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SUMMER MONSOON OVER EASTERN ASIA IN 1979

by

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ABSTRACT

This article analyzes the process of seasonal transition from spring to summer during the monsoon test period of May-July 1979. In the area of southern Asia and the northwestern Pacific, ten days before the outbreak of large scale summer monsoons, there was a strengthening process in upper atmosphere jet stream westerlies for the area of the southern hemisphere between 40^{o} - 160^{o}E in the middle latitudes. As far as the development of longitudinal circulation associated with the middle troposhere of the southern hemisphere as well as strengthening of cross-equatorial southerly air flows associated with lower layers of the troposphere are concerned, at this time, there was an increase in wind speed in southwesterly winds of the lower atmosphere in the tropical zones of southern Asia and the northwest Pacific. In conjunction with this, there was an expansion of ranges toward the north and an increase in tropical easterlies in the upper troposhere of the southern Asia area. Monsoon circulation patterns were strengthened, and the rainbelts of eastern China showed the appearance of seasonal northward shifts. It seems that changes in atmospheric circulation in the southern hemisphere have a triggering effect on the establishment of summer monsoons in the east Asian area as well as on the initiation of the pushing of them toward the north.

FORWARD

East Asia is an area of the world famous for monsoons. Seasonal changes in weather and climate are very conspicuous. Early in the 1950's, Chinese meteorological workers[1] pointed out that seasonal changes in east asian circulation possess characteristics of "sudden changes". From spring to summer, there is the establishment, in southern Asia, of easterly jet streams in the upper troposhere. There is also a retreat of the upper atmosphere westerlies on the south side of the plateau. Along with this, there is an almost simultaneous occurrence of the onset of the Indian summer monsoon and the beginning of the plum rains on the middle and lower Yangtze River. Later research[2] clearly showed that this type of "sudden change" or "mutation" belt is of a global nature.

In the past, due to a lack of data on the southern hemisphere, people did not adequately understand the mutual effects between the northern and southern hemispheres on the period of the onset of the asian summer monsoon. In the 1960's, Findlater[3]discovered that there was an intimate relationship between the summer monsoons, southwest Indian monsoon activity, and east African cross-equatorial low atmosphere jet streams. In recent years, Chinese meteorological workers[4,5]pointed out that summer monsoons coming from low atmospheric gas flows in the southern hemisphere are also capable, through other routes, of crossing the equator, influencing the weather in the South China Sea and the area of the northwest Pacific. This article uses data associated with the 1979 monsoon test period from May-July to discuss, in the process of seasonal transition from spring to summer, the influences of changes in atmospheric circulation in the southern hemisphere on the establishment of summer monsoons in the east asian area as well as the relationships between changes in monsoon circulation patterns in east Asia and rainbelt activity in eastern China.

I. ATMOSPHERIC CIRCULATION CHARACTERISTICS ASSOCIATED WITH THE PERIOD OF SEASONAL TRANSITION FROM SPRING TO SUMMER IN THE EAST ASIA AREA IN 1979

1. Northern Hemisphere Circulation Characteristics

In 1979, the day of the onset of the summer monsoons in Bombay India was June 19. In China's Yangtze-Huai river valleys, on the same day, there was the "plums enter" calendar event. In the northwest Pacific, ITCZ began to be established north of 10°N. The characteristic dates of the three representative transitions to summer differ very 348
little. In 1979, in the May to July period, the rainbelt associated with eastern China was located south of 25°N from the middle of May to the middle of June. This is south China's pre-flood period. From the end of June to the middle of July, the rainbelt moved north to 30°-35°N. This is the plum rain period of the Yangtze-Huai river valleys. At the end of July, the rainbelt moved to 40°N. This is the end of the plum rains of the Yangtze-Huai river valleys (July 23 is called "plums depart"), and the rainy season begins in north China. Within the period of time discussed above, the rainbelts and the trends in changes in position over time of 200mb south asian high pressure ridgelines as well as 500mb subtropical high pressure ridgelines are basically the same. At the time of "plums enter" (middle and late June) and "plums depart" (middle and late July), there are obvious northward shifts in both the 200mb south asian high pressure ridgeline or ridge and the 500mb high pressure ridge. During the pre-flood period in south China, the south asian high pressure ridge is located 20°-22°N. Secondary high pressure ridges are located south of 20°N. In the period of the "plum rains", the south Asia high pressure ridge is located 24°-27°N. Secondary high pressure ridges are at

23^{o}-26^{o}N. After "plums depart", the south Asia high pressure ridge as well as secondary high pressure ridges all shift north to 30^{o}N (see sketch). The situation discussed above clearly shows that, the same as in other years, in 1979, there was an intimate relationship between the northward shift of China's summer monsoon rainbelt and seasonal changes in the atmospheric circulation of the east Asia and northwest Pacific area.

Fig.1a and 1b are average wind time cross section diagrams for 200mb and 850mb cases along 115^{o}E. During the first 10 days or so of May, the middle 10 days or so of June, and the last 10 days or so of July, there are three obvious northward shifts (see Fig.1a) in the 200mb south Asia high pressure ridge (northern boundary of easterlies). Accompanying each of these northward shifts, average wind speeds for northeasterly high altitude winds, from the South China Sea to the Kalimantan to Sumatra belt (Station 59792 to Station 96295), experienced a process of increase to above 20m/s. At the same time, the northern boundary of strong northeasterly winds gradually expanded northwards. When there are increases in high altitude northeasterly winds, 850mb southwesterly winds associated with corresponding areas also increase three times. In conjunction with this, at the same time, there is an expansion northward (see Fig.1b). As far as these three processes of increase in upper atmosphere northeasterly winds, as well as low level southwesterly winds, are concerned, they just respectively show their appearances between the beginning of the south China pre-flood period and the Yangtze-Huai river valley "plums enter" and "plums depart". This explains the fact that, each time there is a northward seasonal shift in east China rainbelts, there is not only a northward expansion of the east Asia monsoon, but there is also a clear strengthening. However, the three processes of strengthening discussed above and associated with monsoon circulation, in changes of time and space, are most certainly not completely the same. In the first process, high altitude ridges change in front, and northeasterly winds increase behind. In conjunction with this, southwesterly winds at low levels, north of secondary highs, will increase earlier than high altitude northeasterly winds. The second instance occurs at approximately the same time. The second and third processes are connected. These phenomena explain the fact that the development process of the three instances, in terms of mechanism, is capable of showing the existence of a number of differences. This question awaits more detailed analysis and study later on.

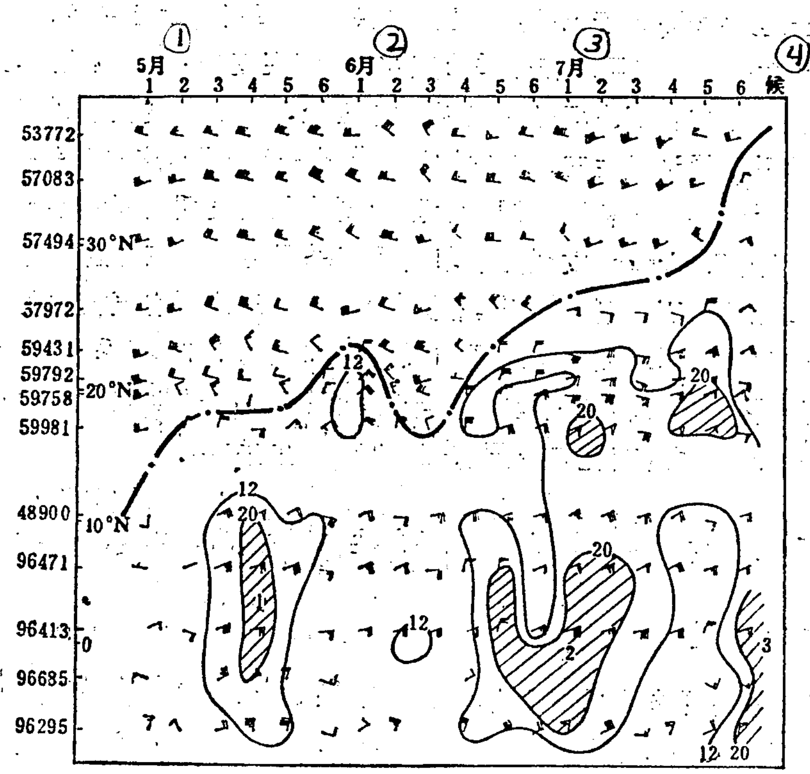

Fig.1a Average Wind Time Cross Section Diagram for the 200mb Case Along 115^{O}E May-July 1979. Thin Solid Lines Are Lines of Equal Wind Speeds for 200mb Tropical Easterlies (1) May (2) June (3) July (4) 5 Day Period

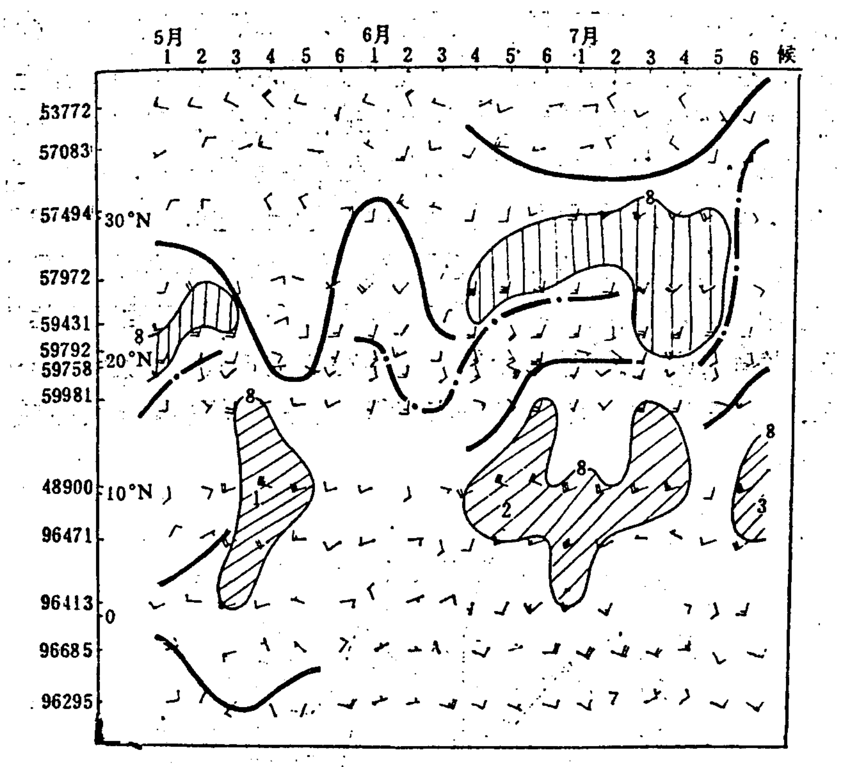

Fig.1b Average Wind Time Cross Section Diagram for the 850mb Case Along 115^{o}E May-July 1979. Broken Point Lines Are 850mb Secondary High Ridges. Coarse Solid Lines Are 850mb Shear Lines. Double Solid Lines Are 850mb ITCZ. Thin Solid Lines Are Lines of Equal Wind Speeds.

During the south China pre-flood period, the 850mb shear line, which is directly related to south China rainbelts, is located between Haikou and Ganzhou (see Fig.1b). At this time, the position of the northwest Pacific secondary highs moves toward the east and south. Southwestern air flows on the south side of shear lines are primarily cross-equatorial flows which come from the southern hemisphere. In the period of the "plum rains", 850mb shear lines move north to the Hankou-Zhengzhou area. Southwest airflows on the south side of shearlines are primarily the secondary north edge lows of the summer monsoon. In the period of the plum rains, in southern edge secondary highs positioned in the north section of the South China Sea, there is ITCZ (tropical convergence zone, as below) development. Air flows southwest of the southern ITCZ edge are cross-equatorial flows coming from the southern hemisphere. At the time of "plums depart", 850mb shear lines move north to north of Zhengzhou. The Yangtze-Huai river valleys are secondary high control, and, on the southern edges of secondary highs, there is also the establishment of ITCZ in the northern part of the South China Sea. The situation described above clearly shows that, in the period of May-July 1979, seasonal northern movements of the China rainbelts and the pushing north of lower level summer monsoons were consistent with each other. The activities of monsoon rainbelts are mutually related to changes in strength of east Asia monsoon circulation as well as to the range of expansion north.

We did analyses of the average flow line diagrams for the 200mb and 850mb cases associated with the various time periods of May-July 1979. It was discovered that changes in circulation associated with the three time periods discussed above were not only limited to the scope of east Asia. Moreover, they were also occurring at the same time in the expanded north Africa-southeast Asia-northwest Pacific area. It is not only south asian high pressure which shifts north. Moreover, it is also the whole high altitude secondary tropical high pressure belt associated with the area discussed above. Besides this, the 1979 northwest pacific tropical area lower layer southwesterly winds also have three processes of strengthening[6]. These three processes respectively correspond to the beginning of the south China pre-flood period and the Yangtze-Huai river valley "plums enter" and "plums depart". In the northwest Pacific, changes in tropical circulation and this type of relationship, which they have with the position of east China rainbelts, is one which arises through the mutual relationships between the three northward leaps of the secondary highs.

2. Southern Hemisphere Circulation Characteristics

At the time of the occurrence of seasonal changes in atmospheric circulation in the east Asia-northwest Pacific area, high and low layer flow fields in the southern hemisphere also show clear changes. First of all is the strengthening of high layer westerly jet streams in the middle latitudes of the southern hemisphere. We graphed out the vertical cross section diagrams of lateral wind speeds for each instance of the various longitudes at 40°, 60°, 80°, 100°, 120°, 140°, and 160°E. Fig.2 is a graph of average maximum wind speed value curves in the case of upper layer westerlies in the middle latitudes of the southern hemisphere, based on the cross section diagrams for the various individual longitudes discussed above. Among these, the tendencies in changes over time of jet stream strength from 40°-80°E are basically the same. Moreover, the trends in changes from 140°-160°E are also very consistent. We are able to take these and divide them into two jet stream areas--east (140°-160°E) and west (40°-80°E). The 100°-120°E zone between the two areas is a transition belt. The longitude ranges of the two east and west jet stream areas discussed above respectively correspond to the east coast of Australia and the southwest Indian Ocean. The core wind speed of the upper layer westerly jet stream in the 40^{o}-80^{o}E range, for the first five day period of June, is the weakest. During the second and third five day periods, there is a rapid increase in strength from west to east. In conjunction with this, one sees the appearance of peak values. In the third five day period of June, the wave peak reaches 100^{o}E. Peak value No.2 shows its appearance between the sixth five day period of June and the first five day period of July. In the second five day period of July, influences arrive at 100^{o}-120^{o}E. In the eastern area jet streams (140^{o}-160^{o}E), there are three peak values. These respectively show their appearances in the third five day period of June, the first five day period of July, and the fifth five day period of July.

We also analyzed the time change curves associated with lateral level temperature difference values in the middle latitudes (23^{o}-45^{o}S) of the troposphere (850mb-250mb) in the southern hemisphere in this period of time (see the broken lines in Fig.2). It was discovered that changes in temperature difference curves and trends in changes of jet stream strengths in westerly winds at the corresponding longitudes were consistent with each other. The explanation for this is that increases in the jet stream core wind speeds in southern hemisphere westerlies are primarily caused by troposhere baroclinic strengthening from the area of the middle latitudes in the southern hemisphere. From the longitudinal cross section diagrams (sketch graphs) of average temperature fields for the various longitude cases, it is seen that, for this period of time, the temperature

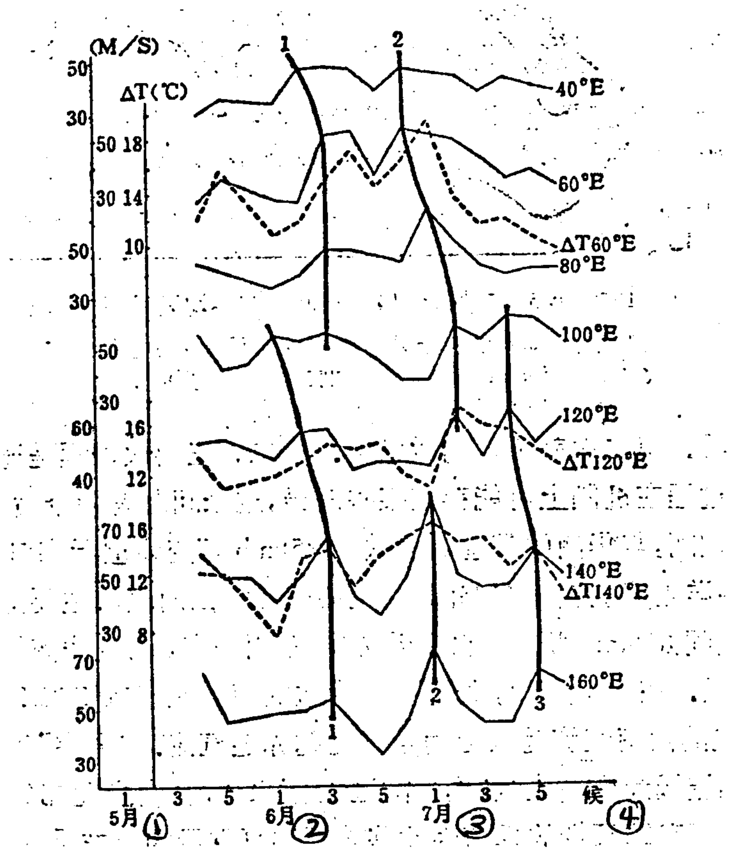

Fig.2 Diagram of Average Maximum Wind Speed Curves for the Case of Upper Layer Westerlies in the Middle Latitudes of the Southern Hemisphere May-July 1979 Solid Line: Average Maximum Wind Speed Value Curves in the Case of Upper Layer Westerly Winds for Various Longitudes (Use Outside Coordinates, Unit: m/s). Broken Line: Longitudinal Level Temperature Difference Value Curves in the Middle Latitudes (23^{o}-45^{o}S) for the Troposhere (850mb-250mb) at

Corresponding Longitudes (Use Inside Coordinates, Unit: ^{o}C). (1) May (2) June (3) July (4) Five Day Period changes in southern hemisphere lower latitude areas are not large. Baroclinic strengthening in middle latitude areas is primarily due to the results of the outbreak of a strong cold wave. From Fig.2, one can also see that, for the second and third five day periods of June, in the southern hemisphere range of 40^{o}-160^{o}E, there was a process of large scale, strong cold air activity. Sikka(7,8) and Kuettner(9) have, from different angles, brought up the influences of a series of baroclinic activities in the first ten days of June in south Africa on Mascarnes high pressure, the strengthening of east African jet streams as well as on the establishment of the southwest India monsoon. Table 2 clearly shows that the process of baroclinic development associated with southern hemisphere middle latitude areas in the second and third five day periods of June is not only limited to south Africa. Moreover, it appears almost simultaneously in the broad south Africa-south Indian Ocean-southwest Pacific area.

The 500mb long wave trough which corresponds to baroclinic activity processes of a broad scope in the southern hemisphere in the second and third five day periods in June is positioned in the vicinity of 50^{o}E and 110^{o}E in the third five day period of June (sketch diagram). In the fourth five day period of June, it moves east to the vicinites of 70^{o}E and 130^{o}E. Besides this, troughs in the vicinity of 170^{o}E also develop strongly in the fourth five day period of June. On the 850mb flow line diagram (sketch diagram) for the same instance, there are three large and strong anticyclonic centers. They are respectively located behind three long wave troughs, forming the southern hemisphere's cold wave cold high pressure belt. We acknowledge that the large scale cold air activity processes in the southern hemisphere in the second and third five day periods of June have an intimate relationship with the establishment of the Indian summer monsoon, the "plums enter" of China's Yangtze-Huai river valleys, as well as with the ITCZ development in the northwest Pacific which begin almost simultaneously in the northern hemisphere from the end of the middle ten days of June to the beginning of the last ten days. One may say that southern hemisphere baroclinic activity processes have a triggering effect on the establishment of the northern hemisphere summer monsoons.

II. THE RELATIONSHIPS BETWEEN MONSOON CIRCULATION AND SUMMER PRECIPITATION PERIODS IN EAST CHINA IN 1979

1. The Relationships of Cross-Equatorial Air Flows in the Vicinity of 80°-90°E and the Torrential Rains in the Pre-Flood Period in South China

In 1979, the torrential rains in the pre-flood period in south China occurred primarily from the middle ten days of May to the middle ten days of June. From 11-15 May, the south China area had a process of torrential rains. From the 200mb average flow line graph (sketch graph) for the third five day period in May, one can see that, from the first five day period in May to the third five day period, the 200mb south Asia high pressure moved north a distance of 5°-10° latitude. In the third five day period of May, air flows on the north side of the south Asia high pressure ridge had their break up area located in the upper atmosphere of south China. This is advantageous to maintaining conditions for upper atmosphere circulation associated with rainbelts in this area. In the equatorial zone of 95°-130°E, by the third five day period of May, high atmosphere cross-equatorial air flows from north to south had already been established. In the 850mb flow field (Fig.3), 850mb shear lines between Ganzhou and Nanning are systems directly producing south China torrential rains. They are quasi-stationary convergence lines between southwesterly air flows which are formed by the turning of northeasterly winds on the south side of variable cold high pressure and cross-equatorial air flows coming from the southern hemisphere. At this time, the positions of northwest Pacific secondary highs shift to the east and south. Their influence on the east asian mainland is not great. In order to investigate the source of this southwestern low atmosphere air flow, we analyzed the time cross section diagram (sketch graph) for 850mb winds in the 0^{o}-20^{o}S area of the Indian Ocean. One can see, in the first five day period of May, in the area 80^{o}-100^{o}E, the appearance, at 850mb, of $>$ 10m/s areas of strong southeasterly winds. In the second five day period of May, the southwest airflows in the equatorial area 80^{o}-90^{o}E strengthen to 12-14m/s. This cross-equatorial air flow and the westerly winds on the south side of Indian low pressure converge in the Bay of Bengal, forming a relatively strong southwesterly air flow. Passing through the Indochina peninsula, it influences the south China area of our country (see Fig.3). Because of this, cross-equatorial air flows which strengthen in the vicinity of 80^{o}-90^{o}E are capable of influencing the formation and maintenance of south China quasi-staionary convergence lines. There is an intimate relationship between this cross-equatorial air flow and the torrential rains of the pre-flood season of south China.

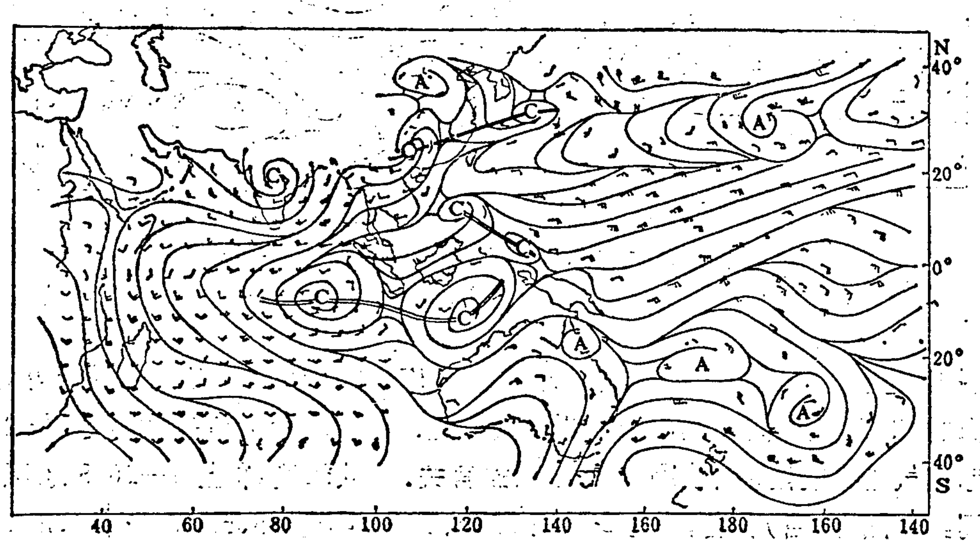

Fig.3 Average Flow Line Diagram for the 850mb Case in the Third Five Day Period of May 1979. Thin Solid Lines: Flow Lines. Thick Solid Lines: Shear Lines. Double Solid Lines: ITCZ.

2. Circulation Characteristics of the Plum Rains Period of the Yangtze-Huai River Valleys

In 1979, 19 June - 22 July was the period of the plum rains in the Yangtze-Huai river valleys (during this, 5-13 July was the central period of the plum rains). From the average flow line diagram (sketch graph) of the 200 mb case in the fifth five day period of June, one can see that, at this time, the south Asia high pressure center had already moved to the south side of the Tibet plateau. The ridge line was 25°-30°N. The air flow dispersion area on the north side of the ridge had already moved north to the upper atmosphere of the Yangtze-Huai river valleys. It is advantageous to the maintenance of high altitude conditions for rainbelts in this area. The northeasterly winds on the south side of the south Asia high pressure ridge strengthened. In conjunction with this, they crossed right over the equator. The northwest Pacific TUTT is located north of 20°N. and west of 145°E. It present an east-west movement. The high altitude anticyclone close to the equator is located in the vicinity of 10°N. This type of formation is advantageous to the development of the northwest Pacific ITCZ north of 10°N(10). In the 850mb flow field (Fig.4), the northwest Pacific secondary highs have already spread west and north to influence the mainland of China. The ridge line is 23°-25°N. The plum rain peak shear line north of the secondary highs is located in the lower part of the air flow dispersion area on the north side of the south Asia high altitude high pressure ridge. On the south side of the secondary highs, the area from the South China Sea to the northwest Pacific has ITCZ development. Under the influence of strong southern hemisphere cold air activity in the second and third five day periods of June, the 20°-40°S area is a variable or denatured cold high pressure zone. Anticyclonic centers are respectively located in south Africa, the central part of the south Indian Ocean, as well as the southeastern part of Australia. West of 160°E, the southern hemisphere has three relatively strong southeast air flows which respectively cross the equator in the western part of the Arabian Sea, the southeastern area of Srilanka, and the northeast side of New Guinea. This causes the onset of the summer monsoons in the area of India, the Indochina Peninsula as far as the South China Sea, as well as the northwest Pacific.

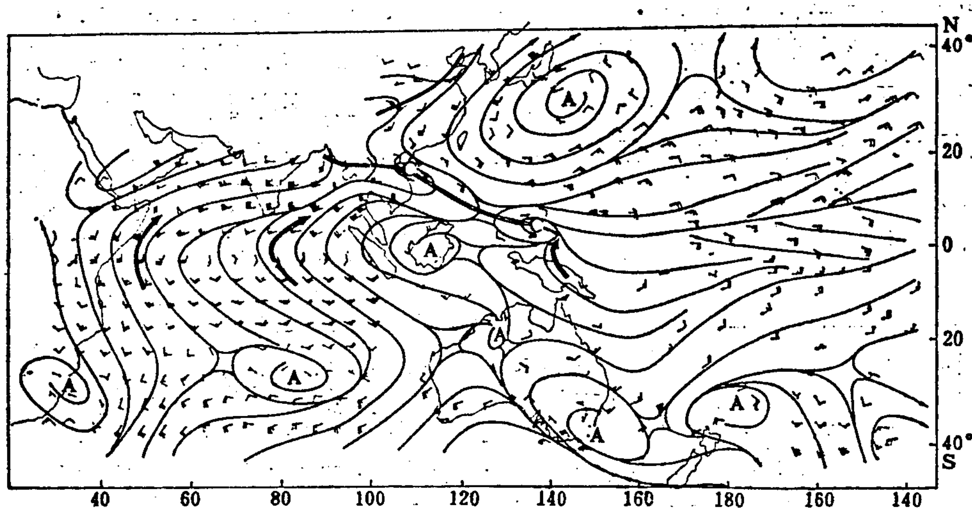

Fig.4 Average Flow Line Diagram for the 850mb Case in the Fifth Five Day Period of June 1979. Thick Arrows Stand for Cross-Equatorial Air Flows. Other Explanations Are the Same as Fig.3.

From Fig.1b, one can also see that, in the period of the plum rains, the north part of the South China Sea shows the appearance of ITCZ. The 850mb secondary high ridge line is located in south China. The explanation for this is that the secondary highs and South China Sea ITCZ are the two main

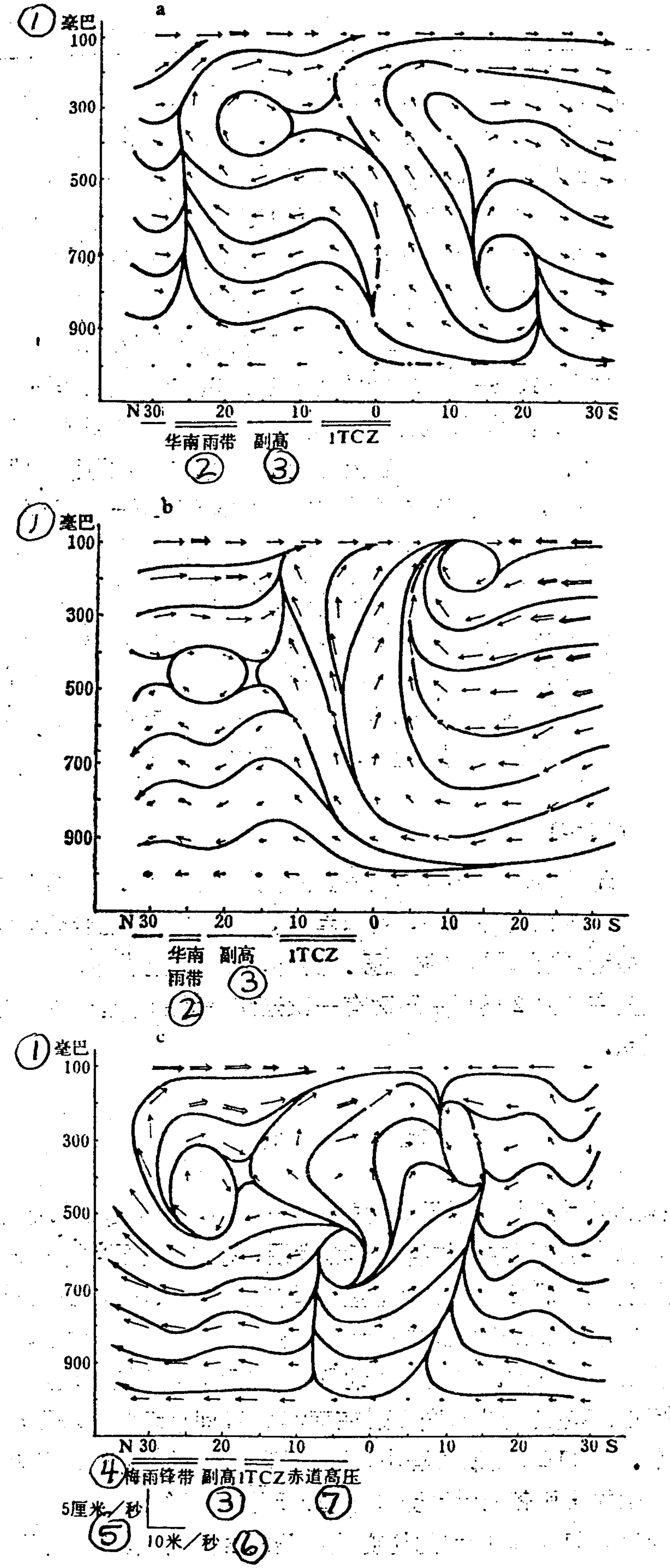
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Fig.5 (See Previous Page) Longitudinal Ring Circulation Cross Section Diagram Along 115^{o}E for the Second, Fourth, and Fifth Five Day Periods of June 1979. a; Second Five Day Period of June. b; Fourth Five Day Period of June. c; Fifth Five Day Period of June. (1) mb (2) South China Rainbelt (3) Secondary High (4) Plum Rain Peak Belt (5) 5cm/s (6) 10m/s (7) Equatorial High Pressure (8) Units: Horizontal Wind Speeds Are m/s. Vertical Wind Speeds Are cm/s. Scale is Appended at the Bottom of Graphs. In the Graphs, the Scales for Double Arrows Are Reduced One Fold.

ascending branches on the north side are located 20^{o}-25^{o}N. Latitude positions for northern hemisphere weather systems are as shown under the Fig.'s. The Hadley circulation center in the southern hemisphere is located at 15^{o}-20^{o}S. When the plum rains begin (see Fig.5b), southerly troposhere wind speeds in the southern hemisphere south of 10^{o}S clearly increase. Rising movements rapidly increase between 10^{o}S - 10^{o}N. The northern boundary of the northern hemisphere ITCZ ascent area expands northward from 5^{o}N to 10^{o}N. Monsoon circulation ring center locations also move north 5^{o} of latitude. The trailing or sinking branches move north from 10^{o}-15^{o}N to 15^{o}-20^{o}N. Rising movements of south China convergence belts weaken. After "plums enter" (see Fig.5c), the northern hemisphere monsoon circulation rings clearly strengthen. From the second to the fifth five day period of June, between 10^{o}-30^{o}N, the high altitude north wind components at 200mb increase from -6.1m/s to -7.7m/s. The low layer south wind component at 850mb increases from 1.8m/s to 5.9m/s. In the fifth five day period of June, the weather systems in the period of the plum rains. In this instance, the establishment of the South China Sea ITCZ is related to the cross-equatorial air flows in the vicinity of 80°-90°E, influencing the strengthening of southwest air flows in the central part of the South China Sea. From the time cross section diagram (sketch graph) associated with 850mb winds in the area 0°-20°S in the South China Sea, one can see that, in the third five day period of June, in the vicinity of 15°S, 90°E, 850mb has a large southeast wind center of 12m/s. The period of time during which these strong southeast winds appear is one five day period behind the southern hemisphere high altitude westerly jet stream strengthenings at 100°E. In the fourth and fifth five day periods of June, in the area 80°-95°E, the 850mb southerly winds on the equator strengthened. At this time, in Fig.1b, the Saigon southwest winds also clearly grow. Close on their heels, one has the appearance of the second process of increase in the southwest air flows associated with the South China Sea area. ITCZ is formed between southwest air flows--after they strengthen--and easterly air flows south of secondary highs. Because of this, under the influence of strong southern hemisphere cold air activity, the relatively strong cross-equatorial air flows in the vicinity of 80°-90°E have key effects on the strengthening of the summer monsoon in the area of the South China Sea as well as on ITCZ development.

Fig.5 is vertical circulation cross section diagrams along 115°E before and after "plums enter". The second five day period of June represents the situation before "plums enter" (see Fig.5a). At this time, the center positions for northern hemisphere monsoon circulation rings are 15°-20°N. The trailing branches on the south side of circulation rings are located 10°-15°N. The trailing or sinking branches of monsoon circulation rings contract to 20°N. The ascending branches have already moved north as far as 25°-30°N as well as to the Yangtze-Huai river valley area north of that. From Fig.5, it is possible to see that changes in longitudinal ring circulations before and after "plums enter" are, first of all, reflected in the strengthening of troposphere south winds in the southern hemisphere in the fourth five day period of June (this is related to the southern hemisphere cold wave process in the second and third five day periods of June). They are additionally reflected in strengthening of rising movements between 10°N-10°S. It is only subsequent to this that there is obvious northward movement and strengthening of northern hemisphere monsoon circulation rings. In conjunction with this, rising branches associated with the north side develop toward the north as far as the Yangtze-Huai river valleys. From this one can see that cold wave processes associated with the southern hemisphere may possibly have triggering effects on the strengthening of east asian monsoon circulations.

3. Circulation Changes at the Time of "Plums Depart"

On July 23, 1979, the Yangtze-Huai river valley had "plums depart". The rainbelt moved north to the north China area. Analyzing average flow line diagrams (sketch graphs) for 200mb and 850mb associated with the fourth five day period and the sixth five day period of July, it is possible to see that the principal changes in northern hemisphere circulations before and after "plums depart" are that secondary high ridge lines once again displace north, and tropical monsoon circulation strengthens. Besides this, from Fig.2, one can see that southern hemisphere high altitude west jet stream strengthening associated with 100^{o}-120^{o}E, from the second five day period to the fourth five day period of July, also has a continuous process of increase. There is a relationship between this process and the "plums depart" associated with the Yangtze-Huai river valleys.

CONCLUSIONS

1. In 1979, as far as the first and second five day periods of the onset of large scale summer monsoons in the east Asia area are concerned, high altitude westerly jet streams in the middle latitude area of the southern hemisphere went through a process of strengthening. At this time, longitudinal circulation in the middle troposphere developed, and cross equatorial southerly air flows associated with the lower layers of the troposphere strengthened. In the case of the southern hemisphere, this type of large scale baroclinic development process has triggering effects on the establishment of summer monsoons in the east Asia area and on their advances northward.

2. In May-July, 1979, seasonal northward movements associated with rainbelts in the eastern part of China are not only the same as secondary high ridge lines in their displacement trends. Moreover, they are consistent with advances northward by low layer summer monsoons. Each time they shift north, east Asia monsoon circulations correspondingly strengthen. In conjunction with this, there is a gradual expansion northward. Changes in longitudinal ring circulations before and after "plums enter" are reflected first of all in a strengthening of the Hadley circulation in the southern hemisphere as well as in the

development of a northward shift of the South China Sea ITCZ rising branch. In the process of ITCZ development, going through the adjustment of vertical circulation rings influences the northward shift of rainbelts on the north side of northern hemisphere secondary highs. The activities of monsoon rainbelts in eastern China are restricted by east asian monsoon circulations.

3. During the pre-flood period in south China, northwest air flows on the south side of shear lines which influence south China precipitation partially spring from cross-equatorial southerly air flows in the vicinity of 80°-90°E. At the time of "plums enter", it is, first of all, this branch of cross-equatorial air flow which influences the establishment of South China Sea ITCZ. In the plum rain period, this air flow has key effects on the development and maintenance of South China Sea ITCZ. With regard to southwest air flows on the south side of plum rain fronts, by contrast, they come primarily from southerly winds on the west sides of secondary highs. Perhaps they are southerly air flows from after the confluence of the Indian monsoon up the flow. This is a point of difference between the east Asia monsoon area and the India monsoon area.

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