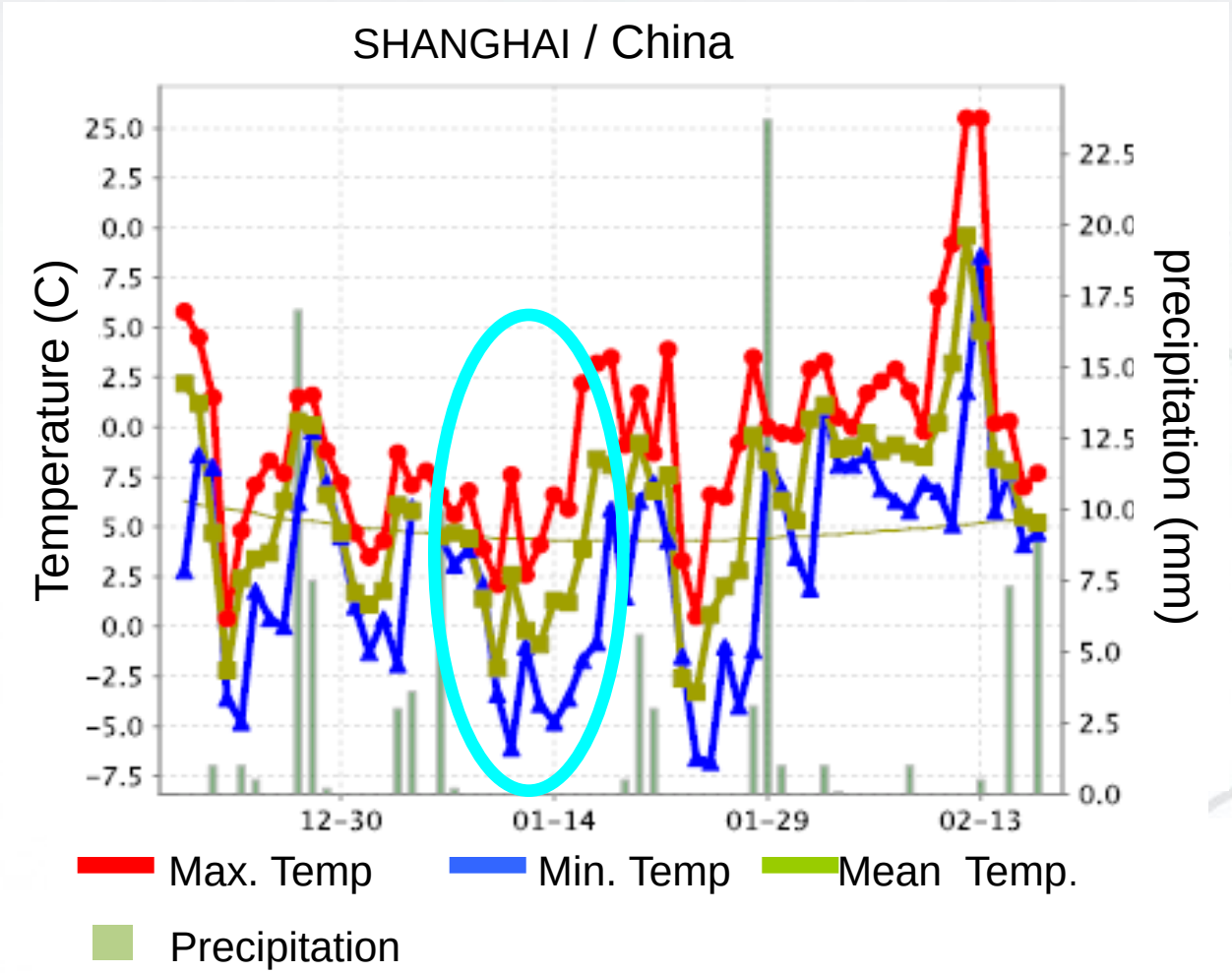
SLP (solid lines) OLR (shaded area) wind at 850hPa (arrows)

Observation



Time sequence of the observation data (SYNOP)

Observation

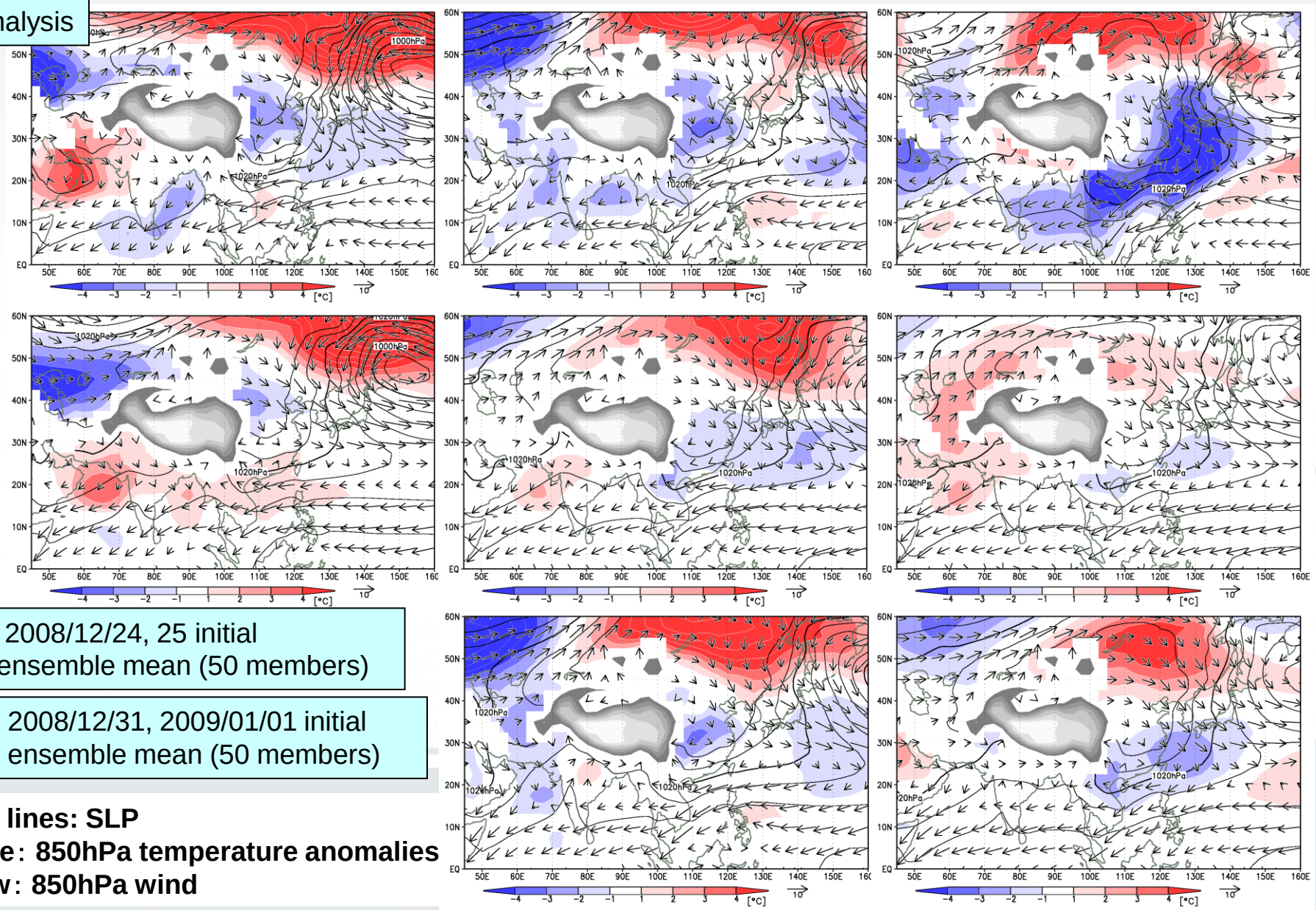


Cold surges in January 2009

Analysis vs. Model prediction

2008/12/27 – 2009/01/02 | 2009/01/03 – 2009/01/09 | 2009/01/10 – 2009/01/16

analysis



2008/12/24, 25 initial ensemble mean (50 members)

2008/12/31, 2009/01/01 initial ensemble mean (50 members)

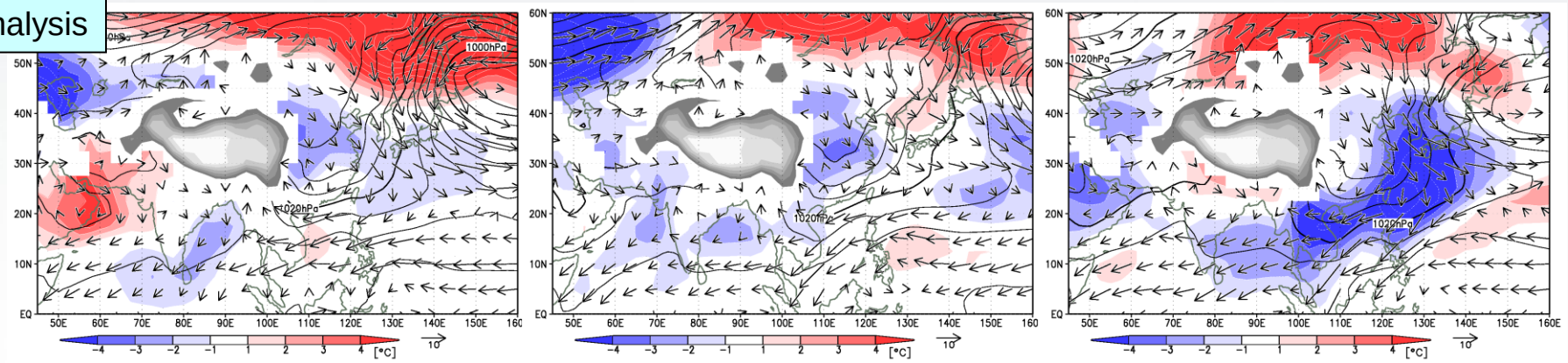
solid lines: SLP
shade: 850hPa temperature anomalies
arrow: 850hPa wind

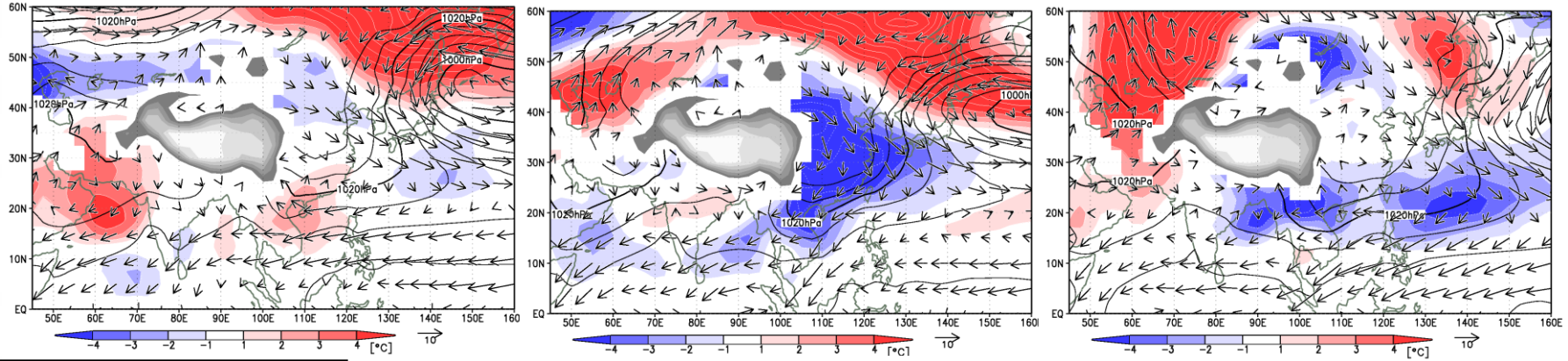
Cold surges in January 2009

Analysis vs. Model prediction

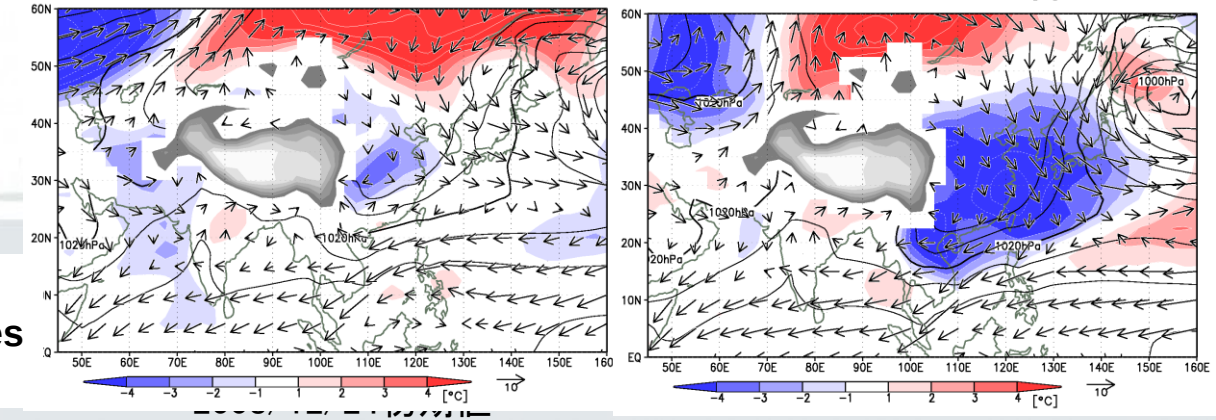
2008/12/27 – 2009/01/02 | 2009/01/03 – 2009/01/09 | 2009/01/10 – 2009/01/16

analysis





2008/12/24 initial control run



2008/12/31 initial control run

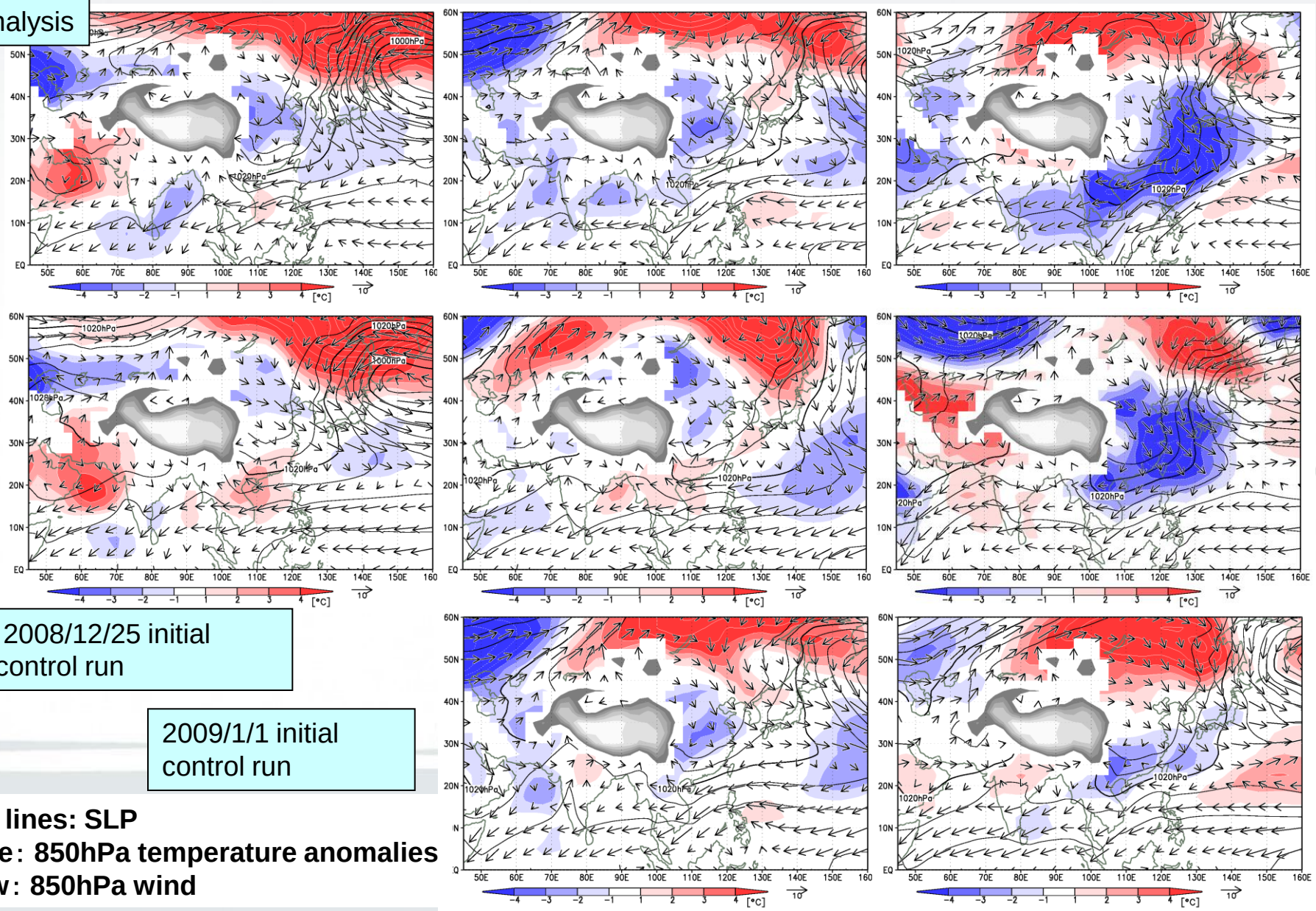
solid lines: SLP
shade: 850hPa temperature anomalies
arrow: 850hPa wind

Cold surges in January 2009

Analysis vs. Model prediction

2008/12/27 – 2009/01/02 | 2009/01/03 – 2009/01/09 | 2009/01/10 – 2009/01/16

Analysis



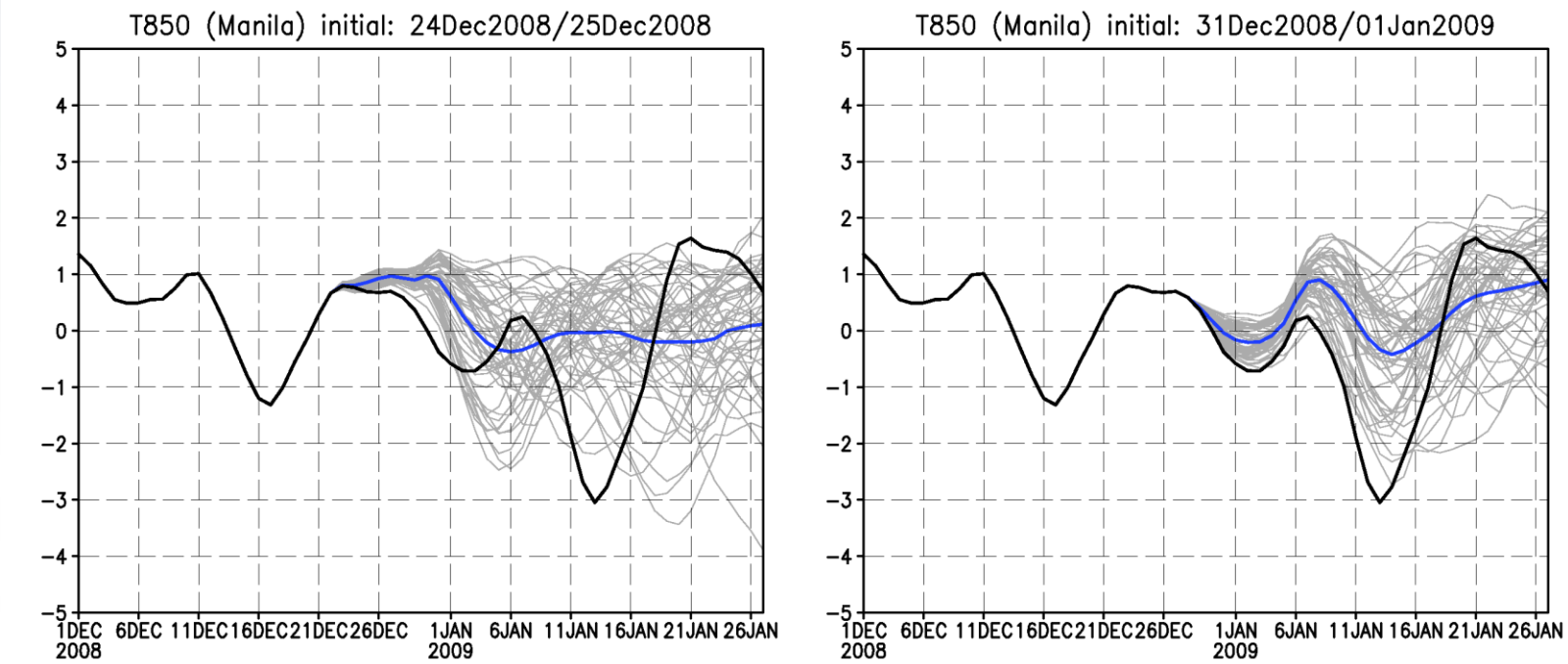
2008/12/25 initial control run

2009/1/1 initial control run

solid lines: SLP
shade: 850hPa temperature anomalies
arrow: 850hPa wind

Cold surges in January 2009

Analysis vs. Model prediction

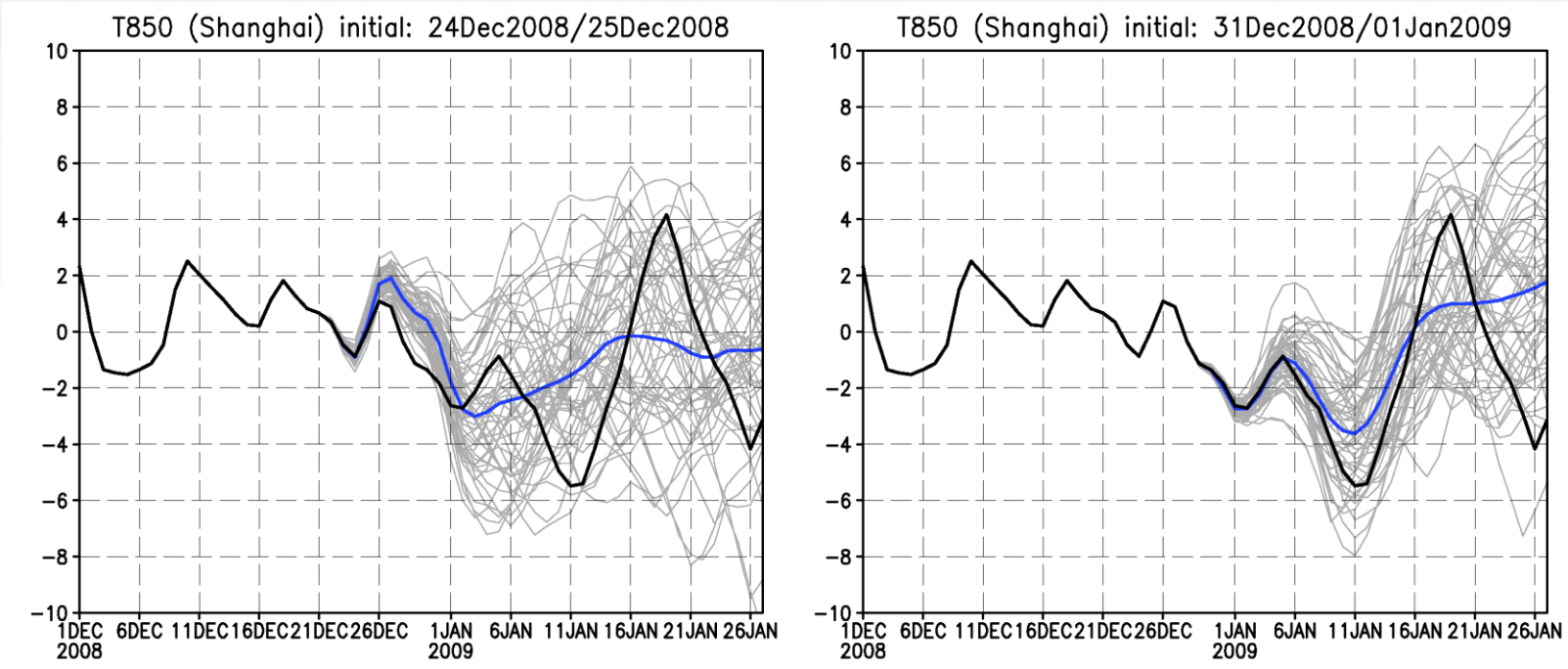


850 hPa air temperature anomalies around Manila
averaged over (12.5N-17.5N, 120E-125E), 7-day running mean

- Black: Analysis (JCDAS)
- Gray: each members
- Blue: ensemble mean

Cold surges in January 2009

Analysis vs. Model prediction



850 hPa air temperature anomalies around Shanghai
averaged over (27.5N-32.5N, 120E-125E), 7-day running mean

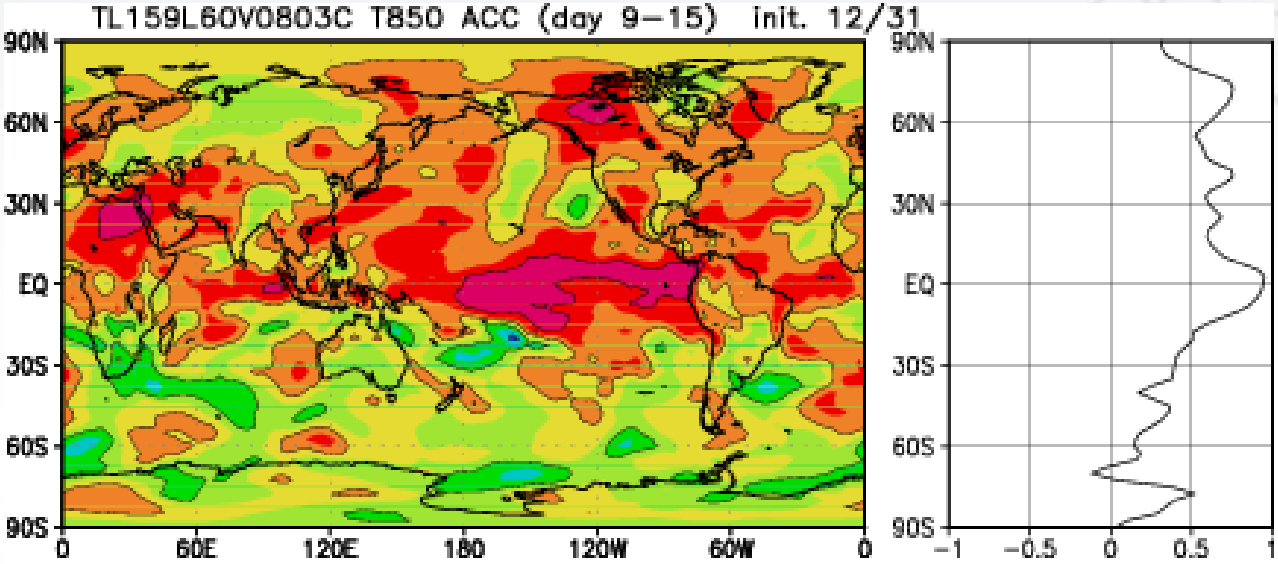
- Black: Analysis (JCDAS)
- Gray: each members
- Blue: ensemble mean

Verification of JMA's one-month forecast model

Verification

ACC (anomaly correlation coefficient)

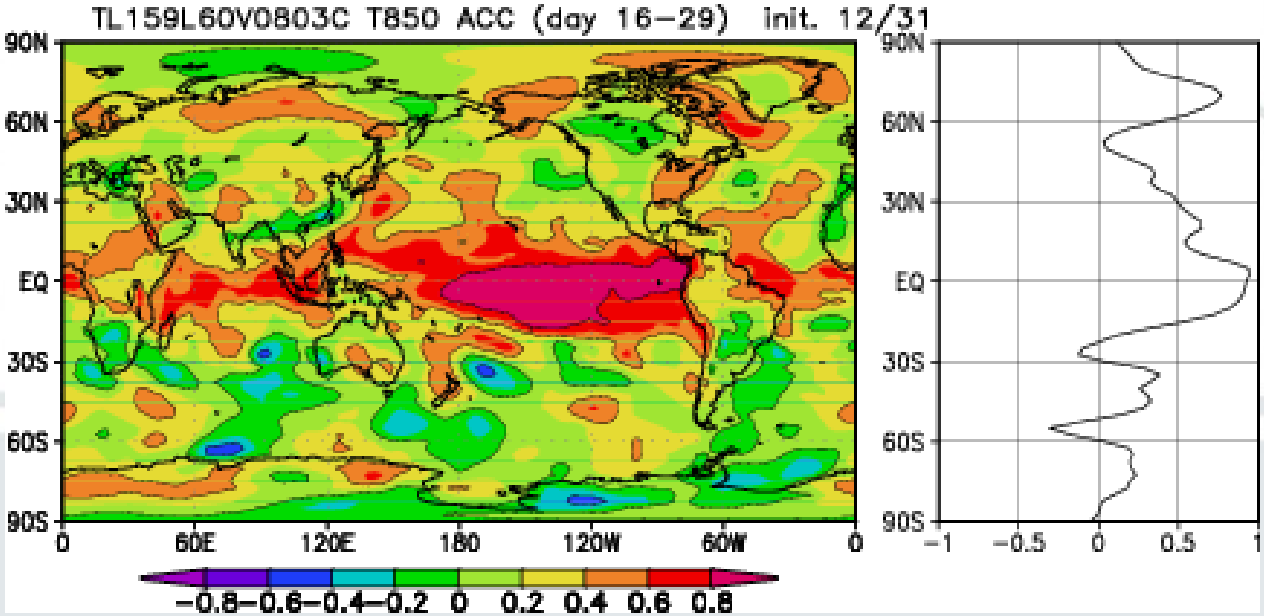
Hindcast of ensemble mean vs. JRA re-analysis data (1979-2004,26 years)



Initial date: 31 December

the second week

(day 9-15)



the third and fourth weeks

(day 16-29)

http://ds.data.jma.go.jp/tcc/tcc/index.html TCC webpage

気象庁
Japan Meteorological Agency

Welcome to Tokyo Climate Center

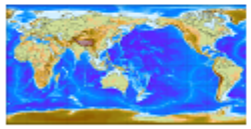
Home | World Climate | Climate System Monitoring | El Niño Monitoring | NWP Model Prediction | Global Warming

HOME

Main Products

- World Climate
- Climate System Monitoring
- El Niño Monitoring
- NWP Model Prediction
- Global Warming
- Climate and Outlook in Japan

ClimatView



GPC Long-range forecast (LRF) Products

Click

What's New

24 March 2009 NEW
- Activity Report of the Tokyo Climate Center

19 March 2009 NEW
- Forecast of cherry blossom blooming dates in 2009 (updated on 18 March)

16 March 2009 NEW
- New Release: Monthly Highlights on Climate System (February 2009)

16 March 2009 NEW
- Updated Information: World Climate
  - Monthly Report (February 2009)
  - Seasonal Report (December 2008 - February 2009)

13 March 2009 NEW
- Updated Information: Global Average Surface Temperature Anomaly (February 2009)

10 March 2009 NEW
- Updated Information: Climate in Japan
  - Monthly Report (February 2009)

TCC webpage

Notice

- JMA's one-month prediction model was upgraded on 21 March 2008. Available products remain the same. Verification maps of one-month probabilistic forecasts at station points have been updated accordingly.
- JMA's extended ensemble prediction systems (EPS) was updated on 9 March 2007. Please refer to the "TCC News No.7" for details.
- JMA's extended ensemble prediction systems (EPS) (for three-month and warm/cold season predictions) was updated on 12 September 2007. Please refer to the "TCC News No.9" for details.

Main Products

Latest Products

One-month Prediction

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

Three-month Prediction

- Three-month Prediction
- Z500, T850 & Psea (No
- Stream function, Veloci
- Verification of recent pr
- Verification of hindcasts
- Probabilistic Forecasts

Warm/Cold Season Predi

- Warm/Cold Season Prec
- Z500, T850 & Psea (No
- Stream function, Veloci
- Verification of hindcasts

2009)

2009)

ID & password required !!

Model Descriptions

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

Download GPC Long-range Forecast (L ts

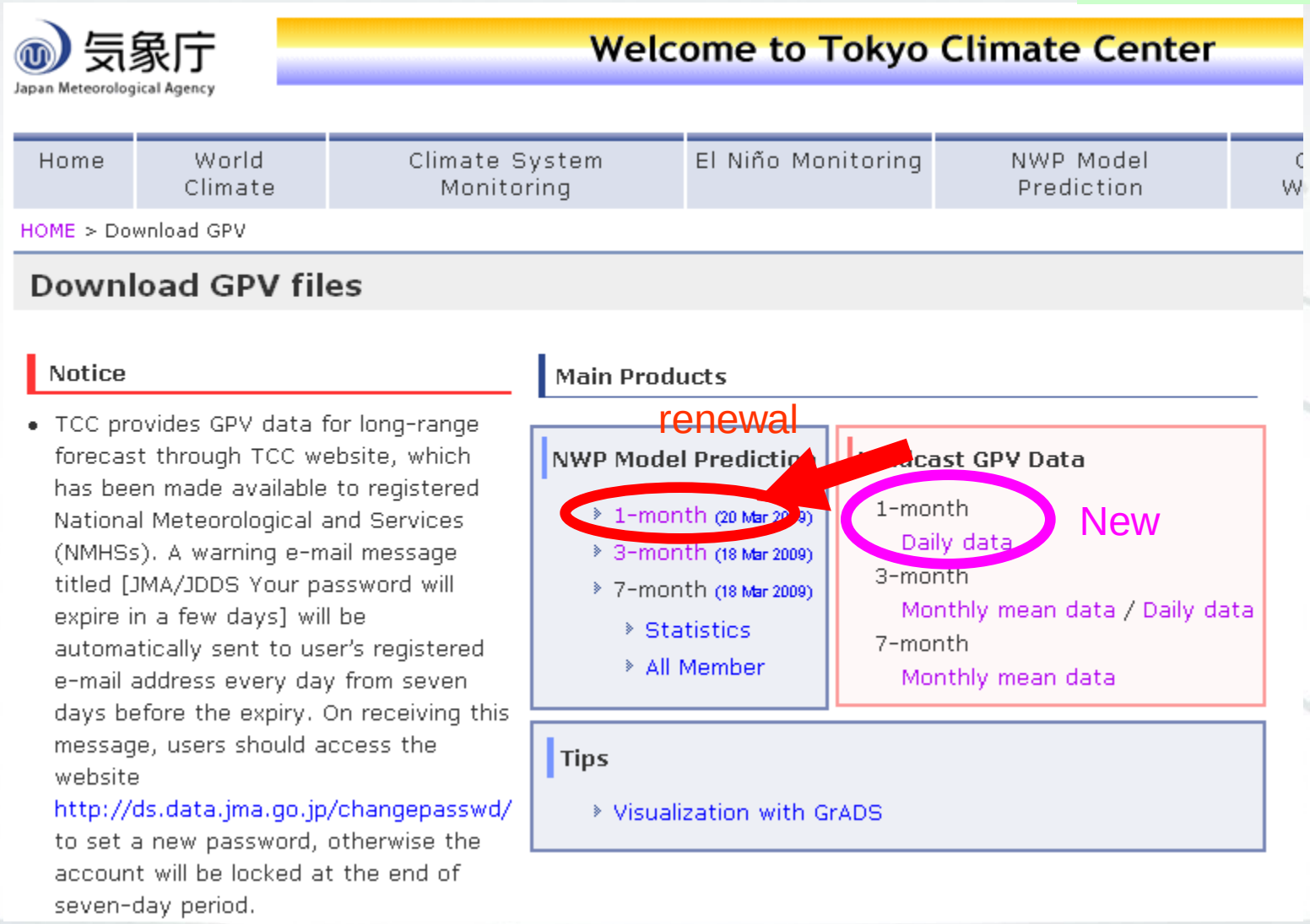
- Download Grid Point Value (GPV) File

Click

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/
- If you have any questions about ID and/or password, please e-mail to: tcc@climar.kishou.go.jp

TCC webpage


気象庁
Japan Meteorological Agency
Welcome to Tokyo Climate Center
Home
World Climate
Climate System Monitoring
El Niño Monitoring
NWP Model Prediction
HOME > Download GPV
Download GPV files
Notice
TCC provides GPV data for long-range forecast through TCC website, which has been made available to registered National Meteorological and Services (NMHSs). A warning e-mail message titled [JMA/JDDS Your password will expire in a few days] will be automatically sent to user's registered e-mail address every day from seven days before the expiry. On receiving this message, users should access the website http://ds.data.jma.go.jp/changepasswd/ to set a new password, otherwise the account will be locked at the end of seven-day period.
Main Products
renewal
NWP Model Predictio
1-month (20 Mar 20
3-month (18 Mar 2009)
7-month (18 Mar 2009)
Statistics
All Member
cast GPV Data
1-month
Daily data
New
3-month
Monthly mean data / Daily data
7-month
Monthly mean data
Tips
Visualization with GrADS

Grid point value products of extended-range forecast in GRIB1

***** NOTICE *****

The GPV products of one-month forecast will be improved in April 2009.
At the same time, the data format will be migrated from GRIB1 to GRIB2.
The provision of the current data file in GRIB1 format will terminate in September 2009 after six-month transition period.

Sample data sets are available at
ensemble statistics and forecasts by individual ensemble members.
For the details, please refer to here.

you can get all members

- Download Grid point value (GPV) data (1mE_GPV.yyyymmdd; *200801-present*).
  Grid point value devided into each element (**for narrow band user**) is here.
- Surface pressure normal data for using atmospheric lower level GPV data
  In 850hPa GPV data, the undefined value (-19999.0) has been assigned to grid points at an elevation of 1500m or higher. Values based
  grid points from 10 January 2008. Please refer to surface pressure normal data based on the Japanese 25-year reanalysis (JRA-25) when
- Old data is here: (*200301-200401*)/(*200402-200712*)
- C programs to read GPV in GRIB1 format
- In addition to "FM 92 GRIB - Edition 1" defined by WMO , some local parameters are used. They are shown below.
  (These parameters are supported by decoding program provided at TCC websit)

  TABLE 2. PARAMETERS & UNITS

140	Large anomaly index
141	Standard deviation of pressure of all ensemble member
142	Standard deviation of geopotential height of all ensemble member
143	Standard deviation of temperature of all ensemble member

- Contents of GRIB1 file

Contents		Level(hPa)	Area	Initial Time and Fore
Ensemble mean value of forecast members	Sea level pressure, rainfall amount	---		Initial time :12UTC o
	Temperature and Temperature anomaly	850,700 EW NI		
	Relative Humidity, Wind (u, v)	850		

3. Diagnosis of the atmospheric circulation for the warm condition in February using ITACS

ITACS (Interactive Tool for Analysis of the Climate System)

will open to NMHSs soon (ID and Password necessary).

Please contact us if you are interested in ITACS.

ITACS

February

data1

dataset	element	data type	area	level	average period	show period
CLIMAT	temperature(C.Deg)	ANOM_SD	ASIA	1000 hPa – 1000 hPa	MONTHLY	RANGE 2009 02 – 2009 02
	Vector ☐		Lat: -10 – 85 Ave ☐		Ave ☑	
	SD ☐		Lon: 30 – 190 Ave ☐			

analysis method : -Analysis_method-

Graphic Option

Colorizing : COLOR
Drawing : SHADE
Image Format : png

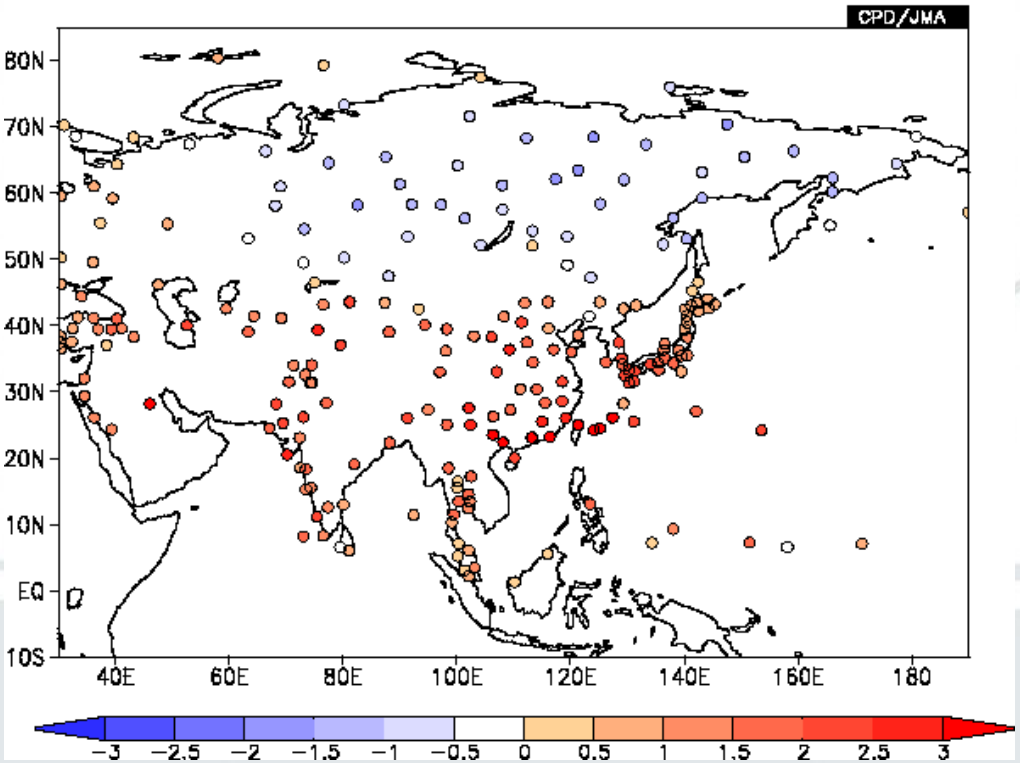
☑ Show Contour Labels
☑ Show Color Bar
☑ Set Contour Parameters for data1
interval : 0.5 min : -3 max : 3
☐ Set Vector size : [inch] value :

Color Table : Blue – Red
North pole
☐ Logarithmic Coordinates
☐ Reverse the Axes
☐ Flip the X-axis ☐ Flip the Y-axis
☐ No Caption

☐ No Scale Labels
☐ Draw Credit Inside

Submit Clear

DATA1 CLIMAT tt ANOM_SD lat = -10:85 lon = 30:190 level = 1:1
time = 2009020100:2009020100 ave = 1MONTH



Observation (CLIMAT)

ITACS

data1

dataset	element	data type	area	level	average period	show period
CLIMAT	temperature(C.Deg) Vector ☐ SD ☐	ANOM	ASIA Lat: -10 – 85 Ave ☐ Lon: 30 – 190 Ave ☐	1000 hPa – 1000 hPa	Year average Ave ☐	RANGE 1979 – 2009 02 – 02

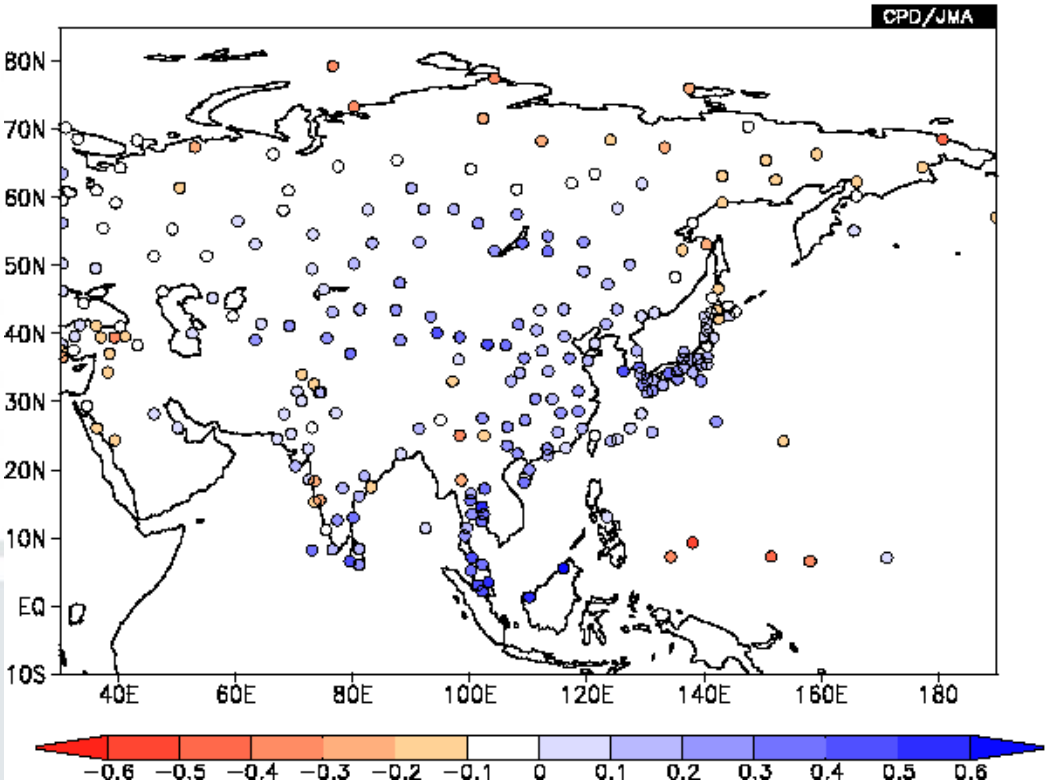
analysis method : CORRELATION_COEFFICIENT

data2

dataset	element	data type	average period	lag	significance
INDEX	NINO.3.4 SD ☐	ANOM	Year average Ave ☐	0 YEAR	90%(two side)

DATA1 CLIMAT tt ANOM lat = -10:85 lon = 30:190 level = 1:1
time = 19790201OO:20080201OO ave = 1MONTH

DATA2 INDEX NINO.34 ANOM lat = -90:90 lon = 0:360 level = 1:1
time = 19790201OO:20080201OO ave = 1MONTH analysis method = CORRELATION_COEFFICIENT

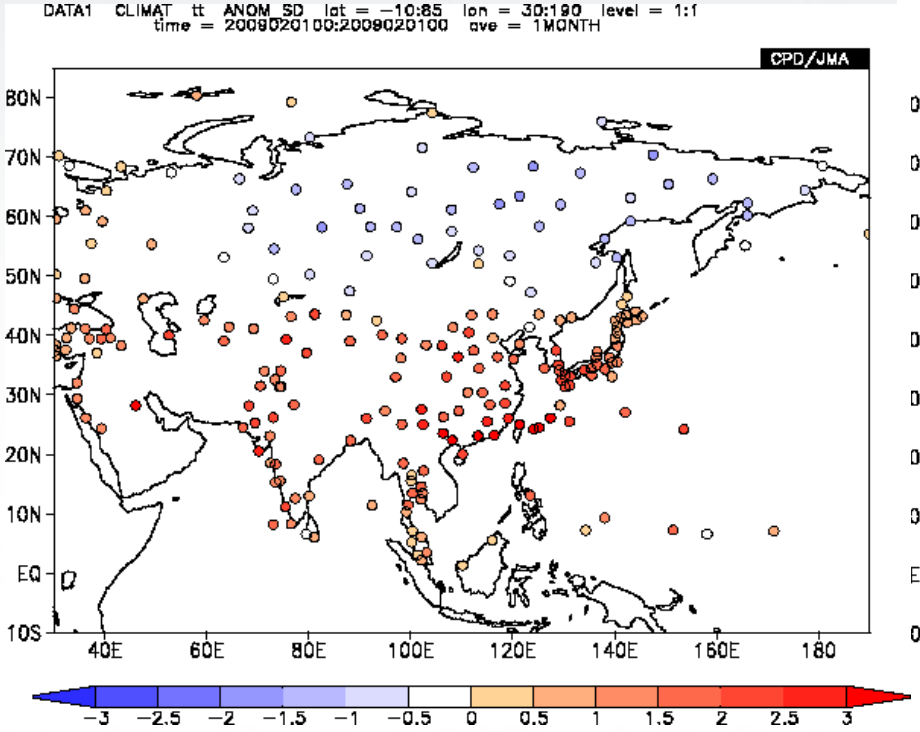


Index in February 2009
nino3 = -0.6
nino3.4= -0.8

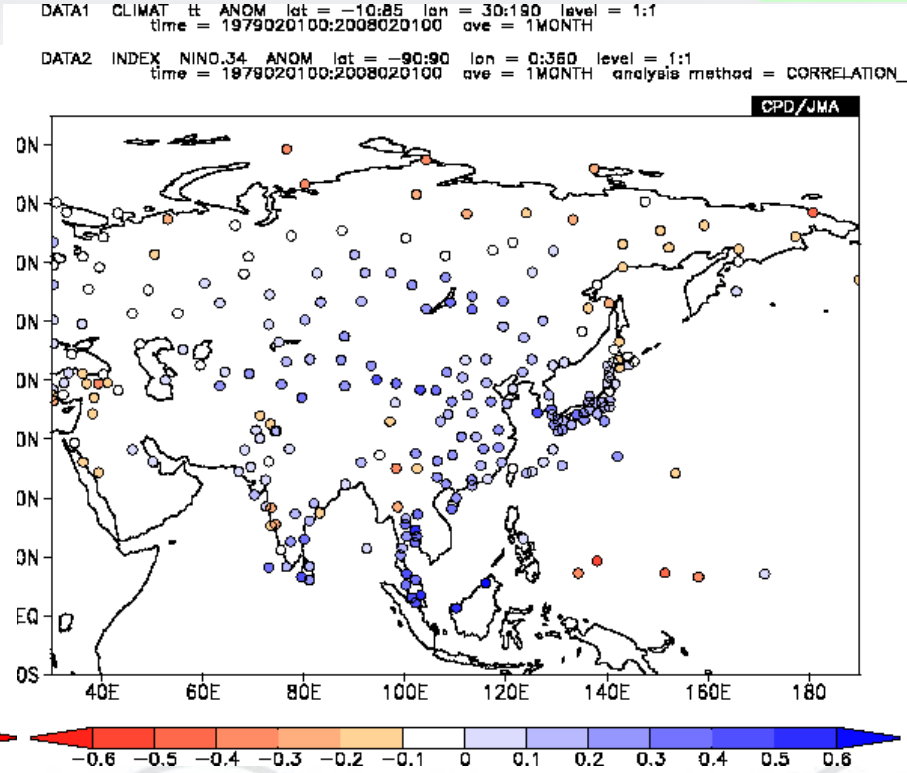
Correlation coefficient

between CLIMAT and nino3.4

ITACS



Observation



Correlation coef. (Observation vs. Nino3.4)

Though NINO3.4 is -0.8 (La Nina condition) in February 2009,

the temperature anomaly pattern is not evident caused by La Nina condition.

ITACS

data1

dataset	element	data type	area	level	average period	show period
SAT	OLR(W/m2)	ANOM	ASIA	1000 hPa – 1000 hPa	MONTHLY	RANGE
	Vector ☐		Lat: -10 – 85 Ave ☐		Ave ☑	2009 02
	SD ☐		Lon: 30 – 190 Ave ☐			2009 02

analysis method : -Analysis_method-

Graphic Option

Colorizing : COLOR
Drawing : SHADE
Image Format : png

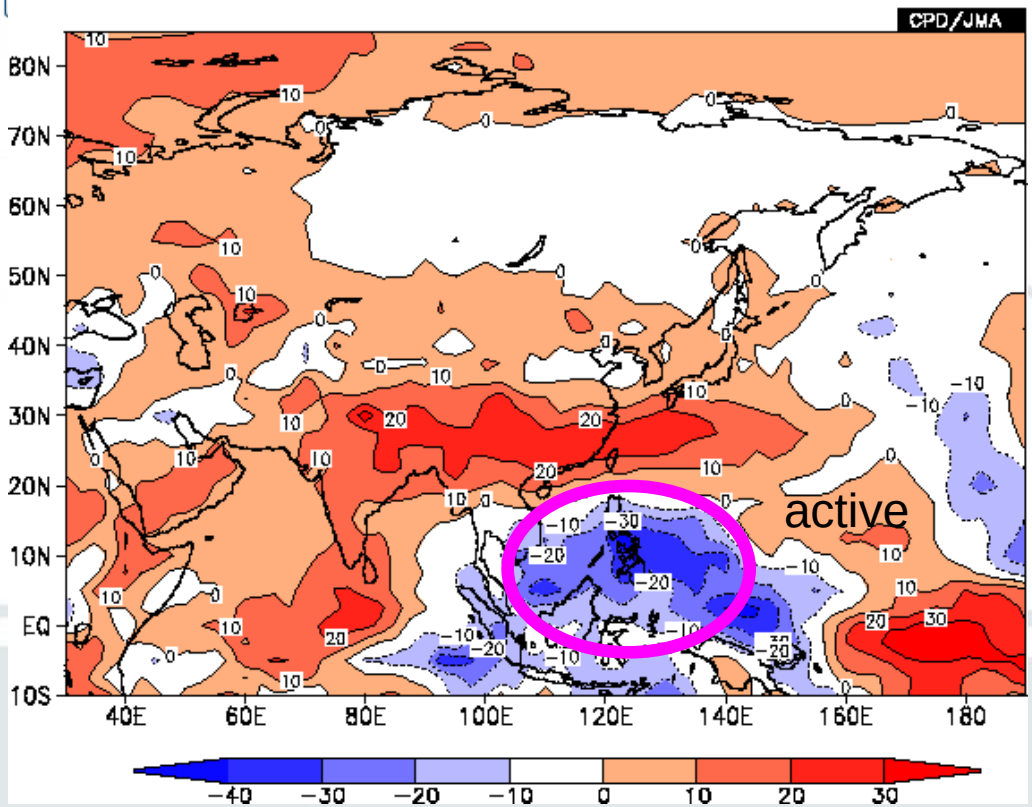
☑ Show Contour Labels
☑ Show Color Bar
☐ Set Contour Parameters for data1
interval : min : max :
☐ Set Vector size : [inch] value :

Color Table : Blue – Red
☐ Polar Stereographic : North pole
☐ Logarithmic Coordinates
☐ Reverse the Axes
☐ Flip the X-axis ☐ Flip the Y-axis
☐ No Caption

☐ No Scale Labels
☐ Draw Credit Inside

DATA1 SAT olr ANOM lat = -10:85 lon = 30:190 level = 1:1
time = 20090201 00:20090201 00 ave = 1MONTH

Submit



OLR anomaly pattern

in February 2009

data1

dataset	element	data type	area	level	average period	show period
CLIMAT	temperature(C.Deg) Vector ☐ SD ☐	ANOM	ASIA Lat: -10 – 70 Ave ☐ Lon: 30 – 190 Ave ☐	1000 hPa – 1000 hPa	Year average Ave ☐	RANGE 1979 – 2008 02 – 02

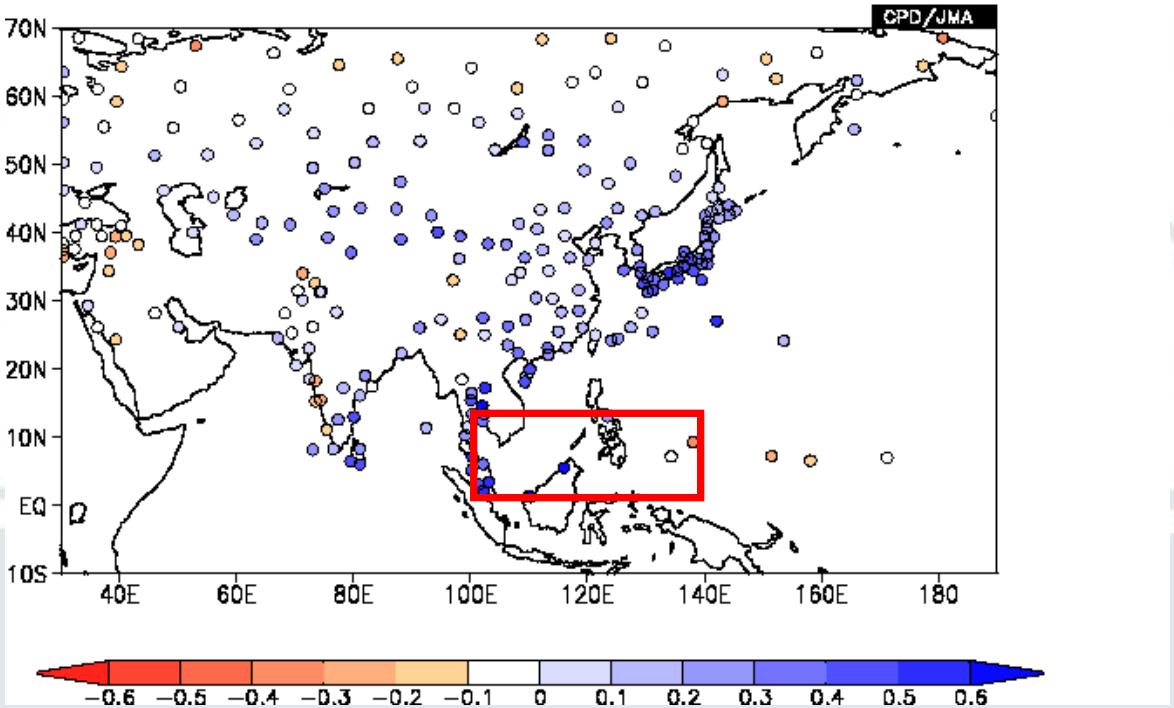
analysis method : CORRELATION_COEFFICIENT

data2

dataset	element	data type	area	level	average period	lag	significance
SAT	OLR(W/m2) SD ☐	ANOM	ASIA Lat: 0 – 15 Ave ☑ Lon: 100 – 140 Ave ☑	1000 hPa – 1000 hPa	Year average Ave ☐	0 YEAR	90%(two side)

DATA1 CLIMAT tt ANOM lat = -10:70 lon = 30:190 level = 1:1
time = 19790201 00:20080201 00 ave = 1MONTH

DATA2 SAT olr ANOM lat = 0:15 lon = 100:140 level = 1:1
time = 19790201 00:20080201 00 ave = 1MONTH analysis method = CORRELATION_COEFFICIEN



data1

dataset	element	data type	area	level	average period	show period
CLIMAT	temperature(C.Deg) Vector ☐ SD ☐	ANOM	ASIA Lat: -10 – 70 Ave ☐ Lon: 30 – 190 Ave ☐	1000 hPa – 1000 hPa	Year average Ave ☐	RANGE 1979 – 2008 02 – 02

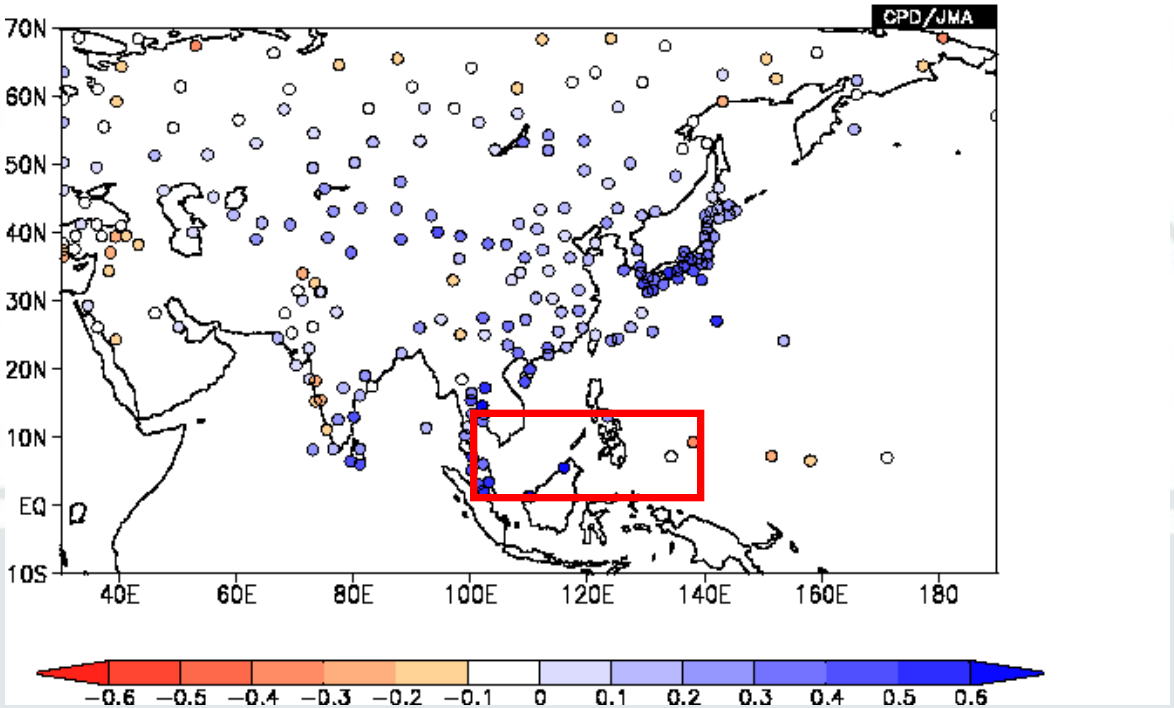
analysis method : CORRELATION_COEFFICIENT

data2

dataset	element	data type	area	level	average period	lag	significance
SAT	OLR(W/m2) SD ☐	ANOM	ASIA Lat: 0 – 15 Ave ☑ Lon: 100 – 140 Ave ☑	1000 hPa – 1000 hPa	Year average Ave ☐	0 YEAR	90%(two side)

DATA1 CLIMAT tt ANOM lat = -10:70 lon = 30:190 level = 1:1
time = 19790201 00:20080201 00 ave = 1MONTH

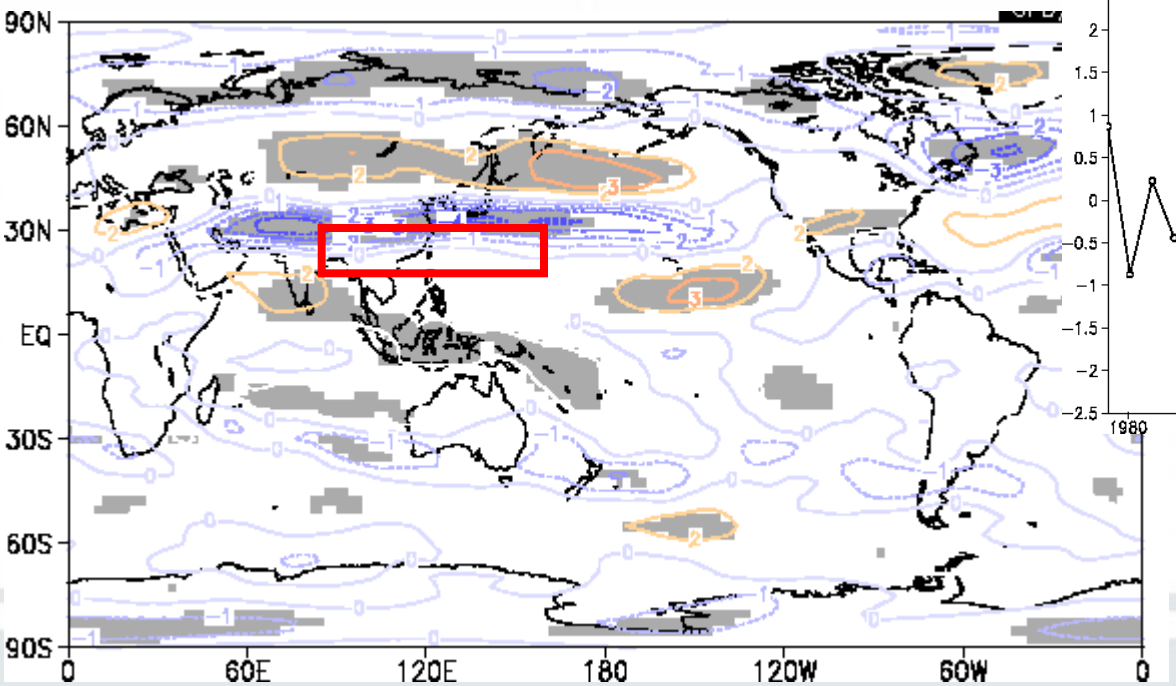
DATA2 SAT olr ANOM lat = 0:15 lon = 100:140 level = 1:1
time = 19790201 00:20080201 00 ave = 1MONTH analysis method = CORRELATION_COEFFICIEN

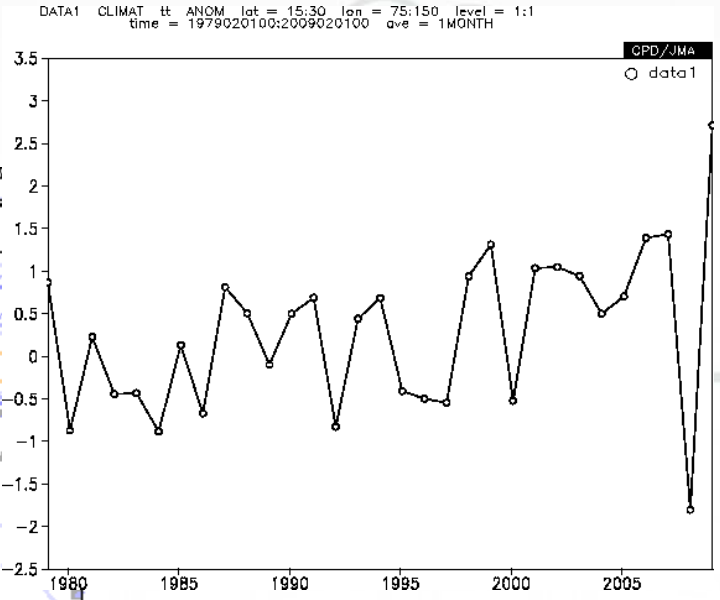


Extreme high temperature in southern Asia

- Circulation anomalies in association with temperature anomalies in southern Asia

U250-T_CLIMAT(15N-30N, 75E-150E)

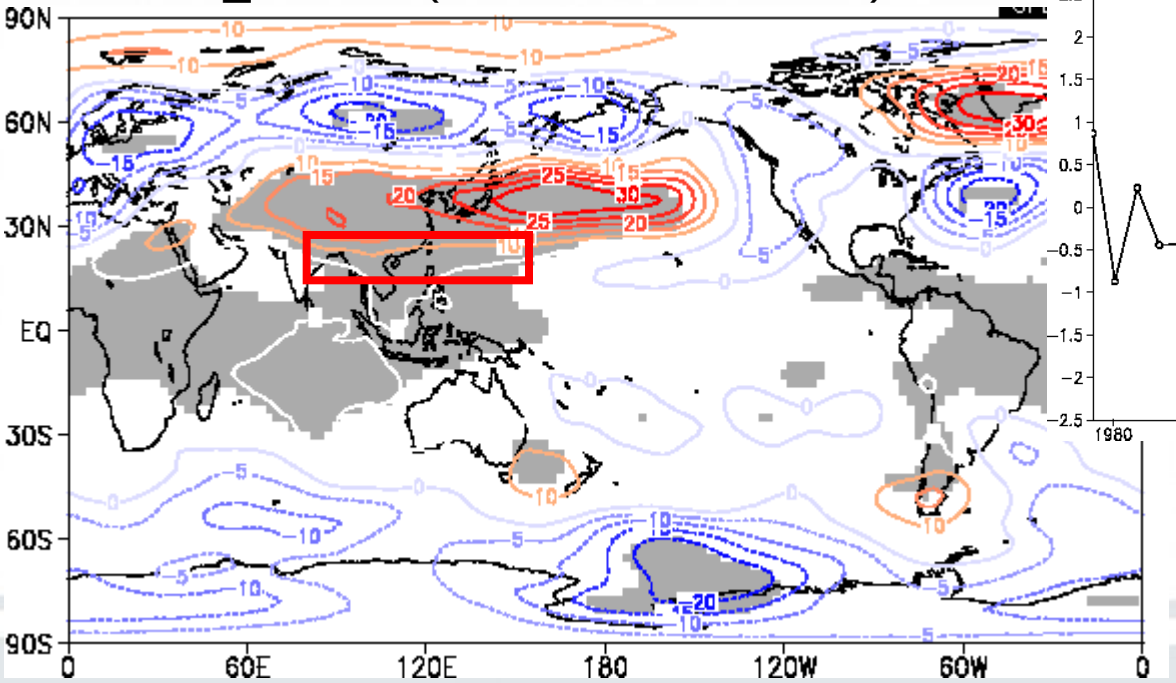


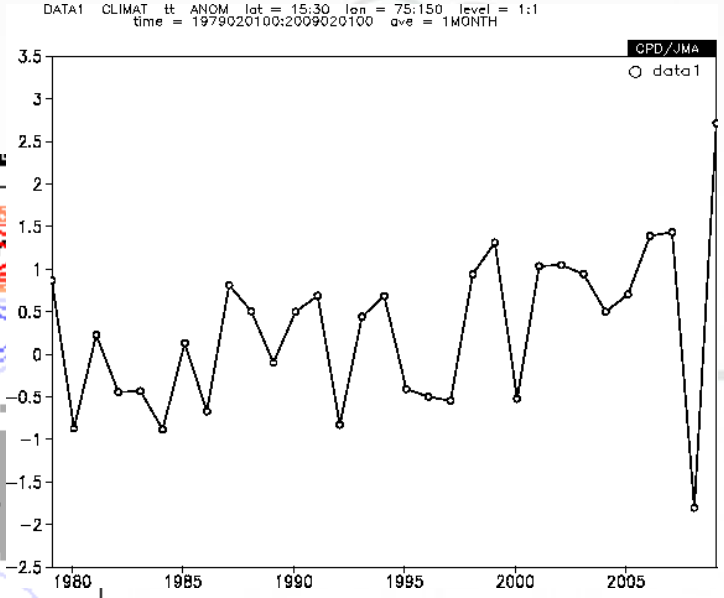


Extreme high temperature in southern Asia

- Circulation anomalies in association with temperature anomalies in southern Asia

Z500-T_CLIMAT(15N-30N, 75E-150E)

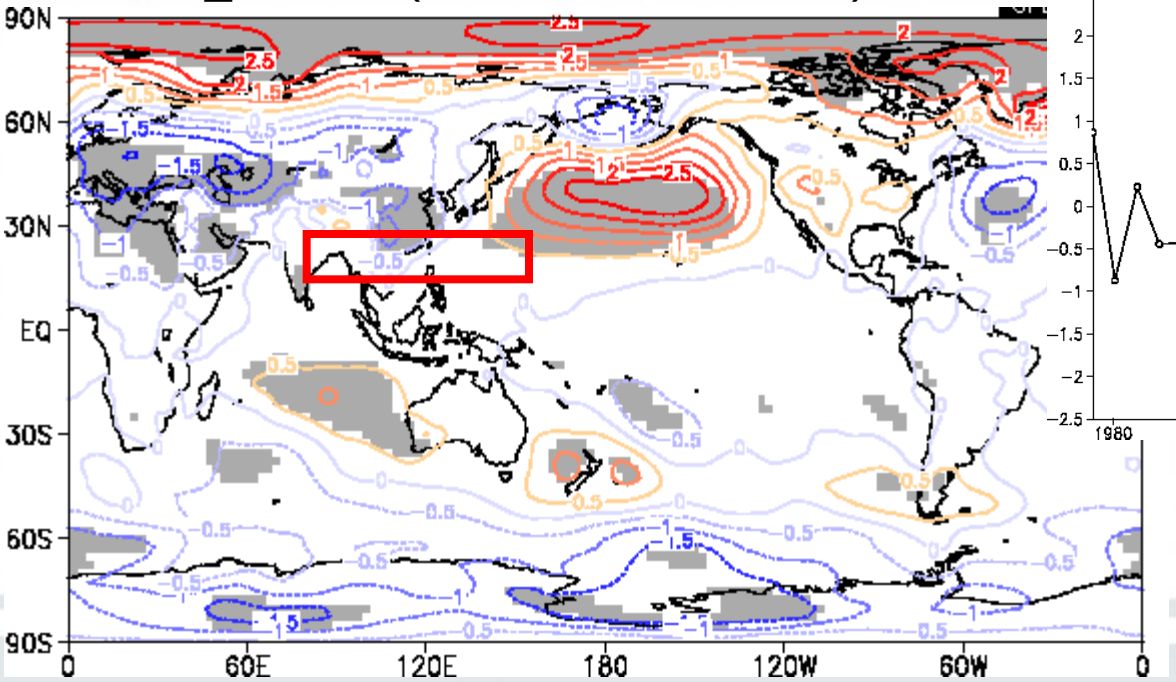


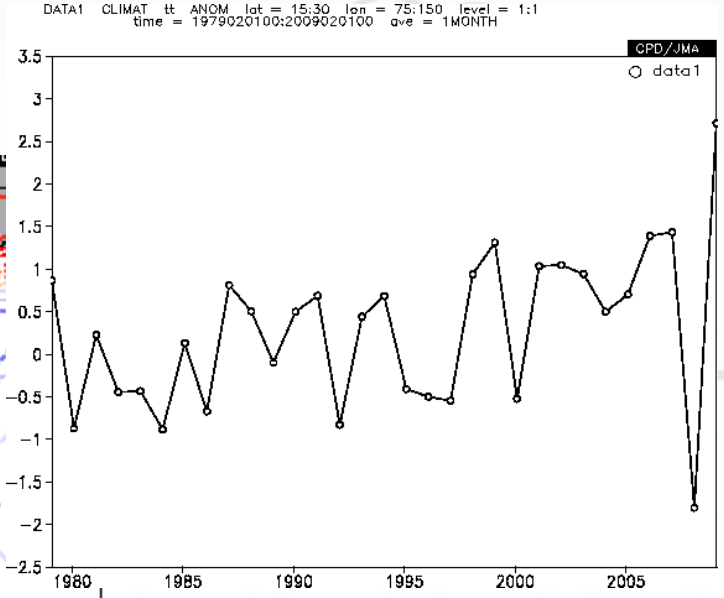


Extreme high temperature in southern Asia

- Circulation anomalies in association with temperature anomalies in southern Asia

SLP-T_CLIMAT(15N-30N, 75E-150E)

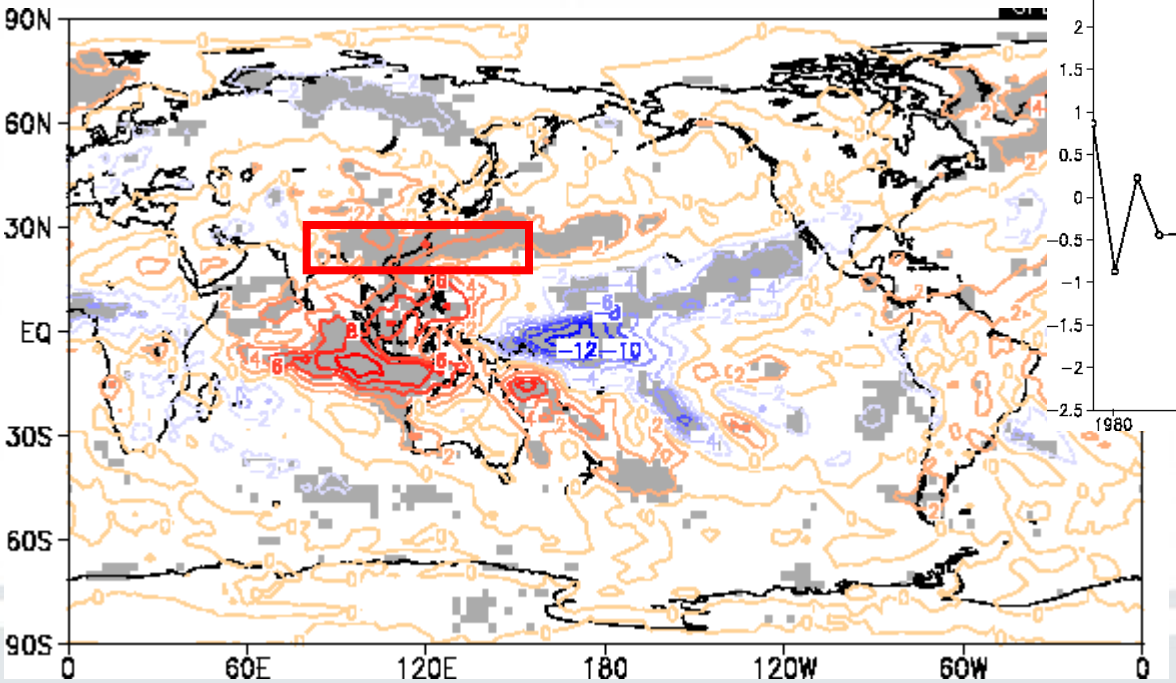


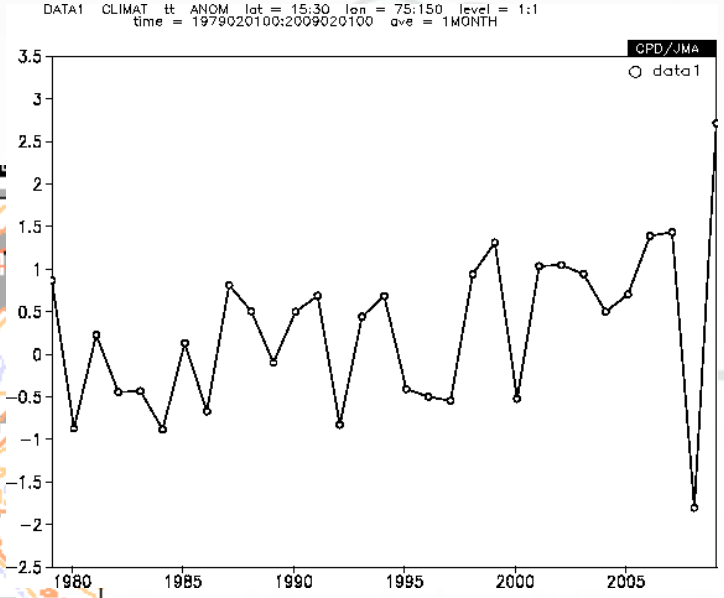


Extreme high temperature in southern Asia

- Circulation anomalies in association with temperature anomalies in southern Asia

OLR-T_CLIMAT(15N-30N, 75E-150E)





data1

dataset	element	data type	area	level	average period	show period
JRA-JCDAS	Geopotential height(gpm) Vector ☐ SD ☐	ANOM	ALL Lat: 20 – 90 Ave ☐ Lon: -45 – 315 Ave ☐	500 hPa 500 hPa	MONTHLY Ave ☐	RANGE 2009 02 2009 02

analysis method : DATA1_DATA2

data2

dataset	element	data type	area	level	average period	show period
JRA-JCDAS	Geopotential height(gpm) SD ☐	HIST	ALL Lat: 20 – 90 Ave ☐ Lon: -45 – 315 Ave ☐	500 hPa 500 hPa	MONTHLY Ave ☐	RANGE 2009 02 2009 02

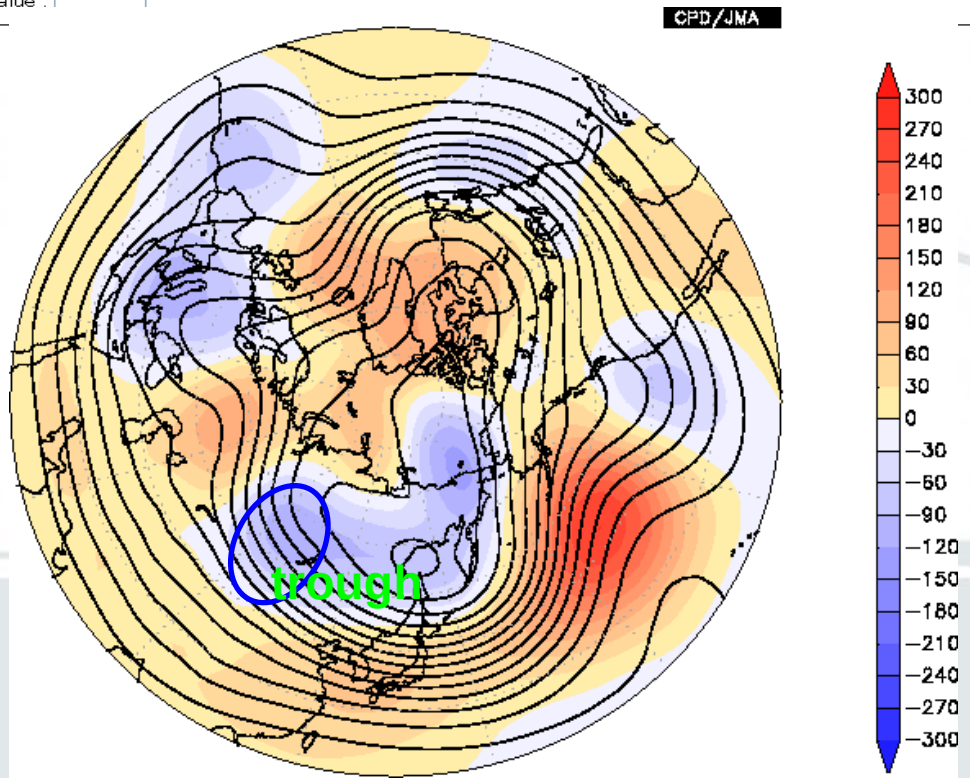
Graphic Option

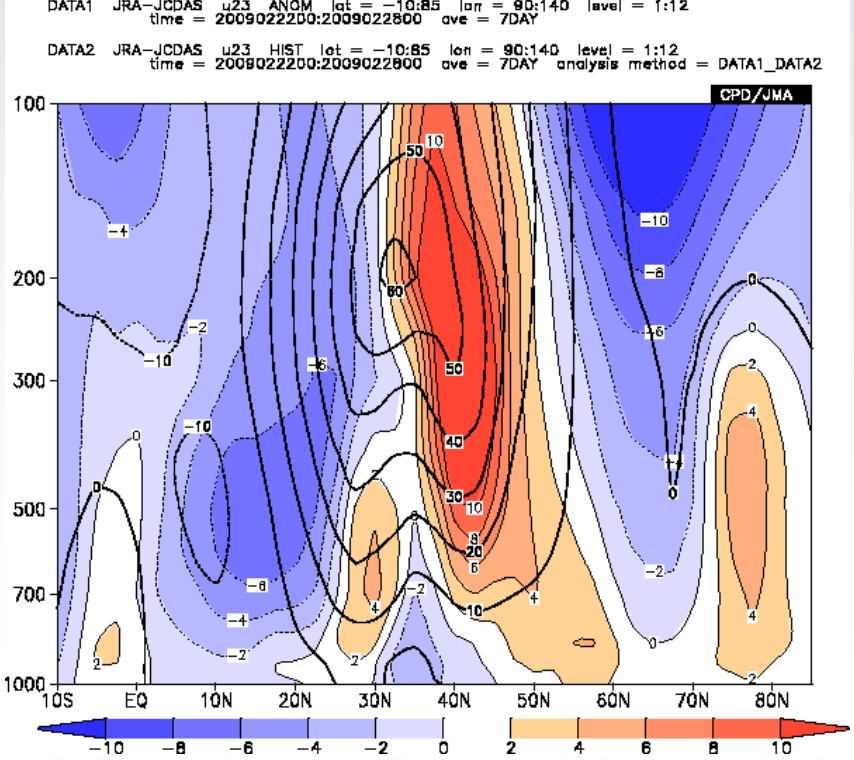
Colorizing : COLOR
Drawing : SHADE
Image Format : png

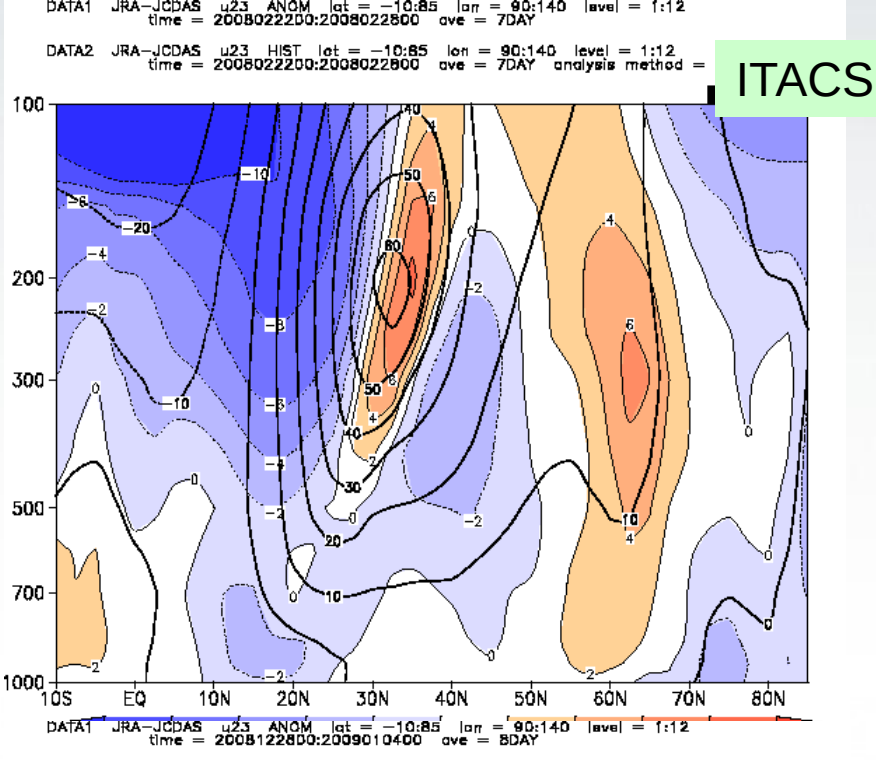
☐ Show Contour Labels
☑ Show Color Bar
☑ Set Contour Parameters for data1
interval : 30 min : -300 max : 300
☑ Set Contour Parameters for data2
interval : 60 min : 4800 max : 6000
☐ Set Vector size : [inch] value :

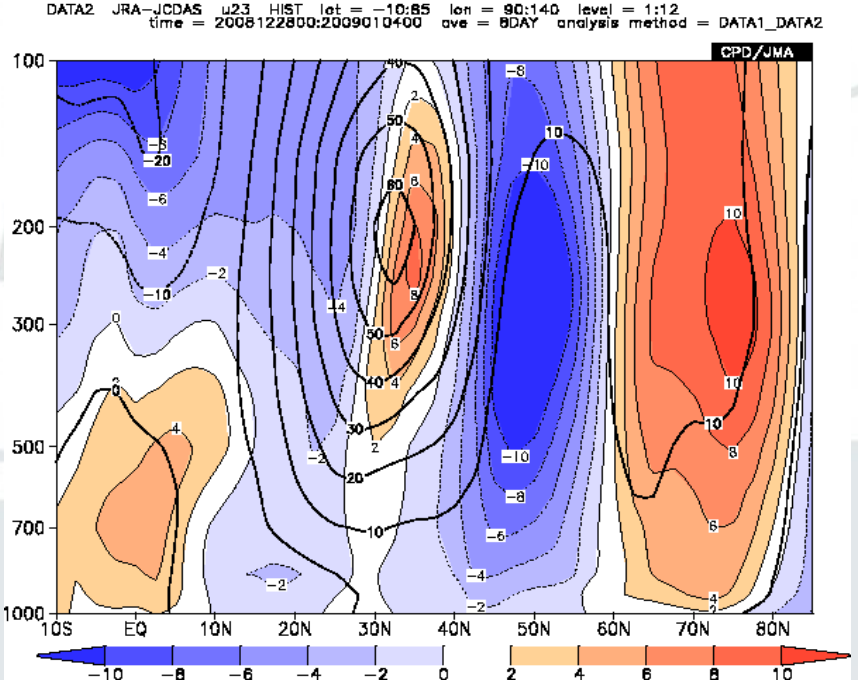
Color Table : Blue – Red
☑ Polar Stereographic : North pole
☐ Logarithmic Coordinates
☐ Reverse the Axes
☐ Flip the X-axis ☐ Flip the Y-axis
☑ No Caption

☐ No Scale Labels
☐ Draw Credit Inside









Left panel shows latitude-height cross section of zonal mean zonal wind averaged 90˚-140˚E in late Feb. 2009. The polar front jet was clearly seen from the upper troposphere to the lower troposphere at around 45˚N. The Siberian high accompanied with cold air mass developed in Siberia and migrated southward. However, the strong westerly in the lower troposphere advected the cold air mass eastward and consequently intercepted the southward migration of the Siberian High.

Upper right panel and lower right panel show in late Feb. 2008 and early Jan. 2009, respectively. These correspond to the time when the development of the Siberian High was observed. We can see the distributions of zonal wind are different from the case of late Feb. 2009.

http://ds.data.jma.go.jp/tcc/tcc/products/model/verif/4mE/vrfmap/month/zpcmap.html

Verification map of three-month forecast for each forecast

forecast period

the third month

initial date

2008.11.14.12Z

element

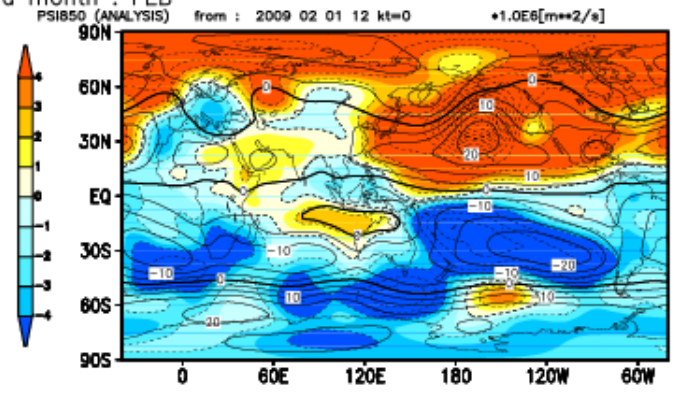
- stream function
- velocity potential
-

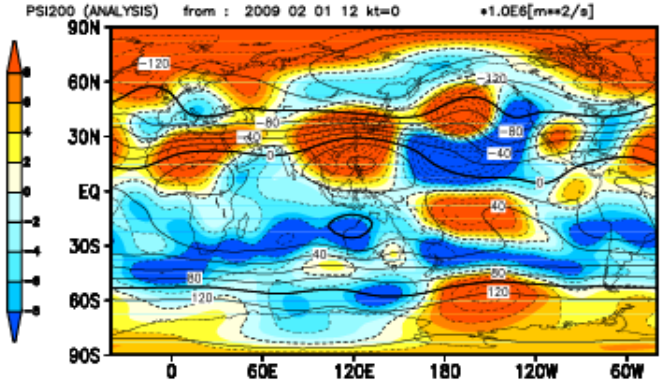
Z500,T850,PSEA

850hPa(top)
200hPa(middle)
precipitation(bottom)
(Shaded patterns show anomalies in left and middle figures, and that show errors in right figures.)

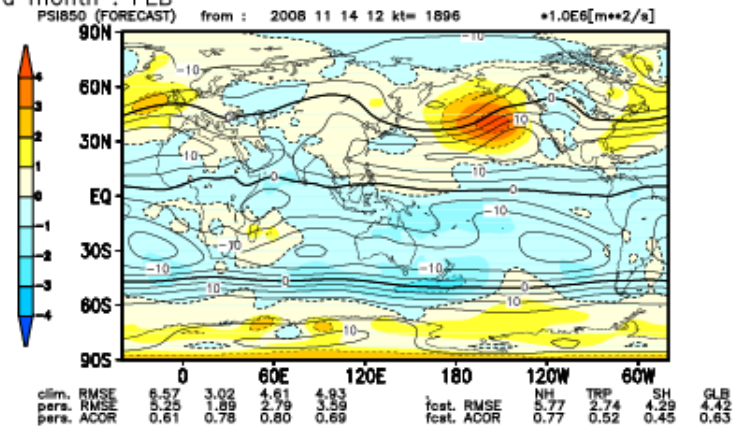
[Contour interval]
PSI850 : 5x1.0E6m^2/s
PSI200 : 20x1.0E6m^2/s
CHI850 : 2x1.0E6m^2/s
CHI200 : 2x1.0E6m^2/s
PRECIP(RAIN) : 4mm/day
OLR : 20W/m^2
Z500 : 120m
T850 : 4C
PSEA : 4hPa

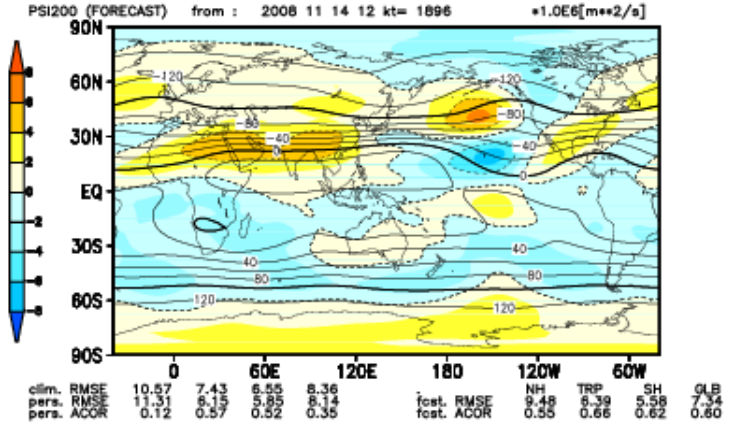
analysis





ensemble forecast





4. Summary

January: Since a ridge formed to the east of the Aleutian, cold surges flew southward periodically. This phenomenon was mainly caused by interaction of the circulations in mid-high latitudes itself, which means the predictability of forecasts was not so long (about two weeks).

February: Convective activities over the Philippines became stronger than January, which caused northward shift of sub-tropical jet stream. In mid-latitude zone, the meander of the jet stream was not so evident.

If you want to analyze the phenomenon or statistical relationships,

ITACS and GPV data are very useful for you!

APPENDIX

Preliminaries to JMA's new coupled seasonal model

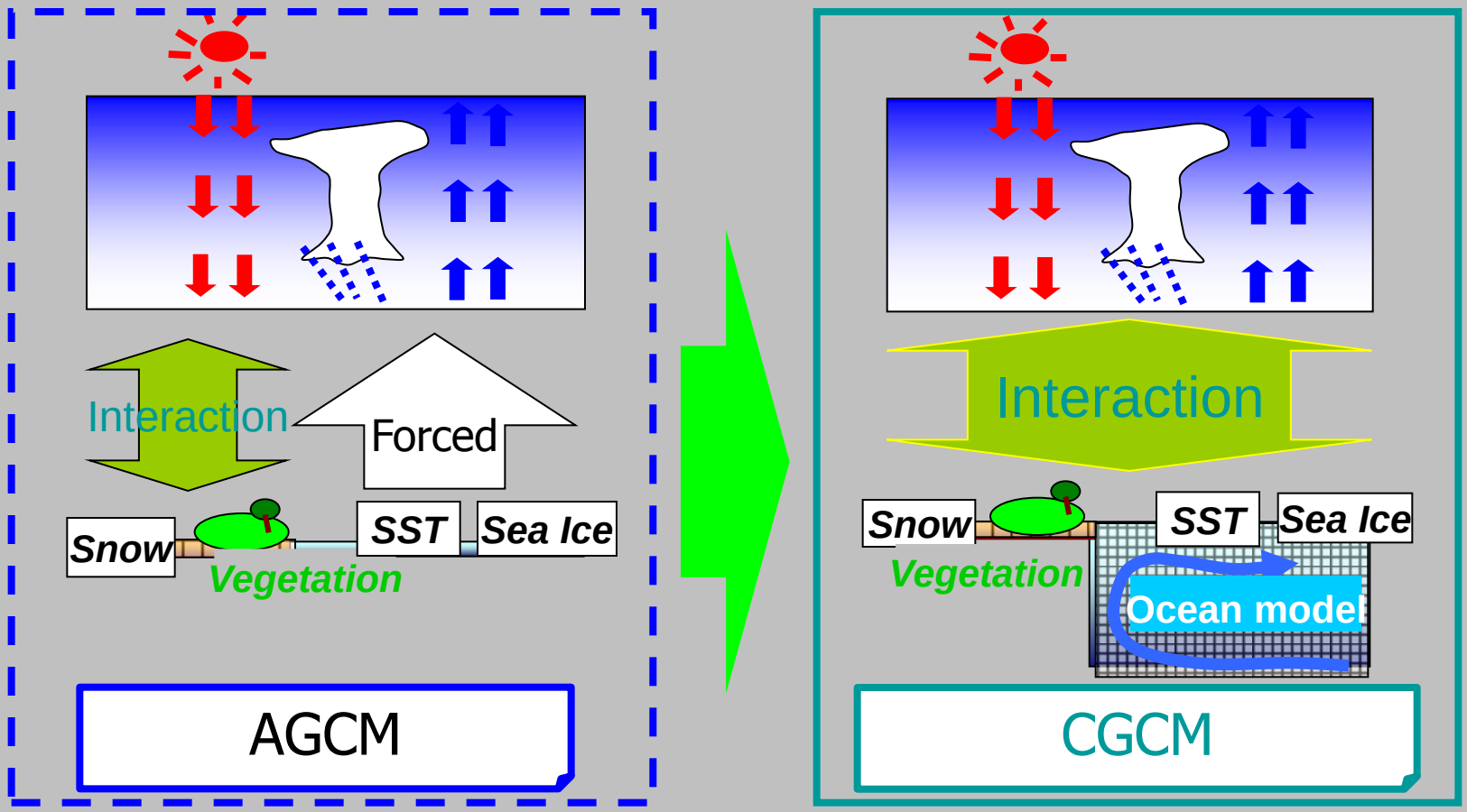
Specifications of the NWP model for seasonal forecast

(To be used for seasonal prediction after February 2010）

	JMA/MRI-Coupled GCM
Atmospheric comp.	JMA/MRI unified AGCM TL95L40 (~180km / 40 levels, 0.4hPa)
Oceanic comp.	MRI.COM (Ishikawa et al. 2005) 75˚S-75˚N, 0˚-360˚ lon1.0˚ - lat 0.3˚-1.0˚ / 50 levels
Coupler	Coupling interval: 1 hour Flux adjustment for heat and momentum flux
Ensemble	BGM/LAF Totally 51members within 25days
Perturbation	Atmospheric BGM → Oceanic perturbation

2-tier model → Coupled model

Interaction between Atmosphere and Ocean
→ Improvement of forecast

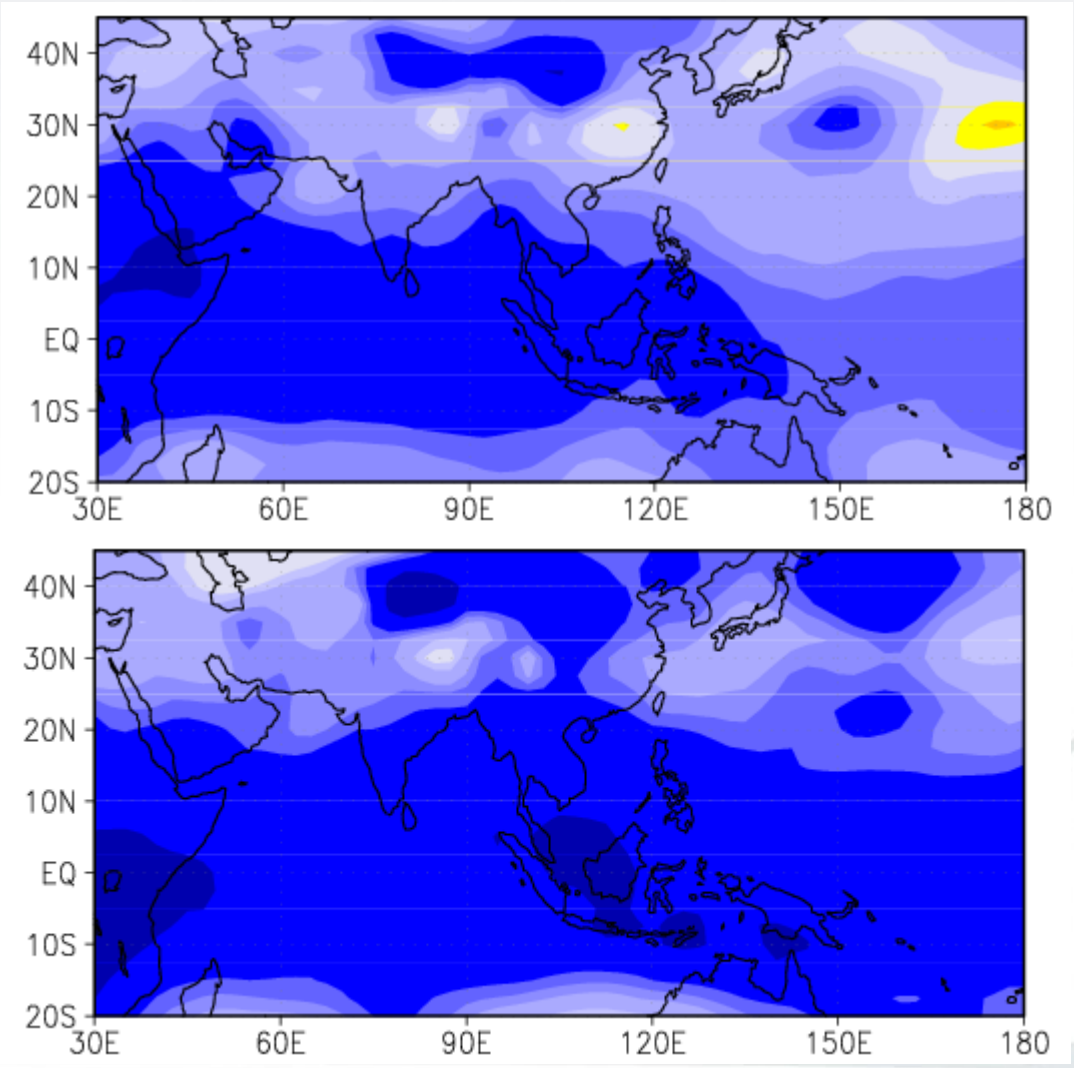


Expected improvement of forecast for Z500

2-tier : ACOR(JJA)
Intial:1.31

Coupled : ACOR(JJA)

Initial : 1.31



Thank you for your attention

HARERUN

a mascot of JMA