On the Vortex- Dipole Triggered Heavy Precipitation during the Mei-yu season of Taiwan

Koung-Ying Liu*
Tian-Yow Shyu  ** Chung-Chih Liu***

* College of Science, Chinese Cultural University, Taipei Taiwan R.O.C.
** Department of Geography, Chinese Culture University, Taipei Taiwan R.O.C.
*** Minghsin University of Science and Technology, Hsin-Chu County, Taiwan R.O.C.
1. What is Dipole?
2. Electric Dipole.
5. The trigger mechanism of heavy precipitation during the Mei-yu season of Taiwan.
Electric Dipole

Is any weather system like the electric dipole system?
Rainy Pattern of surface mean during Mei-Yu Season associated with the vorticity dipole and north wind

- Cold High Pressure
- Warm Low Pressure
- Southwest Flow
- North Flow
The ageostrophic wind is largely responsible for the occurrence of subsynoptic changes in weather. Among the ageostrophic components latitude effect, the confluence and diffluence effect are considered reasons of northerly jet.

The thermal wind and secondary circulation within the same area is toward the north therefore the jet decreases with height, i.e., it forms a wedge with down slope southward.
Ageostropic wind accelerate the low level wind between the dipole and cause northly jet.
When the north flow encountering the moist southwest flow, the moist air could be shoveled upward, creating heavy rainfall.
Vortex Dipole And Northly Flow

Heavy rainfall case
(And then 1987 TAMEX)
The vortex dipole of 850 hpa wind field and relative humidity at 0200 LST 28 May 1981 (from Liu, Hsiao, and Chang 2009).
Convective cloud systems generated along the front, but not located at low center.
Surface map at 06UTC 07 May 1996.

A weak front passed through Taiwan also caused local area heavy rainfall.
The satellite imagery from 11UTC 07 May to 16UTC 07 May 1996.

(a) 11UTC 07 May  (b) 12UTC 07 May  (c) 13UTC 07 May
(d) 14UTC 07 May  (e) 15UTC 07 May  (f) 16UTC 07 May

Convective cloud systems generated along the cloud front associated with north wind, and the convective cloud moved eastward.
Weather element variation in May 7-8 1996

The local rainfall amount near 50mm in a few hours
(1) Wind field of 850 hpa
(2) Vertical motion of 700hpa

The north flow moved from the north part of Mainland China
06 UTC  May 07 1996

(1) Wind field of 850 hpa  (2) Vertical motion of 700 hpa

The north flow moved eastward
(1) Wind field of 850 hpa

(2) Vertical motion of 700hpa

As the north flow near Taiwan area cause the southwest flow very strong vertical motion
When the north flow encounter with the moist southwest flow then the moist air could be shoveled upward motion and create heavy rainfall.
Conclusion

1. Vortex dipole is one of the features that could advantage to the development of the local system.

2. The characteristic of north wind between the Vortex dipole may be one of the reasons that create heavy precipitation.

3. Because the North wind between the Vortex dipole encounter with the Southwest flow, and then force the moist flow climb up the slop of north wind.

4. And trigger the heavy rainfall.
Thank You for Your Attention !!!
\[
dV/\text{dt} = -\nabla \Phi - \mathbf{k} \times \mathbf{Vf} = -f \mathbf{K} \times \mathbf{Vag}
\]