THE CHARACTERISTICS ANALYSIS OF CAUSING STORM RAIN TIBETAN PLATEAU VORTEX IN SOUTHWEST SICHUAN BASIN

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1. INTRODUCTION

The Tibetan Plateau vortex (TPV) is a important low pressure weather scale system, usually generated in summer half year over the Tibetan Plateau sky. The observational facts of TPV is point out by Wu and Chen (Wu, 1964; Chen, 1964) at 60s in 20th century. The horizontal scale of the TPV is about 500km, vertical scale is 2-3km (Yeh and Gao, 1979). The TPV is the main disaster weather systems, influences the most land of China, especially in Sichuan Basin, lead to storm rain and other severe weather disasters. The easterly moved TPV caused a heavy storm rain in Qingyijiang valley, the rainfall volume is 524.7 mm in 17 hours at E'Meishan national station, which is the daily rainfall record data in Sichuan Basin on 28th, July, 1993.

Based on the researcher of other scientists and the Tibetan Plateau vortex and shear line yearbooks, the article analyzed the weather processes caused regional storm rain in Ya'an, Leshan and Meishan cities, the characteristics of the TPVs is captured and some predictions rules are pointed out.

2. DATA AND METHOD

The TPV weather processes from the Tibetan Plateau vortex and shear line yearbooks. Rain fall data is from the 23 county national stations observation. The weather maps from MICAPS is used.

The NCEP (National Centers for Envirmental Prediction) FNL reanalysis data of year 1998 to 2013, four times daily with 1X1 degree spatial resolution data is used.

The Plateau means the altitude more than 3000 meters and the east TPV is at the east side of 92.5 degree longitude.

The storm rain refers the daily rainfall volume more than 50mm and less than 99.9mm. The rain data between 100mm to 249.9mm is the big strom rain. The heavy rain refers the daily rainfall volume more than 25 mm to 50mm, When there is 3 stations happens strom rain, we called it is a storm rain weather process.

3. OBSERVATIONS AND STATISTICS

The occurrence number of high influence leading to heavy rain and storm rain in China Sichuan Basin from 2001 to 2011 is 152 times (Table 1). The most occurrences are in June and July, then May and August. There are 35 times of storm rain processes in Sichuan Basin, 7 times in June, 14 times in July, 11 times in August. So the TPV induced storm rain weather processes is mainly happened in July, less in August.

Table 1 The happening times in months of TPV induced heavy rain and storm rain in Sichuan Basin

Month	Apr.	May	Jun.	Jul.	Aug.	Sep.
Heavy rain	7	20	47	40	25	13
Storm rain	0	3	7	14	11	0

The TPV original source and moving tracks is

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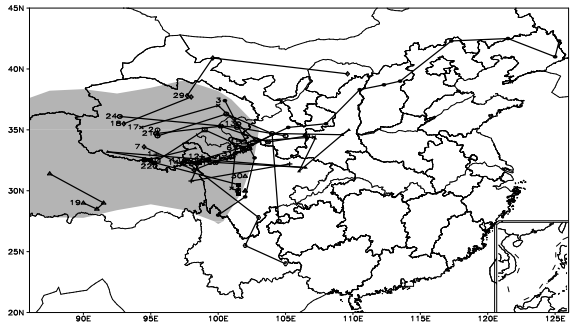
displayed in Figure 1. The time between two points is 12 hours. From the figure 1 we can see that TPVs are mostly generated in 95°E～105°E，27°N ～ 37°N, in Qinghai Province and west Plateau of Sichuan Province. From the life history, the TPVs lead to clear rain in southwest china after they moved to east of Plateau 24 hours, then tended to be weak and disappear, few of them keeped moving east of southeast.

Figure 1 The moving tracks of the TPV induced storm rain in southwest China region

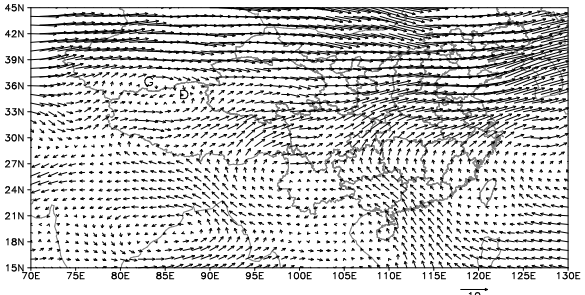


4. THE COMPOSITE CIRCULATION FIELD CHARACTERISTICS OF TPV INDUCED STORM RAIN PROCESSES IN SOUTHWEST CHINA

4.1 THE COMPOSITE WIND FIELD CHARACTERISTICS

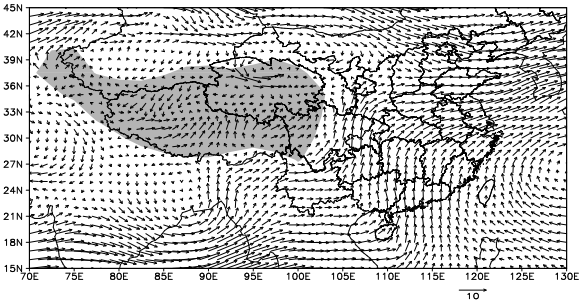
The composite wind field on 500hPa of TPV induced storm rain processes is displayed in Figure 2. From Figure 2, there is vortex region in center of Tibetan Plateau and there are two main are flows, southeast air flow from southwest Plateau edge and southwest air flow from the Bengal gulf, which converge over southwest China making the strong southwest wind belt. The strong wind belt will strengthen the middle and low level systems and make heavy thick water vapor air layer. The composite examples of storm rain is 11 and daily rain data more than 100mm, the wind fields data is from FNL ncep reanalysis data. The average circulation field analysis pointed out (Gao, 2007).

Figure 2 The composite wind field on 500hPa of storm rain processes in southwest China region



The composite wind field on 700hPa of TPV induced storm rain processes is displayed in Figure 3. From Figure 3, there is clearly south wind belt, which is the main characteristic of the 700hPa wind field. The south wind flow brings water vapor and water vapor converges over the Tibetan Plateau, lead to a lots of unsteady energy field.

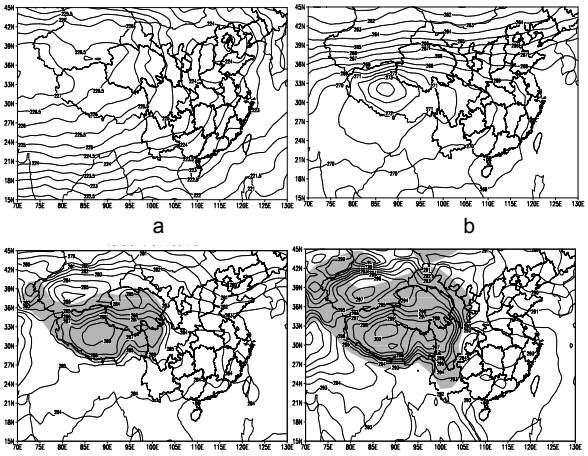
Figure 3 The composite wind field on 700hPa of storm rain processes in southwest China region. The shadowed area is altitude more than 3000m.



4.2 THE COMPOSITE TEMPERATURE AND MOSITURE FIELD CHARACTERISTICS

The composite temperature fields of TPV induced storm rain processes is displayed in Figure 4. In upper, middle and low level, there is warm center in west of Tibetan Plateau, and the warm center is consistent with the vortex center. There is warm center over the Sichuan Basin. The TPV induced storm rain in Sichuan Basin accompany with the warm center on 500hPa, and also the same condition over the middle and east of the Sichuan Basin. There is warm center over the Sichuan Basin.

Figure 4 The composite temperature fields of storm rain processes in southwest China region. A is 200hPa, b is 500hPa, c is 750hpa and the shadowed area is altitude more than 3000m, d is 850hPa and 1500m shadowed area.

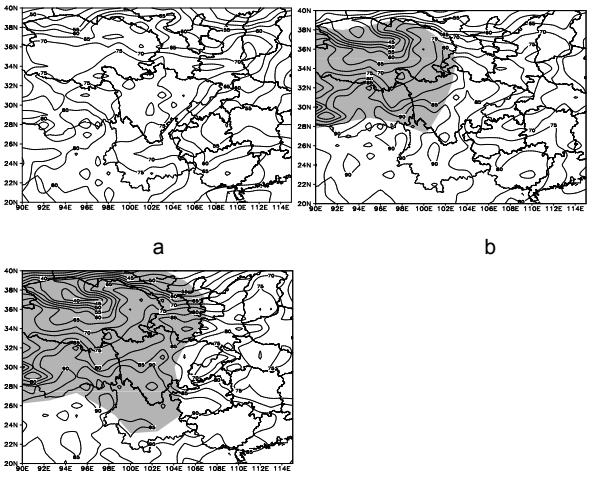


a b

c d

The composite moisture fields of TPV induced storm rain processes is displayed in Figure 5. The south of Tibetan to west Sichuan Plateau region is the big moisture area and the source region of TPV is consistent with the high vapor center.

Figure 5 The composite moisture fields of storm rain processes in southwest China region. A is 500hPa, b is 700hPa and the shadowed area is altitude more than 3000m, c is 850hPa 1500m shadowed area.

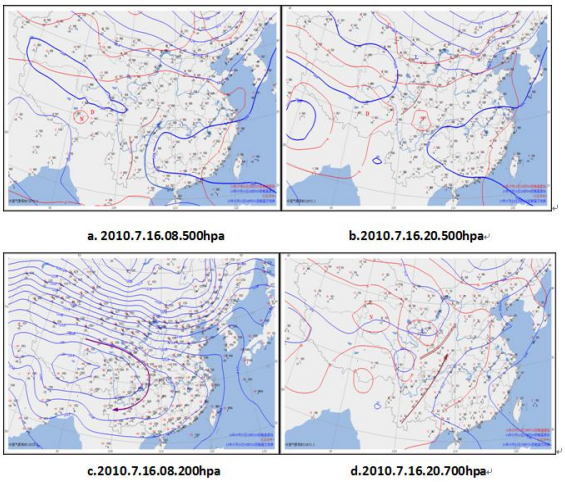


a b

c

A typical TPV induced storm rain weather process on 20z 16th to 20z 17th, July 2010 (Beijing time)in southwest China is analyzed carefully (Figure 6 a, b, c, d). The rainfall data in 23 national stations, the 500hPa, 700hPa, 850hPa circulations is analyzed too. The wind field, temperature, moisture and vertical wind field is analyzed carefully.

Figure 6 The composite moisture fields of storm rain processes in southwest China region. A is 500hPa, b is 700hPa and the shadowed area is altitude more than 3000m, c is 850hPa 1500m shadowed area.



The weather pattern of this process is that there is cold trough in Baikal region with cold air flow and low vortex In the Plateau with warm air flow center on 500hPa, a patter of blocking pattern. On 700hPa, there is shear line along Hetao region with cold air flow, Jiulong low vortex or shear line with warm air center. In this condition, the convergence is strengthened in upper to low levels, the ascending air be stronger, with moisture and unstable energy, the heavy storm rain lead to loss of people. It is a typcial storm rain of TPV along with blocking weather patter, with high energy and high moisture weather process.

5. SUMMUARY

(1) The main influence month in one year of Tibetan Plateau vortex to storm rain in southwest Sichuan Basin in China is July.

(2) The Tibetan Plateau vortex usually moves to

east and leads to clear rain in southwest Sichuan Basin, then turns to be weak and disappear.

(3) The Tibetan Plateau vortex with clear rain influence in southwest Sichuan Basin is usually warm vortex after generation in Plateau and then turns to be baroclinic vortex within 48 hours, with strong cold air flow invasion advection into it.

(4) The Tibetan Plateau vortex with influence to southwest Sichuan Basin usually accompanies with Plateau shear lines and under clear blocking situation background. There are southwest low Jiulong vortexes nearby the Plateau vortex, when most Tibetan Plateau vortex moves eastly, accompanying with low level jet air flow or high south wind air flow and coordination with South Asian High in high level.

(5) The storm rain weather process in China southwest Sichuan Basin caused by Tibetan Plateau vortex has clear high temperature, high moisture characters over Plateau sky, with clear vertical ascending air flow and leaning to north with the altitude ascending, which is good for the air future convection development.

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