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Relationship Between the Meiyu over the Yangtze-Huaihe River Basins and the Frequencies of Tropical Cyclone Genesis in the Western North Pacific

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Outline

- Introduction
- Data and Methodology
- Relationship between the Meiyu and TC genesis
- Composite analysis and cases study(1994,1998)
- Summary

Introduction

- Tropical cyclones (TC) and Meiyu are of the most frequently occurring meteorological phenomena in East Asia in summer…

- Therefore, the research for the Meiyu and the TC activities have been attached much importance, respectively (Ding 2004; Ding et al. 2007; Chan 2000; Wang and Chan 2002; Yumoto and Matsuura 2001 …)

- **IS there any relationship between Meiyu rainfall and TC activity ?**

This is a complicated problem, since the TC can affect Meiyu directly or indirectly and vice verse (Yamada and Kawamura 2007) .

Introduction

Meiyu and TC
(negative correlation)

He and Fu（1992）
Kang et al.(1992)
Xu et al（1994）
Lei et al（2001）
……

Compete for the moisture supply over the East Asia-the WNP regions?

- shorter-term datasets
- case studies
- mechanism needs to be illuminated

• extend such study from viewpoint of climatology
• understand the mechanism
• seek for possible precursors for summer precipitation over the eastern China.

Motivation

Data and methodgy

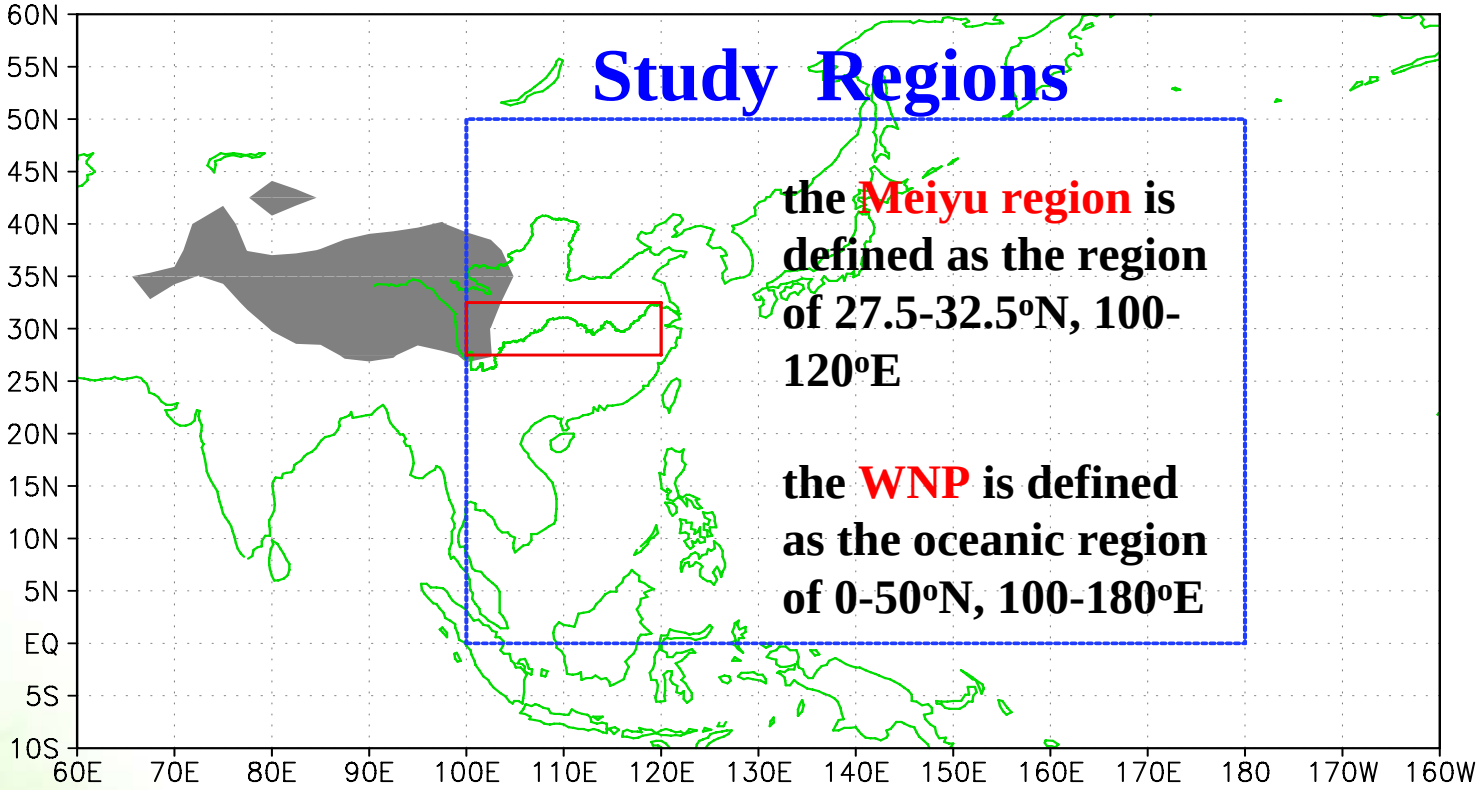
•**Data**

The monthly reanalysis (1958-2001) from European Center of Meteorological Weather Forecast (ECMWF),

The tropical cyclone data (1951-2006) from Joint Typhoon Warning Center (JTWC)

The precipitation observation data (1951-2006) at 743 observation stations of China

Data and methodology

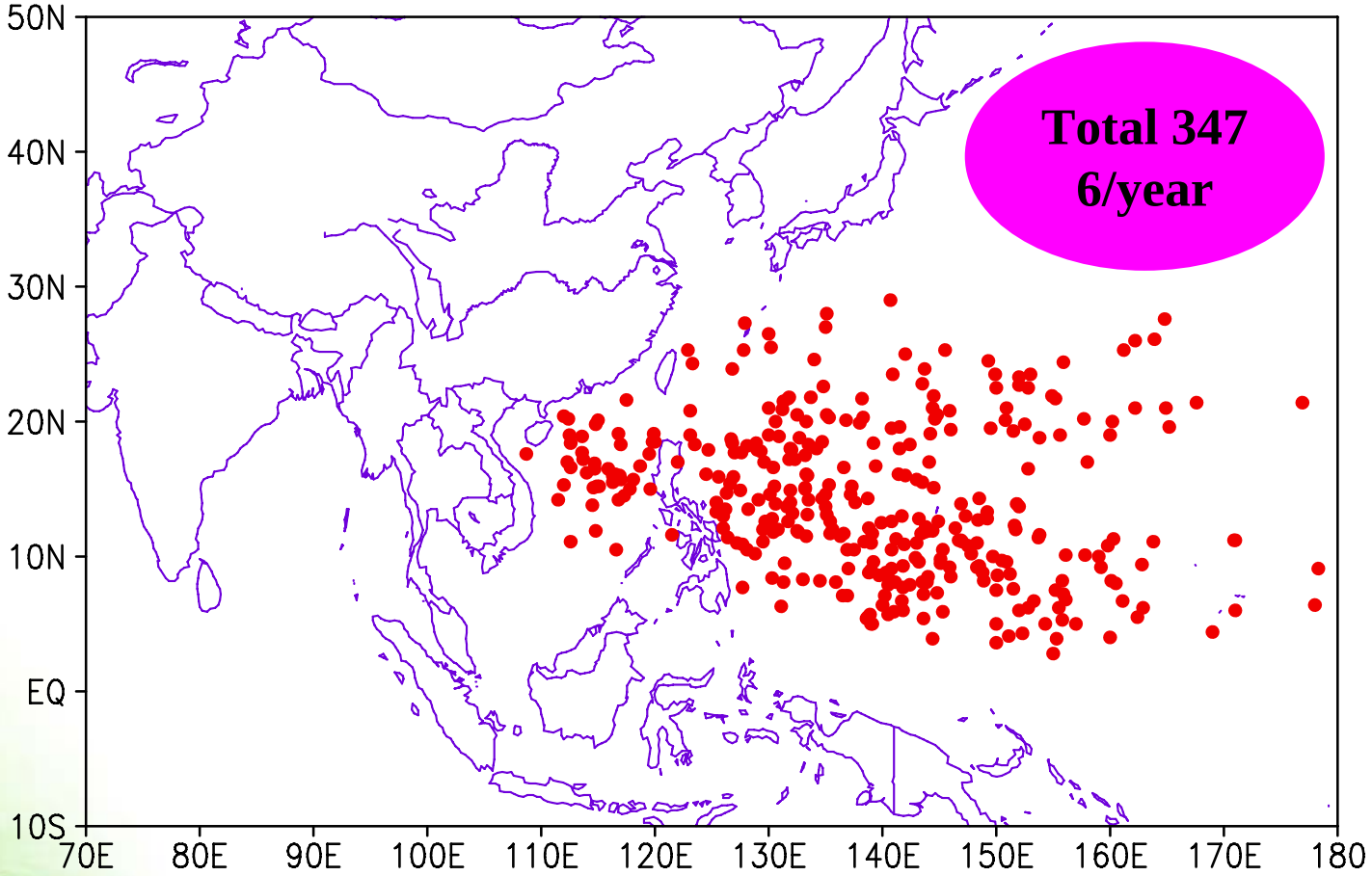


Meiyu Definition :

The averaged onset and ending date of the Meiyu season are June 17 and July 8.(early onset :end of May, late onset :the end of July)

In order to match with the large-scale monthly reanalysis data, the Meiyu period in this study is broadly defined as the two-month rainy period, namely from June to July

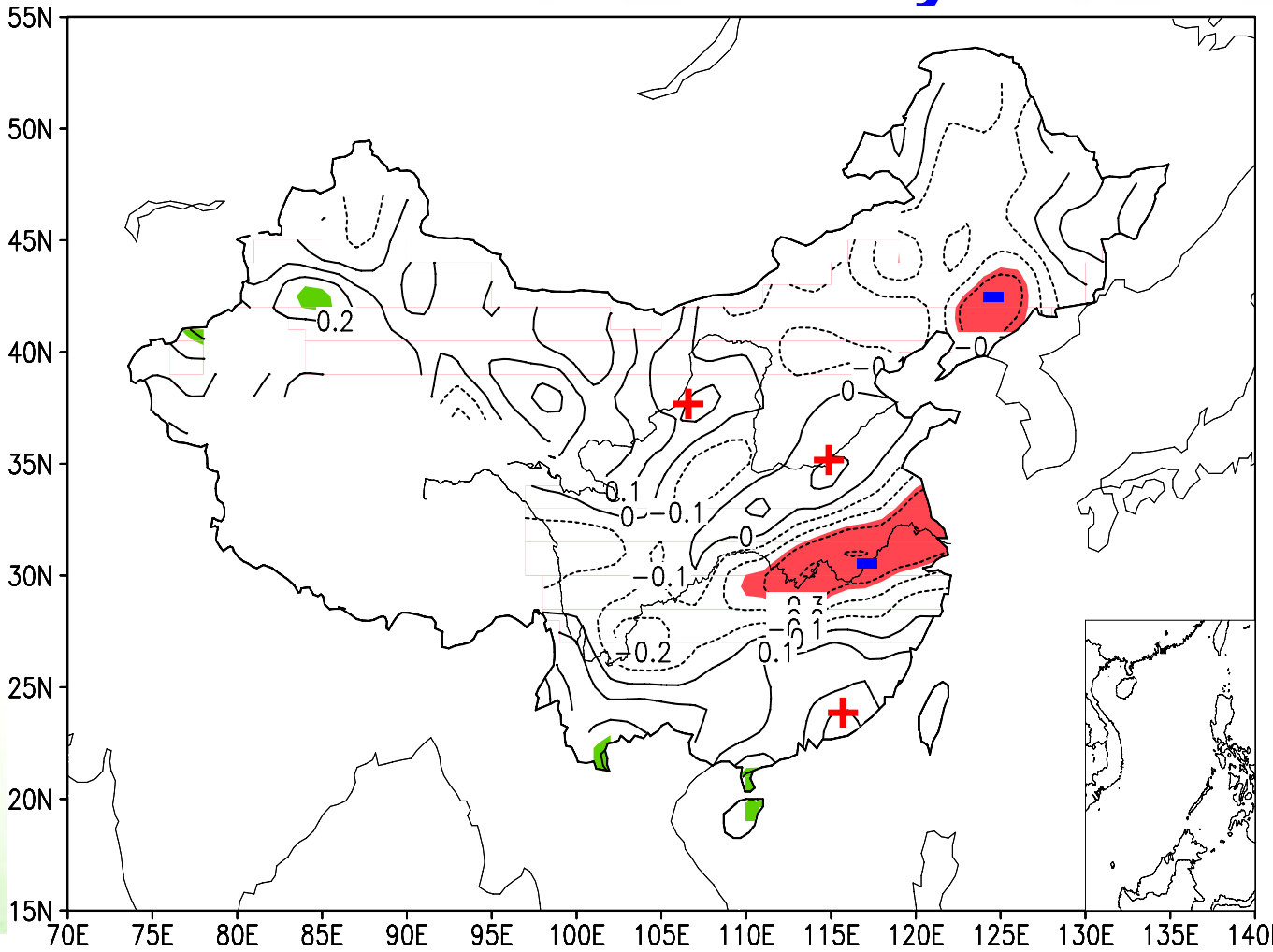
Distribution of the locations of TCs genesis during the Meiyu period (from June to July) from 1951-2006



TC refers to the tropical cyclone with its sustained maximum wind speed exceeding 18m.s^{-1}. Most TCs mainly formed in the region of 5-20^{o}N,110-160^{o}E ）

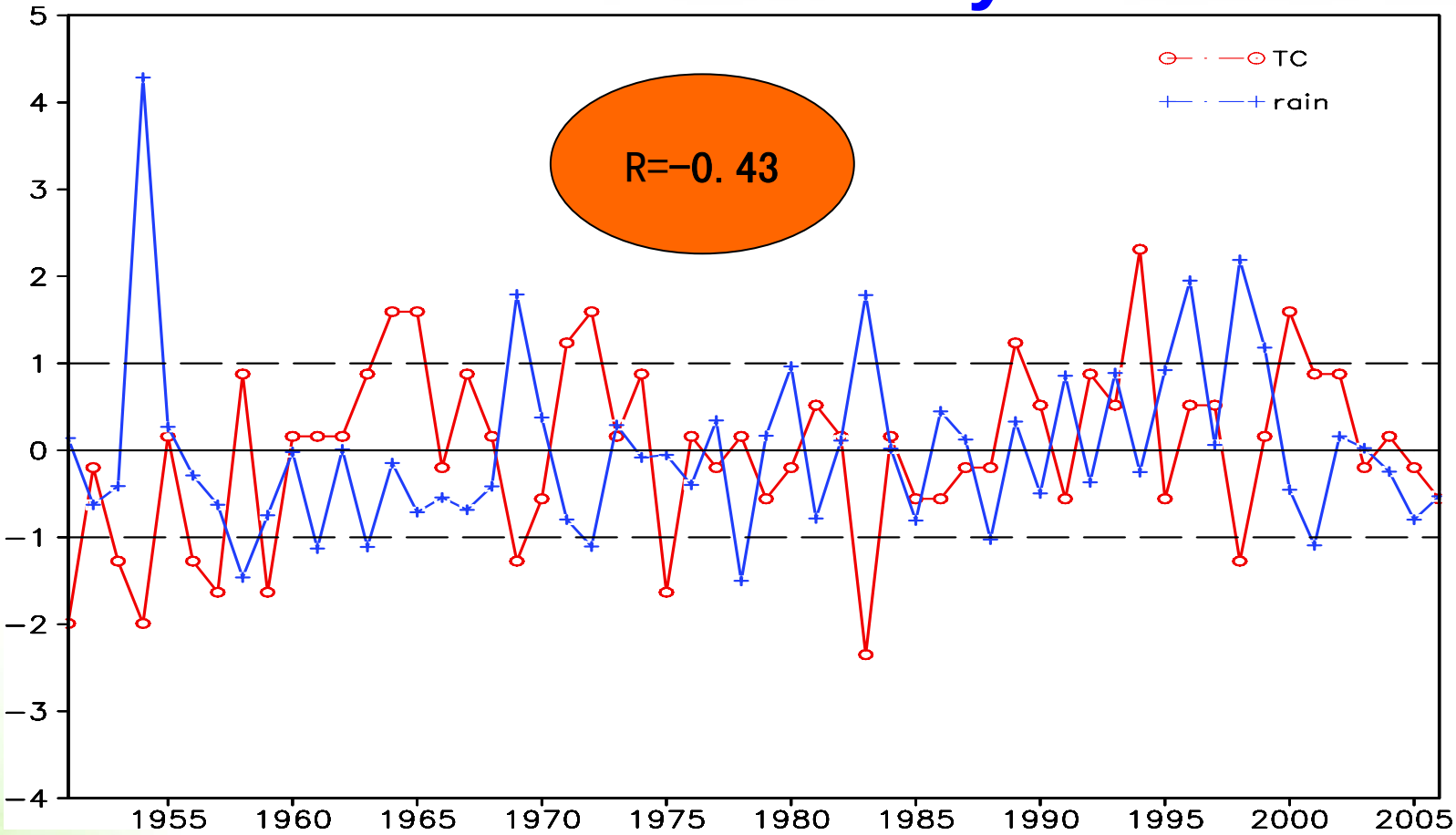
Relationship between the Meiyu and TC genesis

Correlation Analysis



The correlation field between the precipitation at 743 stations in China and the frequencies of TC genesis during the Meiyu period (from June to July) from 1951-2006. The shaded areas are statistically significant at 95% confidence level.

Correlation Analysis



Time series of the normalized frequencies of TCs genesis over the WNP and precipitation over the YHRB. The line with circle refers to the frequencies of TCs generation. The line with plus refers to the precipitation over the YHRB.

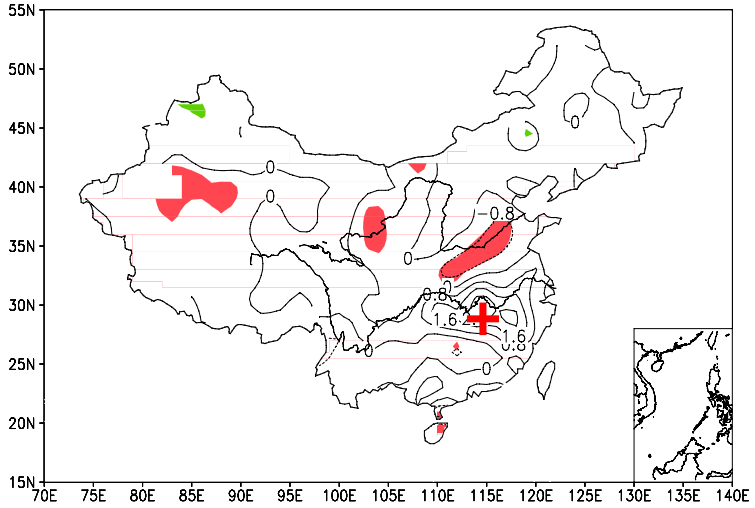
Composite analysis and some cases studies

Composite analysis

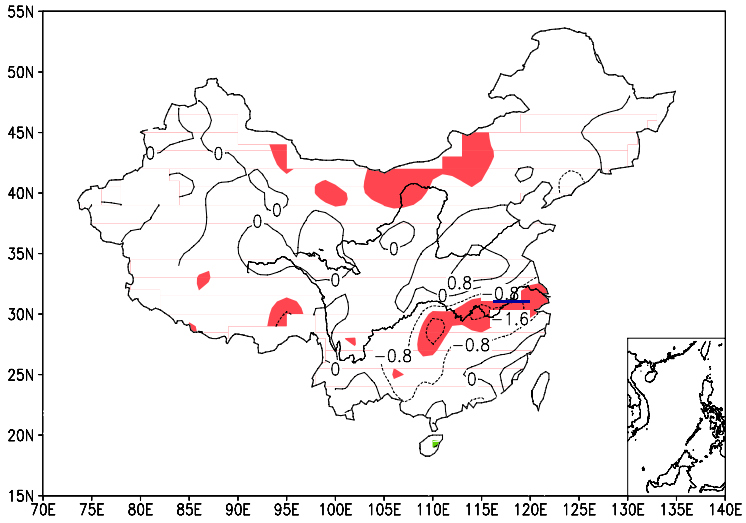
	Years
Years with fewer TCs(10)	1951，1953，1954，1956，1957，1959，1969，1975，1983，1998
Years with more TCs(7)	1964，1965，1971，1972，1989,1994，2000

The standard deviation of +1 and -1 is defined as the threshold for choosing anomalous years

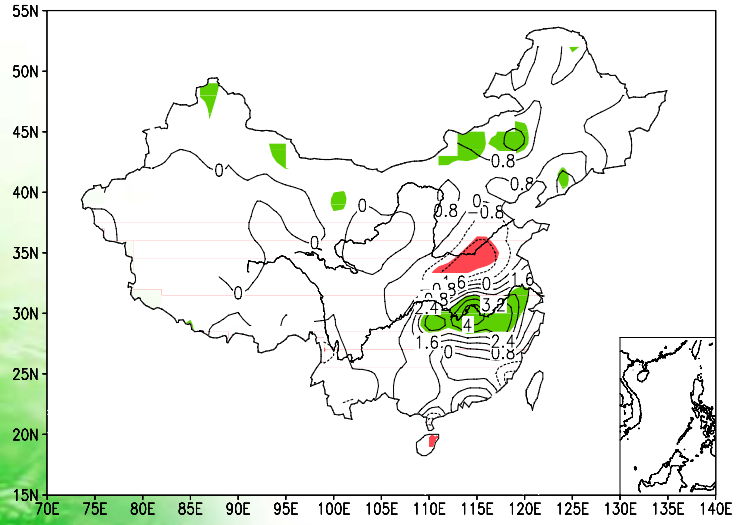
Precipitation anomalies



(a) the years with fewer TCs genesis



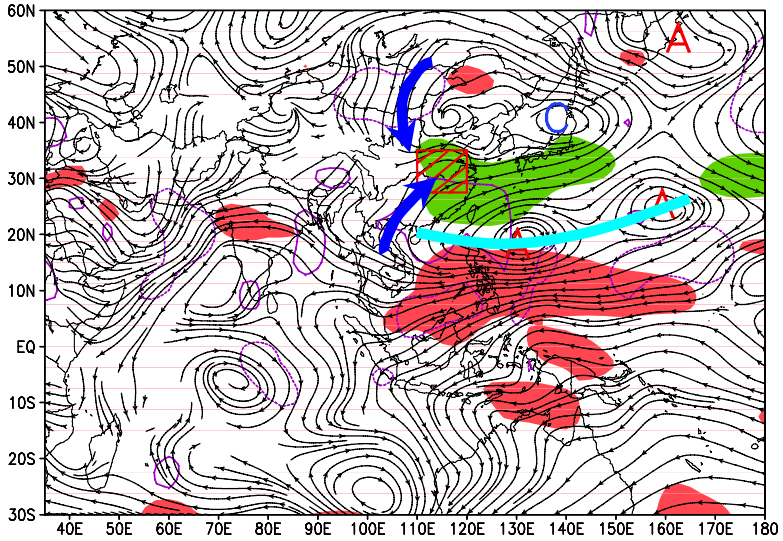
(b) the years with more TCs genesis



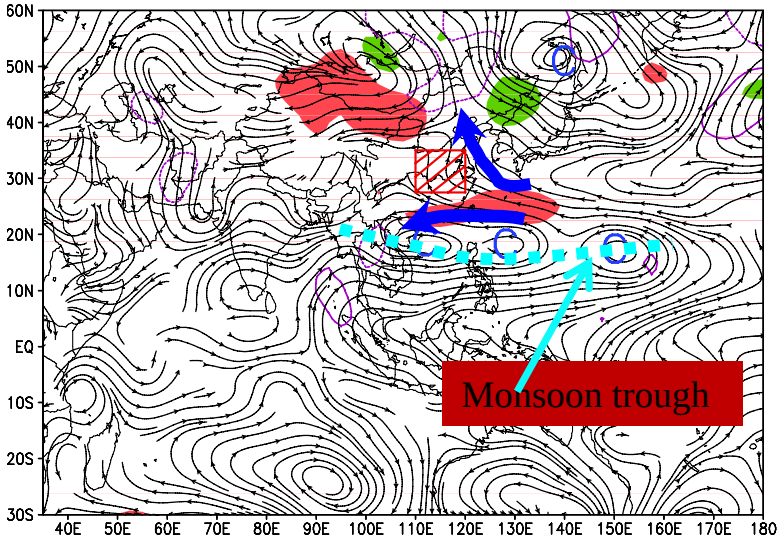
(c) their difference

Composite distributions of precipitation anomalies during the Meiyu period between the years with fewer and more TCs genesis. The shaded areas are statistically significant at the 95% confidence level

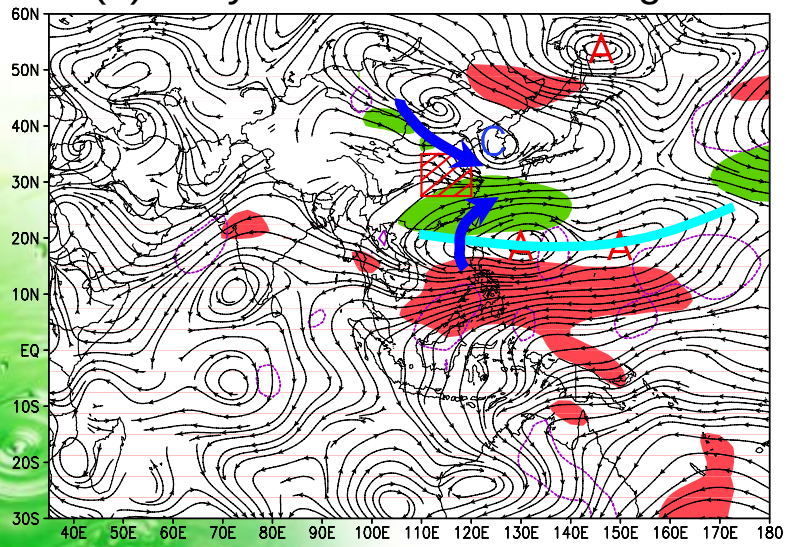
850hPa streamline anomalies



(a) the years with fewer TCs genesis



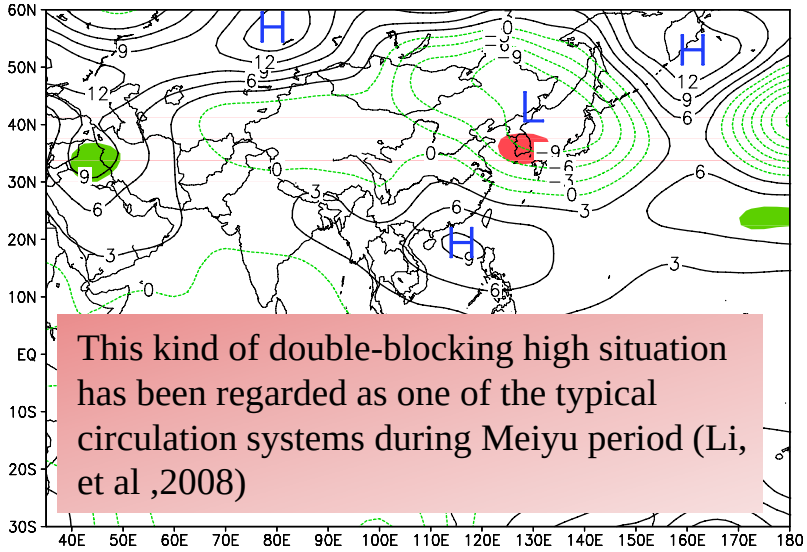
(b) the years with more TCs genesis



(c) their difference

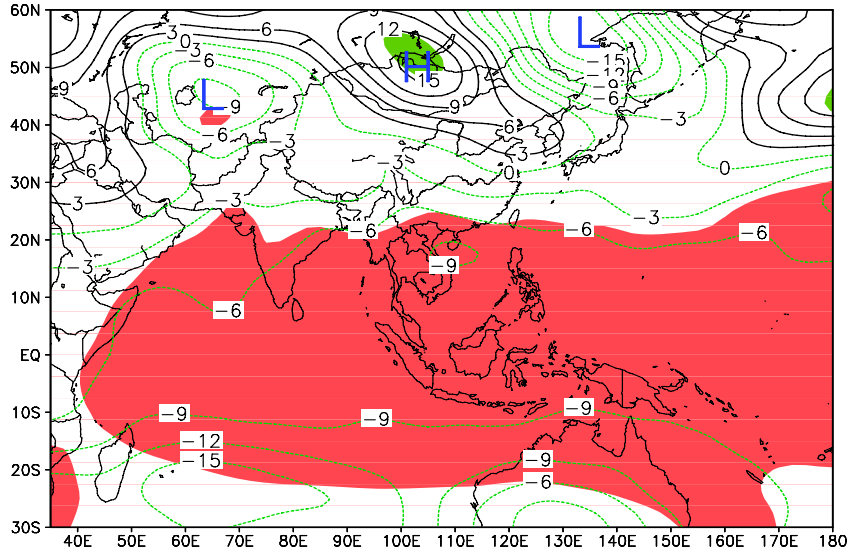
Same as Fig.5, but for the 850 streamline fields. The thick solid line denotes the ridge of anomalous anticyclone and the thick dashed line denotes the anomalous monsoon trough.

500hPa Geopotential height anomalies

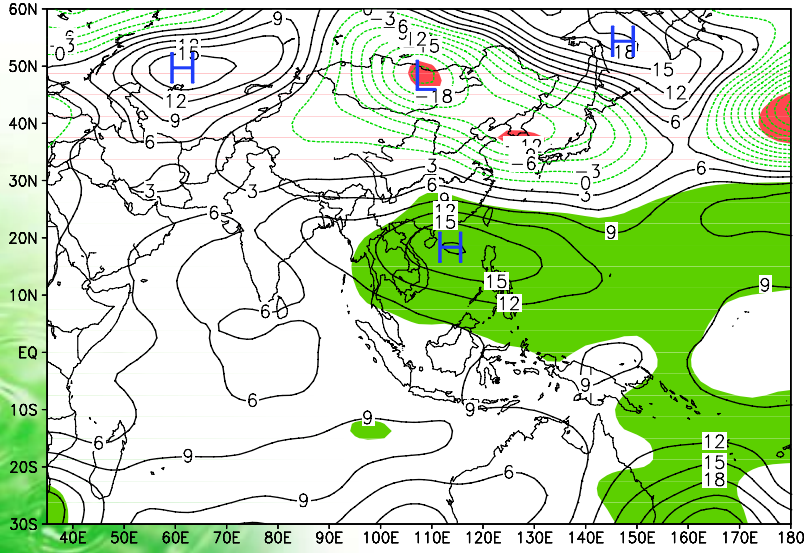


This kind of double-blocking high situation has been regarded as one of the typical circulation systems during Meiyu period (Li, et al ,2008)

(a) the years with fewer TCs genesis



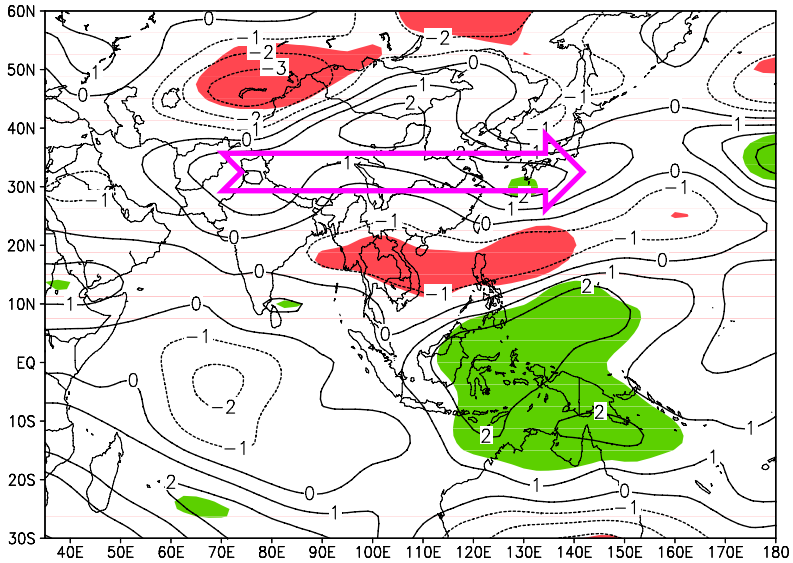
(b) the years with more TCs genesis



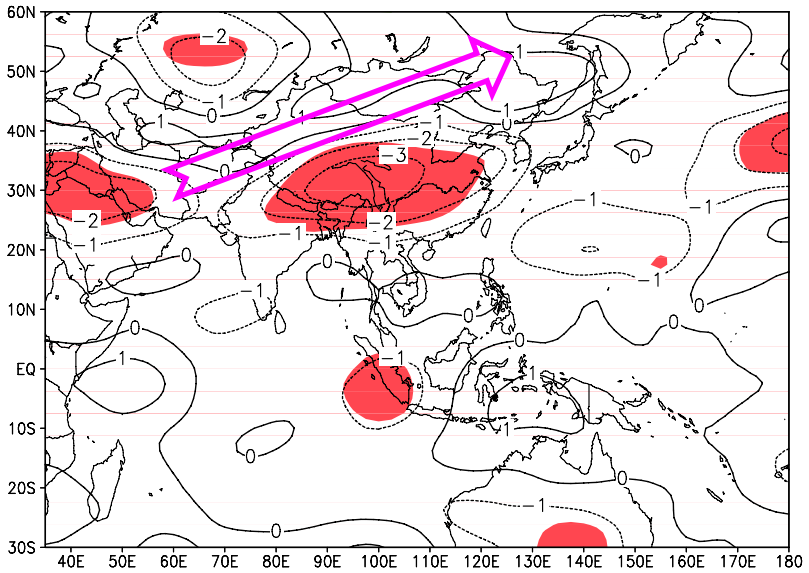
(c) their difference

Same as Fig.5, but for the 500hPa geopotential height.

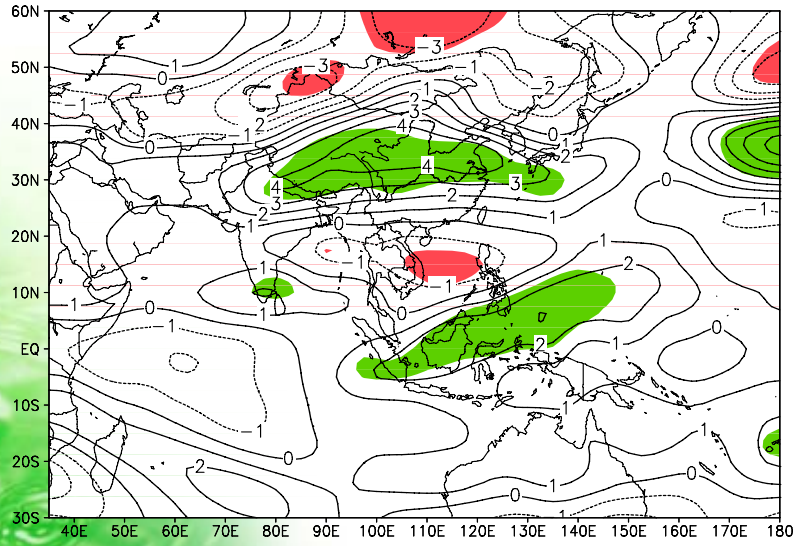
200hPa zonal wind anomalies



(a) the years with fewer TCs genesis



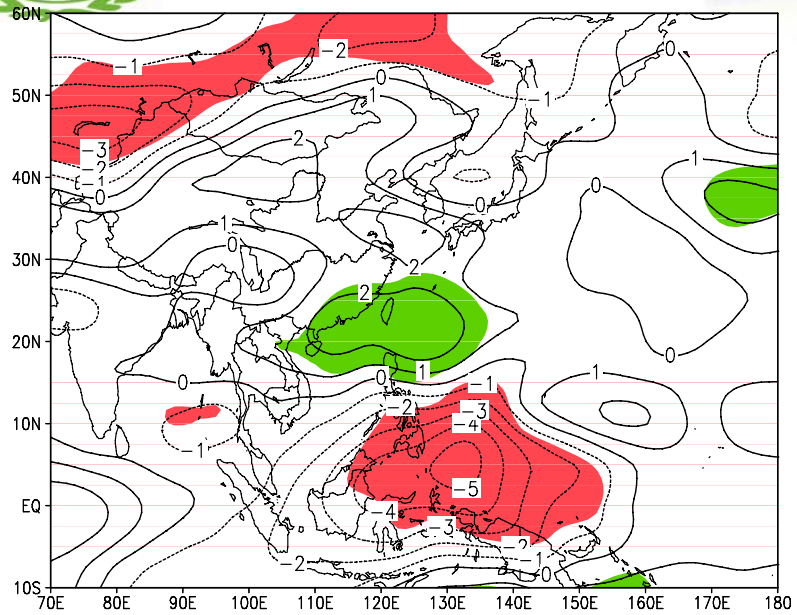
(b) the years with more TCs genesis



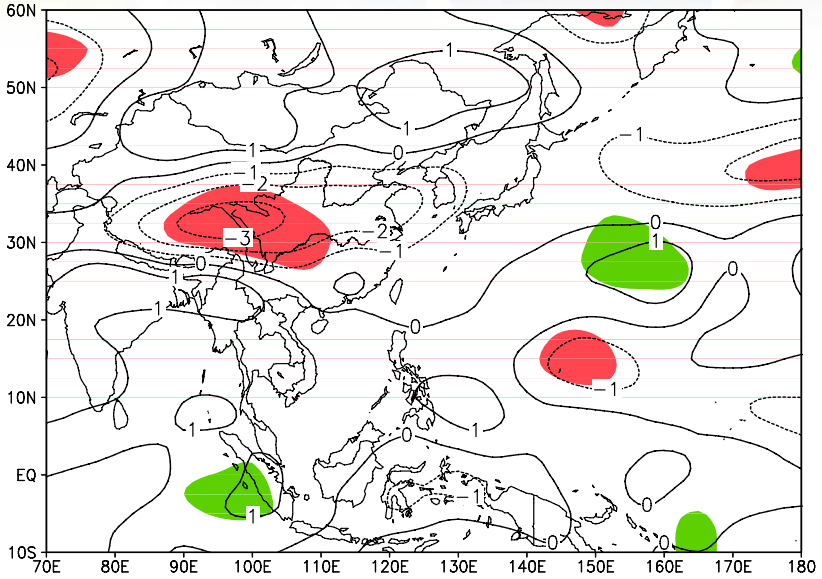
(c) their difference

Same as Fig.5, but for the 200hPa zonal wind.

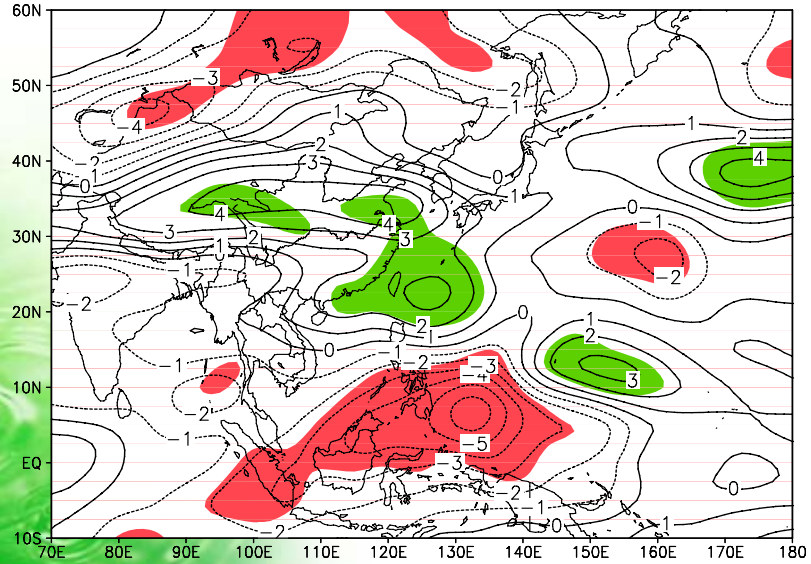
Vertical shear anomalies（U_{200}-U_{850})



(a) the years with fewer TCs genesis



(b) the years with more TCs genesis



(c) their difference

Same as Fig.5, but for the vertical shear.

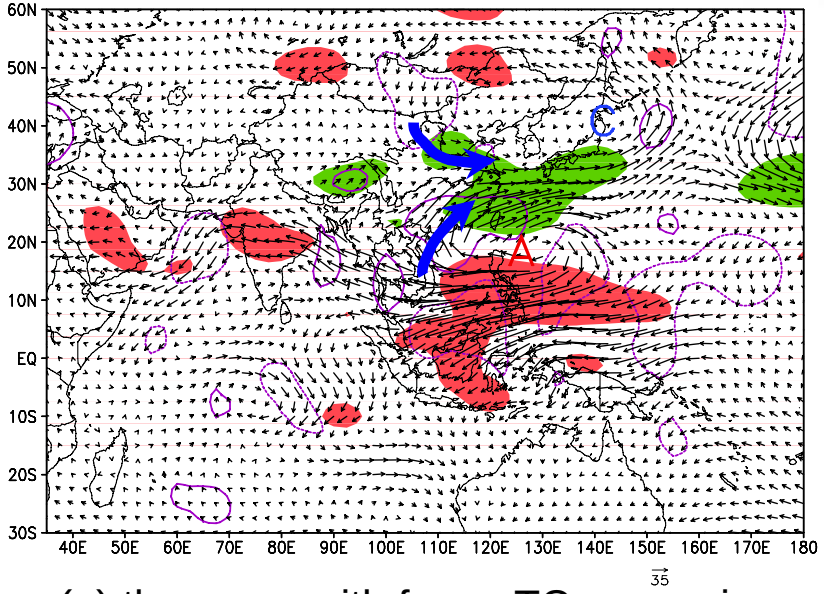
A stronger vertical wind shear is usually believed to be unfavorable for the occurrence and development of the TCs (Gray 1998)

Vertical shear over the region where TCs genesis

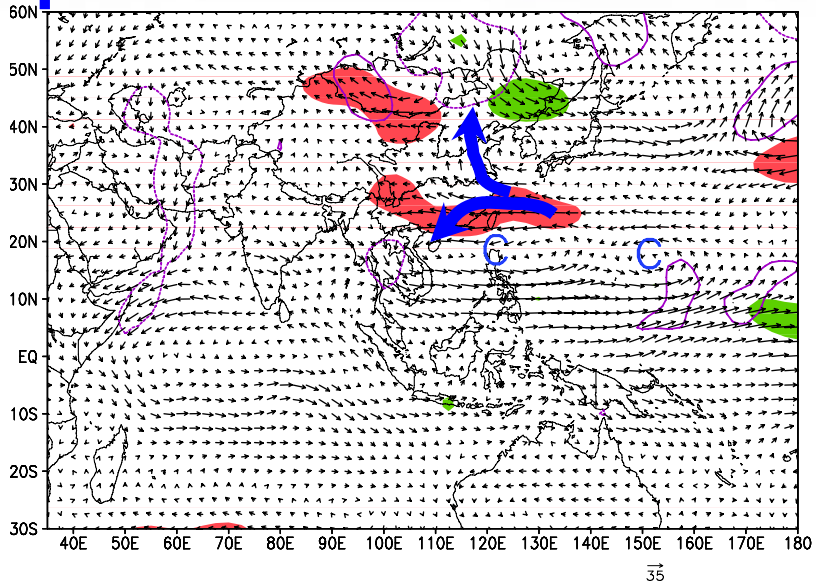
Normal	the years with fewer TCs genesis	the years with more TCs genesis
4.97m/s	5.68m/s (+0.72)	4.28m/s (-0.69)

Stronger vertical wind shear unfavorable for the occurrence and development of the TC.

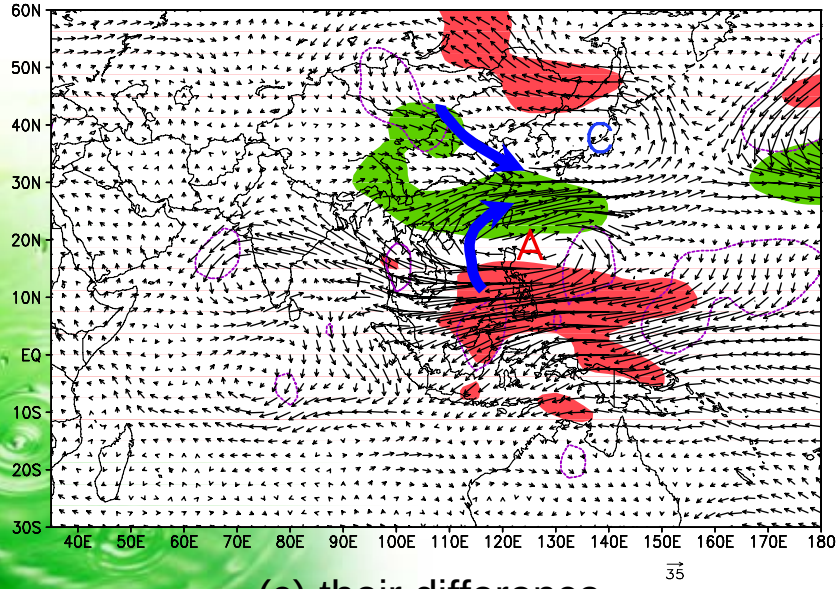
Moisture transport anomalies



(a) the years with fewer TCs genesis



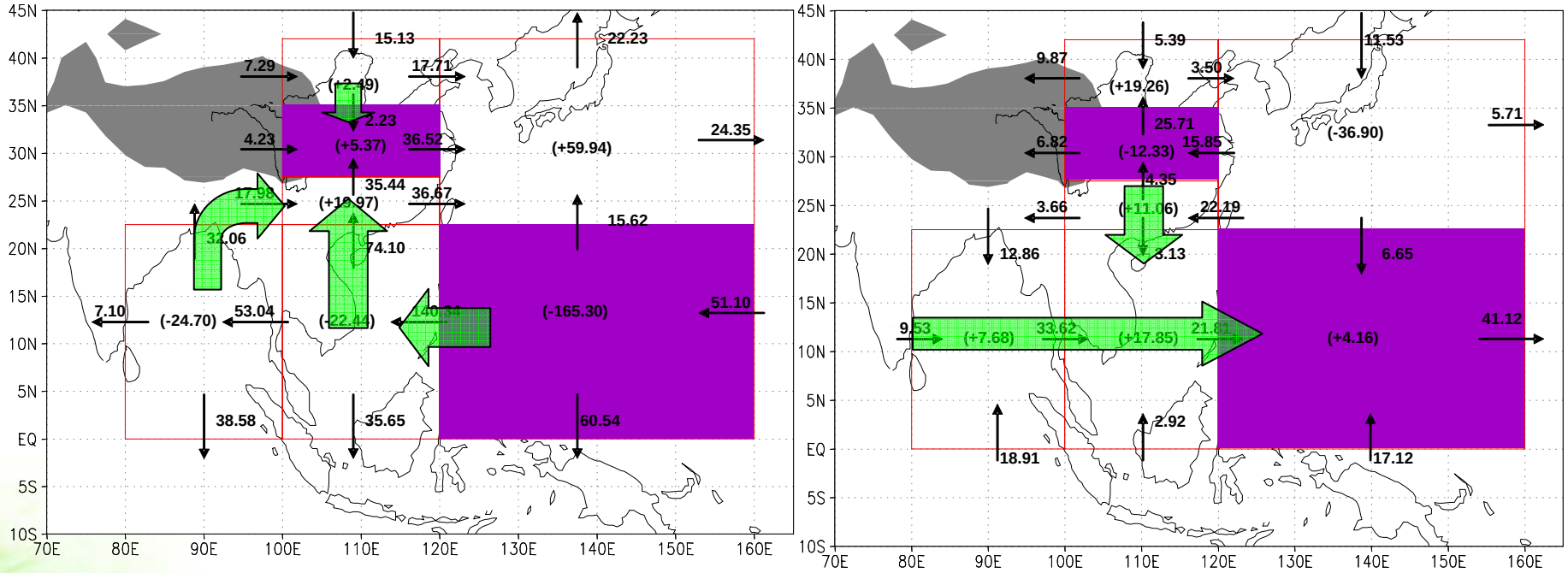
(b) the years with more TCs genesis



(c) their difference

Same as Fig.5, but for the vertically integrated moisture transport.

Composite schematic maps of the anomalous moisture budget



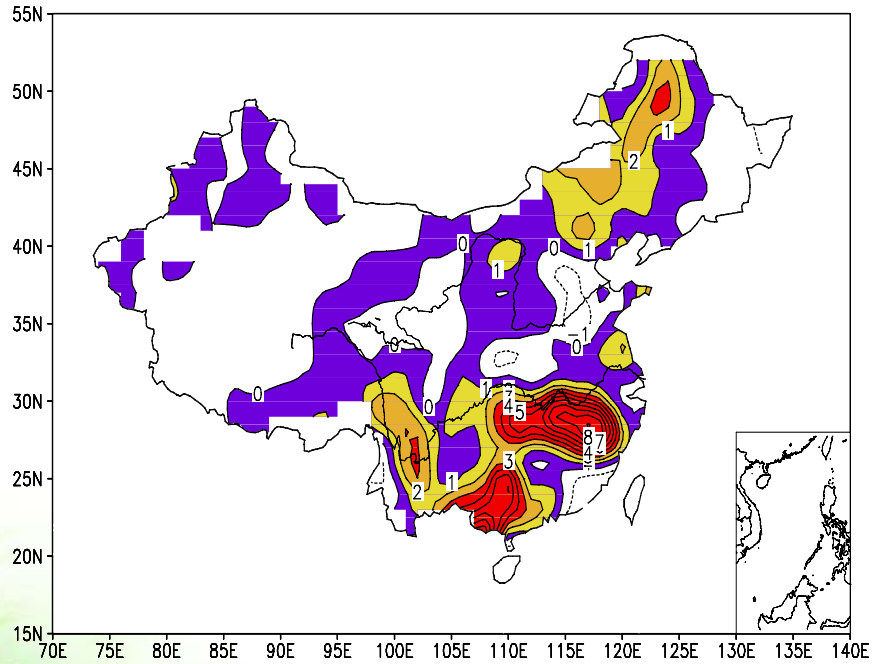
(a) the years with fewer TCs genesis (b) the years with more TCs genesis

Composite schematic maps of the anomalous moisture budget during the Meiyu period .The unit is 10^6kg.s^{-1}. The “+” and “-”means the net influx and efflux respectively.

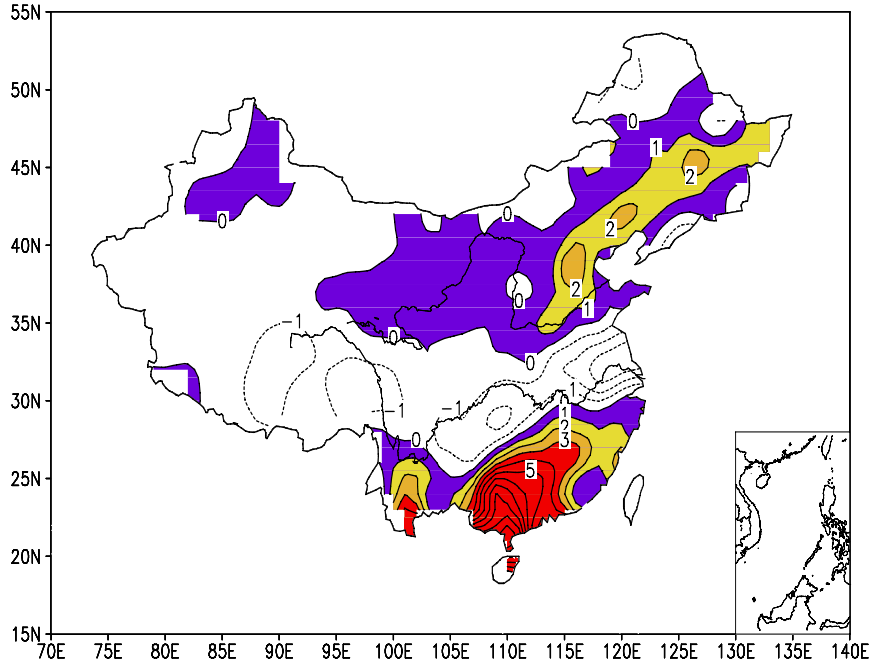
Cases study (after 1990)

Normal	the year with fewer TCs genesis	the year with more TCs genesis
(6)	1998 (3)	1994 (13)

Precipitation anomalies

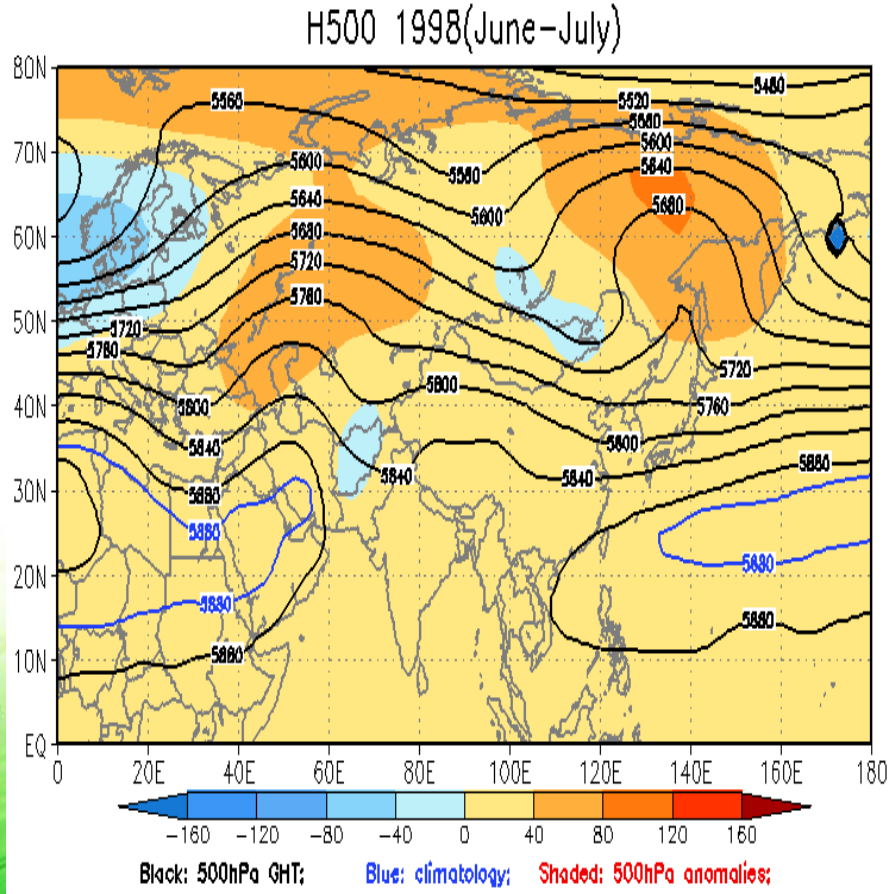


1998

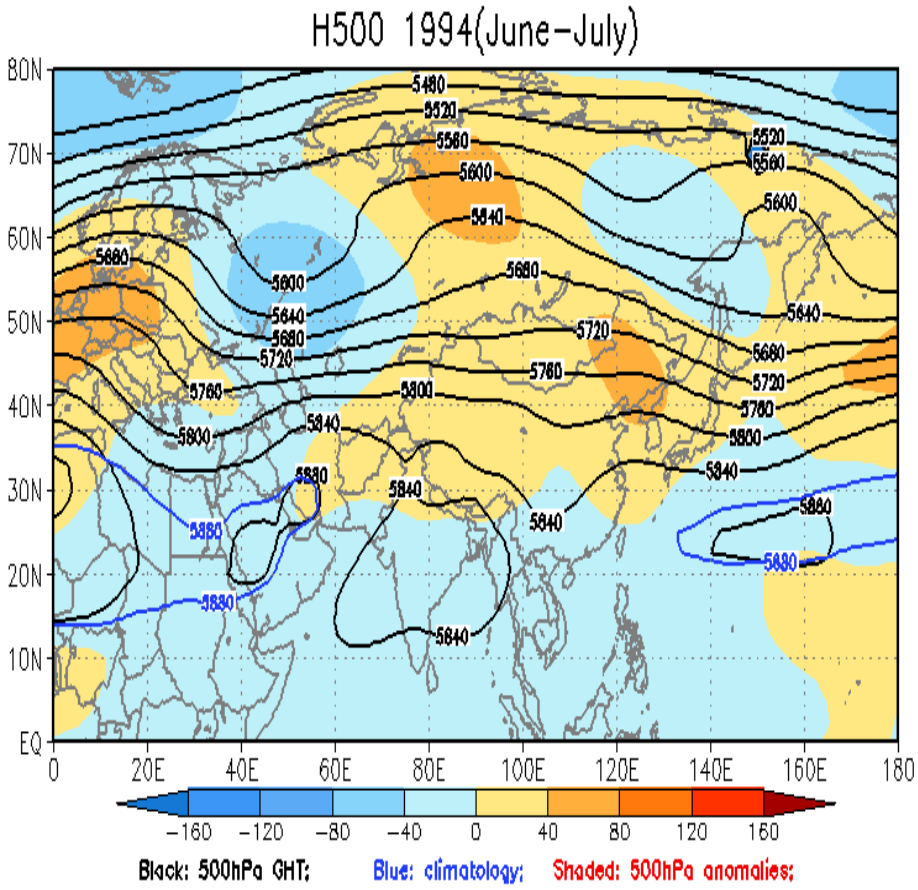


1994

500 hPa Geopotential Height

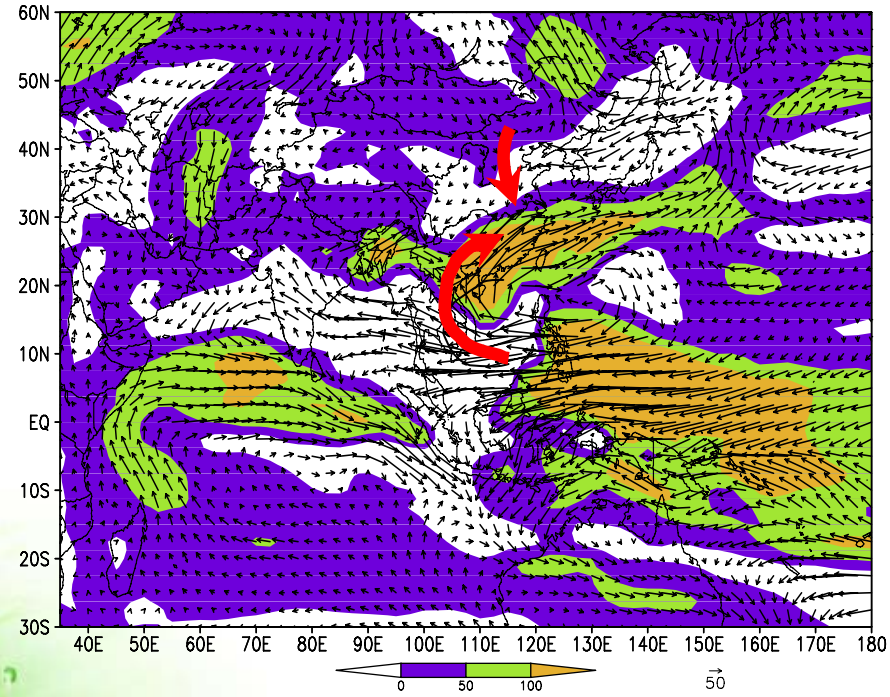


1998

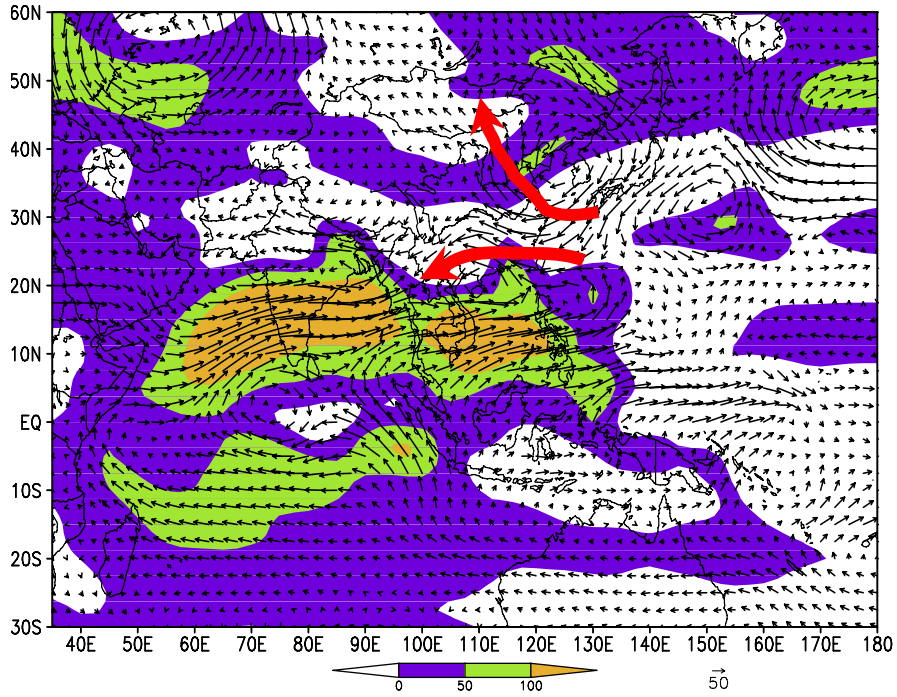


1994

Moisture transport anomalies

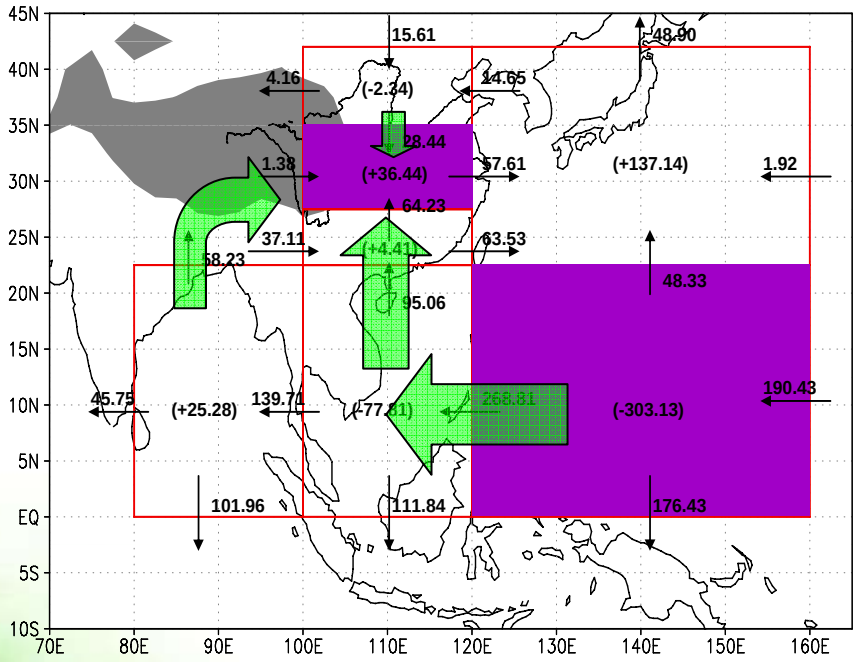


1998

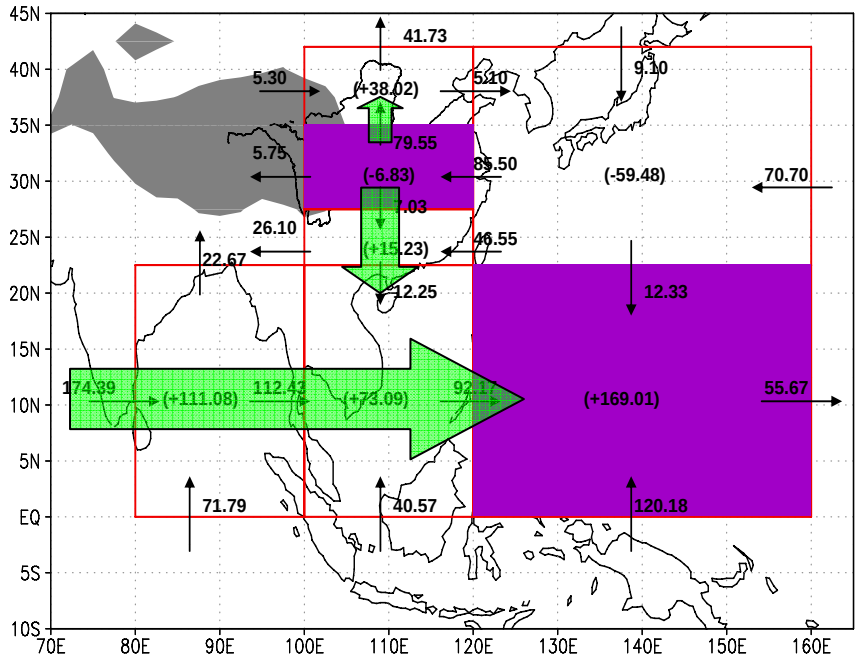


1994

Composite schematic maps of the anomalous moisture budget

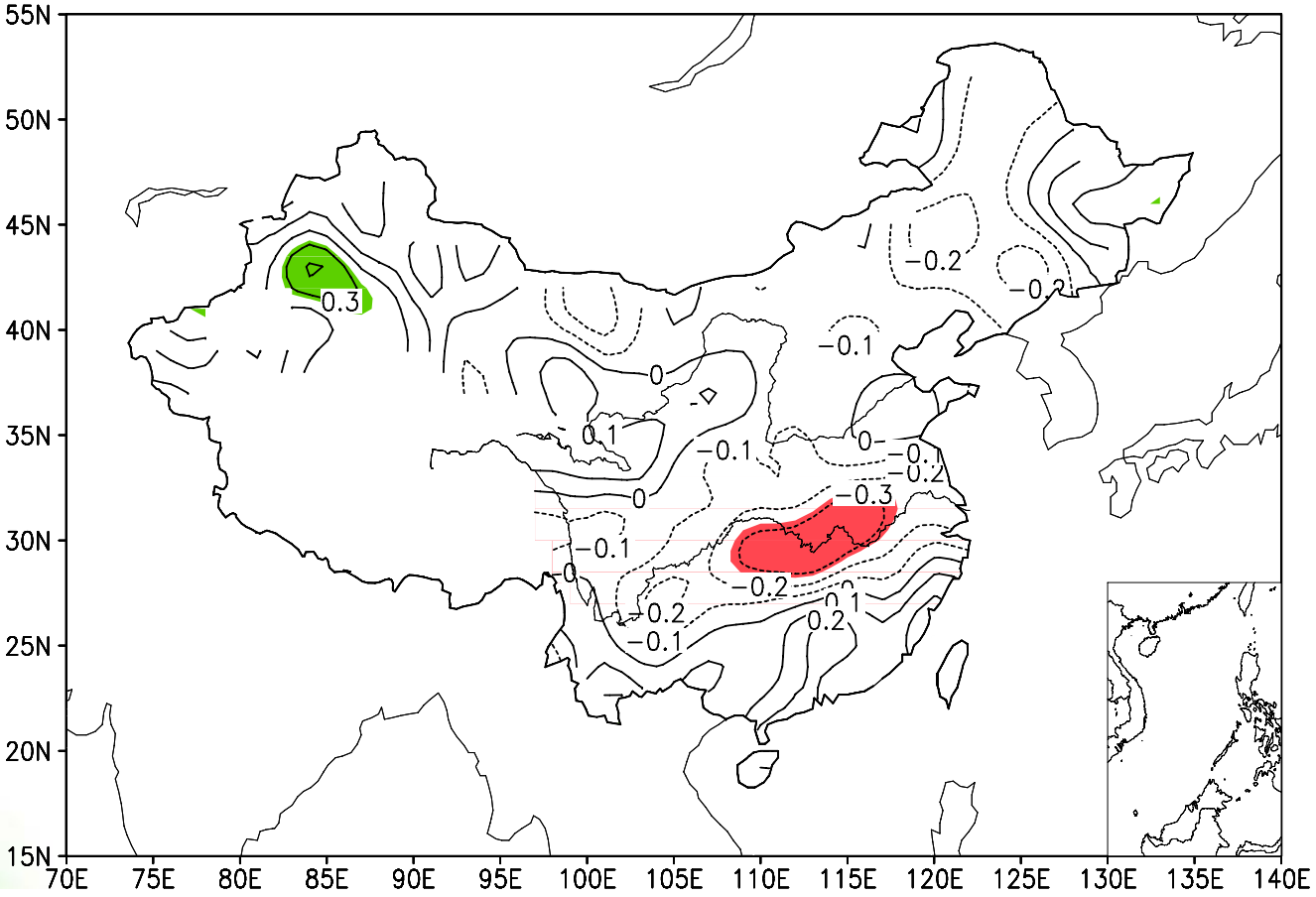


1998年



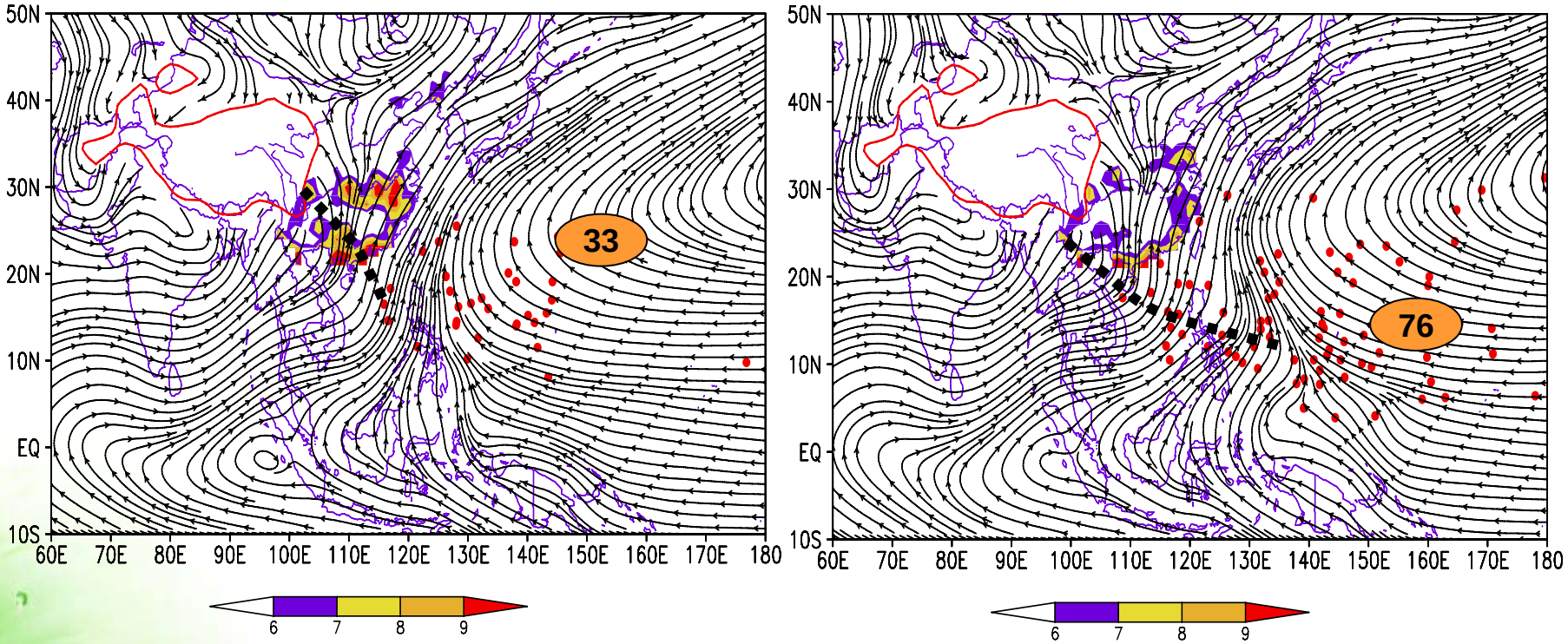
1994年

Correlation Analysis in JJA



The correlation field between the precipitation at 743 stations in China and the frequencies of TC genesis in JJA from 1951-2006. The shaded areas are statistically significant at 95% confidence level.

850hPa streamline , precipitation and genesis of TCs in JJA



(a) the years with fewer TCs genesis **(b) the years with more TCs genesis**

Summary

	the years with fewer TCs genesis	the years with more TCs genesis
Sub-tropical high	Located farther south and west , stronger intensity	Located farther north and east, weaker intensity
Monsoon trough	located farther west, weaker intensity	located farther east, stronger intensity
Geopotential height	Two ridges and one trough	Two troughs and one ridge
Westerly belt	Located farther south、stronger intensity	Located farther north, weaker intensity
Vertical shear	Stronger	weaker
Moisture	SWNP: divergence; YZ: convergence	SWNP: convergence; YZ: divergence
Precipitation	more	Less

Summary

The results have shown that there exists a significant negative correlation between the intensity of Meiyu and the frequencies of tropical cyclone in the WNP, which is due to the fundamental changes in monsoonal airflows and associated moisture transports over East Asia and the WNP.

The kind of negative relationship will be useful for the seasonal climate forecast of the Meiyu and typhoon during flooding season in China or even in East Asia, which can be regarded as one kind of constraint conditions for Meiyu forecast, hereby judging the rationality of typhoon and Meiyu forecasts.

谢谢！

Precipitation anomalies