ENSO Outlook by JMA

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Japan Meteorological Agency

Outline

1. ENSO impacts on the climate
2. Current Conditions
3. Prediction by JMA/MRI-CGCM
4. Summary

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1. ENSO impacts on the climate

Climate tendencies during El Niño/La Niña in boreal winter
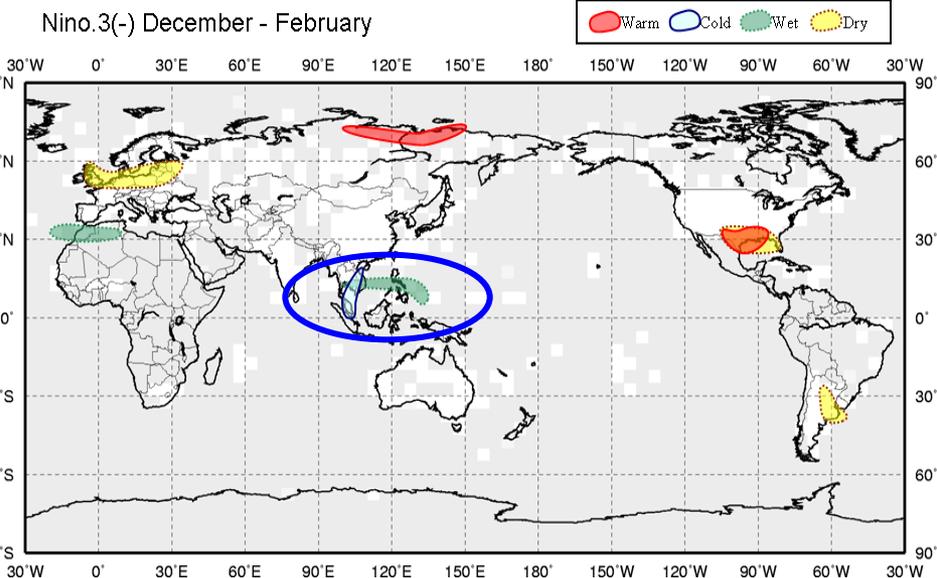
The maps show the regions where climate tendencies observed during El Niño/La Niña events are statistically significant in boreal (northern hemisphere) winter.

✓ *El Niño* : warm tendencies from Malaysia to the Philippines

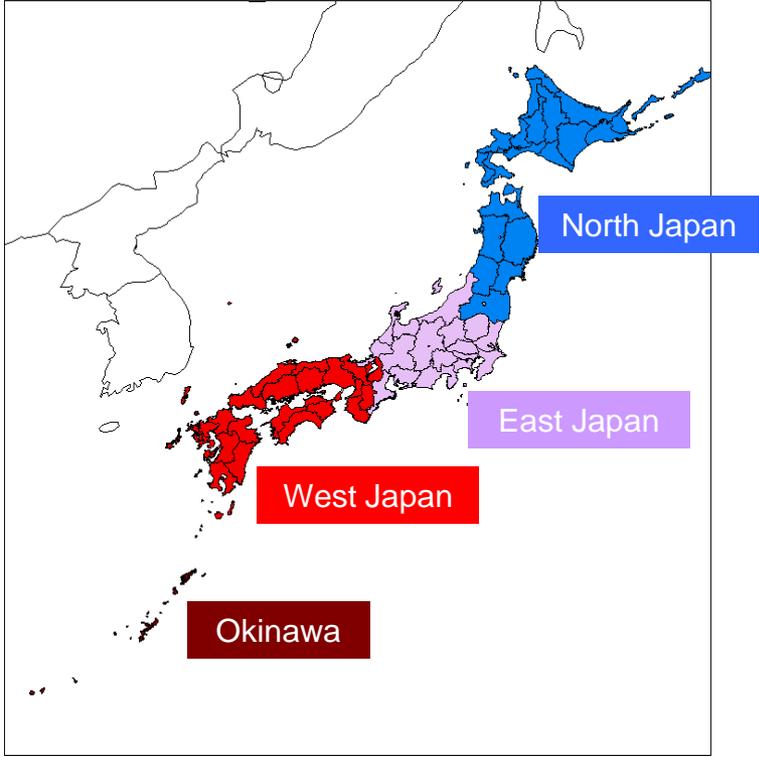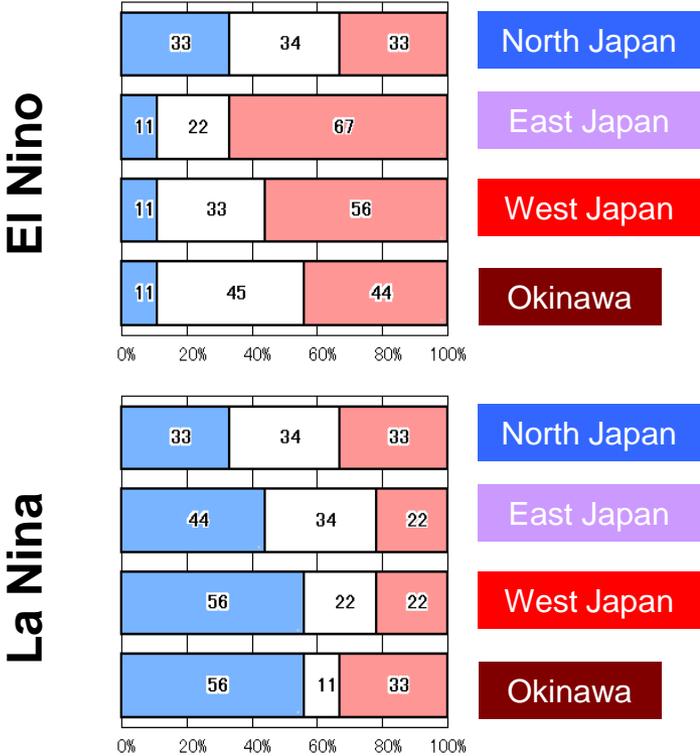✓ *La Niña* : cool and wet tendencies from Cambodia to Malaysia

El Niño
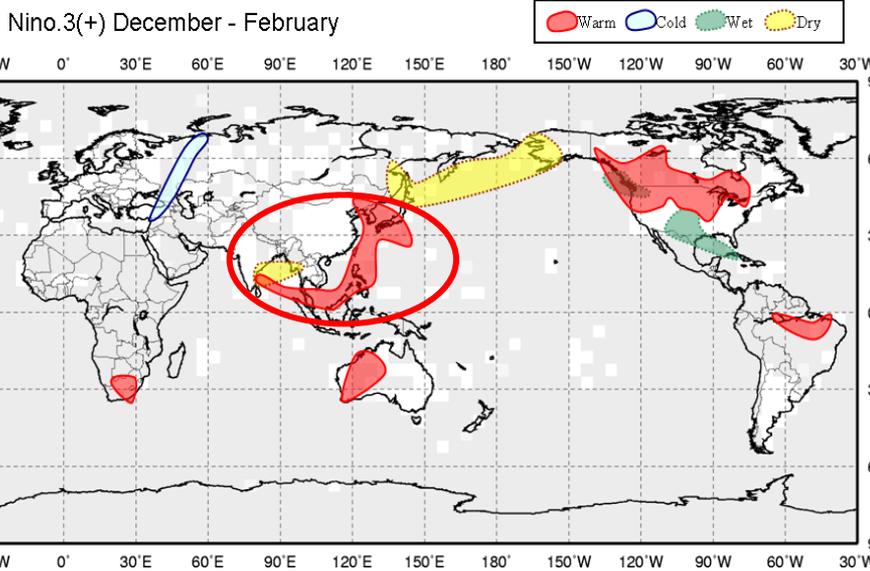
La Niña

ENSO impacts on the climate in Japan

Statistics indicate :
- *Warm winter tendencies during El Niño*
- *Cold winter tendencies during La Niña.*

Frequency distribution for air temperature in boreal winter during El Niño (above) and La Niña (below), in terms of 3 ranges of warmer-than-climatological condition(Red), near-climatological condition(White), and lower-than-climatological condition(Blue)

Last Winter…

In January 2011, it was colder than normal all over Japan.

It was partly influenced by the La Niña events.

Monthly temperature anomalies (°C)
(January 2011)
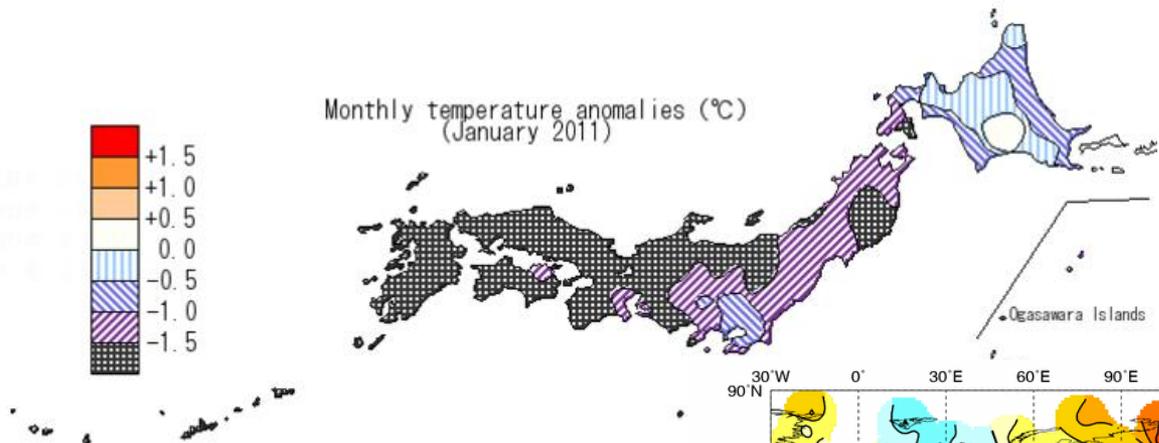
Maps of surface temperature anomalies in January 2011
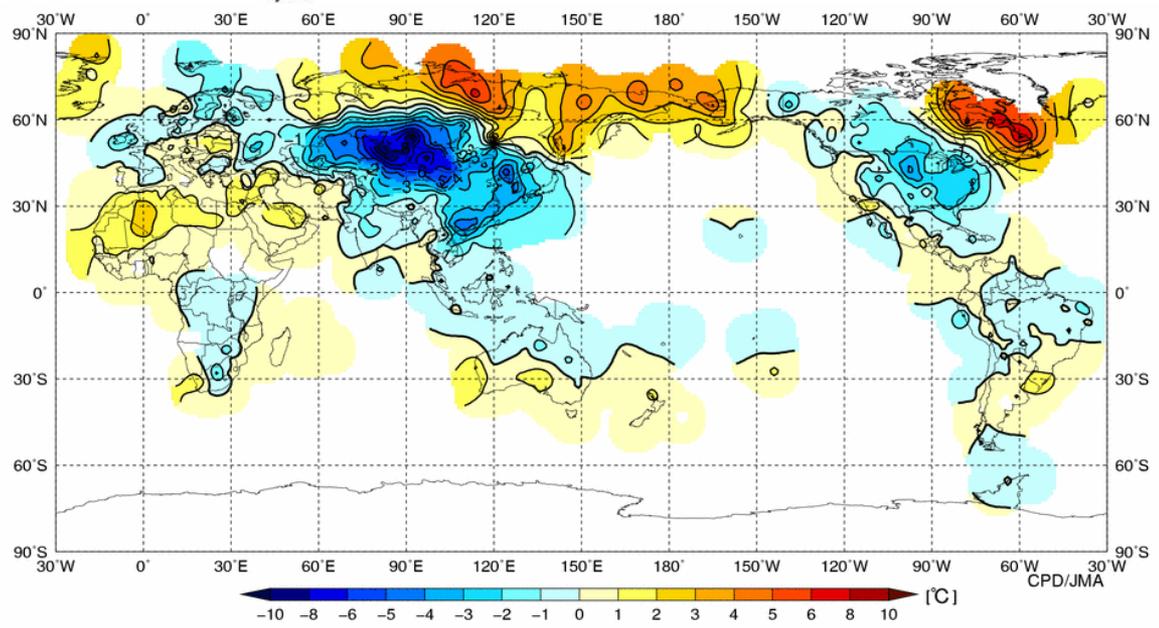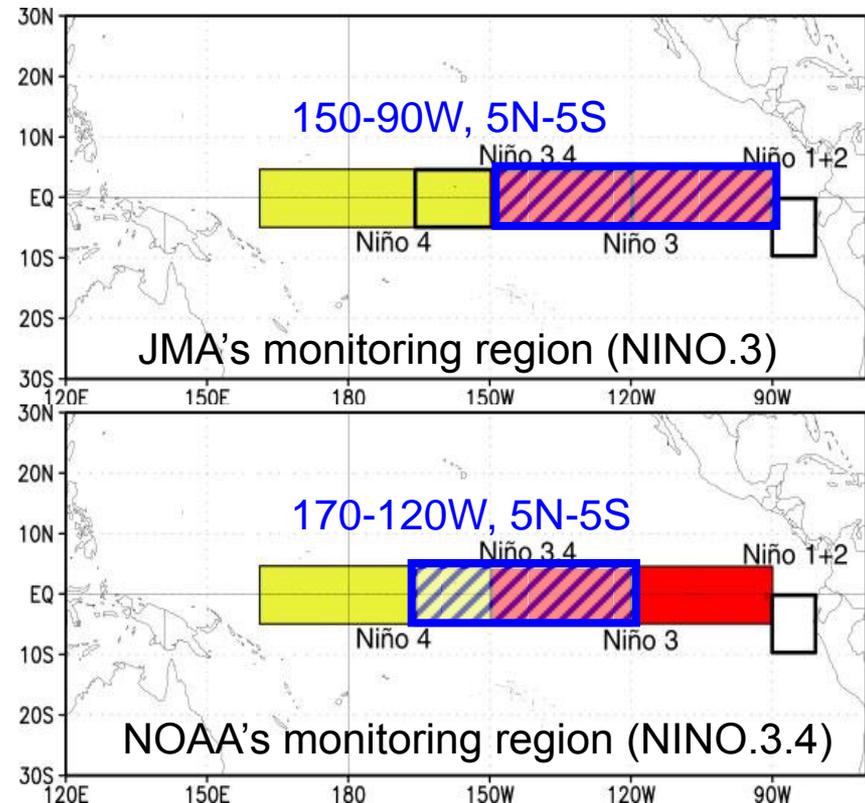
2. Current Conditions

Quantitative definition of El Niño (La Niña) event

Definition of El Niño (La Niña) by JMA

> *5-month running mean of NINO.3 SST deviation stays +0.5ºC or higher (-0.5ºC or lower) for 6 consecutive months or longer.*
> *NINO.3 SST deviation is defined as deviation from the latest 30-year (e.g. 1981-2010 for the year 2011) average.*

150-90W, 5N-5S

JMA's monitoring region (NINO.3)

Definition by NOAA

> *3-month running mean of NINO.3.4 SST deviation from climatological mean stays more than 0.5ºC (less than -0.5ºC) for the consecutive period longer than 5 months.*

170-120W, 5N-5S

NOAA's monitoring region (NINO.3.4)

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# ENSO monitoring indices (NINO.3 SST)

> *The monthly NINO.3 SST deviation in October was -0.9ºC (decreasing).*
> *The 5-month running mean values for August was -0.4ºC (begin decreasing).*

| NINO.3	2010		2011									
	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May	Jun.	Jul.	Aug.	Sep.	Oct.
Monthly mean SST	23.5	23.7	24.2	25.6	26.4	27.2	26.9	26.6	25.7	24.7	24.3	24.1
SST deviation	-1.6	-1.5	-1.4	-0.8	-0.7	-0.3	-0.2	+0.1	0.0	-0.4	-0.6	-0.9
5-month mean SST deviation	-1.5	-1.4	-1.2	-0.9	-0.7	-0.4	-0.2	-0.2	-0.2	-0.4	＊	＊
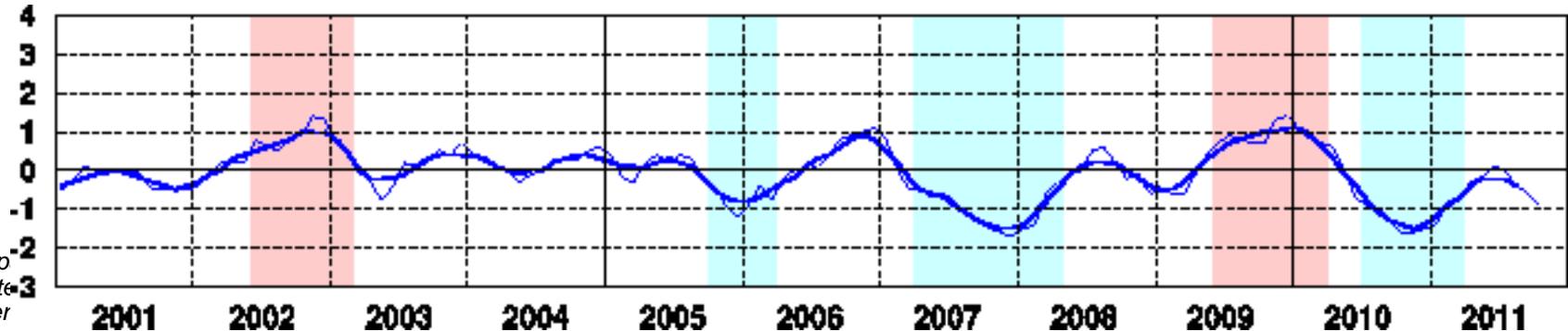
Oceanic conditions in the tropics 1

> ➤ *Negative SSTAs and negative subsurface temperature anomalies were prominent in the central-eastern tropical Pacific.*
> ➤ *Positive subsurface temperature anomalies were confined in the western equatorial Pacific.*
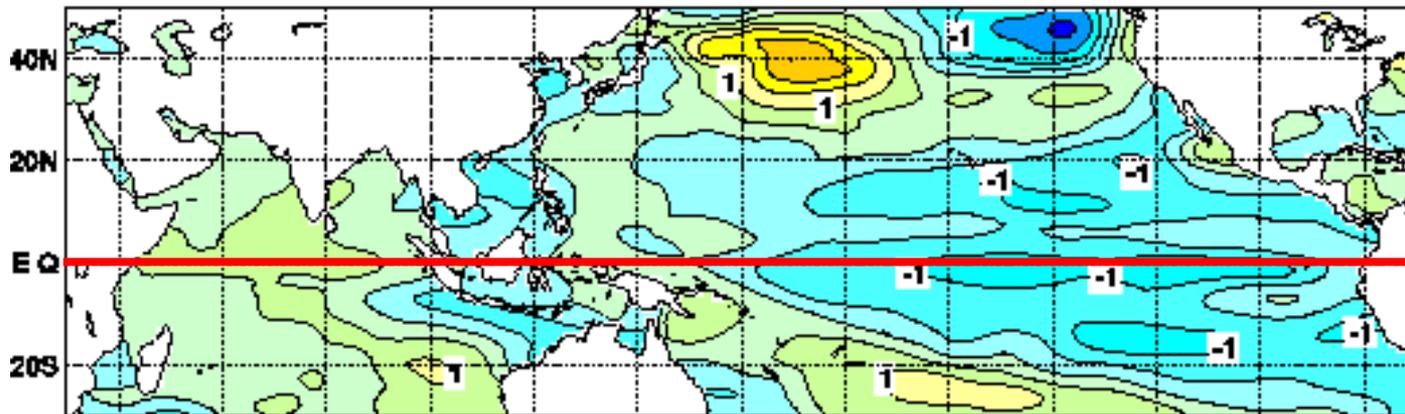
Analyses of the equatorial Pacific Ocean conditions for October, 2011.

(above) SST anomaly

(below) Vertical section of temperature anomaly along the equator
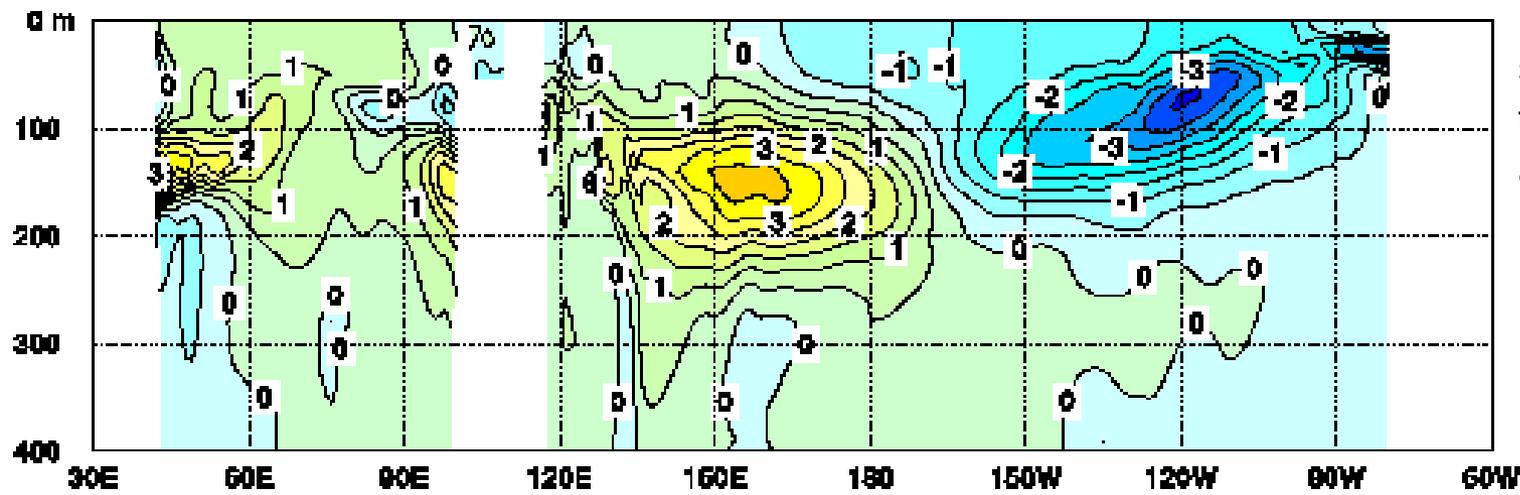
Oceanic conditions in the tropics 2

> Negative SSTAs strengthened in the central-eastern equatorial Pacific.
> Positive OHCAs were confined in the west of the dateline.
> Eastward propagations of cold water were observed.
⇒ Oceanic features in the equatorial Pacific were almost La Niña conditions.
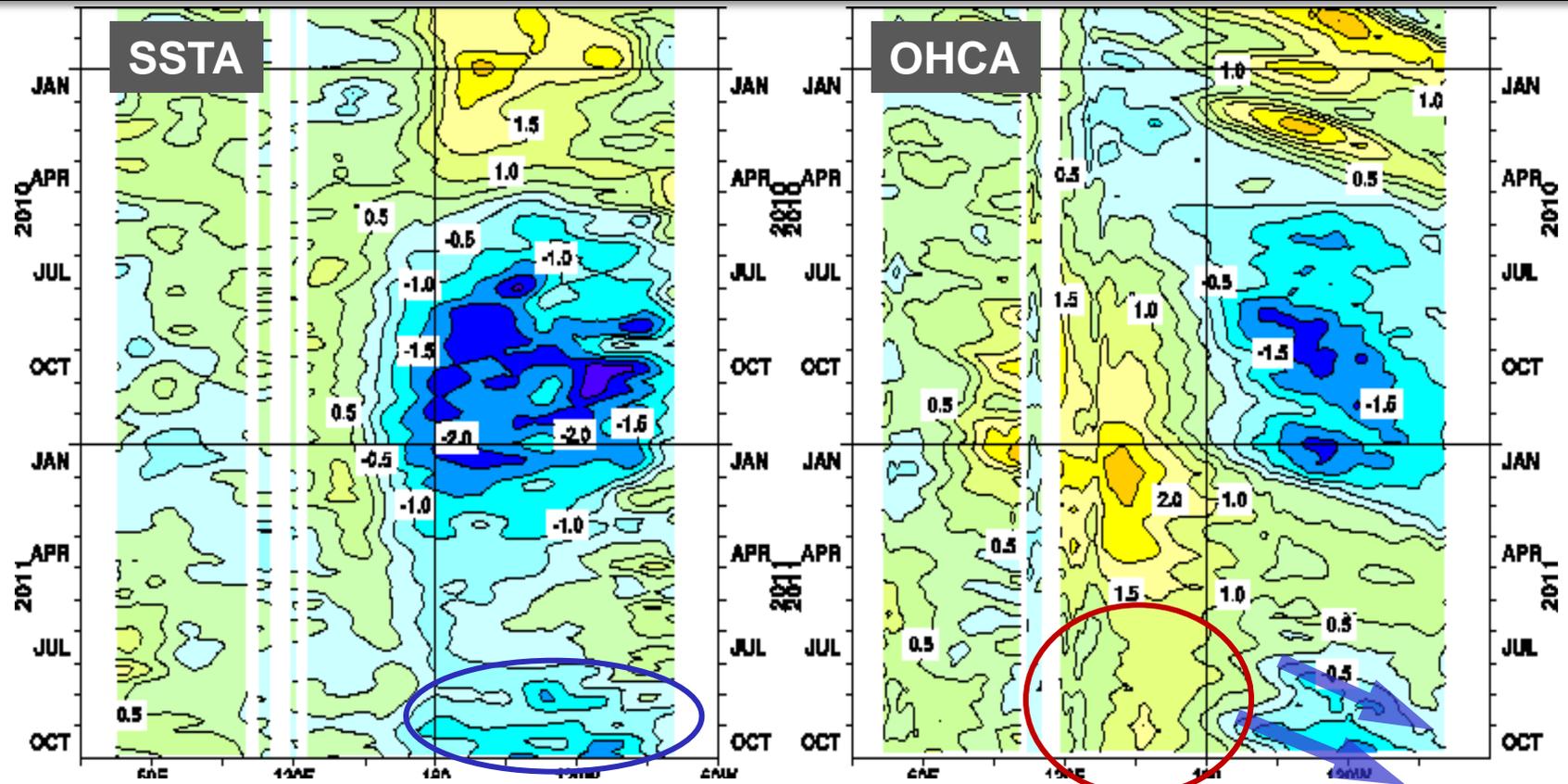
Longitude-time section of SSTA(left) and OHCA(right) along the equator from Nov. 2009 to Oct. 2011.
OHC (ocean heat content) is water temperature vertically averaged from the surface to 300m depth.

Atmospheric conditions in tropics

> *OLR anomalies indicated less active convection in western equatorial Pacific.*
> *Zonal winds at the lower and upper troposphere were near normal.*
> ⇒ La Niña features in the equatorial Pacific atmosphere were weakened in October 2011.

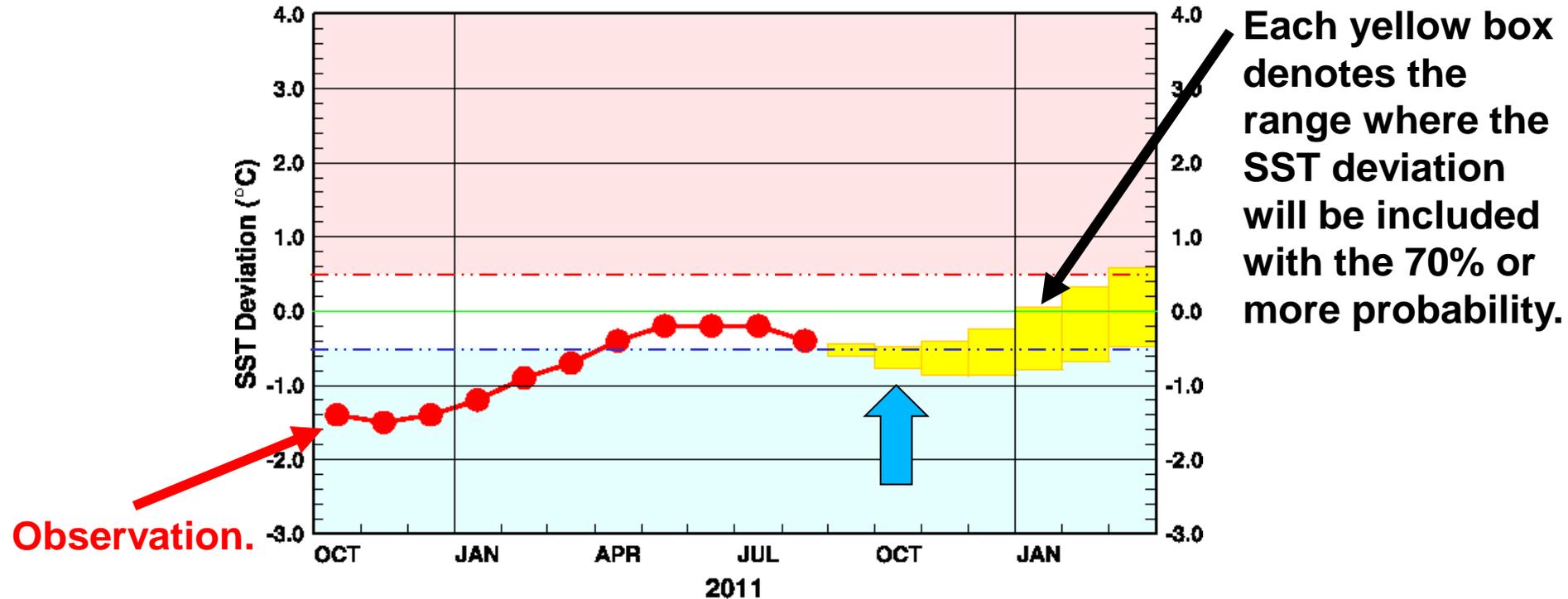**OLR anomalies Oct. 2011**
Blue: more active
Yellow: less active
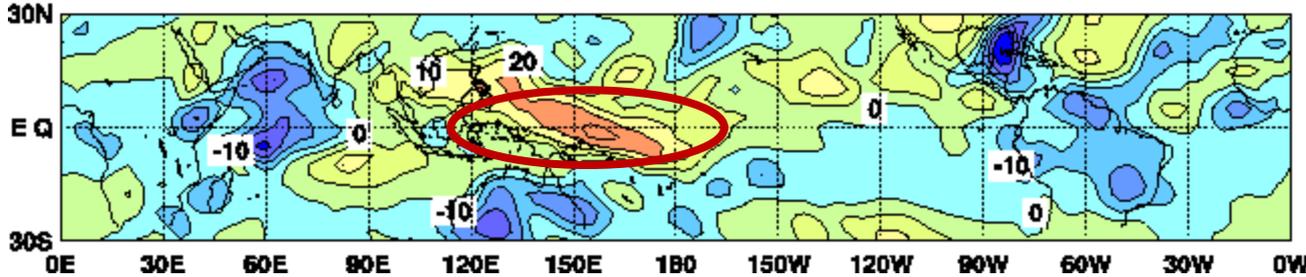
Zonal wind indices in the central equatorial Pacific
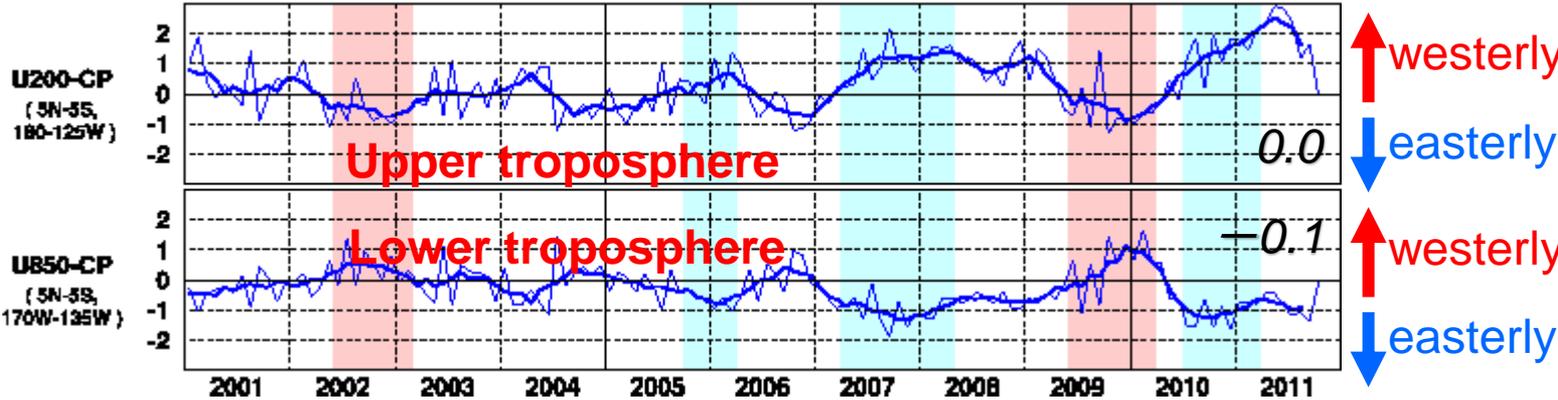
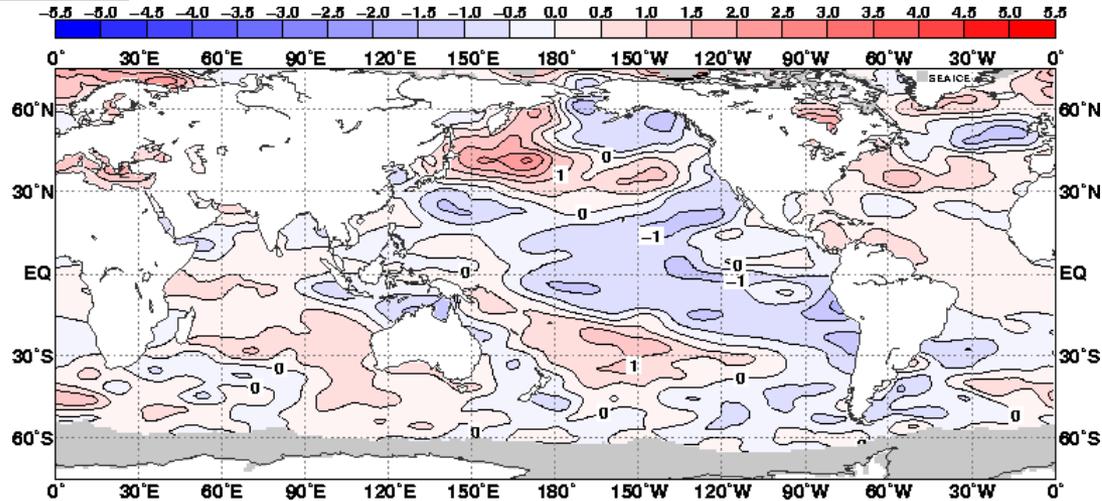# 3. Prediction by JMA/MRI-CGCM

Model prediction (JMA/MRI-CGCM)

✓ *The predicted 5-month running mean NINO.3 SST deviation is likely to be lower than -0.5ºC in October and continue lower than -0.5ºC until winter.*

Each yellow box denotes the range where the SST deviation will be included with the 70% or more probability.

Observation.

The observed (red dots) and predicted (yellow boxes) 5-month running mean NINO.3 SST deviations.

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4. Summary

•*La Niña conditions are present*
•*It is likely that La Niña conditions will decay between winter and spring*

- ◼ <u>*Current conditions*</u>
  - ✓ Oceanic features in the equatorial Pacific were almost La Niña conditions.
    - ➢ JMA's monthly ENSO Monitoring Index in October : -0.9ºC (decreasing)
    - ➢ Negative SSTA and OHCA in the central and eastern tropical Pacific
    - ➢ Positive OHCA in the west of the dateline
  - ✓ La Niña features in the equatorial Pacific atmosphere were weakened in October.
    - ➢ Normal zonal winds in the central Pacific
    - ➢ Less active convection in the western Pacific

- ◼ <u>*Predictions by JMA/MRI-CGCM*</u>
  - ✓ The predicted 5-month running mean NINO.3 SST deviation is likely to be lower than -0.5ºC in October and continue lower than -0.5ºC until winter

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Thank you

Backup Slides

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Global SSTA

Sep. 2011

Oct. 2011

Equatorial Pacific
•Extended negative anomaly

Tropical Indian
•Persistent positive anomaly in the west of Australia

North Pacific
•Persistent positive SSTA in the east of Japan
•Extended negative SSTA in the west of USA

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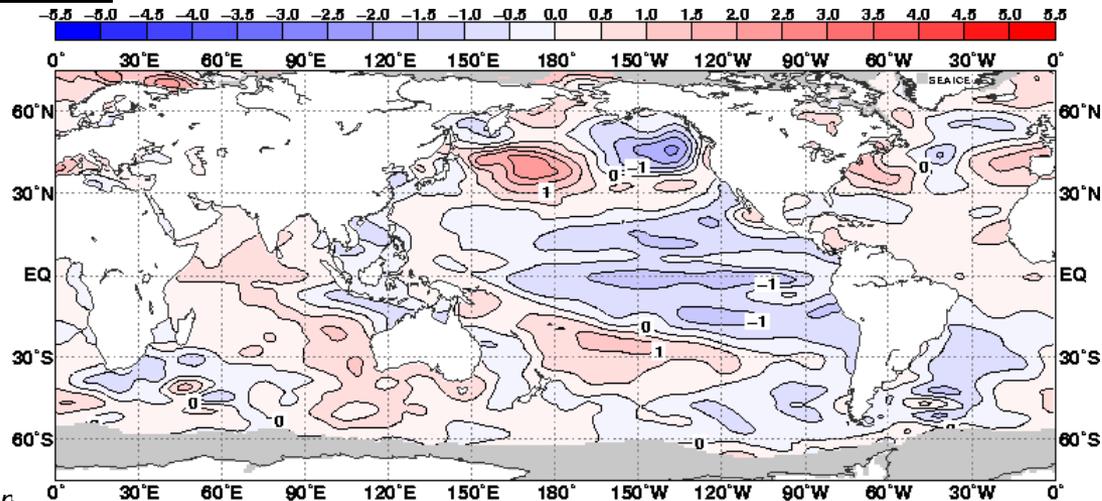
Normalized SSTA

Sep. 2011
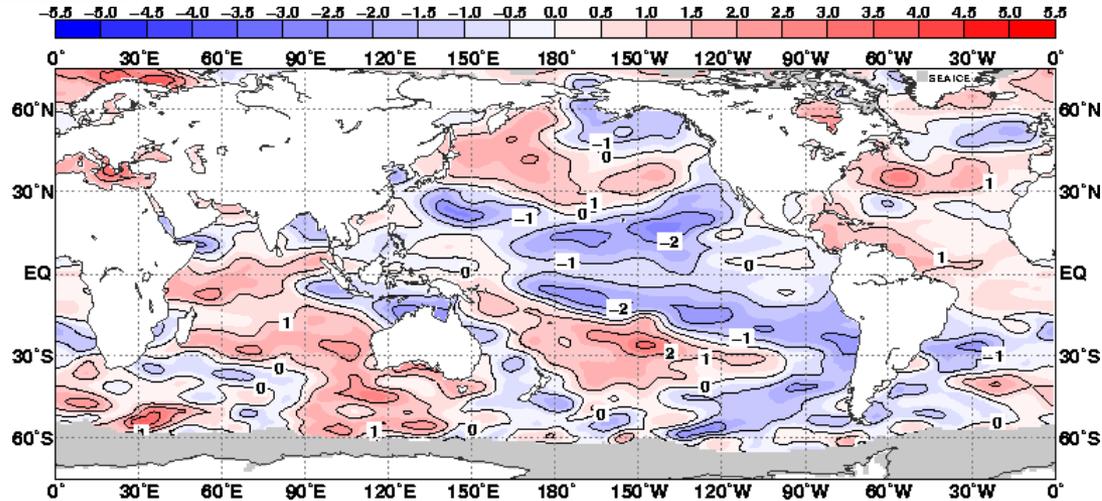
Oct. 2011

Equatorial Pacific
•Less than 1-sigma

Tropical Indian
•More than 1-sigma in the western-central part

North Pacific
•More than 1-sigma in the east of Japan
•Less than 1-sigma in the west of USA

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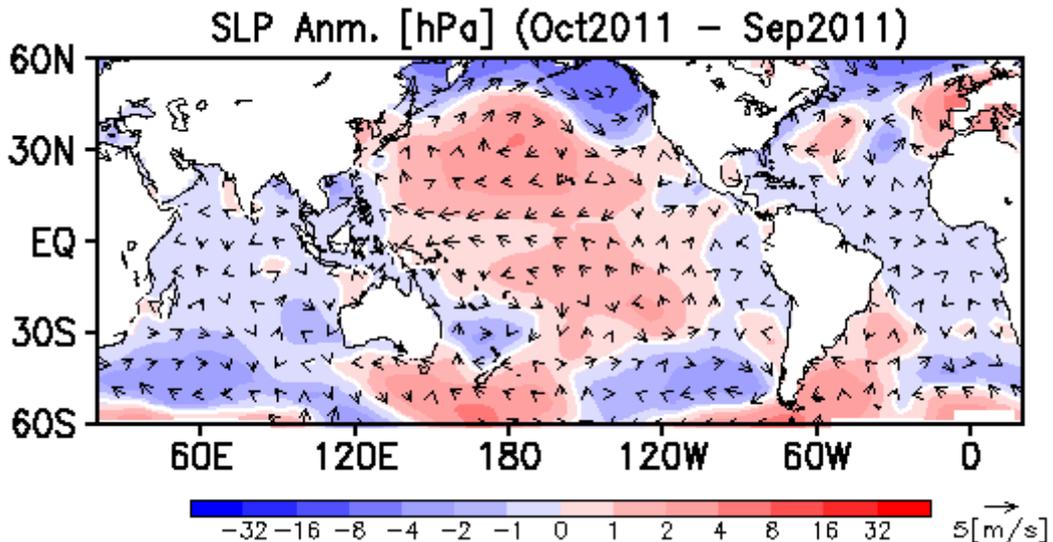Agency
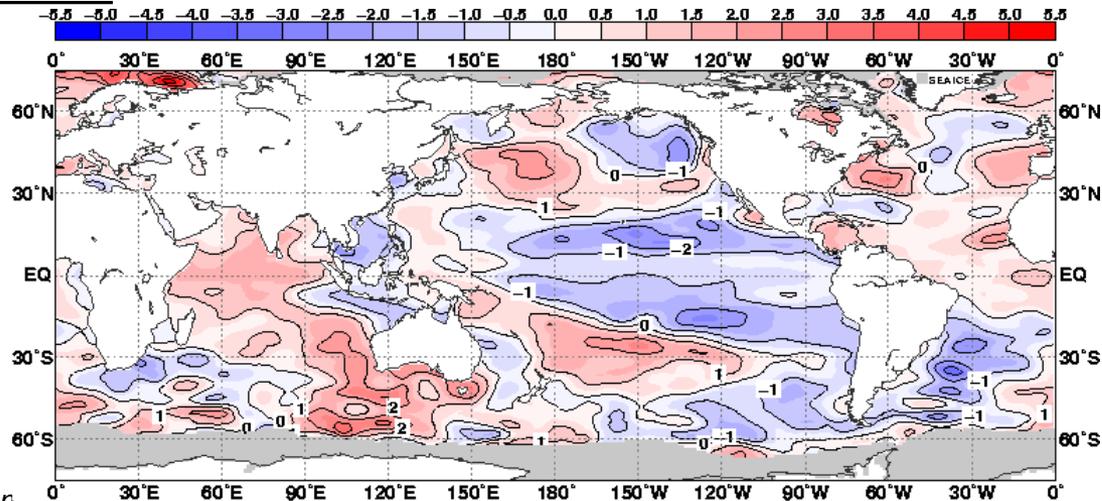
Subsurface Temperature along EQ

Sep. 2011

Oct. 2011
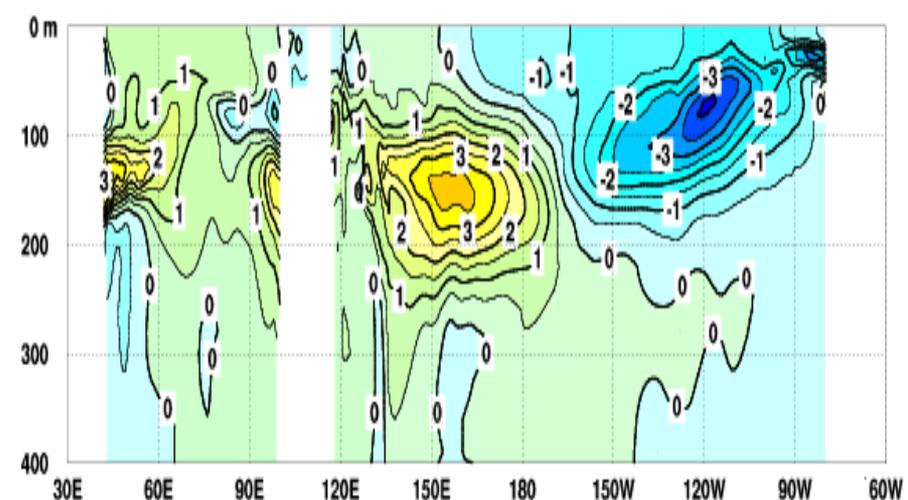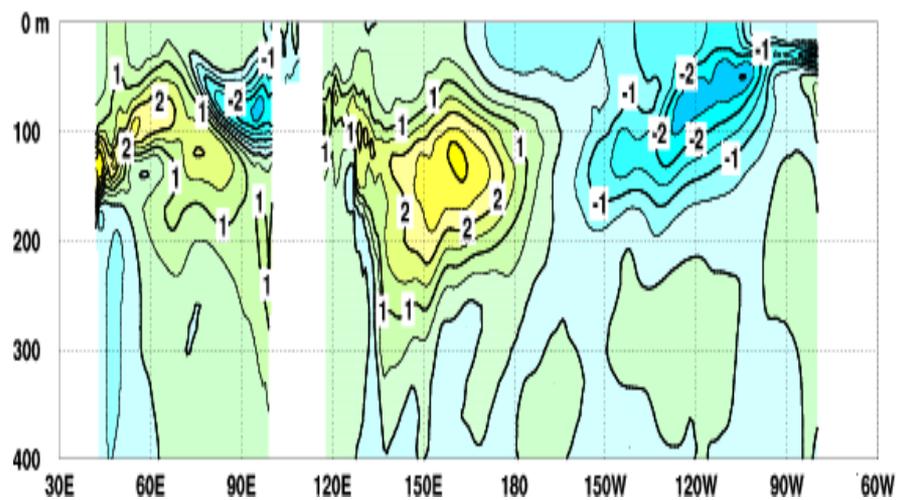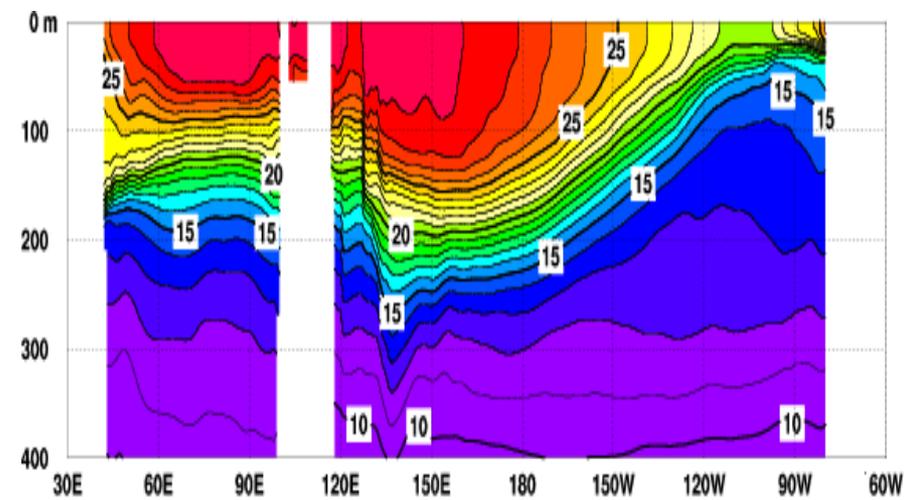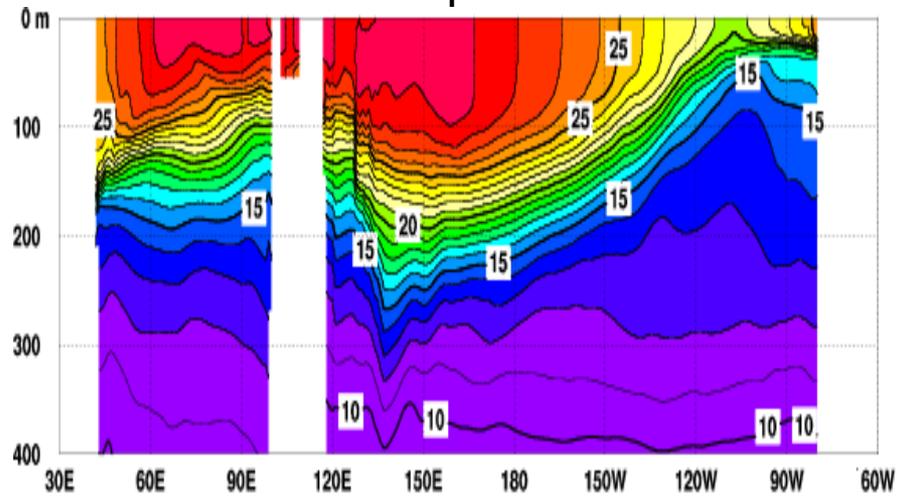
Temperature increased in the western Pacific, and decreased in the central –eastern Pacific
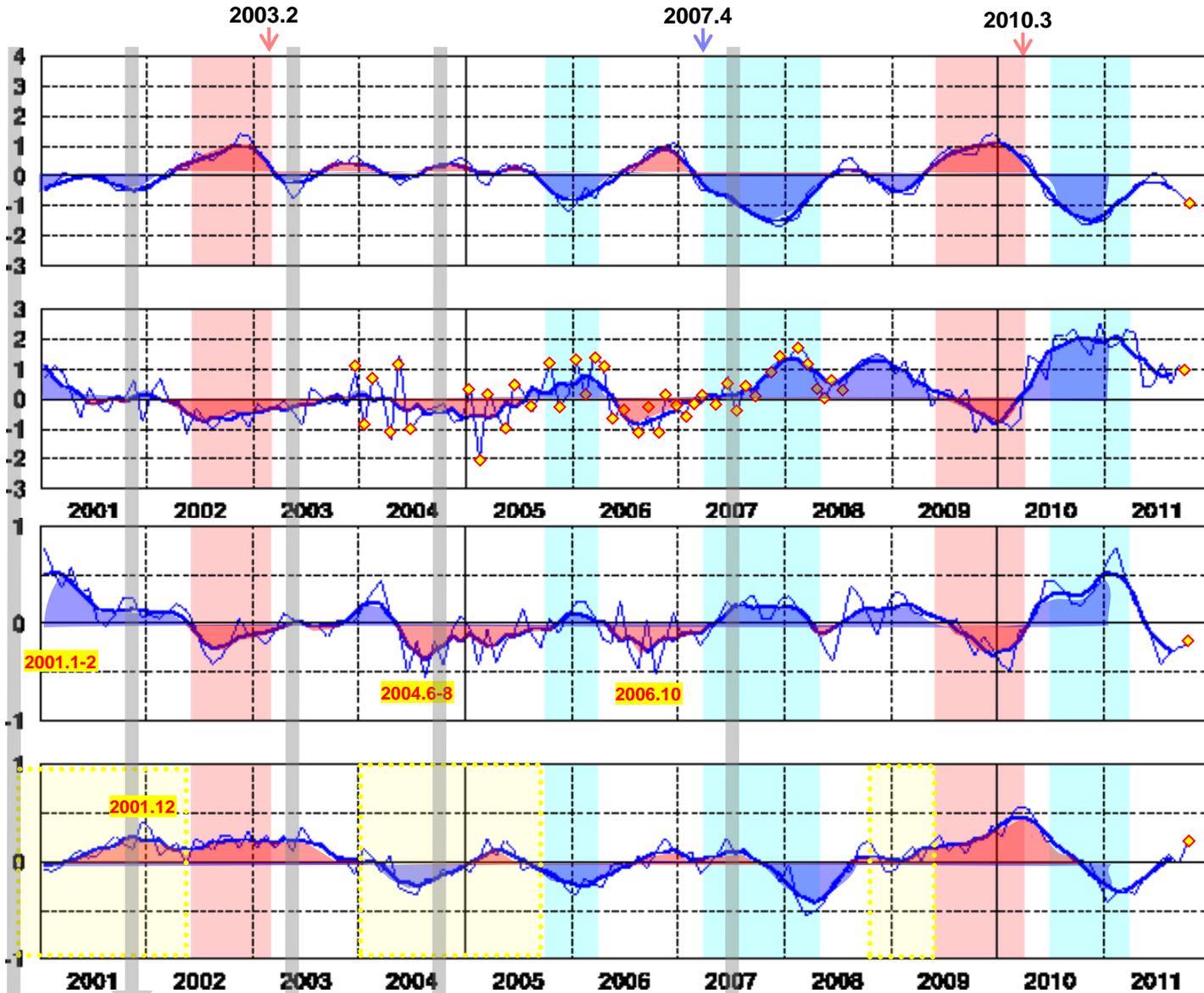Temperature increased in the eastern Indian Ocean

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Surface Flux

Net Heat Flux [W/m²] (Oct2011 – Sep2011)

Obs ΔSSTA [K] (Oct2011 – Sep2011)

ShortWave Rad. Flux Anm. [W/m²] (Oct2011 – Sep2011)

LongWave Rad. Flux Anm. [W/m²] (Oct2011 – Sep2011)

Latent Heat Flux Anm. [W/m²] (Oct2011 – Sep2011)

Sensible Heat Flux Anm. [W/m²] (Oct2011 – Sep2011)

SLP & Wind Anomaly

SLP Anm. [hPa] (Oct2011 − Sep2011)

|V| Anm. [m/s] (Oct2011 − Sep2011)
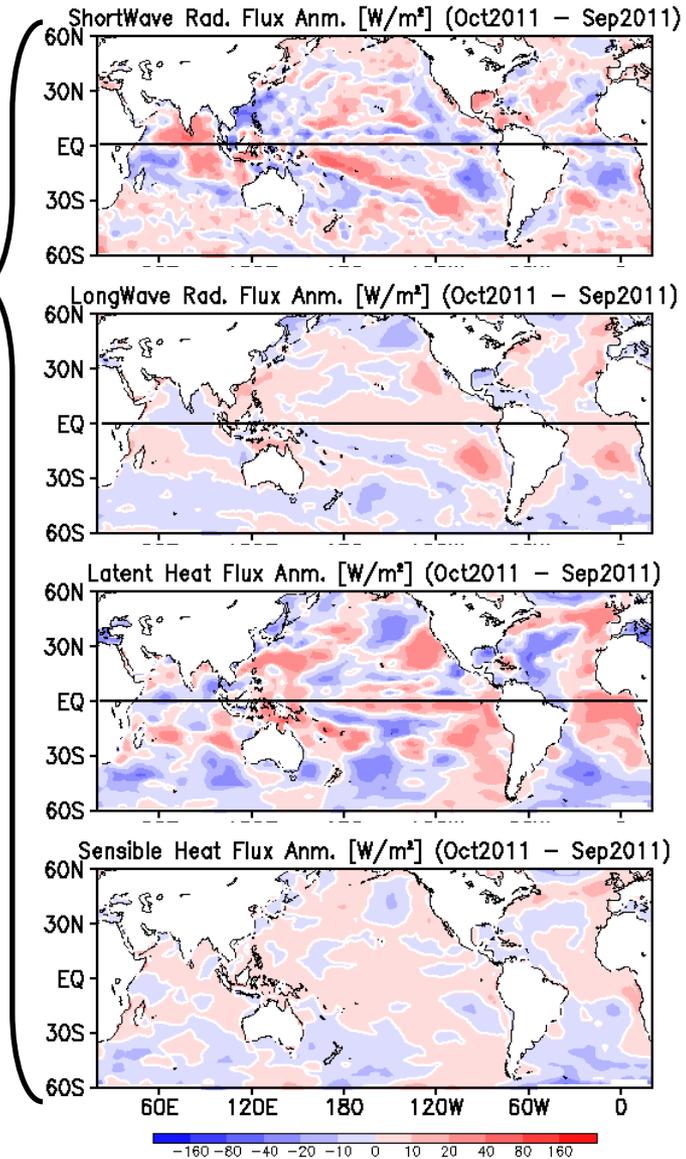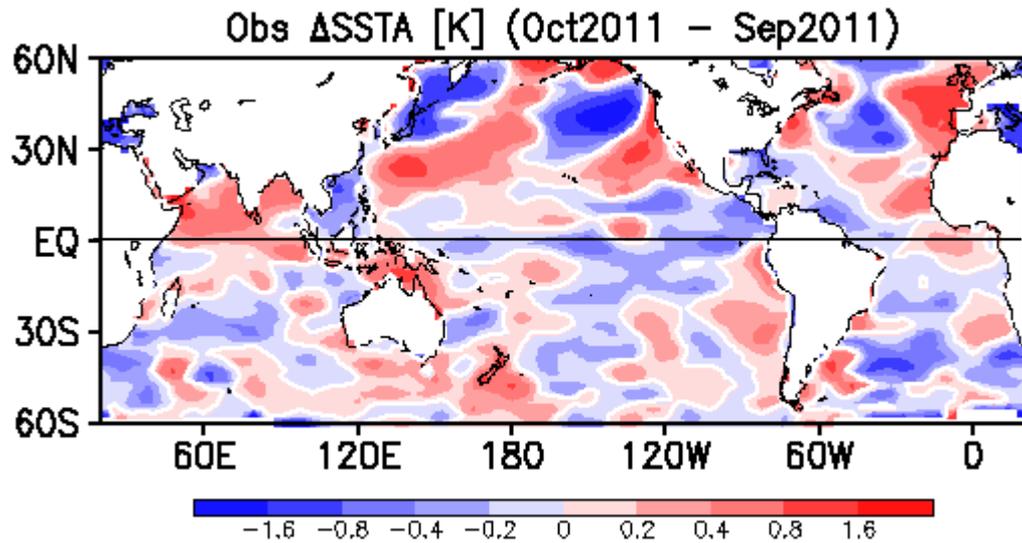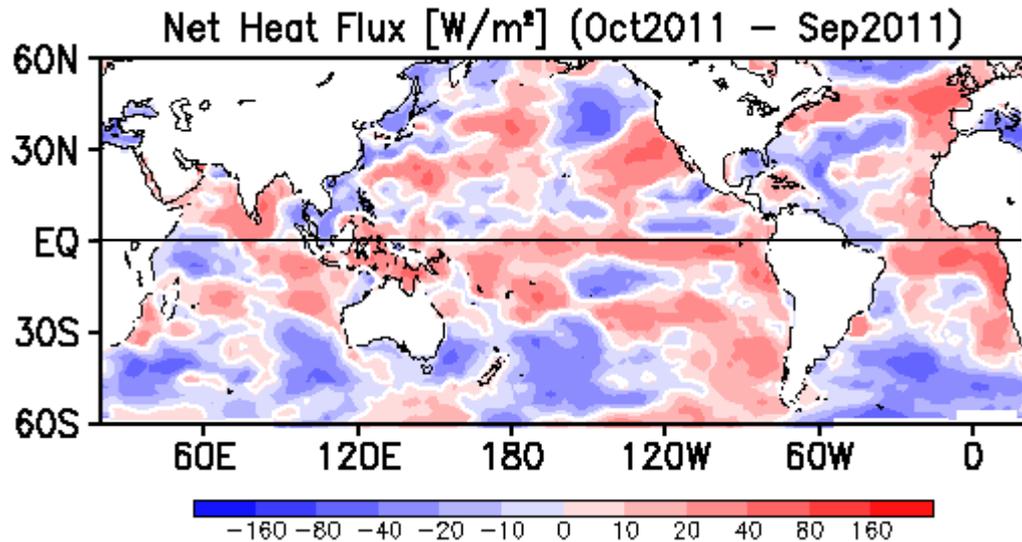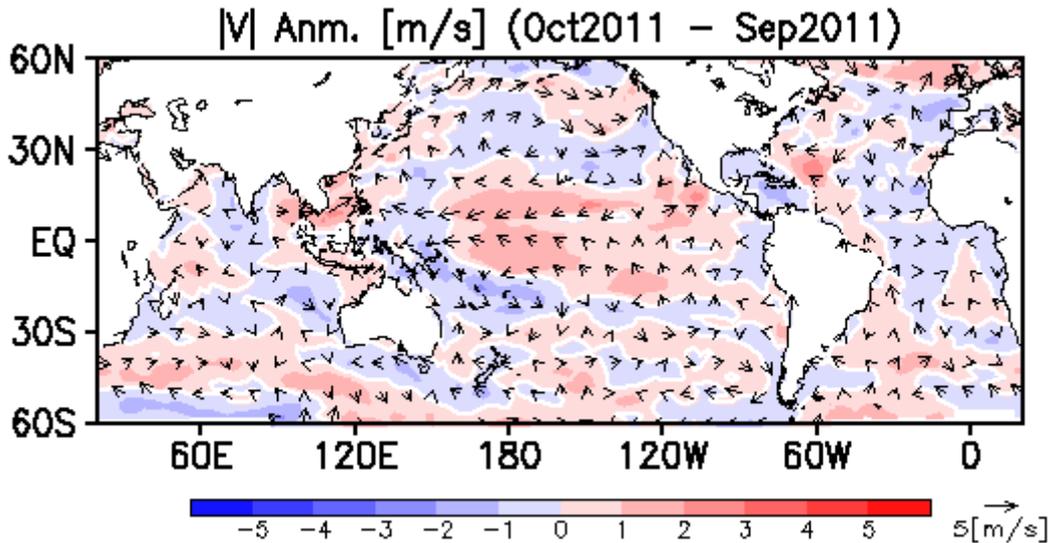
El Nino Monitoring Index and SOI

OLR anomalies

OLR anomaly 5N - 5S

Indo SPCZ ITCZ Atlantic

Jun.
Jul
Aug.
Sep.
Oct.

Nov
Dec
Jan
Feb
Mar
Apr
May
Jun
Jul
Aug
Sep
Oct
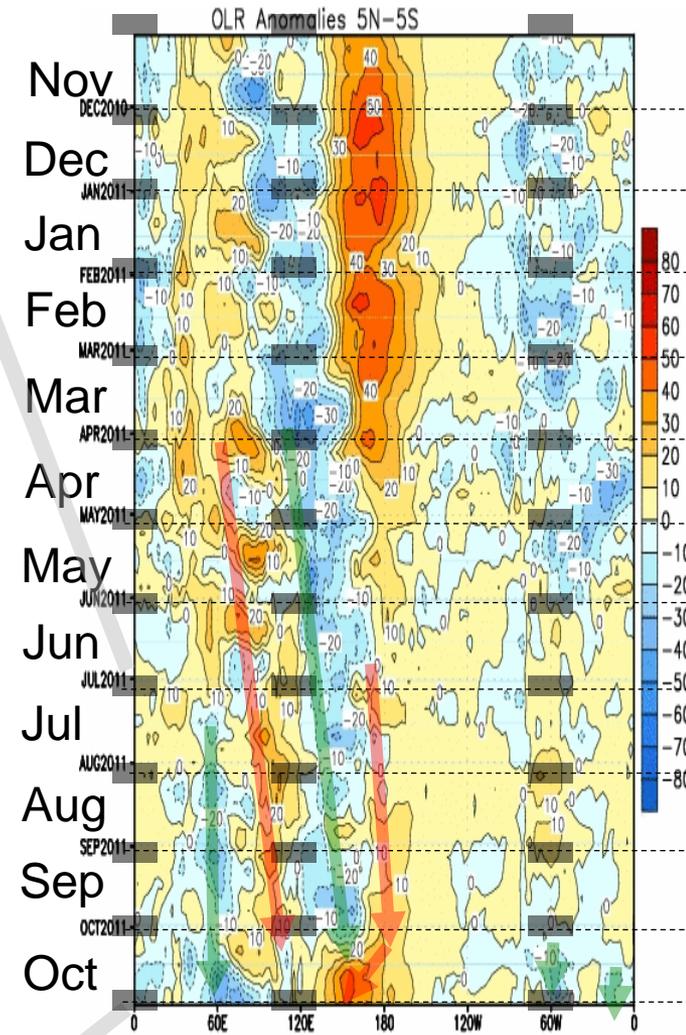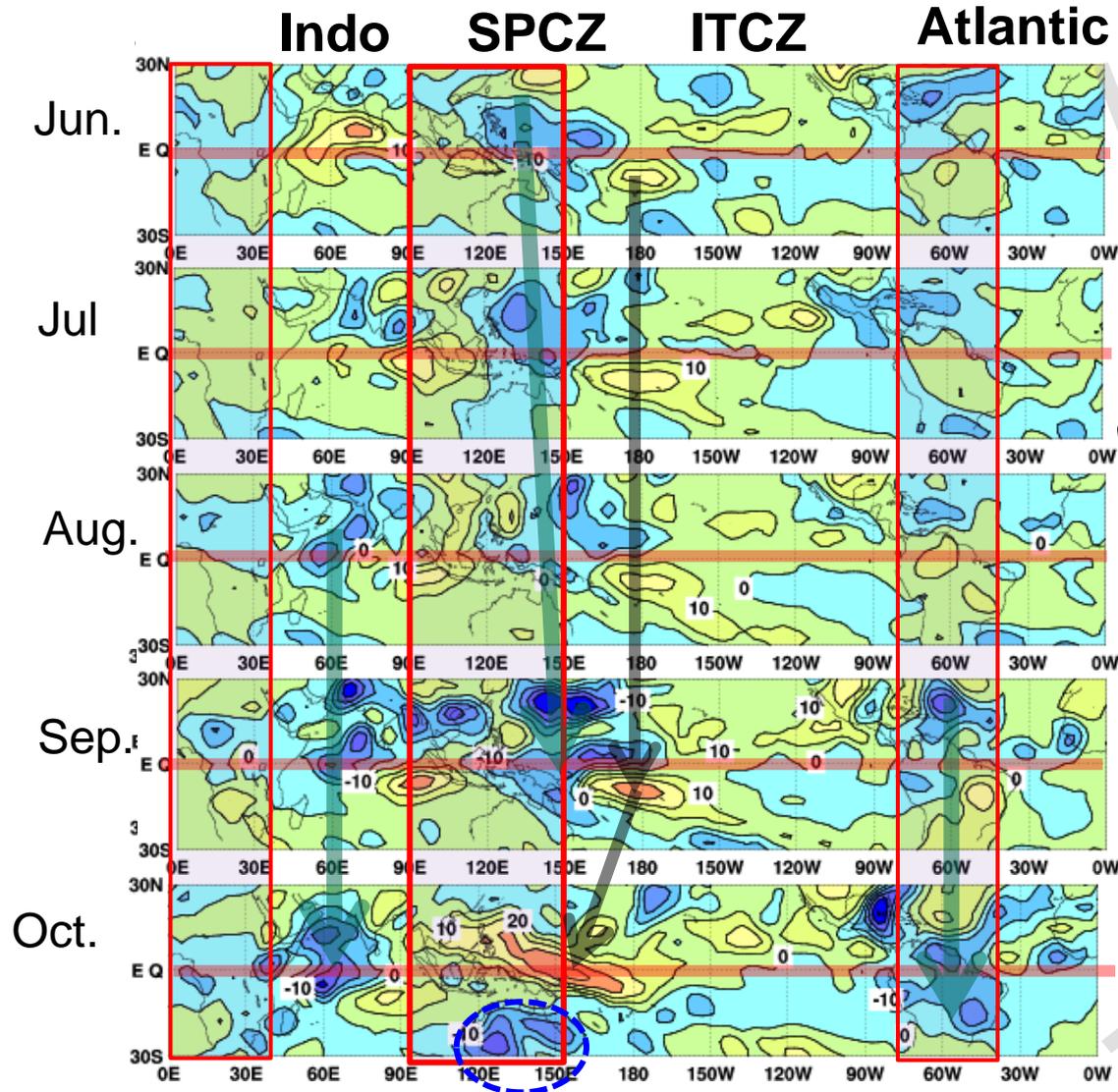
Convective activity was inactive over the Pacific.
active over the Indian Ocean

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CLIMATE PREDICTION CENTER/NCEP

Velocity Potential Anomaly at 200hPa / Zonal Wind Anomaly at 850hPa
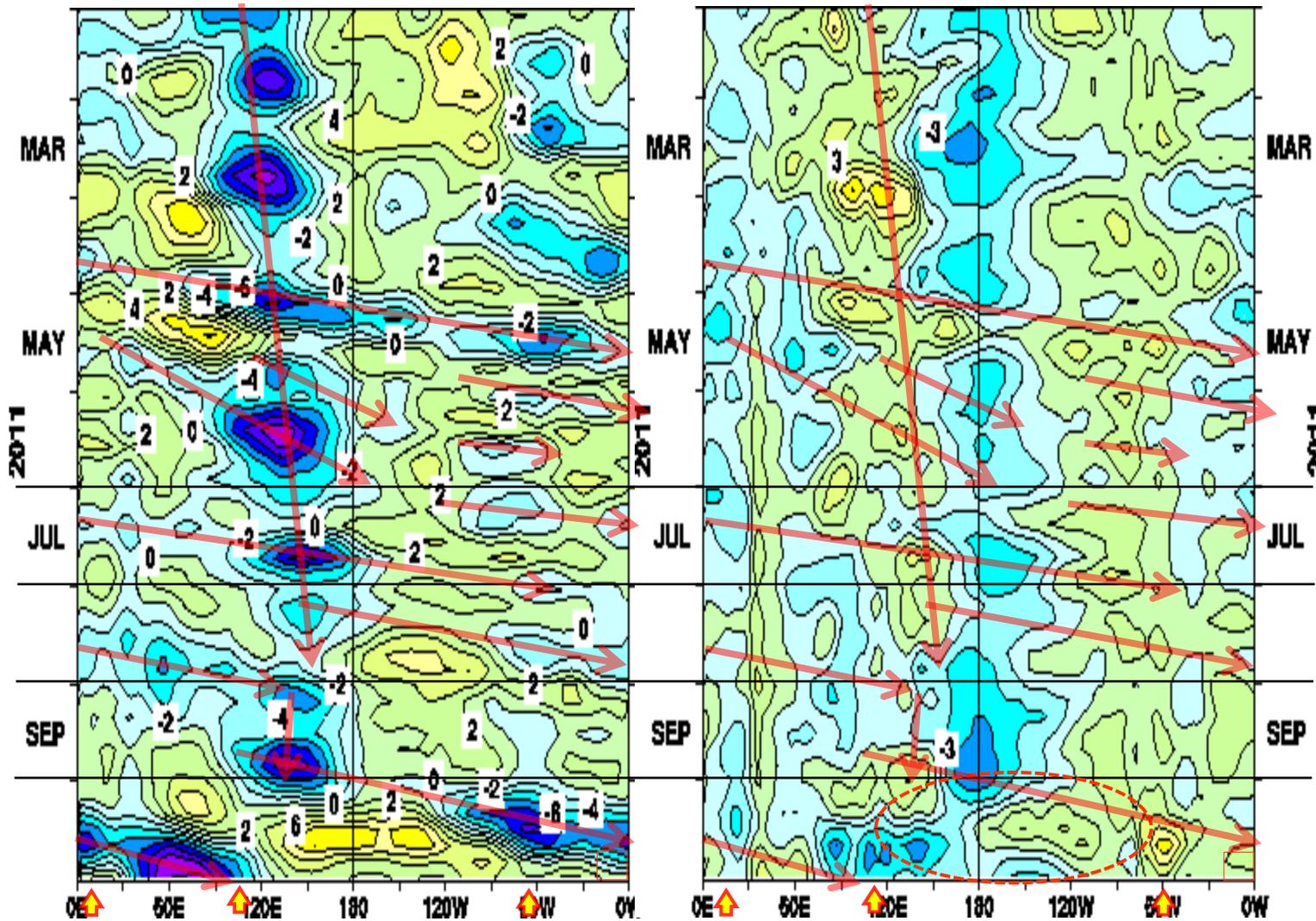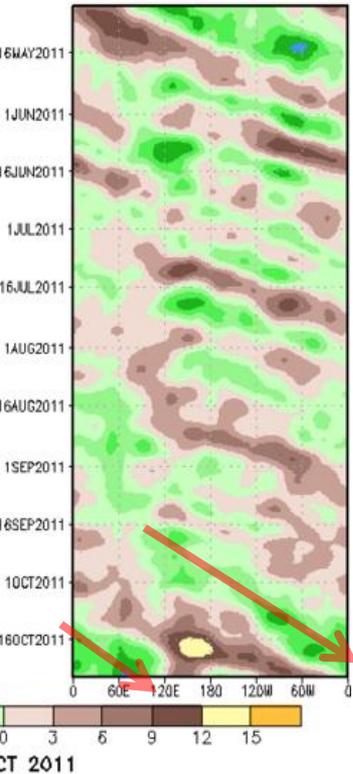
・Active convection propagated eastward from eastern Pacific to Indian Ocean
・Westerly wind at the lower atmosphere was observed in mid-October

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Wind Stress anomalies   **OHC anomalies**   **SST anomalies**

Initial : 2011.10.28   51 member ensemble mean

Winter

Eastward propagation of Cold Water

Easterly wind anomaly

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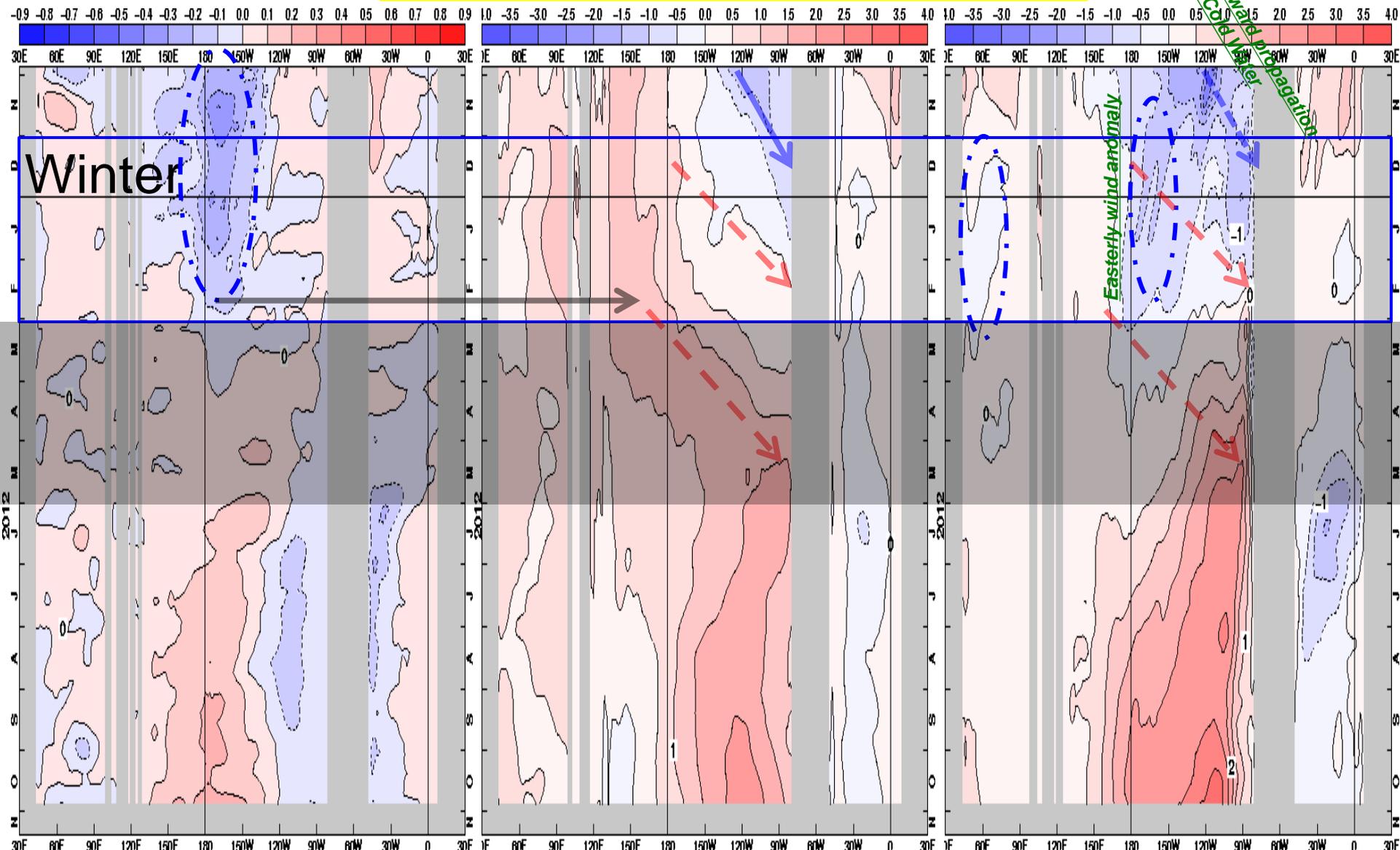
Model Predictions（Initial: Oct. 2011）

BOM

La Nina in Winter
Neutral in Spring
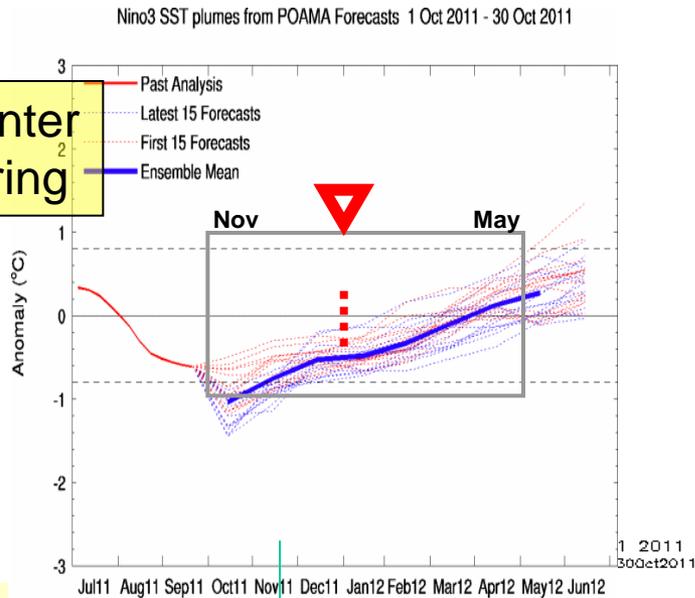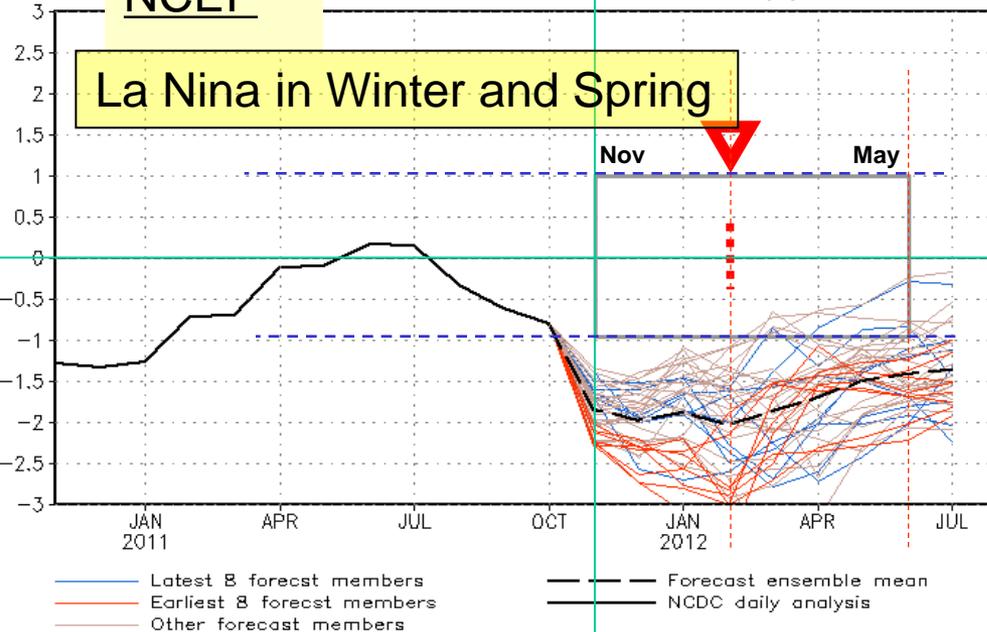
ECMWF

Persistent La Nina through Spring

NCEP

La Nina in Winter and Spring
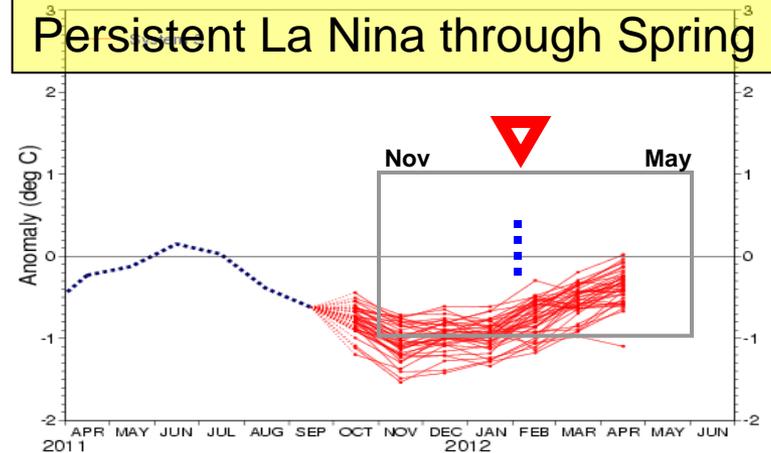
UKMO

La Nina in Winter and Spring
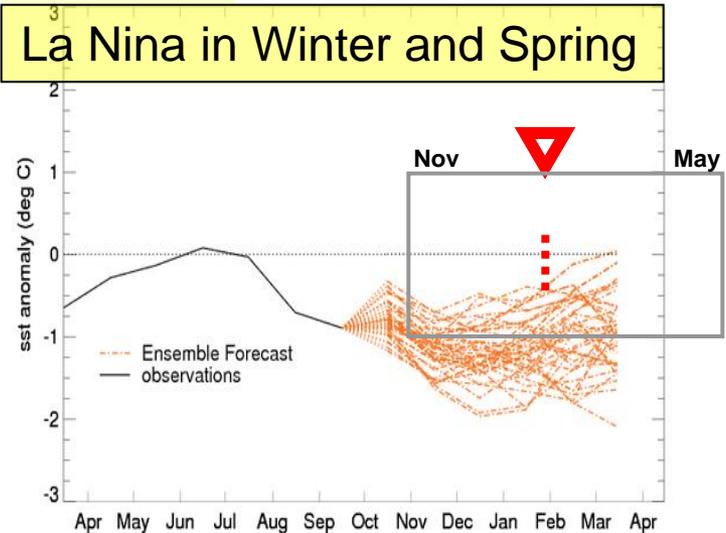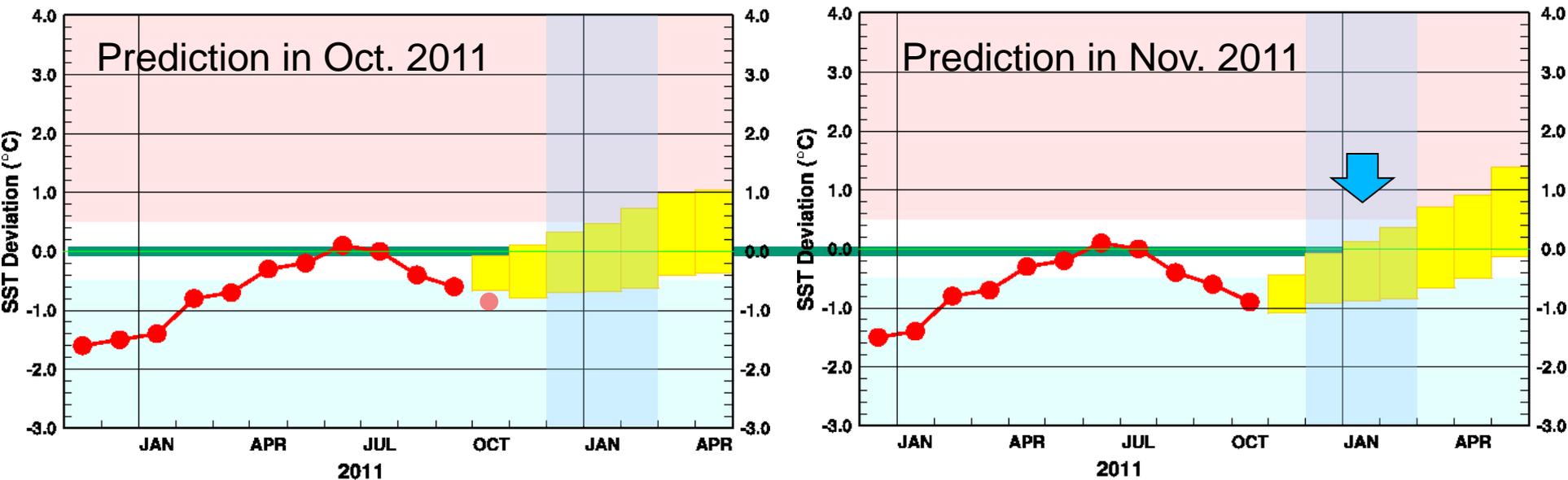
NINO 3.4 Predictions (by IRI)

Model Predictions of ENSO from Oct 2011
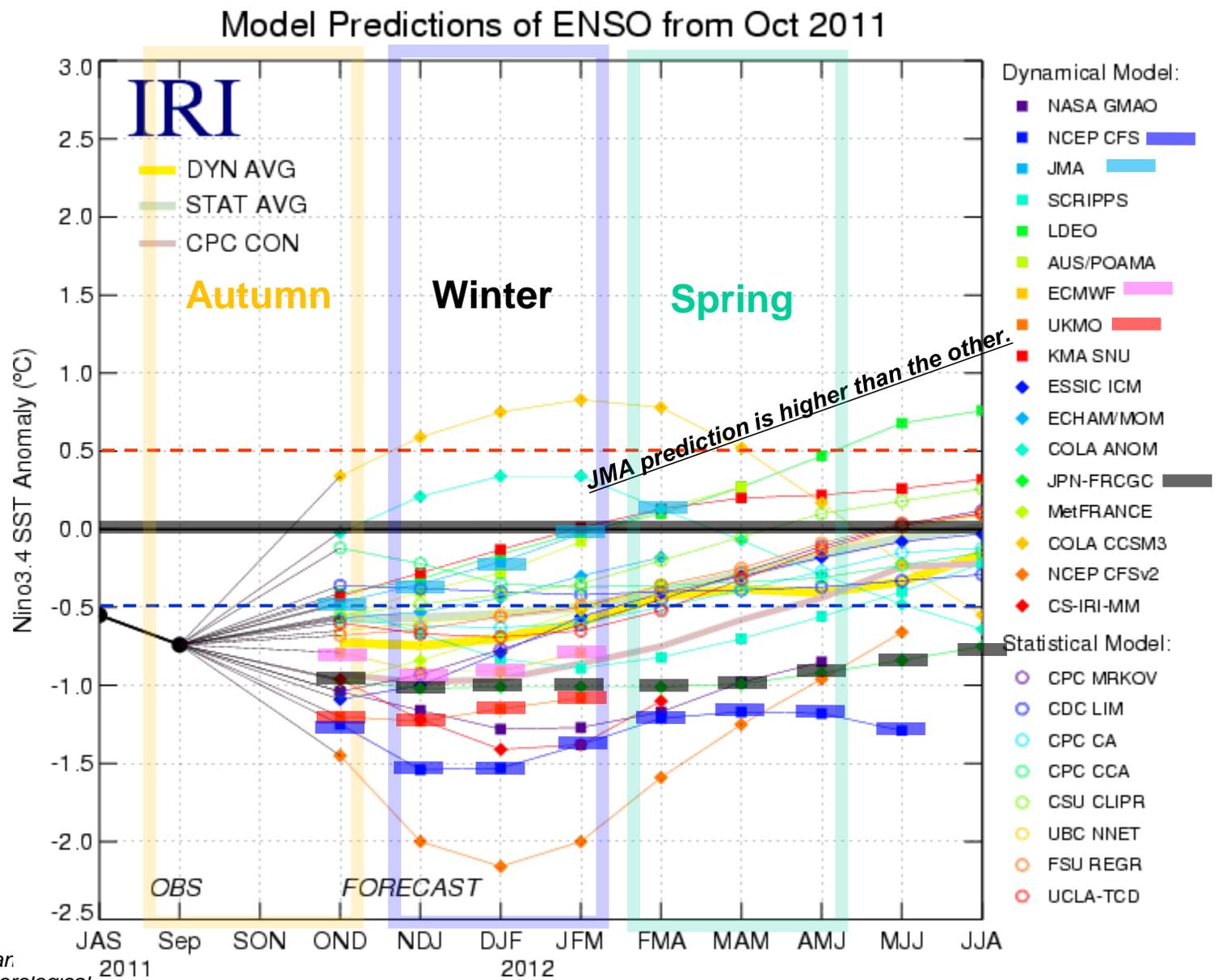
Comparison with the prediction of previous month

> ➤ *The observed value in October (-0.9ºC) was lower than the lower bound of the prediction of the previous month.*
> ➤ *The predicted NINO.3 SST deviation for the boreal autumn and the beginning of the winter is lower than the prediction of the previous month.*


The observed (red dots) and predicted (yellow boxes) monthly NINO.3 SST deviations in the previous month (Oct. 2011; left) and the latest (Nov. 2011; right).

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Outlook of the SST deviation

It is likely that the NINO.WEST and IOBW SST will become near normal

*The SST climatological reference is defined as the SST averaged over a sliding 30-year period for NINO.3, and as linear extrapolations with respect to a sliding 30-year period for NINO.WEST and IOBW.)
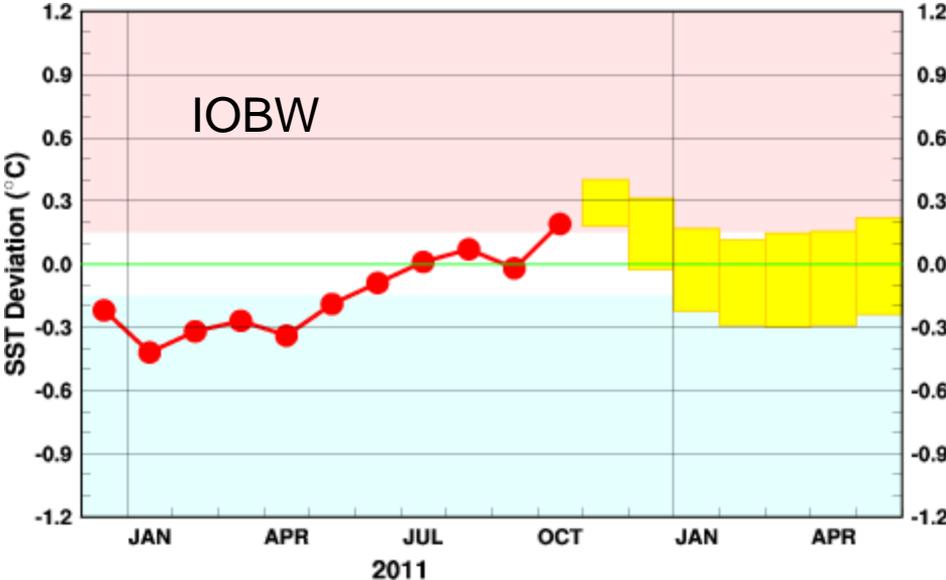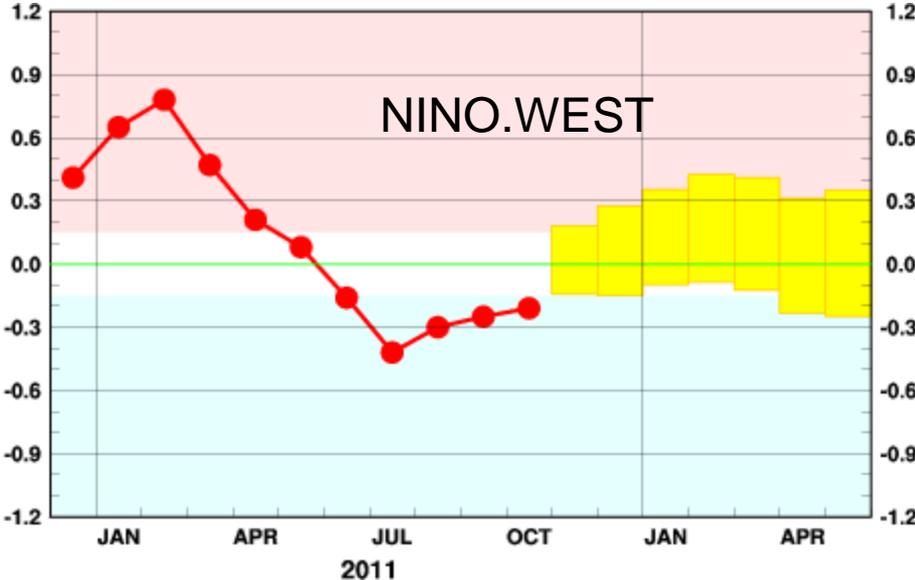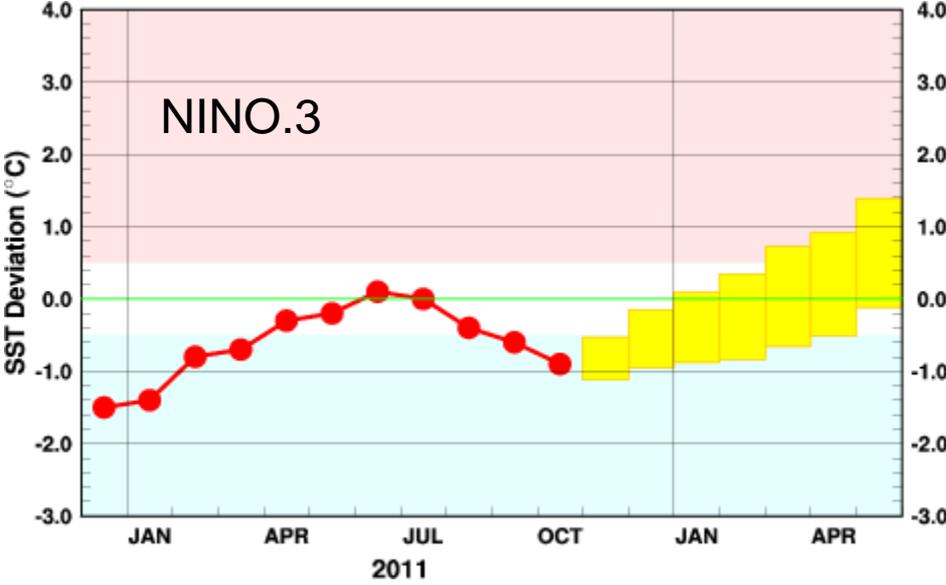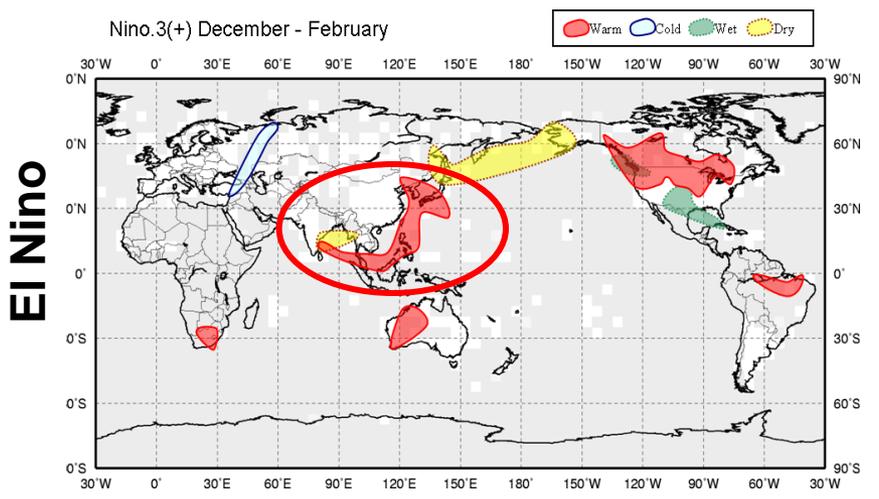
Climate tendencies during El Nino/La Nina

The maps show the regions where climate tendencies observed during El Niño/La niña events are statistically significant in boreal summer/winter.
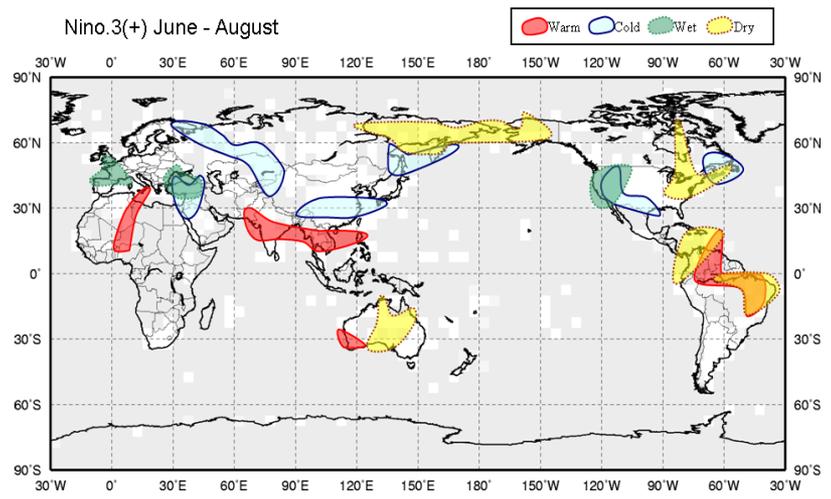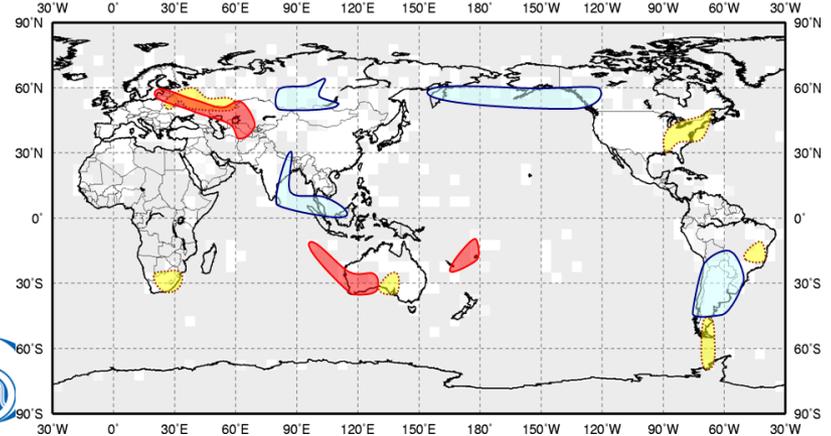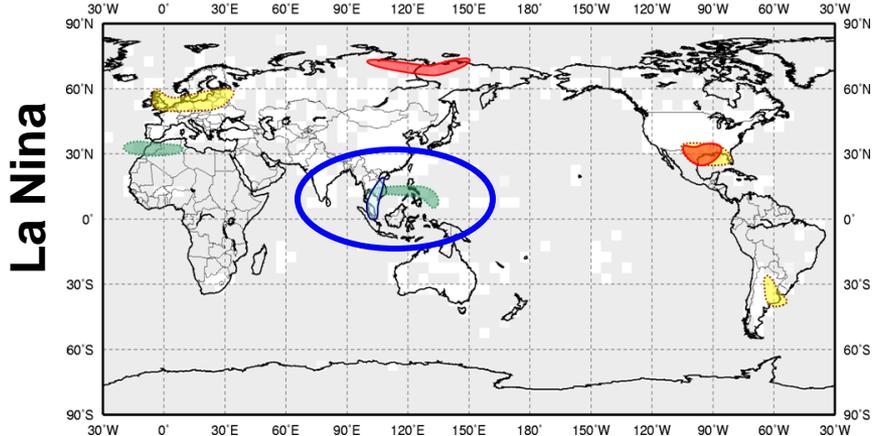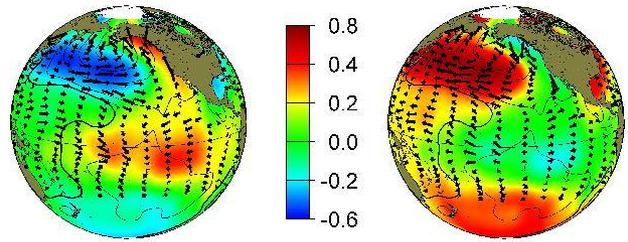

boreal summer

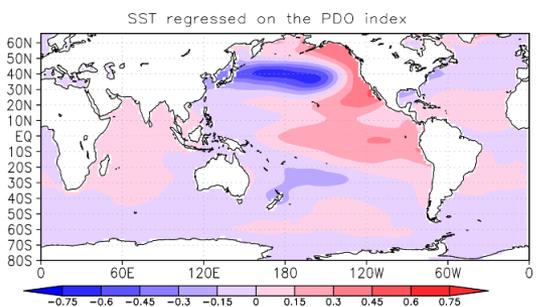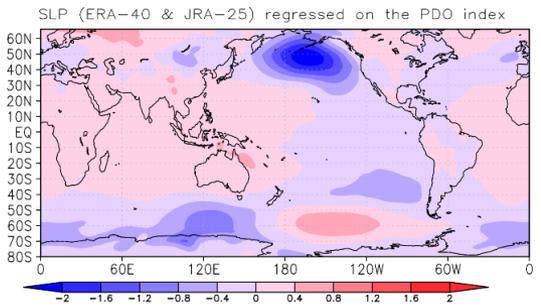boreal winter

PDO & NPI

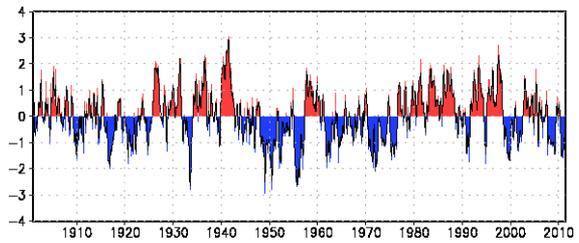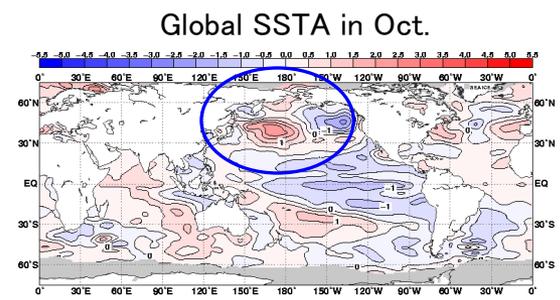PDOI in Oct. : **-1.4**
                negative phase

Typical anomaly patterns of SSTs (shading), SLP (contours) and sea level wind stress (vectors) in the positive (left) and negative (right) phases of the PDO

Typical SST anomaly patterns in the positive phase of the PDO

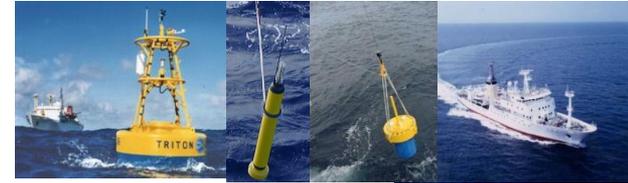Typical SLP anomaly patterns in the positive phase of the PDO

Global SSTA in Oct.

Monthly PDOI

PDO: Pacific Decadal Oscillation

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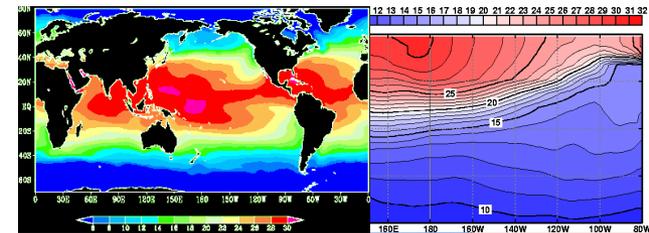Agency

Workflow of monitoring and prediction

1. Acquiring observational data

2. Data quality control & assimilation into the regular grids

3. Numerical prediction

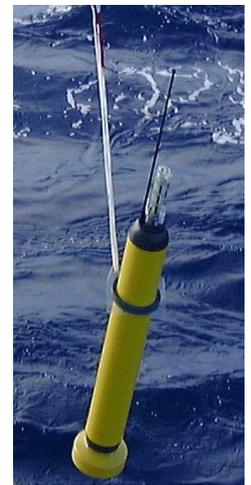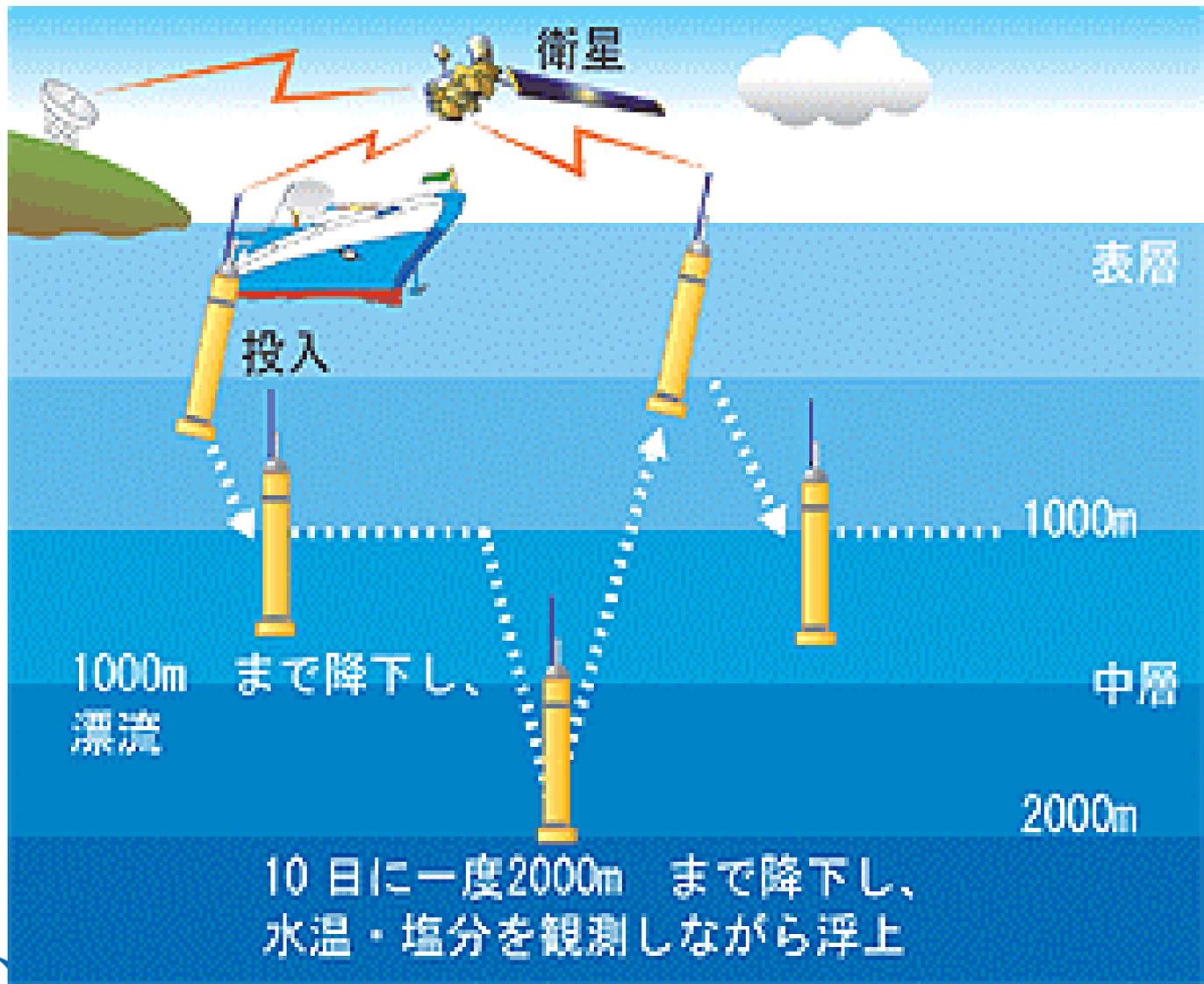   (Atmosphere-Ocean coupled model)
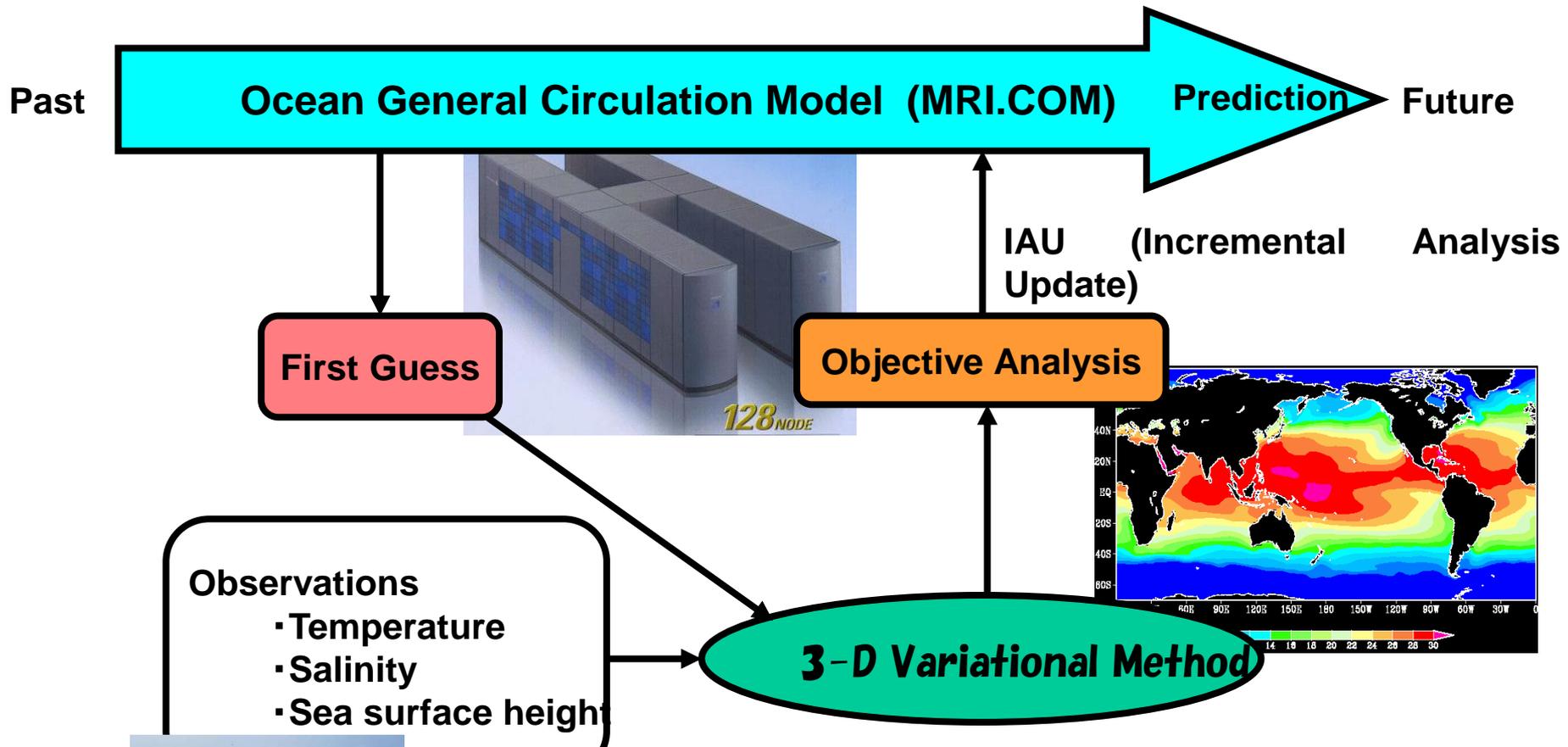
4. Analysis & examination of the model results

5. Products publication

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Ocean observing network for El Niño monitoring

Ocean Data Assimilation System (MOVE-G)

Past

Ocean General Circulation Model (MRI.COM) **Prediction** **Future**

First Guess

IAU (Incremental Analysis Update)

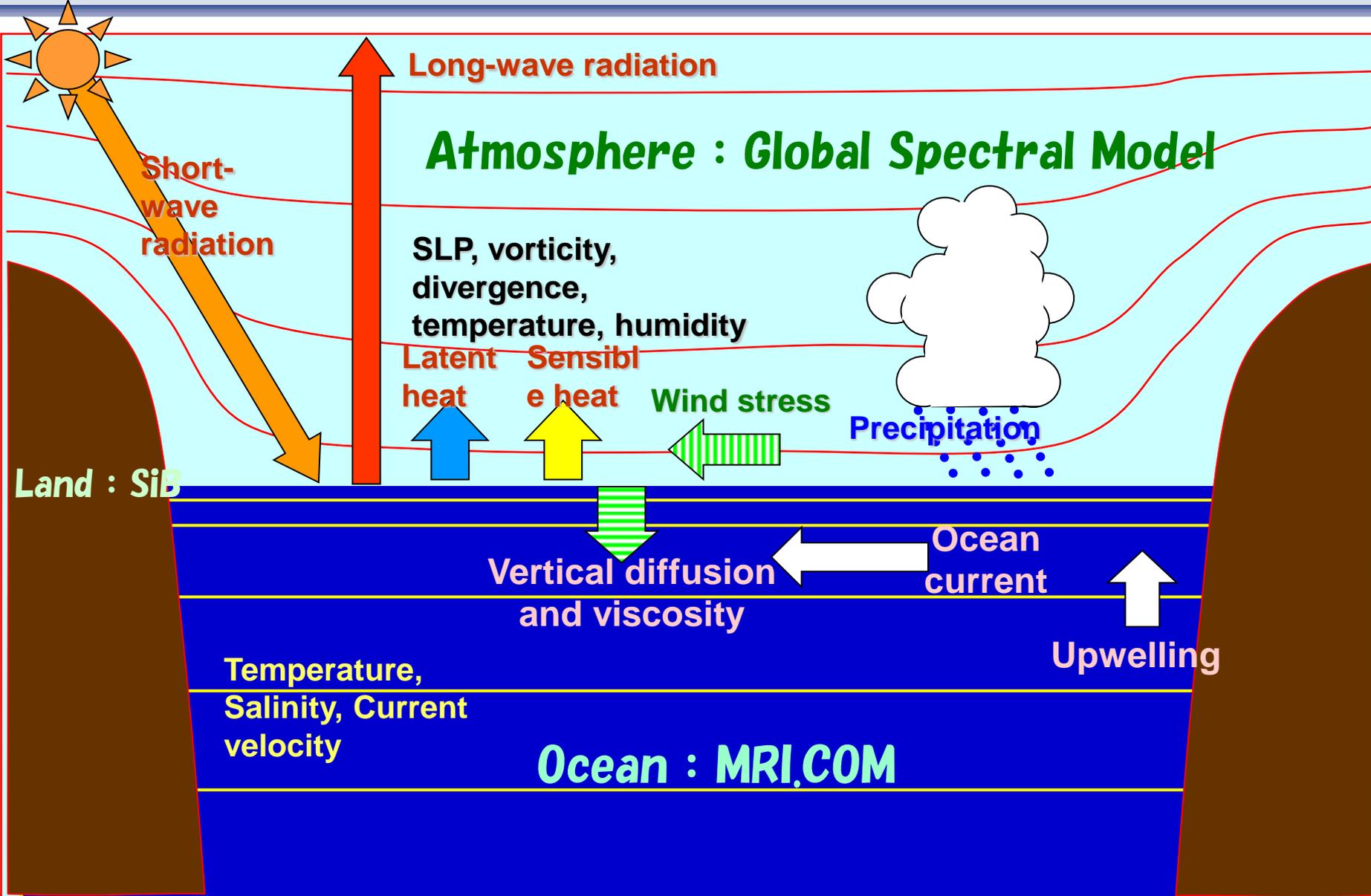**Objective Analysis**

Observations
- **・Temperature**
- **・Salinity**
- **・Sea surface height**

3-D Variational Method

3DVAR: An analysis method for seeking for the physically-consistent optimal data field that is expected to have the least deviation from the true value based upon statistical assumptions.

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Atmosphere-Ocean coupled prediction model

Long-wave radiation

Short-wave radiation

Atmosphere : Global Spectral Model

SLP, vorticity, divergence, temperature, humidity

Latent heat   Sensible heat   Wind stress   Precipitation

Land : SiB

Vertical diffusion and viscosity   Ocean current

Upwelling

Temperature, Salinity, Current velocity

Ocean : MRI.COM

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Prediction model specifications

- Atmospheric component : spectral model
  (T_L95, 192x96 grids, 40 vertical levels)

- Ocean component : grid model (1º x 0.3-1º, 50 vertical levels)

- Initial condition :

  [atmosphere] provided by JCDAS
                      (JMA Climate Data Assimilation System)

  [ocean] provided by MOVE-G

- Prediction period : up to 7 months ahead

- 30-member ensemble forecast

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