



Subseasonal characteristics of diurnal variation in summer monsoon rainfall over central eastern China

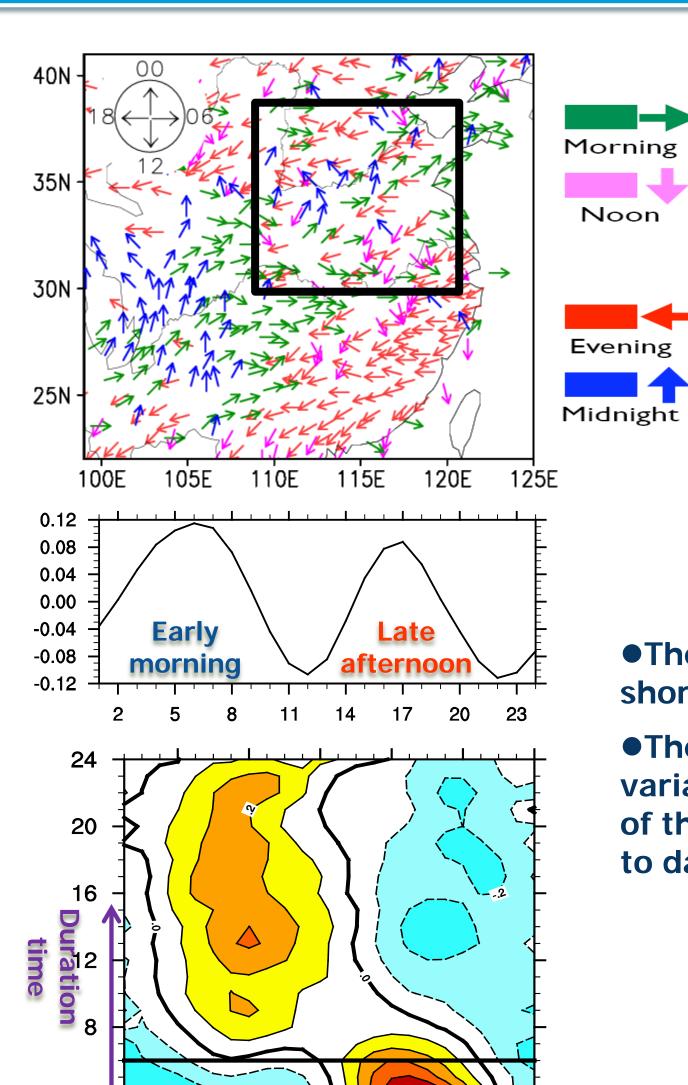




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Introduction

Diurnal cycle of precipitation is an important aspect of regional climate. The regular occurrence of precipitation at a particular time of the day is connected with both regional and large-scale dynamical and thermal conditions.



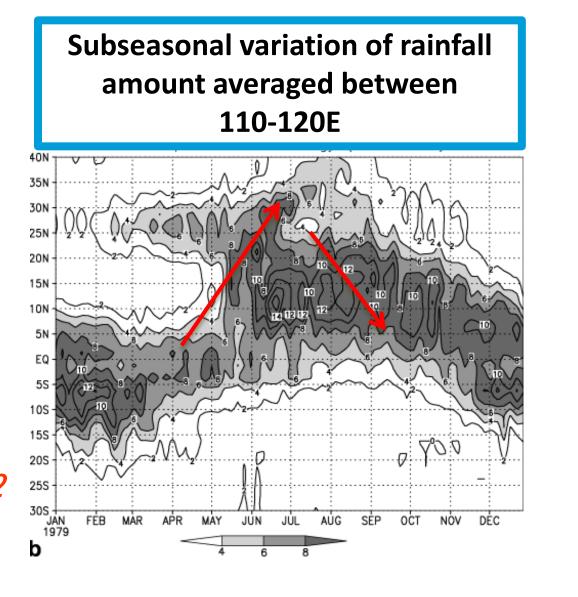
Peak time

- •Summer rainfall over China has pronounced diurnal variation with considerable regional features.
- •However, there are no uniform diurnal peaks of the summer rainfall among different stations in central eastern China.
- Regional averaged results show two comparable peaks.

Yu et al. 2007a

• The rainfall of East Asian summer monsoon exhibits pronounced subseasonal transitions.

Ding et al. 1992



- •The long-duration rainfall event usually has the hourly maximum around early morning and short-duration event gets the maximum around late afternoon in this area.
- ●The late-afternoon peak of short-duration rainfall events may be explained by the diurnal variation of low-level atmospheric stability caused by solar heating, but the physical mechanisms of the prevailing early morning long-duration rainfall events have not been clearly understood up to date.

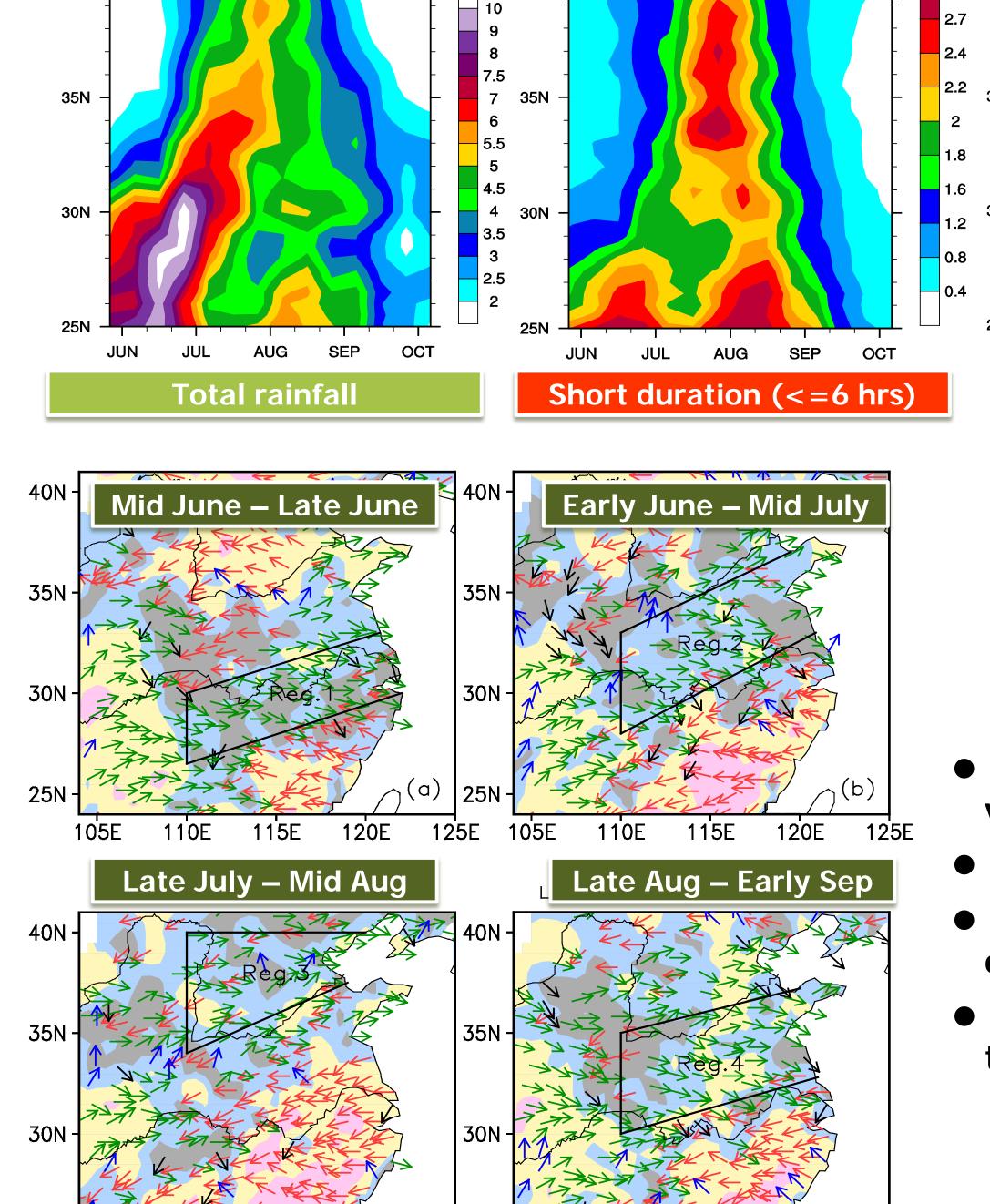
Yu et al. 2007b

- 1. Is there any differences in the contributions of the long- and short-duration rainfall to the monsoon rain belt?
- 2. Does the rainfall in the monsoon rain belt present any unique diurnal feature?

Long duration (>6 hrs)

3. Is there any linkages between the diurnal features of rainfall and large-scale circulation?

Linkage of long-duration rainfall and early morning rainfall with monsoon rain belt

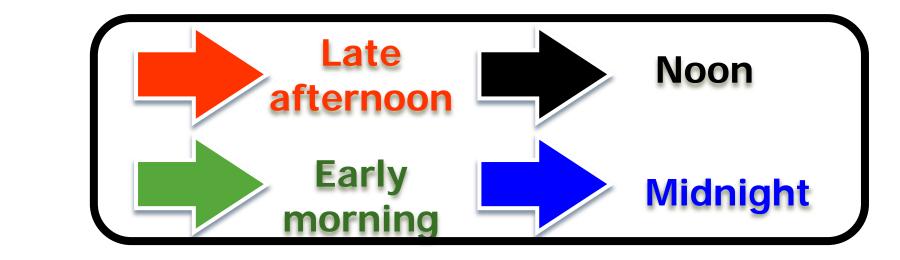


20 30 60

- The time-latitude cross-section of 10-day mean rainfall amount (units:mm/day) of long-, short-duration, and total rainfall averaged between 110°-120°E
- The long-duration rainfall experiences similar subseasonal movement to that of summer monsoon rain belt.
- The short-duration events mainly occur in July and August over most of central eastern China.

Spatial distributions of the diurnal peaks and amplitude (% of daily mean)

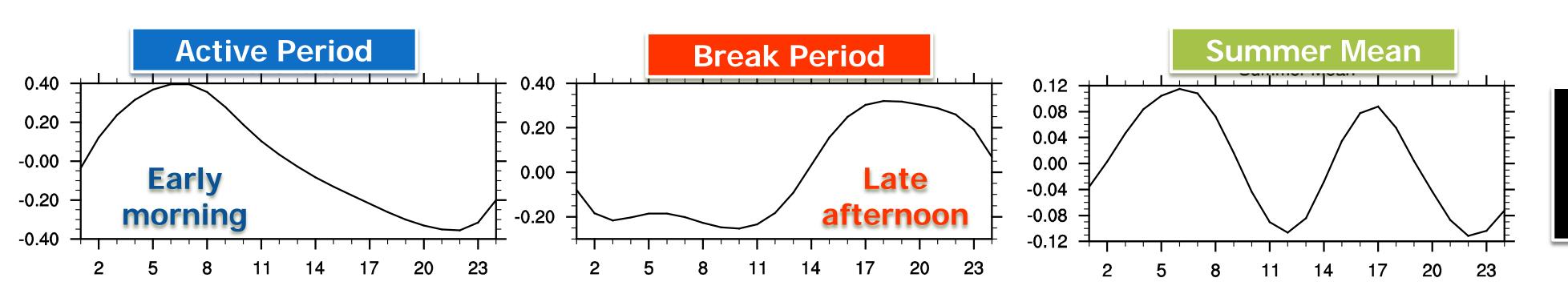
- of rainfall diurnal cycle averaged in different periods
- Rainfall in central eastern China mainly peaks in late afternoon (red vectors) and early morning (green vectors)
- Early morning diurnal peaks exhibit band-like spatial distributions
- Early-morning rainfall show subseasonal movement coinciding with that of monsoon rain belt.
- Late-afternoon rainfall peaks generally locate to the south and north of the rain belt.



Diurnal features in the active and break monsoon period

Active monsoon period: the time period when the summer monsoon rainfall belt locates in the target region.

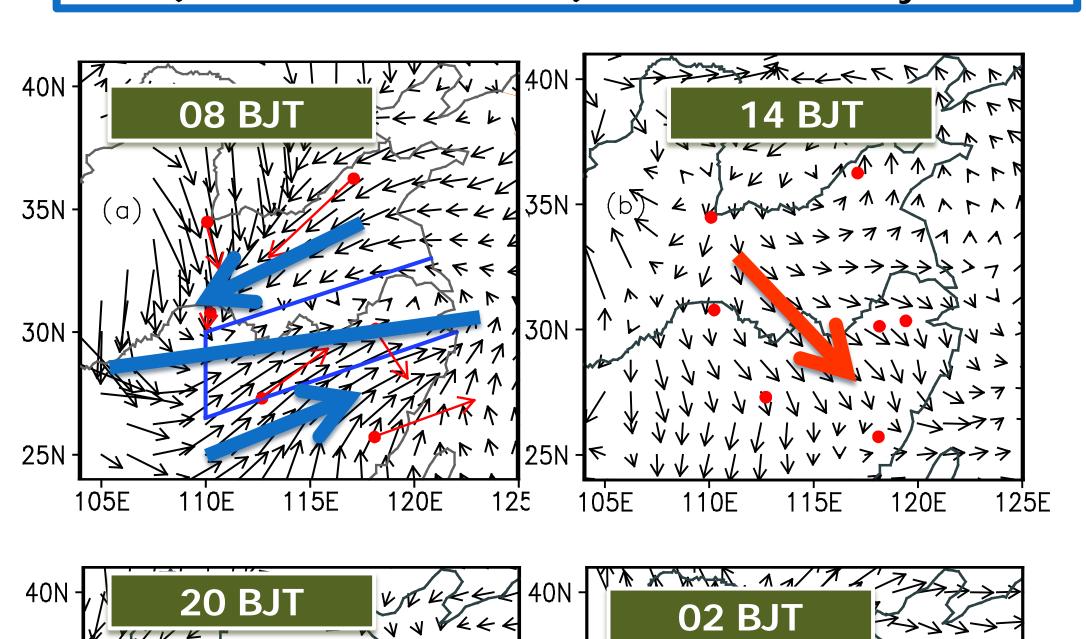
Break monsoon period: the time period when the monsoon rainfall belt moves out of the target region

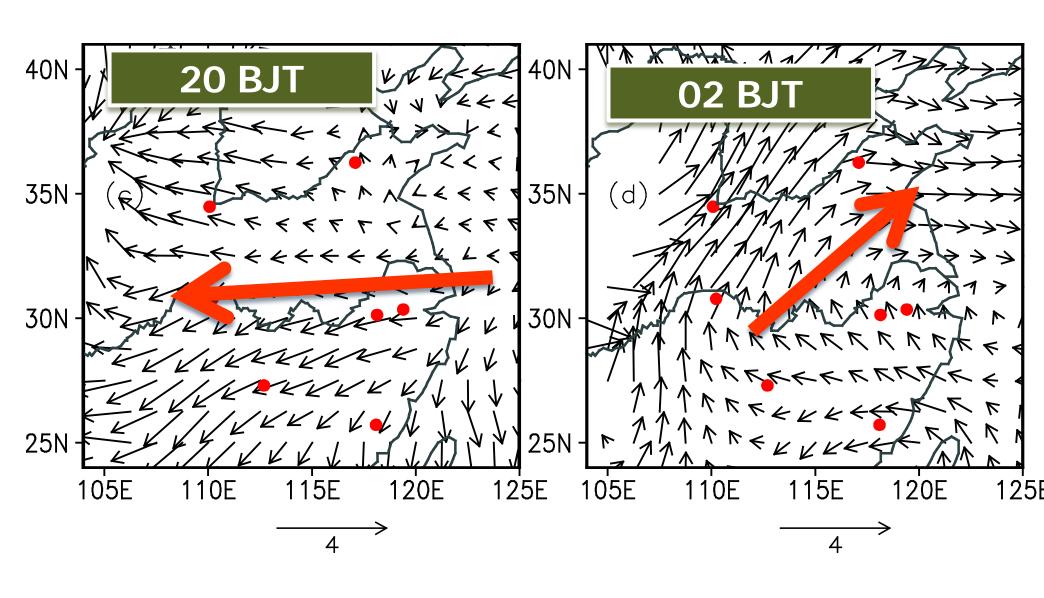


Mid-to-lower reaches of Yangtze River Valley

- •During the active period, monsoon rainfall is dominated by the long-duration events with early-morning diurnal peak.
- •During the break period, monsoon rainfall is dominated by shorter duration events with late-afternoon diurnal peak.
- ●The different diurnal variation of monsoon rainfall between the active and break monsoon periods can explain the two comparable diurnal peaks averaged in summer central eastern China.

Wind anomaly @850 hPa in active monsoon period (minus summer mean) of JRA25 reanalysis





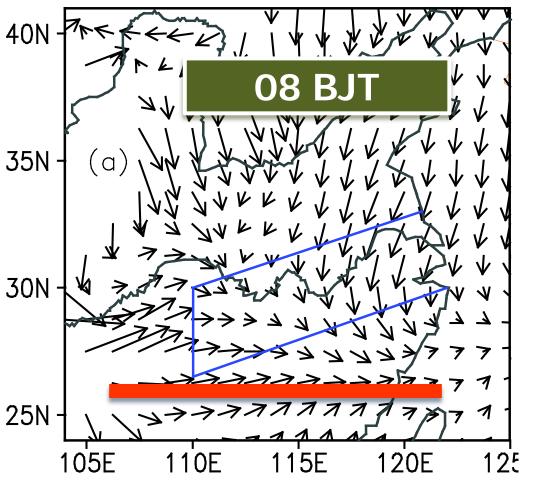
Active period at 08 BJT:

- Southwesterly anomalies over southern China and northeasterly ones over the north of Yangtze River Valley
- The combination of the cyclonic vorticity and enhanced moisture transported by the southwesterly provides a favorable environment for the nocturnal rainfall systems to develop and maximize in the early morning.

Active period at

- ●14 BJT: northerly
- 20 BJT: easterly
- 02 BJT: southeasterly

dominant the area of monsoon rain belt



Wind anomaly of break monsoon period 08 BJT

Break period at 08 BJT:

 The convergence locate at the south to the monsoon rain belt.

Summary

- 1.The long-duration rainfall experiences similar subseasonal movement to that of summer monsoon rain belt. The short-duration events mainly occur in July and August over most of central eastern China.
- 2. The early-morning rainfall shows subseasonal movement coinciding with that of monsoon rain belt. The late-afternoon rainfall peaks generally locate to the south and north of the rain belt.
- 3. Rainfall at different latitudes of central eastern China exhibits similar diurnal features when partitioned into active and break periods. During the active period, monsoon rainfall is dominated by the long-duration events with early-morning diurnal peak. During the break period, monsoon rainfall is dominated by shorter duration events with late-afternoon diurnal peak.
- 4. The different diurnal variation of monsoon rainfall between the active and break monsoon periods can explain the two comparable diurnal peaks averaged in summer central eastern China.

Yuan, W., R. Yu, H. Chen, J. Li, and M. Zhang, 2010: Subseasonal Characteristics of Diurnal Variation in Summer Monsoon Rainfall over Central Eastern China. *Journal of Climate*, 23, 6684-6695.

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