Precipitation Characteristics and Associated Environmental Conditions during SoWMEX/TiMREX

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Outline

1. Scientific Objectives of the Study
2. Data and Methodology
3. Identify significant continuous rainfall periods (SCRPs) and rainfall characteristics
4. Environmental conditions and microphysical characteristics for different rainfall types
5. Verification of simulated results
6. Concluding remarks

Warm season convective systems and prevailing winds in the monsoon regions

- Studies of monsoon from different geographic locations show nearly parallel results among wind regimes, environmental conditions and associated convective features :

Rondônia, Brazil

Regime 1

	Environment Conditions		Convection Features		
	CAPE	Midlevel Humidity	Lightning Frequency	Dominated Precipitation Type	Convection Intensity
Regime 1	Lower	Moister	Lower	Stratiform	Weaker
Regime 2	Larger	Dryer	Higher	Convective	Stronger

Halverson et al. 2002, Petersen et al. 2003, May and Ballinger 2007

Johnson et al. (2005) SCS – oceanic MCSs

Regime 2

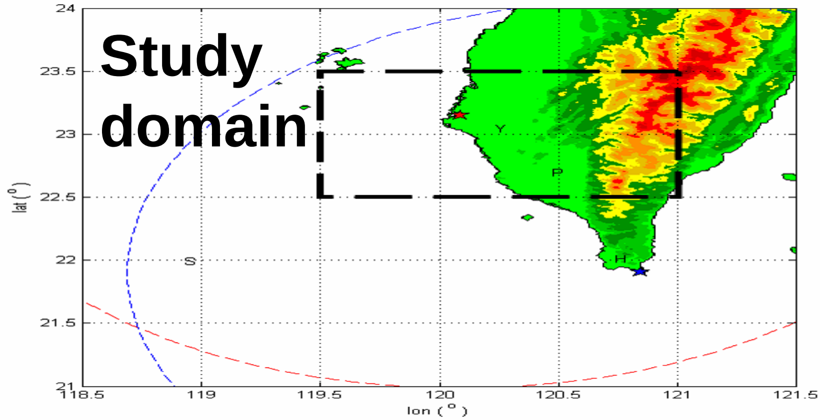
Purpose of the study

- The Mei-Yu season is the main rainy season of Taiwan which has rainfall peak frequently occurring on the windward side of southwestern Taiwan. SoWMEX/TiMREX provides high-resolution data in SW Taiwan for a better understanding of the precipitation systems under the influence of southwesterly flow during the Mei-Yu season.

- Significant continuous rainfall periods are identified and the rainfall characteristics, environmental conditions, and microphysical parameters are analyzed.

- Rainfall simulation results from WRF is verified by the SoWMEX/TiMREX data and the implication is suggested.

Data and Methodology



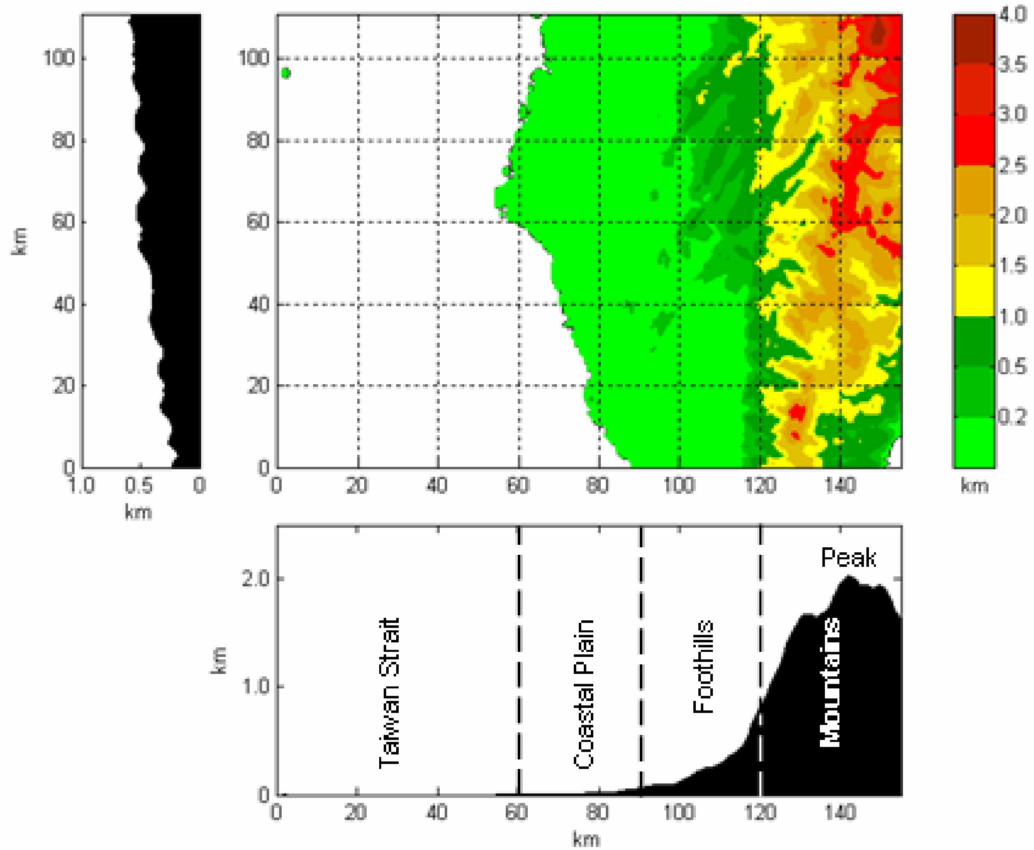
Identify SCRPs

- **Radar composite (10 min)**

1)Radar-derived rainfall rate (5.5mm/h in continuous 3 hours) $Z = 32.5\ R^{1.65}$

2) Precipitation type (Con./Str.) Steiner et al. (1995)

- **Lightning,** Frequency and density.



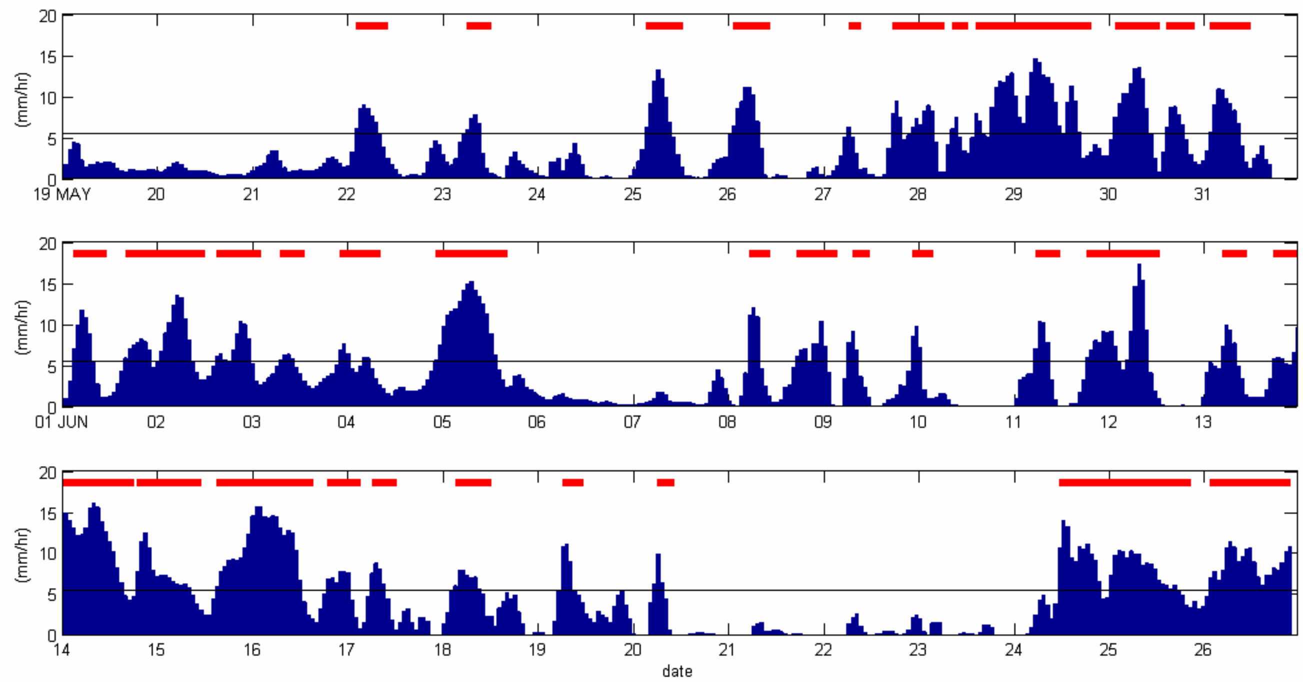
Environment regime

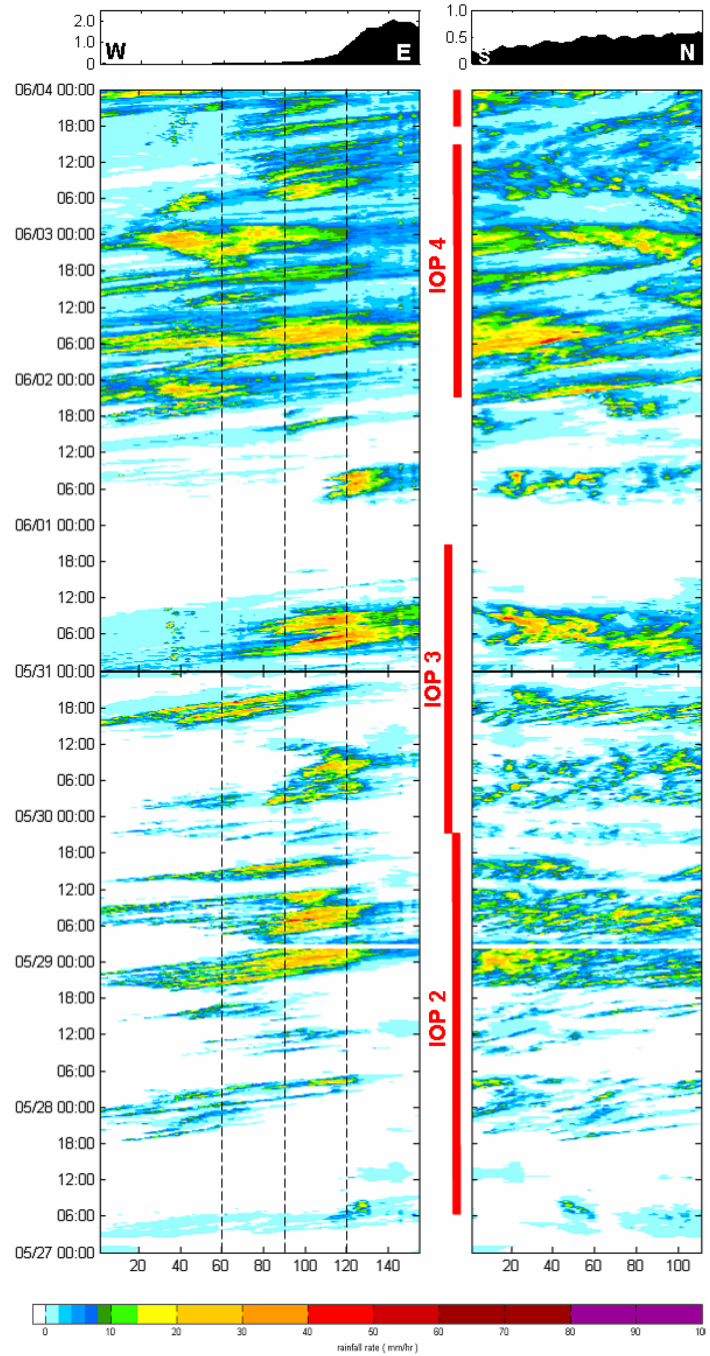
Storm development upstream condition: thermodynamic and dynamical.

Identify Significant Continuous Rainfall Period

- **Study period: SOP(05/19 ~ 06/26)**

By setting an arbitrary threshold of 5.5 mmh^{-1} for the successive 3-hour period averaged rainfall intensity of the rainfall area in our domain, 34 SCRPs were identified.



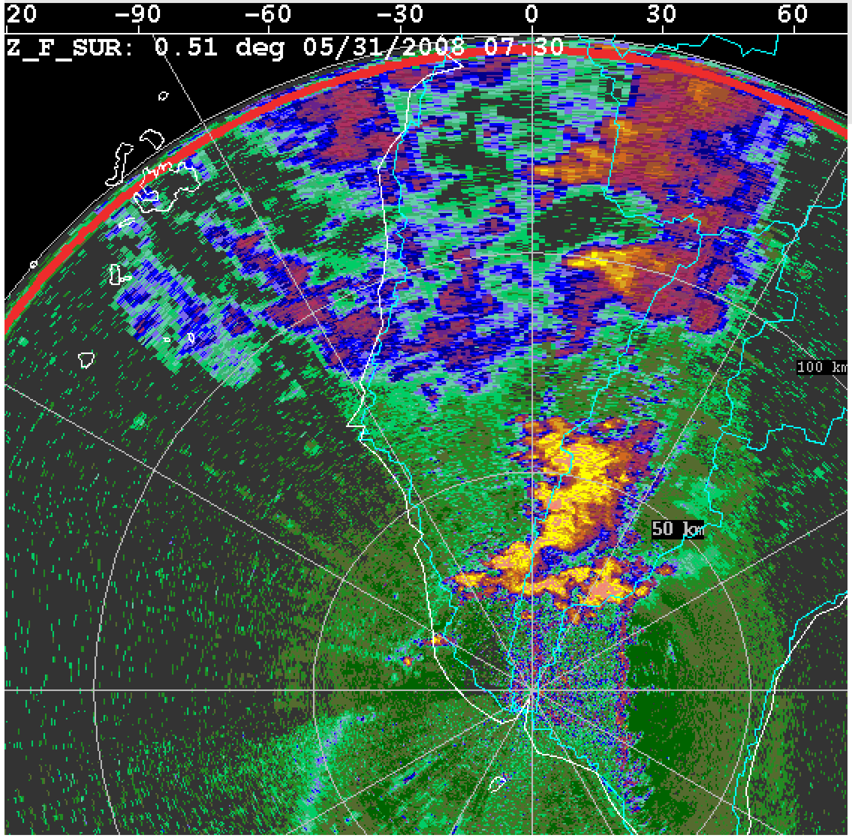


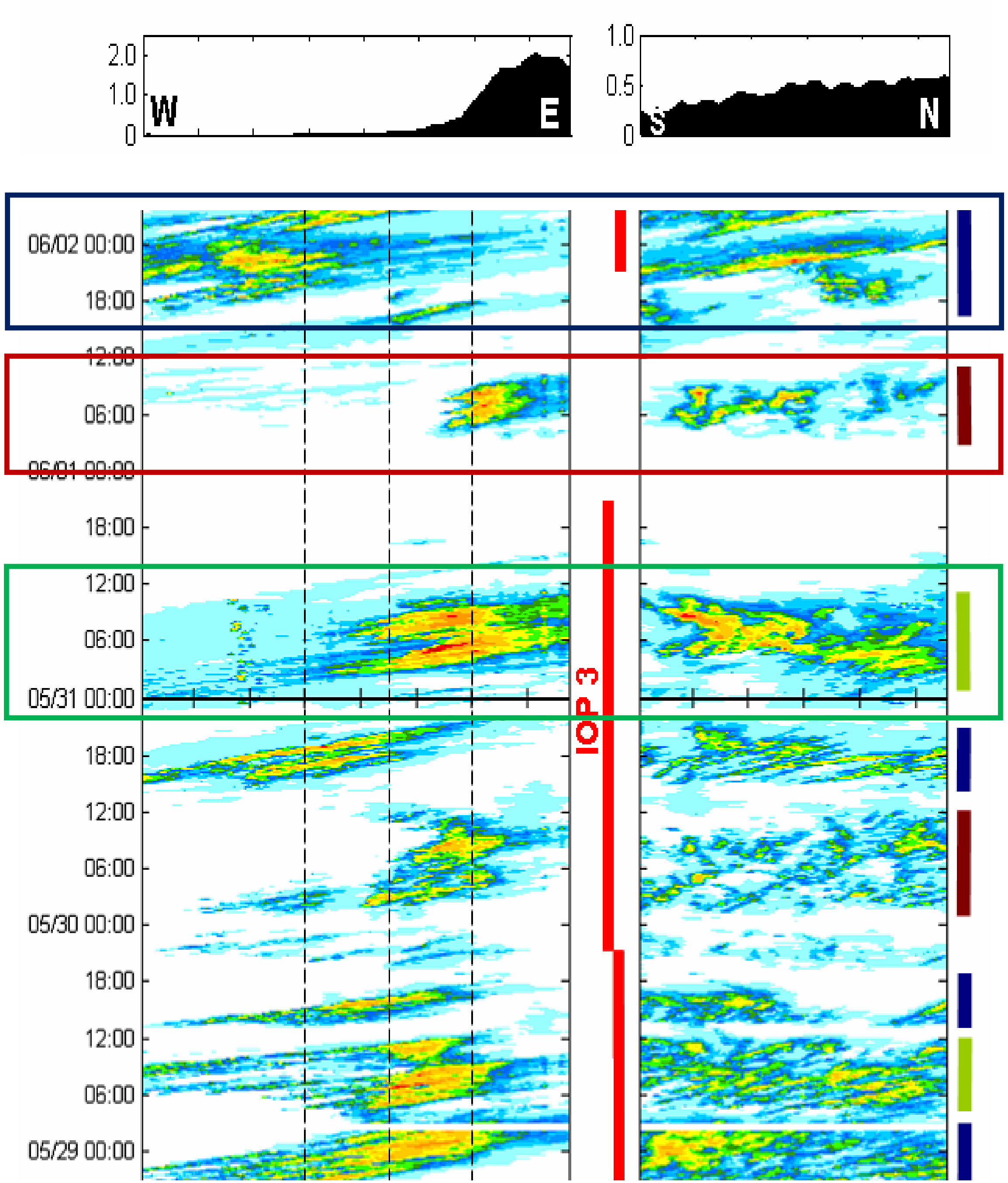
3 types of SCRPs are identified to characterize the origin of initiation

1) Land type……(L) 18

2) Ocean type….(O) 17

3) Mixed type…..(M) 5

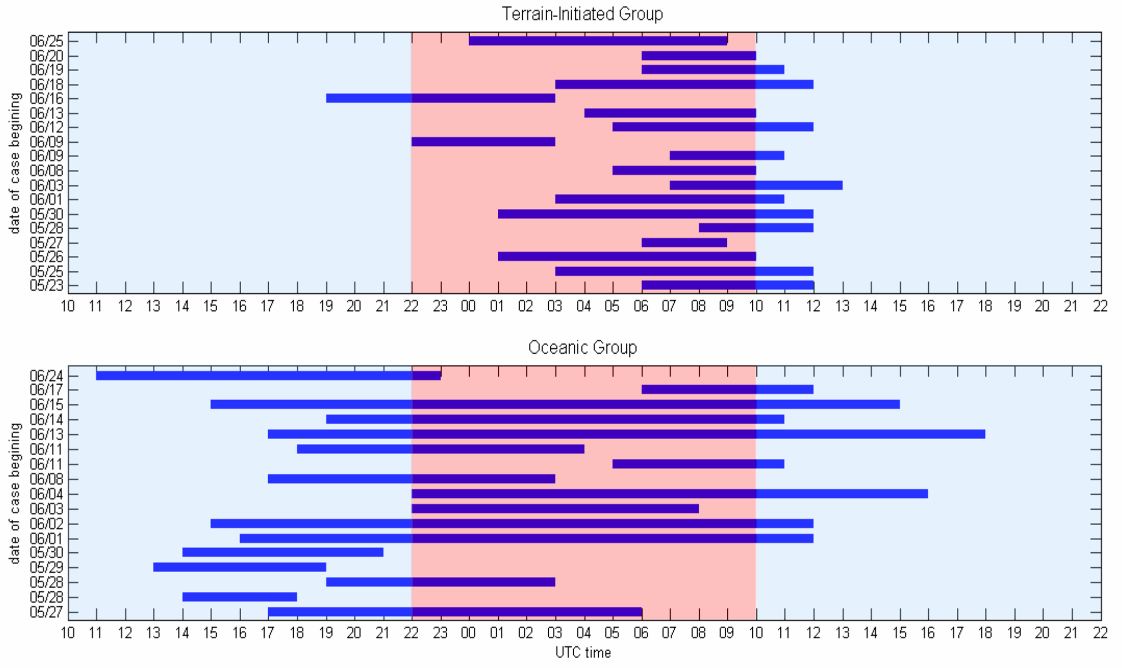


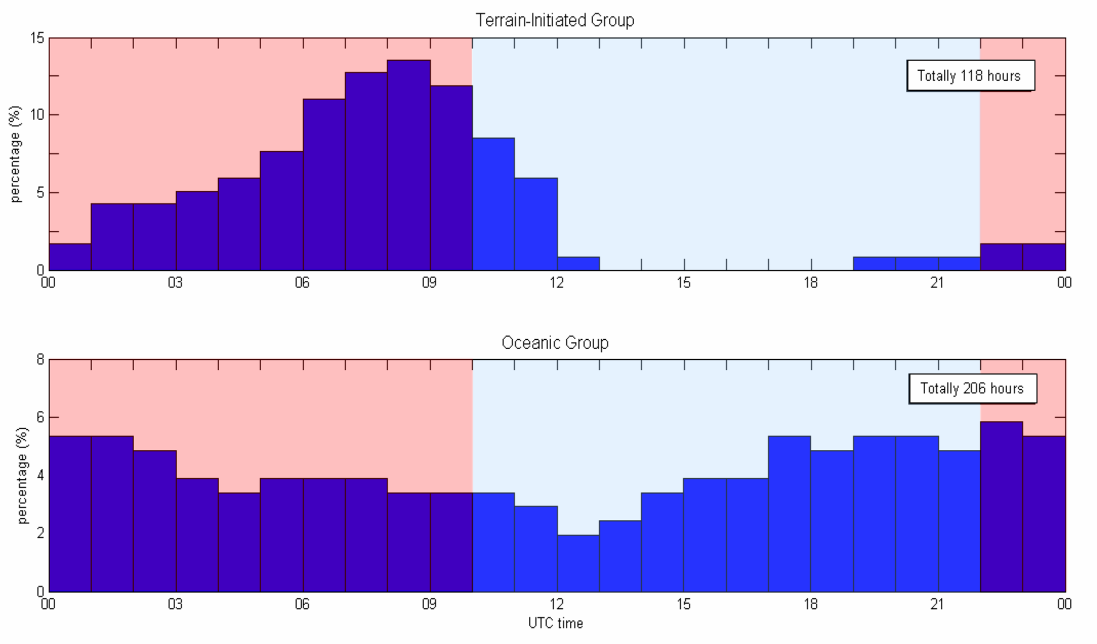


Temporal Characteristics

6am-6pm

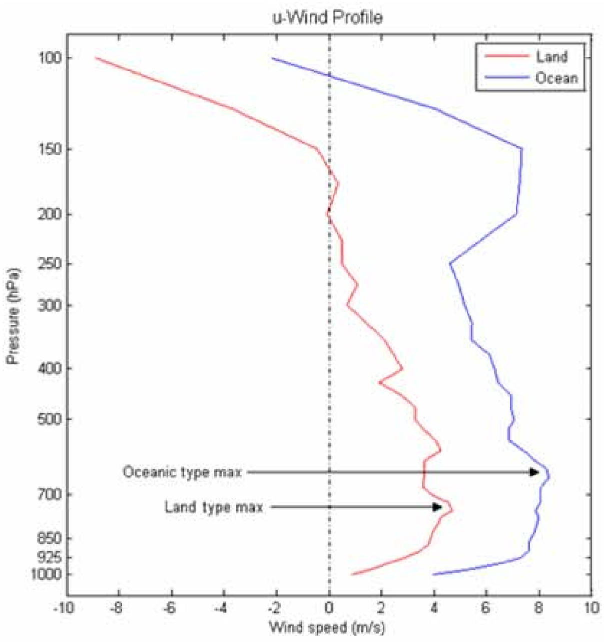
- The O-type events have almost **twice** longer duration than L-type.
- Most L-type events have their beginning in daytime, and 76% of O-type events originate in the nighttime or earlier morning.

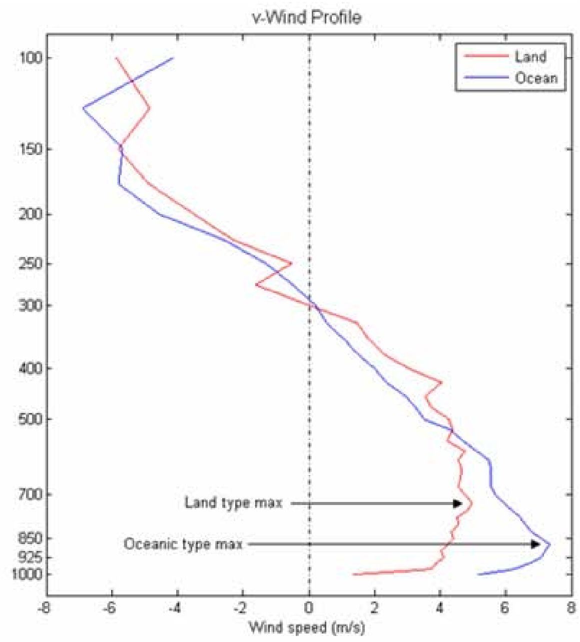


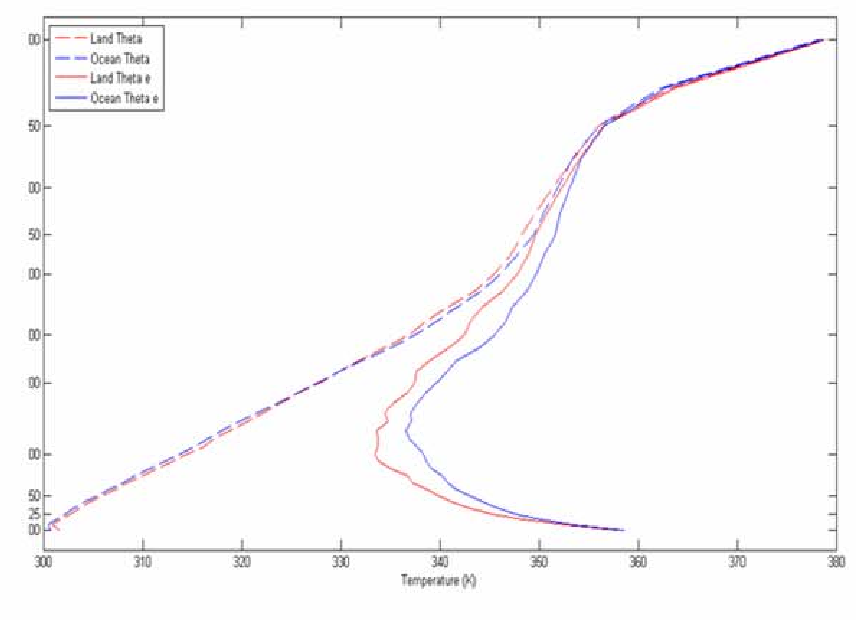


- Significant diurnal cycle signal in the L-type events associated with afternoon maximum, whereas the O-type events possess nearly equivalent probability in all times.

Environment and precipitation characteristics: U and V components of wind, theta, theta-e, lightning, and conv/stra partition for land and ocean events



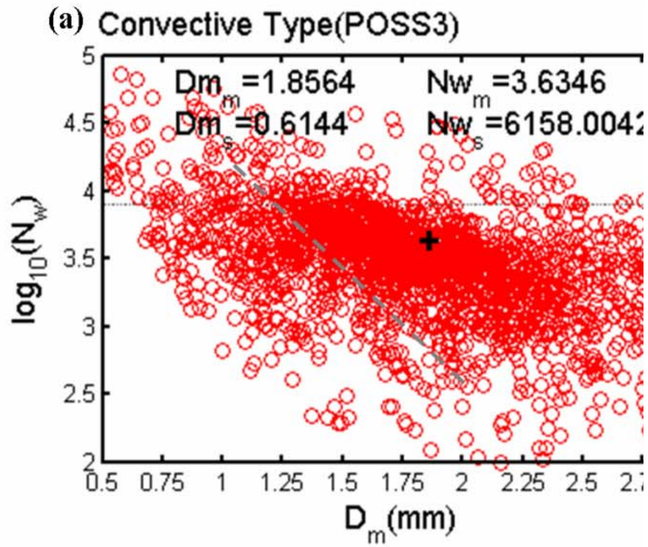


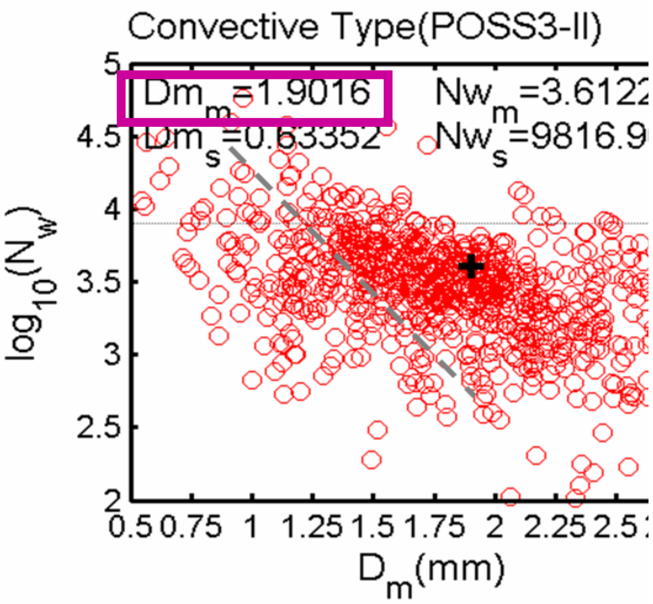


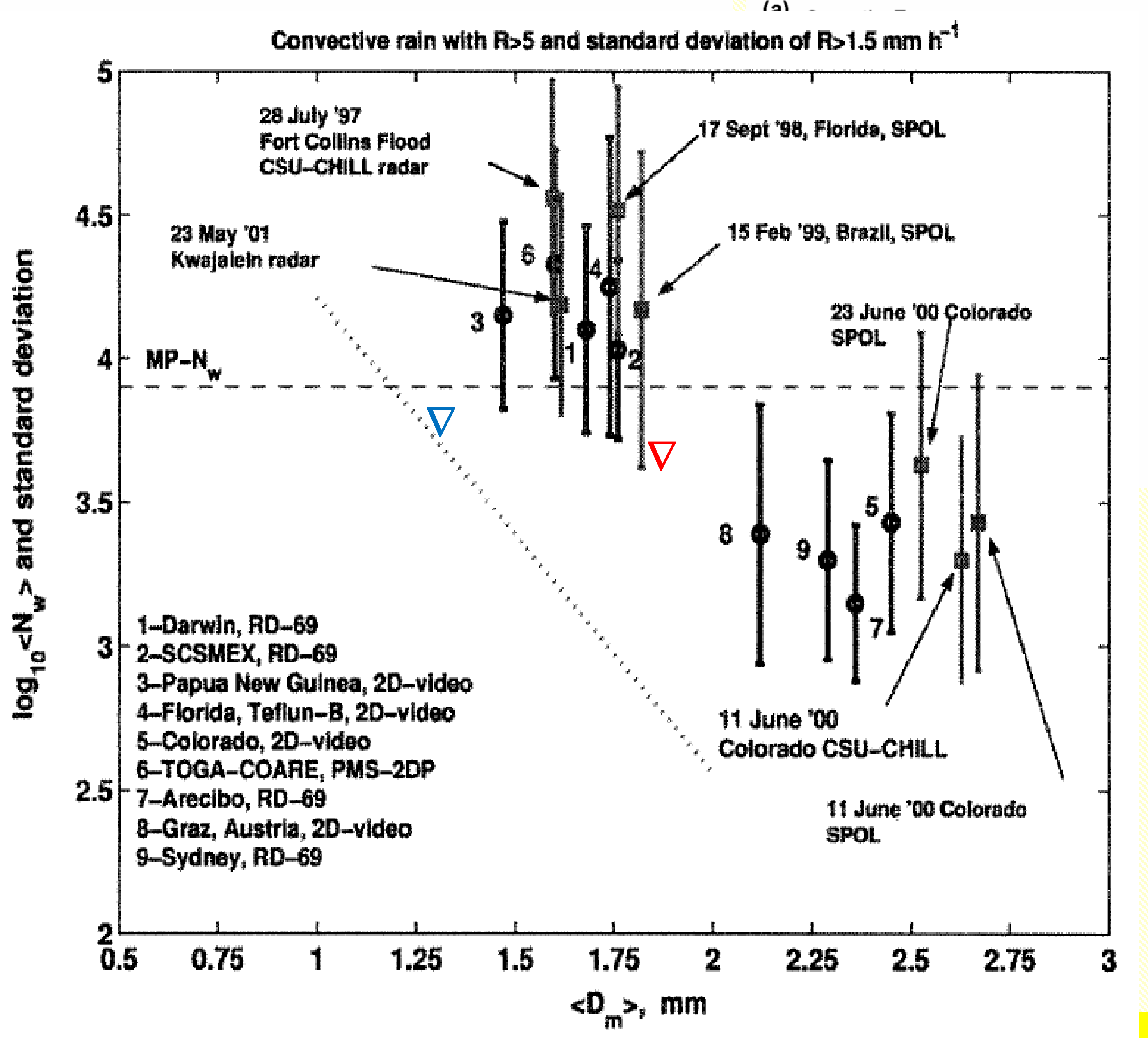
Property / MCSs	Duration (h)	Lightning Frequency (#/h)	Lightning Density (#/h km^2)	Conv / Stra rain area in %
All	9.6	95	0.092	59 / 41
Land (18)	6.6	48	0.181	64 / 36
Oceanic (17)	12.1	113	0.024	54 / 46
Mixed (5)	11.8	189	0.025	61 / 39

Supersite POSS (III)

From Bringi et al. (2003)

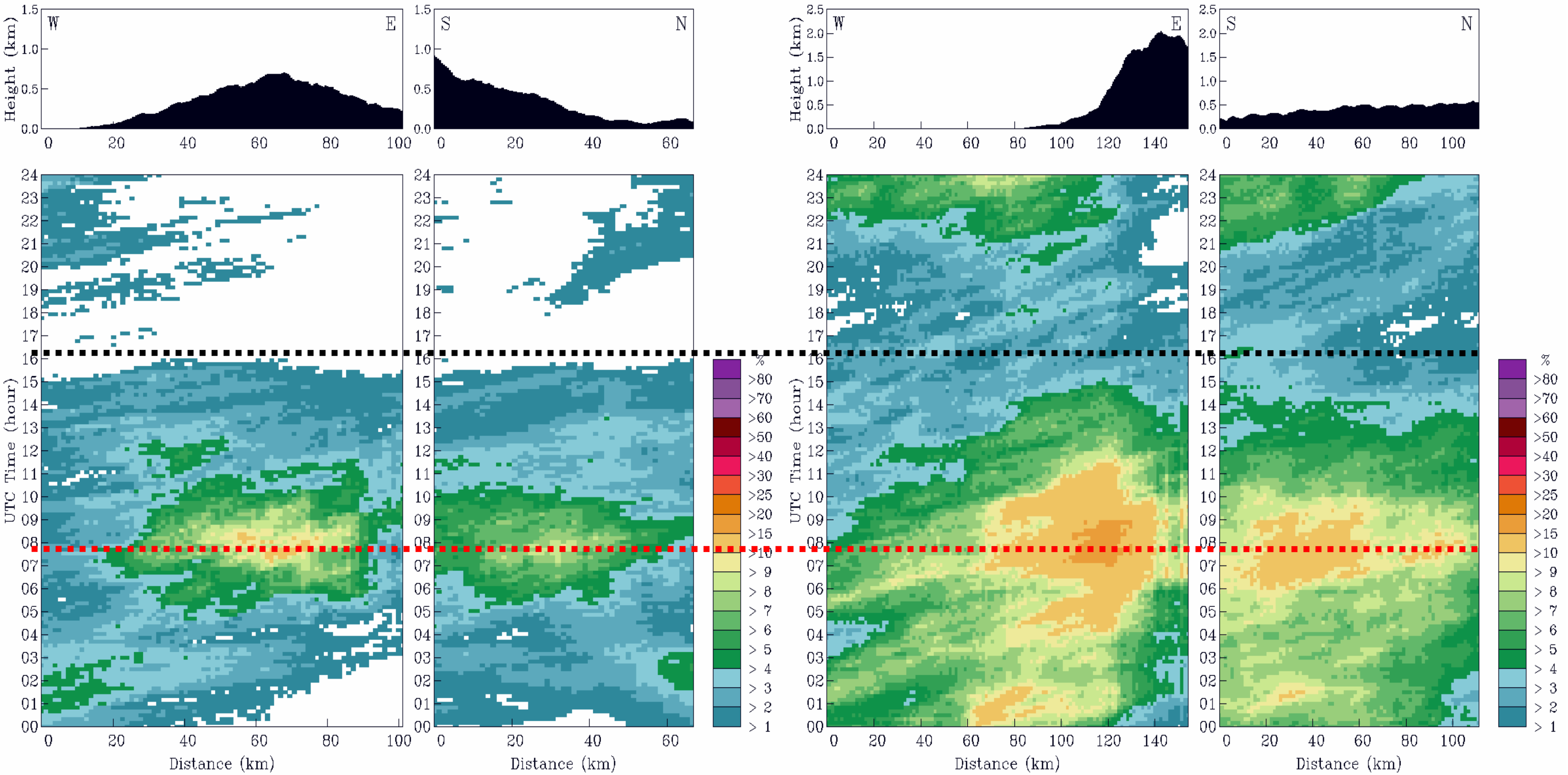




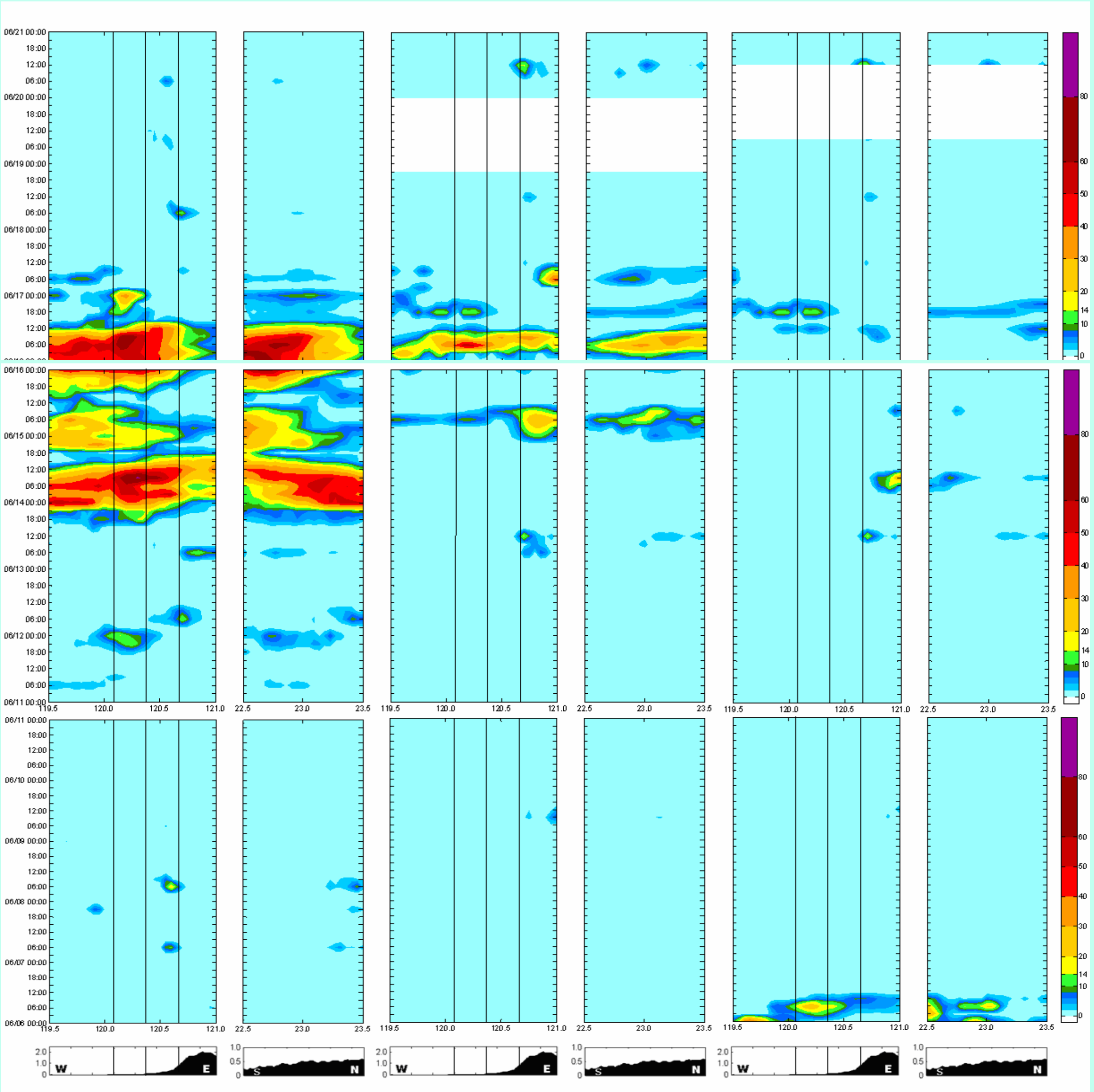


SPOL RHI 39° data

Diurnal variability of occurrence frequency of convective activity in northern (L) and southern (R) Taiwan during SoWMEX/TiMREX period (May 15-June 30, 2008)
(North: 24.6~25.2N, 120.8~121.8E; South: 22.5~23.5N, 119.5~121.0E)



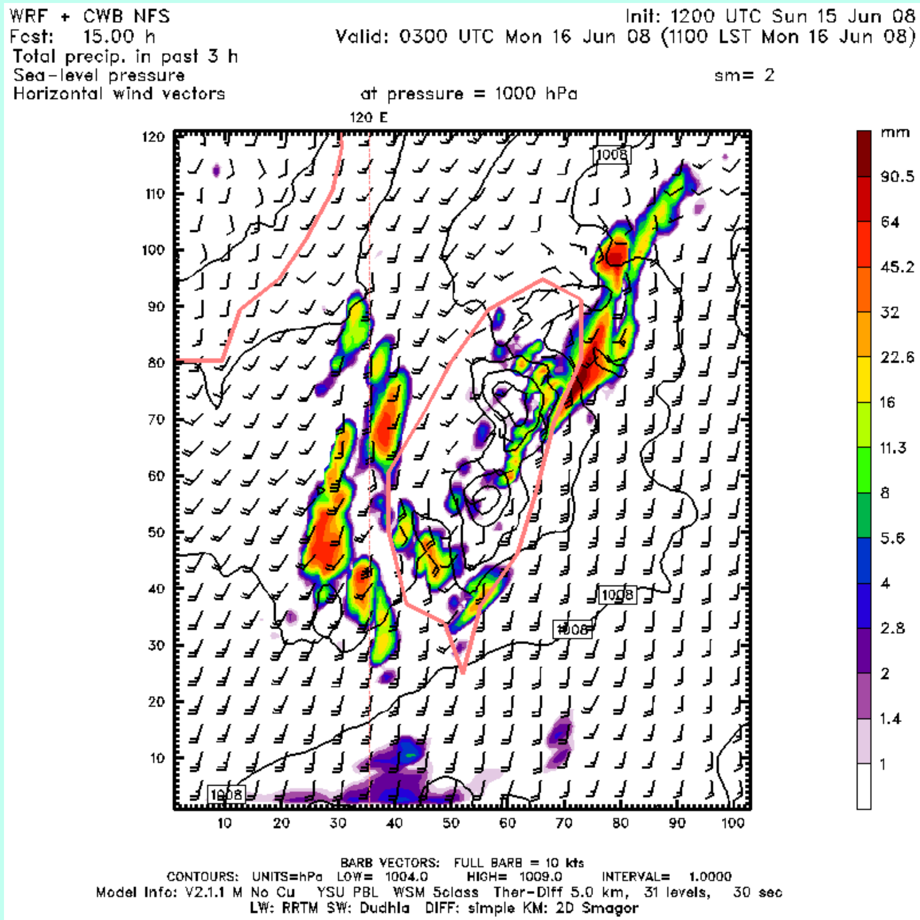
WRF model verification using QPESUMS, 5 km resolution, from 6-20 June 2009



QPESUMS

Fcst period: 12~36 hr

Fcst period: 24~48 hr



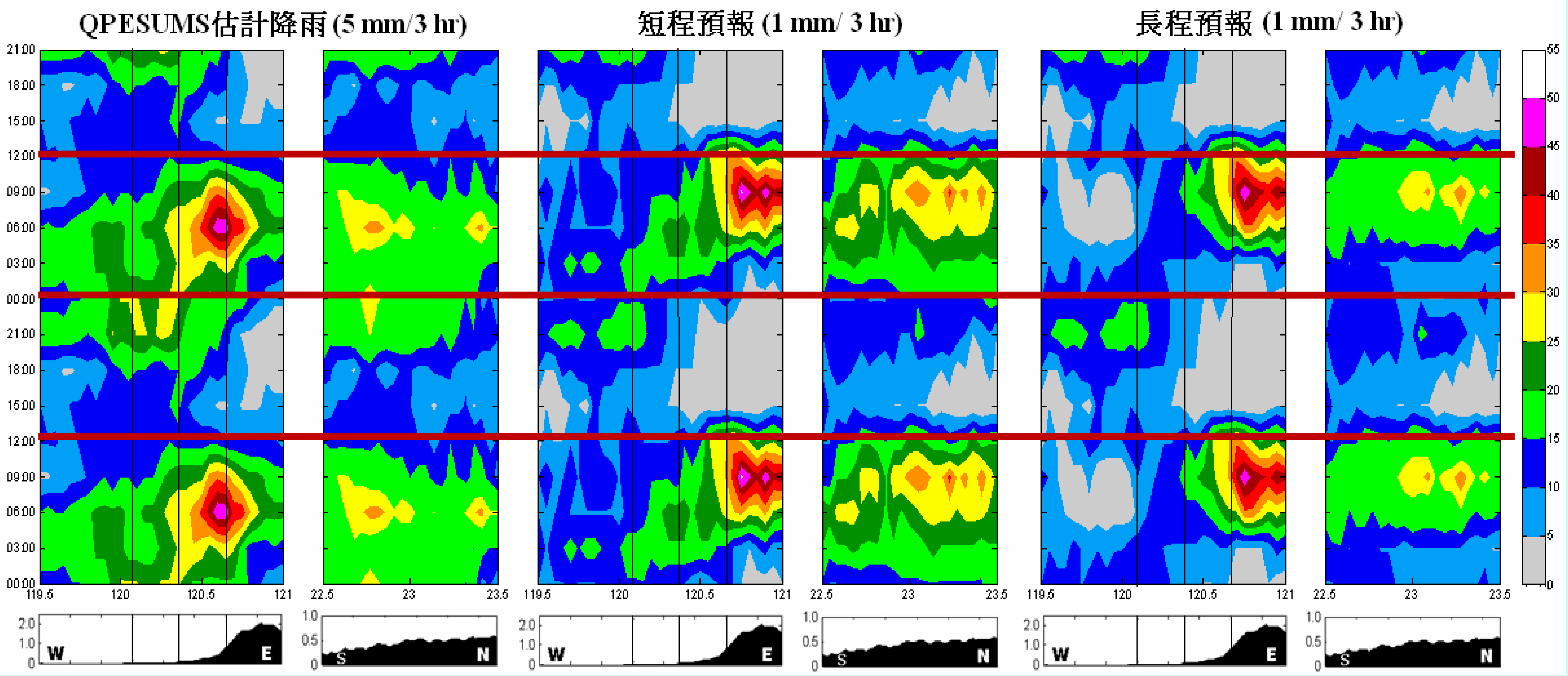
High resolution run once every 24 hrs using 12UTC as initial condition

Model verification for diurnal variability of rainfall during the SoWMEX/TiMREX (6-25 June 2009)

QPESUMS

Fcst period: 12~36 hr

Fcst period: 24~48 hr



Concluding remarks (1/2)

- The SCRPs can be identified as: land, oceanic, and mixed types of rainfall systems. In general, the oceanic and mixed types have longer duration than land type and prefer to be initiated (or propagated into the land) during the nighttime or early morning.

- The environment regime for the land type events is similar to the break (buildup), easterly, and northerly regime in Australia, Brazil and East Pacific. This regime has higher CAPE, relatively weaker prevailing flow, and drier troposphere. The land type systems generate higher convective areal fraction and more active lightning activity.

- Pronounced diurnal cycle is not only over terrain but also over the plain area and which is highly correlated with the afternoon thunderstorms. The ocean and plain areas show significant signal of early morning activity with a smaller frequency.

Concluding remarks (2/2)

- The DSD of the stratiform component of the monsoon rainfall systems over south Taiwan shows a similar characteristic value as that measured in the other of the world. The convective component, however, has **a larger size** but **less number density** than others.

- Model verification results suggest the high resolution simulation has captured the major precipitation features during the experiment period, however, the intensity is weaker. The profound diurnal cycle has simulated well but the location and the timing shifted to higher mountain and to a later time.

~ The End ~

Thanks for Your Attention !