Interdecadal change of the South China Sea Summer monsoon onset

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Introduction

- The South China Sea summer monsoon (SCSSM) has abrupt climatological onset.
- Recently the interdecadal change of the SCSSM around 1993/1994 has been discussed (*Kwon et al. 2005 & 2007, Wang et al.2009, Kajikawa et al. 2009*)

[Q] this change has seasonal dependency?

Objectives

1. To detect the interdecadal change in the SCSSM evolution, specially its onset and withdrawal
2. To examine the nature and processes of such an interdecadal change
3. To determine the potential factors responsible for the change in the timing of SCSSM onset if any.

Data set

1. Interpolated OLR (*Liebmann and Smith 1996)*
2. NCEP/NCAR reanalysis (*Kalnay et al. 1996)*
3. Hadley Center SST (*Rayner 2003)*
4. IBTrACS: TC track data (*Knapp et al. 2010*)

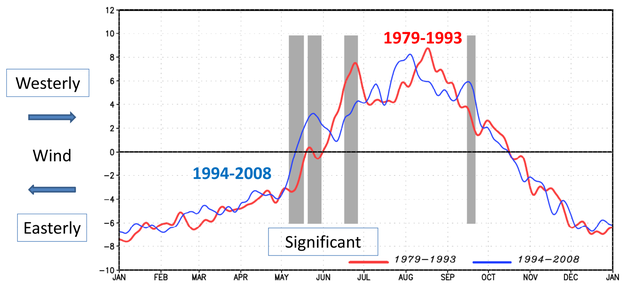

Figure 1: Time series of climatological mean 850hPa zonal wind (5N-15N, 110E-120E) as the SCSSM index during 1979-1993 and 1994-2008. The period when the difference between the two indices is statistically significant is shaded.

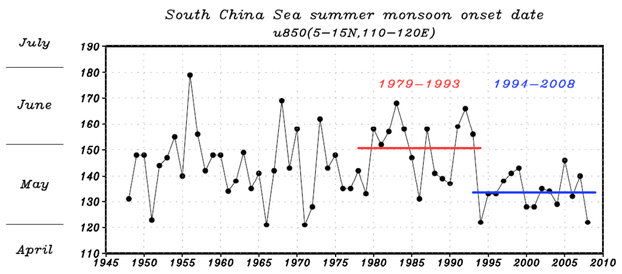

Figure 2: Time series of the SCSSM onset date. The onset day is defined based on *Wang et al. 2004's* definition, (1) SCSSM index > 0 m/s during 5-day after the onset; (2) SCSSM index >0 m/s (15 days / 20days after the onset) ; and (3) the accumulative 20 days mean SCSSM index > 1 m/ s.

- ✓ A significant advance in the SCSSM onset dates around 1993/1994: May 30th for 1979-1993 and May 14th for 1994-2008. (Fig. 1 and Fig.2)
- ✓ The relatively late onset during 1979-1993 is primarily determined by the northward seasonal march of the ITCZ , whereas the advanced onset during 1994-2008 is affected by the enhanced NW-ward moving tropical disturbances from the equatorial western Pacific. (Fig. 3)

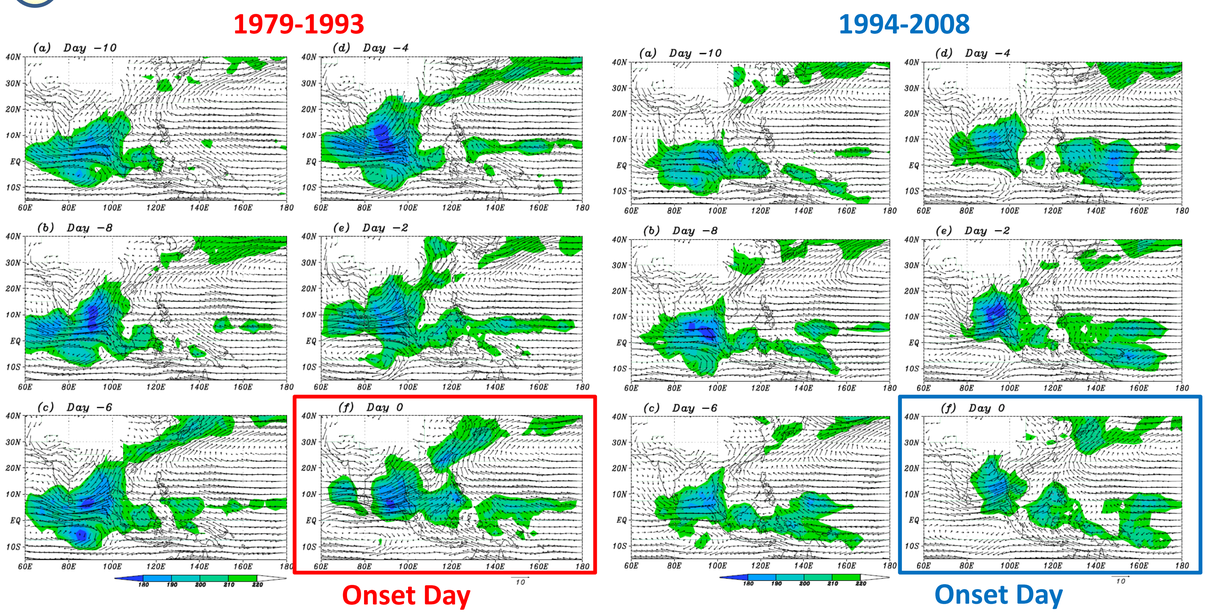

Figure 3: (Left) Composite evolution of OLR and 850hPa wind based on the SCSSM onset date in each year in the epoch 1979-1993 from 10 days before onset (day -10) to onset date (day 0). Shading interval is 20 W/m2 and vector unit is 10 m/s. (Right) Same as Left panel but for the epoch 1994-2008.

References

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Acknowledgement

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Factors responsible for the SCSSM onset variability around 1993/1994

Abrupt convection enhancement for the monsoon onset — Shifted two weeks

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Thermal condition Convective instability — no significant change (figure not shown)

+

Tropical disturbances as triggers for monsoon onset — Possibly changed …

Tropical Cyclone genesis

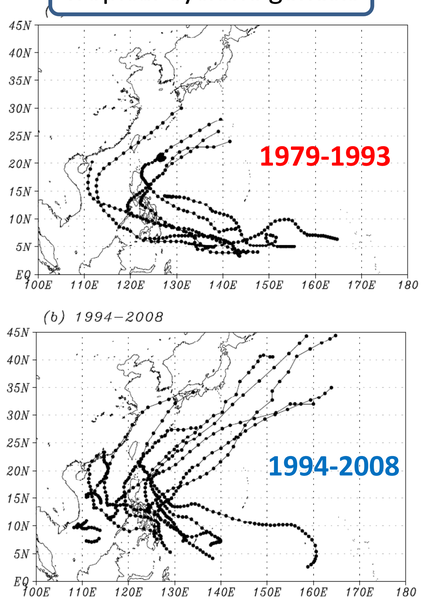


Figure 4: Tropical cyclone tracks, which passed through the SCS and/or the Philippine Sea (10N-20N, 105E-130E) in April 15th - May 15th during (a) 1979-1993 and (b) 1994-2008.

Intraseasonal variability

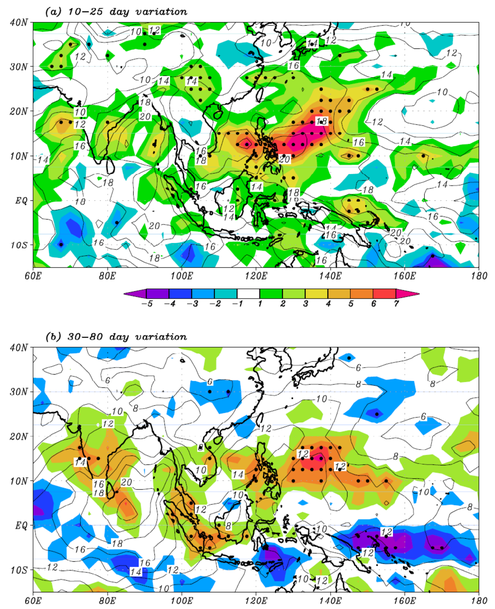
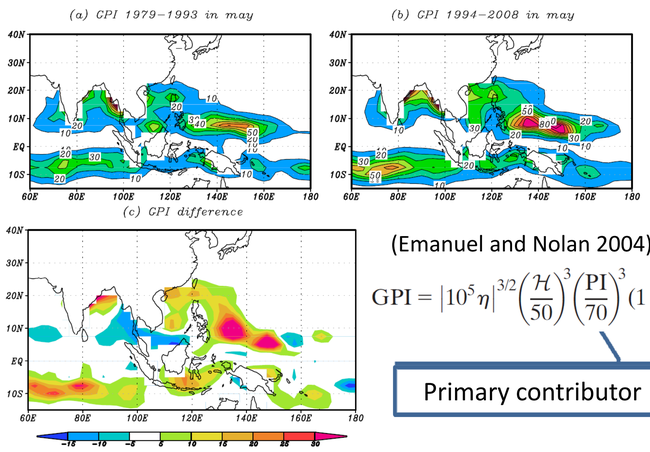


Figure 5: The epochal difference in the OLR anomalies on (a) 10-25-day and (b) 30-80-day time scale during April 15th - May 15th (1994-2008 minus 1979-1993). The contours denote climatological ISV during 1979-1993. Dots indicate area where the difference is 95% significant.



(Emanuel and Nolan 2004)

$$\mathrm{GPI} = \left|10^5 \eta\right|^{3/2} \left(\frac{\mathcal{H}}{50}\right)^3 \left(\frac{\mathrm{PI}}{70}\right)^3 (1 + 0.1V)^{-2}$$

Primary contributor

Figure 6: The tropical cyclone Genesis Potential Index (GPI) in May during (a) 1979-1993 and (b) 1994-2008. (c) The difference: 1994-2008 minus 1979-1993.

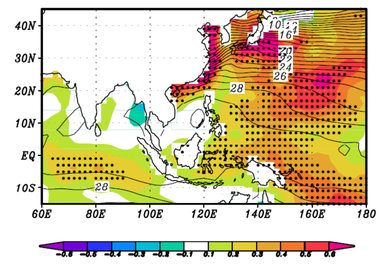


Figure 7: Epochal mean SST difference in May (1994-2008 minus 1979-1993; Shading) and the climatology during 1979-1993 (contour). Dots are plotted over the area with 95% significance.

Summary

We found a **significant change in the SCSSM onset around 1993/1994**

1. The advanced onset during 1994-2008 is affected by the enhanced activity of northwestward moving tropical disturbances.
2. During 1994-2008, the ISV over the WP is enhanced in April and May; further the number of TC, passed through the SCS/PS, is about doubled compared with during 1979-1993.
3. These enhanced ISV and TC activity are attributed to a significant increase in SST over the WP. Thus, the advanced SCSSM onset is rooted in the decadal change of the SST over the equatorial WP.