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Interannual Variation in the Seasonal Northward Movement of the Baiu Front in the Western North Pacific

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Introduction

1. The Baiu/Mei-yu frontal activity has interannual variability, which is associated with the ENSO or TBO. (e.g. Nitta et al. 1987, Tanaka 1997, Tomita et al. 2004 and so on).
2. The Baiu front shows a seasonal northward excursion from May to July in the western North Pacific.
3. The interannual variations of the northward excursion

⇨ Seasonal prediction of the Baiu rainfall in Japan

Objectives

1. To reveal the interannual tendencies in the northward excursion of the Baiu front.
2. To understand the physical mechanisms (Roles of the upper ocean thermal inertia)

⇨ The findings contribute to improve the seasonal prediction of the Baiu frontal activity.

- Key Words -

the Baiu front, ENSO, the atmospheric bridge, MLD

Data and Methodology

<Used datasets>

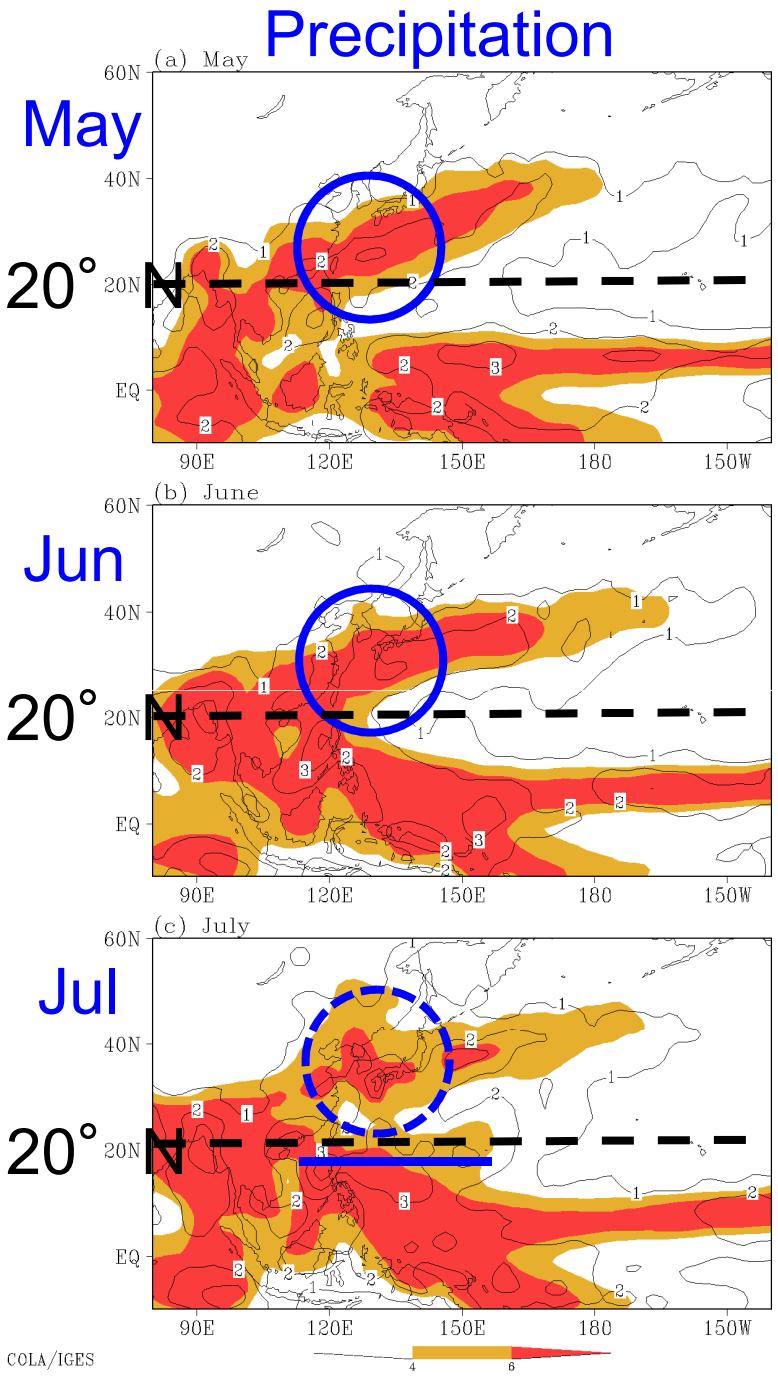
(1) GPCP: Global precipitation
(2) NCEP-DOE AMIP II: Atmos. surface variables
(3) SODA: Parameters in the upper ocean

(global gridded data, 1979-2003 (25 yrs), monthly)

<Methodology>

(1) Extended EOF (EEOF)
(applied to the GPCP precipitation from May to July)

(2) Composite and correlation analyses based on the score time series, and so on.



Seasonal Movement of the Baiu Front from May to July

(1) May to June

northward shift + enhancement

(2) June to July

further northward shift

W. Pacific, 20˚N = enhancement

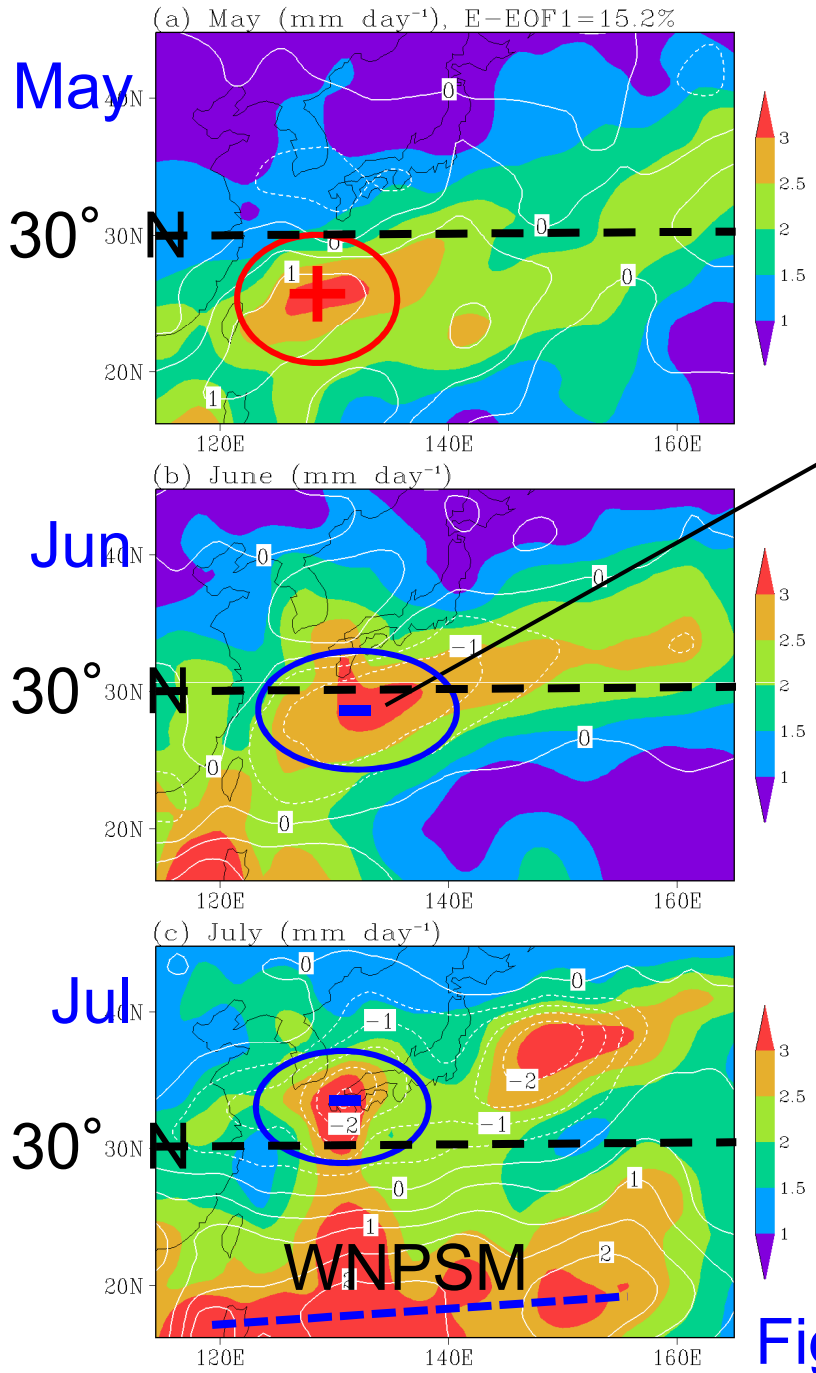
(3) Large STD = Large mean

northward shift coincidently

(color: mean, contour: STD)

Fig. 1

Interannual Variability in the Northward Shift of the Baiu Front



partially 50%

EEOF of precipitation in May-July

(1) 1st mode = STD distribution

(2) Northward shift

(3) May-June: changed = **+** to **-**

(4) June-July: maintained = **-** to **-**

(5) July: + maximum along 20° N

EEOF-1 (15.2%)

(color: STD, contour: eigen vector)

Fig. 2

COLA/IGES

Time variability in EEOF1 (Score Time Series)

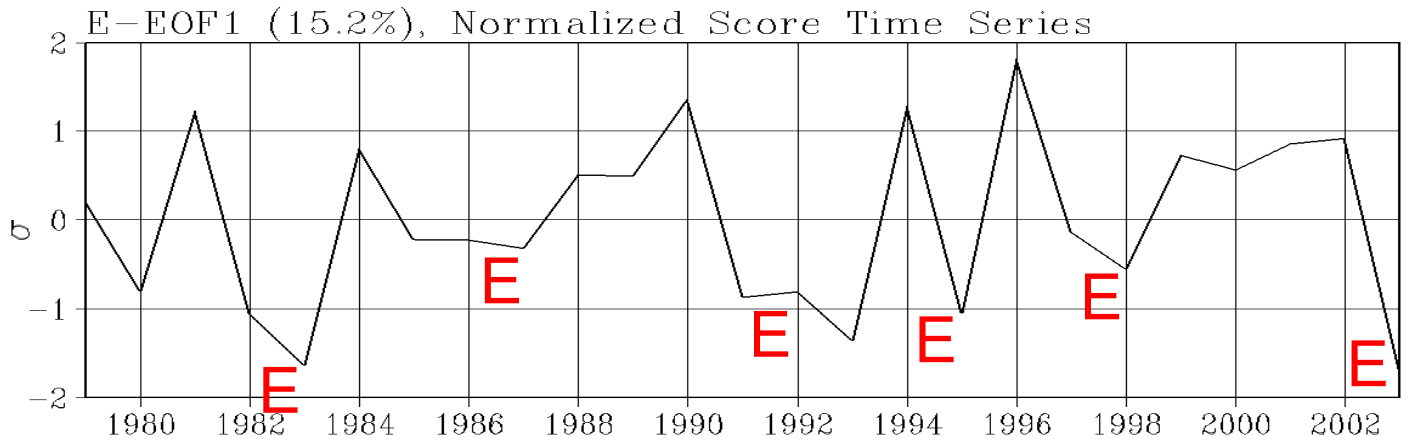
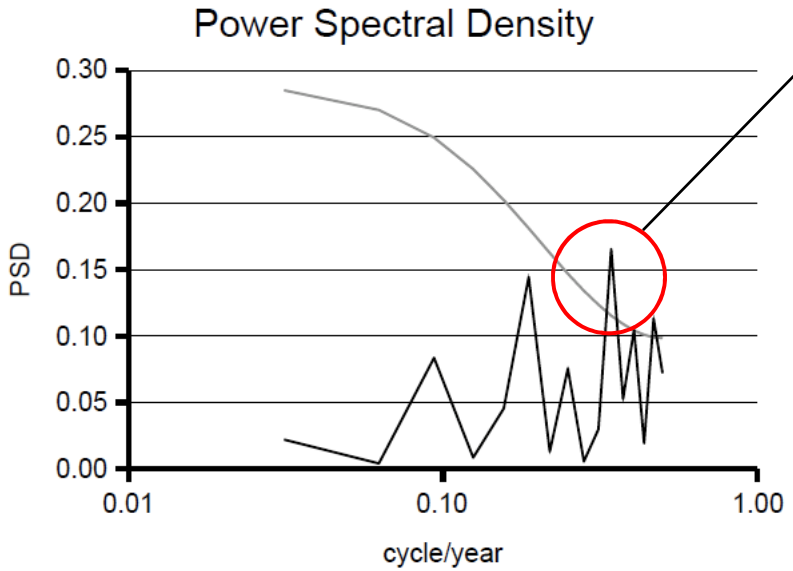


Fig. 3



2.9 yrs

(E: ENSO warm events)

(1) ENSO = Negative
(1982-83, 1986-88, 1991-92, 1994-95, 1997-98, 2002-03)

(2) Dominant 2-3-yr period

Fig. 4

Correlations between Score and Precipitation in the Active Centers

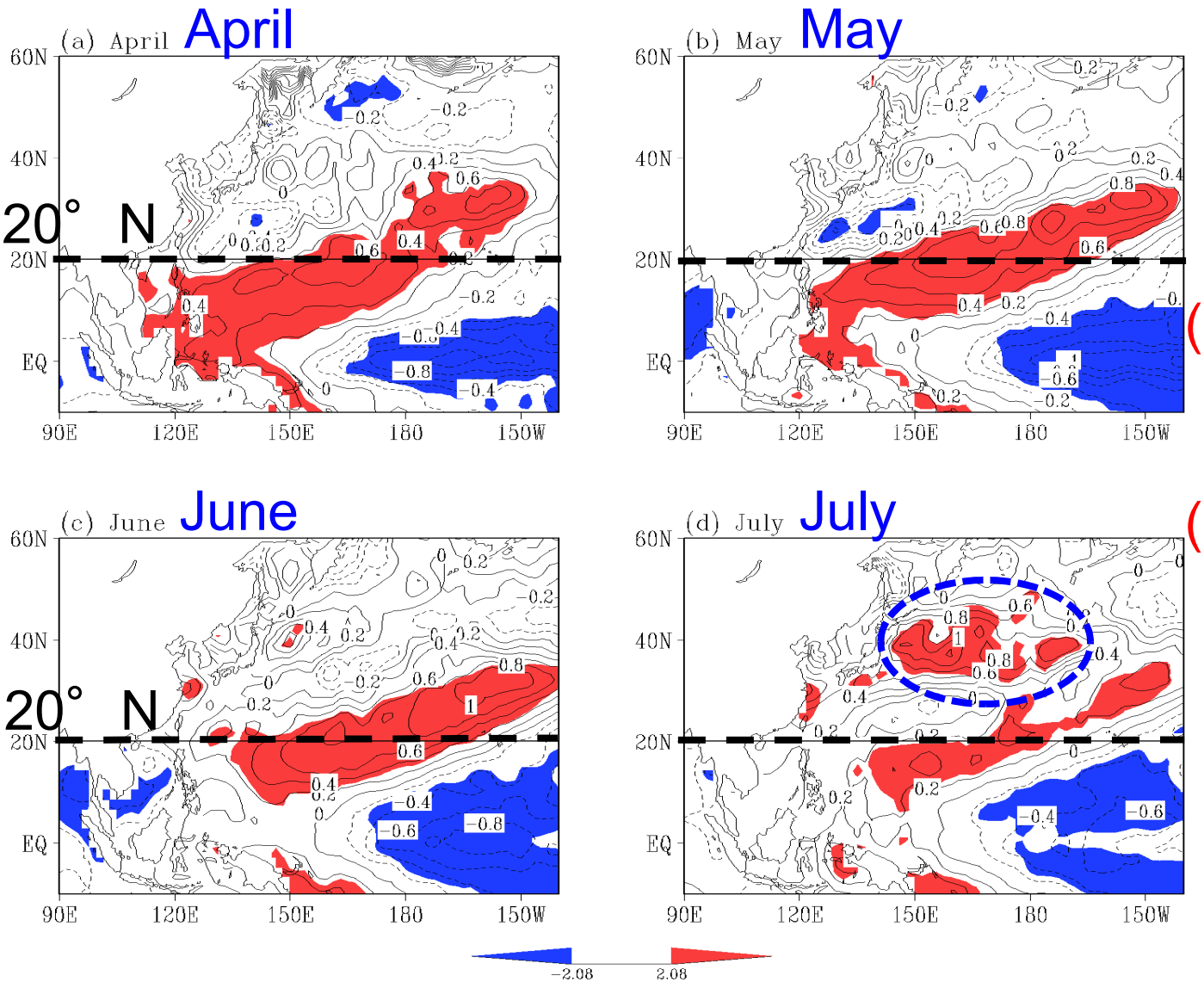
Table 1

	May	June	July	NINO3
Score	**+0.40**	**-0.44**	**-0.61**	**-0.49**

(color: 95% significance (= ±0.4))

(1) significant high correlations in MJJ
(2) from May to June, the polarity is changed
(3) high correlation with ENSO

Persistence of SSTAs in the WNP



La Niña pattern

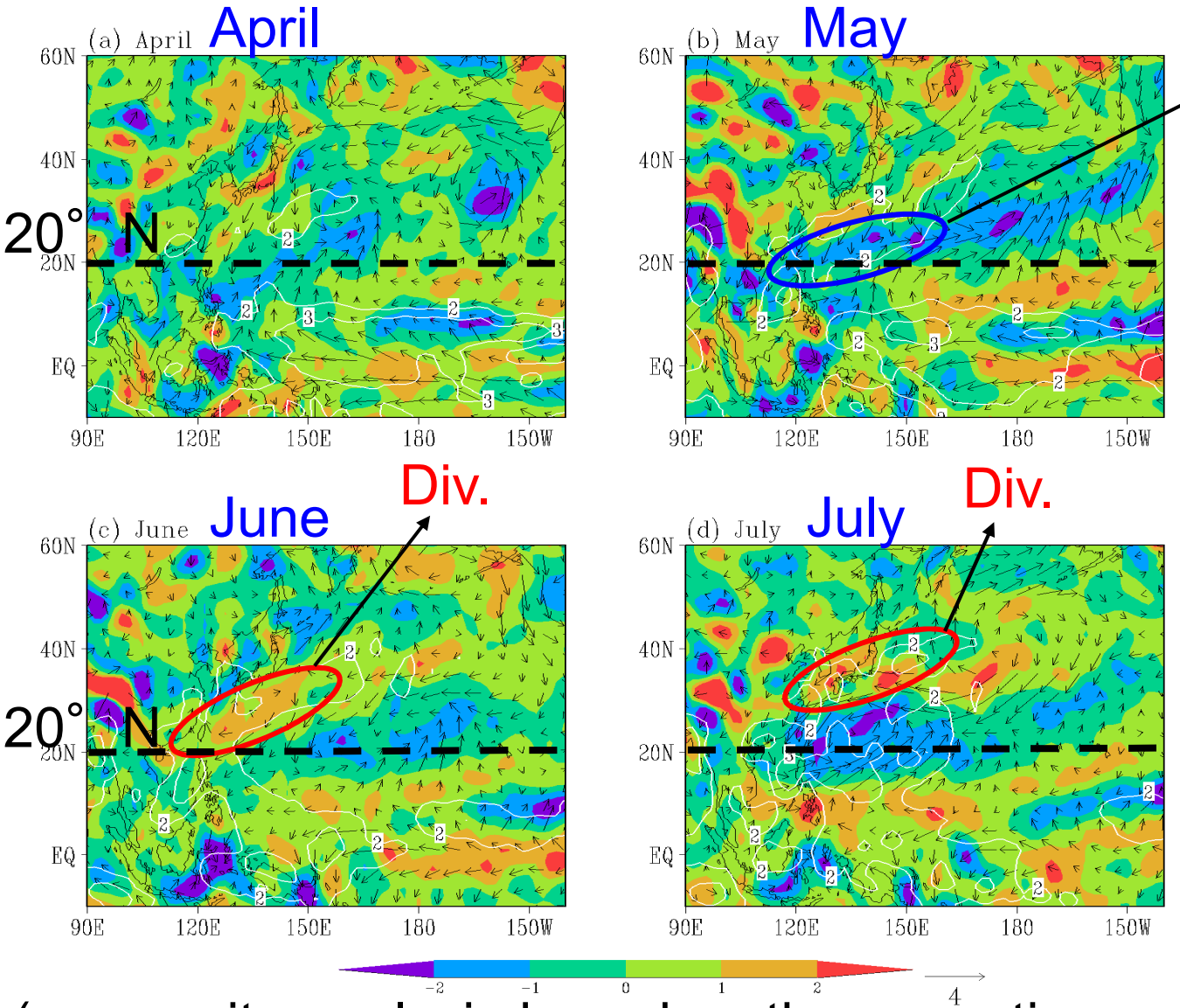
(1) S of 20° N
persistence of
ENSO pattern

(2) N of 20° N
in July,
+ anomalies

Fig. 5

(composite analysis based on the score time series)

Northward movement of the Baiu front and anomalous low level atmospheric circulations



(1) Div. & Conv.
= Fixed

(2) Large STD
= N. Shift

⇨ Change of the polarities

Warm: Div.

Cold: Conv.

White: Large STD

Fig. 6

(composite analysis based on the score time series)

GrADS: COLA/IGES

MLD, (u, v), and persistence of SSTAs

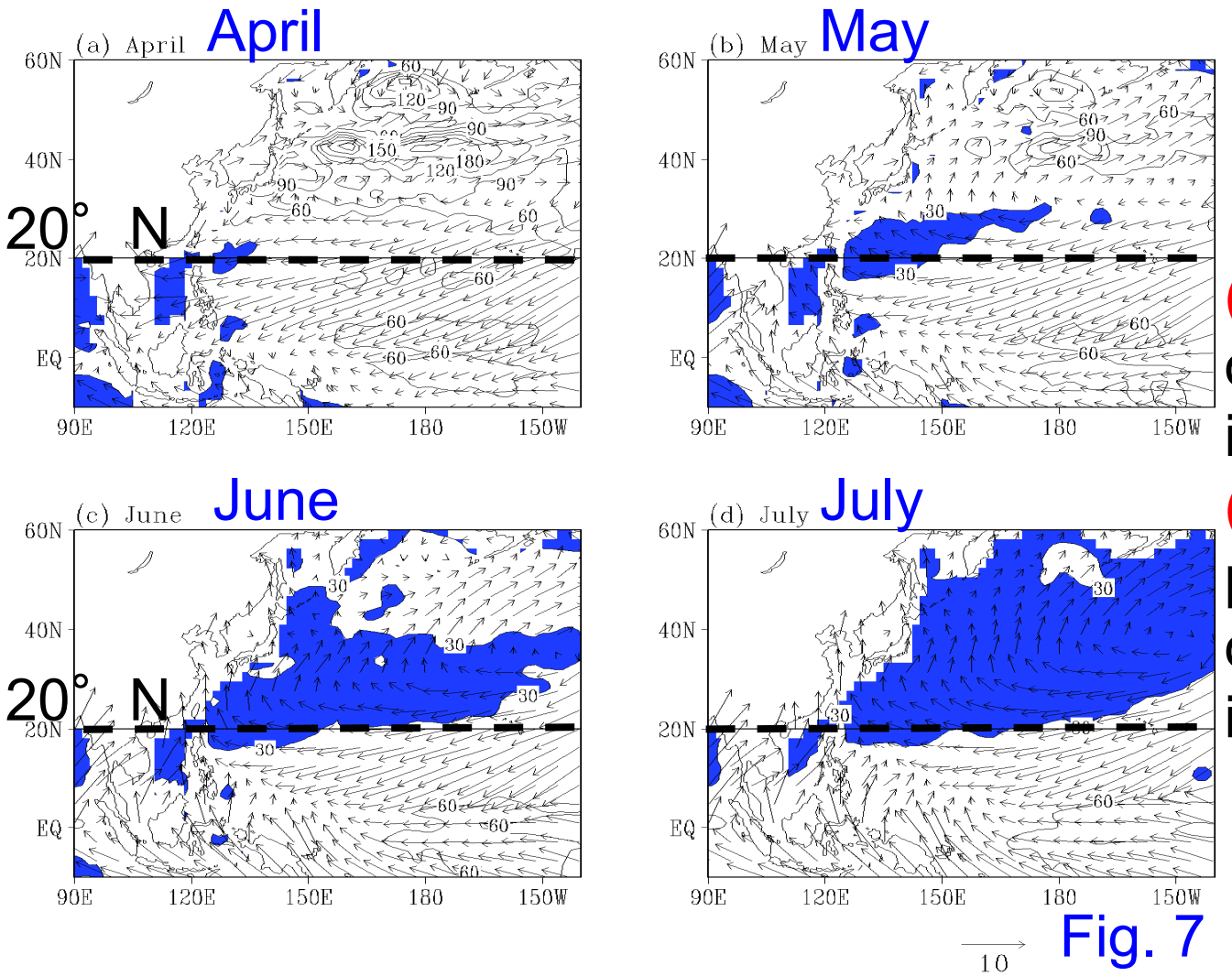


Fig. 7 (seasonal change of MLD and (u, v))

MLD
=> thermal inertia
=> persistence

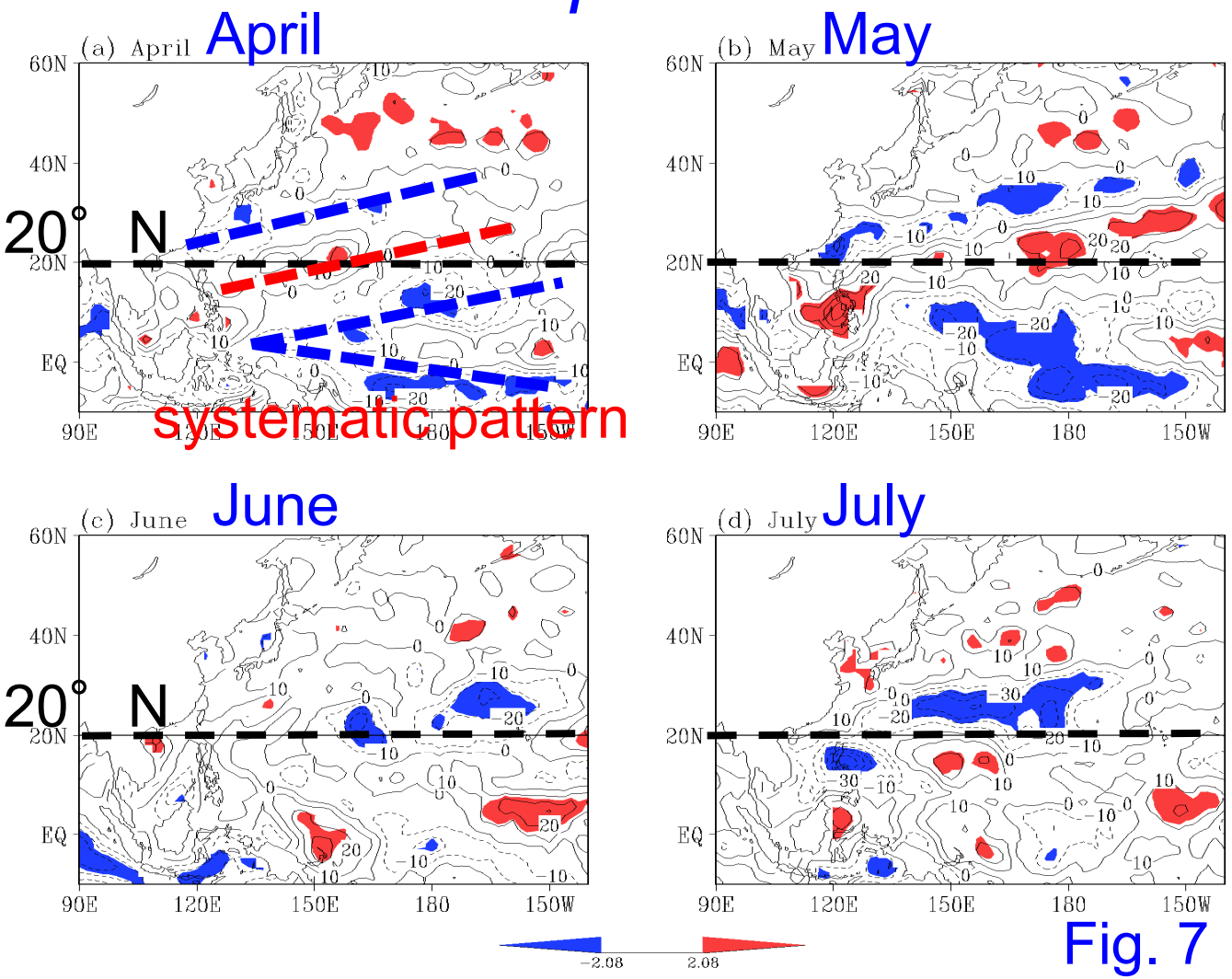
(1) N of 20° N
deep => shallow
inertia: to be small

(2) S of 20° N
persistence of
deep MLD
inertia: large

blue : MLD< 30 m
(u, v): vector

DS: COLA/IGES

Surface heat fluxes (SR+LR+LH+SH) and persistence of SSTAs



Surface heat fluxes
= forcing of SSTA

(1) Apr. and May systematic pattern

(2) 40° N in July positive SSTAs

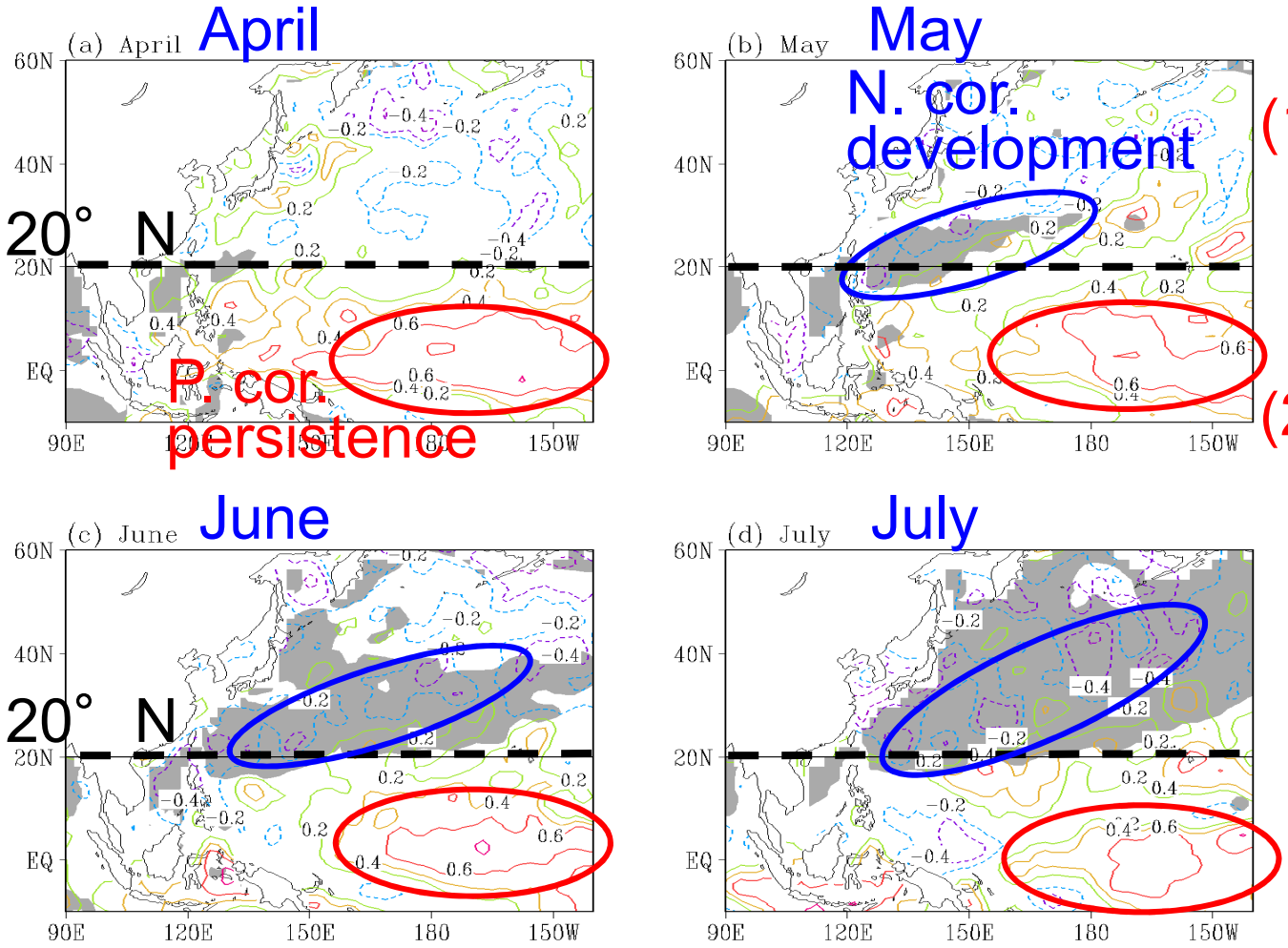
red: warming

blue: cooling

Fig. 7

(anomalous surface heat fluxes)

Local correlations between SST and precipitation



(1) N of 20° N
development of shallow MLD
atmos => ocean

(2) S of 20° N
persistence of deep MLD
ocean => atmos

Shade:
MLD < 30 m
Colored contours:
Warm: +, Cold: -
correlations

(local P.-SST cor. with MLD < 30 m)

IDS: COLA/IGES

Fig. 8

Summary

In the WNP, the Baiu precipitation anomalies tend to change their polarity in the northward movement from May to June.

⇒ Seasonal prediction of the Baiu precipitation

- Physical processes of the change -

(1) S of 20° N, MLD is deep
=> Large heat capacity => Persistence of SSTA

(2) The atmospheric bridge => Fix the surface divergence/convergence anomalies in the tropics and extratropics

(3) Seasonal northward shift of the Baiu front in the mean P field
=> the northward shift of the P anomalies

(4) From May to June, the P anomalies move on the anomalous conv. and then on the anomalous div.

(5) The change of polarity in P anomaly occurs from May to June
=> Application to the seasonal weather forecast.