A Study on the Forecasting Method of Mesoscale Convective Systems during the Mei-Yu Period (I): Analyses on Heavy Rainfall Events During the Post-TAMEX Exercise

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June, 1993

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ABSTRACT

GMS satellite imagery, hourly rainfall report surface and upper observations during 1992 Post-TAMEX Forecasting Exercise period were used to study the characteristics of the heavy rainfall events. Results showed that two third of events were produced by frontal weather systems. But the other one third were produced by the non-frontal. Obviously, the non-frontal/ weak forcing factors were also important trigger mechanism for the MCS formation and intensification.

Three kinds of surges were found in the TAMEX-92 period, they were equatorward, tropical and collapsing tops. The first two were belong to synoptic scale, and the last one was meso-scle. The equatorward surge brought the cold and dry air from the higher latitude to Taiwan and its vicinity, then produce heavy rainfall. Tropical one transport warm and moist air from tropical area to Taiwan and its vicinity, and produced heavy rainfall. Down draft due to the collapsing tops can induce or enhance the sourounding MCS. Therefore, the surges played very important role for the occurrence of heavy rainfall events.

1. Instruction

The weather requirements in the United States range from numerical weather prediction (NWP), field forecaster to training and research. NWP using precipitation attempt to validate and visualize the numerical weather models. As field forecaster, short range, Nowcasting and synoptic scale forecasting techniques are developing for forecasting the flash floods. The Interactive Flash Flood Analyzer (IFFA) are also used for estimating rainfall from convective systems. On training and research, are working with the forcaster in the United States and also several countries on better understanding and improving flash flood forecasting, such as People's Republic China (PRC)/Mainland China, Taiwan, Senegal, Africa and south America. In the United States, the climate requirements for global, monthly and seasonal rainfall put into global models. And we also have effort to insert the rainfall estimates into hydrological, river flow modeling systems.

Satellite offer only a pice of puzzle when you looking at a short range forecasting of MCSs and precipitation. Even though, satellite data is only a piece of data, it has an ability to analyze on all scale that related precipitation. In other word, you could see from global scale, synoptic scale, mesoscale and storm scale all on one picture. No other data source can do it, such as doppler radar, surface and upper observations as well as vertical profiler. We have to work with the advantage to improve the forecasting on heavy rainfall. There are all kinds satellite information available to the United States ranging from geostationary satellite which have very good time and space resolution, all the way down to the polar orbit which is very poor temporal resolution data. But the polar data much higher spatial resolution and physical related to precipitation in the United States. Starting in 1996, Taiwan also available to have same type information U.S. get that involved this very good physical relationship to precipitation. It would come with NOAA-K, -L, -M polar satellite.

The philosphy of persistence and continuity may use in short range forecasting and Nowcasting. Persistence and continuity means extrapolation and trend. The extraplotion is " easy". The hard part is that processes are looking for the development and dissipation of the MCSs. That requires you put satellite data, doppler radar, surface and upper observations as well as model outputs together. To come up with the left-handed thinkers which are intutive,experimental, emperical and an art. Nowcasting is an art in using all available resources.

A simply, of course is left-handed thinker, simply concepts for looking at low level flow, information for maitainence and intensification to see this location in tropic around Taiwan. The confluence areas (directional confluence ans also speed confluence) are favorable area for MCSs initiation and maintainence. And contrast, using the left-handed thinker approach, difluence (directional difluence and speed difluence) at low level go along with a dissipatation MCS. Nowcasting system you are going to develop and devote. The forcing model of Mainland China is strong. Conceptual models for MCS development over Mainland China and Taiwan are very similar. A lots of way, in many time before strong system that go on with the heavy rainfall over Taiwan area, the Indo-China connection, Bay of Bengal connection, the Mei-Yu front, and the low-level jet, theta-e axis and upper jet streaks (Fig. 1). Taiwan has similar type connections on Mainland China but get little complecated in Mainland China because it involves with mid-latitude jet streak and also with the southwest vortex. The southwest vortex is a very big contributor to heavy rainfall along the Yangtze River area of Mainland China.

The biggest problems for forecasting flash floods over Taiwan are follows. Forecasting the movement of focusing mechanisms which Mei-Yu front on the synoptic scale and outflow boundary on the mesoscale. And then timing of lifting mechanisms, like jet streaks, meso-alpha wave, low-level meso low (e.g. 850 hPa). The timing of lifting mechanism is extremly difficult. You can see them in the data field, in the imagery. The timing when they are going to affect Taiwan. Of course, forecasting the movement of typhoons is a major problem. And finally most major is orographic influences.

The present paper use the GMS satellite imagery, hourly rainfall report surface and upper observations to give a brief summary of heavy rainfall events during 1992 Post-TAMEX Forecasting Exercise period and also some recommendations. Results involve storm scale, mesoscale and synoptic scale. The results are expected to provide reference to the analyses on the mesoscale and Nowcasting/very short range forecasting.

2. Satellite Forecasting Funnel

For using the detected advantage of satellite data and use Satellite Forecast Funnel approach that look at data from the global scale all the way down to the storm scale in the heavy rainfall for the period of Mei-Yu period (Fig. 2). And using the forecasting funnel approach, we develop techniques, conceptual models, checklist (Fig. 3) and handle the all good of each one of the scale that read up the prepare the environment for the event. Event means the heavy rainfall. The feed back process from storm scale on back to the global scale (Fig. 4). On the storm scale, the MCS can modify the environment by producing outflow boundary, a mesoscale-induced meso-vortex at low-mid levels, and also anticyclonic jet streak north of the vortex (Fig. 5). There was a MCS produced meso-vortex at least ones during the May - June 1992 (Fig. 6). For example, on June 3, 50 mm rainfall amount of a day was produced at north Taiwan produced by this vortex. There was a rather deep mesoscale convective system located over the eastern China on 1630 UTC June 3 (Fig. 6a). A small Vortex moved south-southeastward and eventually produced very warm top rainfall over the northern Taiwan area (Fig. 6b & c). Sometime intense convection develop over Mainland China but produced downstream ridge over Taiwan. Downstream ridge will tend to less rainfall facts. This case produced very light rain over Taiwan area on 0933 UTC May 14, 1992 (Fig. 7). It perhaps latent heat process warming the troposphere down stream build the ridge, making Taiwan environment for only light rainfall amount. Another feed back process from the small scale, mesoscale to large scale.

3. Statistics / Results on the " STORM SCALE "

3.1 Cases Used

In the study have worked done the cases used were 48;predicted was 15, overpredicted was 9, and unpredicted was 24. Of predicted and overpredicted were 24 cases. They included IOP (Intensive Operational Period) alert and IOP warning events which means some of them occurred in the same day. So,48 cases were not mean 48 days. It means 48 events or 48 cases. Again it include alert days and warning days. The simple done here, unpredicted was 50%, overpredicted was 19%, and predicted was 31%. However,went back to the data that heavy rainfall events.

Heavy rainfall events tended to occurred in clusters. Clusters mean consective daily event period. Therefore, using persistency, the predicted cases would increase by 10. And the prediction ability would become 52% (25/48). When you got heavy rainfall in one day, the environmentis still good for the following day on heavy rainfall.

Table 1 is six forecasting areas in Taiwan versus rainfall. There were about 60 events could be counted in the satellite imagery that go along with heavy rainfall period. Although try to avoid that, some overlaps are possible. The probability of heavy rainfall events over the western Taiwan (85%) was much more than that over the eastern part (15%). The biggest one was over northern Taiwan (35%), while the smallest was over the southeast (1.7%). Obviously, 50～100 mm mean the maximum (75%). But only one event over 200 mm. So, the experiment last year is boring.The heavy rainfall event of 50 mm/day raw versus the six forecasting areas, the small to the east. They also have a few number of rain gauges (Fig. 8). So, it's not sure that the rainfall were over there. For example, there was an MCS with overshooting top was over a void area (0834 UTC, June 11) (Fig.9), but no rain was reported in the eastern part of Taiwan. Look at satellite imagery, a very good overshooting top was observed. The overshooting top is a good indicator of heavy rainfall (Scofield, 1987).

Fig.10 was another heavy rainfall event.It indicated that a MCS with cold top located at data void area. Less than 5 mm/day was reported in the eastern Taiwan. IR imagery indicated that a very pronounce MCS with grey shade colder than -62℃ located in the eastern Taiwan again. But the rainfall reported was less than 5mm/day. So, a data source that is not as part of perfect that we are working.

3.2 Cloud Top Temperatures

Table 2 shows the cloud top temperature of those 60 cases (60 events) versus six forecasting areas mentioned above. The satellite imageries were processed by MY enhancement curve (Chi et al., 1992). The grey level of cloud top broke down the enhancement level to unhanced (warmer than -32℃), warm top (-32～ -52℃), dark gray (-52～ -62℃; quasi-cold top) and cold top (colder than -62℃). It is very interesting that in the southern part of Taiwan. Even though, few cases down there, but prety high percentage of cold tops. The percentage of cold top over northern Taiwan was high, but also get high percentage of dark grey and warm tops. I guess the people live there hope to get a colder and colder top over there because the colder top the easier to estimate the rainfall. But see the northern part of Taiwan, very high percentage of the warm top convection, for example, there is a typical land-breeze situation-A typical TAMEX-92 MCS (Fig. 11). In satellite imagery, on May 7 at nighttime land-breeze between Mainland China and Taiwan. The land-breeze brew on shore and produced over 100 mm of a day in the central Taiwan.

Also look at the cloud top temperature versus rainfall (Table 3). Cloud top temperature is go from unhanced to cold top versus rainfall of 60 cases (events). And basically, we can say that the unhanced which is small amount only 10%. Unhanced can not really detected on the imagery. Hopefully, doppler can see that. Warm top 37%; dark grey 25% and cold top 28%. And again this brings up system can reenforces the typical TAMEX-92 MCS. A case (0833UTC, May 31) produced 100 mm/day in the northeastern Taiwan (Fig. 12). The MCS was over Taiwan area.And the cold top with dark grey shade was over the northeastern Taiwan.

Additional results on cloud top temperature which are very important that average time for the cold cloud top for 0832 UTC (late afternoon). TAMEX-92 dominated by frontal and local terrain induced MCS. Advection systems tend to have a colder top that those produced by local terrain effects.Advection system that one came from Taiwan strait and/or Mainland China to Taiwan. Colder IR top of the local produced MCS occurred in the afternoon. Advection system can have colder tops any time of the day or night. Advection system can not follow the local heating time, could be radiational cooling nighttime minimum on the IR temperatures, could be in the afternoon and following sometime.Finally,local terrain induced MCSs only lasted 1-2 hours;the others advection systems lasted 5-6 hours and one case was 12 hours.

3.3 Satellite Rainfall Estimates

The satellite rainfall estimation within three days (June 6～8) during TAMEX-92 experiment. On three days period, three areas (northern,central and southern) rainfall estimated based on hourly rainfall estimating techniques (Scofield, 1987), the error been 30%~50%. The bias was basically negative which means this rainfall is generally under estimated. 30% error is uite good. The United States doing this job since 1978, the error is also ~30%. You do this only one year. However though, problem area over central Taiwan and southern Taiwan We would say "congradulation" on that, because the skill close to the state of the art. Also the forecast technique taking estimated either on extrapolation or use left-handed to enhance them or to reduce them. Whatever the technique that was used on that, the three hour forecast technique or outlook technique. The errors were 43%, 74% and 57% for northern, central and southern Taiwan respectively.

3.4 Propagation

MCS propagation during TAMEX-92 was also brifly examined. Propagation called forward, regenerative and super cell. Advection systems were mostly comprised of forward propagating MCSs except when the destabilization and lifting occurring west of the MCS to produce backward propagation MCS, that is, the MCS system was go from a forward to back building on its western side. While the terrain produced MCSs were generally quasistationary or moved forward. The statistics was break down here: fast forward was 52%; slow forward was 40 %. So, 92% of MCS in the past summer moved forward with high percentage. Disappoint! And backward 6 % which look killers. Regenerative was 2%. An example of backward propagating MCS (Fig. 13) developed from a sea breeze interacted with outflow boundary, with upper-level system, resulted in a backbuilding MCS and produced over 100 mm/day during its affected Taiwan. This case had been analyzed by Chi et al. (1993).

Another one back progating MCS case (Fig. 14) occurred in the southern Taiwan where you have. Over 50 mm/day reported from this MCS here which start off-shore Taiwan. This is during the nighttime hour of 1733 UTC (Fig. 14a) start off-shore. During the next one hour (Fig. 14b) that MCS propagated backward to the southern Taiwan produced over 50 mm of rain. Backward propagating MCS was rare in last summer not go on very exciting weather, heavy rainfall events.

4. Statistics / Results on the " SYNOPTIC / MESOSCALE "

4.1 Surges

The following discussion is open scale. It is from storm scale to synoptic scale/mesoscale. First of all talking about surges that can be seen in the IR data. The surges can be observed even better on the water vapour imagery on 6.7μm that the Central Weather Bureau of Republic of China will get in 1994 or 1995. The surge process that go on in the atmosphere that we really don't understand very well, but it seems to be related to the development, initiation of weather system like MCSs, maybe typhoons. Surges discussed here can be divided into equatorward surges, tropicall surges and collapsing tops (warming up).

4.1.1 Equatorward (Synoptic Scale)

Look at the equatorward surge briefly here. IR data is a not advanced data, is very limited for looking at surges.But it's "start!". The equatorward surges are that clear air at IR (especially water vapour) imagery moved from the north to the south. And the intrusing of the dry air interacted with the tropical, high theta-e air, high K-index and CAPE air at unstable area to initiate MCSs. Basically, 300 hPa flow like Fig. 15. There are two type surges, they are direct and indirect. The direct is when the whole jet stream coming down, looks surge coming directly. Indirect, the jet did not down with them. It stay the north area, but the surge coming down. The surge as see in the satellite data still take place. Surge at 700 hPa shows in Fig. 16. The deformation zone goes southward, then going back to the west and bexome cyclonic. Althouh the IR imagery is not really good data for this, number of surges occurred during the TAMEX-92. For example, the case produced 50 mm/day over northeast Taiwan (Fig.17). The dry air comes from the north to south a cloud cluster formed at the northeastern Taiwan at 0232 UTC, May 1 (Fig. 17a). The next following hour (Fig. 17b~c), the cloud cluster evoluved into a deep convection and produced 50 mm rainfall amount that day.

The most disappoint rainfall event of the year back satellite interpretation was this surge occurred when over 200 mm of rain occurred over Taiwan. The most disappoint with the expected satellite signature and some way that question is rainfall or not.Again animation really need for this. Water vapour are "really" useful. Again storm that produced 200 mm/day was really warm top even not dark gray is warm than -52℃ producing the heaviest rainfall amount for TAMEX-92. Satellite picture at 2133 UTC May 21 (Fig.18a). It's several hours later for the surge. And northern Taiwan was covered by basically low-level clouds, but not distingushing precipitation elements in the satellite data (Fig. 18b).

4.1.2 Tropical (Synopticc Scale)

Another type of surge is tropical on moist air (Fig. 19). It's different from the equatorward surges. The equatorward surge is dry surge. This is the moist surge. In the satellite dada as seen by a band of bands. A band of cloud/a band of moisture moves out from the Bay of Bengal, Indo-China area over the Taiwan area. So, the tropical surge is a surge of moisture air. Fig. 20 was one of the tropical surge. 50 mm of rain occurred in south Taiwan may due to this surge. A surge comes out from the tropical, from the Bay of Bengal, from the Indo-China and over the southern region of the surge.The area of .cold top convections that developed and produced over 50 mm of rain in the south Taiwan. The moisture surge not dry surge, the moist surge and the every hour the persistence cold top. 50 mm seems too light. Look at the imagery here, it seems look like more than 50 mm occurred, maybe 100 mm or 200 mm event. During TAMEX-92, very approximately, up about 17 equatorward and 21 tropical. Equatorward more frequently in May and the grey shade resulted in MCS warm top,and warm dark grey. And the tropical surge around 20, more frequently in June,.and the colder top.

4.1.3 Collapsing Tops (Mesoscale)

Fig. 21 shows the schematic of mesoscale surge go along with the mesoscale surge is collapsing top. When the cloud top collapsing, the air bring down in all direction. With the mesoscale surge air bring down resulting in that the air destabilization going on to the west and to the east. And back to the TAMEX-92, one case of this kind of surge occurred in the period of 0233~0533 UTC May 17 (Fig. 22). Fig. 22 showed that a mesoscale surge colappsing MCS over eastern Mainland China (called MCS-C), and there was over 100 mm reported in central Taiwan.The downdraft which pdoduced by the collapsing top can trigger the souroundinq MCSs. The MCS-C was goint to collapse, while the one (MCS-B) was going to develop over the west of MCS-C and the other one (MCS-A) going to develop over the Taiwan area. The MCS-C continue to dissipate, while MCS-A get colder top the white area, and other one (MCS-B) start to become collder. When the cloud top of MCS-C total collapse, the MCS which over was very active, it produced over 100 mm in the central Taiwan. So, mesoscale surge the collapsing of one MCS and developed another one in the surrounding the one collapsing.

4.2 Frontal Versus Non Frontal

The 48 cases of weather system associated heavy rainfall curred during the TAMEX-92were shown in Fig. 23. It included 32 frontal and 16 non-frontal situations. The frontal situation that the front whinthin the box area and non-frontal situation was no front is expected within the box (20～27° ;117～125° E) (see Fig. 24). In other word, 32 frontal, front was in the box, and 16 non-frontal, front was outside the box. 32 frontal that can be divided into post-frontal (2),pre-frontal (7), collocated front (12) and behind the front (11).16 non-frontal were mesolows (8),land/sea breezes (4), easterly wave (2) and tropical disturbance (2). 16 of those break down, for the catagories, meso low is important.

Fig. 23 also show that the non-frontal situation was important because it possessed one-third last Mei-Yu season. Although most of heavy rainfall is produced by the strong forcing (e.g. front, low level jet,...), weaking forcing factors the through the convective scale interaction processes produce heavy rainfall are easily expected (Purdom, 1986). However, events produced by the strong forcing mechanisms are more predictable that those produced by the weak forcing one. Therefore, study on weak forcing mechanism is also very important.

4.3 Frontal position versus low level jet/ θe / Area

Basing on the evaluation report of the 1992 Post-TAMEX Experiment (Lee, 1992). The weather systems which associated with heavy rainfall events devided into frontal type (pre-front F1, collocated front F, post-front F2), without frontal type (M) in the area of 20-27° N; 118-125° E). Table 4 is the list of maximum, minimun and moderate rainfall amount and associated weather patterns in each forecast period for the 1992 Post-TAMEX Experiment. In the 24 cases of unpredicting, 12 cases were associated with front and the other 12 were not releated to front.

Table 5 shows the characteristics of nine cases of MCS which were associated with frontal type. Among these cases, 7 produced heavy/terrential rainfall, but the other 2 didn't. Those cases were all frontal type, but why some of them causing heavy rainfall, while some didn't? In order to understand the reason, some parameters were selected to compare with the two different situations. Result showed that the favorable conditions in synoptic environment were surface front associated with low level jet (850 hPa or 700hPa) and θe maximum axis area nearby. If low level jet was absent, even frontal system passing by, it would not resulted in heavy/terrential rainfall.

4.4 Non-frontal versus low level convergence/warm air advection/θe/time

Table 6 indicates the characteristics of 9 MCS cases without front. There were 7 cases with mesolows, 2 were land-sea breeze phenomina. Some cases only showed meso low pattern but without favorable conditions. But some had a few favorable conditions (e.g. low level convergence, LLJ, warm advection, θe maximum axis) except meso low situation. All of the cases had heavy rain occurred in the afternoon.

5. Summary and Recommendations

5.1 Summary

GMS satellite imagery, hourly rainfall report surface and upper observations during the 1992 Post-TAMEX Exercise period were used to study the characteristics of the heavy rainfall events. The prelimary results as follows:

(1) Two third of the events were produced by frontal weather systems. But the other one third were produced by the non-frontal ones. Obviously, the non-frontal/weak forcing factors were also important trigger mechanism for the MCS formation and intensification.

(2) Three kinds of surges were found in the TAMEX-92 period, they were equatorward, tropical and collapsing tops. The first two were belong to synoptic scale, and the last one was meso-scle. These surges played very important role for the occurrence of heavy rainfall events.

(3) The equatorward surge divided into direct and indirect surge. The direct one was the whole jet stream coming down with the cold air, while indirect the jet did not come down with them. The surge brought the cold and dry air from the higher latitude to Taiwan and its vicinity, then produce heavy rainfall.

(4) Tropical surge transport the warm and moist air from tropical area (the Bay af Bengal, Indo-China and south China Sea, etc.) to Taiwan and its vicinity, and produced heavy rainfall.

(5) Down draft due to the collapsing tops can induce/enhance the sourounding MCS.

(6) The favorable conditions in synoptic environment were surface front associated with low level jet (850 hPa or 700 hPa) and θe maximum axis area nearby. If low level jet was absent, even frontal system passing by, it would not resulted in heavy/terrential rainfall.

5.2 Recommendations

From the study, some recommendations are made as follows. They divided into short term and long term.

5.2.1 Short term

(1) Must continue forecasting and NOWCASTING efforts on the WINS System.
(2) Must use satellite animation where every cloud feature is tracked and understood.
(3) Need to use satellite data for error checking and initializing Numerical "SYNOPTIC SCALE" Forecast Models (winds, Vorticity, fronts, etc.)
(4) Need to use satellite data (integrated with other data) for developing conceptual models for application to the mesoscale and storm scale.
(5) Need a better understanding of Heavy Rainfall produced from weak forcing events.
(6) Need to develop rules and conceptual models for predicting organized local produced thunderstorms.
(7) Need to better understand the local circulation such as the low level meso low associated with heavy rainfall.
(8) Need to understand synoptic and mesoscale environments associated with warm top thunderstorms.
(9) Must install doppler radars and more rain gauges (especially in Eastern Taiwan).
(10) Need data from surrounding water.
(11) Must understand how to use the 6.7 μm water vapor imagery to be available on GMS and FY #2 (12) Need to develop software to allow the calculation of relative flow into a MCS.
(13) Need to use sea surface temperature data to compute a low level "equilibrium" θe field.

5.2.2 Long term

(1) Need more spatial and temporal data for better assessment of initial conditions.
(2) Need more data from Mainland China.
(3) Need commercial aircraft to provide wind, temperature and moisture observations over Taiwan and surrounding area.
(4) Need vertical wind profilers.
(5) Regional Model (CWB) needs to produce better fields such as low level winds and θe.
(6) Need to develop a 12 and 24 hour QPF technique.
(7) Need to be able to combine GMS with Fy#2 to possibly obtain 15/30 minute imagery products; also steorographic products.
(8) Need to develop an orographic Numerical Forecast Model for predicting location, coverage and intensity of "orographic pro-

duced" convection.

(9) Need to use cloud models for better understanding precipitation processes such as warm top convection.

(10) Hardware Preparation:

A. Must prepare to receive Fy #2 satellite data.

B. Must prepare to receive NOAA-K, -L, -M data in 1996 (e.g., mircrowave and 3.7 μ m)

6. Acknowledgement

The authors wish to thank Meteorological Satellite Center, Central Weather Bureau of the Republic of China for supporting data. This research was supported by the Central Weather Bureau under Grant CWB82-3M-04.

7. References

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Table 1 Six forecasting areas in Taiwan versus heavy rainfall events. The six areas are N: Northern Taiwan; NE: Northeast Taiwan; C: Central Taiwan; E: Eastern Taiwan S: Southern Taiwan, and SE: Southeast Taiwan.

RAINFALL (MM)	FORECASTING AREAS						TOTAL
	N	NE	C	E	S	SE	
50-100	18	3	16	0	8	0	45
100-150	2	2	2	3	4	1	14
> 200	1	0	0	0	0	0	1
TOTAL	21	5	18	3	12	1	60

Table 2 Same as Table 1, but for cloud top temperature versus Taiwan Areas. Cloutd top gery shade are U:unenhanced (warmer than -32℃); WT: warm top (-32～-52℃); DG: dark gray (-52～-62℃); CT: cold top (colder than -62℃).

CLOUD TOP GREY SHADE	FORECASTING AREAS					
	N	NE	C	E	S	SE
U	2	0	3	0	1	0
WT	9	3	6	3	1	0
DG	4	1	6	0	4	0
CT	6	1	3	0	6	1

Table 3 Same as Table 1, but for cloud top temperature versus rainfall.

RAINFALL (MM)	CLOUD TOP GREY SHADE			
	U	WT	DG	CT
50-100	6	16	12	11
100-200		5	3	6
>200		1		
TOTAL = =60 MCS EVENTS	6 +	22 +	15 +	17

U = 6 = 10% of the events
WT = 22 = 37% of the events
DG = 15 = 25% of the events
CT = 17 = 28% of the events

Table 4 The rainfall amount of minimum, medium and maximum in the each location at the each predicting and its valid time and associated weather patterns in the period of 1992 Post-TAMEX Forecasting Exercise. # and * indicted unpredicat and overpredict respectively.

				North (04 stations)			Northeast (6 stations)			Central (26 stations)			East (1 station)	South (08 stations)			Southeast (3 stations)			天氣型態
				min	mid	max	min	mid	max	min	mid	max		min	mid	max	min	mid	max	
#	01	0429 10 E	- 0501 10	0.0	5.0	44.5	16.9	41.3	55.5	0.0	2.3	15.5	23.5	0.0	0.0	2.0	0.0	0.0	20.1	M
#	02	0430 10 E	- 0502 10	0.0	0.5	66.0	3.5	16.3	20.5	0.0	1.3	38.5	29.5	0.0	0.0	4.0	0.0	2.6	3.3	M
	03	0501 16 1A	- 0502 16	0.0	0.0	65.0	10.5	11.5	25.0	0.0	1.0	45.0	29.5	0.0	0.0	4.0	0.0	2.6	3.3	FI/M
	04	0501 22 E	- 0502 22	0.0	3.0	30.0	1.0	10.7	28.0	0.0	1.6	35.5	1.0	0.0	0.0	3.5	0.0	2.6	2.6	M
#	05	0502 10 E	- 0503 10	0.0	0.0	30.0	11.0	42.3	60.5	0.0	0.5	35.0	116.5	0.0	0.0	2.0	0.0	0.0	0.8	M/FI
#	06	0503 10 E	- 0504 10	0.0	0.0	48.0	2.5	17.8	34.5	0.0	0.0	61.5	13.5	0.0	1.3	11.5	0.0	0.0	0.7	FI/M
	07	0504 10 E	- 0505 10	0.0	0.0	32.0	0.0	1.0	10.0	0.0	0.0	9.5	4.0	0.0	0.0	9.0	0.0	0.0	0.0	M
	08	0505 10 E	- 0506 10	0.0	0.0	3.0	0.0	0.0	11.9	0.0	0.0	0.0	5.1	0.0	0.0	11.0	0.0	0.0	0.0	M
	09	0506 10 E	- 0507 10	0.0	0.0	5.0	0.3	0.0	0.0	0.0	0.0	0.3	1.1	0.0	0.0	0.0	0.0	0.0	0.0	M
#	10	0507 10 E	- 0508 10	0.0	3.0	12.0	0.0	0.5	3.0	0.4	4.3	109.7	3.5	0.0	0.0	0.0	0.0	0.0	0.0	M/FI
	11	0507 22 1A	- 0508 10	0.0	4.3	25.0	0.0	0.5	2.0	3.4	15.0	86.4	3.5	0.0	0.0	21.5	0.0	0.0	0.0	M/FI
*	12	0507 22 1A	- 0508 22	0.0	0.0	27.5	0.5	1.6	2.5	5.0	16.3	75.4	0.0	0.0	0.0	21.5	0.0	0.0	0.0	M/FI
*	13	0508 10 1A	- 0509 10	0.0	10.0	37.0	0.0	2.0	46.7	0.5	20.0	87.5	0.0	4.0	3.0	41.8	0.0	0.0	0.0	FI/F
	14	0508 16 1A	- 0509 16	0.0	21.5	49.5	3.5	13.3	48.0	4.5	22.5	41.0	0.0	2.0	7.0	60.3	0.1	0.3	4.5	F
#	15	0509 10 E	- 0510 10	0.0	14.0	48.5	5.7	12.0	21.0	1.6	9.2	38.0	0.0	2.0	18.0	35.7	0.3	2.7	15.5	F/FI
#	16	0510 10 E	- 0511 10	0.0	0.0	38.0	0.2	2.0	4.0	0.0	0.5	53.0	0.5	0.0	0.0	6.5	0.0	0.0	0.0	FI
	17	0511 10 E	- 0512 10	0.0	0.0	1.0	0.0	0.1	1.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	FI/M
	18	0512 10 E	- 0513 10	0.0	0.0	1.0	0.0	0.0	1.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	M
	19	0513 10 E	- 0514 10	0.0	0.0	27.5	0.0	0.7	3.9	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.3	0.4	2.5	M
	20	0514 10 E	- 0515 10	0.0	1.0	10.5	0.0	2.2	13.0	0.0	0.0	2.0	25.0	0.0	0.0	0.0	0.0	5.5	17.0	FI
*	21	0515 10 1T	- 0515 22	0.0	20.5	41.5	5.5	7.6	47.0	0.0	1.3	31.5	2.3	0.0	0.0	0.5	0.0	3.5	7.5	FI
#	22	0515 10 E	- 0516 10	0.0	1.5	50.0	0.9	2.2	19.4	0.0	1.5	21.5	15.4	0.0	0.0	0.5	0.0	3.8	8.0	FI/F
#	23	0516 10 E	- 0517 10	0.0	0.0	52.0	0.4	3.5	40.5	0.0	0.0	20.0	0.5	0.0	0.0	0.0	0.0	0.5	0.7	F/FI
	24	0517 10 1A	- 0518 10	0.0	23.0	58.0	5.4	7.0	11.0	22.2	62.0	199.5	4.5	38.5	63.0	120.0	8.8	11.0	14.3	F
	25	0517 16 1Y	- 0518 04	0.0	21.0	64.5	0.4	5.0	8.5	18.5	39.5	75.0	4.5	14.0	55.5	102.0	2.0	5.6	8.6	F
*	26	0518 10 1T	- 0518 22	0.0	0.0	21.0	0.3	6.5	11.0	0.0	4.5	38.5	2.5	0.0	2.5	8.0	0.0	0.5	1.5	F
	27	0518 10 E	- 0519 10	0.0	0.5	36.5	0.0	2.2	0.0	0.0	7.5	25.5	3.0	0.0	6.0	41.0	0.0	1.0	3.6	F/FI
	28	0519 10 E	- 0520 10	0.0	0.5	17.0	0.0	0.5	1.0	0.0	3.5	17.0	0.0	0.0	0.0	1.5	0.0	0.0	3.0	M/FI
	29	0520 10 E	- 0521 10	0.0	0.0	10.0	0.0	0.0	0.0	0.0	0.0	8.5	0.0	0.0	0.0	0.5	0.0	0.3	0.0	FI/M
#	30	0521 10 E	- 0522 10	1.0	61.0	202.0	2.0	19.4	34.5	1.0	36.5	77.5	4.7	0.0	1.0	19.3	1.0	1.0	13.3	FI/F
#	31	0521 10 E	- 0522 16	0.0	70.0	314.0	0.0	29.8	51.0	2.5	31.7	69.0	10.7	1.0	0.5	19.5	1.4	1.8	12.5	F
	32	0522 10 1A	- 0523 10	0.0	17.0	63.5	0.0	15.0	21.0	1.5	14.8	68.0	3.0	2.0	0.0	10.0	0.0	0.1	8.5	F/FI
	33	0522 10 E	- 0523 16	0.0	6.0	39.0	0.0	1.0	8.0	0.0	5.7	38.0	0.0	0.0	0.0	4.5	0.0	0.1	6.3	FI
	34	0523 10 E	- 0524 10	0.0	0.0	39.0	0.0	0.4	0.5	0.0	0.3	16.5	0.0	0.0	0.0	9.5	0.0	0.0	14.0	FI/M
	35	0524 10 E	- 0525 10	0.0	0.0	2.0	0.0	0.0	6.0	0.0	0.0	3.4	0.0	0.0	0.0	9.5	0.0	0.0	0.0	M
	36	0525 10 E	- 0526 10	0.0	1.0	18.5	0.5	0.0	2.0	0.0	0.0	1.6	0.1	0.0	0.0	1.0	0.0	0.0	0.0	FI/F
*	37	0526 10 1A	- 0527 10	0.0	1.0	13.0	5.0	0.3	7.0	0.0	1.5	58.5	0.0	0.5	2.5	6.4	0.0	0.7	4.0	F/FI
*	38	0526 16 1A	- 0527 16	0.0	0.5	5.0	3.0	4.4	12.0	0.0	1.0	17.0	0.0	0.0	2.5	6.4	0.0	0.7	4.0	F/FI M
	39	0527 10 E	- 0528 10	0.0	0.0	2.0	0.0	1.0	20.5	0.0	0.0	1.0	0.0	0.0	0.0	0.5	0.0	1.0	1.3	M
	40	0528 10 E	- 0529 10	0.0	0.0	3.5	0.0	0.0	0.0	0.0	0.0	0.5	0.0	0.0	0.0	14.0	0.0	0.0	0.0	M
	41	0529 10 E	- 0530 10	0.0	0.0	2.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.5	0.0	0.0	0.0	M/FI
	42	0529 10 E	- 0530 10	0.0	0.5	36.5	0.0	0.0	3.0	0.0	1.1	50.5	0.0	0.0	0.0	0.6	0.0	0.0	0.0	M/FI
	43	0530 10 E	- 0531 10	0.0	0.5	27.0	0.5	0.7	6.5	0.0	0.5	39.5	0.0	0.0	0.0	15.6	0.0	0.2	0.0	FI/F/FI
	44	0530 16 1A	- 0531 10	0.0	3.5	22.0	2.0	22.6	105.1	0.0	3.0	73.5	112.5	0.0	0.0	15.8	0.0	0.2	0.0	F/FI
#	45	0531 10 E	- 0601 10	0.0	15.0	71.0	32.0	47.6	105.5	1.0	28.0	83.0	154.0	3.7	4.5	15.0	0.3	1.5	113.4	FI
#	46	0601 10 E	- 0602 10	0.0	0.0	2.5	0.0	0.0	1.0	0.0	0.0	37.0	0.0	0.0	0.0	109.0	0.6	1.7	2.8	M
#	47	0602 10 E	- 0603 10	0.0	0.0	36.0	0.0	0.0	0.0	0.0	0.0	40.0	0.0	0.0	0.0	21.5	0.0	0.0	0.0	M
#	48	0603 10 E	- 0604 10	0.0	0.0	54.0	0.0	0.0	1.0	0.0	0.0	7.5	0.0	0.0	0.0	24.5	0.0	0.0	0.0	M
	49	0604 10 E	- 0605 10	0.0	0.0	27.0	0.0	0.0	0.5	0.0	0.0	0.0	0.0	0.0	0.0	0.5	0.0	0.0	3.0	M/FI
#	50	0605 10 E	- 0606 10	0.0	0.0	31.0	0.0	3.5	31.5	0.0	0.0	12.2	0.0	0.0	0.0	2.5	0.0	0.0	0.0	F/M
	51	0606 10 E	- 0607 10	0.0	3.0	34.5	0.0	0.0	3.2	0.0	5.0	29.7	0.0	0.0	1.0	30.5	0.0	0.0	0.0	FI
	52	0606 10 1A	- 0607 10	0.0	12.0	70.0	5.5	6.5	10.0	0.0	11.3	49.0	0.0	0.0	0.0	11.5	0.0	0.0	0.0	FI/F
	53	0607 10 1T	- 0607 22	0.0	23.5	90.5	1.5	9.2	60.0	0.0	27.5	53.7	2.0	0.0	0.0	12.0	0.0	0.0	5.4	F
	54	0607 10 1Y	- 0608 04	0.0	14.3	62.0	1.5	4.5	32.0	0.0	9.4	42.5	3.5	0.0	0.0	22.5	0.0	4.0	5.4	F
	55	0608 10 1T	- 0608 22	0.0	52.0	95.0	1.9	5.3	35.5	4.5	24.0	61.5	7.5	0.0	25.5	80.5	0.0	2.0	10.2	F
	56	0609 10 1T	- 0609 22	0.0	0.0	0.5	0.2	0.5	0.5	0.0	0.0	41.5	4.5	0.0	0.3	13.0	0.0	0.0	0.0	F
*	57	0609 16 1Y	- 0610 04	0.0	0.0	14.0	0.0	0.2	1.0	0.0	1.1	27.0	0.0	0.0	1.4	8.5	0.0	0.7	1.0	F
#	58	0610 10 E	- 0611 10	0.0	2.0	13.5	0.5	1.0	1.5	0.0	3.5	38.0	0.5	0.0	5.0	52.0	0.0	0.2	0.9	FI/F
#	59	0611 10 E	- 0612 10	0.0	0.0	63.5	2.1	6.0	40.0	0.0	0.0	27.5	0.0	0.0	0.0	29.0	0.0	3.2	21.0	F
	60	0612 10 E	- 0613 10	0.0	0.0	44.0	0.0	4.1	34.0	0.0	0.0	6.5	0.0	0.0	0.0	39.0	3.0	29.7	39.0	F/M
#	61	0613 10 E	- 0614 10	0.0	12.5	132.5	0.0	30.3	65.0	0.0	1.0	38.0	3.2	0.0	3.5	70.0	0.0	0.5	1.3	M
#	62	0614 10 E	- 0615 10	0.0	1.0	50.5	0.0	0.4	1.5	0.0	4.0	27.0	0.0	0.0	0.0	49.5	0.0	0.0	3.4	M
#	63	0615 10 E	- 0616 10	0.0	0.0	46.0	0.0	9.0	22.5	0.0	0.0	37.5	0.0	0.0	0.0	56.5	0.0	4.0	0.0	FI
#	64	0615 16 E	- 0616 16	0.0	0.0	37.0	0.0	6.0	11.0	0.0	9.3	54.5	0.0	0.0	0.5	32.0	0.0	0.0	0.0	FI
#	65	0616 10 E	- 0617 10	0.0	0.0	12.0	0.0	0.0	0.0	0.0	7.3	56.5	0.5	0.0	0.0	32.0	0.0	0.0	0.0	FI
	66	0617 10 1A	- 0618 10	0.0	2.0	35.5	0.0	0.5	12.0	0.0	12.0	50.0	0.0	0.0	1.0	32.5	0.0	0.0	2.8	FI/F
*	67	0617 16 1A	- 0618 16	0.0	5.5	41.5	0.0	0.5	6.9	0.0	12.5	36.5	7.0	0.0	1.3	14.0	0.0	0.0	2.4	F
	68	0618 10 E	- 0619 10	0.0	2.5	29.0	0.0	1.6	5.0	0.0	1.0	8.0	0.0	0.0	0.0	30.5	1.5	3.3	32.1	F
#	69	0619 10 E	- 0620 10	0.0	0.0	93.5	0.0	3.6	22.0	0.0	2.3	98.0	0.0	0.0	0.5	102.0	0.1	4.5	37.0	FI/M
	70	0620 10 E	- 0621 10	0.0	0.0	15.5	0.0	0.0	4.0	0.0	0.0	16.5	0.5	0.0	0.0	13.5	0.0	0.5	0.7	M
	71	0621 10 E	- 0622 10	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.4	0.0	0.0	0.0	2.5	0.0	0.0	0.0	M
	72	0622 10 E	- 0623 10	0.0	0.0	1.0	0.0	0.0	0.0	0.0	0.0	0.5	0.0	0.0	0.0	2.0	0.0	0.0	0.0	M
	73	0623 10 E	- 0624 10	0.0	0.0	0.5	0.0	0.0	0.0	0.0	0.0	0.5	0.0	0.0	0.0	2.5	0.0	0.0	0.0	FI/F
	74	0624 10 E	- 0625 10	0.0	0.0	17.0	0.0	0.0	0.0	0.0	0.0	10.0	0.0	0.0	0.0	30.0	0.0	0.0	0.0	FI/M
	75	0625 10 E	- 0626 10	0.0	0.0	9.0	0.0	0.0	0.0	0.0	0.0	9.0	0.0	0.0	0.0	29.5	0.0	0.0	0.0	FI
	76	0626 10 E	- 0627 10	0.0	0.0	41.0	0.0	0.0	1.0	0.0	0.0	1.0	0.0	0.0	0.0	4.0	0.0	0.0	0.0	M/FI
	77	0626 10 E	- 0627 10	0.0	0.0	49.0	0.5	5.0	28.2	0.0	0.0	1.0	0.0	0.0	0.0	45.5	0.0	0.0	3.5	FI/M
	78	0627 10 1A	- 0628 10	0.0	8.5	112.2	5.0	20.0	40.0	0.0	1.5	34.0	0.0	0.0	0.0	60.5	0.0	3.2	13.8	M
	79	0627 16 1Y	- 0628 04	0.0	3.0	70.7	4.5	10.5	26.0	0.0	0.5	34.0	0.0	0.0	0.0	38.0	0.0	0.0	13.8	M
*	80	0628 10 1A	- 0629 10	0.0	0.5	33.0	0.0	0.0	0.5	0.0	0.0	4.5	0.3	0.0	0.4	21.0	0.0	0.0	12.0	M
	81	0628 16 E	- 0629 16	0.0	0.0	5.0	0.0	0.0	0.0	0.0	0.0	14.0	1.3	0.0	0.0	21.0	0.0	0.0	20.2	M
	82	0629 10 E	- 0630 10	0.0	0.0	0.0	0.0	0.0	1.0	0.0	2.3	42.5	1.0	0.0	0.0	1.5	0.0	0.0	8.0	M

Table 5 Characteristics of nine cases for MCS/heavy rainfall with fronte.

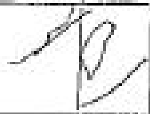
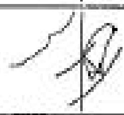
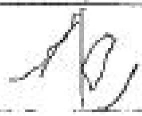
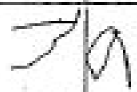
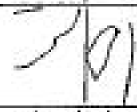
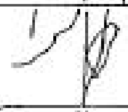
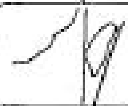
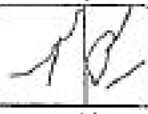
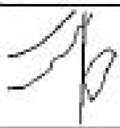
Date	Weather Pattern	850hpa Jet	700hpa Jet	θe Max. Axis	Heavy Rain Areas
May 7～ 9	M/F1,F1/F,F	+	+	+ 	C,S
16～18	F/F1,F,F	—	+	+ 	N,C,S
21～22	F1/F,F	—	+	+ 	N,C
25～27	F1/F,F/F2.M	—	—	— 	—
30～31	F1/F/F2,F2	—	+	+ 	NE,SE,E
June 4～ 5	M/F1,F1/M	+	—	+ 	N
7～ 9	F,F,F	—	+	+ 	N,C,S
16～18	F1,F1/F,F	+	+	+ 	C
22～24	M,F1/F,F2/M	—	—	— 	—

Table 6 Same as Table 5, but for without front.

Date	Weather Features	Heavy Rain Areas	θe Max. Axis	MCS	Heavy Rain Period
May 1～2	Land-Sea Breeze	N	+ 	+	1.06Z-12Z
2～3	Meso Low	NE,E	+ 	+	NE:2.15Z-3.00Z E:2.18Z-3.00Z
3～4	Meso Low	Cm	− 	+	3.06Z-12Z
JUNE 1～2	Meso Low 850hpa Wind Shear	Sm	+ 	+	1.06Z-12Z
2～3	Meso Low 850hpa Wind Shear	Sm	+ 	+	2.06Z-09Z
3～4	Meso Low 850hpa Wind Conv. 850hpa Warm Advection	Nm	+ 	−	3.06Z-09Z
13～14	Land-Sea Breeze 850hpa Jet 850hpa Moisture Advec.	N,NE,S	+ 	+	N:13.03Z-09Z S,NE:13.06Z-09Z
14～15	Meso Low Heat Convection 850hpa Jet 850hpa Moisture Advec. 850hpa Wind Conv. 850hpa Warm Advection 700hpa Jet	Nm	+ 	+	14.06Z-09Z
19～20	Meso Low 850hpa Wind Shear 850hpa Moisture Advec. 850hpa Wind Conv.	Nm,Cm,Sm	− 	+	Nm,Cm:19.06Z-12Z Sm:19.06Z-09Z

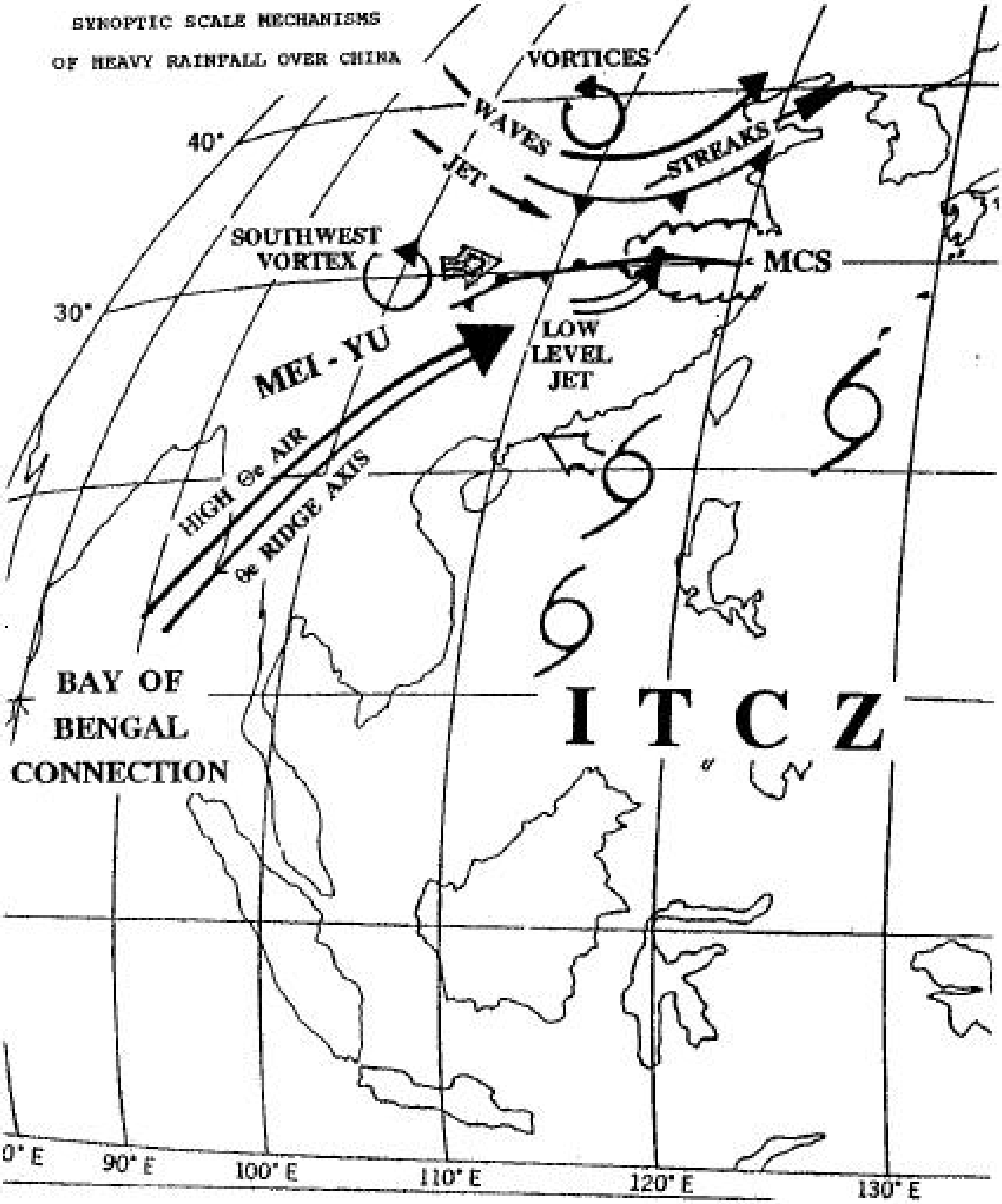


Fig. 1 Synoptic scale mechanisms of heavy rainfall over subtropical China during Mi-Yu season.

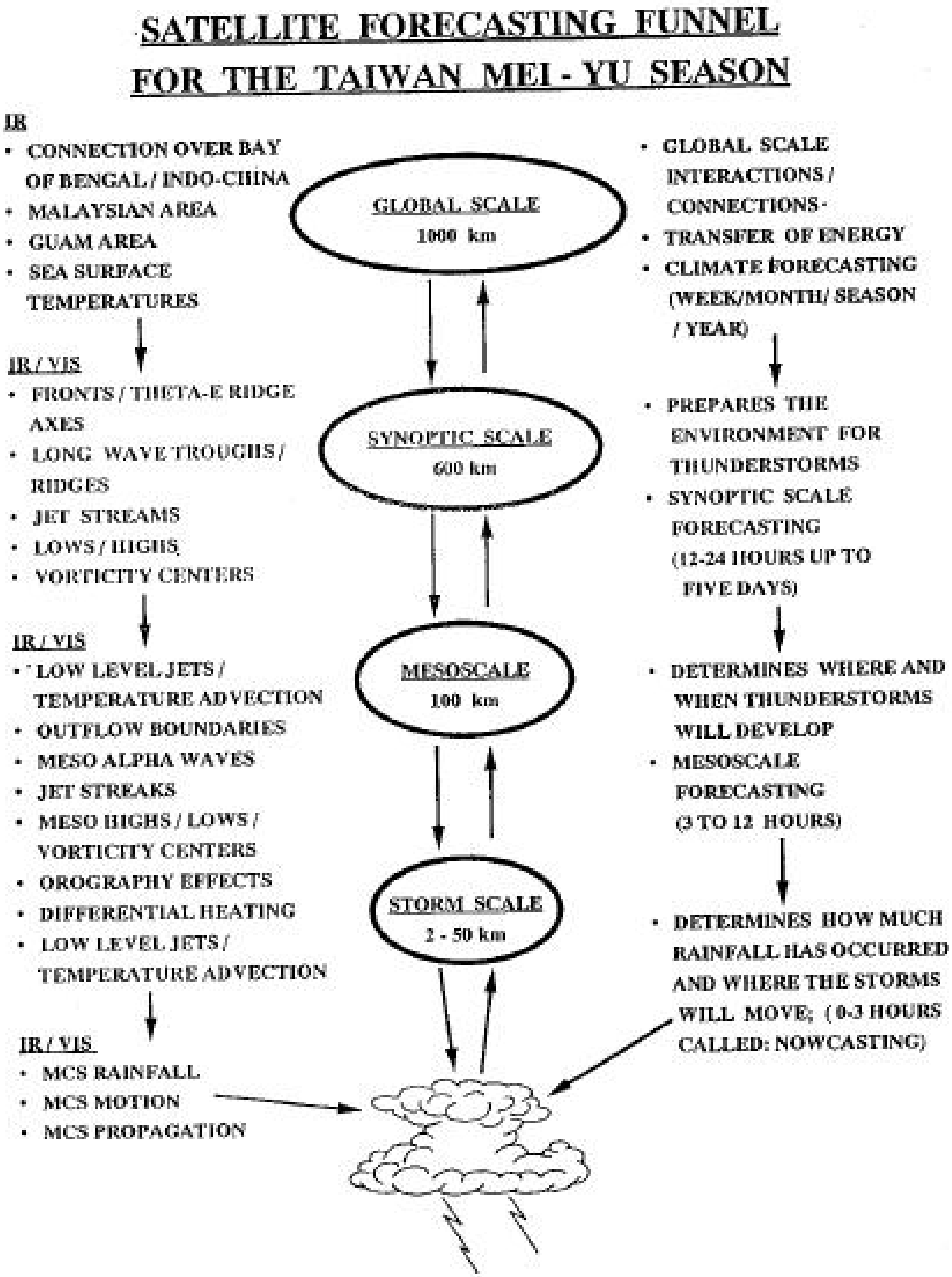


Fig. 2 Satellite forecasting funnel for the Taiwan Mei-Yu season.

SATELLITE / INSTABILITY CHECKLIST FOR THE FORECASTING OF HEAVY RAIN / FLASH FLOODING OVER TAIWAN

CHECK ALL THAT APPLY

YES	NO	
		GLOBAL SCALE
____	____	Is there a tropical connection present ? (Bay of Bengal/Indo-China, Malaysian, Guam)
		SYNOPTIC SCALE
____	____	Is there a frontal zone, theta-e ridge axis present or expected to effect the area ?
____	____	Is the low level flow increasing (presence of low level jet) ?
____	____	Is the 850 mb dewpoint $\geq$ 16 °C ?
____	____	Are Instability Bursts or Destabilization processes present or expected over the area ?
____	____	Are mid to upper level jets streaks / disturbances present or expected to effect the area ?
		MESOSCALE
____	____	Are local island and orographic efforts present or expected to produce or enhance the convection ?
____	____	Are outflow boundaries present ?
____	____	Are mesoscale vortices / waves or lows present ?
____	____	Are mesoalpha waves present ?
____	____	Will convection modify the environmental flow and temperature fields ?

- -

IS TODAY GOING TO BE A WEAK OR STRONG DAY ?

WEAK   STRONG

ARE FLASH FLOODS EXPECTED ?

YES   NO

LOCALIZED   WIDESPREAD

WHERE ?

Fig. 3 Satellite/insatbility checklist for the forecasting of heavy rain/flash flooding over Taiwan during the Mei-Yu season.

SCALES OF PRECIPITATION

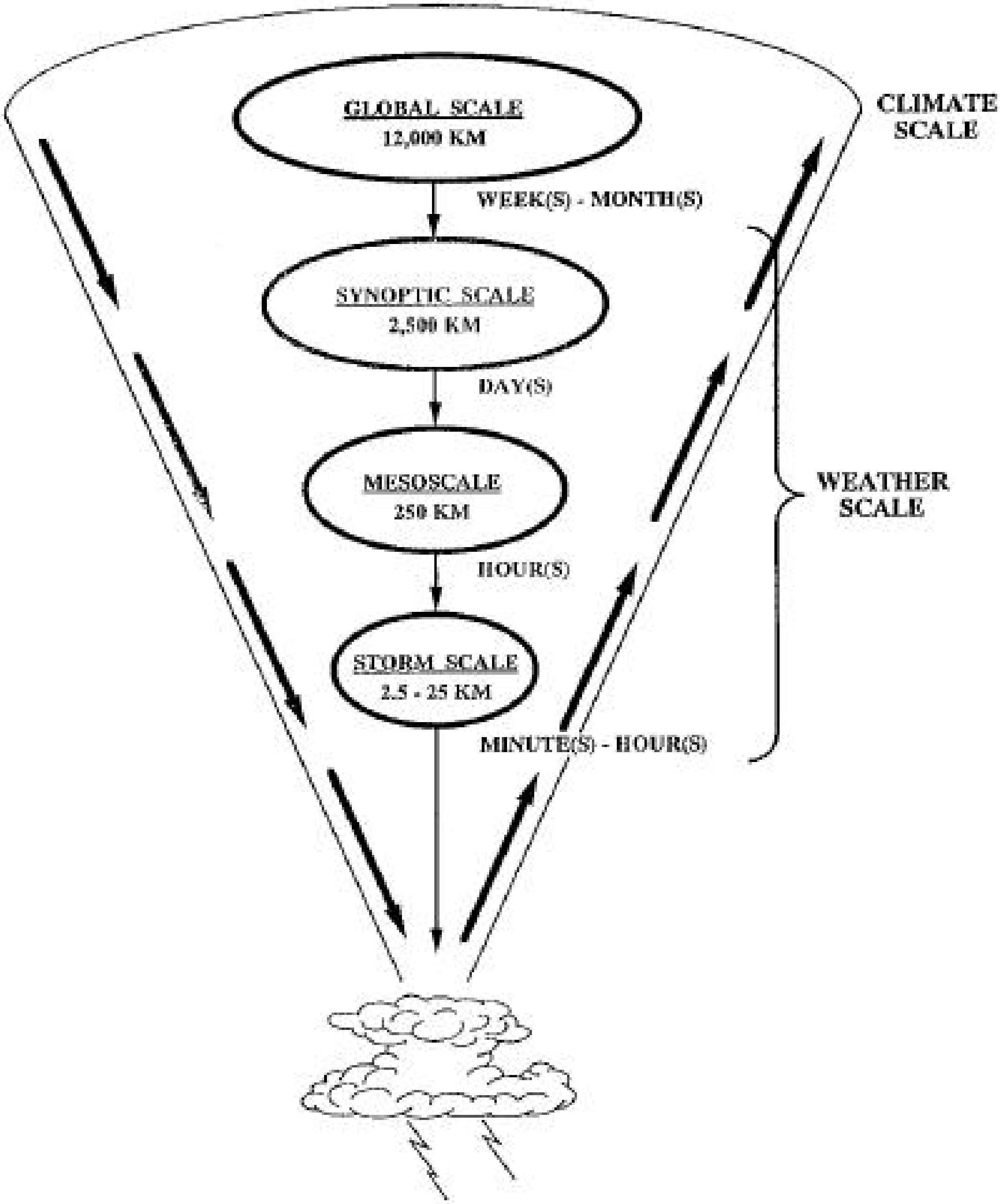


Fig. 4 The schematic diagram of scales of precipitation and feed back process.

VERTICAL STRUCTURE OF A MATURE MCC

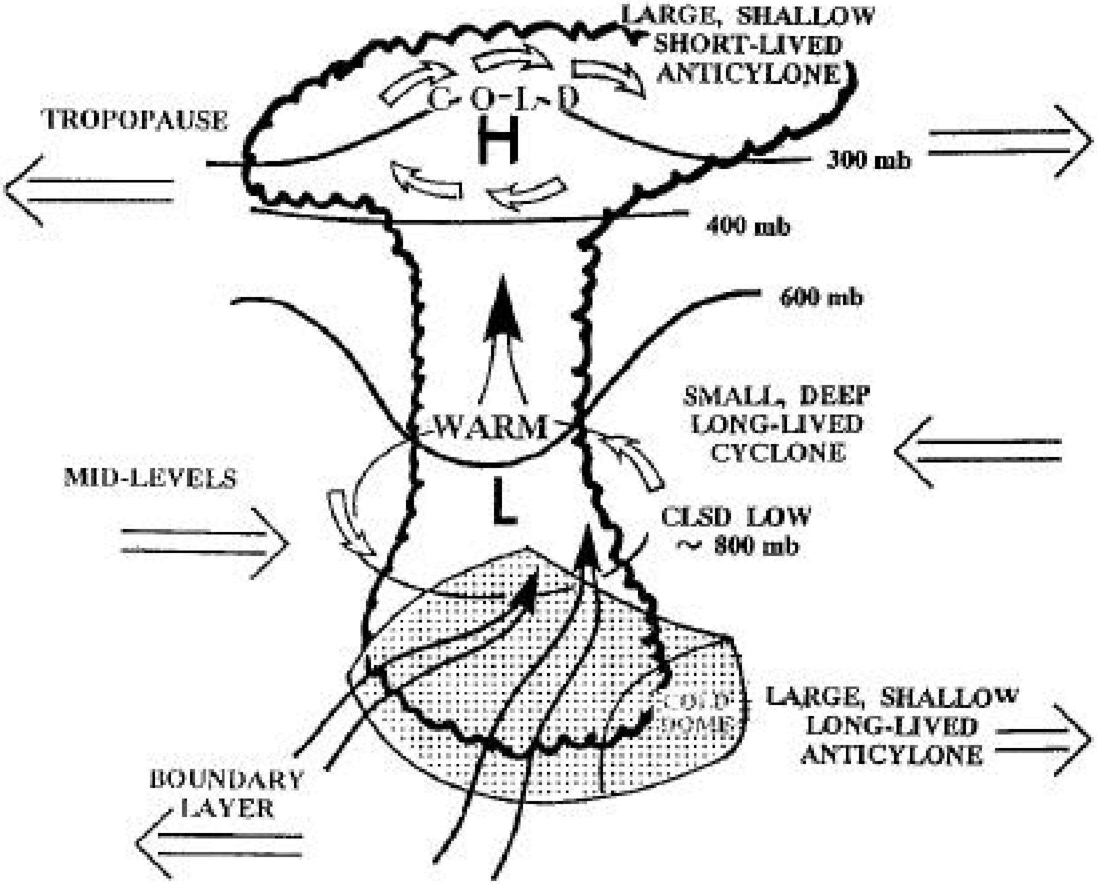


Fig. 5 The schematic diagram of vertical structure of a mature MCC.

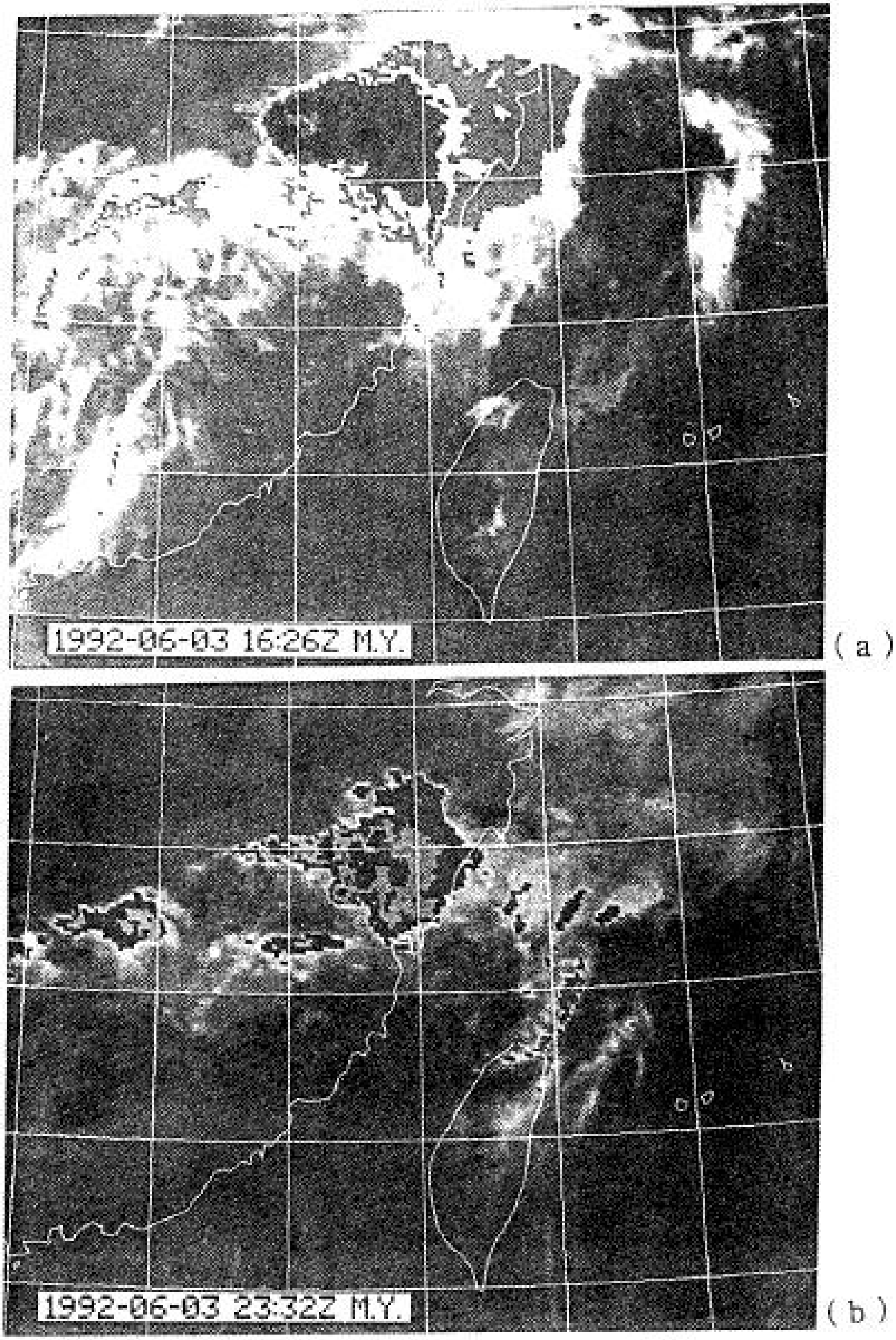


Fig. 6 Enhanced IR imagery at (a) 1626 UTC, and (b) 2333 UTC, Jun3 3, 1992.

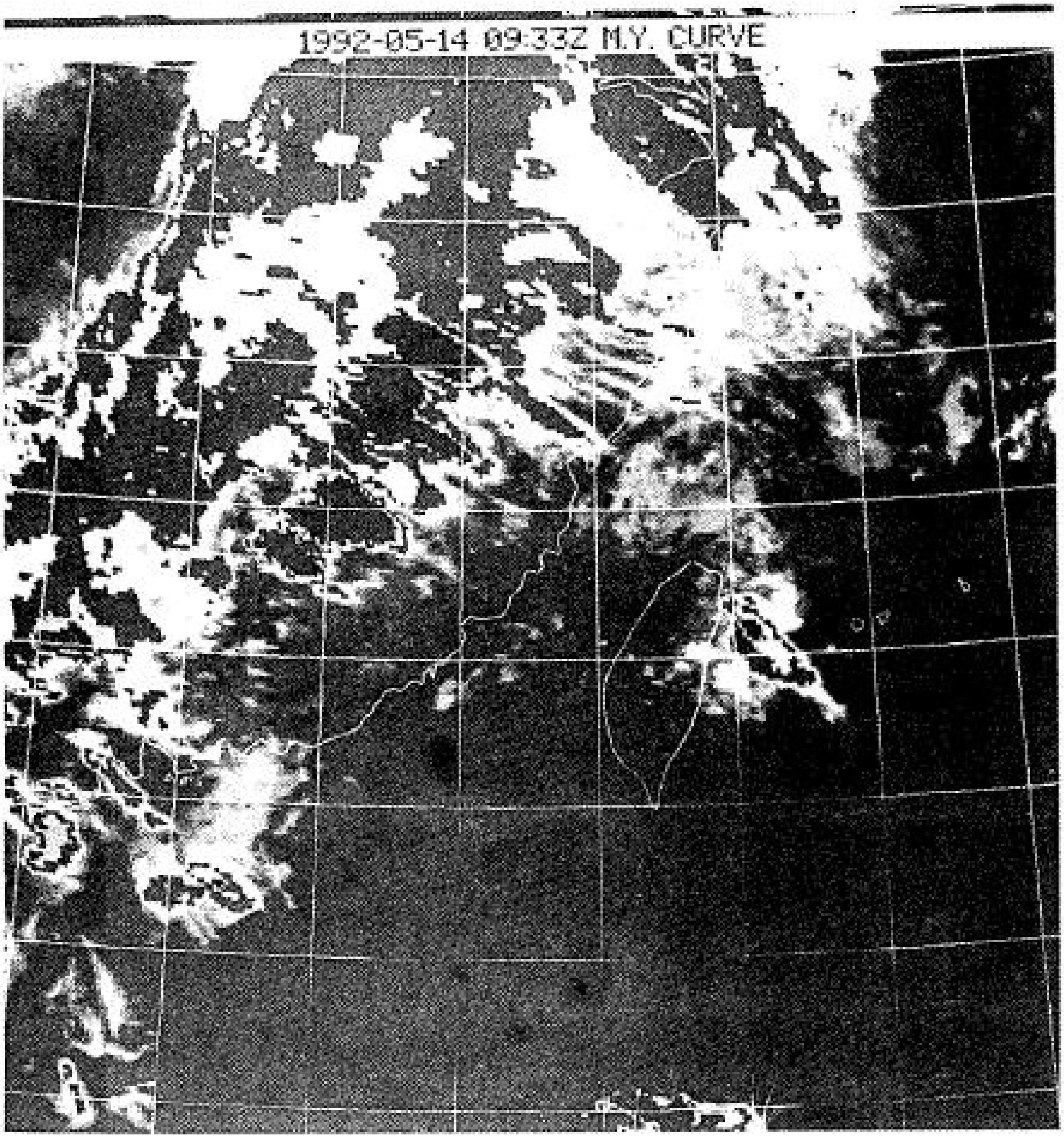
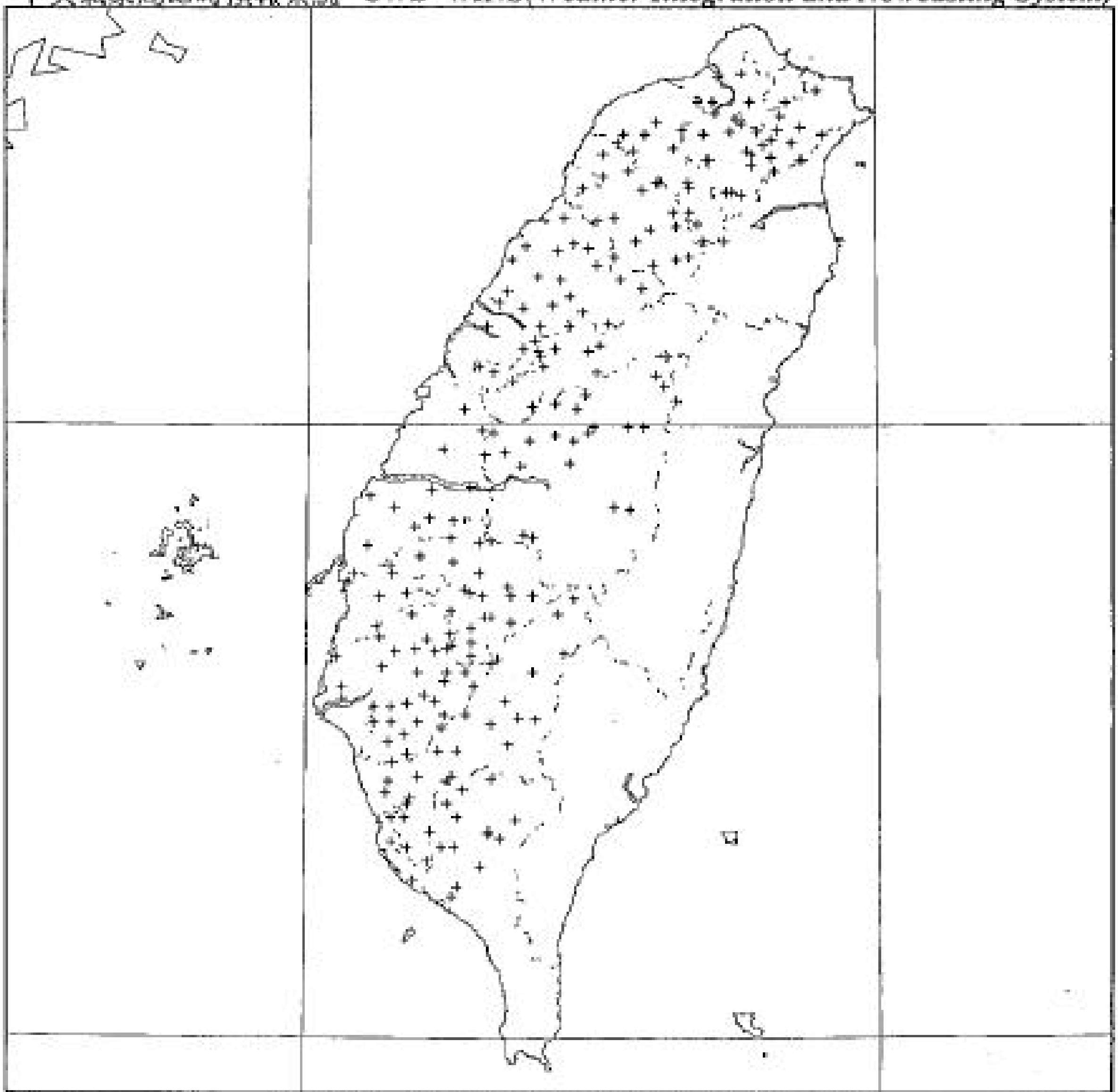


Fig. 7 Same as Fig. 6, but for 0933 UTC, May 14, 1992.

中央氣象局即時預報系統 *CWB WINS(Weather Integration and Nowcasting System)*



CWB RAINGAUGE NETWORK

Fig. 8 CWB raingauge network.

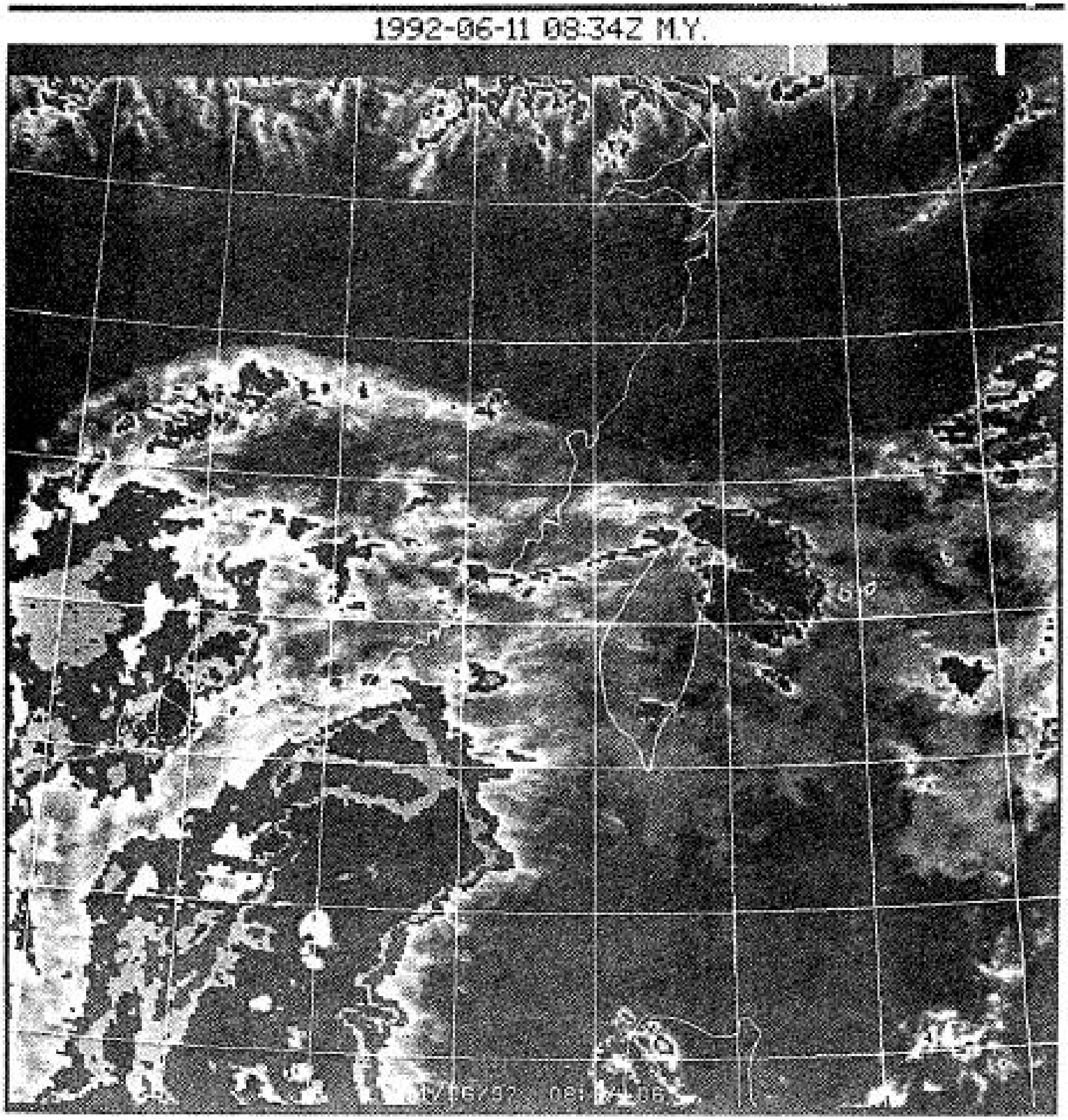


Fig. 9 Same as Fig. 6, but for 0834 UTC, June 11, 1992.

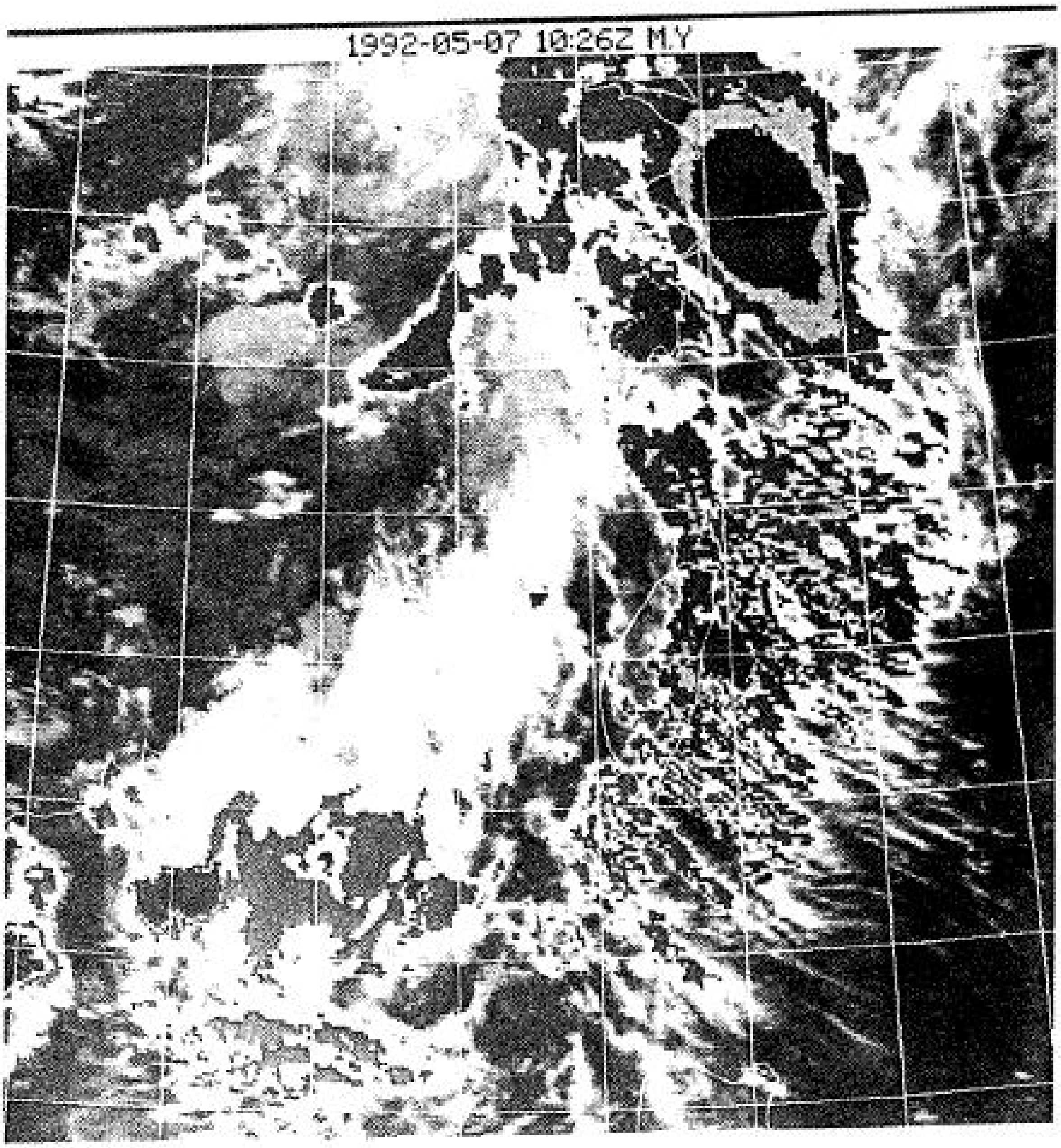


Fig. 10 Same as Fig. 6, but for 1026 UTC, May 7, 1992.

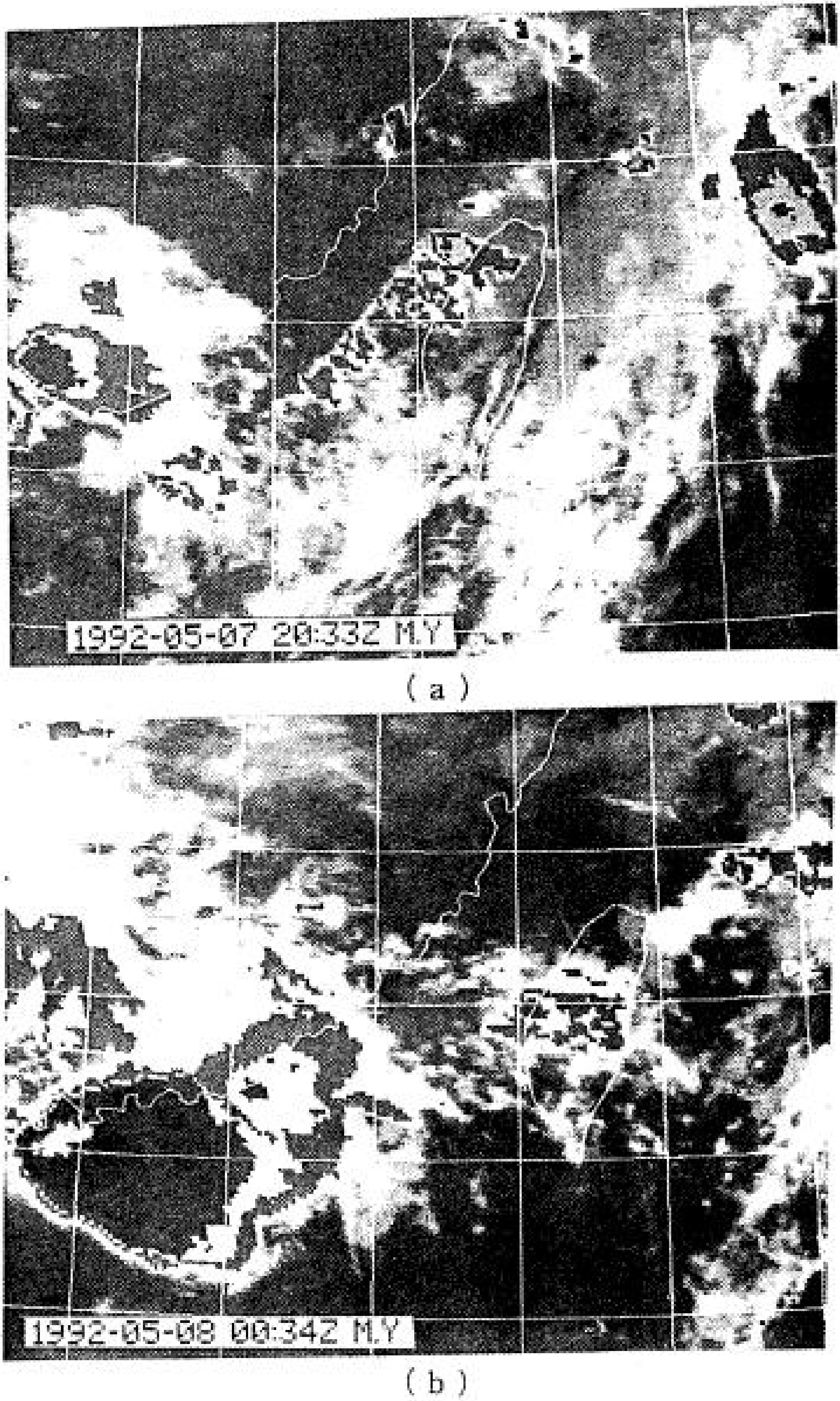


Fig. 11 Same as Fig. 6, but for (a) 2032 UTC, May 7, and (b) 0034 UTC, May 8, 1992.

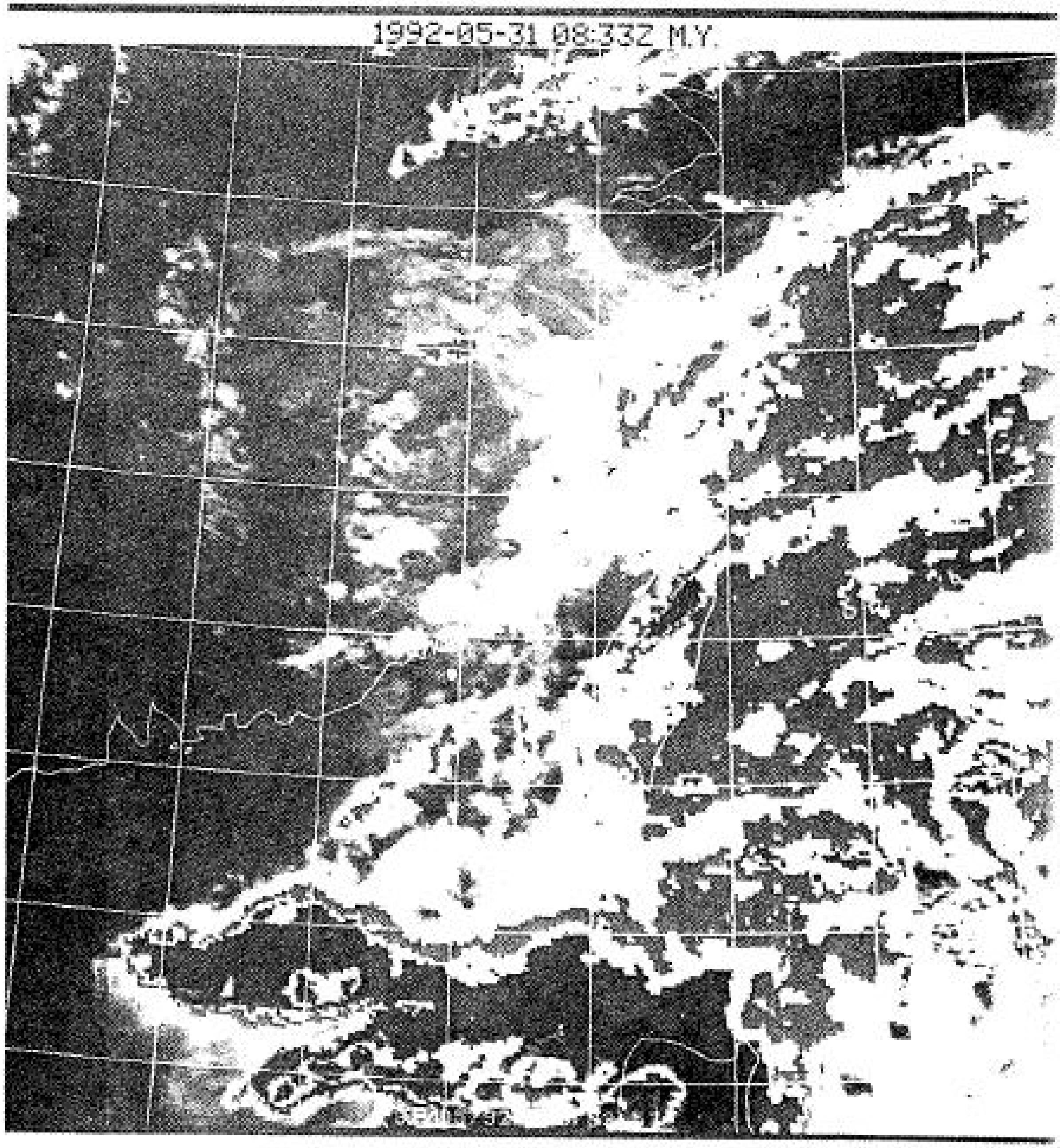
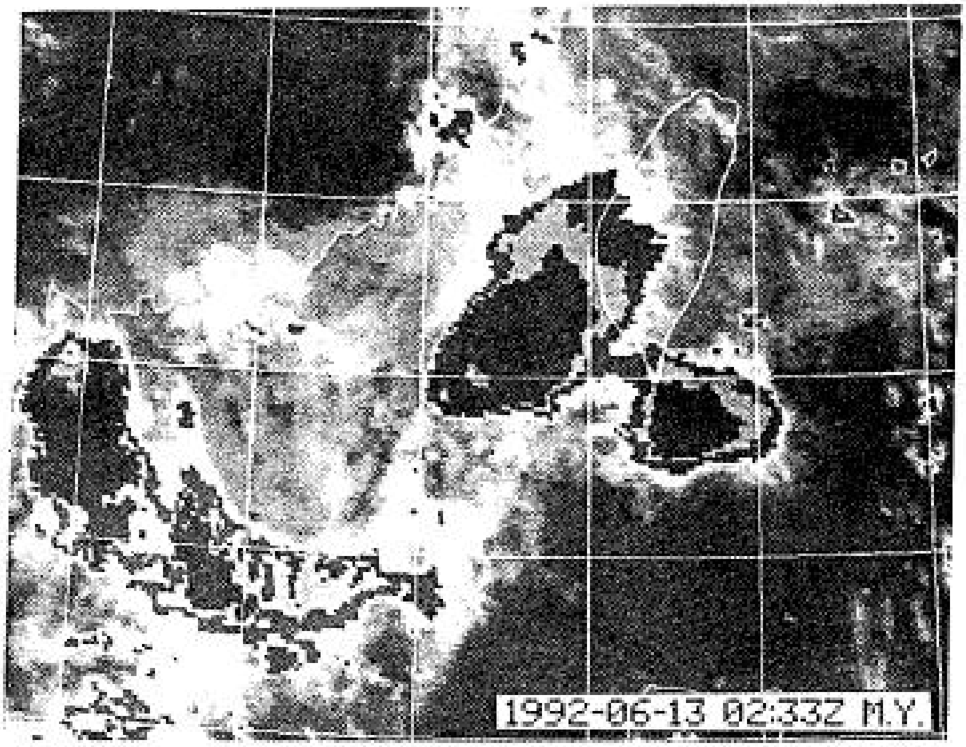
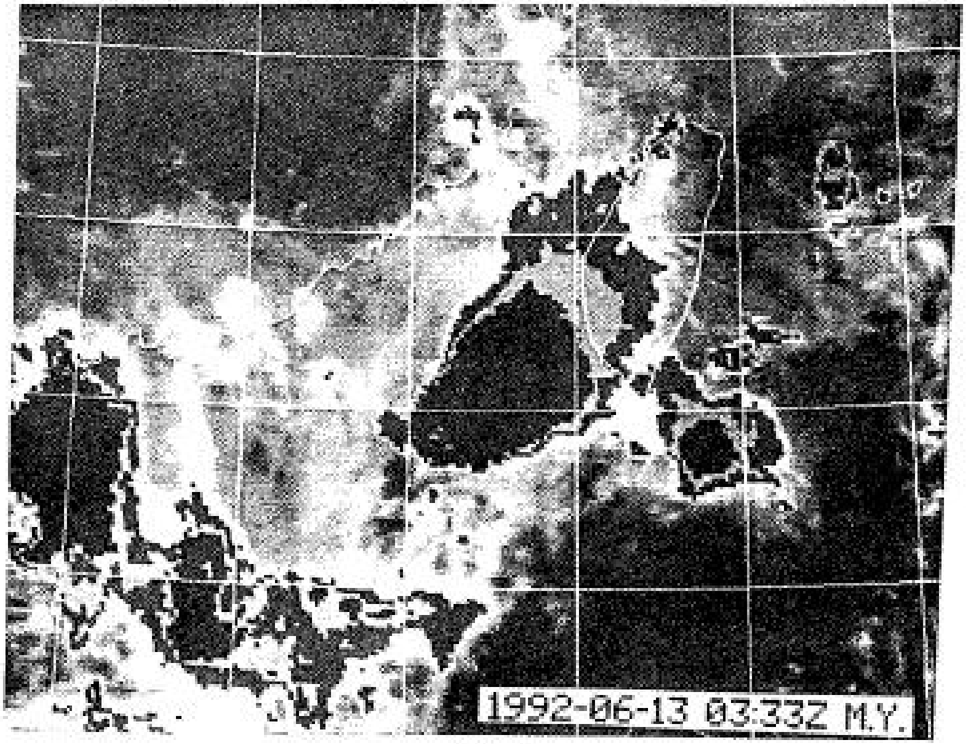


Fig. 12 Same as Fig. 6, but for 0833 UTC, May 31, 1992.

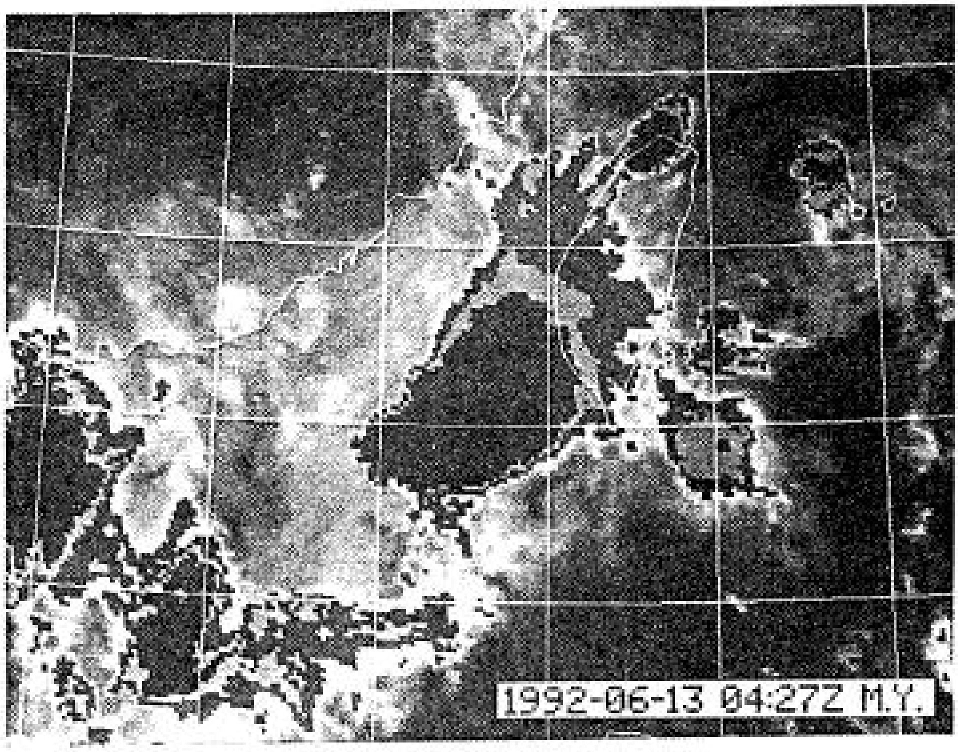


(a)

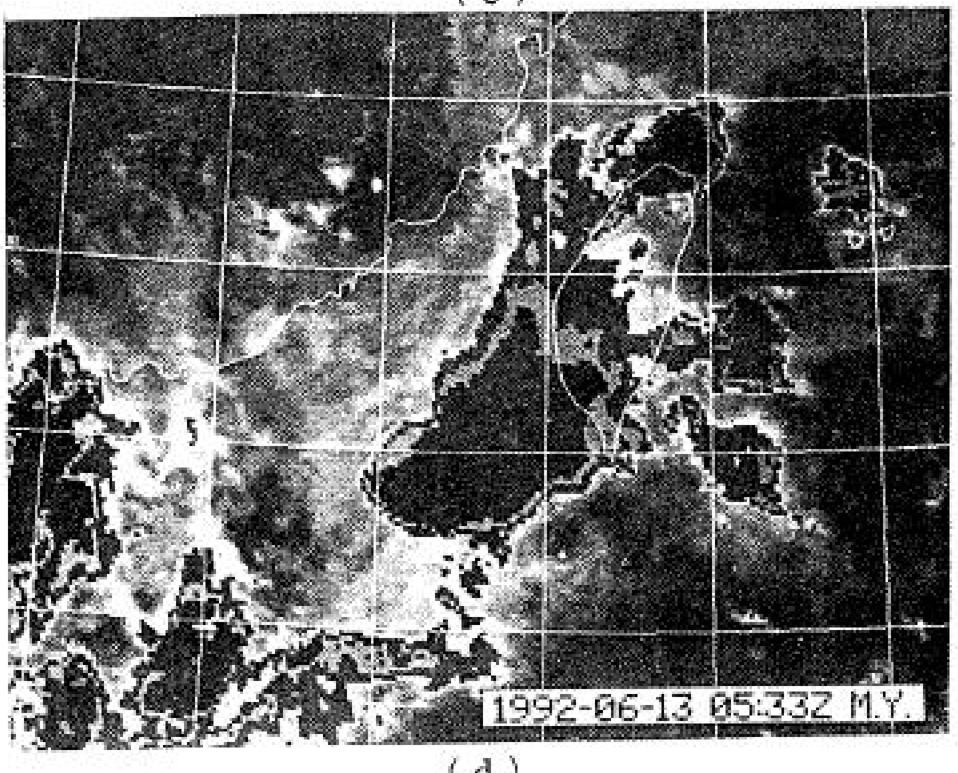


(b)

Fig. 13 Same as Fig. 6, but for (a) 0233 UTC, (b) 0333 UTC, (c) 0427 UTC, and (d) 0533 UTC, June 13, 1992.

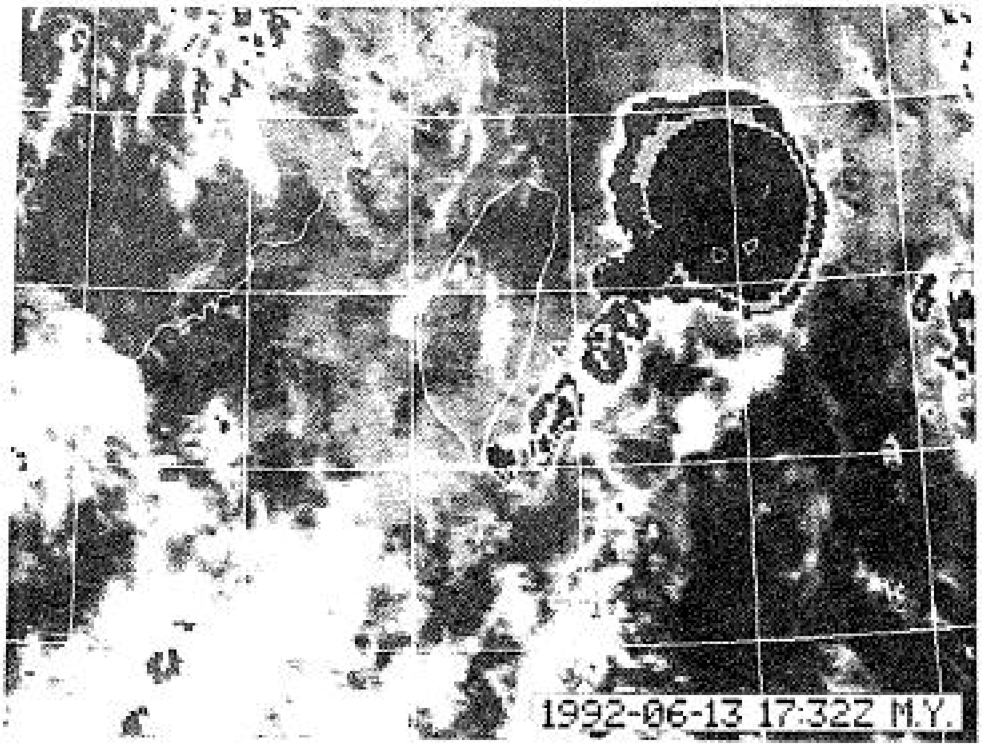


(c)

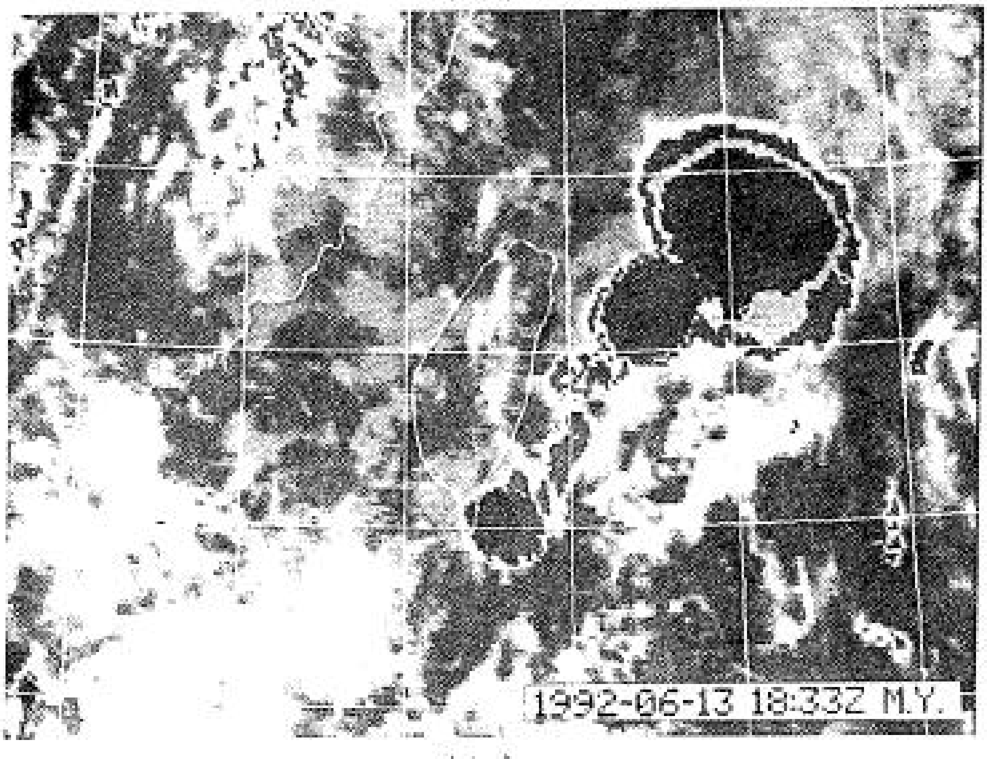


(d)

Fig. 13 (Continued).



(a)



(b)

Fig. 14 Same as Fig. 6, but for (a) 1732 UTC, and (b) 1834 UTC, June 13, 1992.

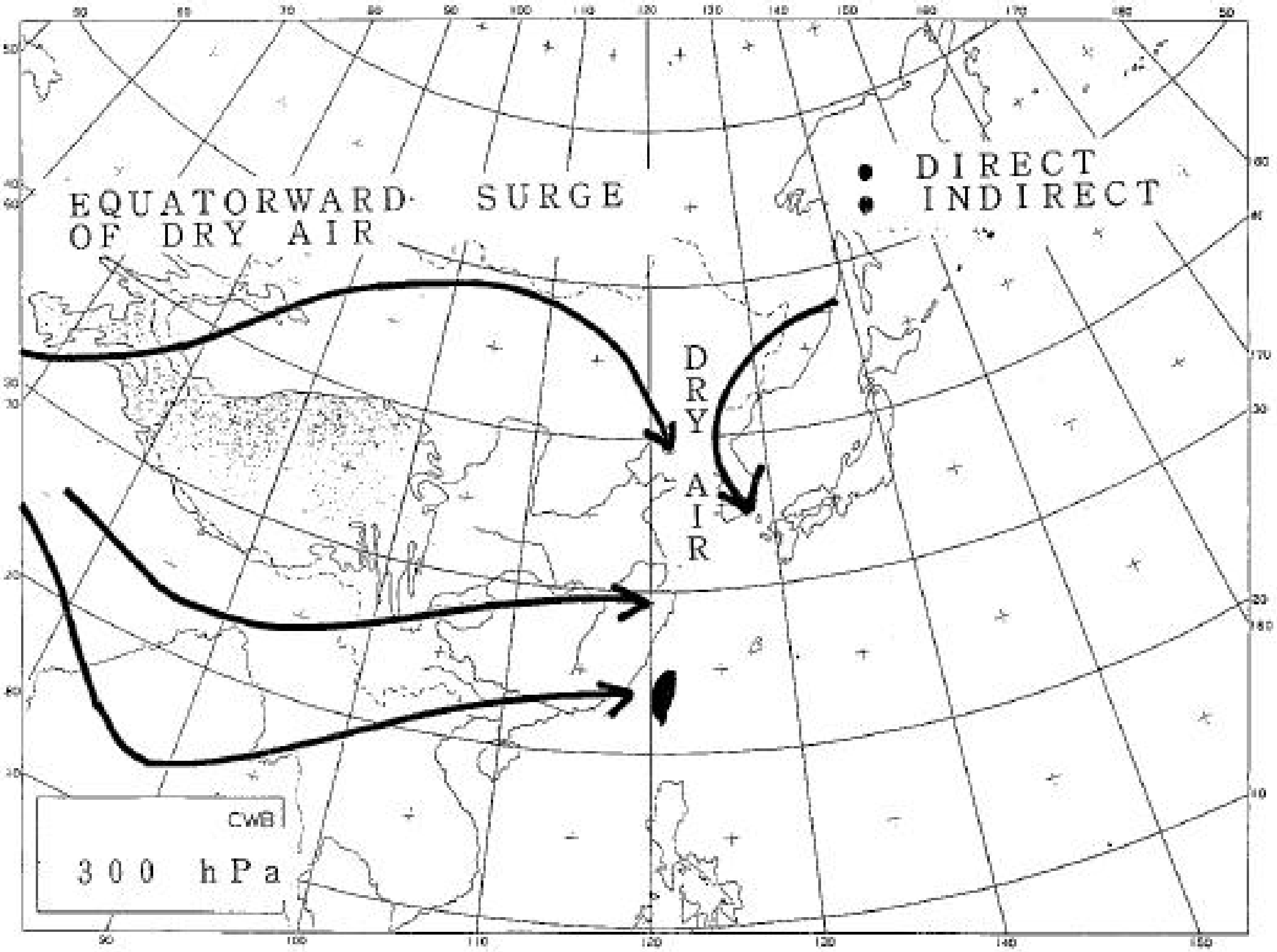


Fig. 15 The schematic digram of equatorward surge of dry air at 300 hPa.

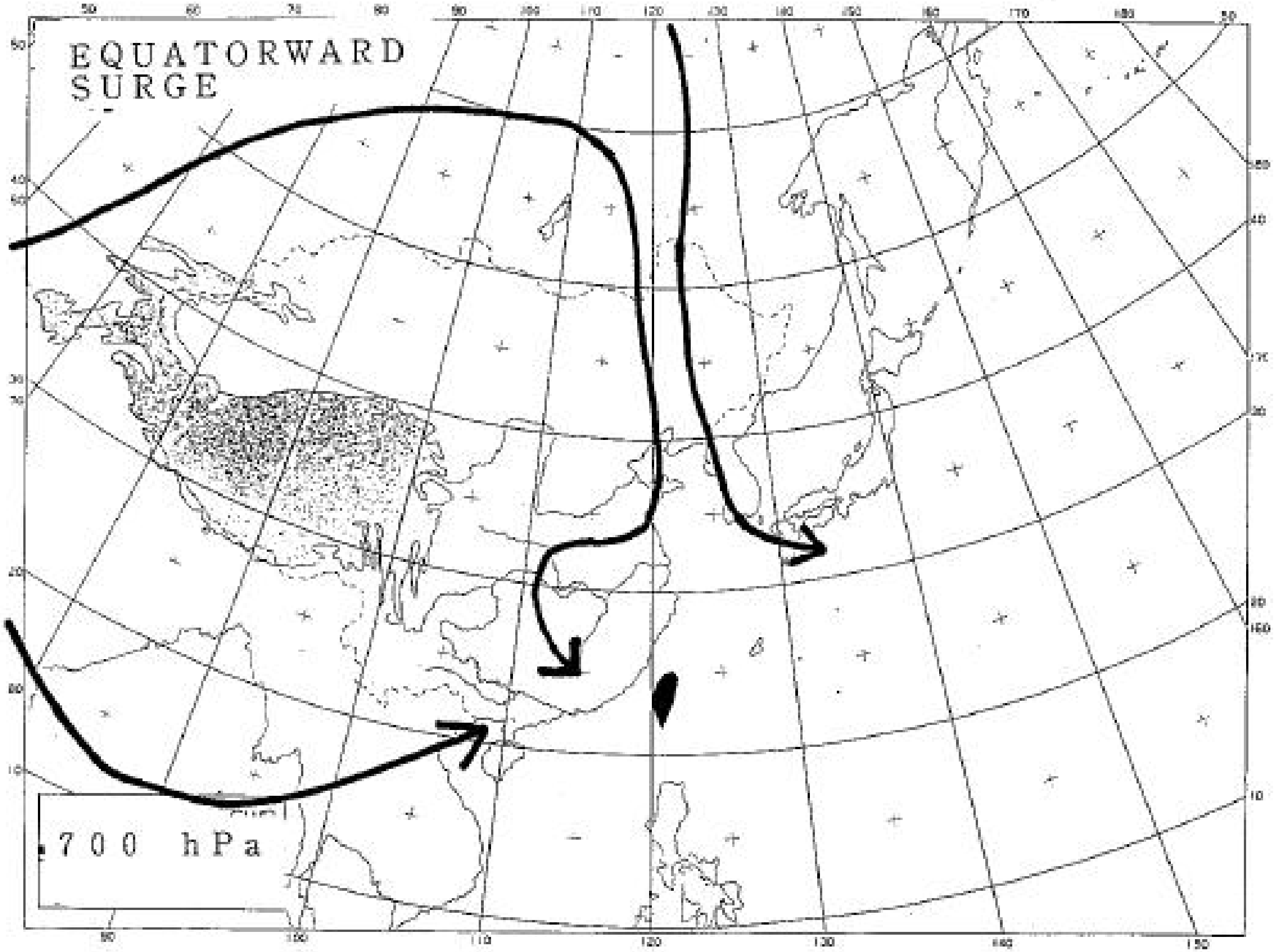
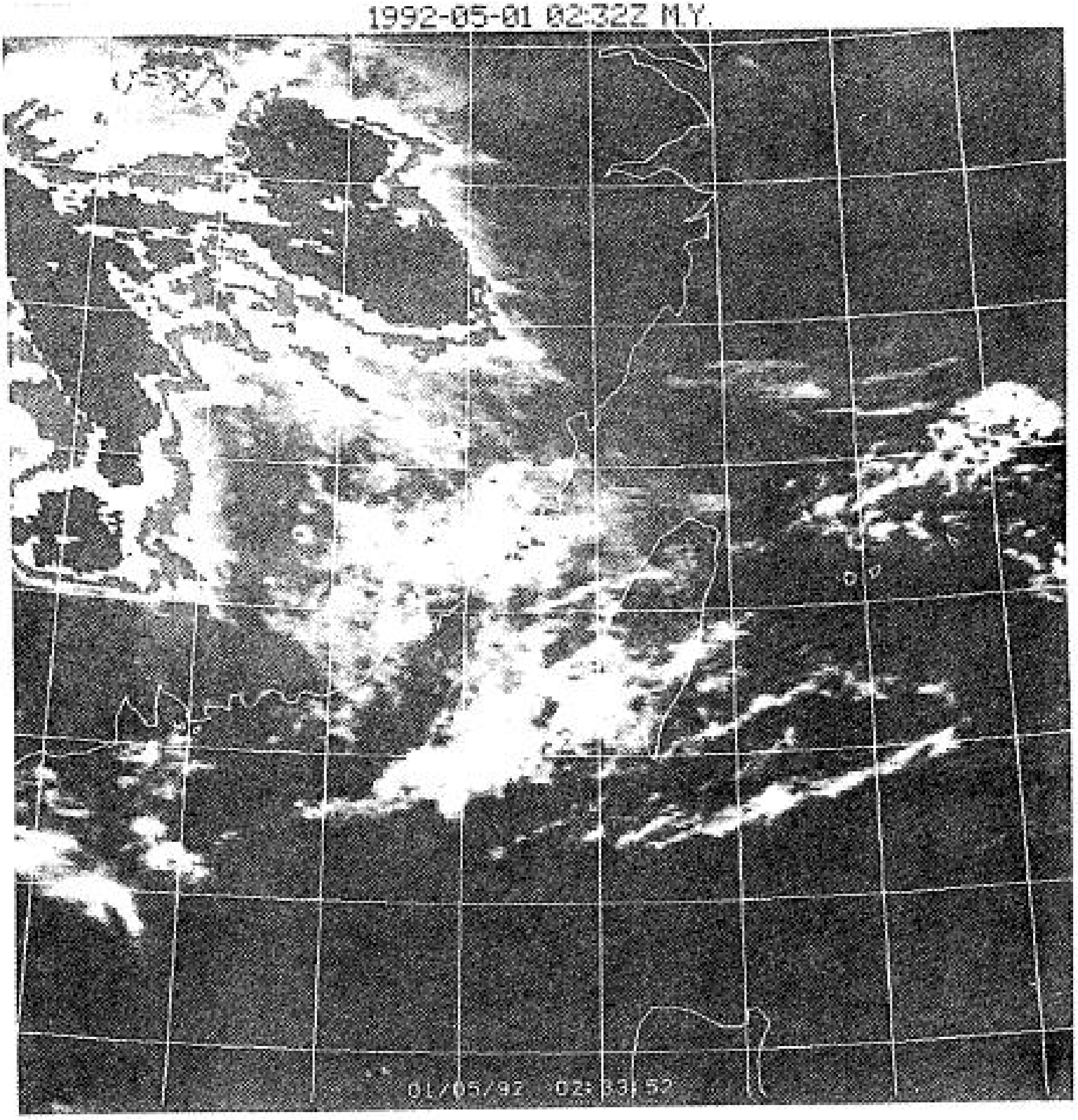
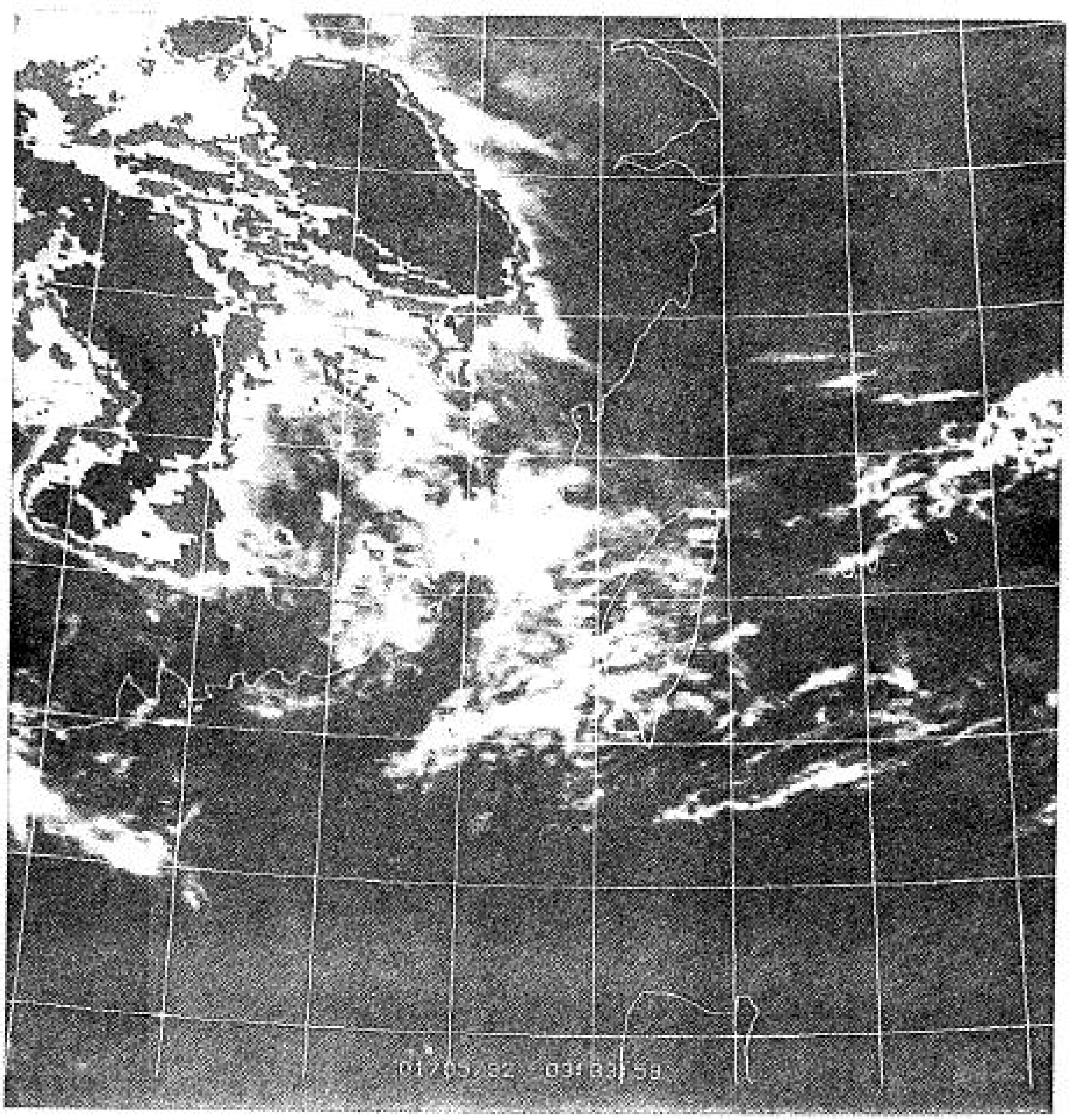


Fig. 16 Same as Fig. 15, but for 700 hPa.



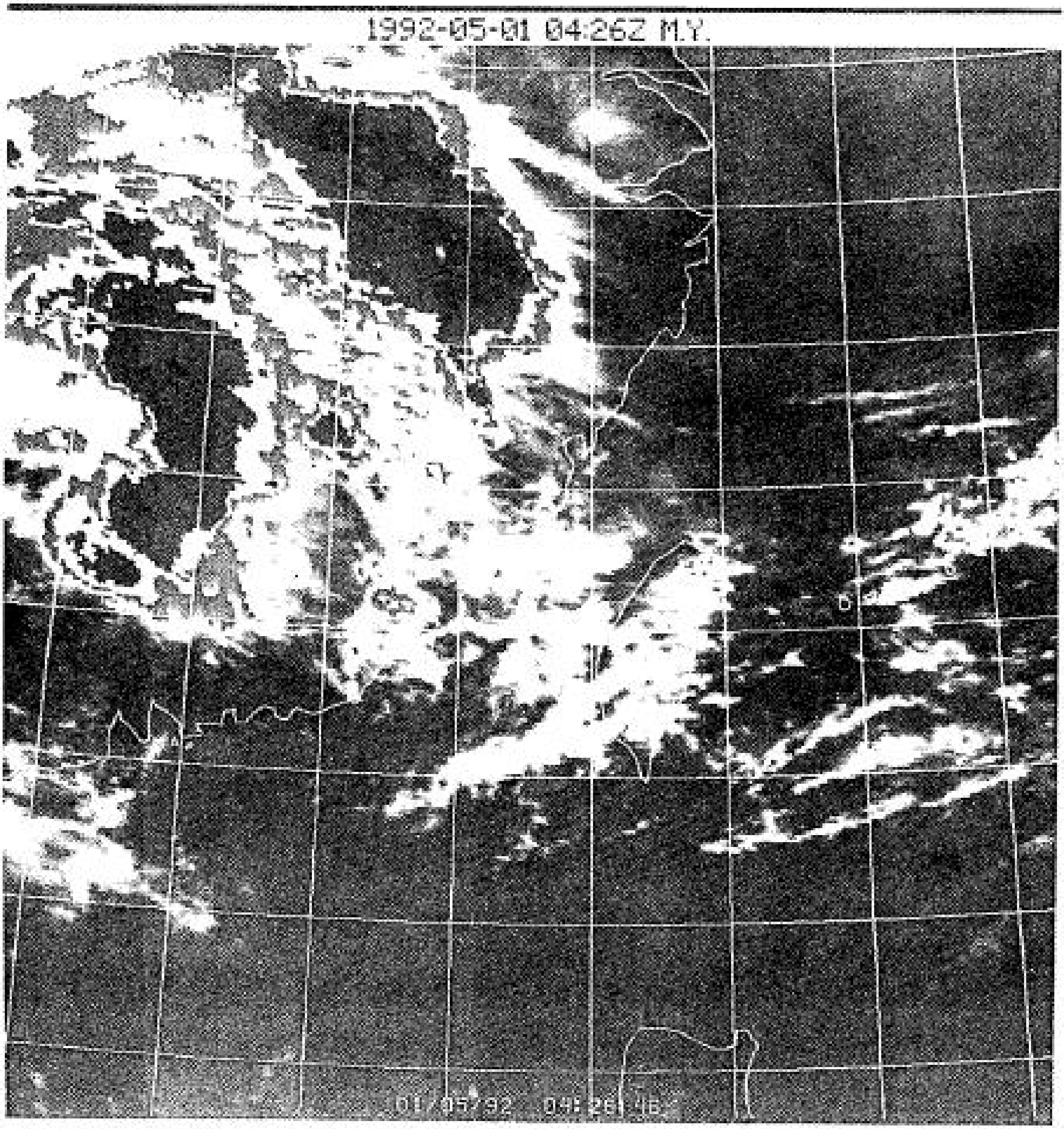
(a)

Fig. 17 Same as Fig. 6, but for (a) 0232 UTC, (b) 0333 UTC, (c) 0426 UTC, (d)0532 UTC, and (e) 0632 UTC, May 1, 1992.



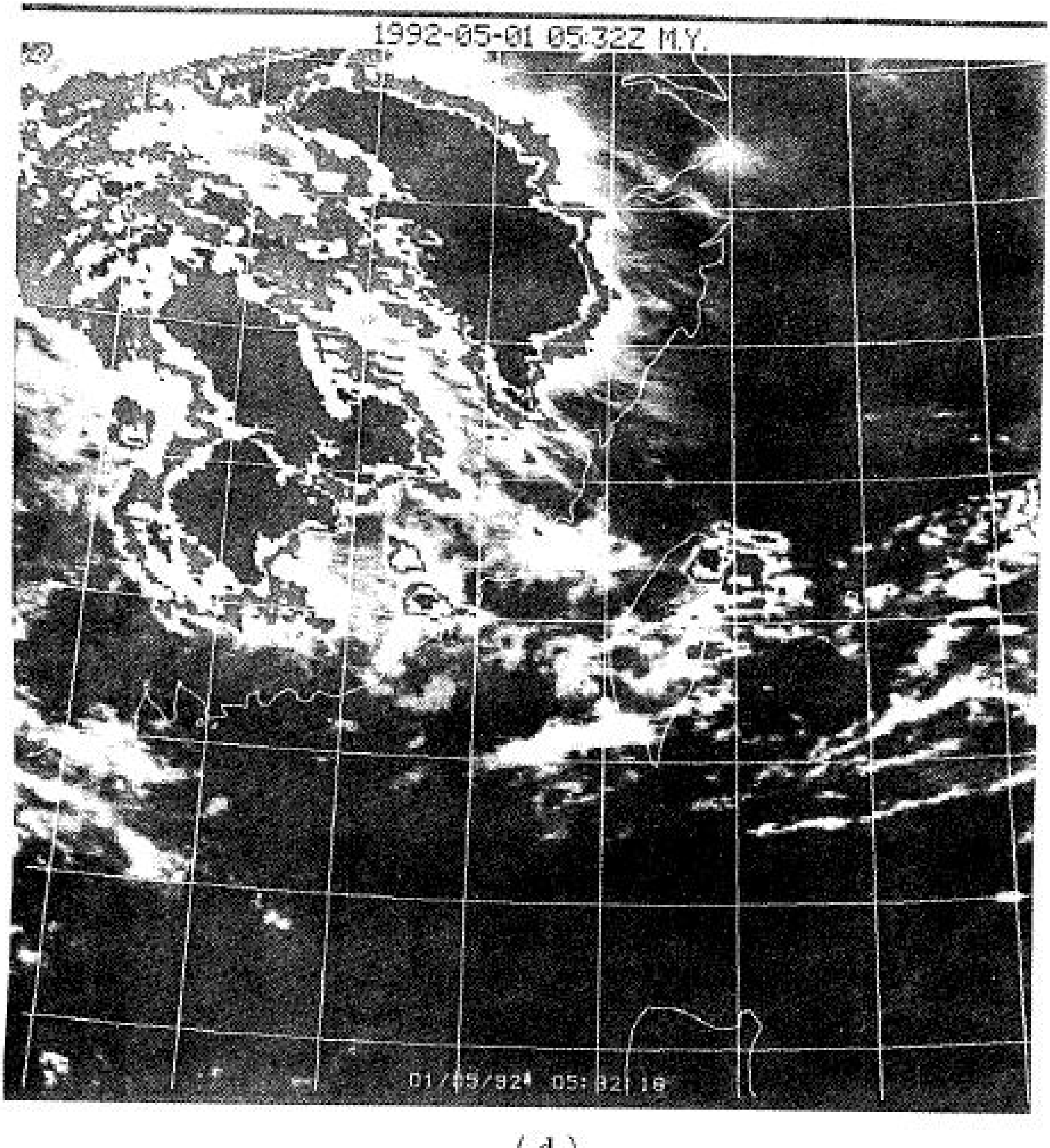
(b)

Fig. 17 (Continued).



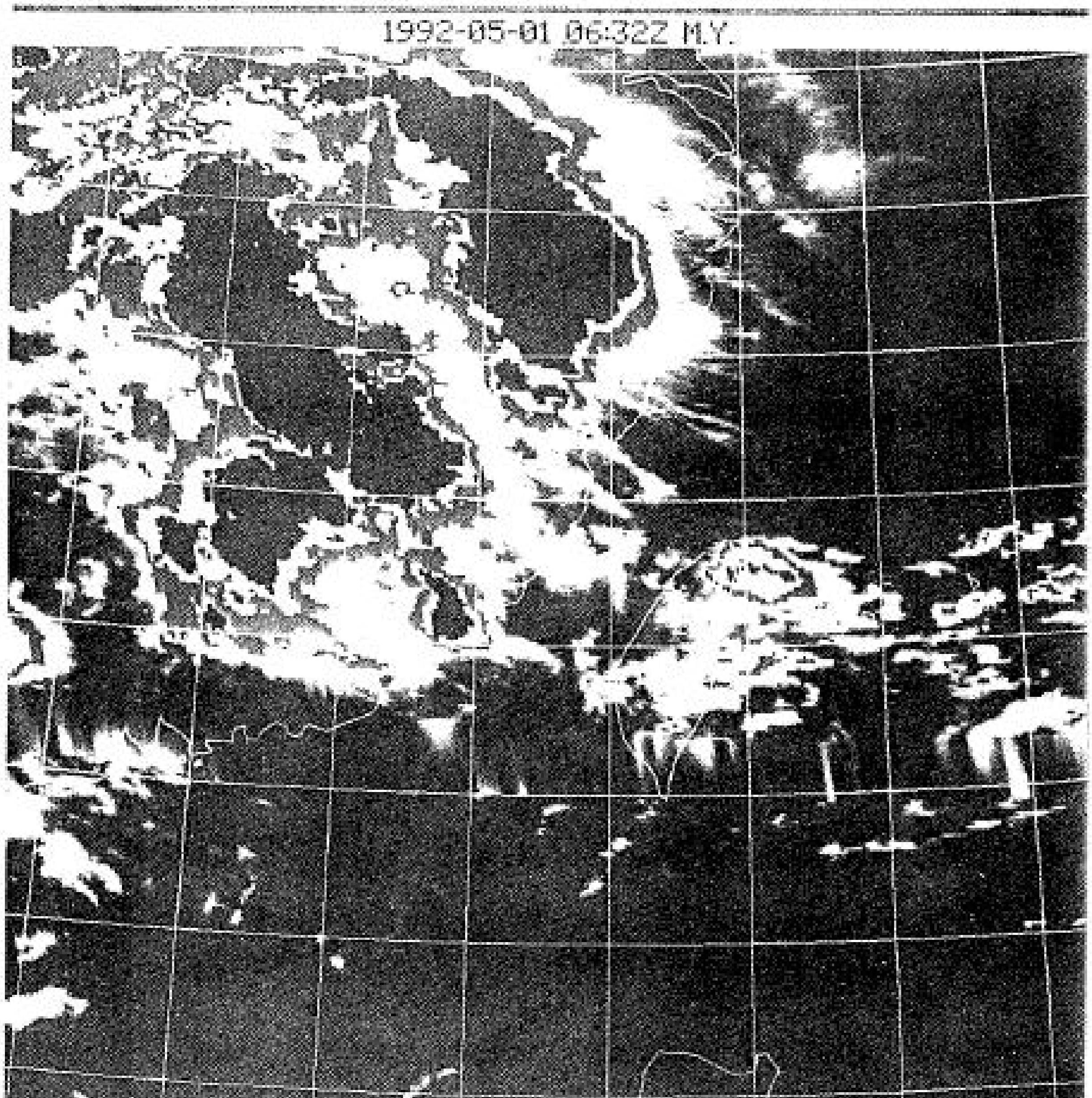
(c)

Fig. 17 (Continued).



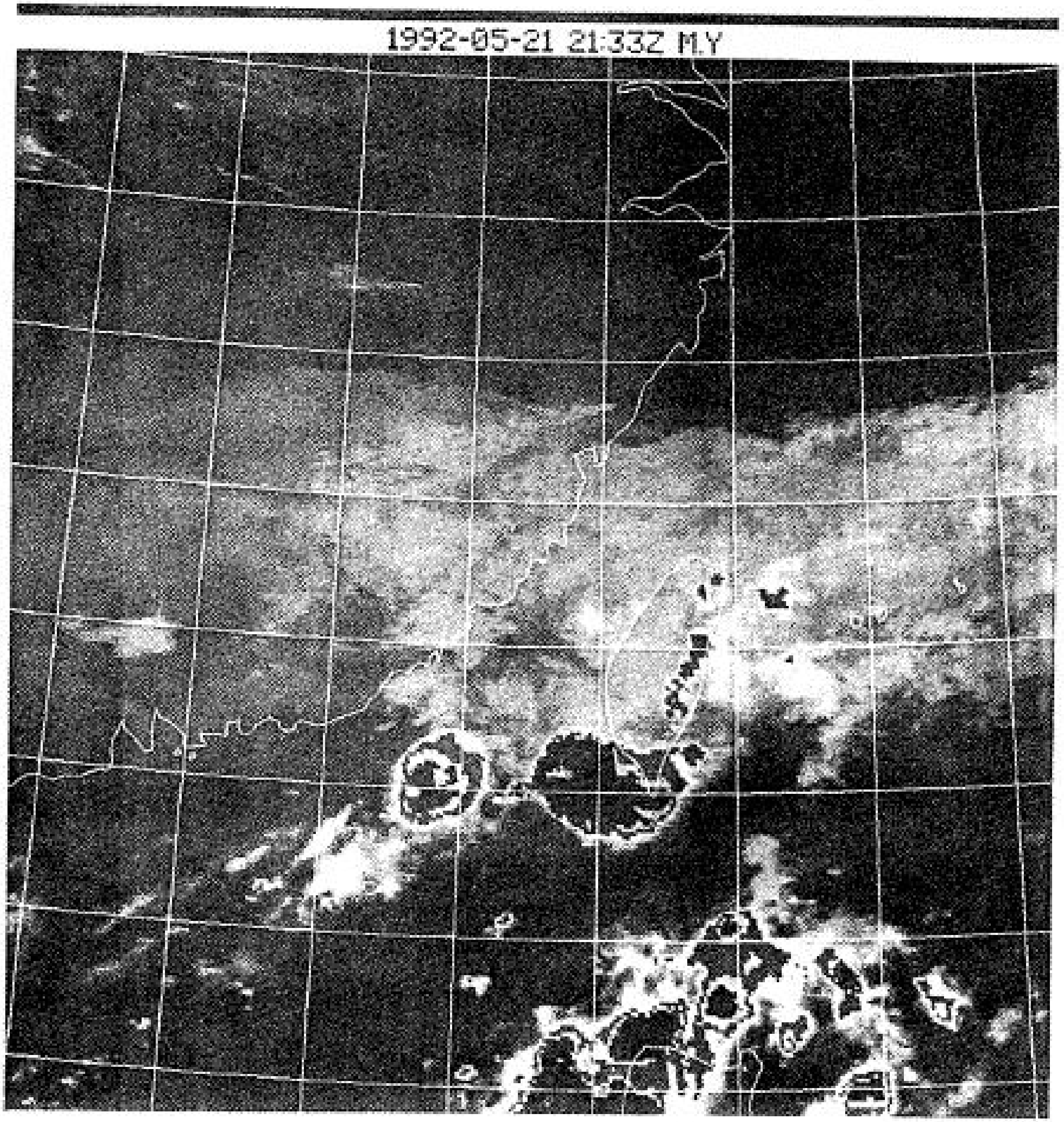
(d)

Fig. 17 (Continued).



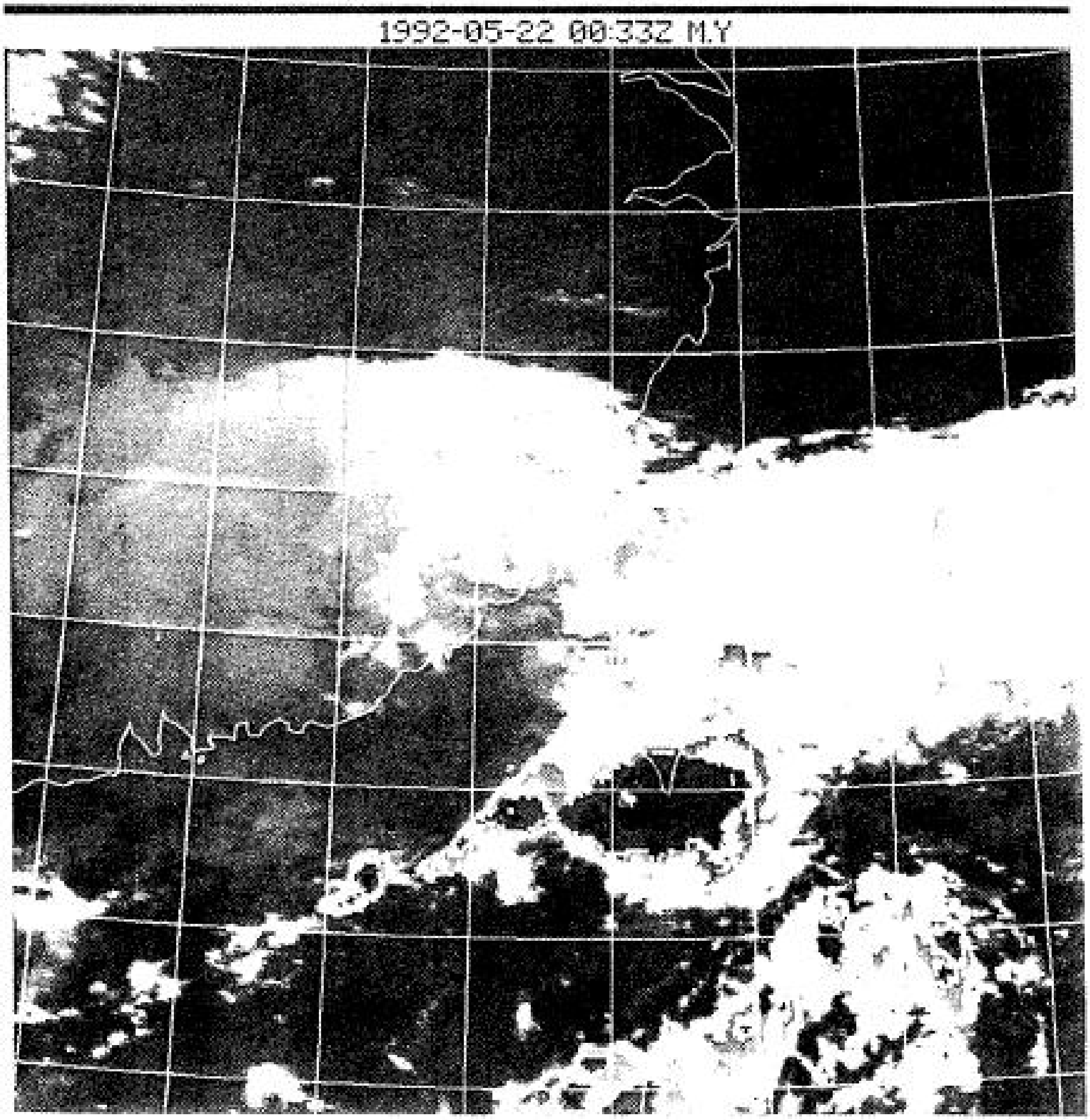
(e)

Fig. 17 (Continued).



(a)

Fig. 18 Same as Fig. 6, but for (a) 2133 UTC, May 21, and (b) 0333 UTC, May 22, 1992.



(b)

Fig. 18 (Continued).

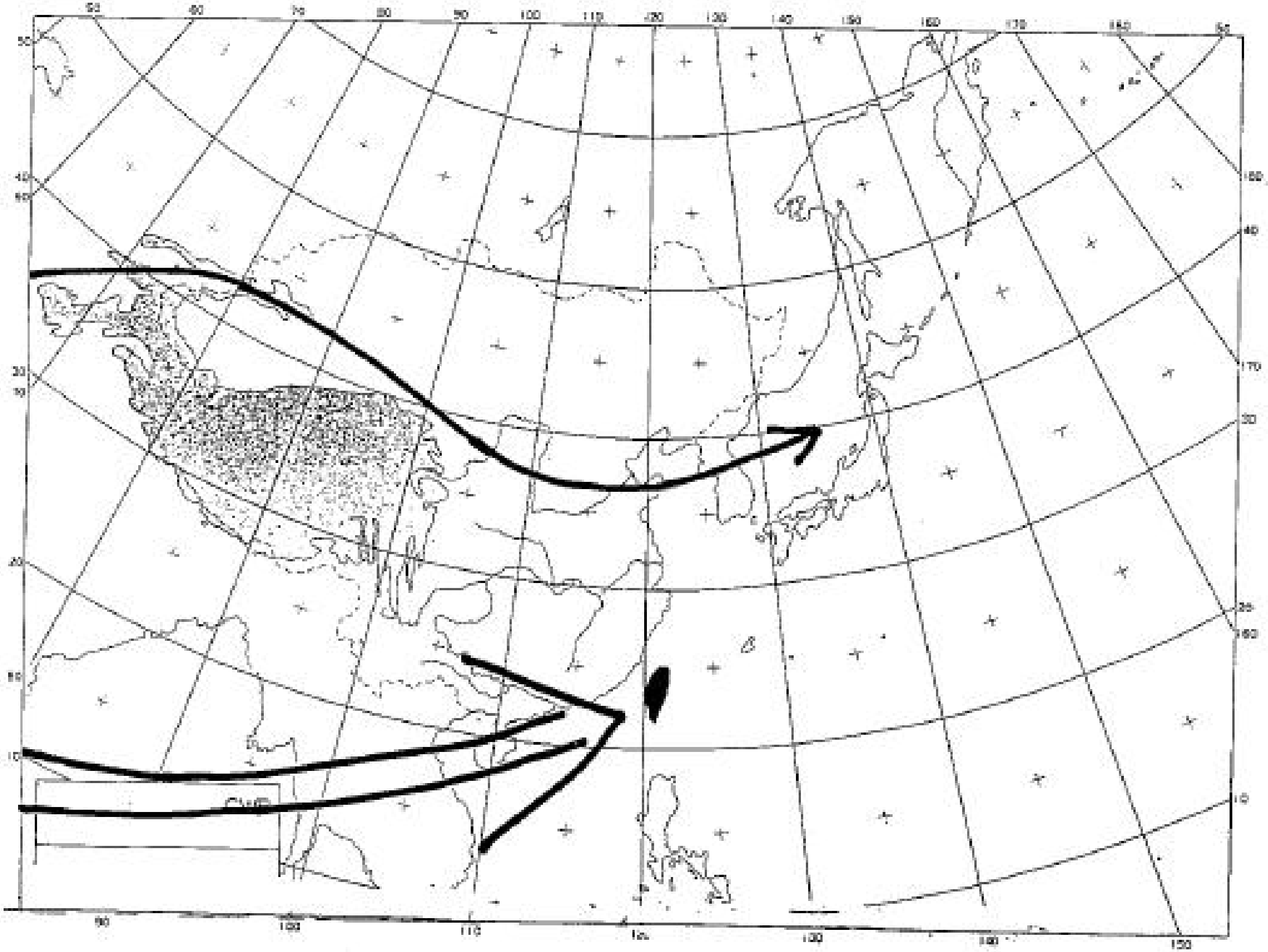
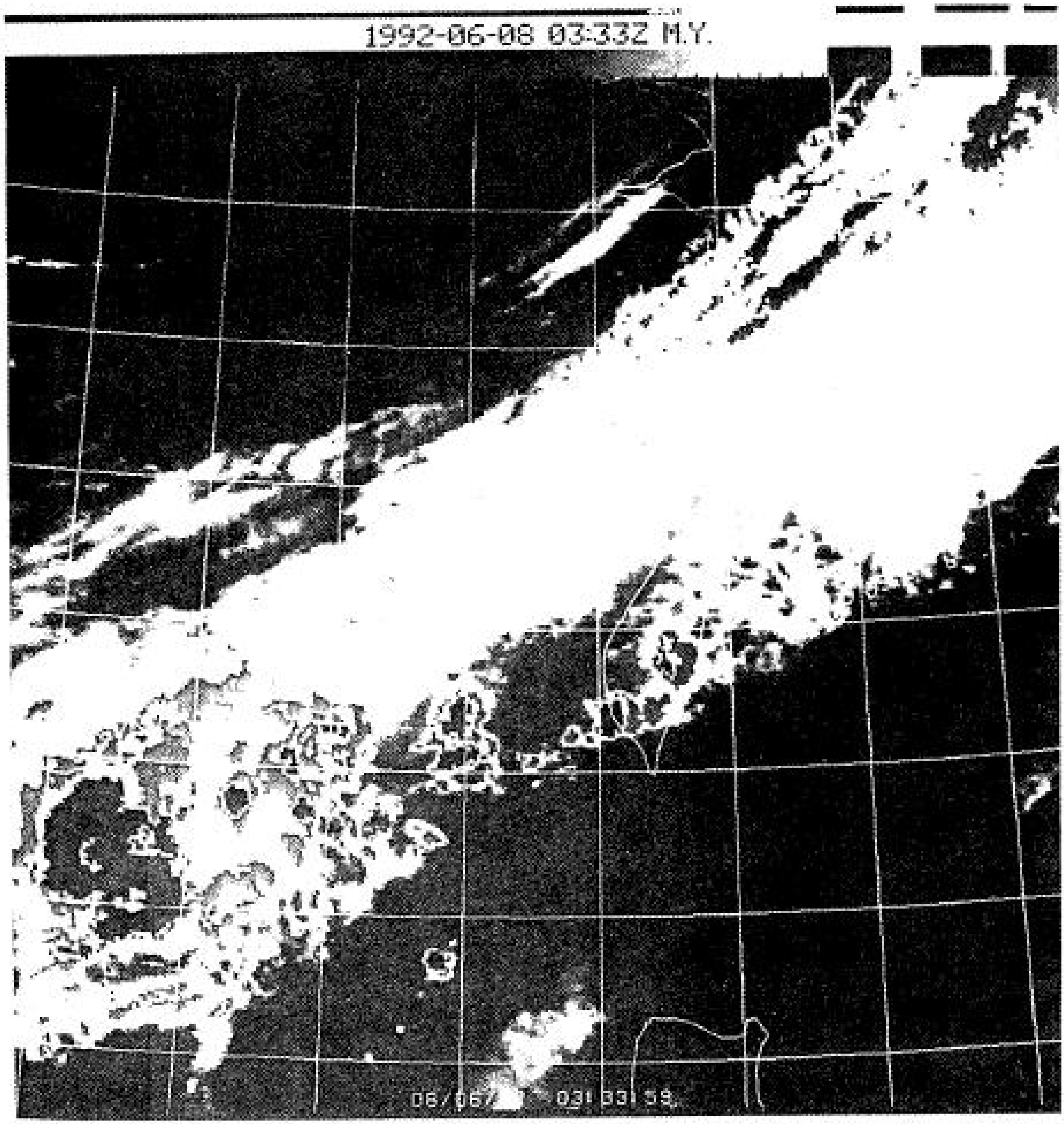
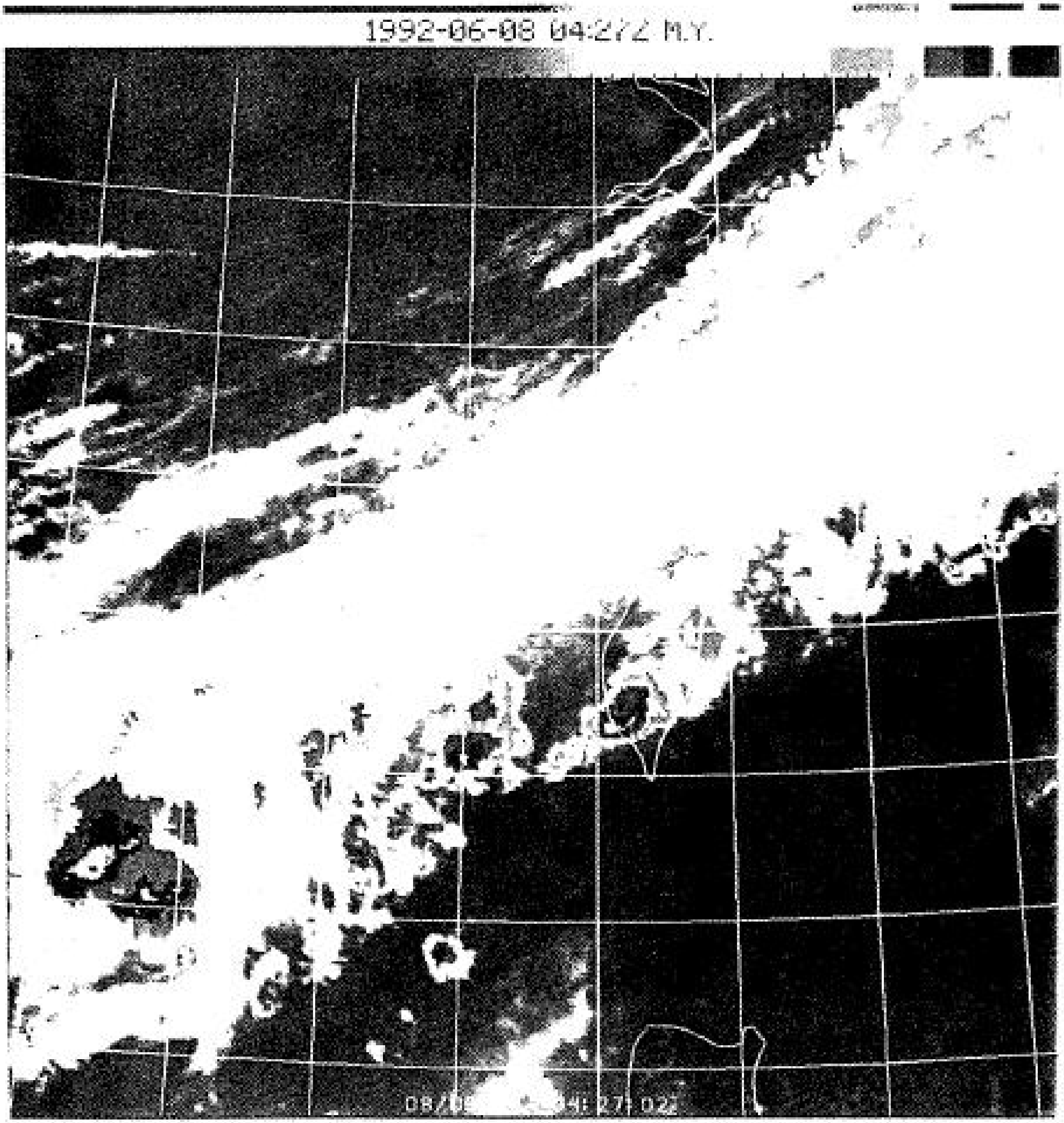


Fig. 19 The schematic diagram of tropical synoptic scale surge of moist air.



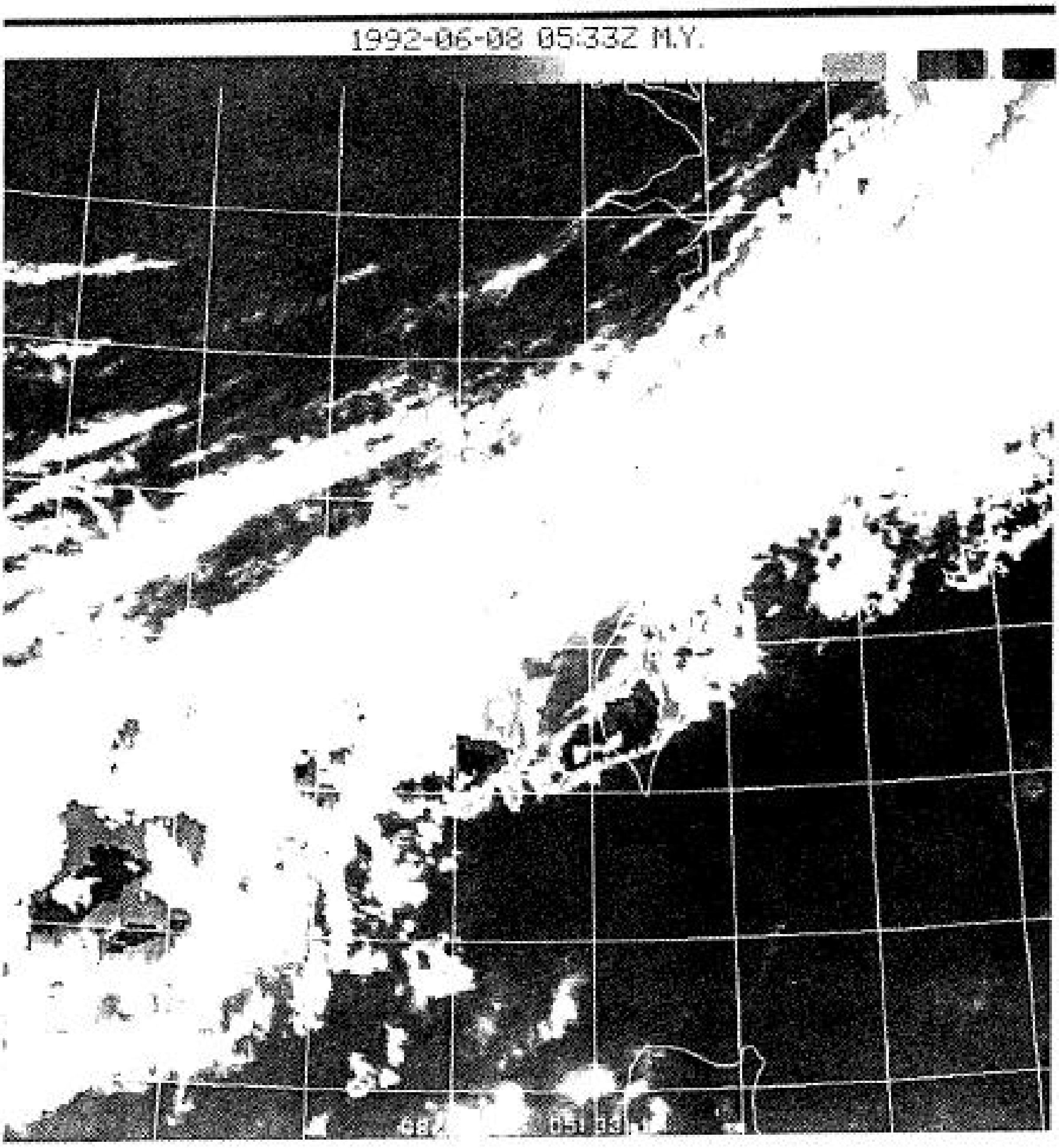
(a)

Fig. 20 Same as Fig. 6, but for (a) 0333 UTC, (b) 0427 UTC, (c) 0533 UTC, June 8, 1992.



(b)

Fig. 20 (Continued).



(c)

Fig. 20 (Continued).

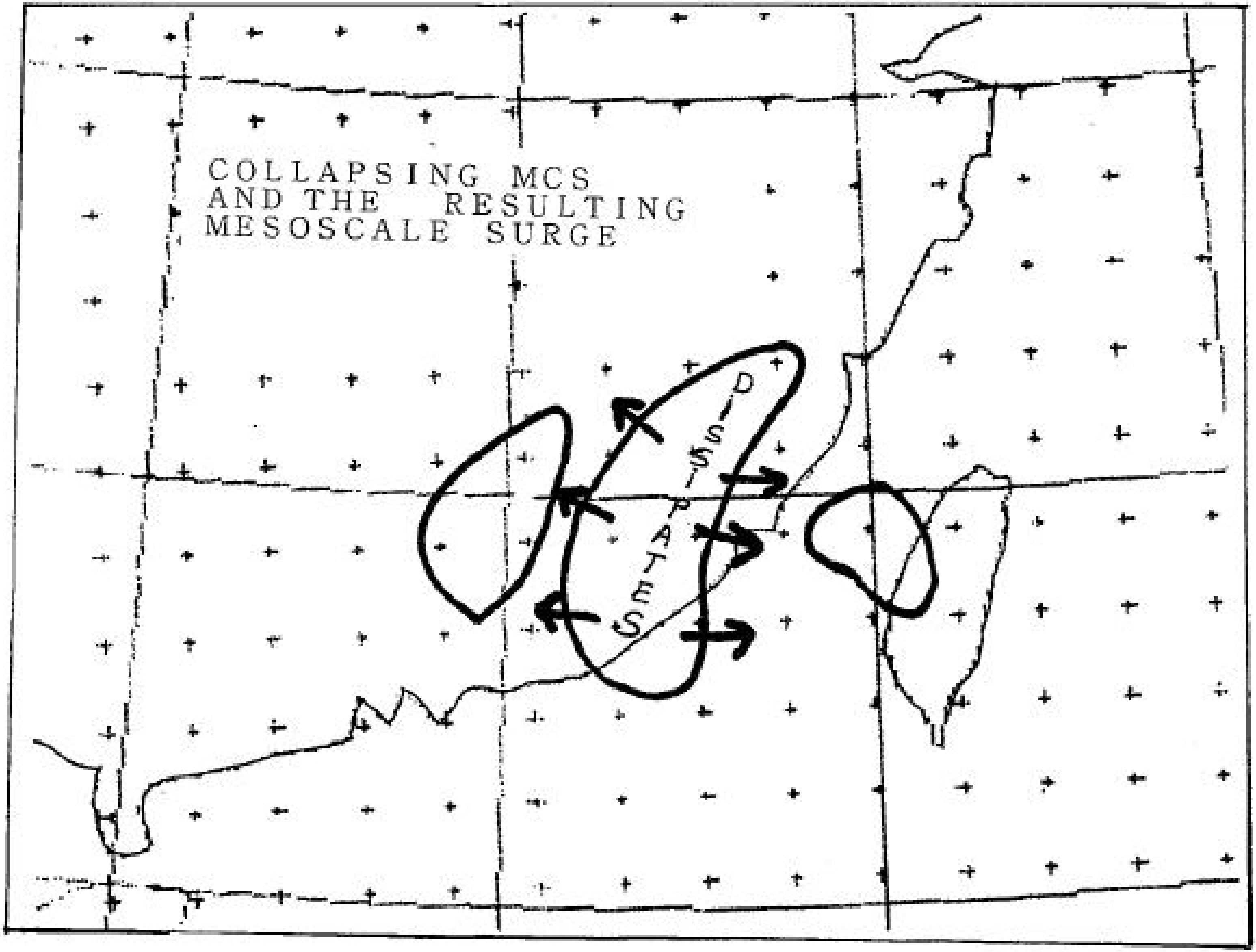
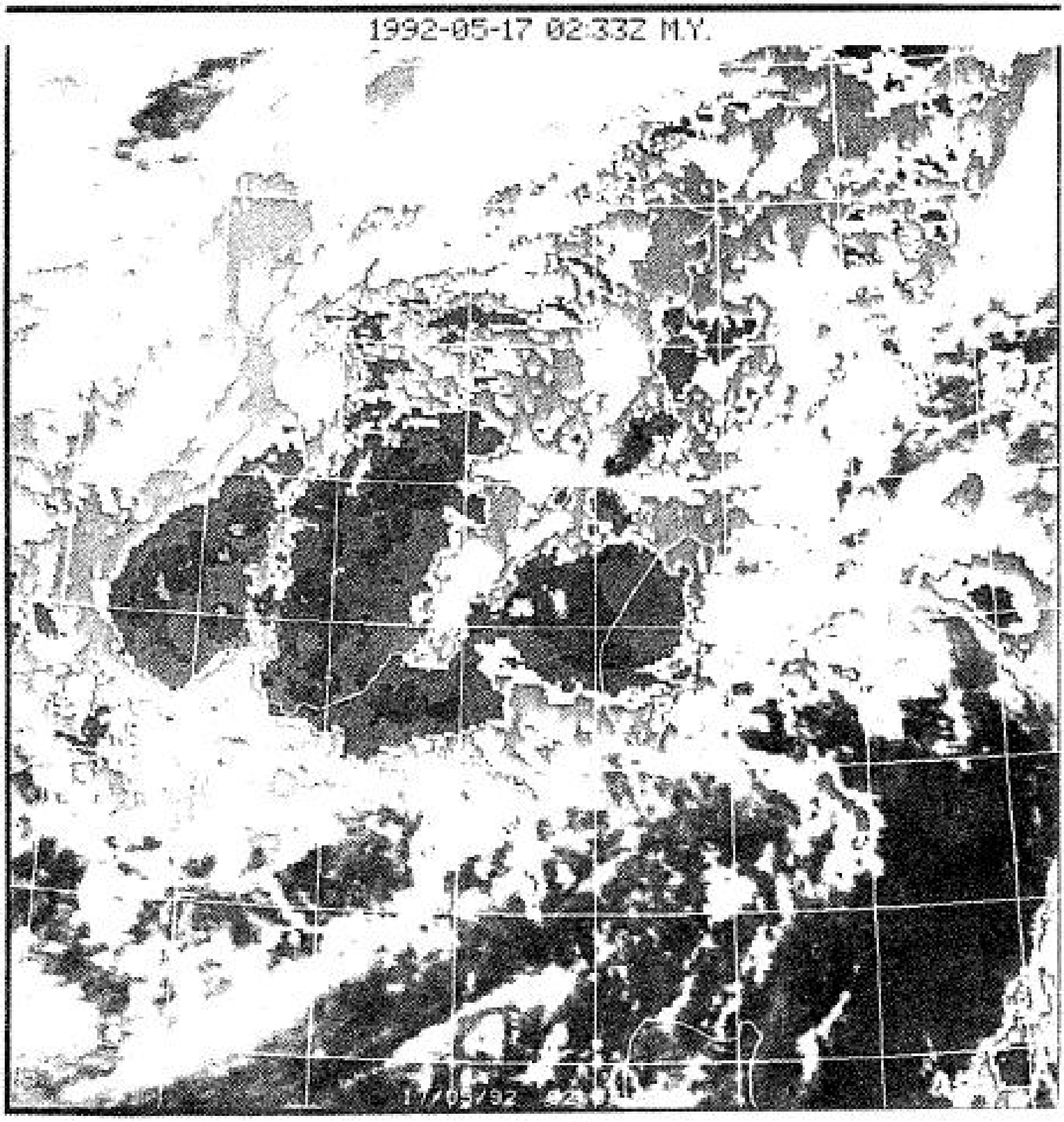
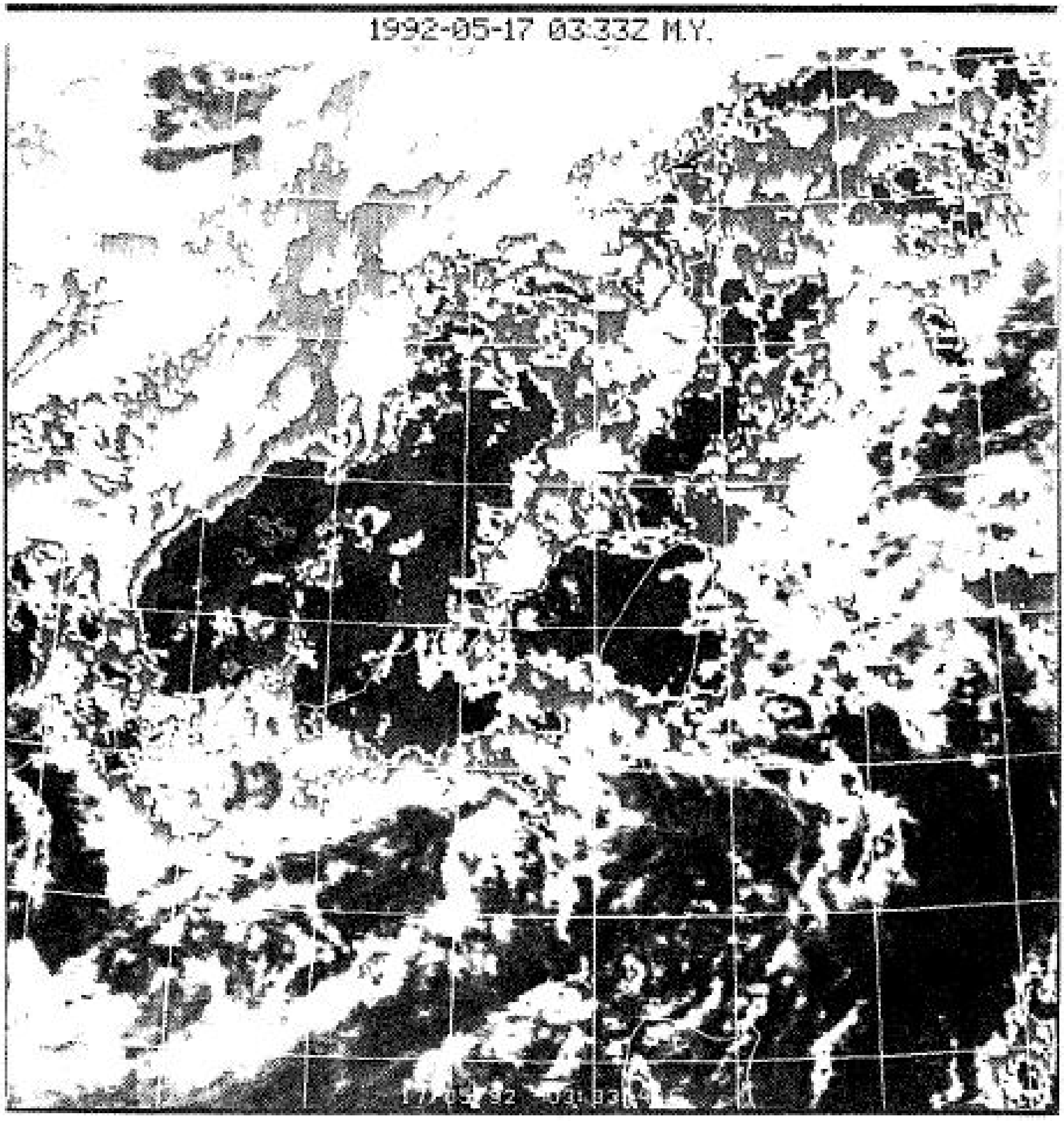


Fig. 21 The schematic digram of collapsing MCS and the resulting mesoscale surge



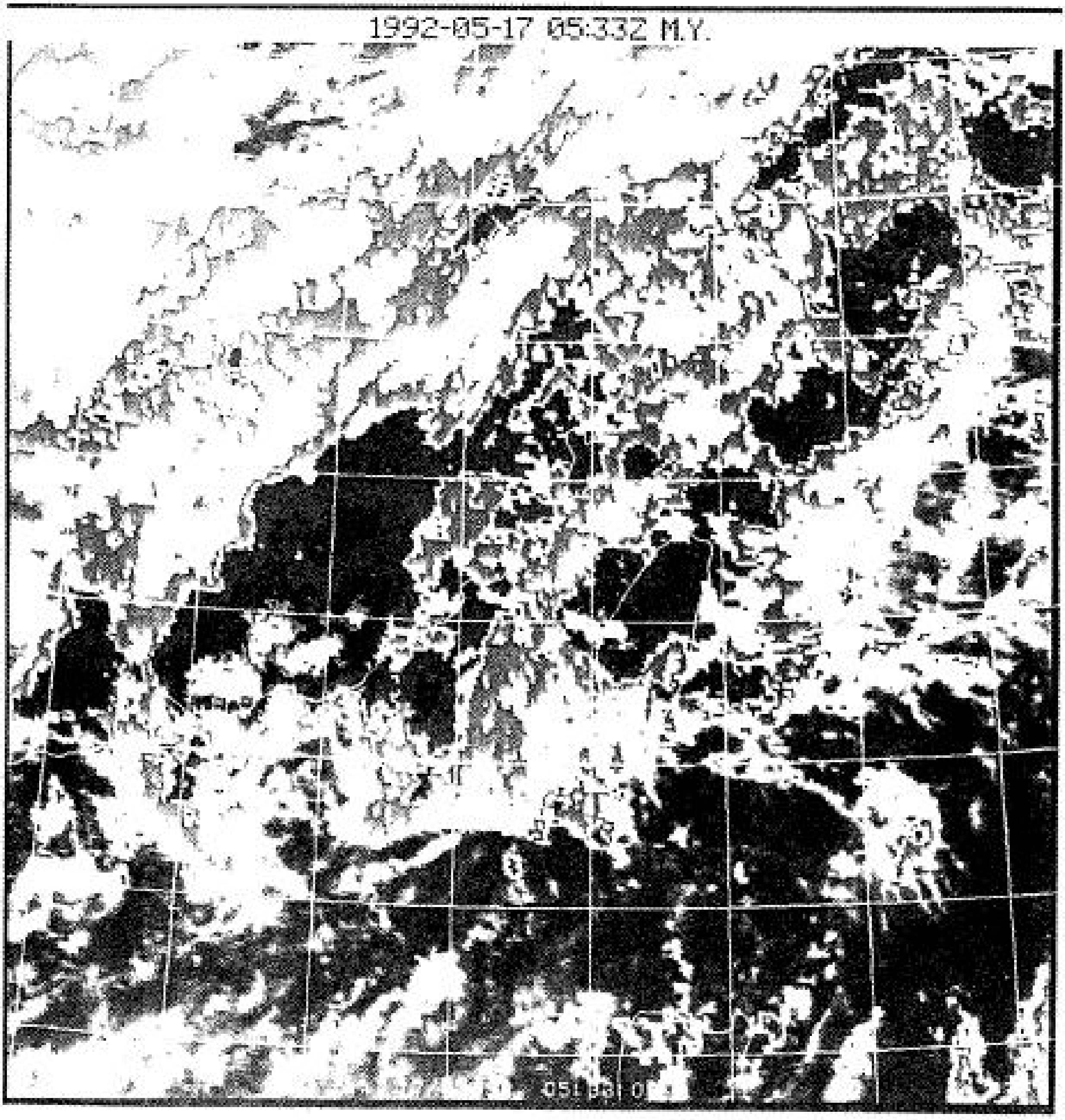
(a)

Fig. 22 Same as Fig. 6, but for (a) 0233 UTC, (b) 0333 UTC, and (c) 0533 UTC, May 17, 1992.



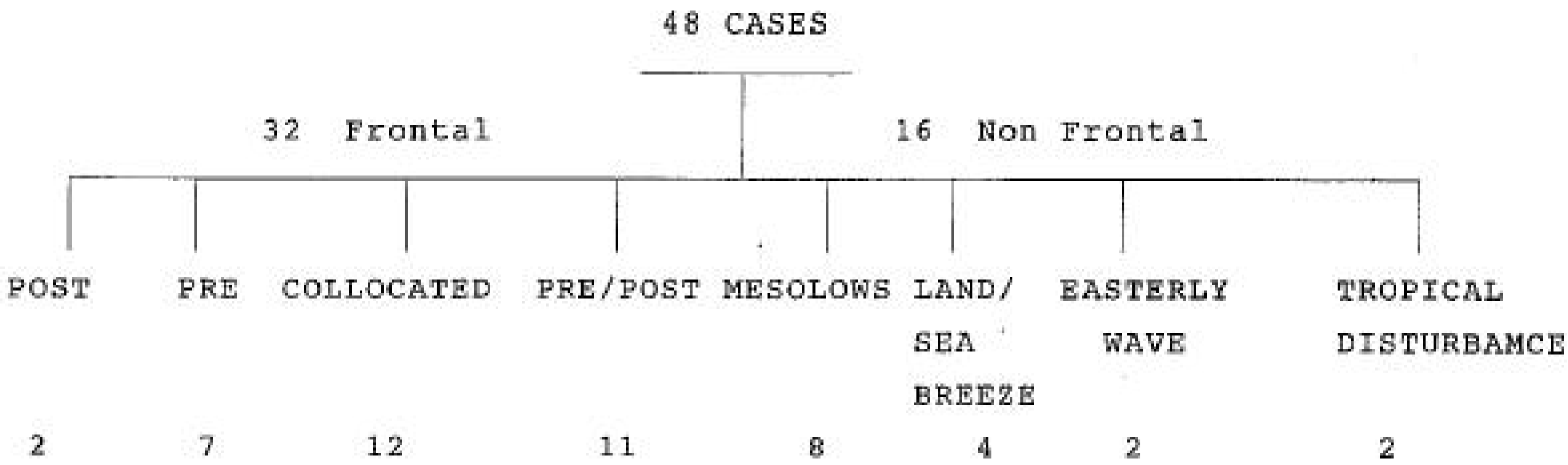
(b)

Fig. 22 (Continued).



(c)

Fig. 22 (Continued).



*NON FRONTAL ≡ No front is expected within a 24 hour period between 20° N to 27° N and 117° E to 125° E

Fig. 23 48 heavy rainfall events occorred during the 1992 Post-TAMEX Forecasting Experiment period. The weather system associated with these events were also showed in this diagram.

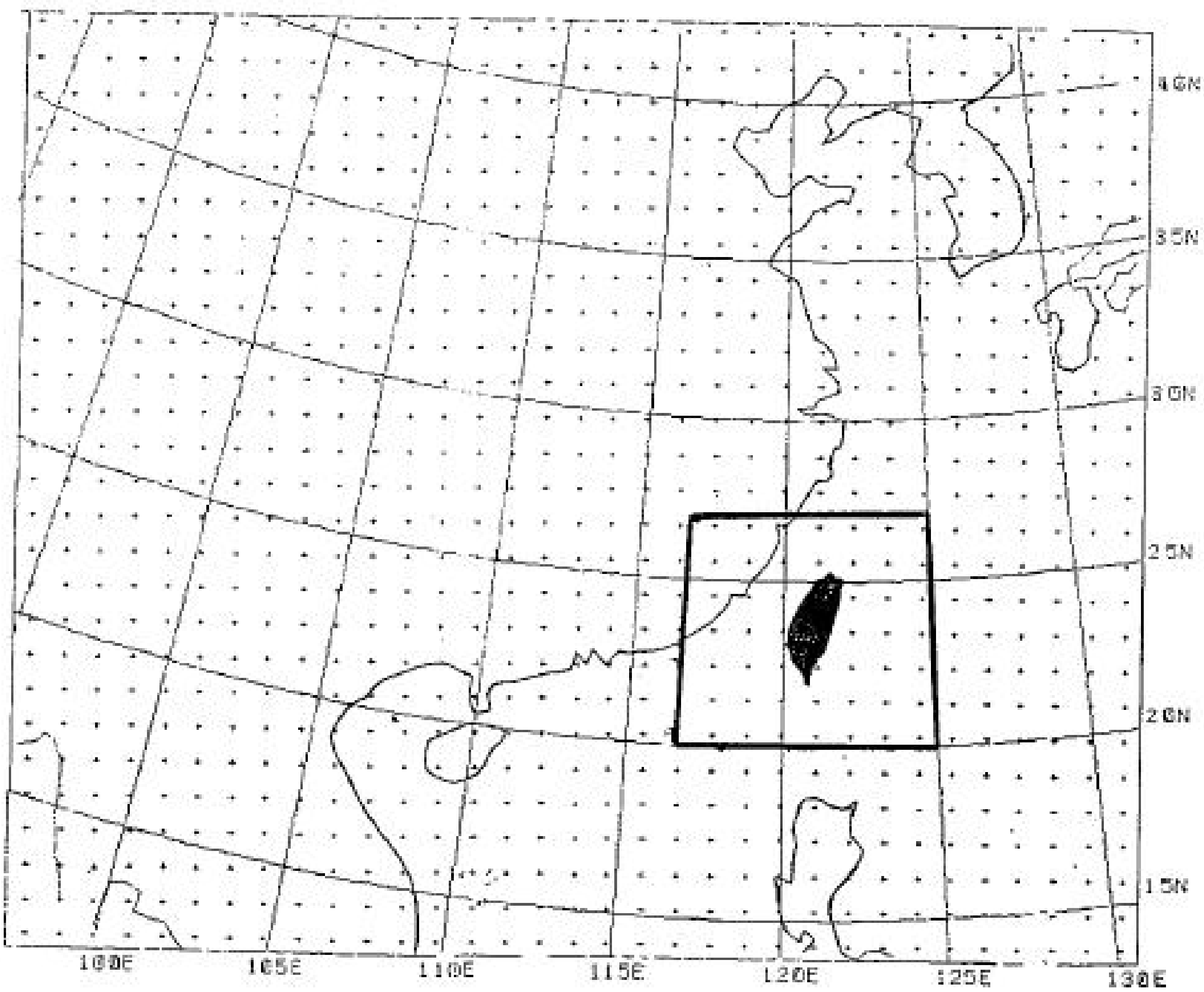


Fig 24. The domain of the frontal (within the box) and non-fronal (without in the box) within a 24 hour period.

梅雨期臺灣地區中尺度對流系統預報方法研究（Ⅰ）：1992年TAMEX預報實驗豪（大）雨事件之分析

史考費德[1]　　紀水上[2]　　丘台光[3]

中華民國八十二年六月

1　美國國家海洋大氣總署國家環境衛星資訊局衛星應用實驗室
2　交通部中央氣象局氣象衛星中心
3　交通部中央氣象局氣象科技研究中心