

# Changes in precipitation frequency, intensity and duration in the vicinity of Taiwan

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# 不同模式不同情境下的降雨頻率與強度變化

1 OCTOBER 2007

SUN ET AL.

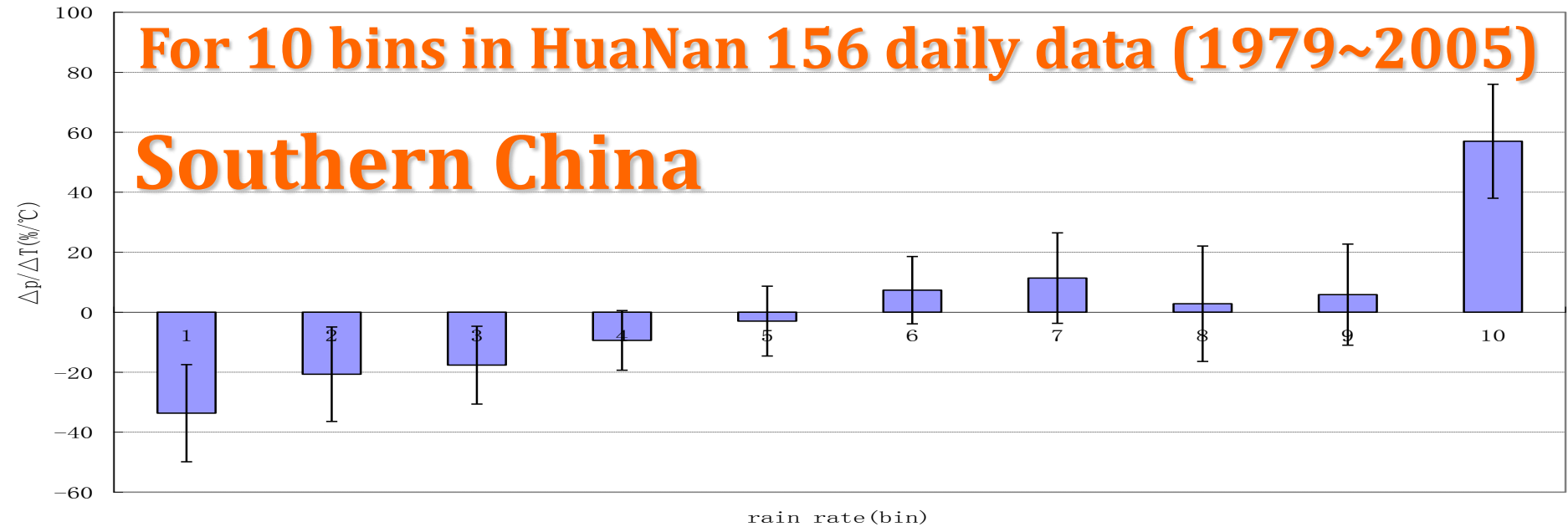
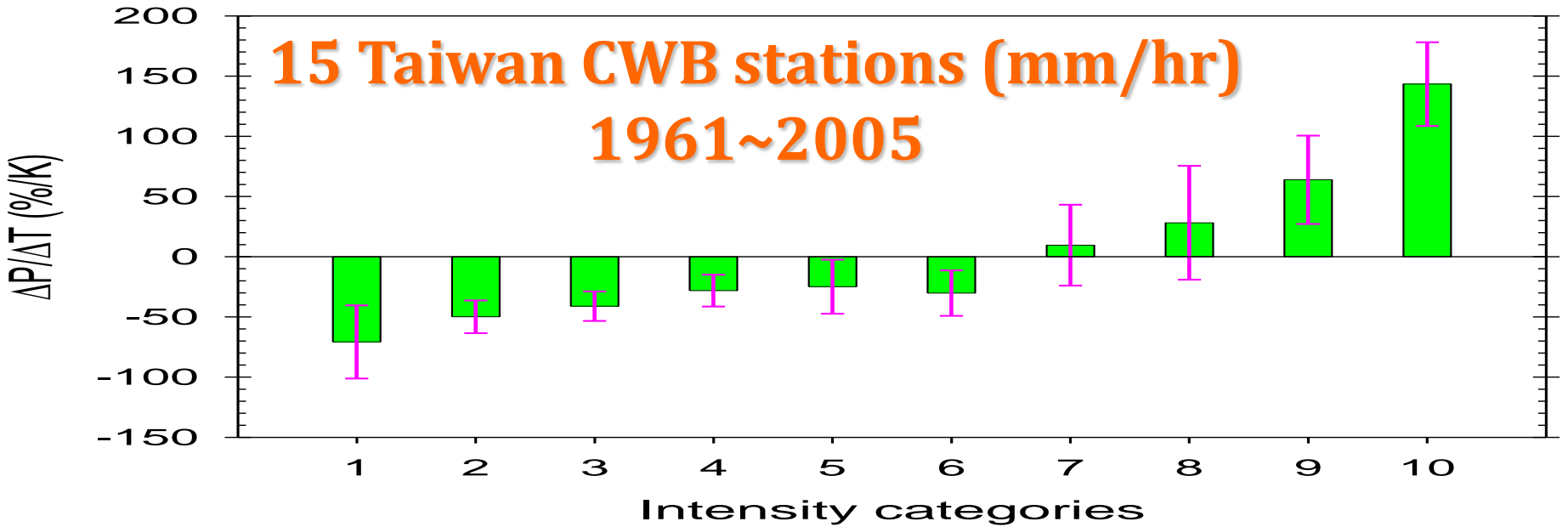
4803

TABLE 1. Percentage changes from 1980–99 to 2080–99 in globally averaged total precipitation amount (Pr), frequency (Freq), intensity (Inten), convective precipitation amount (Prc), and absolute changes in surface air temperature for SRES B1 scenario (Tas). The second column shows the letters used for different models in Figs. 3–5.

Model name	Model symbol	Pr (%)	Freq (%)	Inten (%)	Prc (%)	Tas (K)
CGCM3.1(T47)	A	3.28	0.05	3.14	0.88	1.58
CGCM3.1(T63)	B	4.46	0.44	3.92	3.00	2.16
CNRM-CM3	C	2.46	-0.34	3.23	1.86	1.61
CSIRO Mk3.0	D	1.84			1.79	1.07
GFDL CM2.0	E	3.41	0.17	3.14	0.76	1.98
GFDL CM2.1	F	2.14	-0.06	2.20	-0.72	1.56
GISS-ER	H	3.12	0.13	2.98	5.06	1.42
FGOALS-g1.0	K	2.10	0.66	2.43	2.56	1.64
INM-CM3.0	L	3.80	-0.57	4.69	6.44	1.97
IPSL CM4	M	4.92	-0.44	5.39	4.19	2.14
MIROC3.2(hires)	N	5.42	-0.90	6.86	6.08	3.07
MIROC3.2(midres)	R	3.74	-0.49	4.09	7.14	2.22
ECHAM5	S	4.20	-2.44	7.18	4.11	2.16
MRI CGCM2.3.2	T	3.35			4.14	1.48
CCSM3	W	3.92	0.55	3.85	4.86	1.54
PCM	X	4.69	0.22	3.67	5.41	1.42
UKMO-HadCM3	Z	2.08			2.48	1.91
Average		3.47	-0.22	4.06	3.53	1.82

TABLE 2. Same as in Table 1, except for SRES A2.

Model name	Model Symbol	Pr (%)	Freq (%)	Inten (%)	Prc (%)	Tas (K)
CGCM3.1(T47)	A	6.16	-0.43	6.39	0.65	3.18
CGCM3.1(T63)	B					
CNRM-CM3	C	5.13	-1.01	7.11	3.49	3.42
CSIRO Mk3.0	D	4.28			4.35	2.57
GFDL CM2.0	E	2.59	-0.78	2.52	-5.08	3.26
GFDL CM2.1	F	1.67	-0.79	2.35	-5.85	3.01
GISS-ER	H	4.90	-0.10	4.87	8.47	2.68
FGOALS-g1.0	K					
INM-CM3.0	L	5.49	-1.58	7.33	10.41	3.25
IPSL CM4	M	7.49	-1.51	8.62	4.43	3.53
MIROC3.2(hires)	N					
MIROC3.2(medres)	R	4.01	-1.28	5.41	6.85	3.61
ECHAM5	S	6.12	-4.04	12.02	5.54	3.49
MRI CGCM2.3.2	T	5.41			6.54	2.54
CCSM3	W	7.26	0.43	7.68	8.60	3.58
PCM	X	3.81	-0.006	4.24	4.10	2.27
UKMO-HadCM3	Z	2.78			2.92	3.28
Average		4.80	-1.0	6.23	4.00	3.12



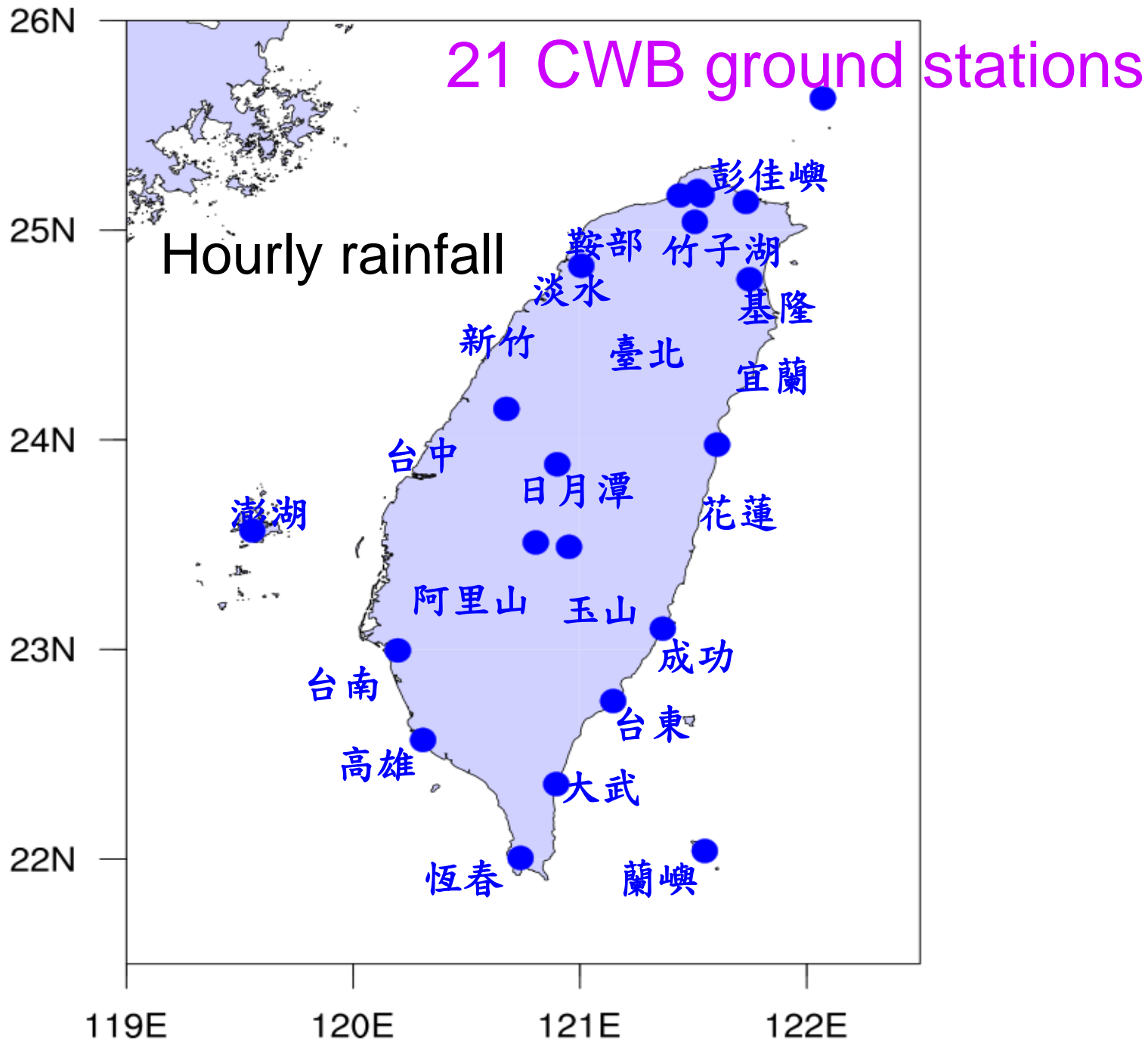
Liu, S. C., C. Fu, C.-J. Shiu, J.-P. Chen, and F. Wu (2009), Temperature dependence of global precipitation extremes, *Geophys. Res. Lett.*, 36, L17702, doi:10.1029/2009GL040218

# Typhoon and non-typhoon rainfall

➤ Frequency

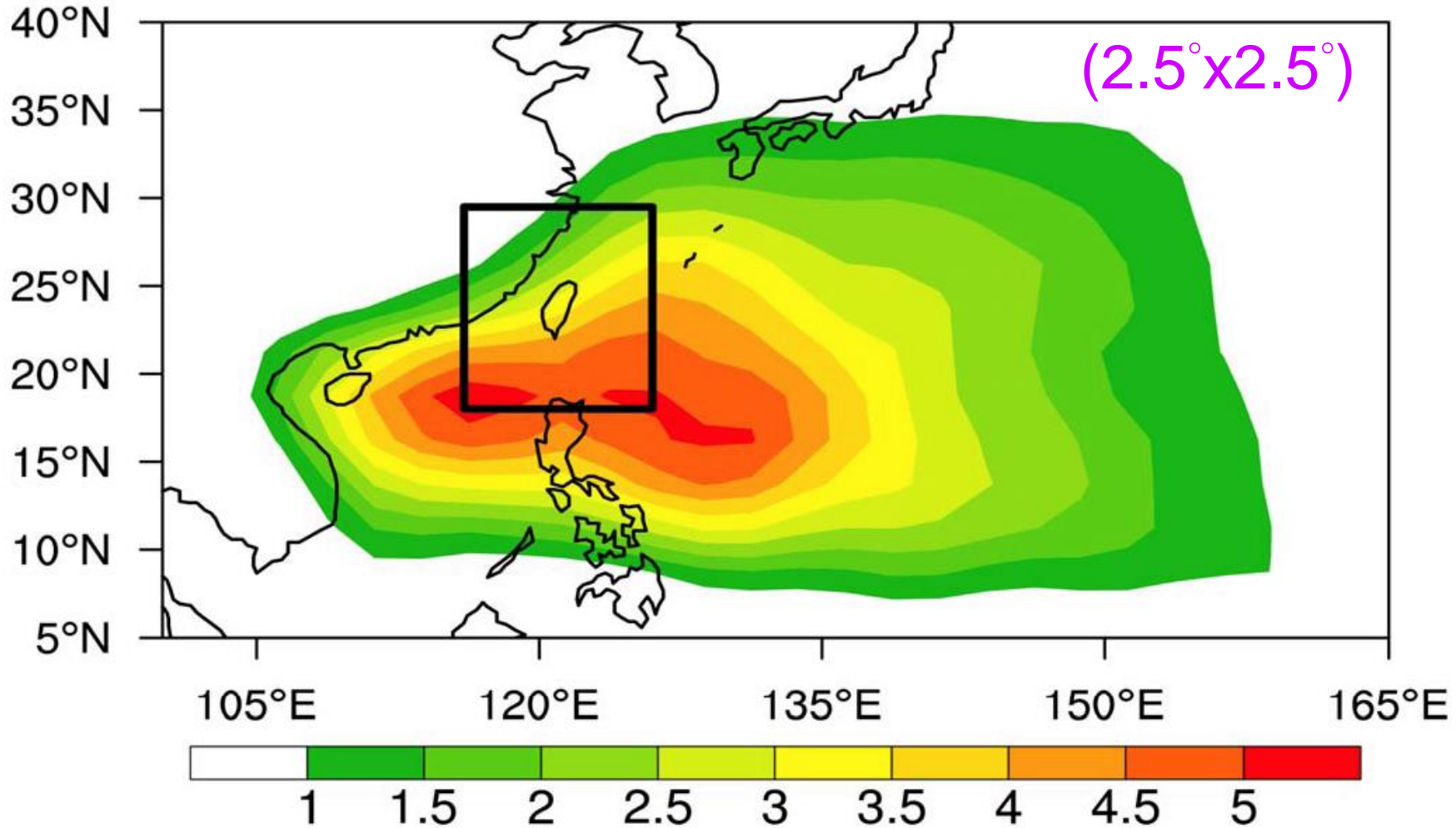
➤ Intensity

➤ Duration



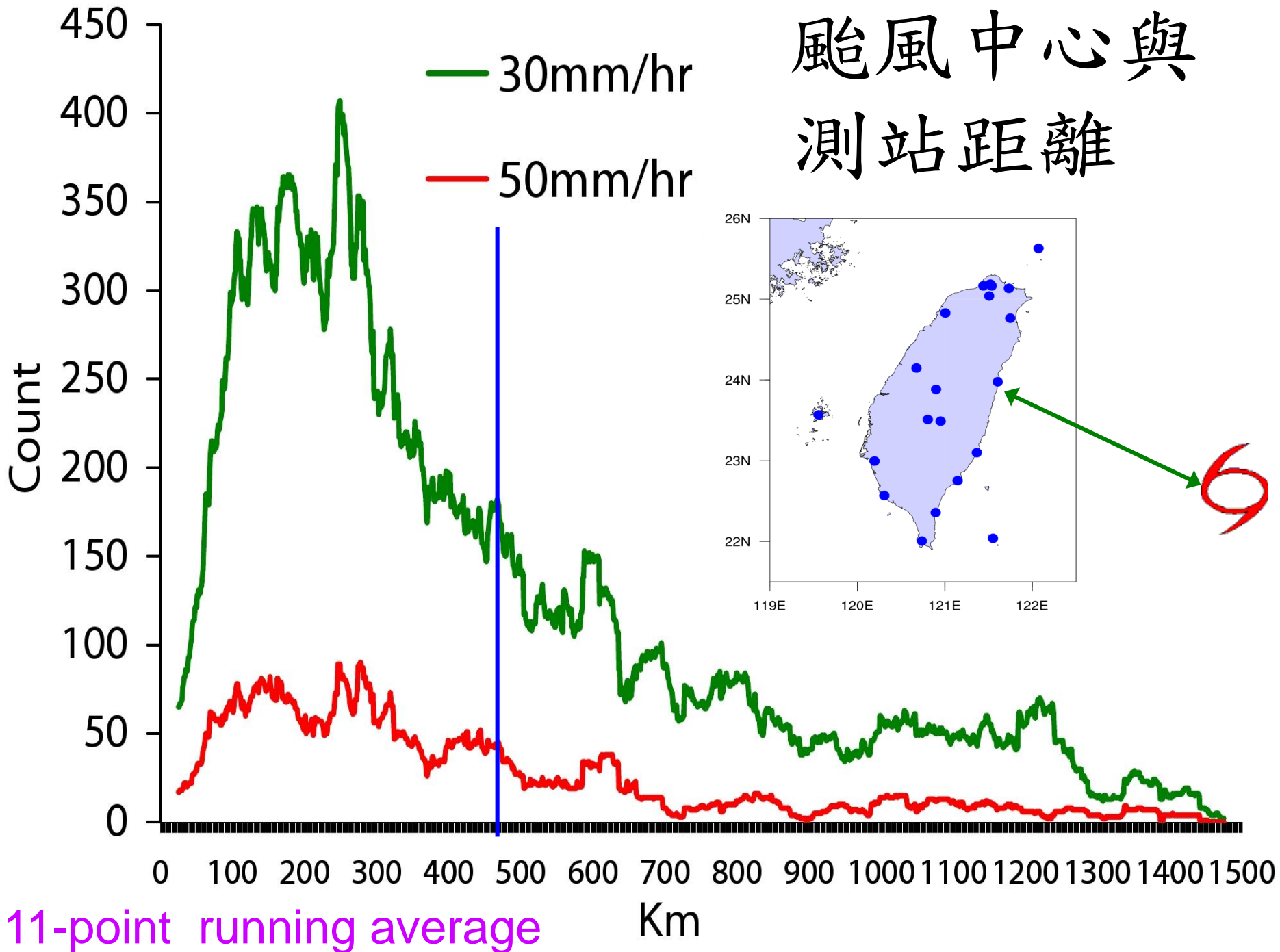
JTWC - frequency

Annual (1970-2010)

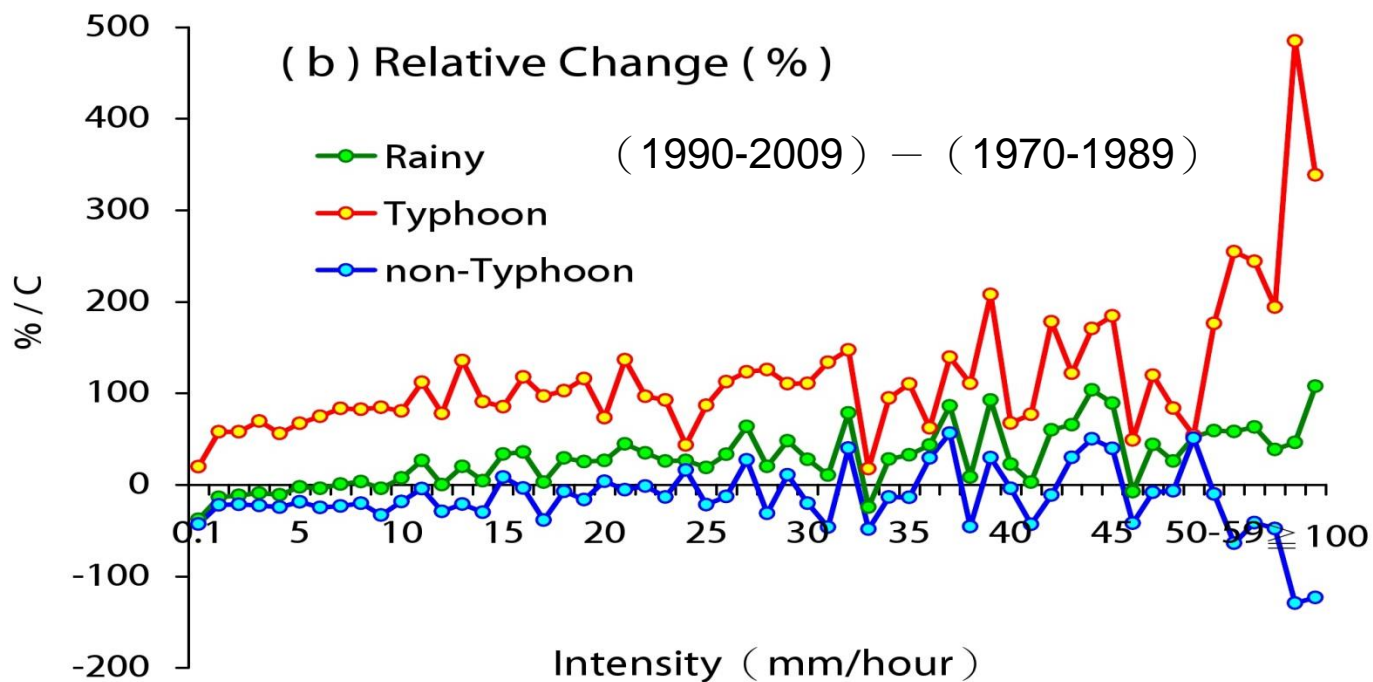
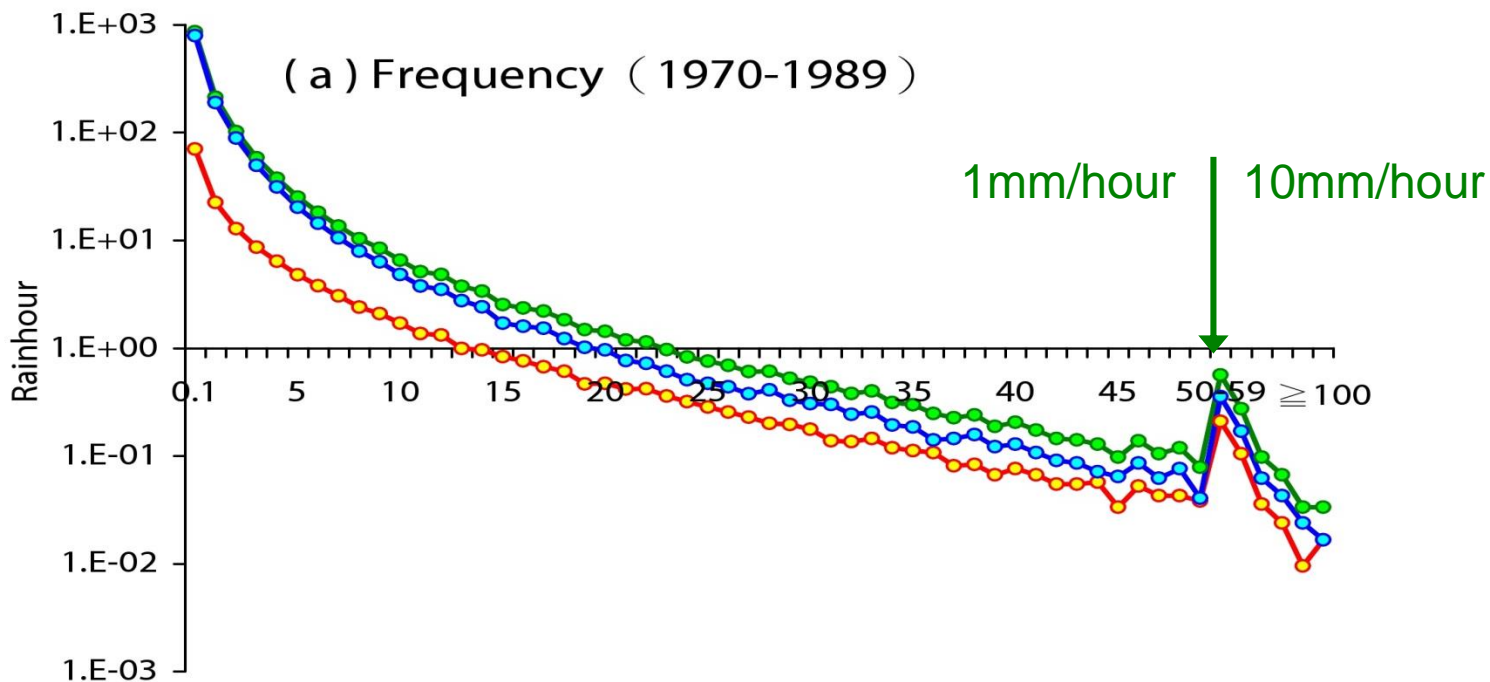


black box (18°N~29.5°N、116°E~126°E)  
represents the typhoon-influenced region.

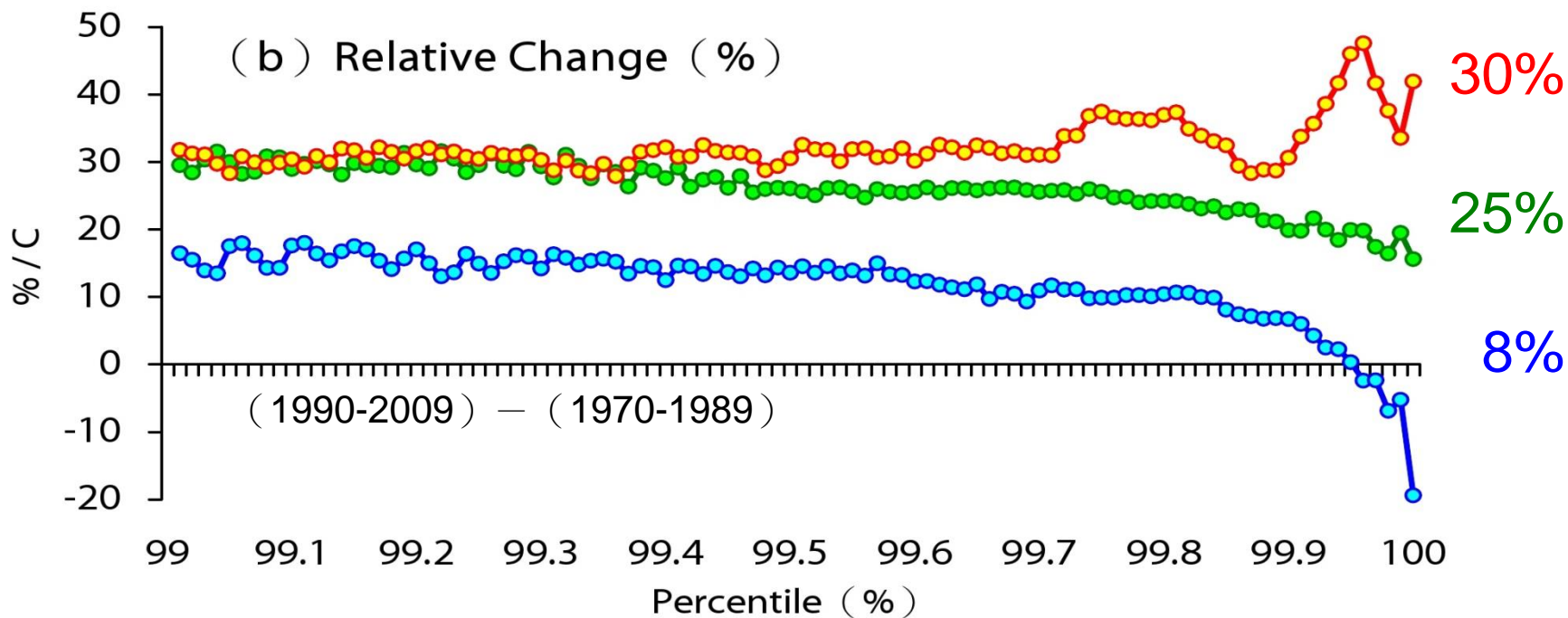
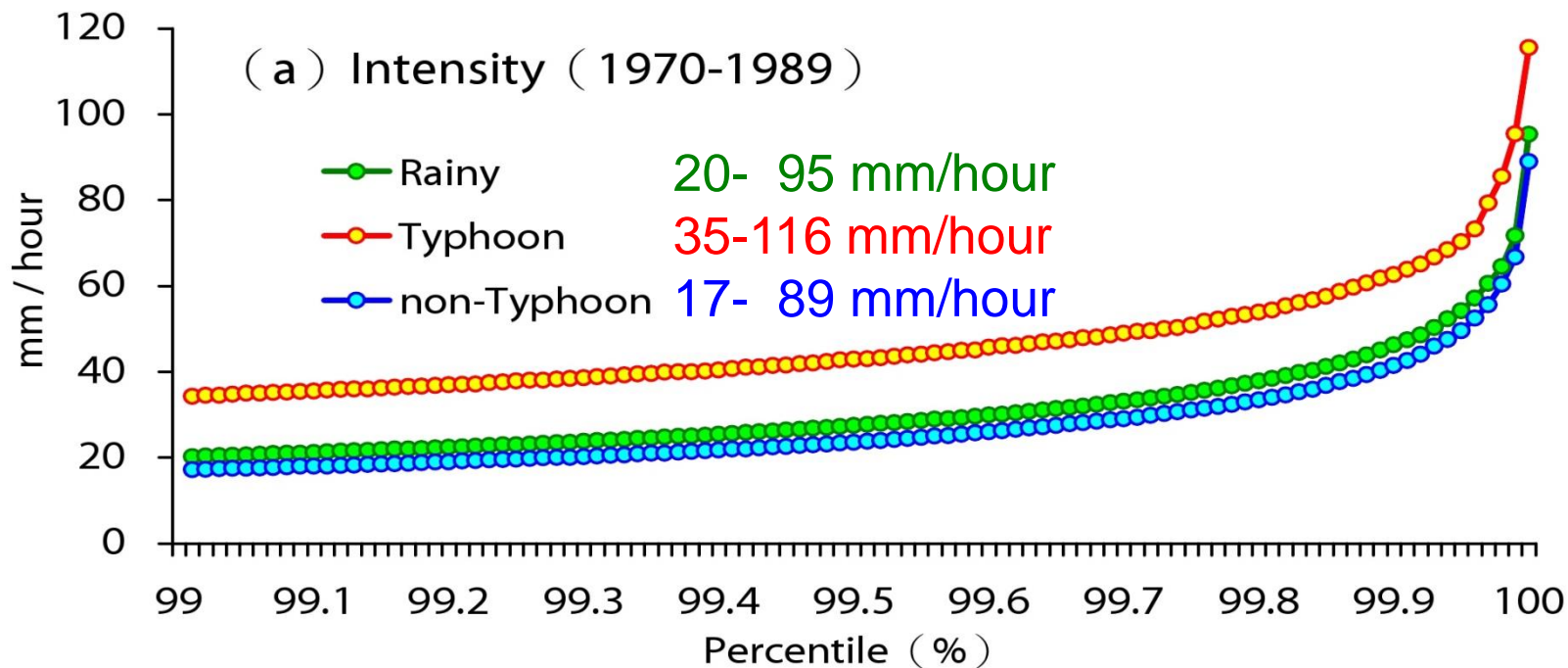
# 颱風中心與 測站距離



11-point running average



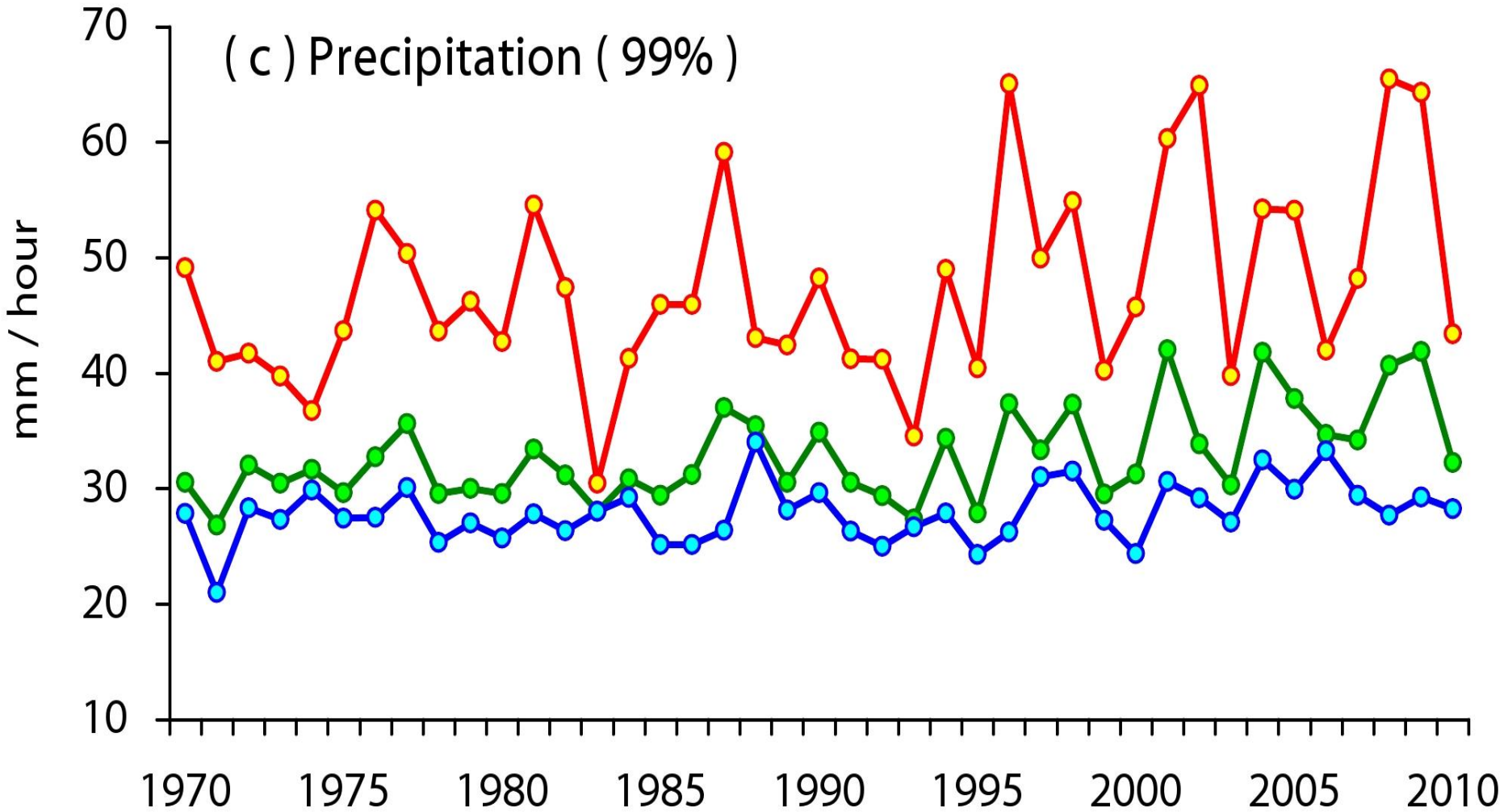




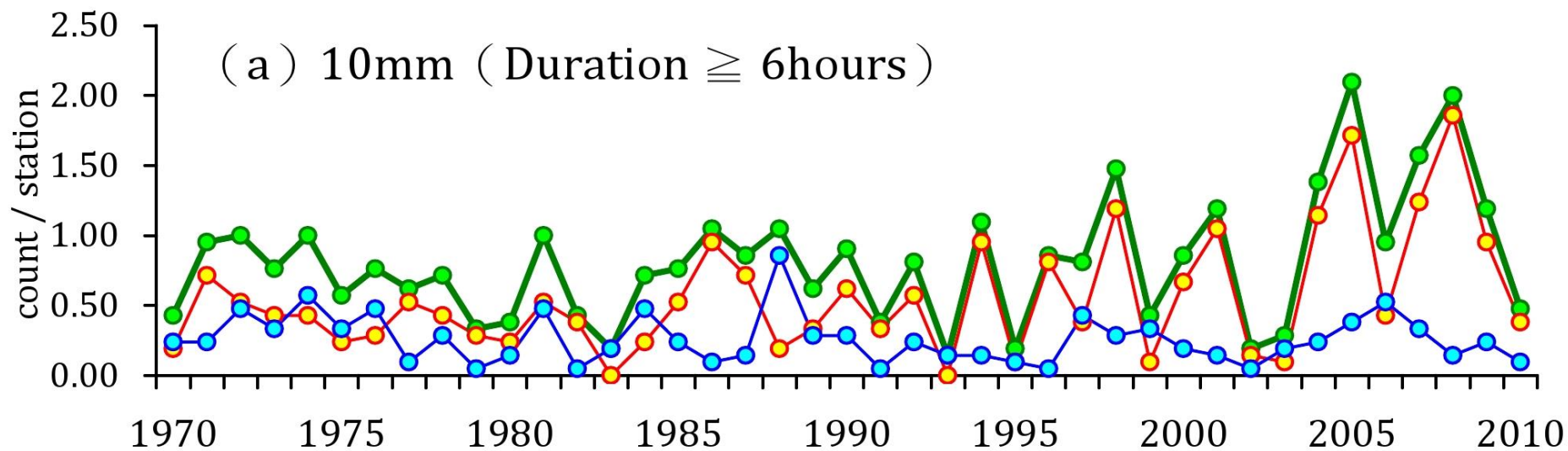
2.5 (mm/hour)/decade

1.7 (mm/hour)/decade

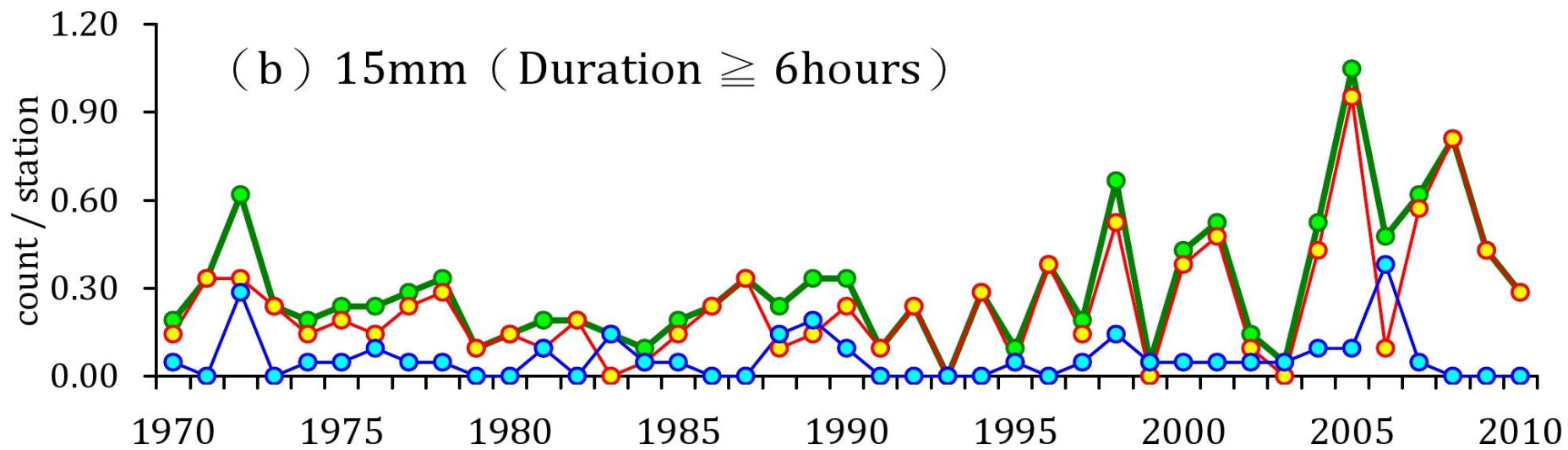
0.6 (mm/hour)/decade

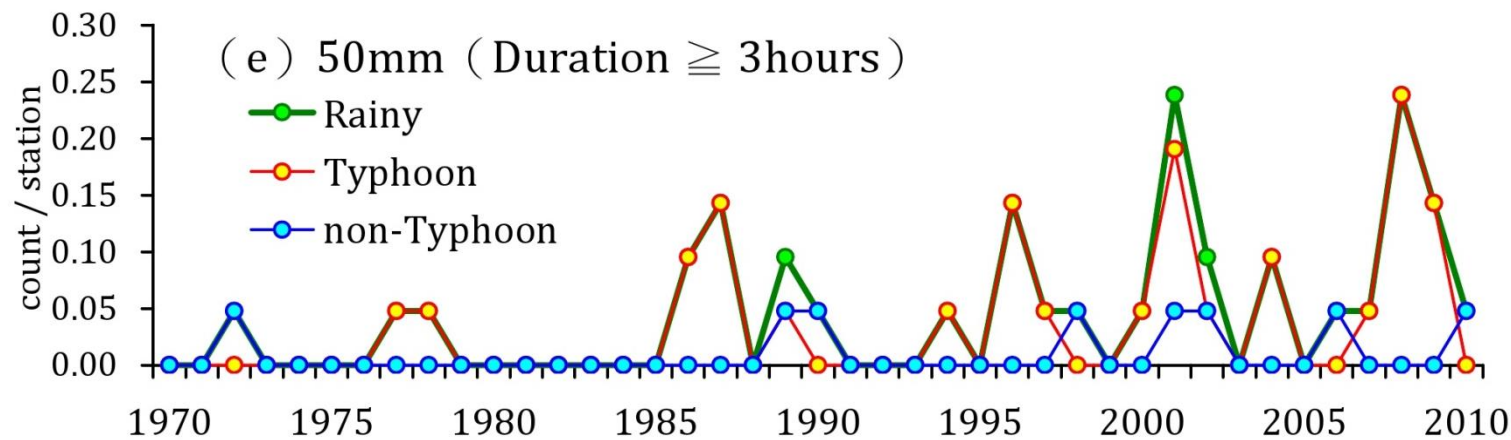
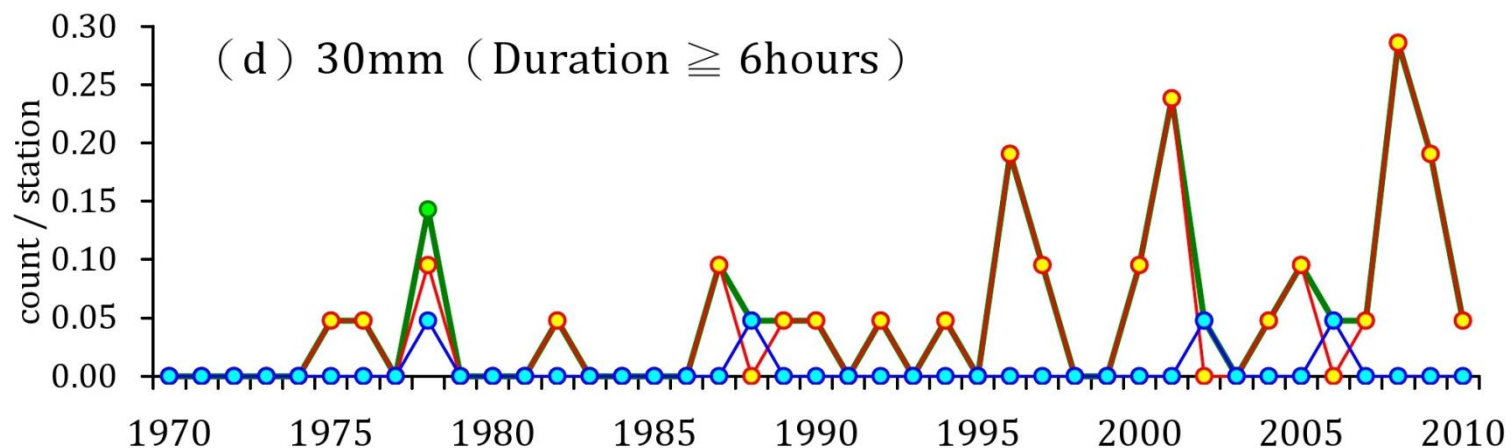
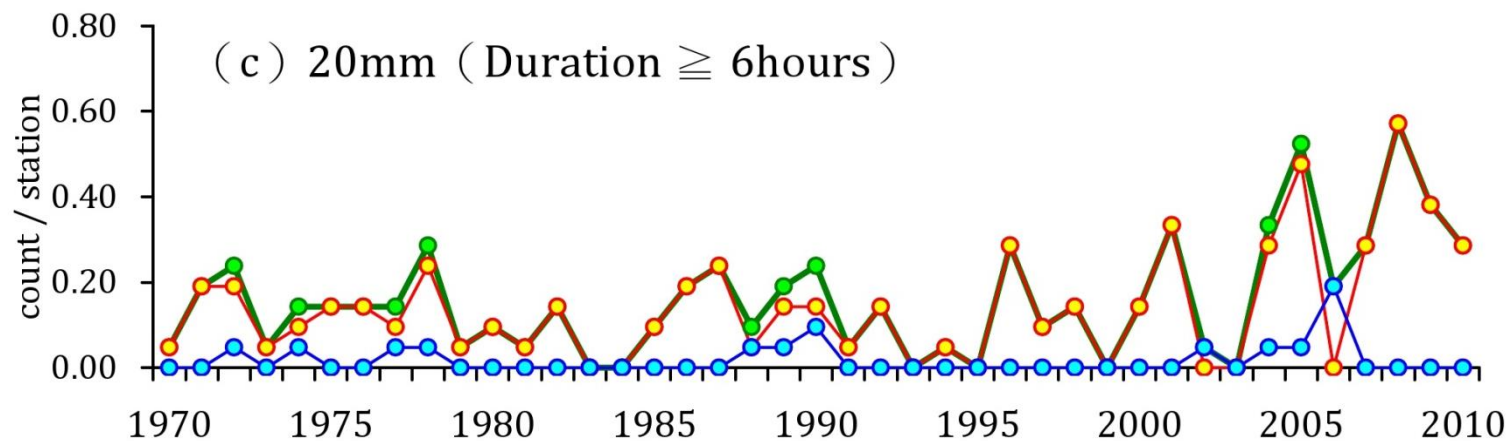


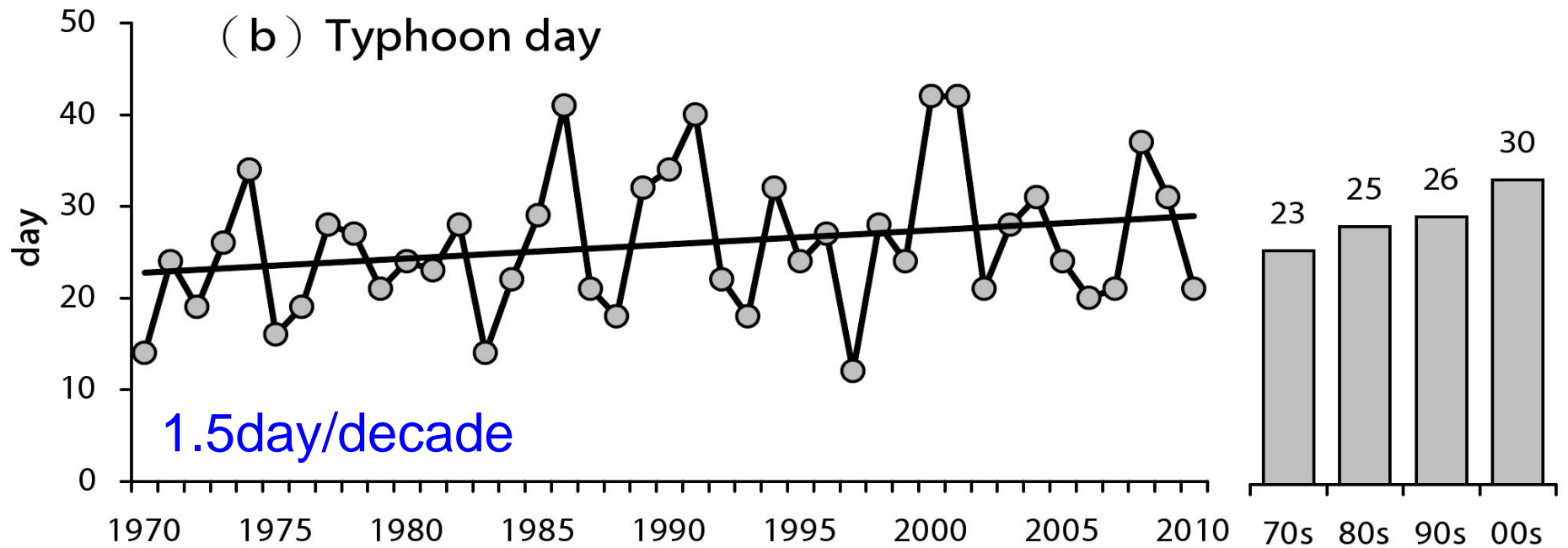
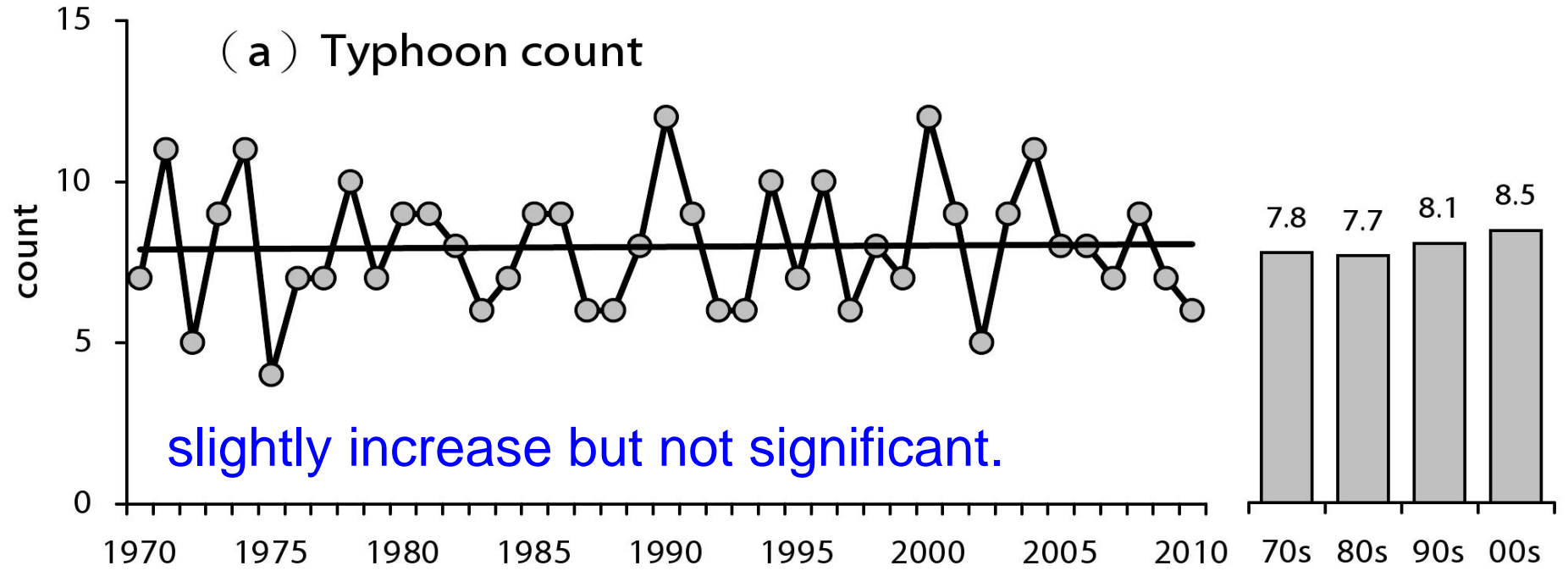
(a) 10mm (Duration  $\geq 6$ hours)

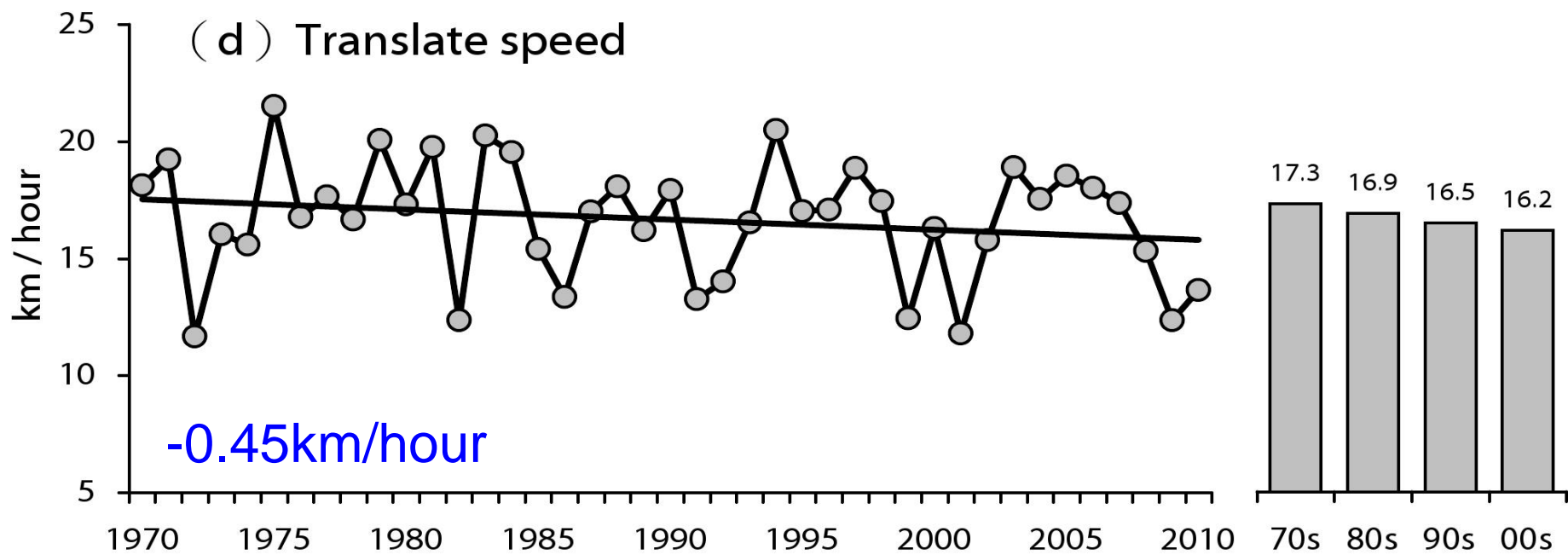
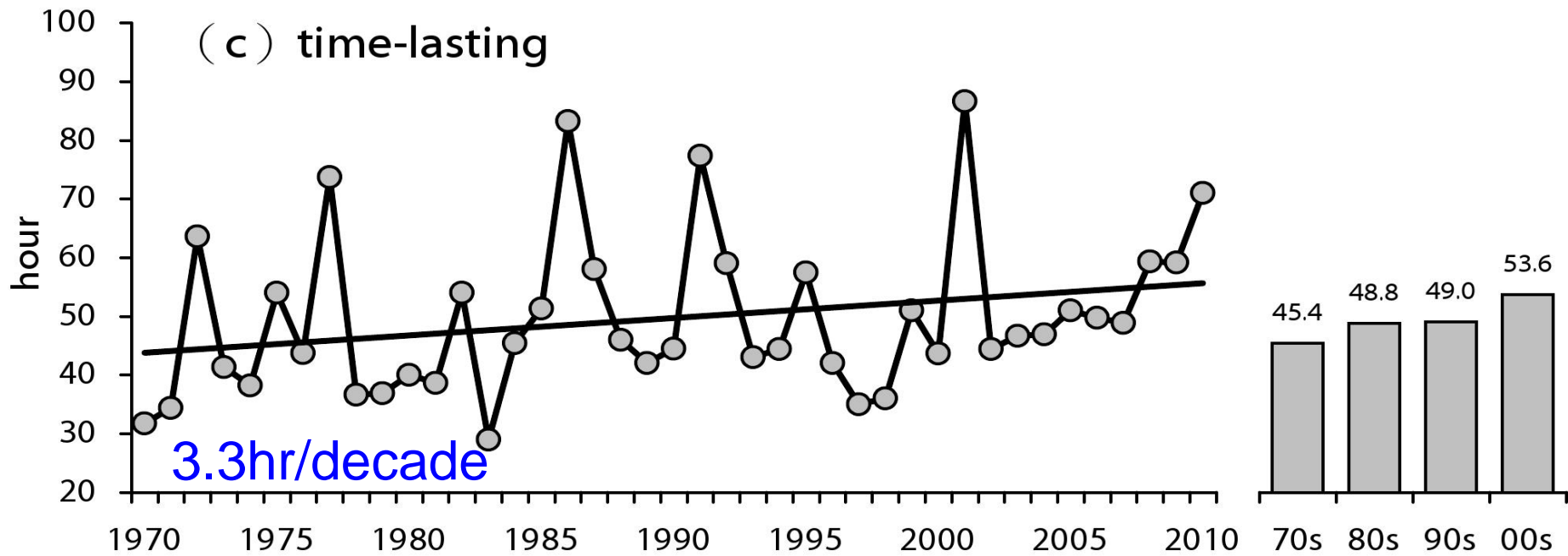


(b) 15mm (Duration  $\geq 6$ hours)

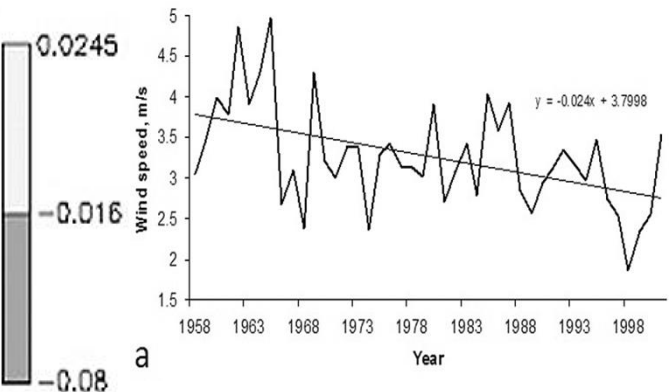
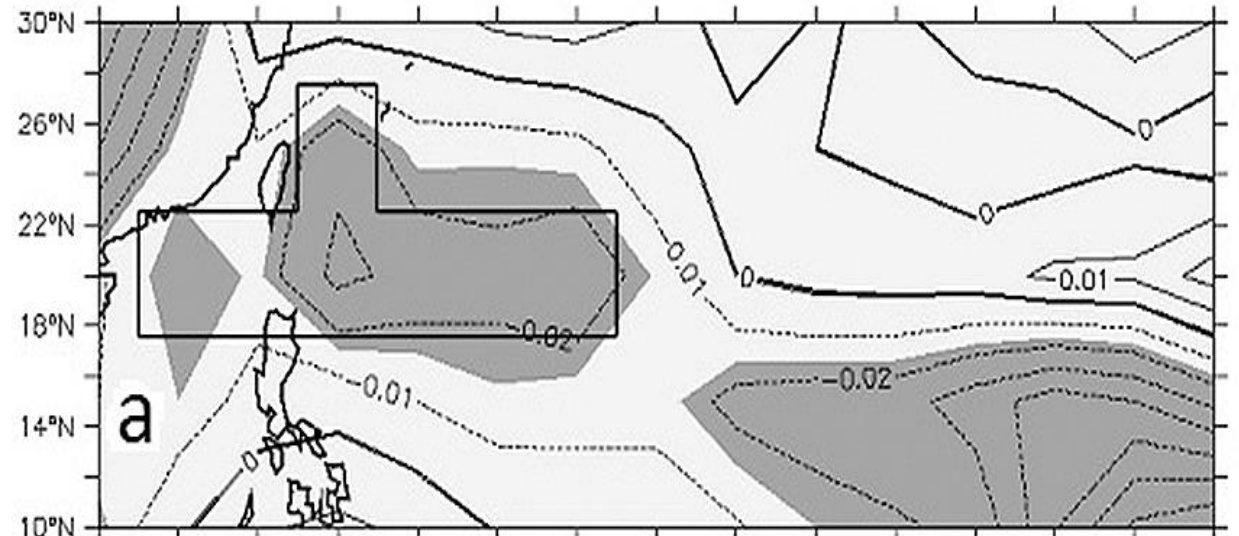




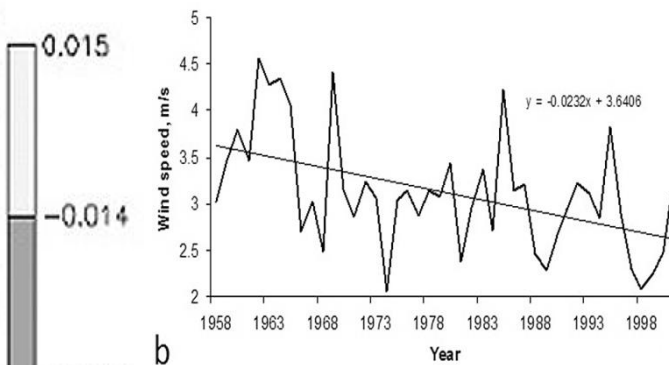
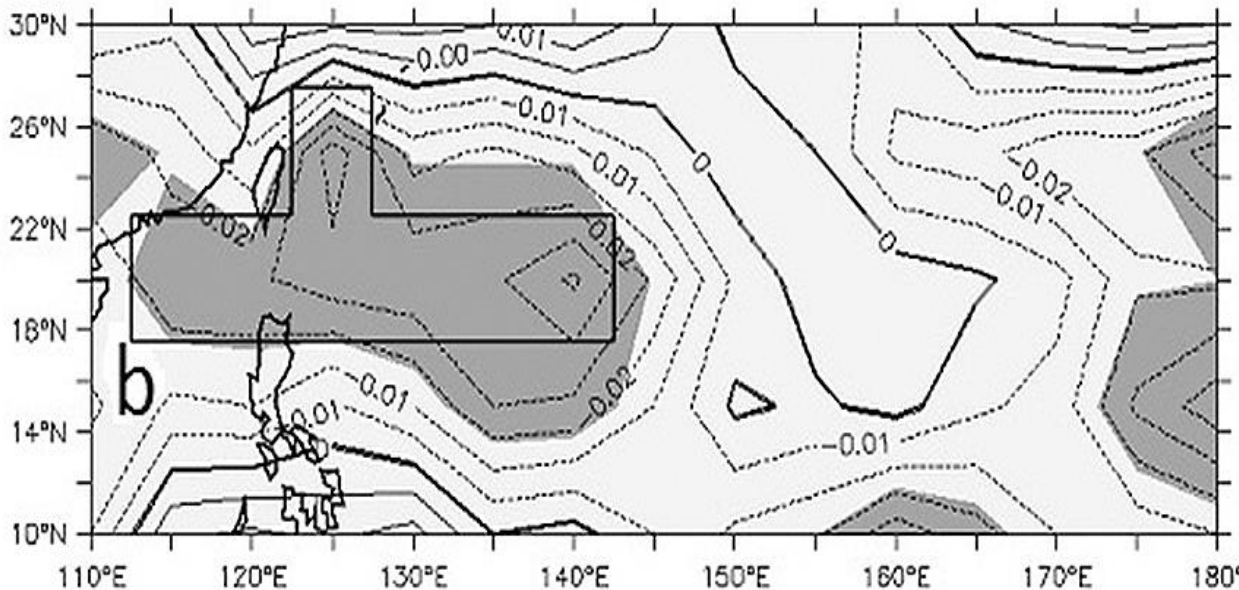




Trends in steering flows for July–September from 1958–2001. Shading indicates statistical significance at 5% level. Broken lines denote negative trend. Unit of trend is  $\text{m s}^{-1} \text{ yr}^{-1}$  Chu et al. 2012



**NCEP/NCAR reanalysis**



**ERA reanalysis**

# Summary

1. 整體而言：台灣地區小雨 ( $\leq 2\text{mm/hr}$ ) 頻率減少  
強降雨 ( $\geq 30\text{mm/hr}$ ) 顯著增加
2. 降雨頻率：颱風→各等級降雨強度發生頻率增加  
非颱風→小雨減少、其他強度降雨頻率無明顯改變
3. 降雨強度：極端強降雨 (99%) 有增強趨勢。  
→颱風帶來的極端降雨，增加幅度明顯比非颱風大。  
→駛流減弱、颱風處於鄰近台灣地區的生存天數增加、生命期拉長以及移動速度減慢。
4. 降雨延時：持續性的強降雨出現頻率增加。  
→時雨量 $\geq 10$ 毫米，且延時在六小時 (含) 以上  
→時雨量 $\geq 50$ 毫米，且延時達三小時 (含) 以上



# The End

# Question?