WRF Simulations of a Heavy Rainfall Event in Taiwan

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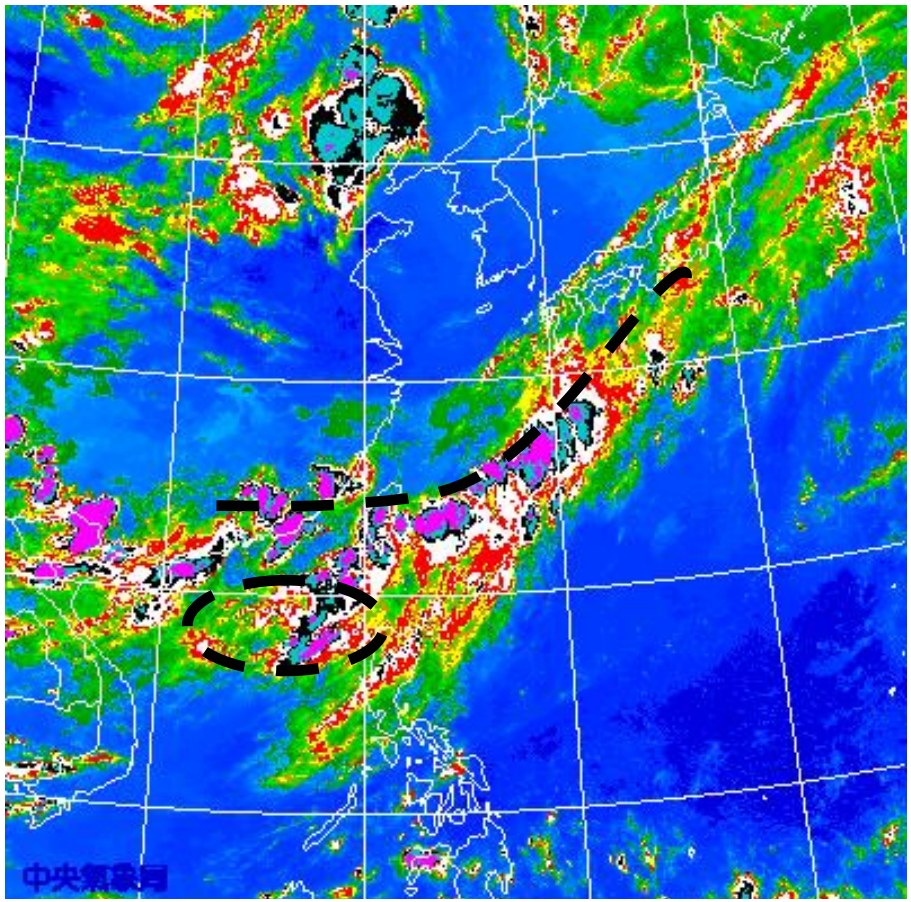
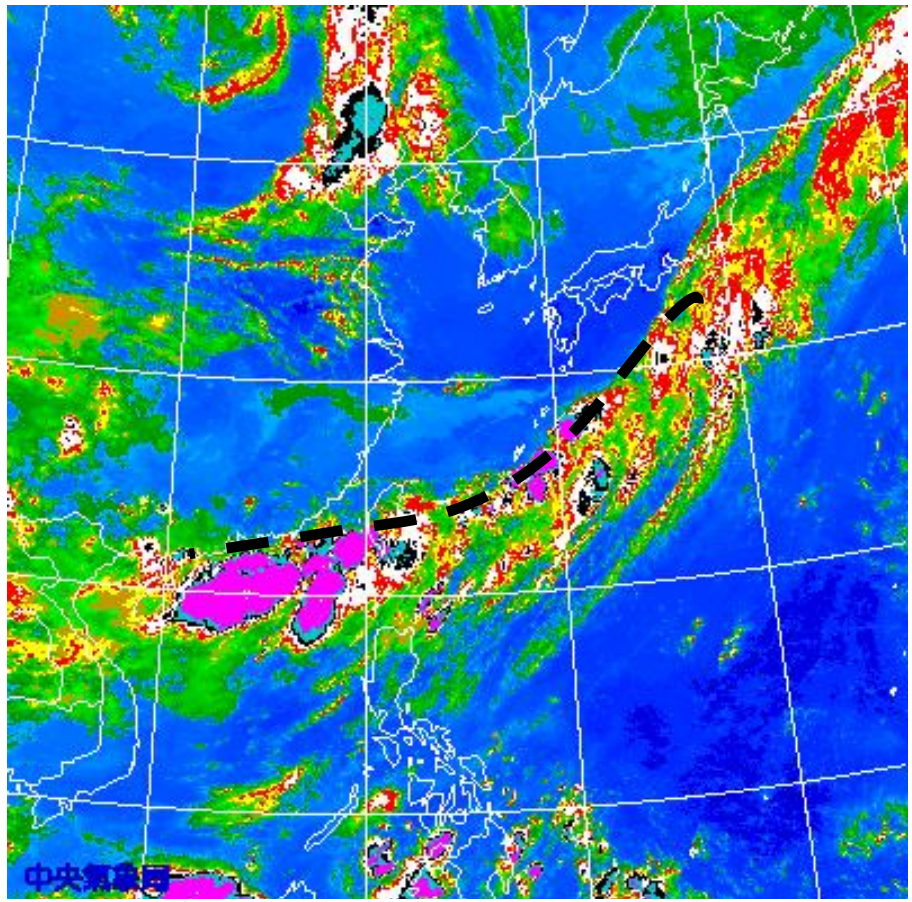
Yi-Chin Liu
Cheng-Shang Lee

Enhanced IR satellite imaginary

2005/6/12 12 UTC

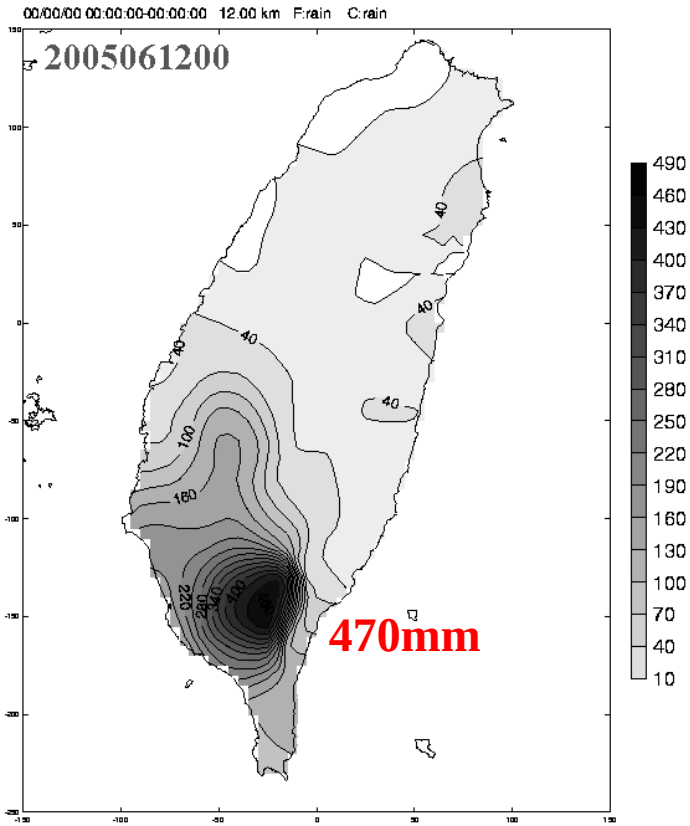


2005/6/13 00 UTC

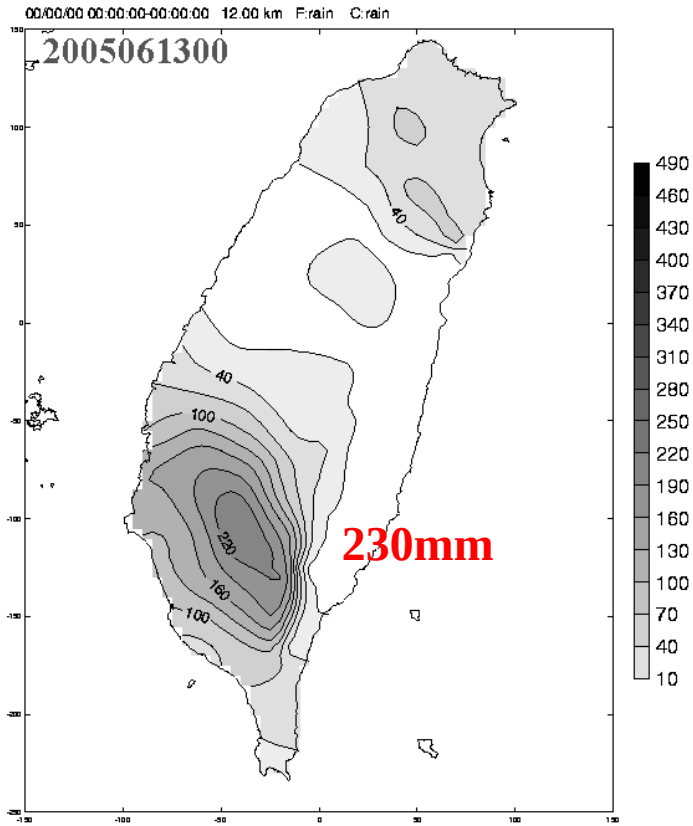


Daily accumulated rainfall

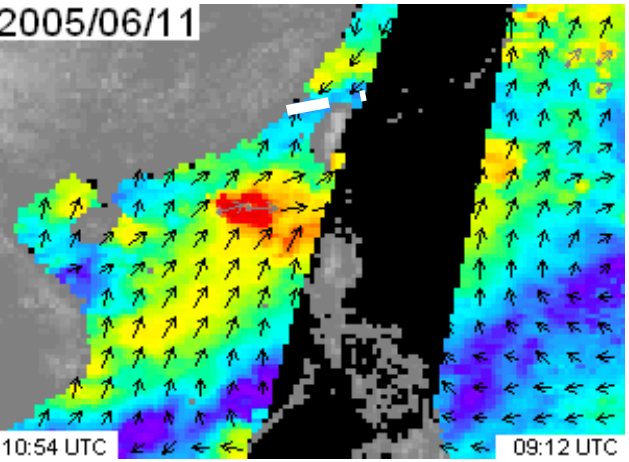
6/12 00 ~ 6/13 00 UTC

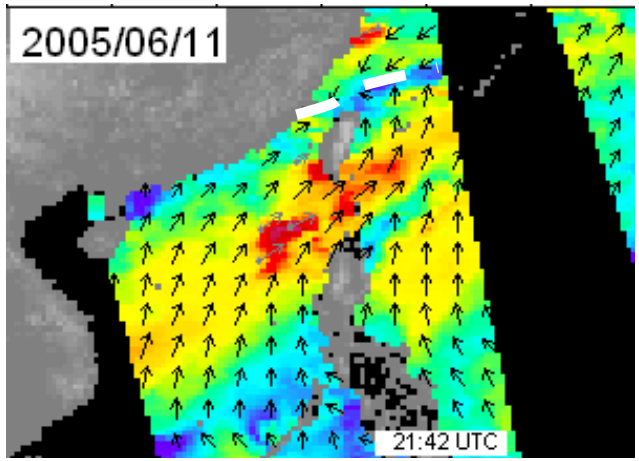


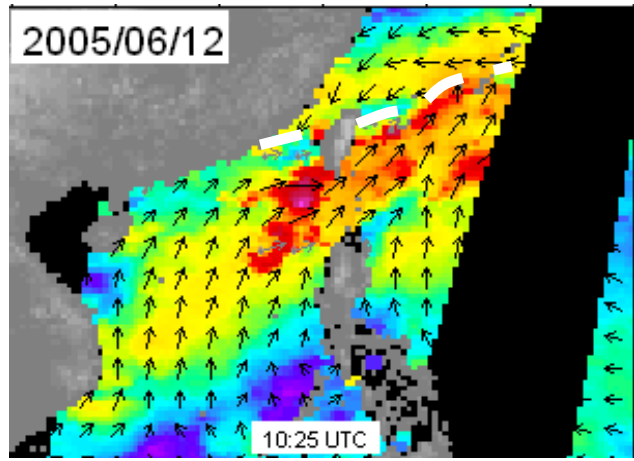
6/13 00 ~ 6/14 00 UTC

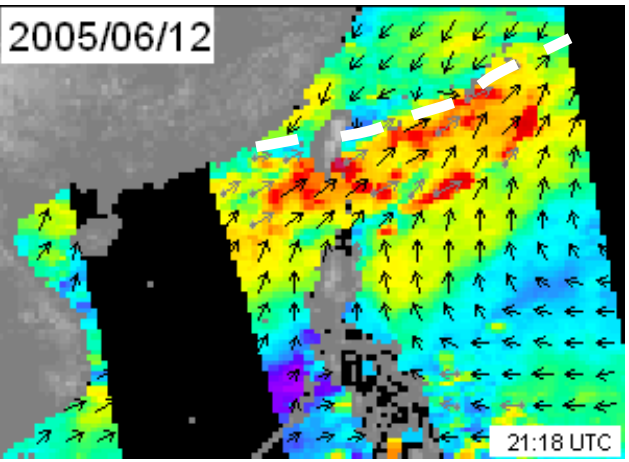


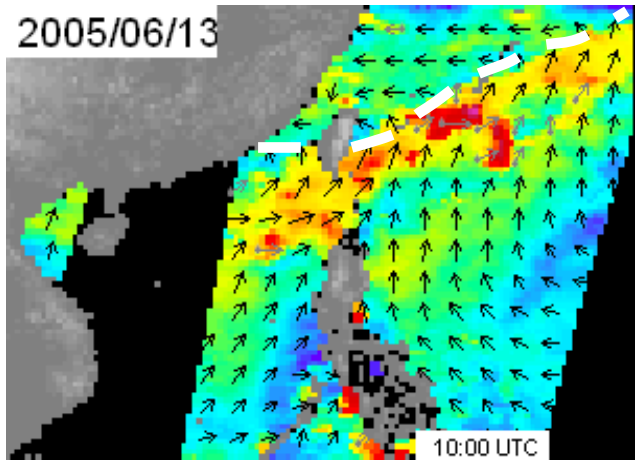
QuikScat wind field

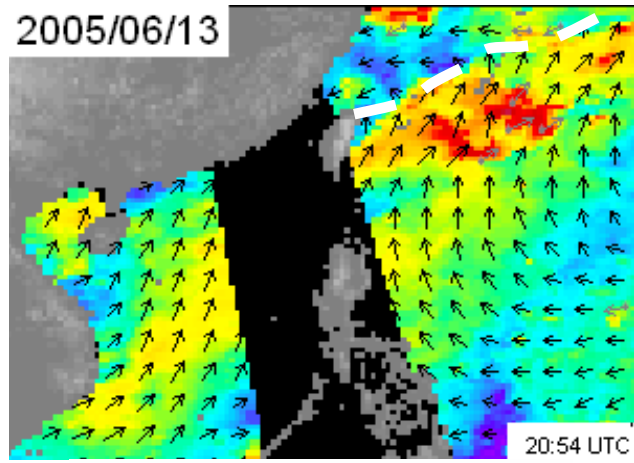




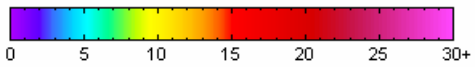








Color: Wind speed



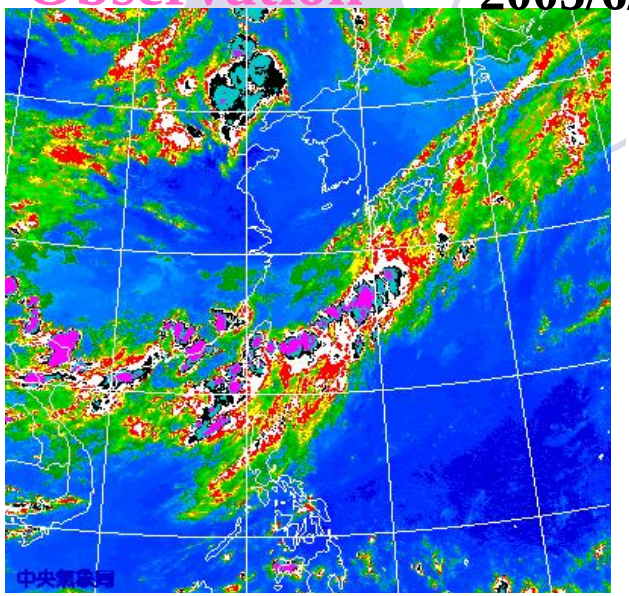
MEFSEA

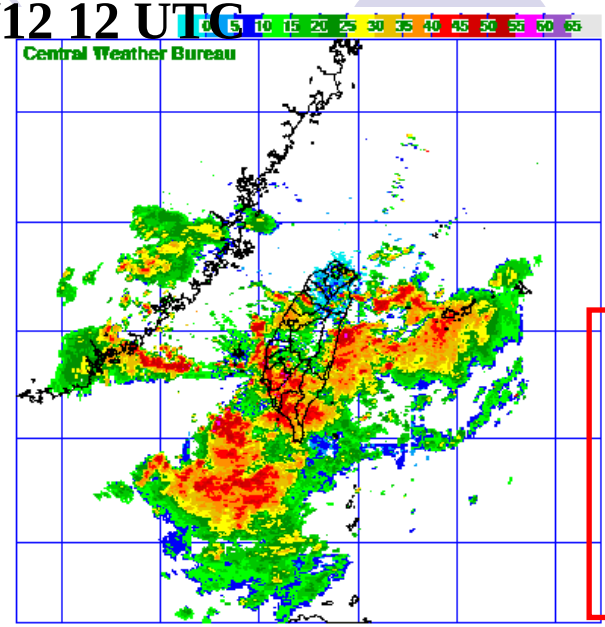
- **Mesoscale Ensemble Forecast for SouthEast Asia**
- **A real-time mesoscale ensemble forecasting system that includes 3 WRF members, which use the same physics combination, including Kain-Fritsch cumulus parameterization scheme, WSM 5-class microphysics scheme, and YSU PBL scheme. (obtained from the best result of the sensitivity study we performed in 2004)**
- **The only difference is on the IC & BCs, which include the IC & BCs from the CWB GFS, NCEP GFS, and NCEP GFS+WRF 3D-Var.**
- **Each member runs twice a day at 0000UTC and 1200UTC. Forecast length is 72 h. 2 domains (45, 15km).**
- **Products are displayed at a website: *http://pblap.atm.ncu.edu.tw/mefsea***

Real-time simulation (15km) Initialized at 2005/6/11/1200UTC

Observation

2005/6/12 12 UTC





*Contour: sea level pressure

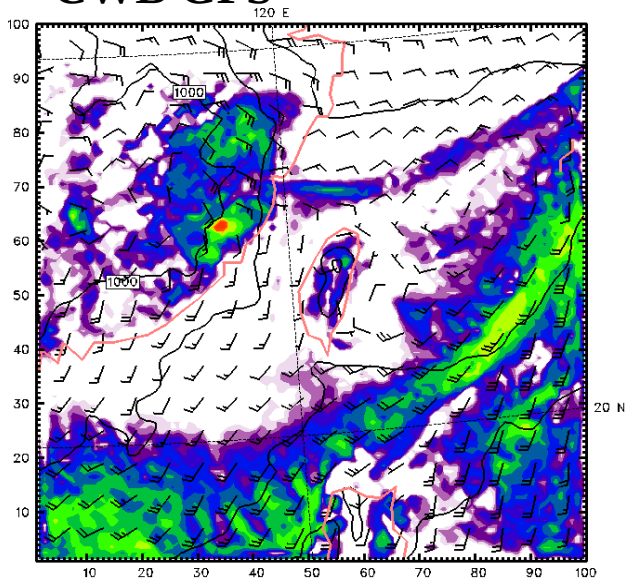
*Color: 12 h accumulated rainfall (6/12 00~12 UTC)

* 1000-hPa wind field

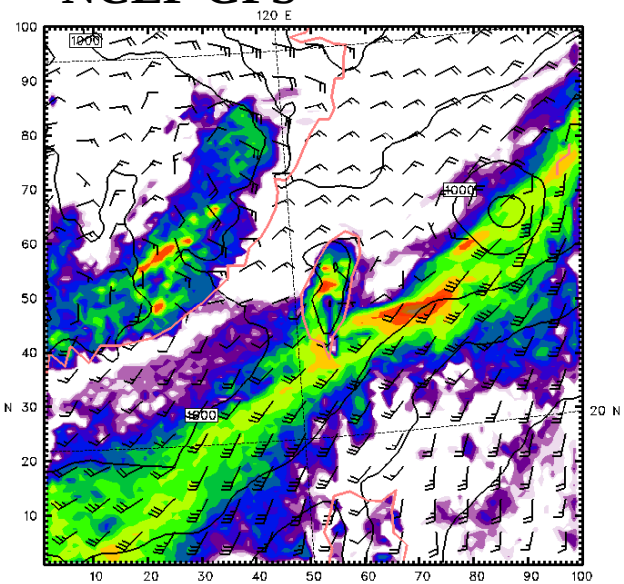
WRF members

2005/6/12 1200 UTC(24h)

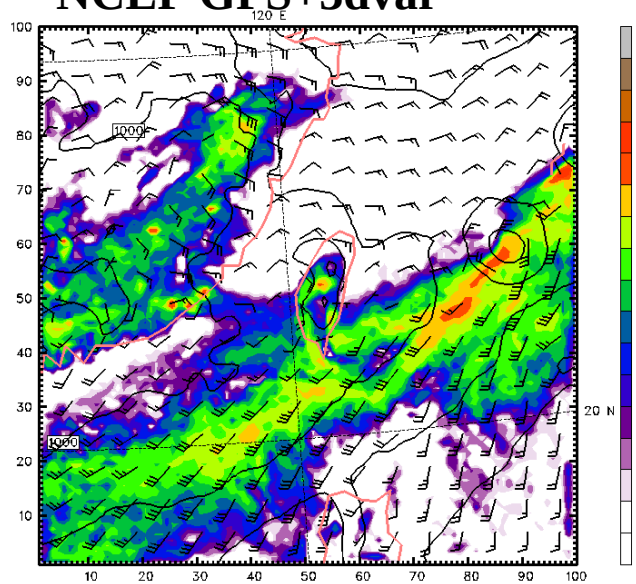
CWB GFS



NCEP GFS

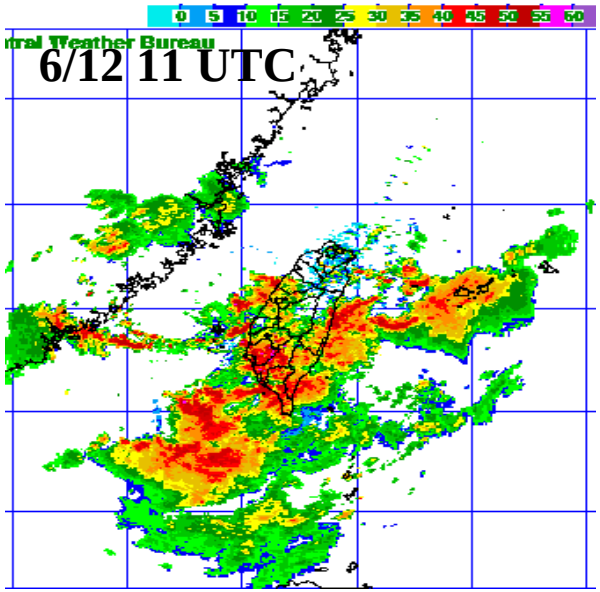


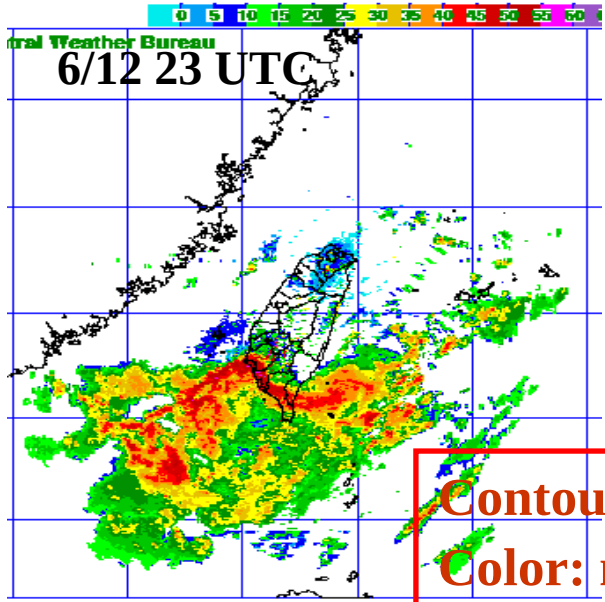
NCEP GFS+3dvar



Radar reflectivity

Observation





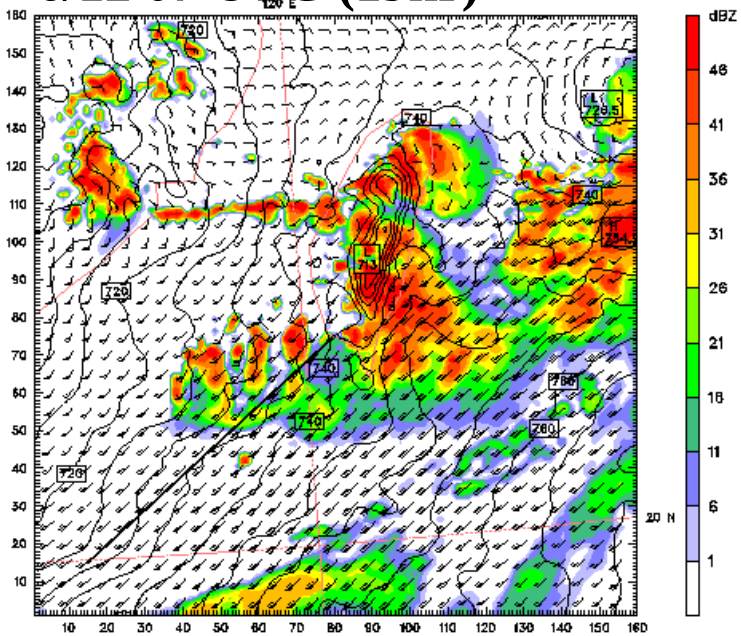
Contour:925hPa ght

Color: max-dBz

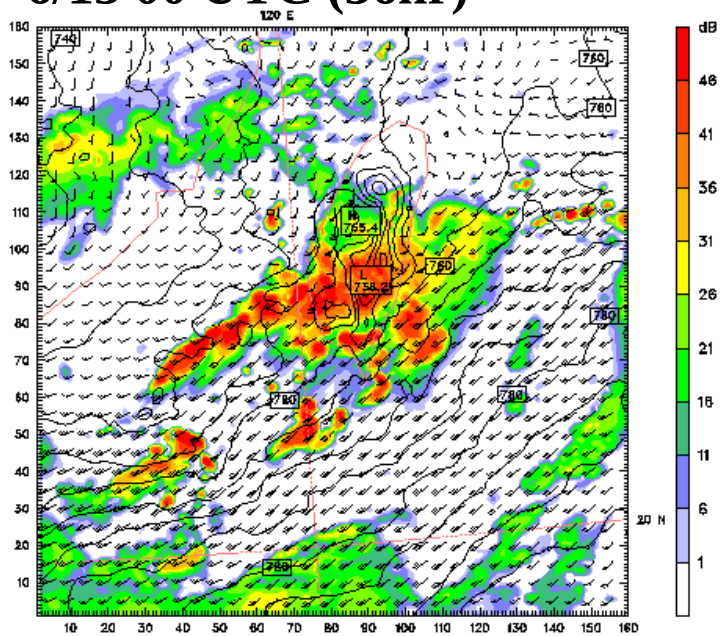
925-hPa wind filed

Simulation, 5km

6/12 07 UTC (19hr)



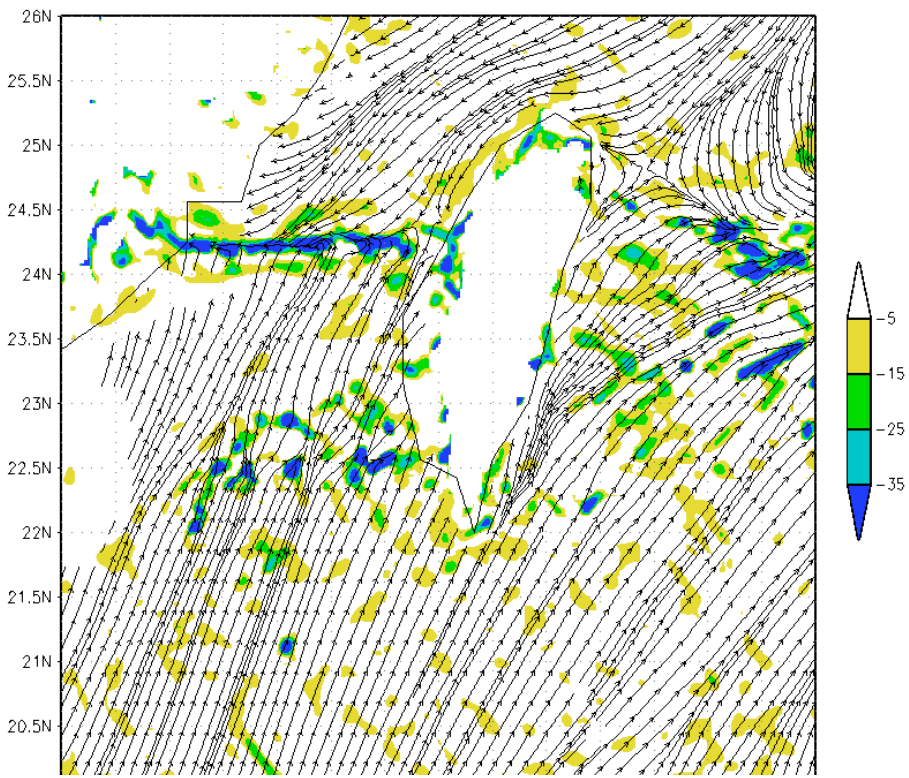
6/13 00 UTC (36hr)



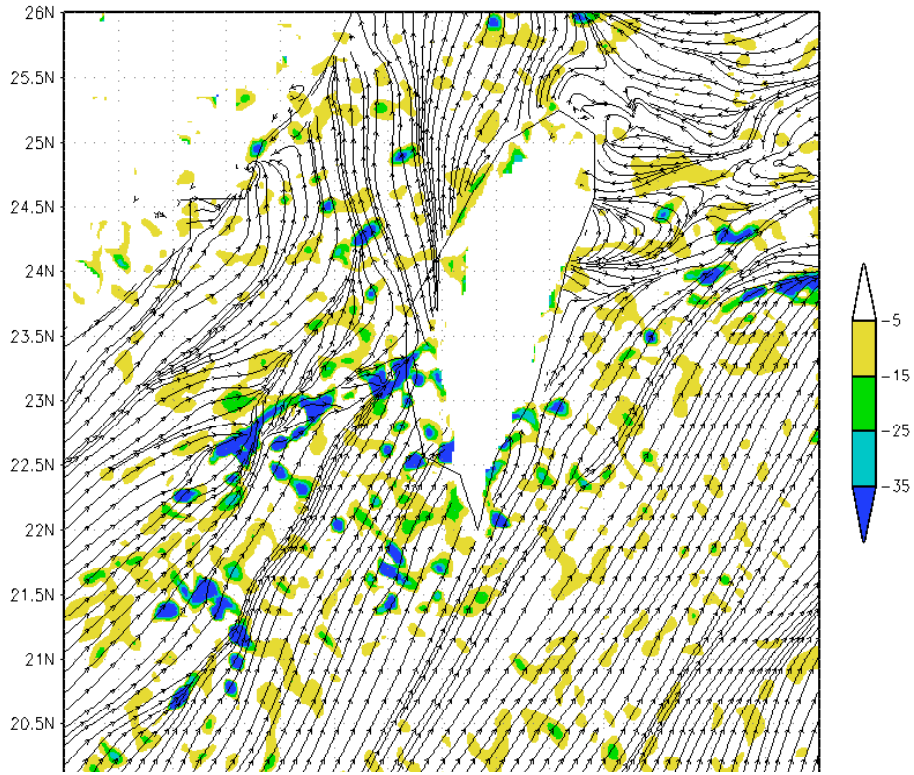
Streamline and convergence field (950hPa)

Color: convergence

6/12 07 UTC (19hr)



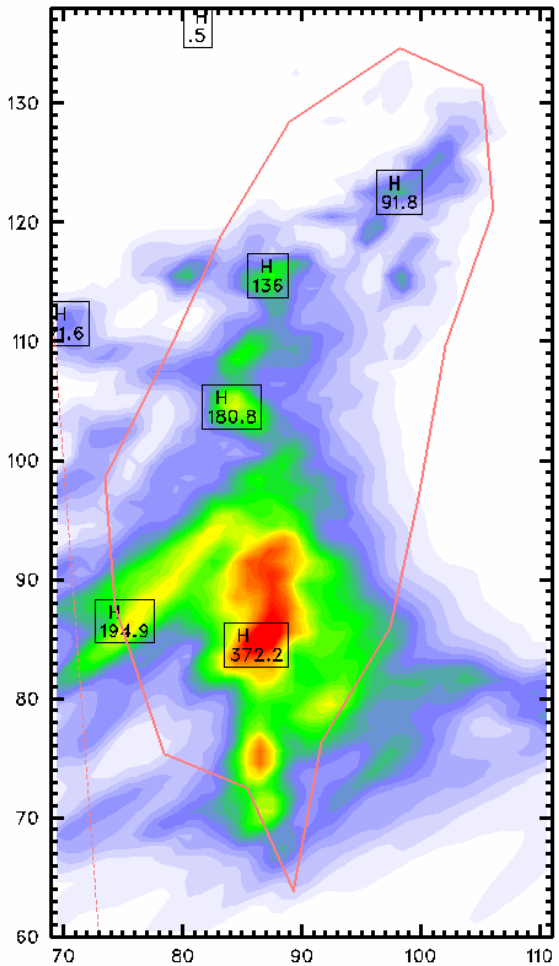
6/13 00 UTC (36hr)



High resolution: 5km

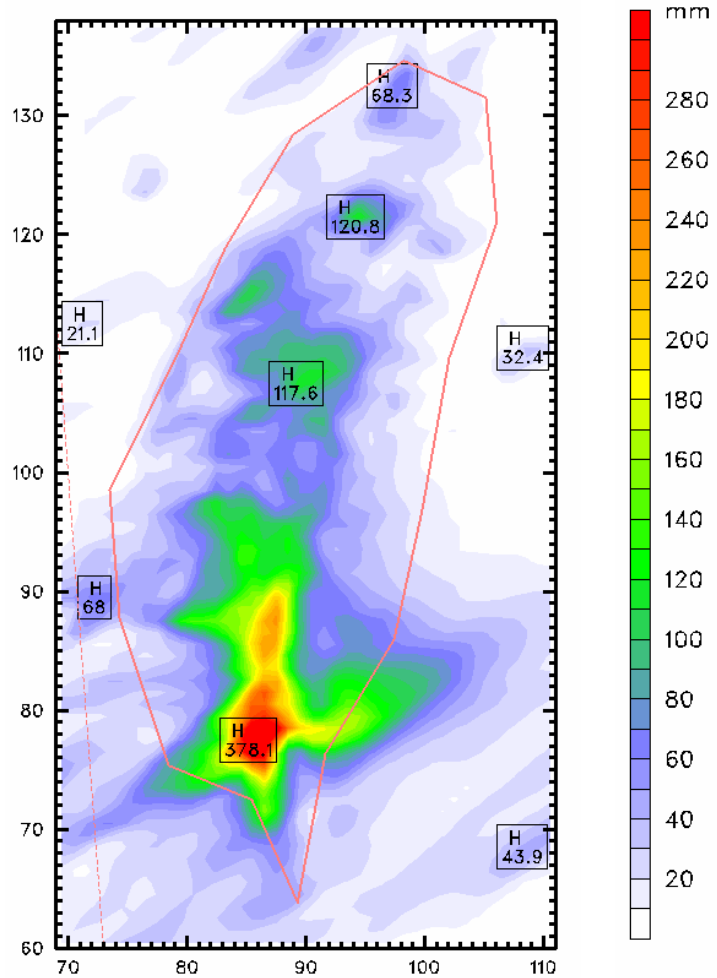
Daily accumulated rainfall

Simulation (12-36h)



2005/6/12 0000 ~ 13 0000 UTC

(36-60h)



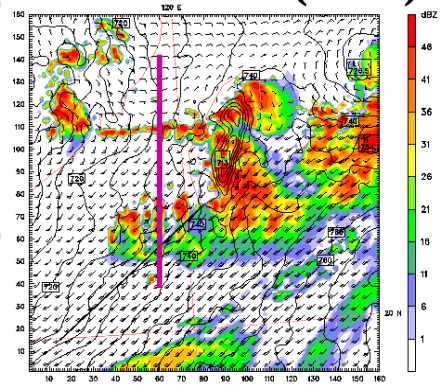
2005/6/13 0000 ~ 14 0000 UTC

North-South cross section

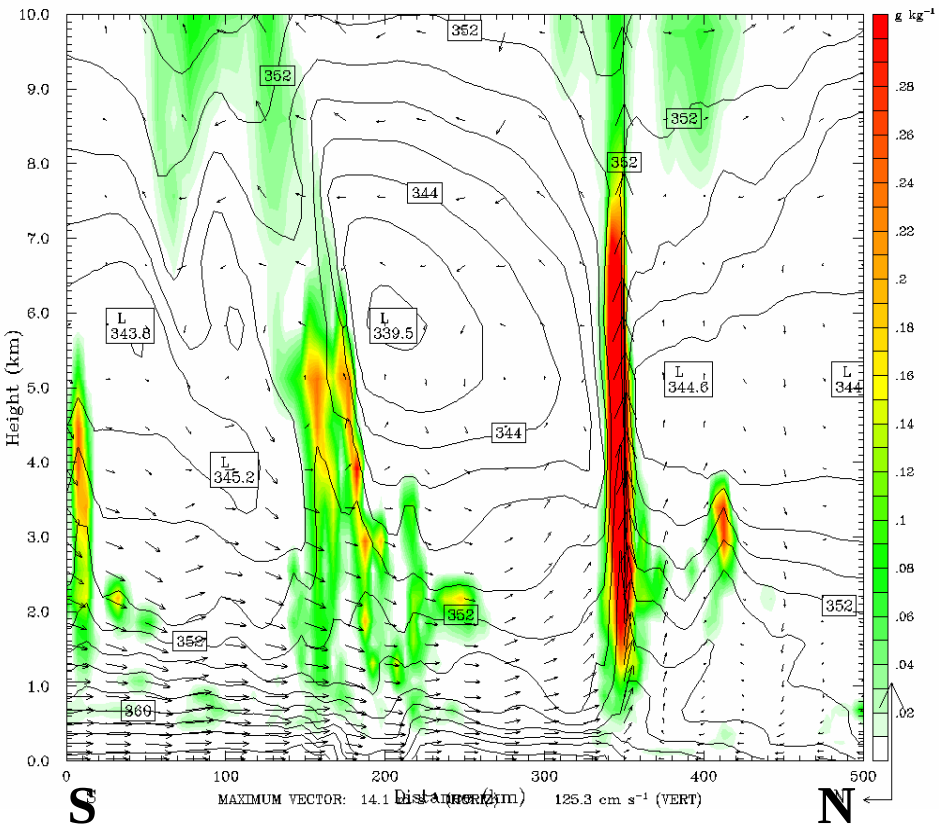
Contour: theta-e

Color: cloud mixing ratio

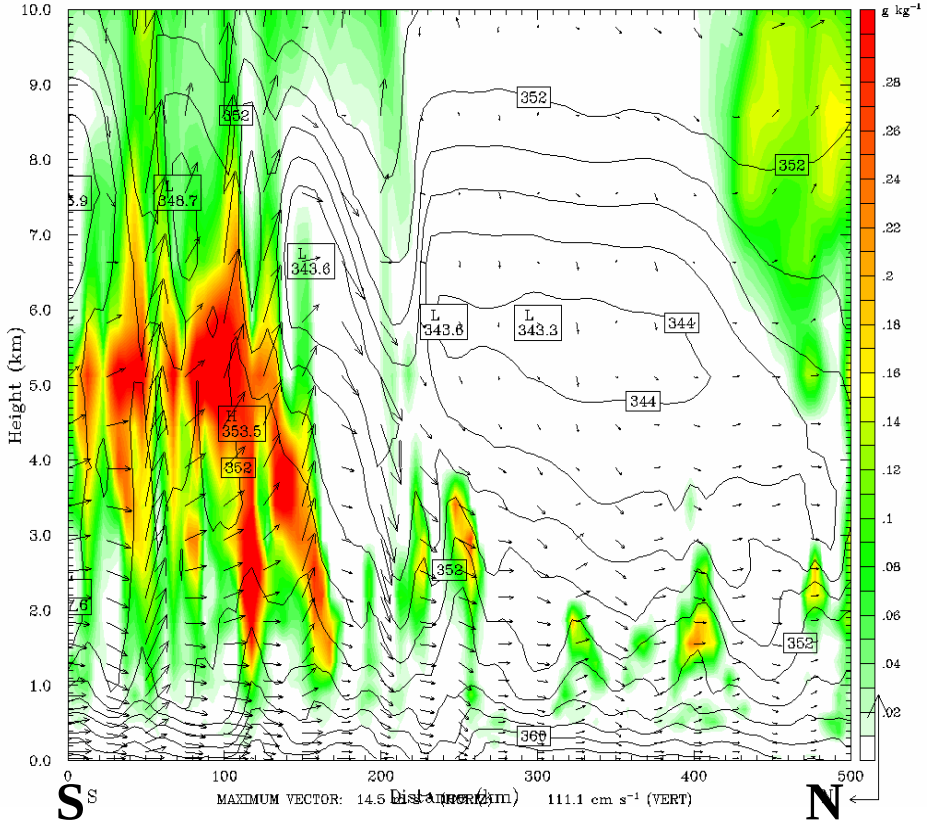
6/12 07 UTC (19hr)



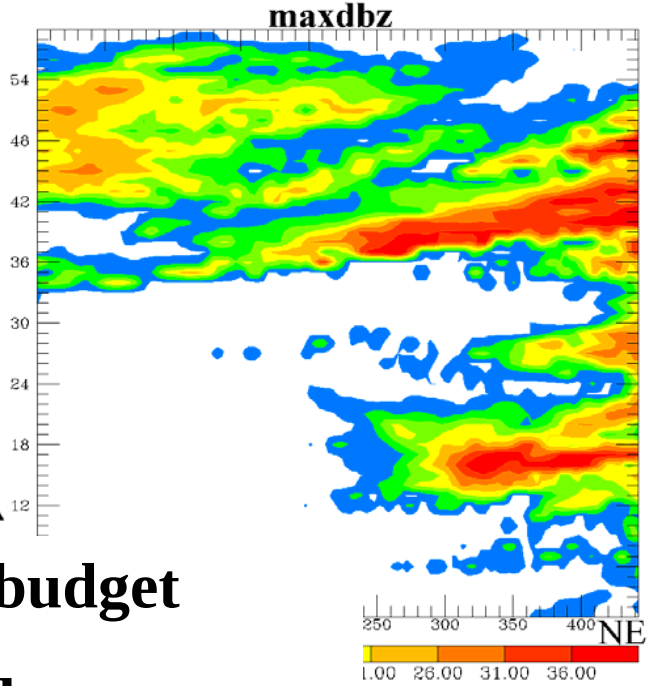
6/12 07 UTC (19 hr)

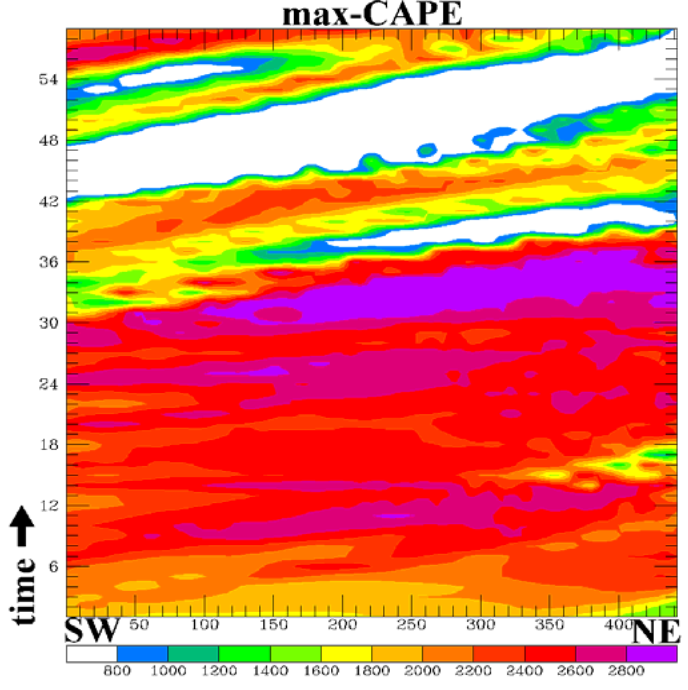


6/13 02 UTC (38 hr)



Max. value in the air column

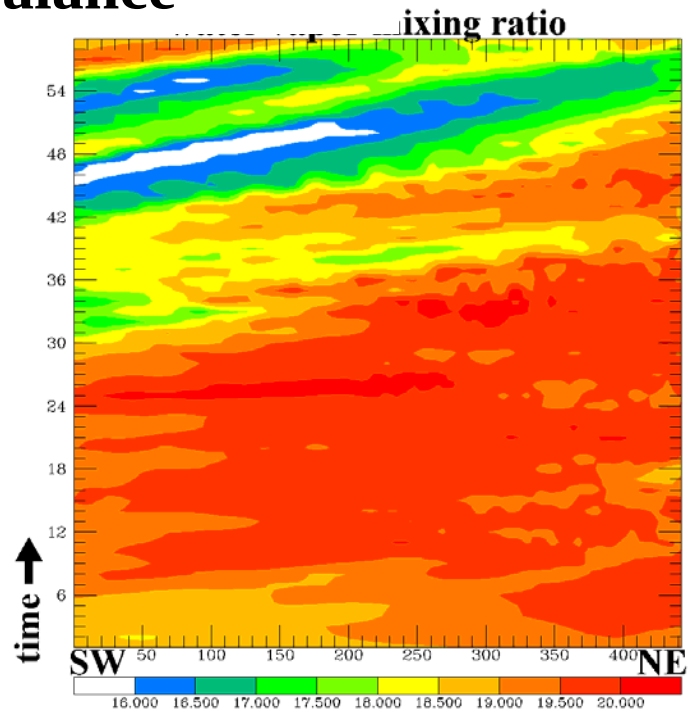


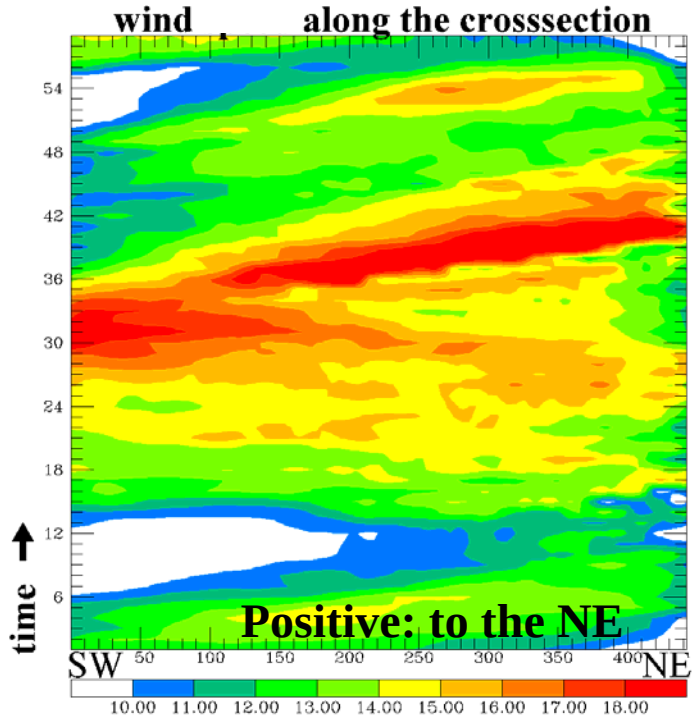


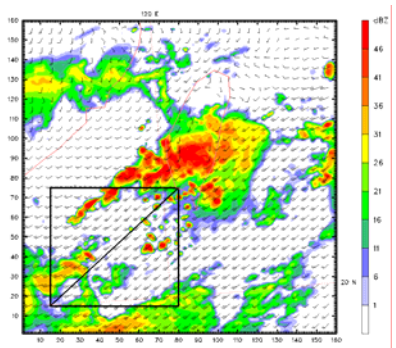
1. **Misture budget**
2. **Force balance**

Vertical average:

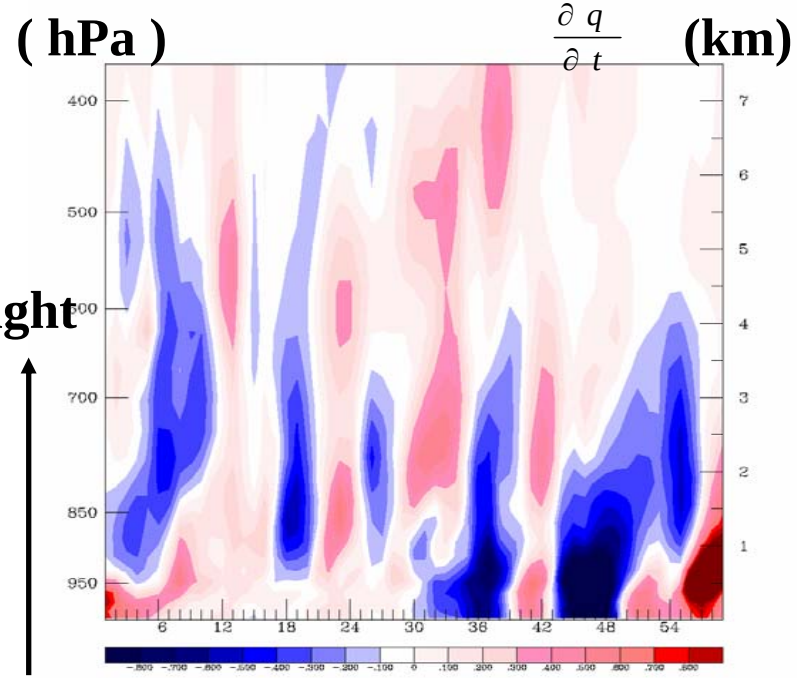
*below 850hPa

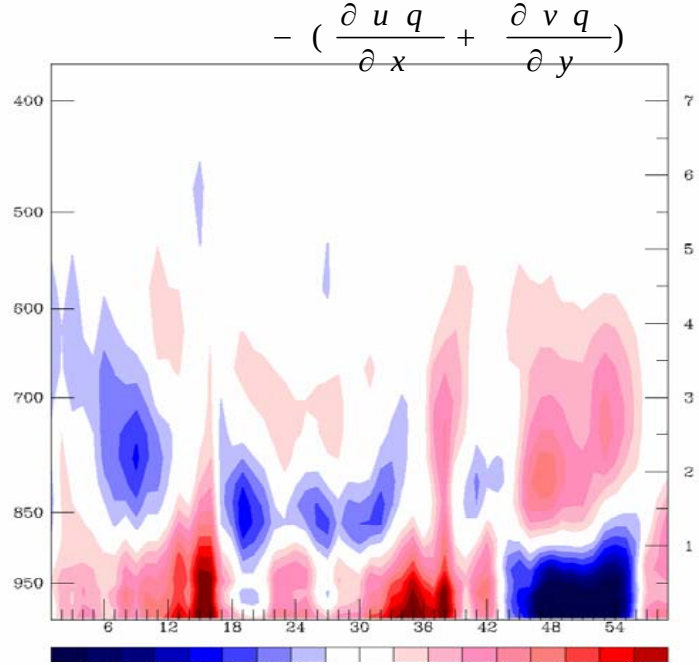


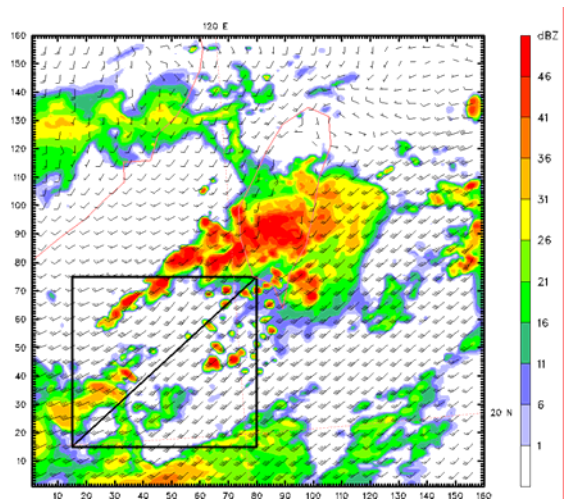


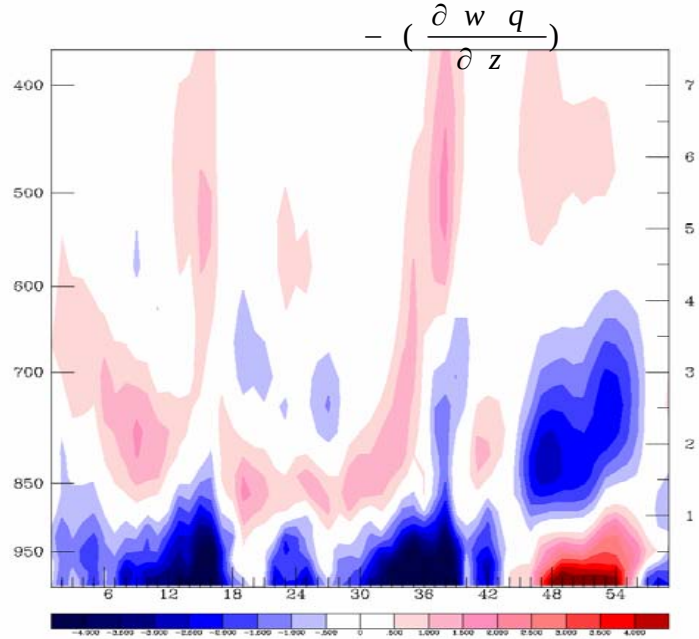


Moisture budget of the SW flow



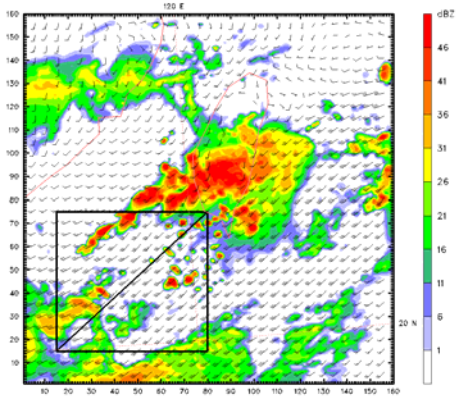


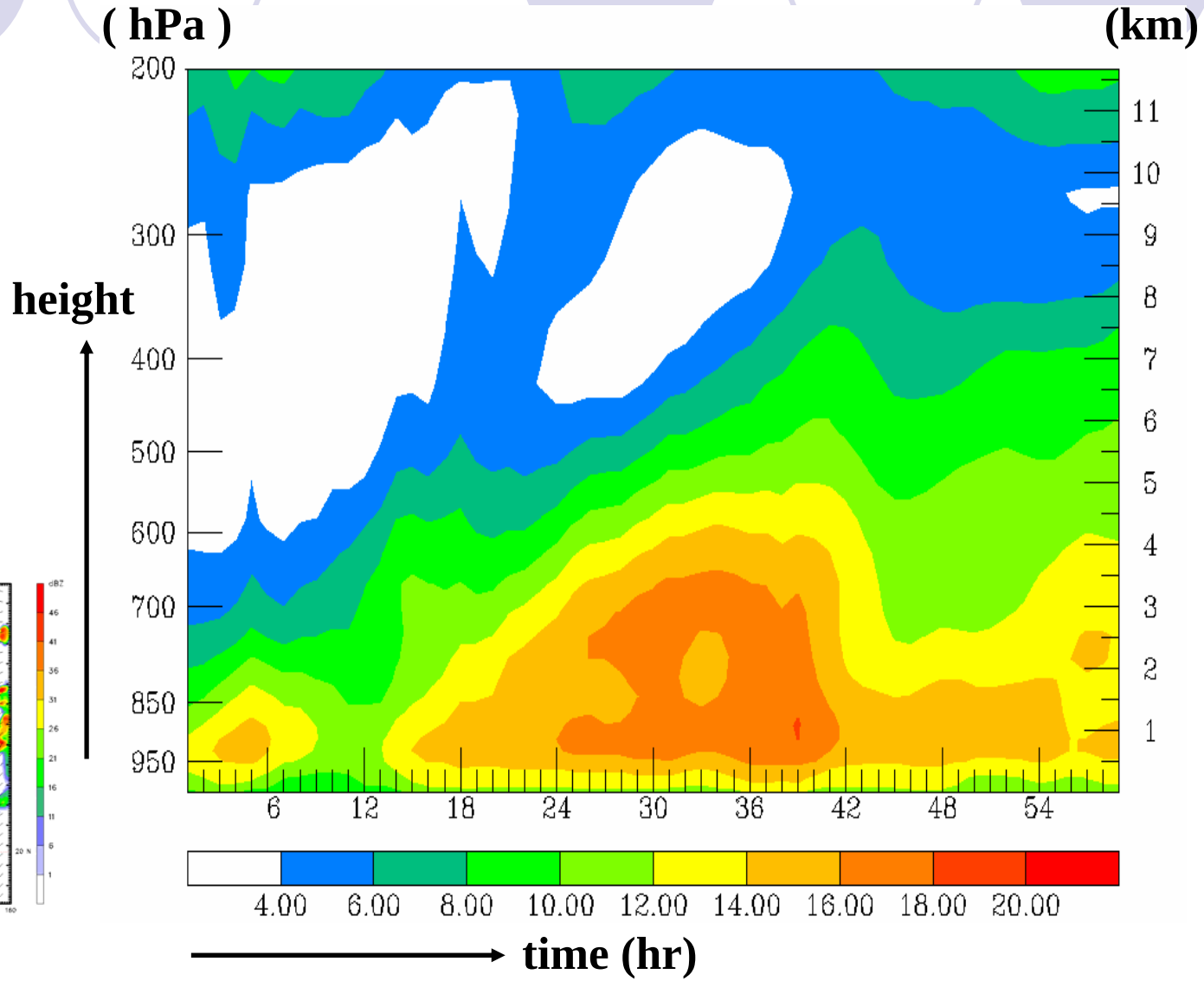




Residual was not counted:
Condensation
Evaporation
Eddy, etc.

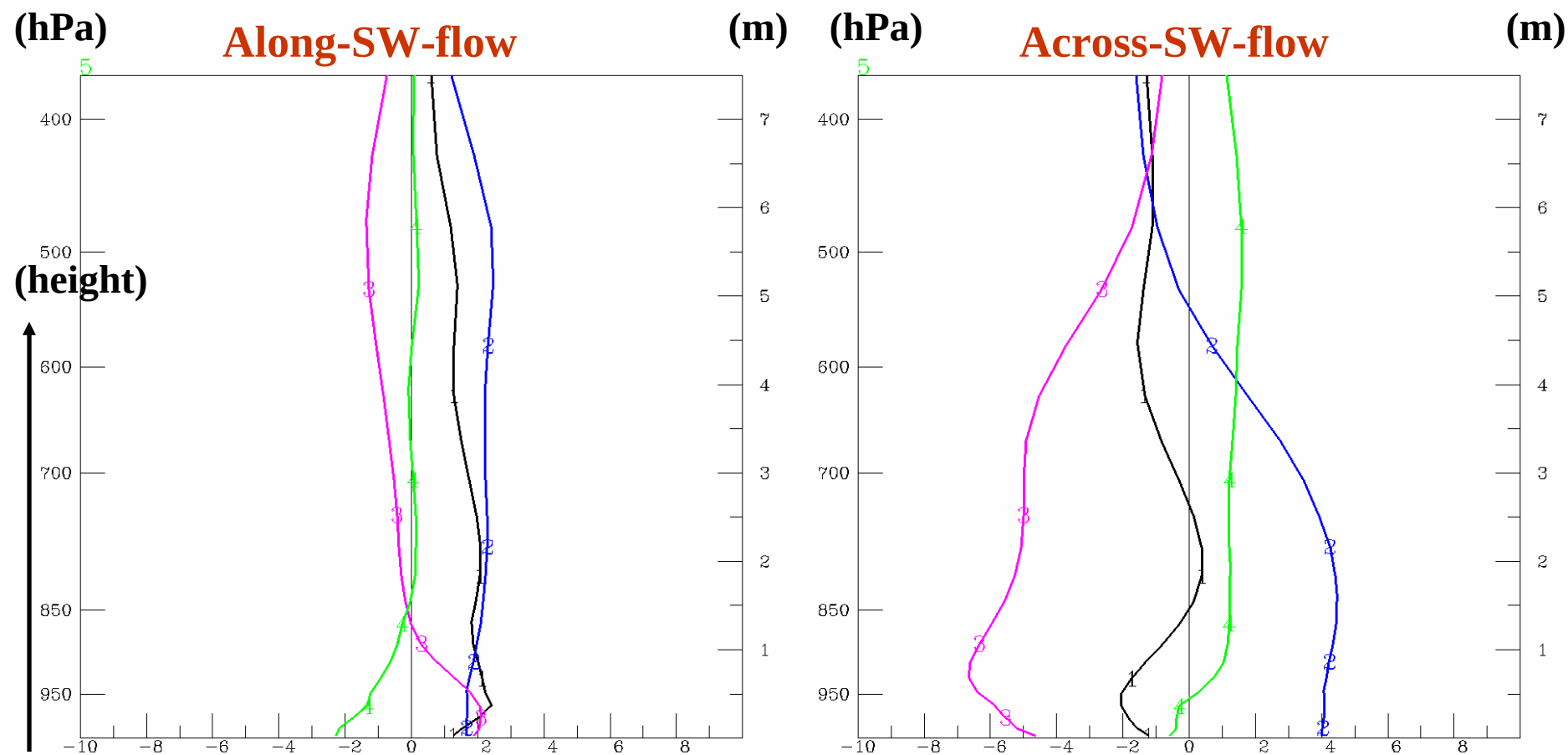
Wind speed of the SW flow





Force balance of the SW flow

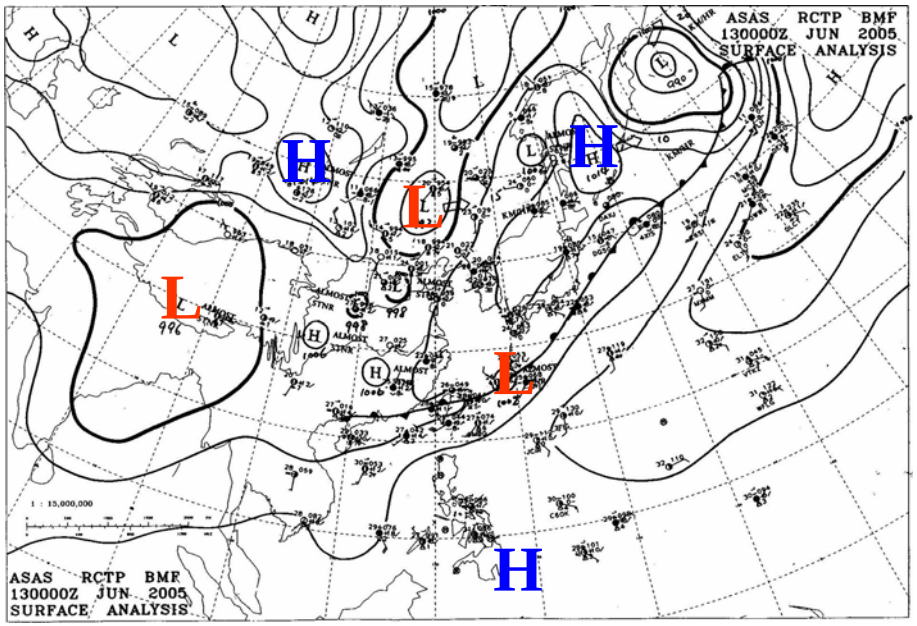
1. Accl
2. PGF
3. Cor. F.
4. Residual



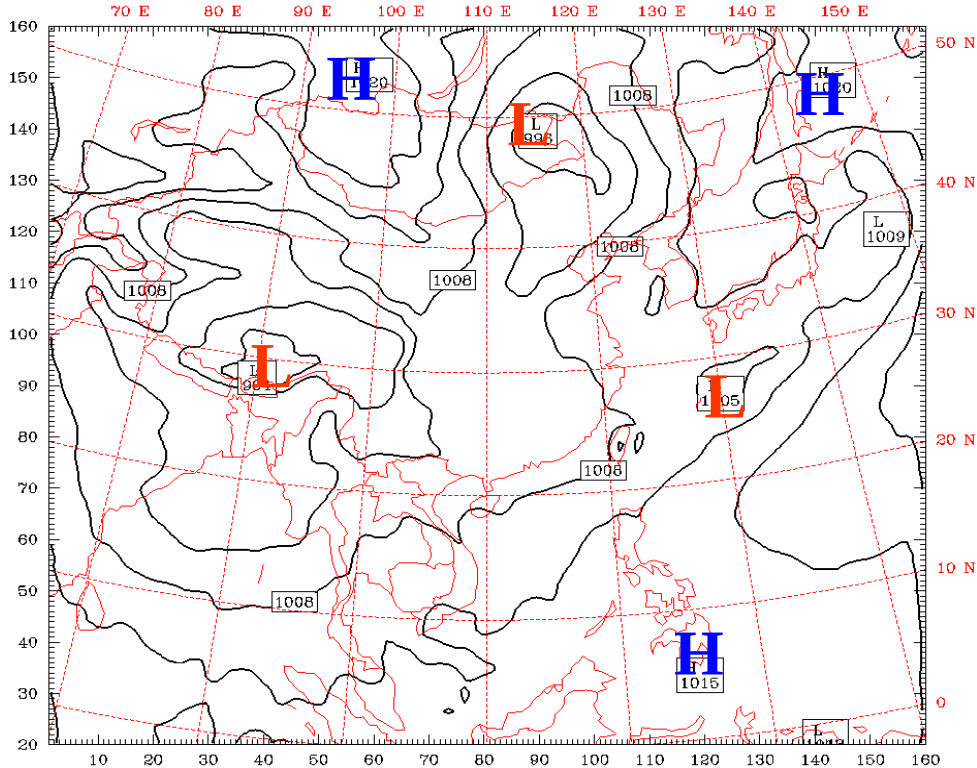
6/12 01 ~ 03 UTC (13~15 hr)

Surface map

Observation



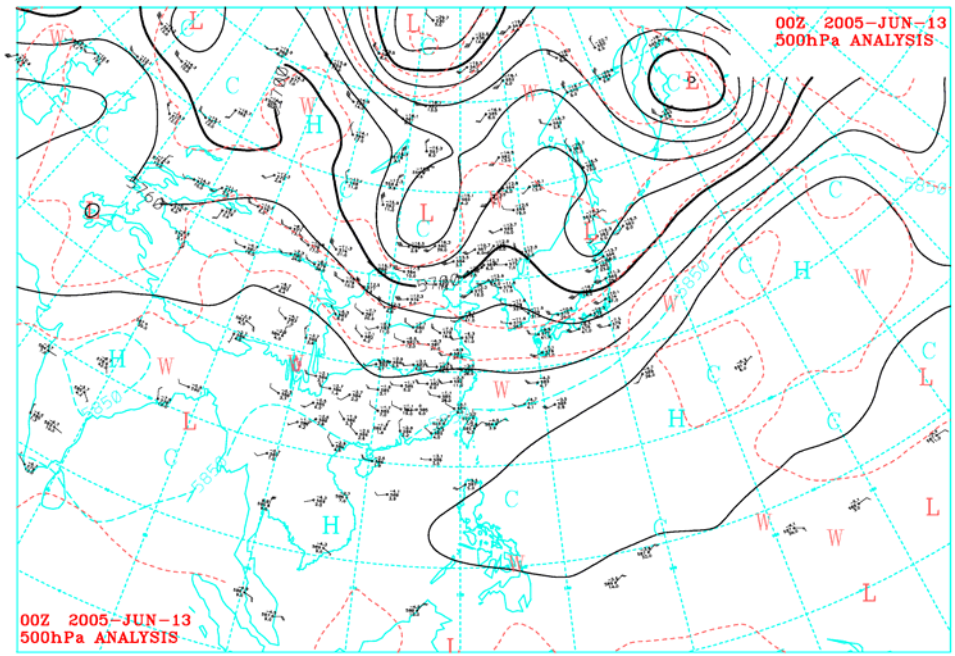
Simulation (36 h), SLP



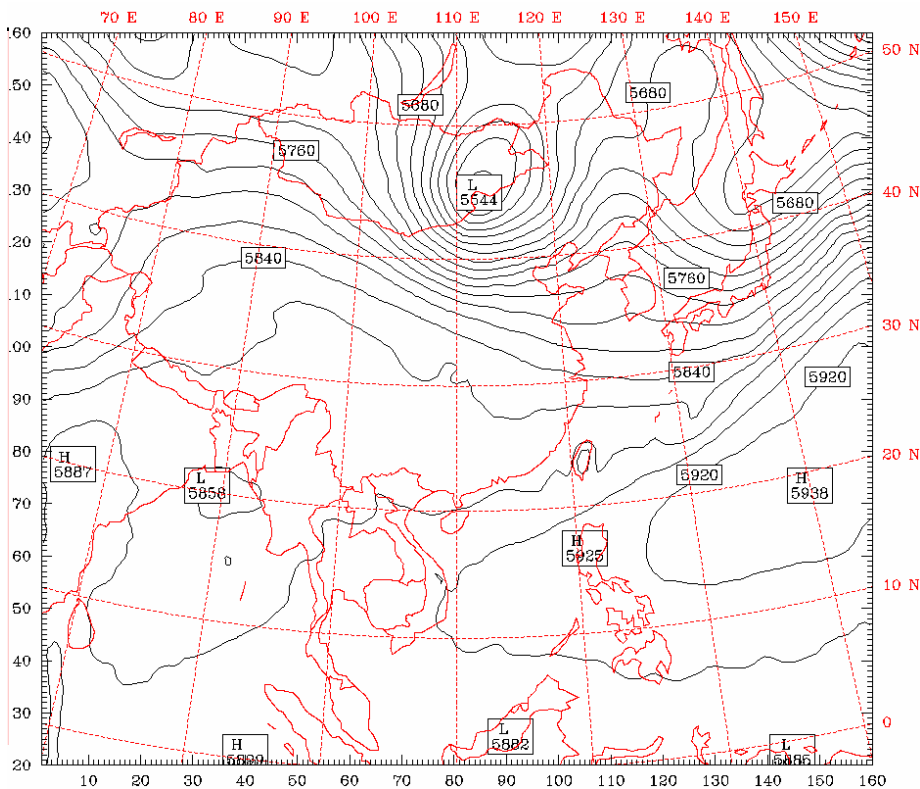
2005/6/13 0000 UTC

500 hPa map

Observation



Simulation(36h), ght



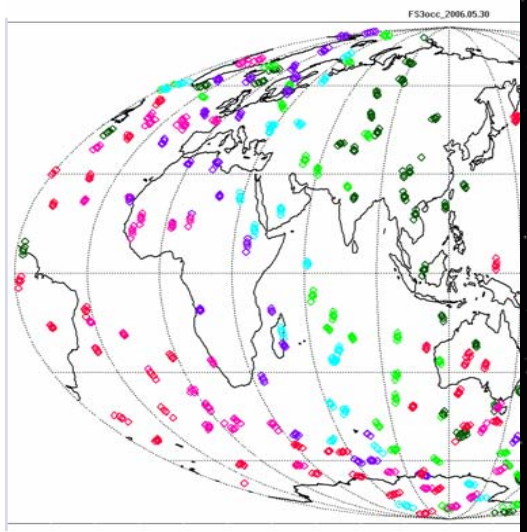
2005/6/13 0000 UTC

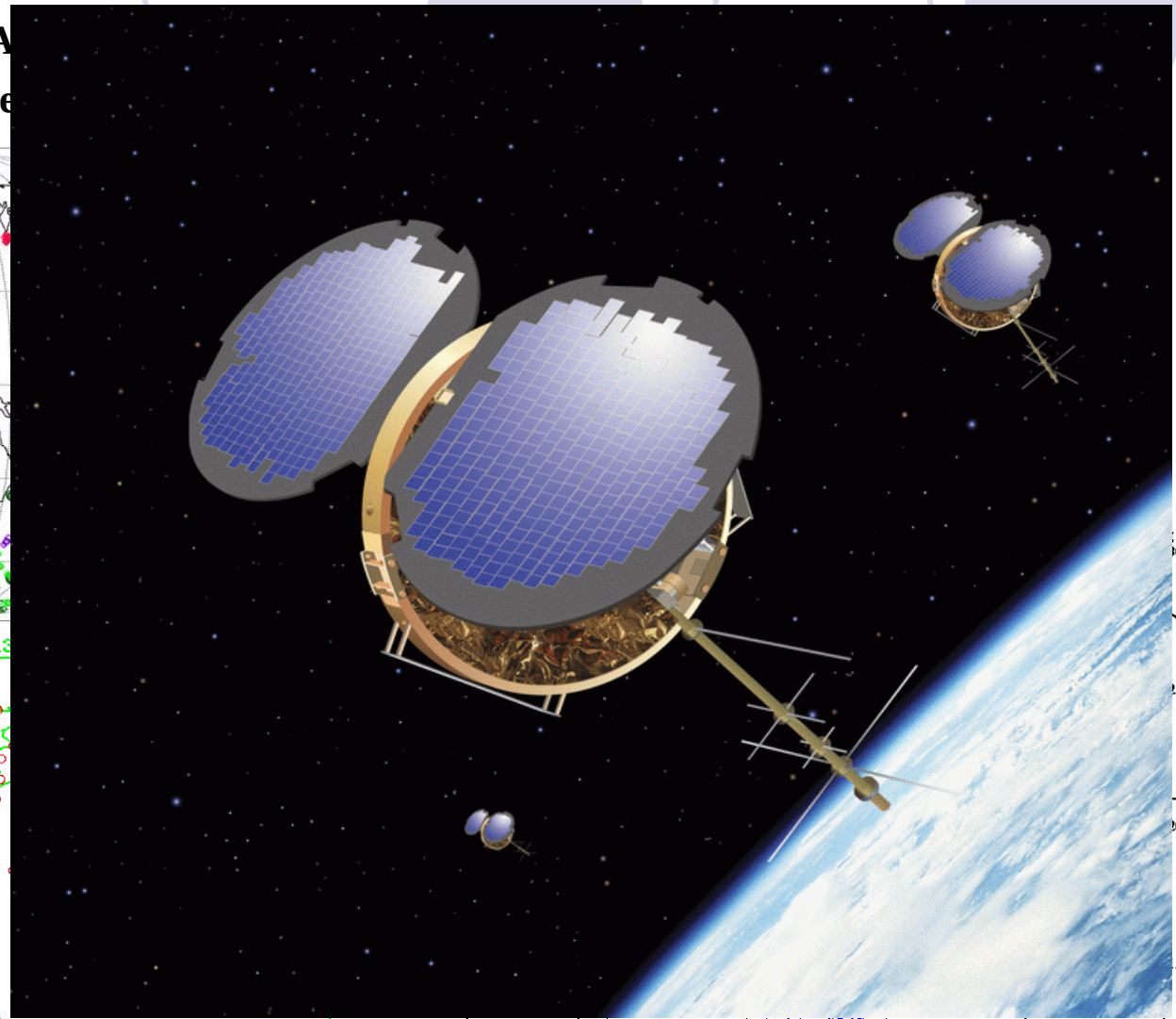
Future Work

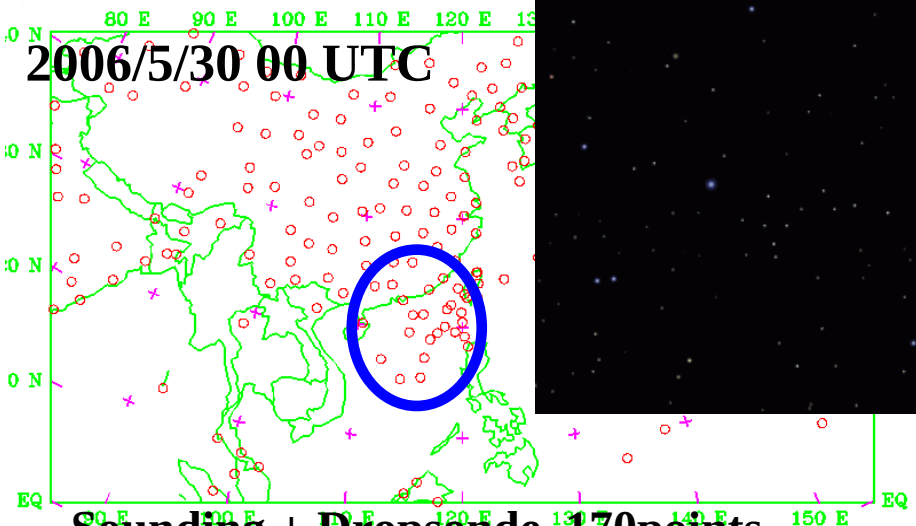
1.Dropsonde field experiment over northern SCS.

2.Validation of FORMOSA

verification for model pre





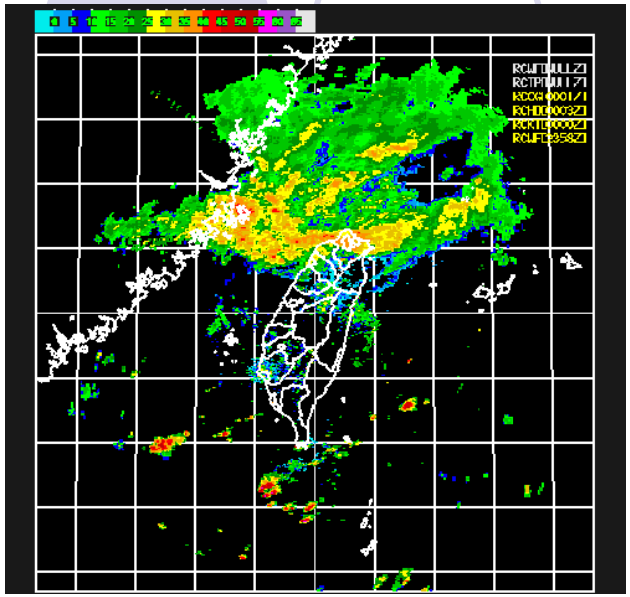


2006/5/30 00 UTC

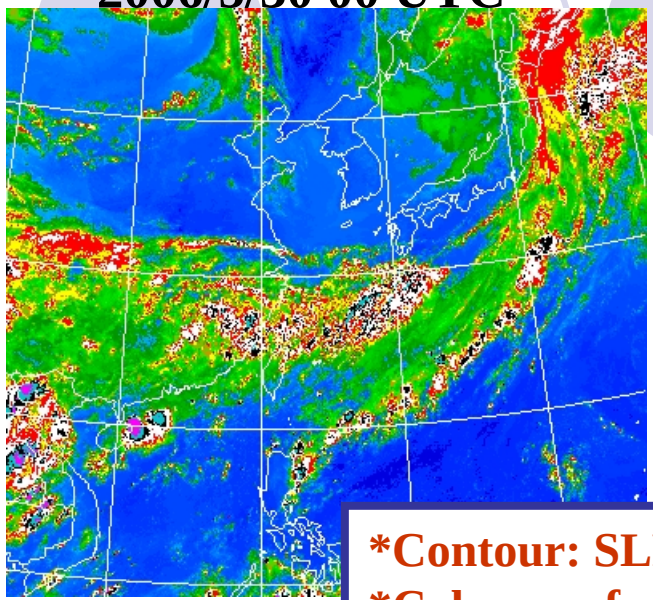
Sounding + Dropsonde, 170points

Observation

2006/5/30 00 UTC



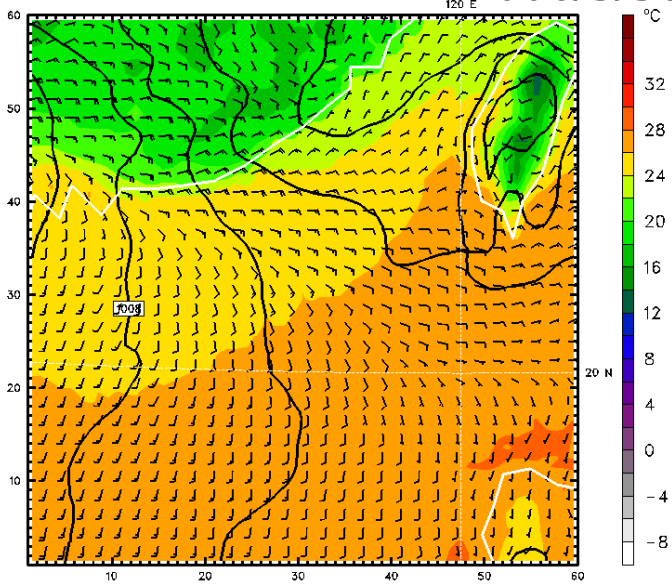
2006/5/30 00 UTC

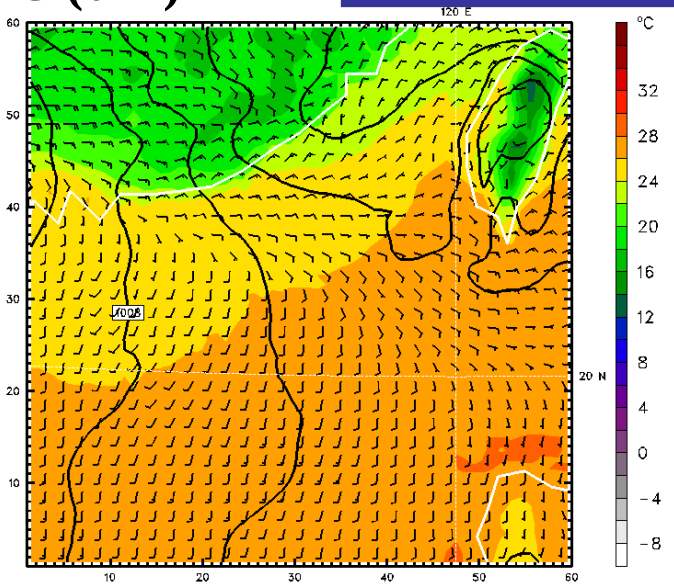


*Contour: SLP
*Color: surface air temp
*Surface wind field

No drop WRF-Var Drop

2006/5/30 00 UTC (0hr)



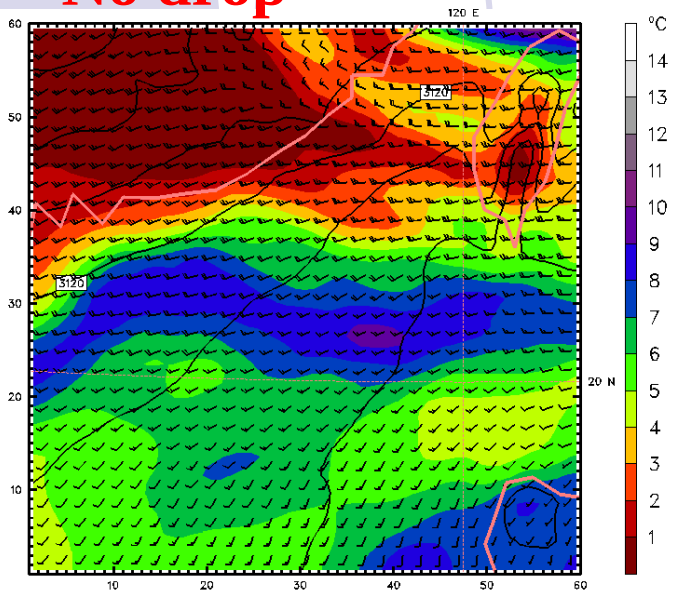


Initial time

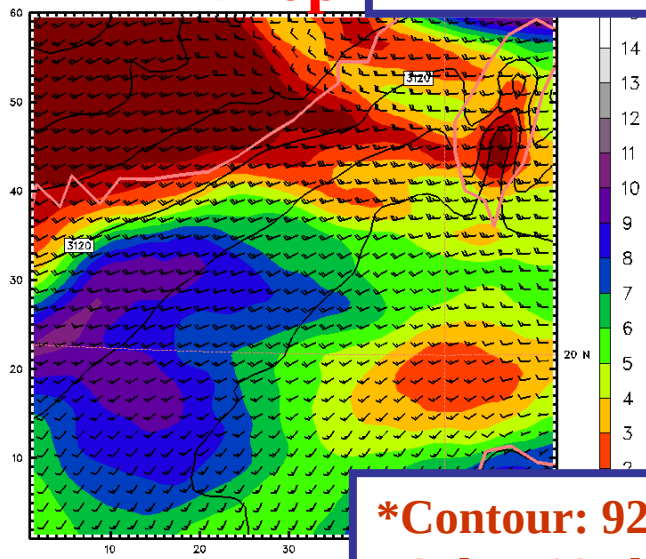
2006/5/30 00 UTC (0hr)

*Contour: 700 hPa ght
*Color: (T-Td)
*700 hPa wind field

No drop



Drop

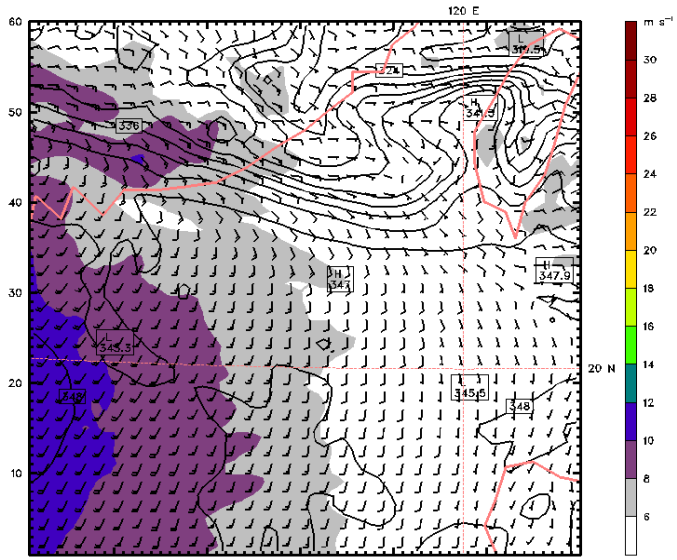


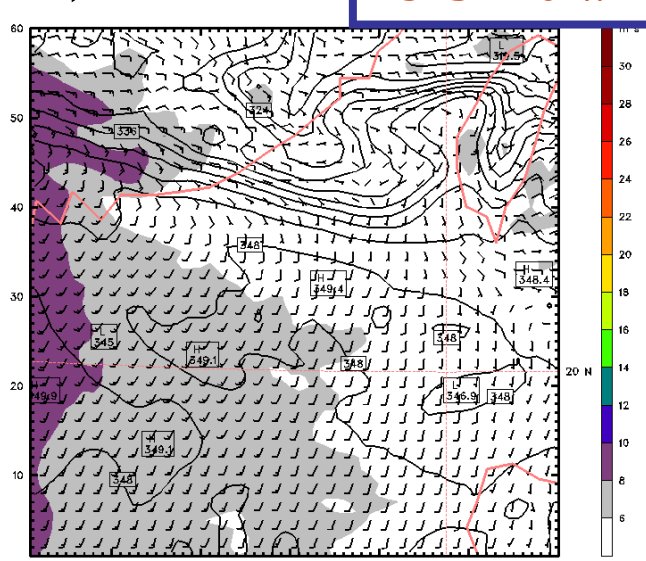
*Contour: 925 hPa θ_e
*Color: 925 hPa wsp
*925 hPa wind field

No drop

2006/5/30 00 UTC (0hr)

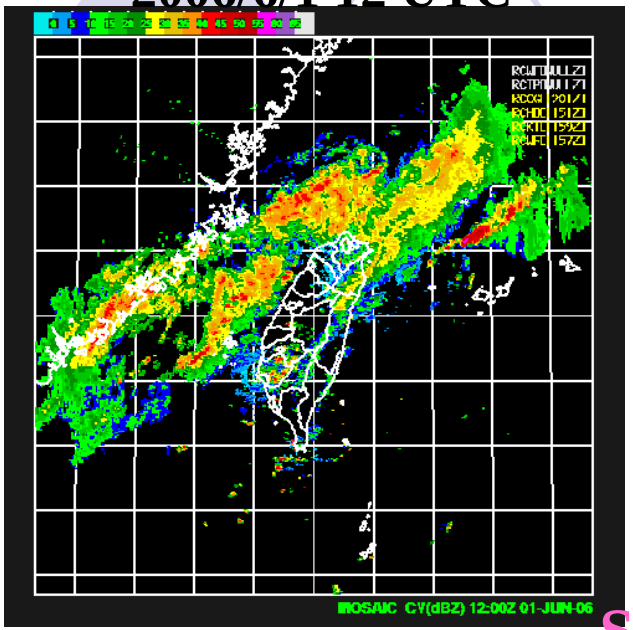
Drop



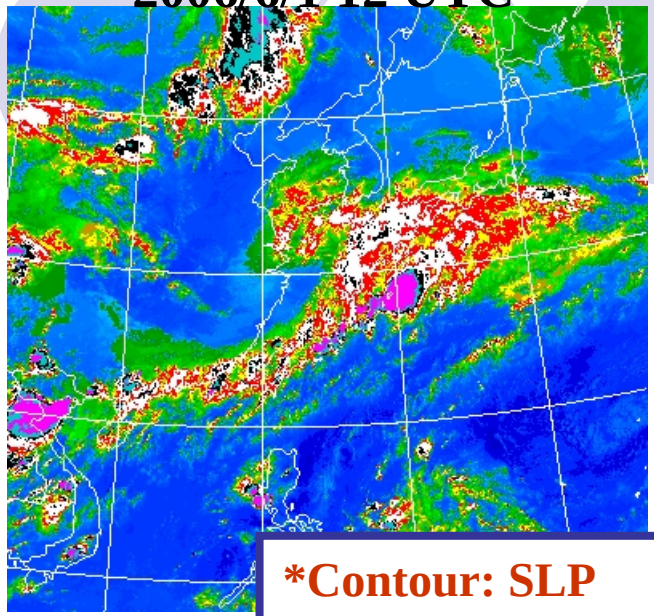


Observation

2006/6/1 12 UTC

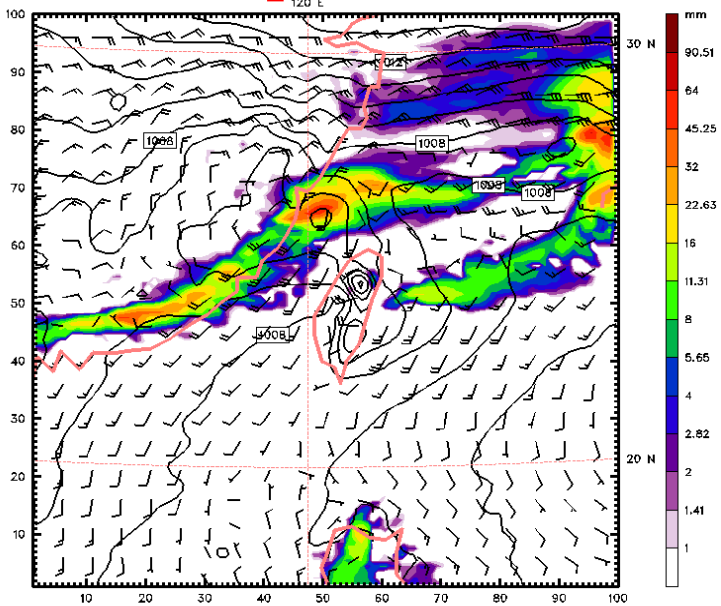


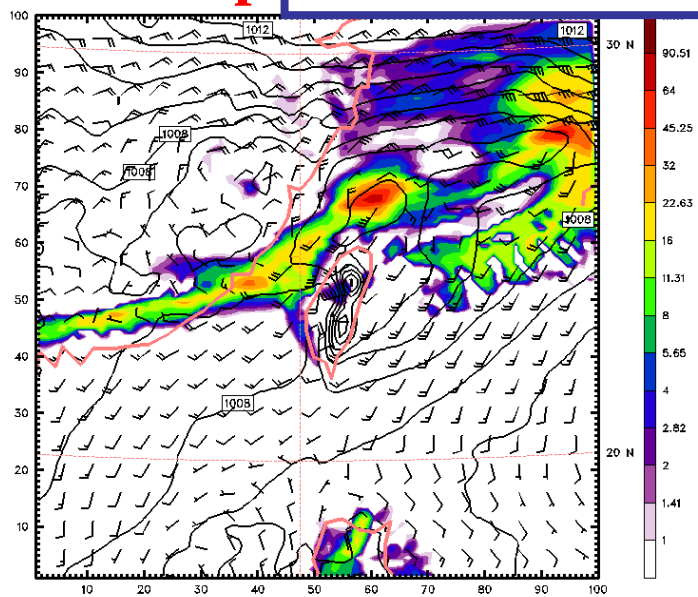
2006/6/1 12 UTC



Simulation

No drop 2006/6/1 12 UTC(60hr) **Drop**





*Contour: SLP
*Color: 3hr accum rainfall
*1000 hPa wind field

Summary

- **The real-time 15-km WRF simulated well the frontal rainband, but with not enough rainfall. The 5-km WRF performed well in simulating MCS and rainfall in Taiwan.**
- **The low-level jet in the SW flow brought moist air northeastward toward Taiwan, and producing strong convection when the potential unstable air was lifted at the places of frontal convergence or confluence flow.**
- **Low-level moisture flux convergence and vertical moisture flux divergence were large when strong convection occurred.**
- **The SW flow increased its intensity because of large PGF resulting from the westward extension of the Pacific High.**
- **By adding dropsonde data in WRF-Var, the simulation of rainfall could be improved.**