NUMERICAL SIMULATION OF THE FORMATION OF A MIXED CONVECTIVE AND STRATIFORM CLOUD SYSTEM IN GUIZHOU PROVINCE

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1. INTRODUCTION

The mixture of convective and stratiform clouds is an important precipitation system and also a major focus of weather modification studies. In these types of systems, the radar PPI images show that many convective cells or bands can exist within the stratiform background. But their formation, evolution mechanism and physical characteristics are not clearly understood. In this presentation, the formation and evolution of a mixed convective and stratiform cloud system is analyzed in detail.

A process of mixed convective and stratiform cloud system happened in Guizhou province is very typical. The favorable weather situation is that the north area in Guizhou province is influenced by cold airflow from leaning north direction, and at the same time, south-west airflow invade Guizhou and meet with the cold air, so a convergence line is formed at 850hpa (lon:104-112,lat:22-28). Accordingly, a stationary front is emerged on the ground, and Guizhou is almost in the cold area of the front. Influenced by this weather situation, an obvious process of mixed convective and stratiform cloud system emerged. Besides, another favorable condition is that there is vertical wind shear between 700hpa and 850hpa.

2. SIMULATION SCHEME

Using the mesoscale model WRF(2.1.2), we simulated the process happened in May 17-18th, 2005. The initial data are from the NCEP data based on 1°×1° resolution. Two nested grid domains were used in the current simulation, which have a grid resolution of 18km and 6km. The Kain-Fritsch scheme for convective parameterization was used for domain 1 and the Lin cloud microphysics parameterization is used for the second domain 2.

3. CONTRAST OF SIMULATION RESULTS WITH OBSERVING DATA

The simulated rain band of 24hr is basically consistent with the observation. As shown in fig.1, the simulated total water content distribution(fig.1a) is very similar with the cloud system in the black rectangle in the satellite cloud picture(fig.1b). Fig.1c is radar cloud system distribution in Guiyang, we find that the simulated radar echo distribution and intensity(fig.1d) are almost same with those in fig.1c. The simulated rainfall(fig.1f) is similar with the observations (fig.1e). These prove that the simulation results is very well and we can analyze the process in detail.

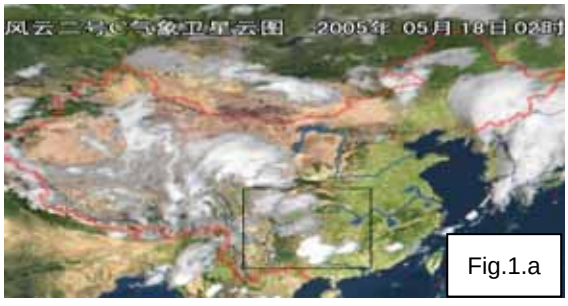

Fig.1.a

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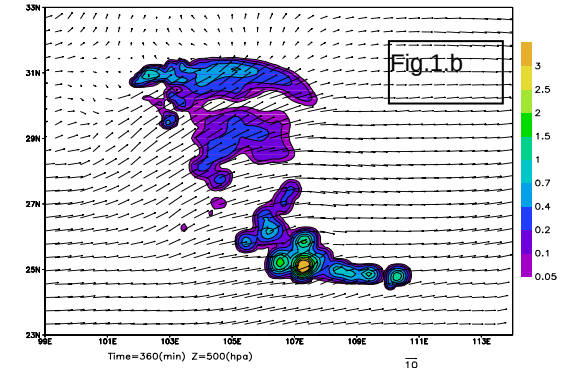
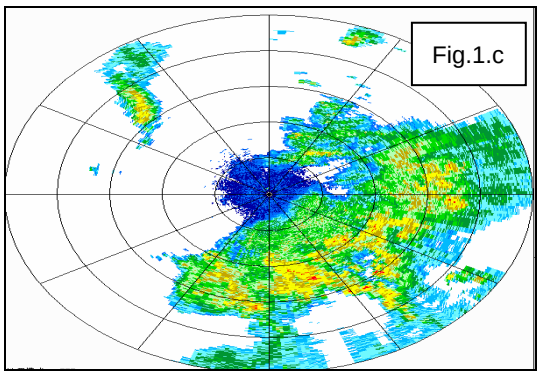
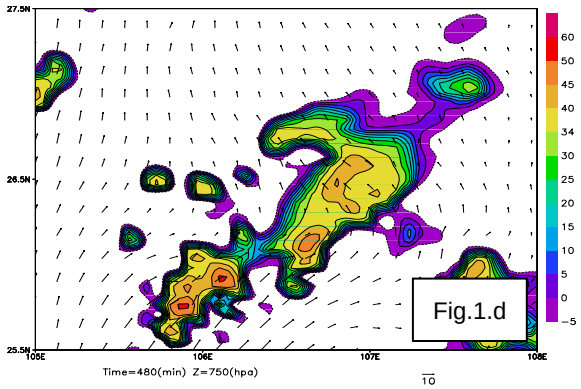
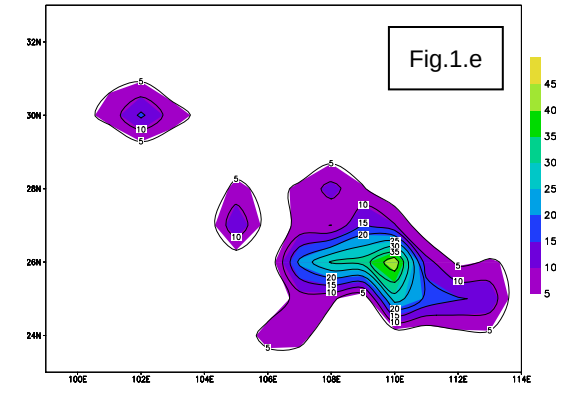








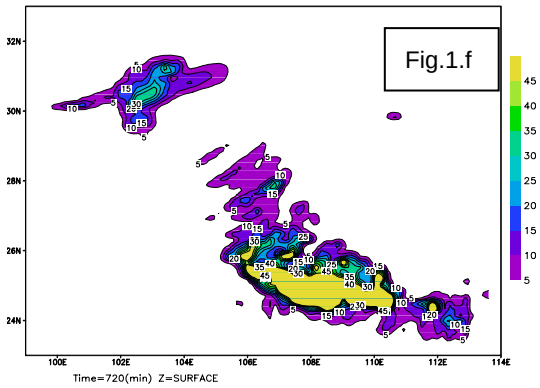


Fig.1 simulation and observed results(1a. satellite picture at 02:00 18th ; 1b. simulated total water content at 500hpa at 02:00 18th; 1c. radar echo picture at 1.5°of PPI at 03:00; 1d. simulated radar echo at 03:00; 1e. observed precipitation distribution; 1f. simulated precipitation distribution)

4. ANALYSIS OF THE FORMATION PROCESS

Judged by radar echo pictures and simulation results, this process of mixed convective and stratiform mixed clouds happened in May 17-18th 2005 is caused by convection merger. There are 3stages: (1)convective cells merge into a big convective cloud; (2)convective clouds merge into convective cluster; (3)convective clusters merge into the mixed convective and stratiform mixed cloud system.

4.1 CONVECTIVE CELLS MERGE INTO A BIG CONVECTIVE CLOUD

In the vicinity of the convective line, many convective cells come forth, and in their moving process, they may span and connect, and then they may turn stronger and higher. The merging process often begins from the middle and lower part between clouds. Fig.2 shows the merging process of three convective cells. Along the moving direction, it seems that the back convection can absorb energy and water vapor of the front one, so the back convection will turn stronger and the others will turn weaker. At last, they merge into a

one bigger convective cloud.

At the same time, the similar merging process happens at other areas of Guizhou province, so many bigger convective clouds form.

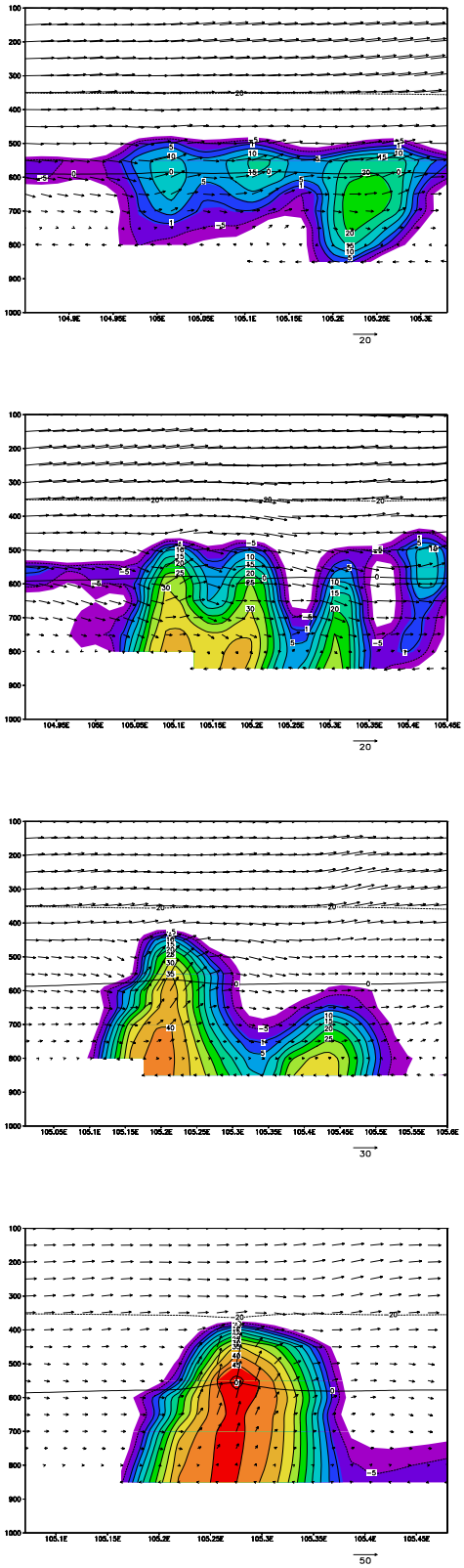


Fig.2 merging process of 3 convective cells

4.2 CONVECTIVE CLOUDS MERGE INTO CONVECTIVE CLUSTER

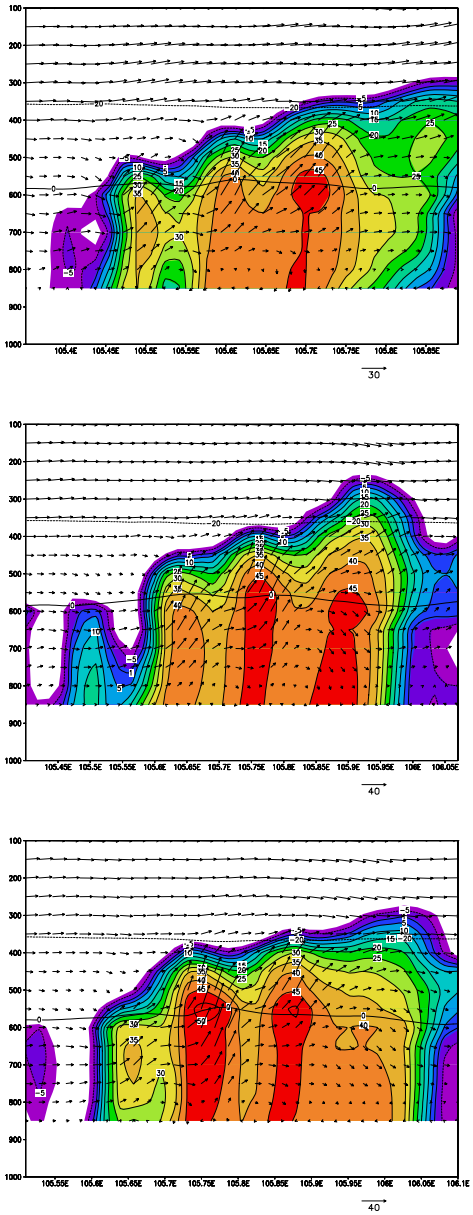
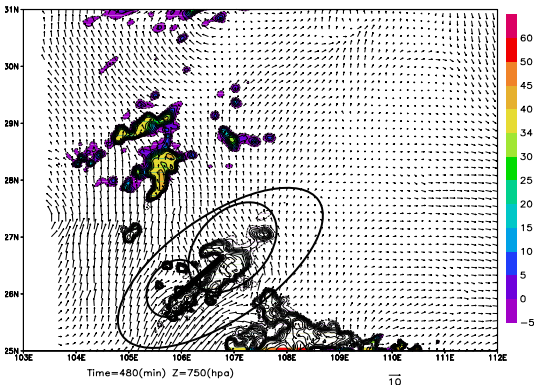
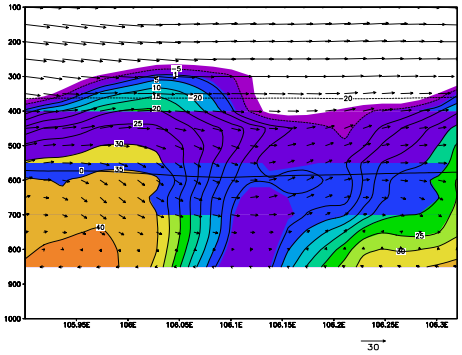


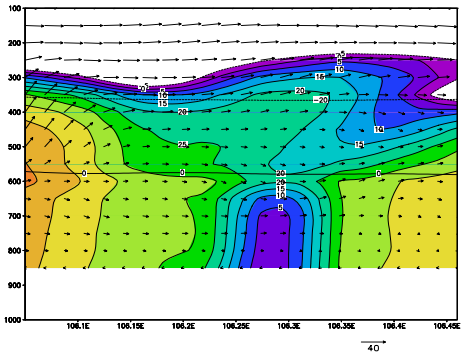
Fig.3 merging process of convective clouds

In the moving process of many bigger convective clouds, the front convections are often be absorbed and the back convections develops. Herein, convective cells will constantly supply the convective cluster, as shown in fig.3.

4.3 CONVECTIVE CLUSTERS MERGE INTO THE MIXED CONVECTIVE AND STRATIFORM CLOUD SYSTEM







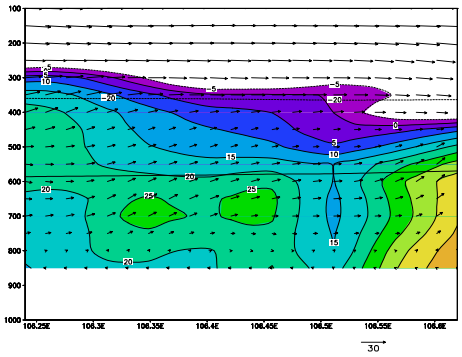


Fig.4 merging process of convective cluster

In this precipitation process, there are 2 big convective clusters in Guizhou province. Fig.4 shows the merging process of two convective clusters into the mixed convective and stratiform cloud system. The merging process begins from the upper part because vertical wind wear and also the quicker airflow in the upper level.

4.4 STAGE OF MIXED CONVECTIVE AND STATIFORM CLOUD SYSTEM

With the development of merger, evolution, the cloud system exhibits obvious mixed state. Fig.4 show one part of the cloud system.

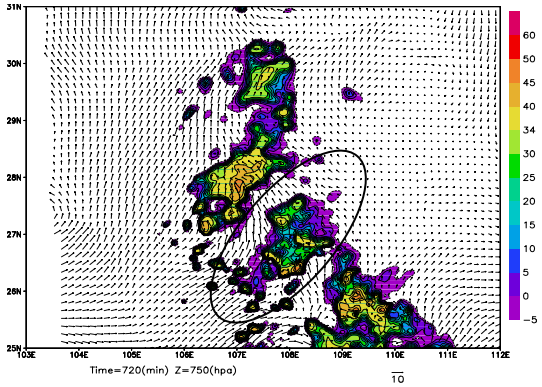


fig5.a. the mixture at 750hpa

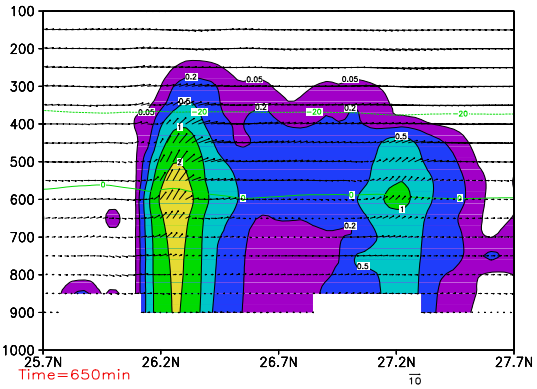


Fig5.b. vertival section along lon 107.6°

ACKNOWLEDGEMENT

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