Characteristics of Warm Season Convection over Pearl River Delta, China

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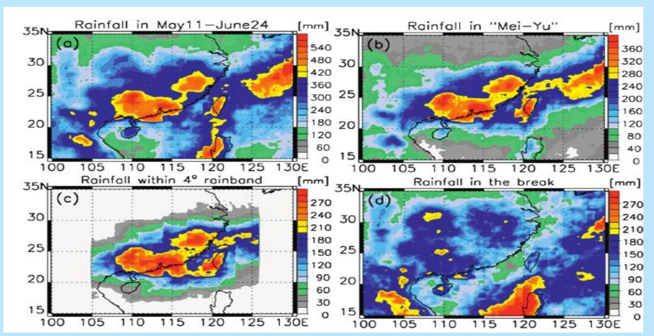
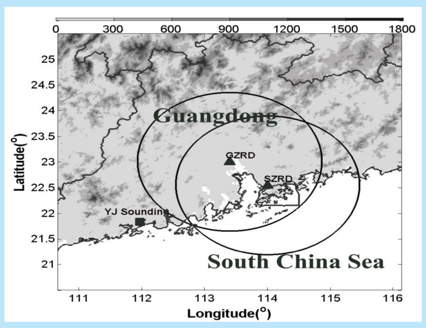
Introduction

In each warm season (May - September), with the northward moving of the West pacific subtropical high, rain-producing phenomenon dominates the weather over China. This period represents the local rainfall maximum each year. South China was a rainfall center during warm season. especially the Pearl River Delta and it's coast



Xu et al, 2009



Locations of the radars (black triangle) and sounding station (black square).

Objectives

Most previous works aim to study the convection's characters in this region are based on satellite observation. But satellite data can't provide detailed temporal change and three-dimensional structures with inadequate temporal and spatial resolution.

This study examines, for the first time, the detailed temporal change and spatial distribution of convection over Pearl River Delta during warm season by using three years of Ground-based Doppler radar data located at Guangzhou, China.

Data

1. Radar : Guangzhou and Shenzhen operational Doppler radar
2. Sounding : Yangjiang operational sounding station data
3. automatic surface meteorological observing station data
4. Reanalysis data : JMA reanalysis data (0.25° * 0.2°)

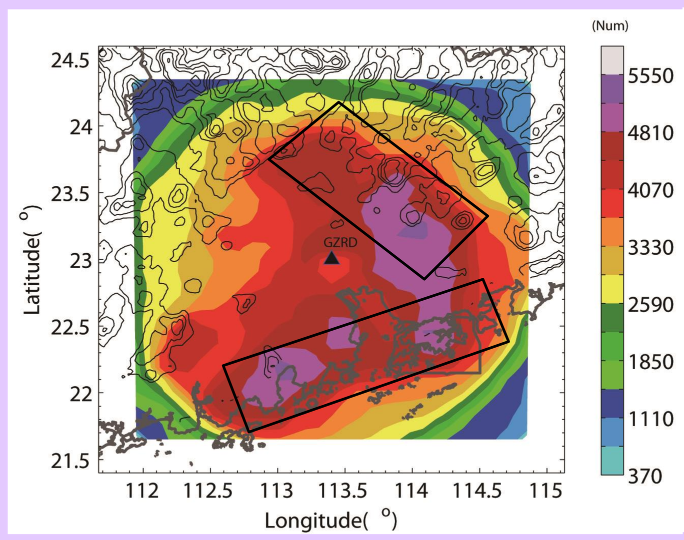
Characteristics of Warm Season Convection

I. Spatial Distribution

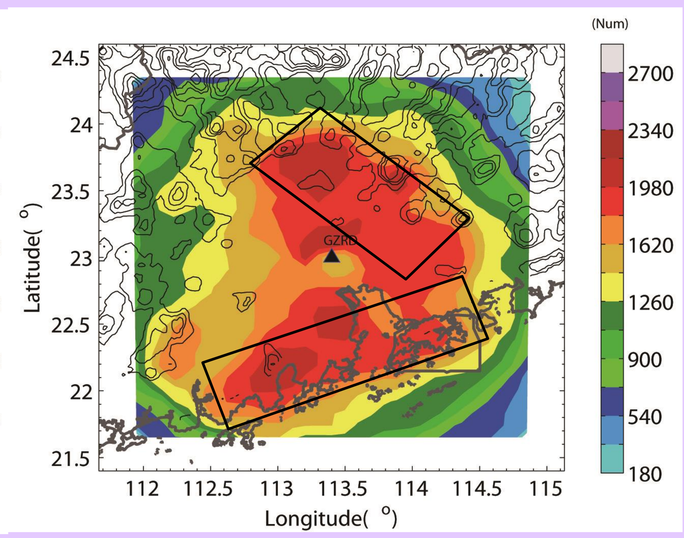
The left figure are the spatial distribution of identified convective features occurrence frequency. There are **two frequency maximums** over this region. One is **on the windward slope of east mountain area** and the other is **over coastal region**

The spatial distribution pattern of convection **under weak synoptic force** is still **similar** with the entire warm season (right figure). Two maximums on windward slope and along coastline are still very obvious.

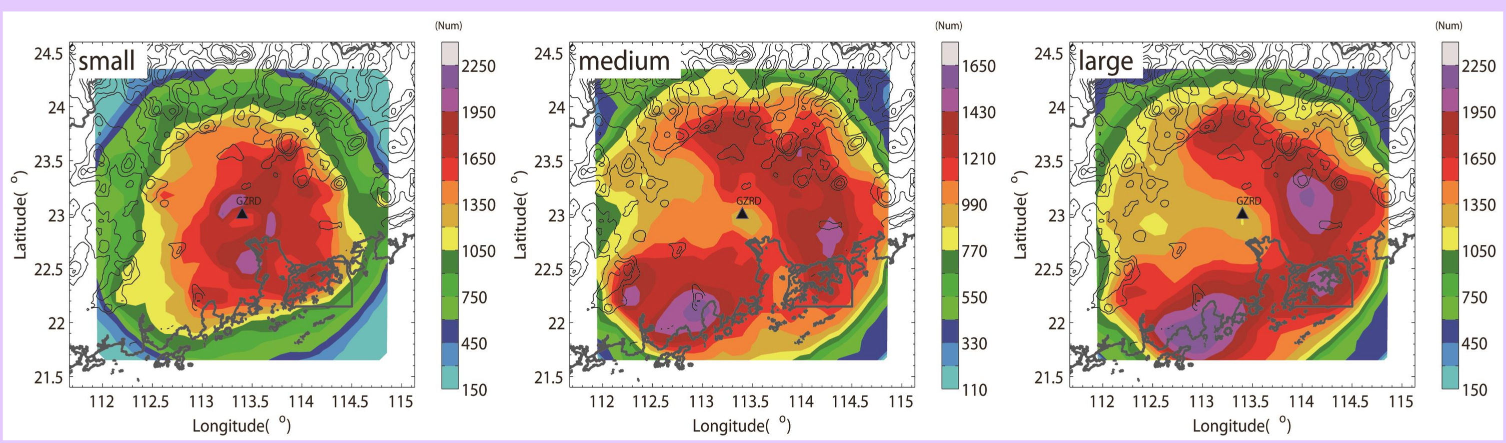
Spatial distribution



Spatial distribution under weak synoptic force



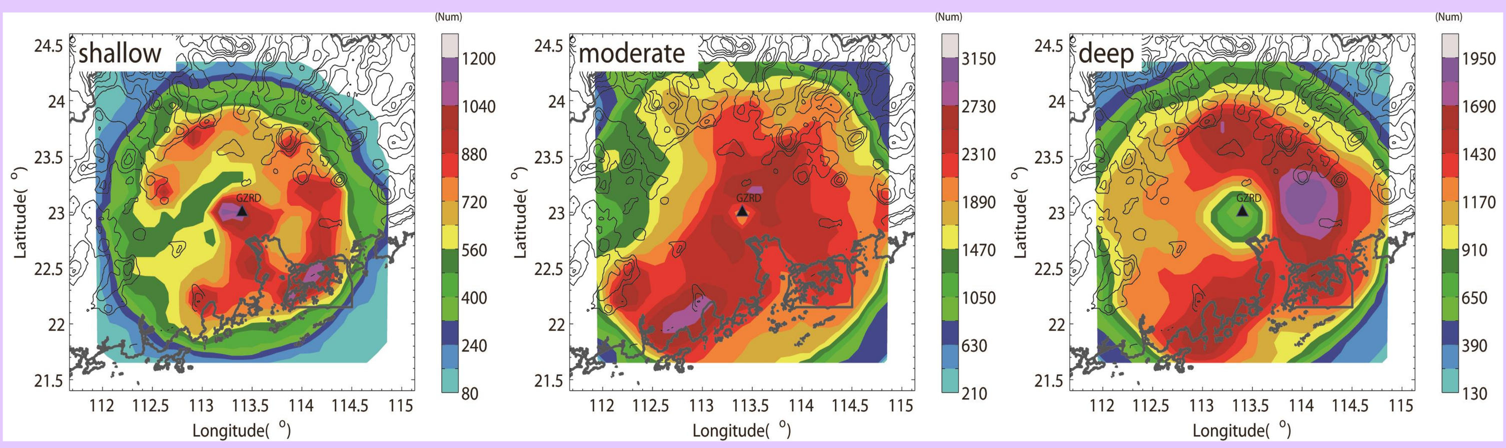
Spatial distribution of different size convection



small convective feature : $S < 100km^2$
medium convective feature : $100km^2 \leq S \leq 400km^2$
large convective feature : $S > 400km^2$

With the increasing of convective area, occurrence frequency maximum on windward slope and along coastline become clearer and clearer.

Spatial distribution of different depth convection

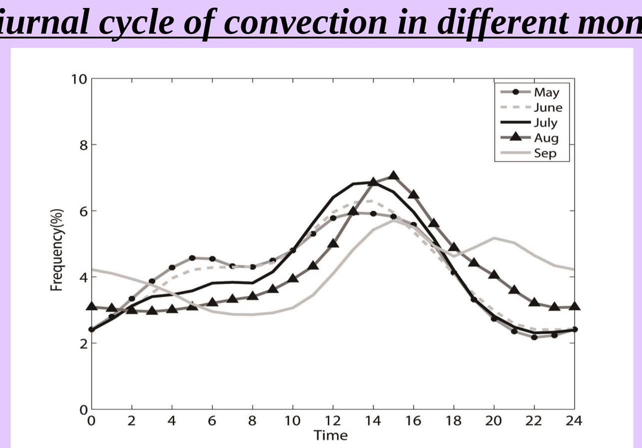


shallow convective feature : ET < 6km
moderate convective feature : 6km ≤ ET ≤ 12km
deep convective feature : ET > 12km

With the increasing of convective depth, occurrence frequency maximum on windward slope and along coastline become clearer and clearer.

II. Monthly Variation

Diurnal cycle of convection in different month

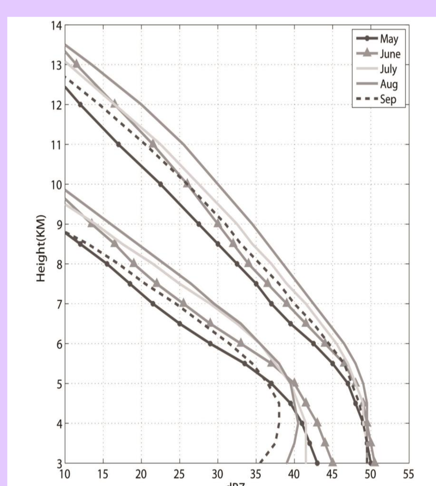


storms occur most frequently in **early afternoon**.

August and **July** have the most prominent **single peak cycle**.

May and **June** have **a second peak** in the early morning and **September** (late summer) has one in early evening.

VPRR of convection (50th and 90th percentile)

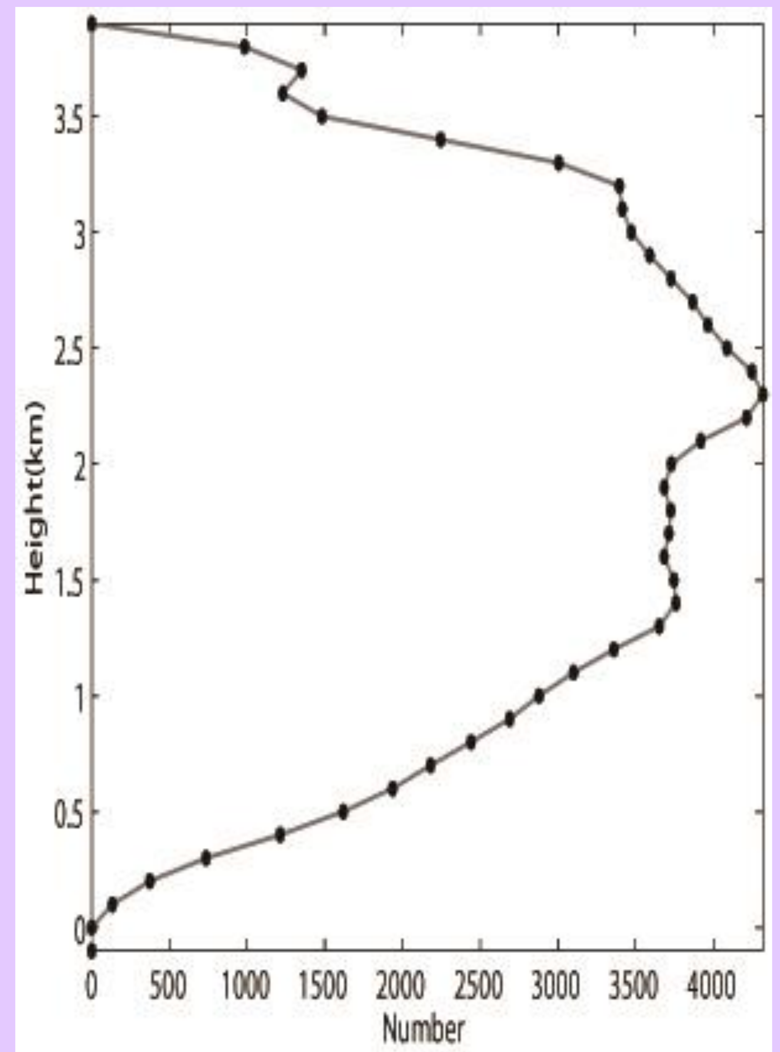


Extreme convection in **August** is the **strongest**

Convection is **weakest** during in **Mei-Yu season**.

III. Possible mechanism of coastal convection

Vertical profile of low-level jets' occurrence number（VAD）



VAD wind data of Guangzhou Doppler radar is used to detect low-level jets

Criteria used to identify LLJ incidences
(1) maximum wind speed $\geq 12.5\ ms^{-1}$;
(2) direction of maximum wind between 180° to 270° ;
(3) vertical shear below and up wind maximum $\geq 1.0 * 10^{-3}s^{-1}$.

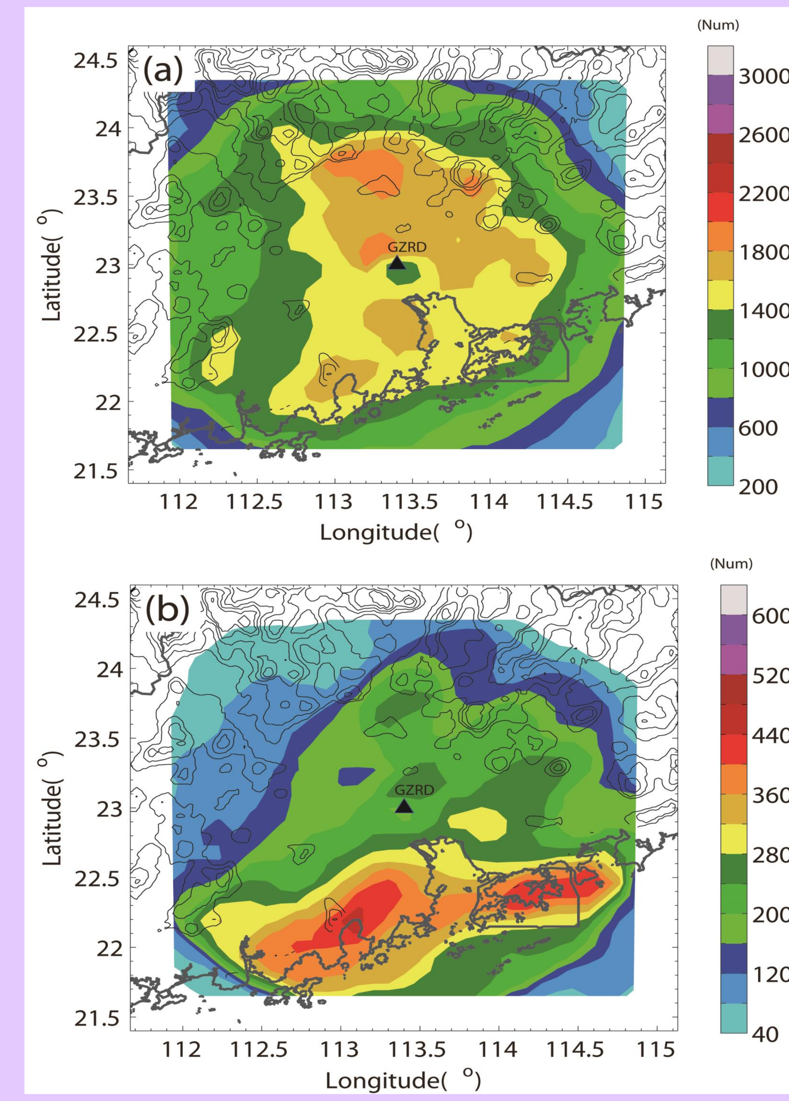
LLJs in Pearl River Delta had has **only one peak of LLJ incidences on 2300m altitudes** (left figure)

This incidences peak is closely related to **synoptic-system-related LLJs (SLLJs)**

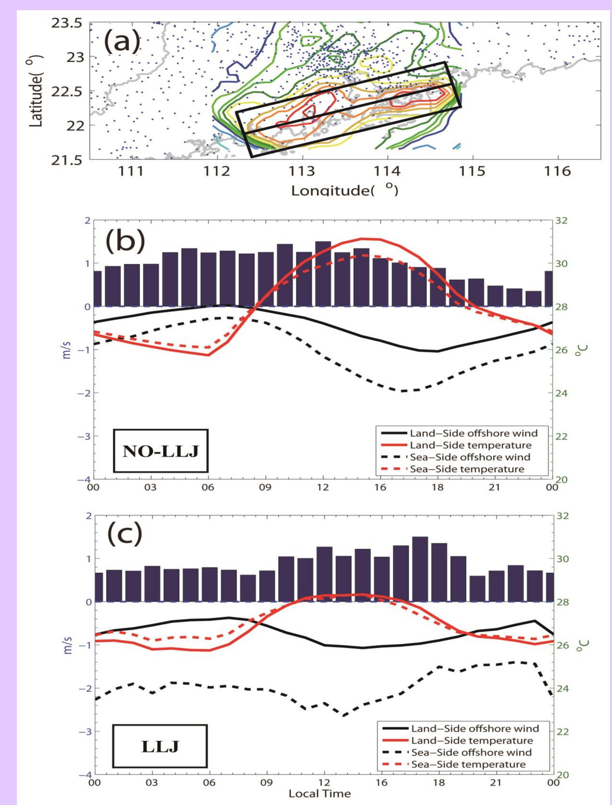
Prominent convective frequency maximum **along coastline** and no frequency maximum inland in **SLLJs days** (right figure)

Prominent convective frequency maximum on the **windward slope** in **No-SLLJs days** (right figure)

Spatial distribution of convection during NO-LLJ and LLJ days



Diurnal change of surface temperature, off-shore wind and precipitation in No-LLJ and LLJ days

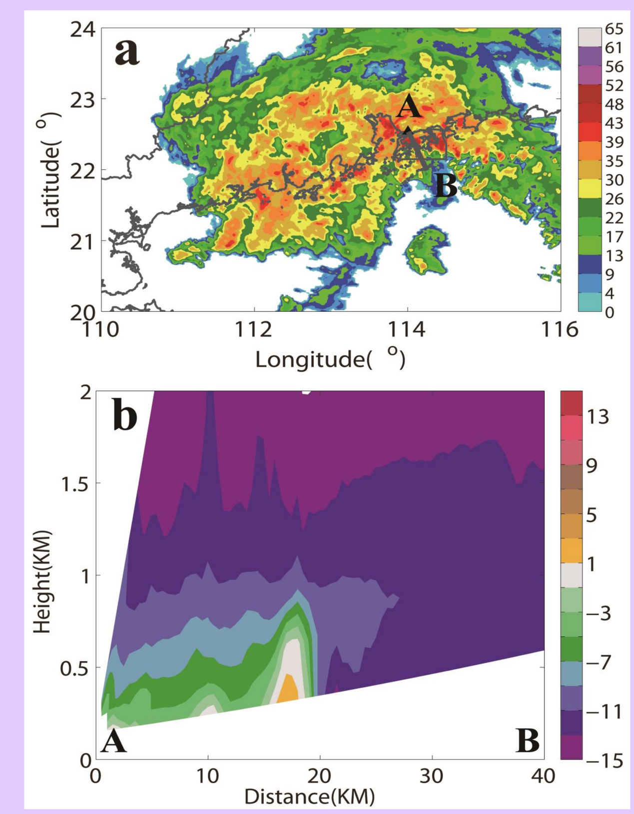


Diurnal changes of surface temperature and offshore wind during no-SLLJs days are much more prominent than changes of SLLJs days.

The early afternoon surface temperature peak is weaker in SLLJs days due to the cooling effect of stronger coastal precipitation in these days.

Velocity convergence effect along coastline (the solid black line minus the dashed black line) in SLLJs days was much stronger than the convergence in no-SLLJs days.

Rainfall process from 22 May to 23 May in 2009



Convection moved from sea to coastline and strengthened, new convection cell keep initiated on coast during this precipitation episode.

Average radial velocity RHI shows During this rainfall process, environmental wind on low level was onshore wind. After this flow reached coast, the wind speed decreased dramatically and obvious velocity convergence can be found along coastline.

Summary

- Coastal area and windward slope are two convection centers in Pearl River Delta during warm season.
- Diurnal cycle changed from month to month. Most convection occurred in early summer and convection is strongest during August.
- Coastal convection is closely related to SLLJs and coastal convection center can only be found during SLLJ days. It is initiated by stronger velocity convergence along coastline during SLLJ days

Acknowledgements

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