Session 1: Atmospheric Convection
Monsoon

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An integrated project: *Interaction of convection over the Maritime Continent-SCS with large-scale motion*
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To be proposed to the funding agency in Taiwan

First Int'l Science and Planning Workshop on Years of the Maritime Continent (YMC)
CCRS, Singapore, January 27 – 30, 2015

Maritime Continent (MC) + South China Sea (SCS)

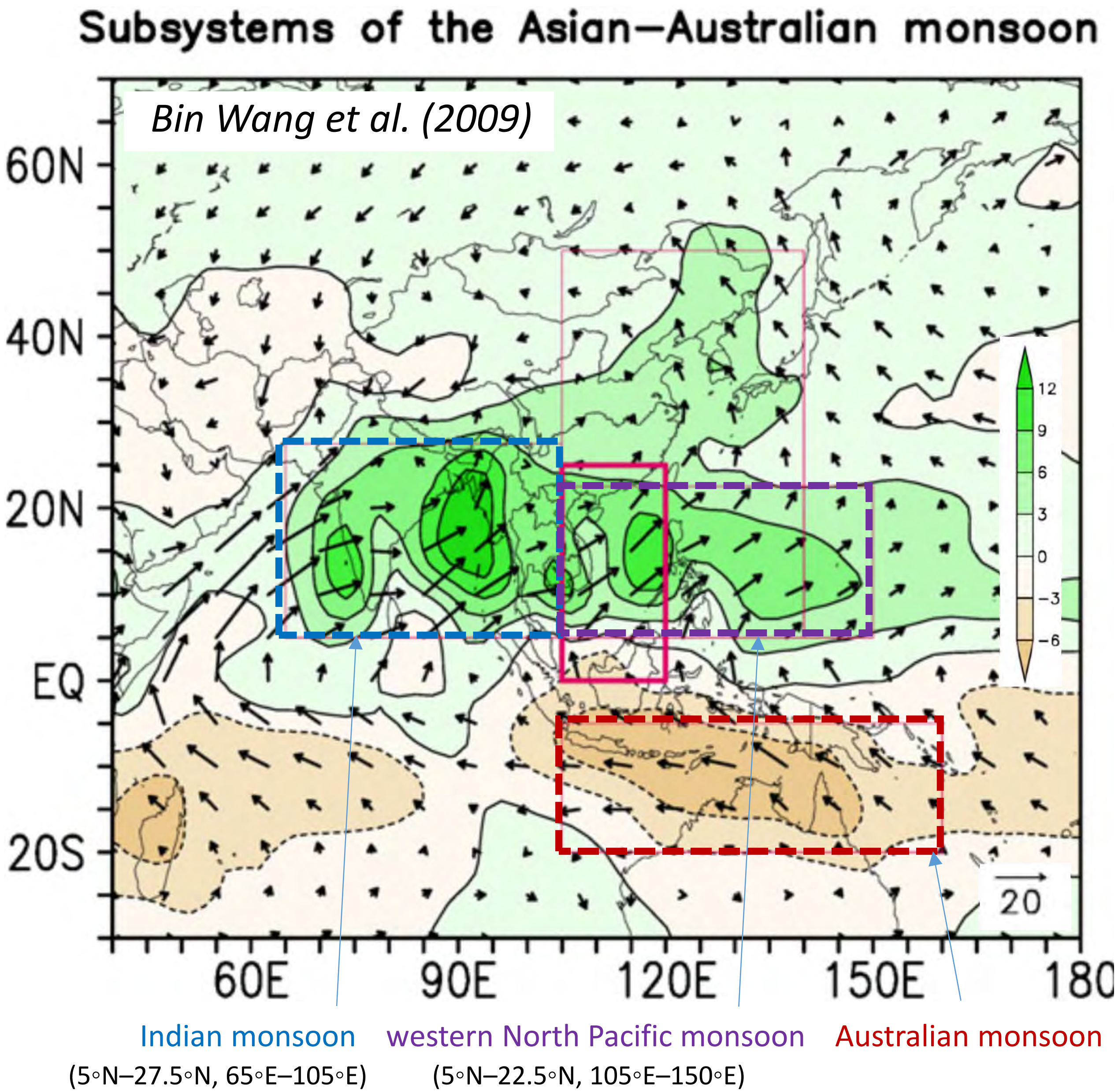
1. Convection in the MC is tightly coupled with the uprising branch of the meridional Walker circulation and local Hadley circulation with energetic winter monsoon-climate variability.

2. acts as a water vapor pathway connecting the **Indian** and Western **North Pacific (WNP)** monsoon during boreal summer

3. connecting the most powerful EA winter monsoon with the **Australian summer monsoon**

(JJA) minus (DJF) (1979 to 2006)

CMAP precipitation rates (mm/day), V925 NCEP/DOE reanalysis



Winter monsoon (wet phase of MC monsoon)

the Siberian High (SH) ↔ MC convection

Variability of SH is influenced by the **EA major trough** and the **EA jet stream**.

→ triggers **cold surge** winds
the strongest cold surges are concentrated in the SCS where they can reach MC and cross the equator (Chang et al. 2006, 2015). Although cold surge winds are typically dry, they are moistened by the over-water trajectory (Johnson and Houze 1987) and have been associated with enhanced **upper-tropospheric outflow over the MC**, which is related to an enhanced **EA local Hadley Cell** that may strengthen the **EA jet** and lead to further interactions with the midlatitude systems.

This strong interaction between the midlatitude and tropical components through cold surges and convection feedback to the East Asian jet (e.g., Chang and Lau 1982; Lau and Chang 1987; Neal and Slingo 2003) reinforces each circulation, which makes the Asian winter monsoon one of the most energetic planetary-scale circulation systems in the earth's atmosphere (Chang et al. 2006).

Winter monsoon

Research Objectives

to study the boreal winter midlatitude-tropical interactions in East and Southeast Asia associated with the MC convection. In particular,

Midlatitude to tropics:

The influence of Siberian High (SH) on the MC convection through the synoptic scale cold surges in the SCS is known. Is there also a longer time scale relationship beyond the synoptic scale, i.e., intraseasonal, seasonal, and longer, between SH and tropical weather in the SCS and the MC? How does this relationship affect neighboring countries

Tropics to midlatitude:

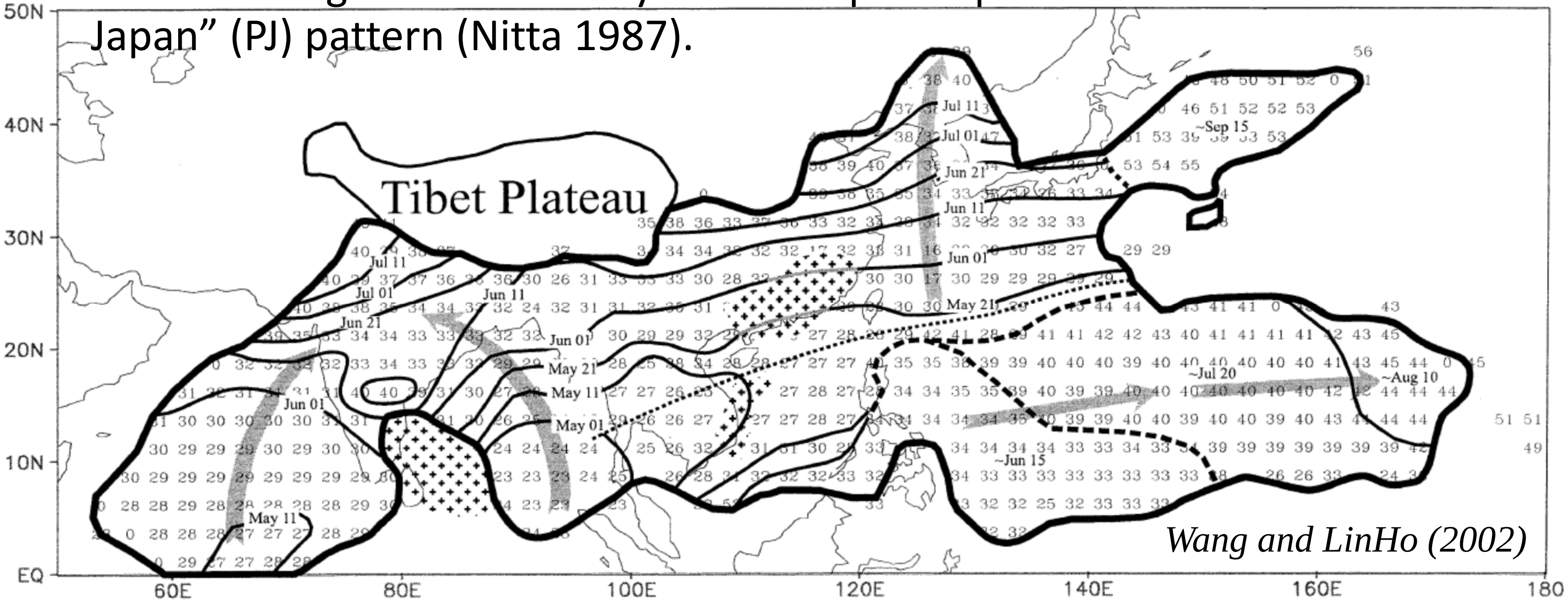
The feedback from the MC convection can strengthen the East Asian Jet is known. Is there also a relationship of the feedback that influences the East Asian Major Trough, and how does these possible feedbacks affect neighboring countries ?

Proposed Key YMC observations

Intensive obs. in the SCS (Nansha Dao) and MC including surface & upper-air data, air-sea fluxes, convection

Summer monsoon (wet phase of Asian monsoon)

During the onset months of the boreal summer monsoon, most of the variability is in Indo-China (April), followed by Bay of Bengal and SCS (May) including Meiyu in Taiwan and Baiu in Okinawa (Matsumoto 1997; Wang and LinHo 2002). Convection emerges in Philippine Sea in mid-June and jump eastward & northward in mid-July (Ueda 1995; Ueda et al. 2009). Northward migration of convection in WNPSM is associated with Madden-Julian Oscillation (MJO) (Lau and Chan 1986; Lau et al. 1988; Wang and Rui 1990; Kikuchi et al. 2012). The heat source of WNPSM convections generates Rossby waves response poleward called “Pacific-Japan” (PJ) pattern (Nitta 1987).



Wang and LinHo (2002)

Summer monsoon

Research Objectives

To study interaction between the MC-SCS convection and WNP monsoon to improve the representation and predictability of WNP monsoon:

Intraseasonal evolution of WNP mosnoon

How does the terrain of the MC affect the MJO interacting with the slowly evolving seasonal transition ?

What causes northward propagation of the MJO?

What causes the penetration of SW flow from SCS into the Philippine Sea (to enhance low-level conv.)? Is it crucial for the onset of WNP? (Wu and Wang 2001; Kubota et al. 2011)

What is the influence of the cross equatorial flow through inner seas of Indonesia on the seasonal march?

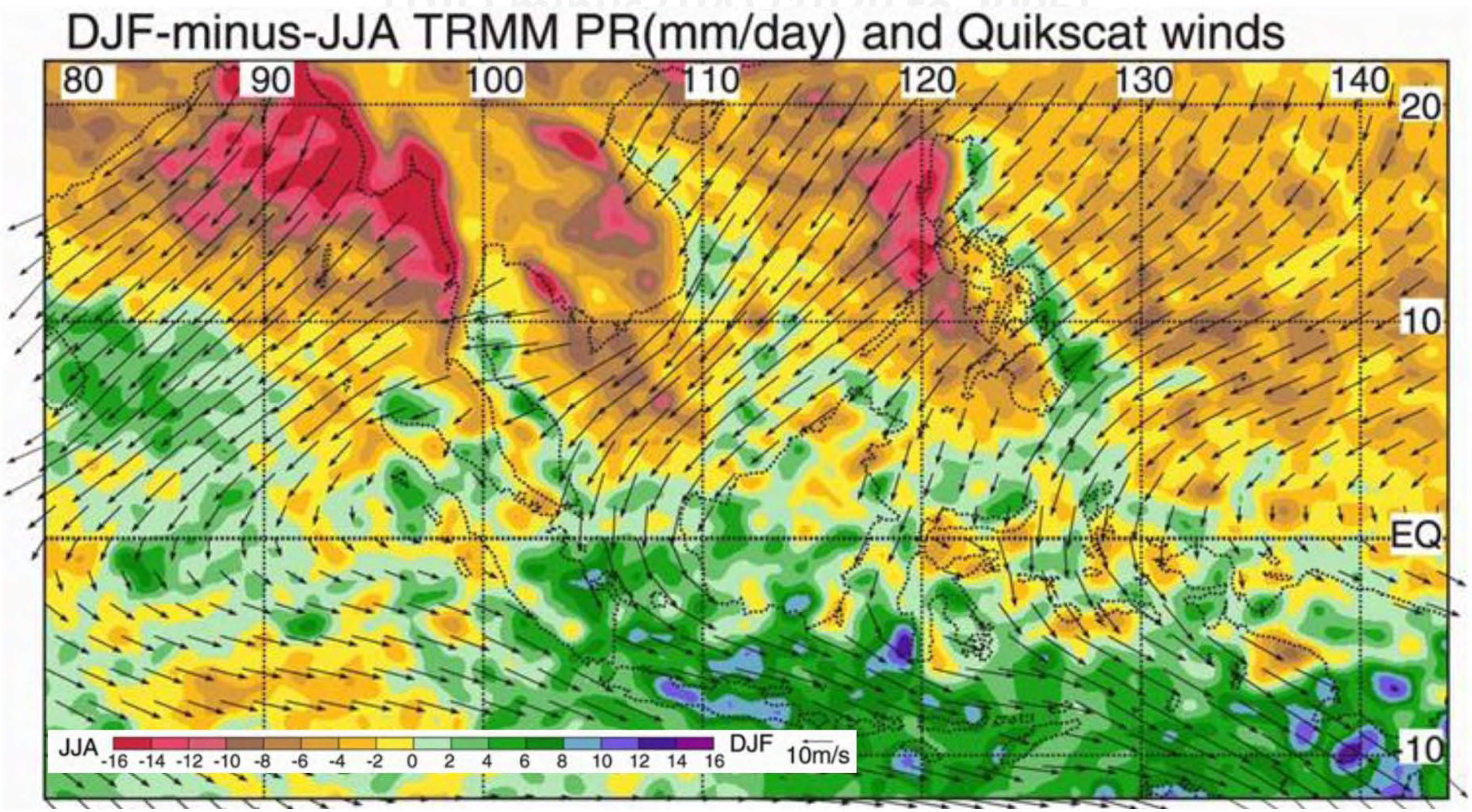
- Effect of Terrain on the MC convection and MJO
- Role of vertical-sheared mean flow (Jiang et al. 2004; Drbohlav & Wang 2005)
- Air–sea interaction processes (Hsu and Weng 2001; Fu et al. 2003; Fu and Wang 2004)

Summer monsoon

Proposed Key YMC observations

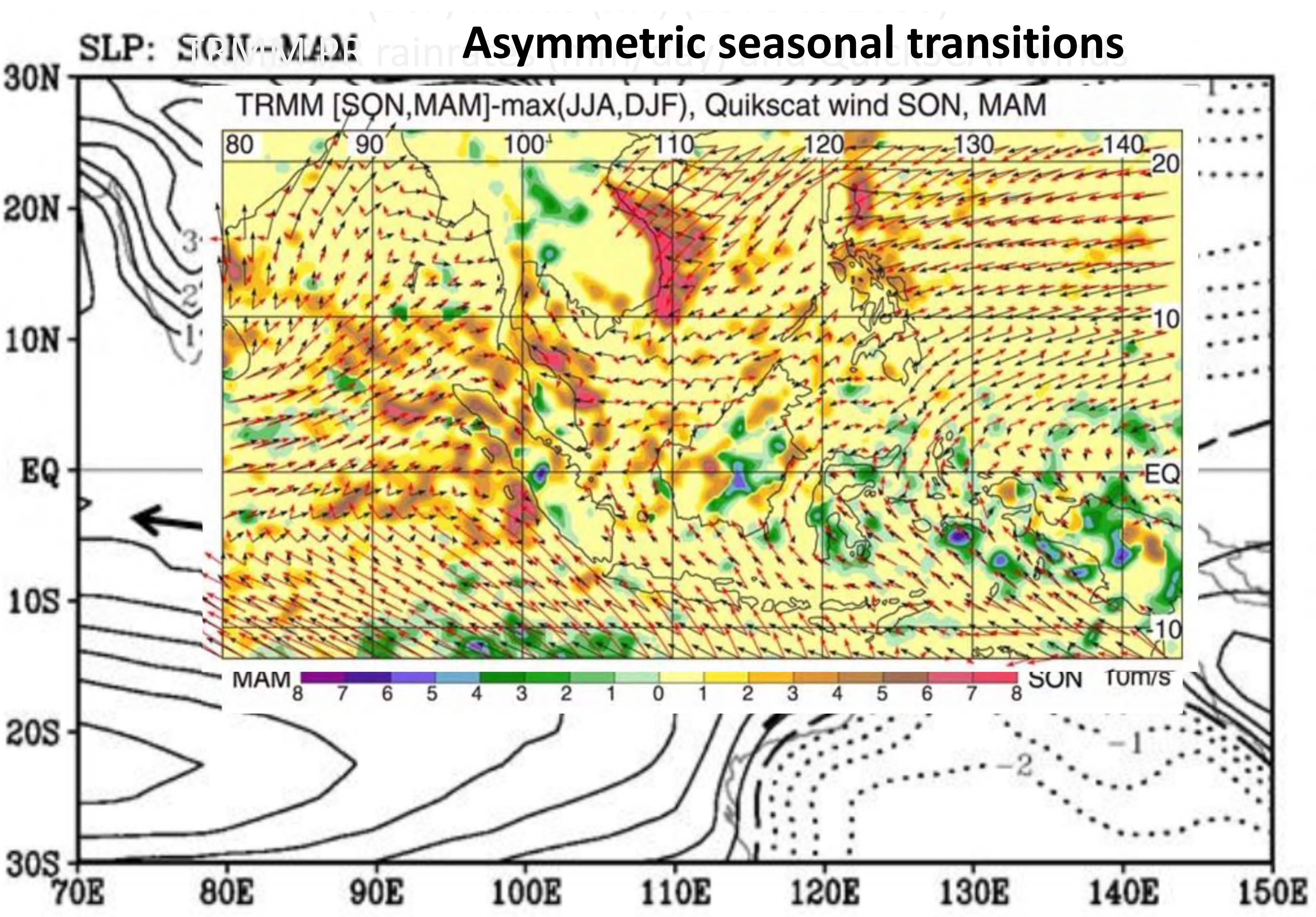
Intensive observations in the MC, SCS, and Philippines by additional surface stations, upper-air sounding and air-sea exchanges (satellites and research vessels)

Asymmetric seasonal transitions



The terrain of the SCS-MC affects the spatial distribution of rainfall in the boreal summer and winter monsoon regimes and the asymmetric seasonal marches during the transition seasons (Lau & Chan 1983; Meehl 1987; Yasunari 1991; Matsumoto 1992; Matsumoto & Murakami 2002; LinHo & Wang 2002, Hung & Yanai 2004)

Asymmetric seasonal transitions



SSTA/heating in the MC $\rightarrow$ circulation in tropical western Pacific (Subtropical high, equatorial zonal winds)

$\rightarrow$ Equatorial waves, recharge & discharge of warm water)