Trigger and Evolution of the Mesoscale Convection: A Case Study over Pearl River Delta in South China

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1. Introduction

There has been an increased emphasis placed on the convective rainfall in South China during warm season (from May to September). Pearl River Delta (PRD after), which is the population and economy center of South China, is one of the most prominent convective rainfall centers in South China (Xu, Yu) and has much more lighting than any other place in China (Sun). Different with other rainfall centers with huge mountains, PRD is a plain surrounded by hills and coastline. Our previous work shown convective rainfall occurred most frequently on the windward slope of eastern hills area and along coastline (figure1).

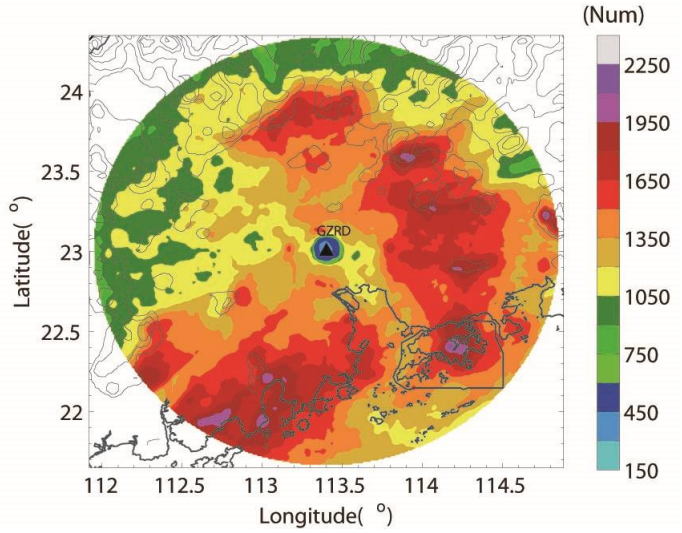

Figure1. Spatial distributions of the occurrence frequency of convective features, Orography is super-imposed in the figure in black contours with 150 m intervals.

The precipitation occurred on windward slop is closely related to the lifting effect of orography while precipitation occurred along coast is much more complicated. How sea-breeze, low-level jet, orographic effect, boundary layer process and inland precipitation can affect the initiation and development of coastal convection is still unclear. On the other hand, model forecast ability on this kind of convection is also very weak. This paper documents a coastal convective rainfall process occurred in PRD on 5 May 2008. Six operational Doppler radar, satellite, sounding, AWS and reanalysis data are used to document the environment and development of this process and we also used the Variational Doppler Radar Analysis System (VDRAS) to analysis the detailed wind and

thermodynamic fields by assimilating these 6 radars in Guangdong province. In this work, we focus on the triggering and developing stages of costal convection, so all analysis in this paper is in the first 6hour of this process.

2. Surface and radar analysis

There had inland precipitation before the coastal convection and dissipated around 0400 UTC (not shown there). 7hr accumulated rainfall from 0500UTC to 1200UTC shows there had several rainfall centers along the coastline and the most prominent center was located around Yangjiang (over 60 mm). Accordingly, radar reflectivity over 30 dBZ occurred most frequently in this area.

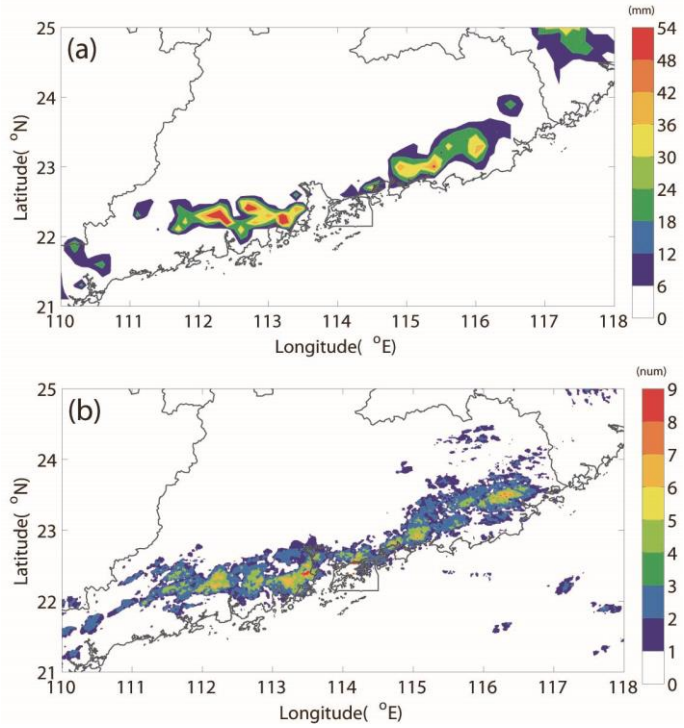

Figure2. Spatial distributions of accumulated rainfall detected by AWS stations (a) and composite reflectivity over 30dBZ detected by Yangjiang radar (b) from 05UTC to 12UTC on 5 May 2008 .

Composite radar reflectivity of 6 operational Doppler radars in Guangdong province shows: with the beginning of sea breeze at around 0500UTC, a convergence line was formed near Yangjiang. Two distinct CCI groups (CCI-A and CCI-B) associated with this convergence line were involved in this process. The initiation of CCI-A started at around 0500UTC on the landside of convergence line where is the joint place of low-level warm center and moisture band from sea. Then this convective storm moved toward east direction and developed slowly. At 0630 UTC, this storm's outflow boundary collided with convergence line, the convective strength became much stronger and storm embedded into this convergence line after that. The CCI-B on the other hand was more typical of sea-breeze frontal convection, which was initiated in the instable area of sea-breeze front and related to the updraft brought by convergence line.

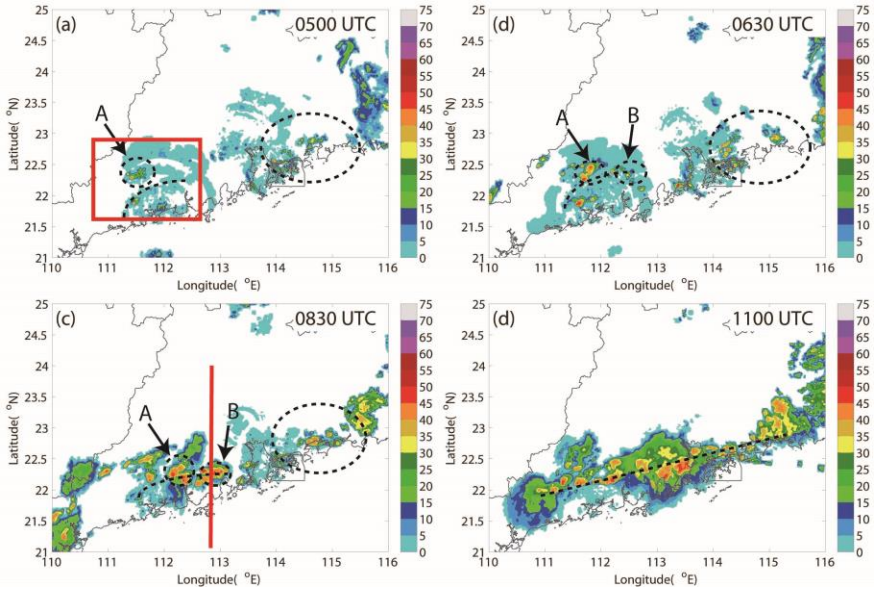

Figure3. Composite reflectivity of 6 operational Doppler radars in Guangdong province at (a) 0500, (b) 0630, (c) 0830, and (d) 1100 UTC 5 May 2008. Red box in (a) is the analysis area discussed in Fig. 4. Red line in (c) is the section in Fig. 5.

The CCI-A was initiated on the windward slop (around 600m height) of Ehuangzhang mountain at 0401 UTC, where is also the joint place of low-level warm center and moisture band from sea. The retrieved thermodynamic and humidity fields shows the relative humidity and energy of atmosphere here is kept increasing before the initiation and the LCL is 527m at 0401 UTC. We also calculated the Froude number of the upstream point (red star in figure 4) of the initiation place which is 0.778 at this time.

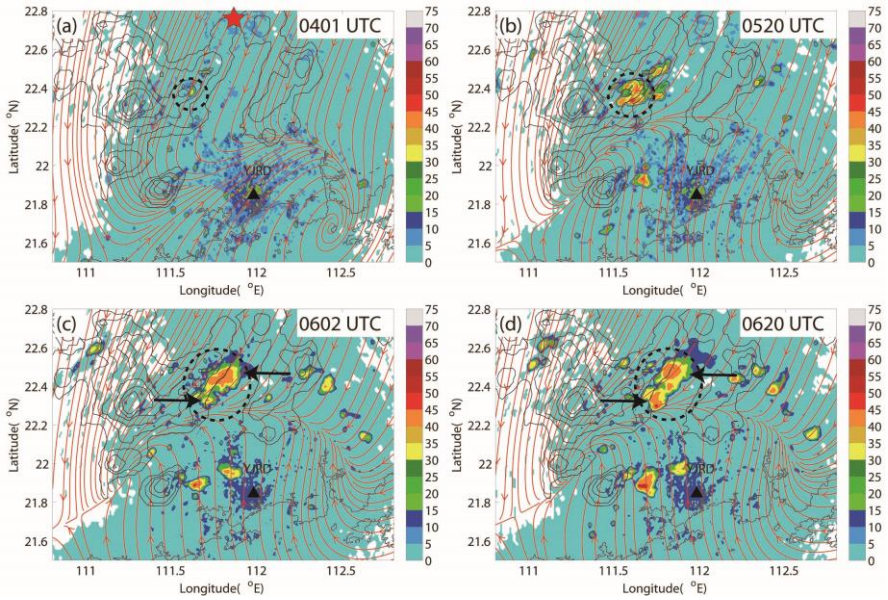

Figure4. VDRAS wind filed on 187.5m superimposed on the composite reflectivity of Yangjiang Doppler radar (showed by black triangle in figure) at (a) 0401, (b) 0520, (c) 0602, (d) 0620 UTC 5May 2008.