

The relationship of the TC activity over the Western North Pacific and the typhoon invaded Taiwan in this decade

- *review*
- *Data*
- *result*
- *summary*

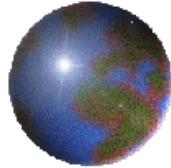
Hsin-Hsing Chia, Ching-Teng Lee., Tzu-Ting, Lo

Central Weather Bureau



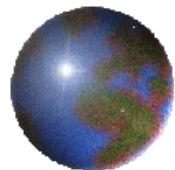
Motivation

	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	Ave.
WNP	23	26	26	21	29	23	23	24	22	22	26.6
TWN	5	7	2	3	5	4	4	5	4	3	3.1



Top 30 of Maximum 60 mins rainfall record

排序	站名	測站站碼	降水量(mm)	發生日期	影響天氣系統
1	澎湖	46735	214.8	1974/07/06	西南氣流
2	彭佳嶼	46695	186.0	2002/07/10	娜克莉颱風
3	新城	C0T84	167.5	2005/10/02	龍王颱風
4	南區 氣象中心	46741	163.3	1947/07/29	西南氣流
5	東吉島	46730	158.0	1987/05/18	鋒面
6	恆春	46759	156.5	2005/09/23	丹瑞颱風
7	南港	C0A9G	151.5	2004/09/11	海馬颱風
8	春日	C1R26	150.5	2003/08/03	莫拉克颱風
9	大武	46754	148.2	1956/04/23	賽洛瑪颱風
10	新發	C1V24	148.0	2008/07/17	卡玫基颱風
11	大坑	C1F97	147.5	2008/07/18	卡玫基颱風
12	甲仙	C0V25	145.5	2008/07/17	卡玫基颱風
13	鼻頭角	C0A95	145.0	2002/07/10	娜克莉颱風
14	嘉義	46748	144.0	2001/09/18	納莉颱風
15	彭佳嶼	46695	142.0	1981/06/13	艾克颱風
16	光復	C0T96	141.5	2001/07/30	桃芝颱風
17	鳳凰	C0I09	141.0	2001/07/30	桃芝颱風
18	嘉義	46748	140.0	1981/09/03	艾妮絲颱風 引進西南氣流
19	臺中	46749	137.6	1972/06/12	熱帶低壓
20	奮起湖	C0M53	137.0	2001/07/30	桃芝颱風
21	鞍部	46691	136.5	2001/09/05	低壓帶
22	鞍部	46691	135.3	1983/09/18	鋒面
23	花蓮	46699	135.0	1990/06/23	歐菲莉颱風
24	嘉義	46748	134.0	1977/08/18	熱帶低壓
25	琉球嶼	C0R27	134.0	1996/08/30	賀伯颱風
26	車城	C1R32	133.5	2003/08/03	莫拉克颱風
27	麟洛	C1R21	131.5	2003/08/04	莫拉克颱風
28	馬頭山	C0M41	130.5	2008/08/17	卡玫基颱風
29	中竹林	C1F9A	130.0	2004/07/03	敏督利颱風 引進西南氣流
30	來義	C1R24	129.5	2009/08/08	莫拉克颱風



Review

1951~2001

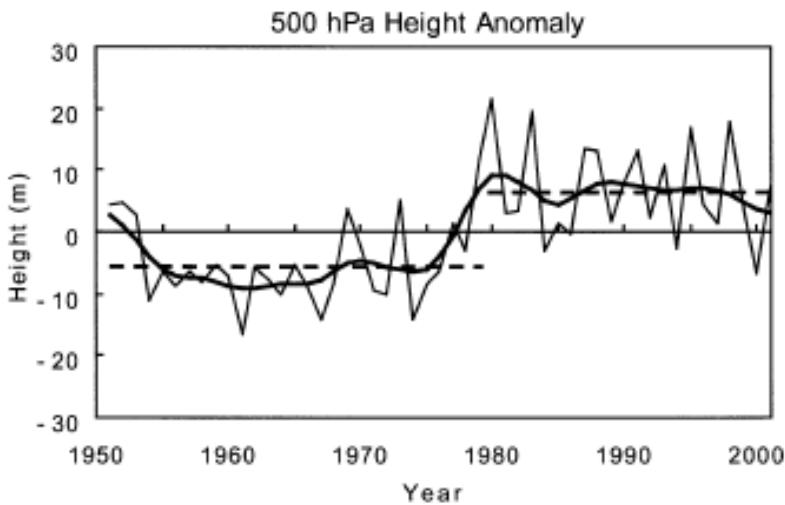


FIG. 3. Time series of SNPH anomaly in the region of 20° – 25° N and 125° – 140° E. Heavy solid line denotes 9-point Gaussian filtered values and heavy dotted lines denote the means for the periods 1951–79 and 1980–2001.

Ho et al.(2004) J.Climate

The most significant differences appear in regions surrounding SH

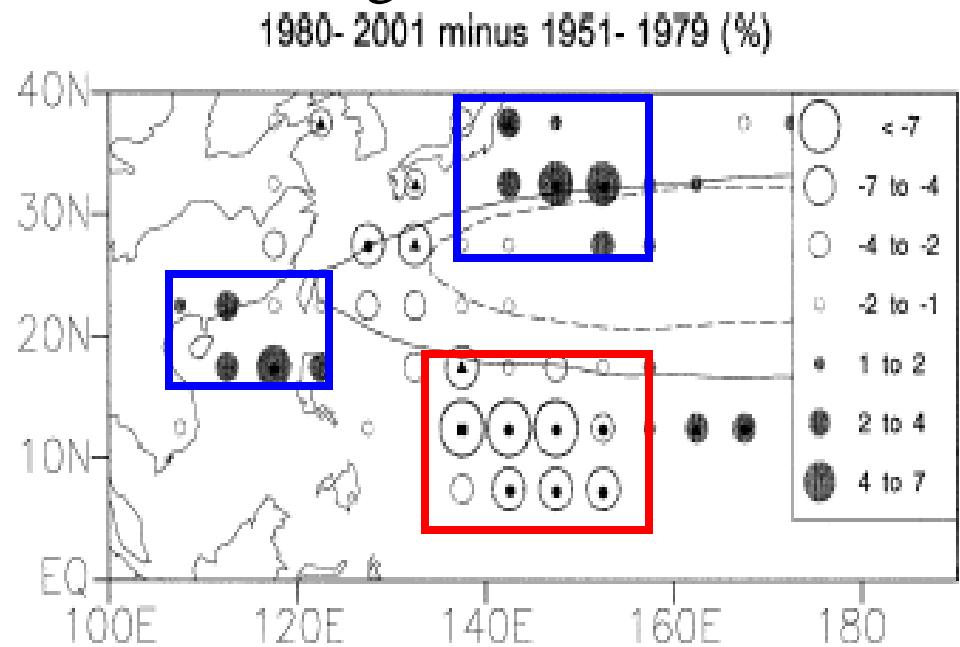
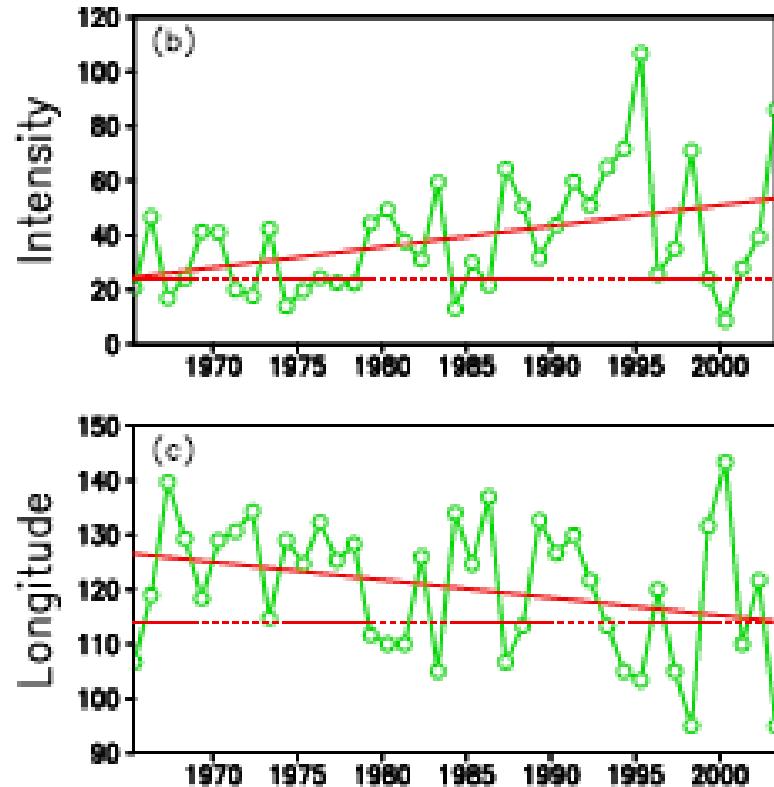
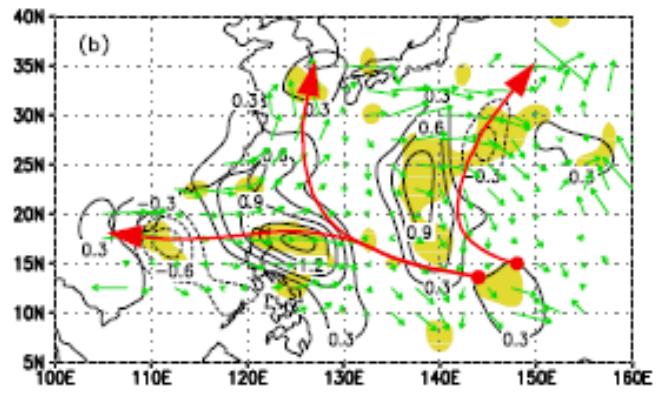


FIG. 4. Geographical distribution of the difference in typhoon passage frequency between the periods 1980–2001 and 1951–79. Dotted and solid lines indicate the mean position of 5780 gpm for 1951–79 and 1980–2001, respectively. Symbol \blacktriangle represents the 90% confidence level, \bullet the 95% confidence level, and \blacksquare the 99% confidence level.

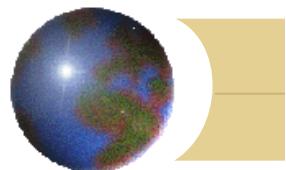


Review

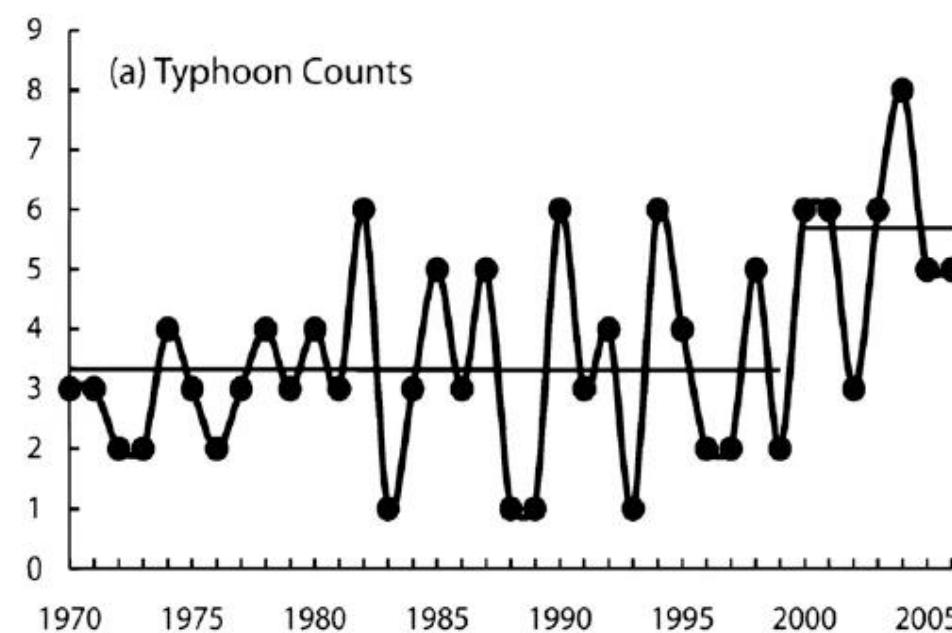
(1965~83)-(1984~03) JJASO



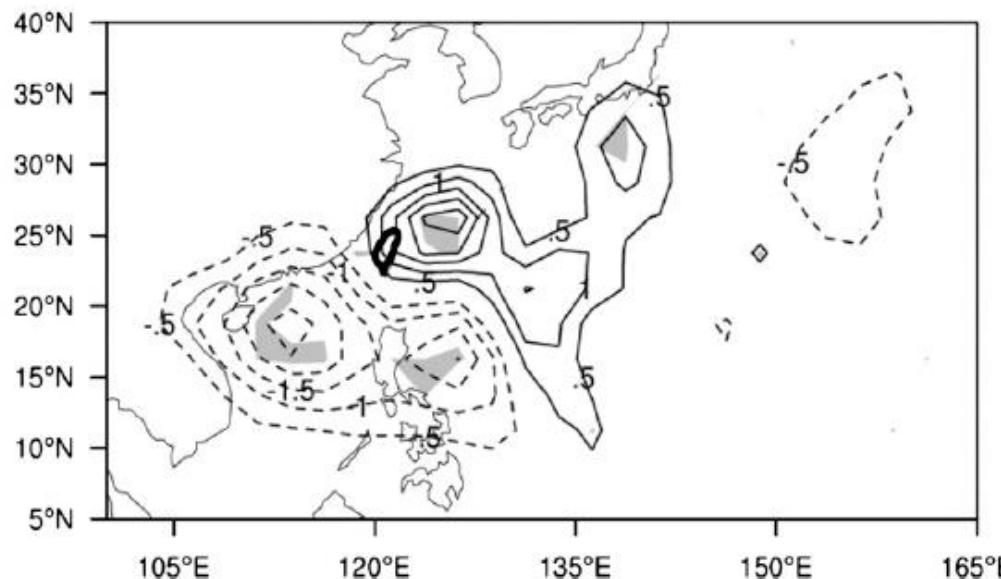
The prevailing track shift is due to the westward expansion and strengthening of the WNP subtropical High



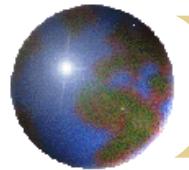
(a) Typhoon Counts



(d) RSMC - JJASO activity

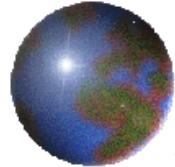


Tu et al. (2009)



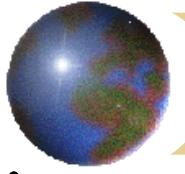
Data

- CWB Invaded Typhoon(1897~2009)
- CWB Typhoon Warning data(1958~2009)
- JTWC BestTrack(1979~2009)
- NCEP ReAnalysis - II(1979~2009)

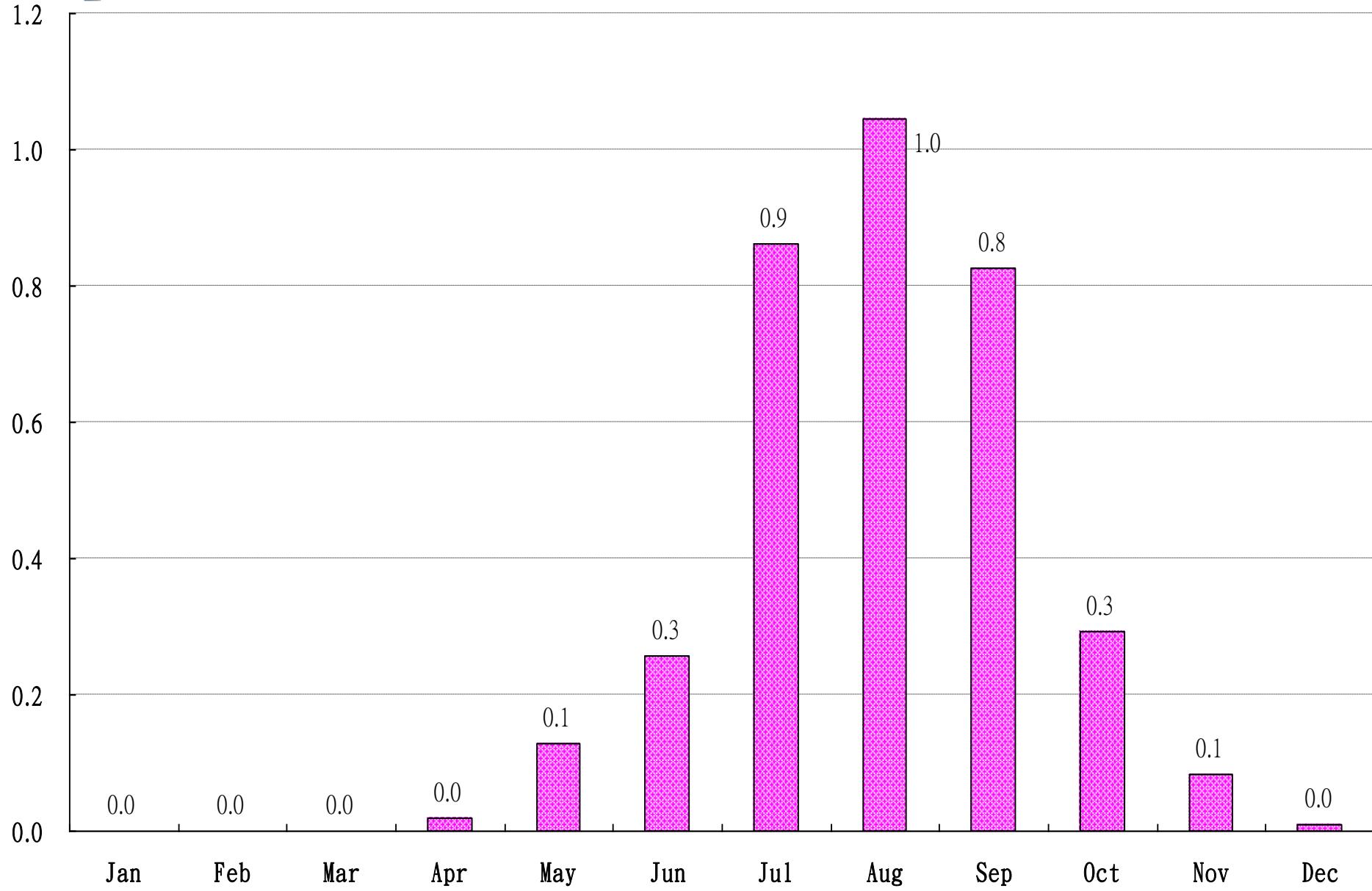


Definition

- Strong typhoon: $V_{max} >= 51.0 \text{m/s}$
- Medium typhoon: $32.7 \text{m/s} \leq V_{max} \leq 50.9 \text{m/s}$
- Weak typhoon: $17.2 \text{m/s} \leq V_{max} \leq 32.6 \text{m/s}$
- Sea(land) typhoon warning - Typhoon forecast range of 7 wind storm may hit Taiwan or Quemoy and Matsu waters within 100 km of 24(18) hours before, it shall release the sea(land) typhoon warning issued once every 3 hours later



Monthly LTM of Invaded Typhoon



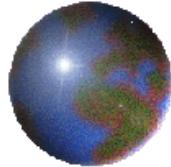


The definition of Invaded Typhoon

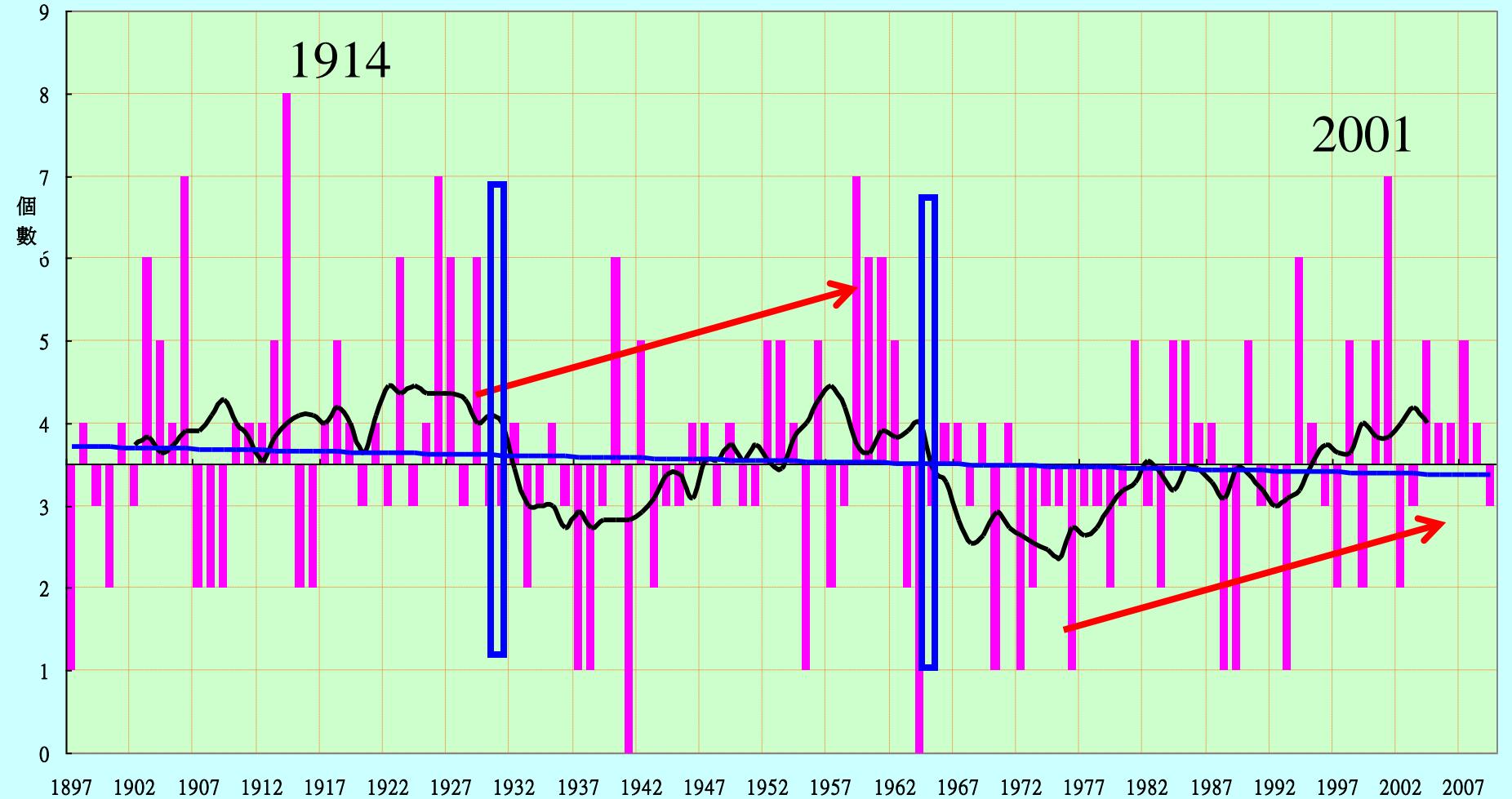
- (1) Before 1961, Skirted the coast of the island of Taiwan within 200 kilometers, or two hundred kilometers away in the pass, the ground station of the island measured maximum (ten-minute average) wind speed at 10 m / s or 100 mm or more rainfall
- (2) After 1962 , Center of the typhoon landed in Taiwan; or while not only in the coastal waters of Taiwan after landing, but disaster was reported in the island

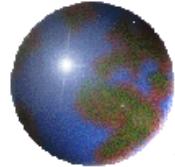
(1)1961年及以前採用 “掠過台灣本島海岸二百公里以內；或於二百公里以外通過，而本島平地測站所測得之最大(十分鐘平均) 風速在10公尺/秒或雨量在100公釐以上者” ；

(2)1962年及以後採用 "颱風中心在台灣登陸； 或雖未登陸僅在台灣近海經過，但陸上報出有災情者

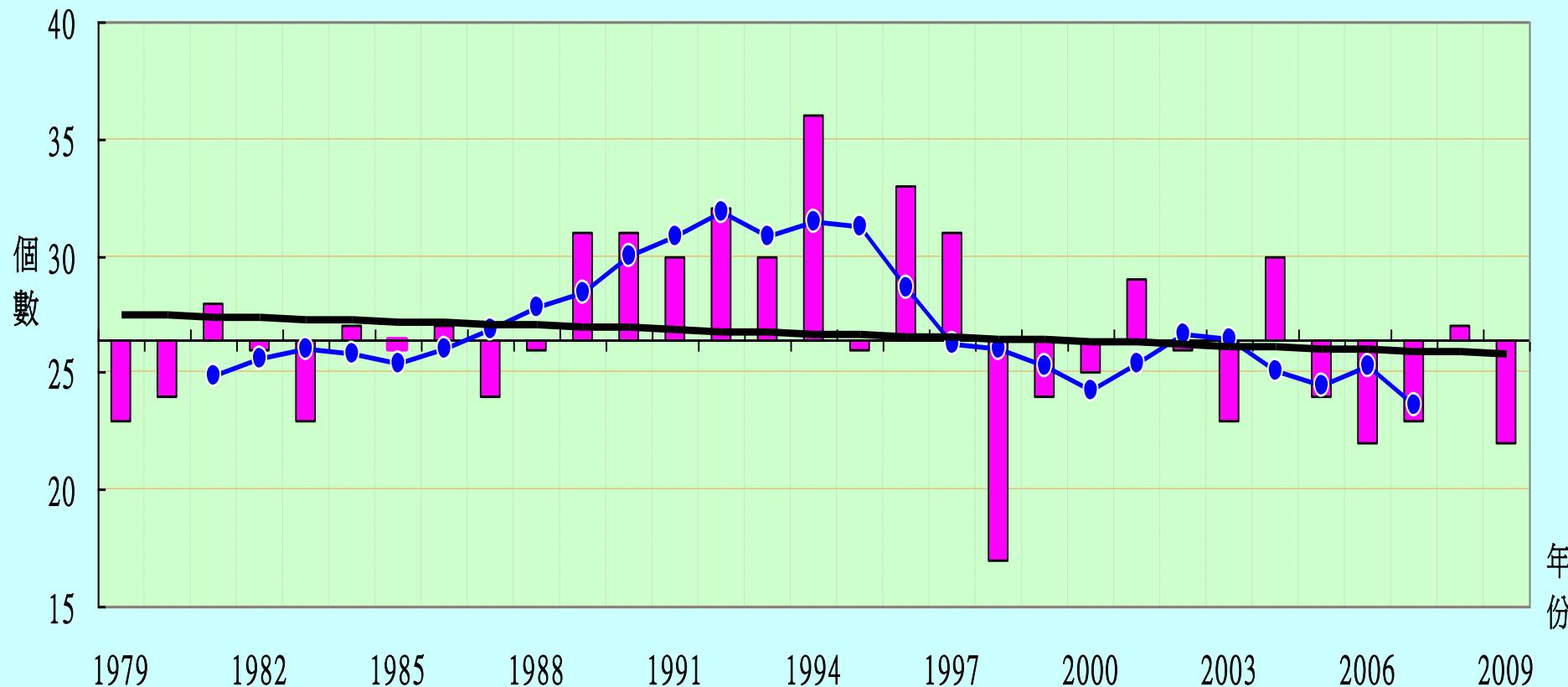


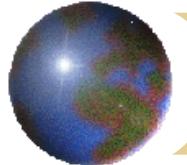
Annual Invaded Typhoon from 1897 to 2009(LTM:3.5)



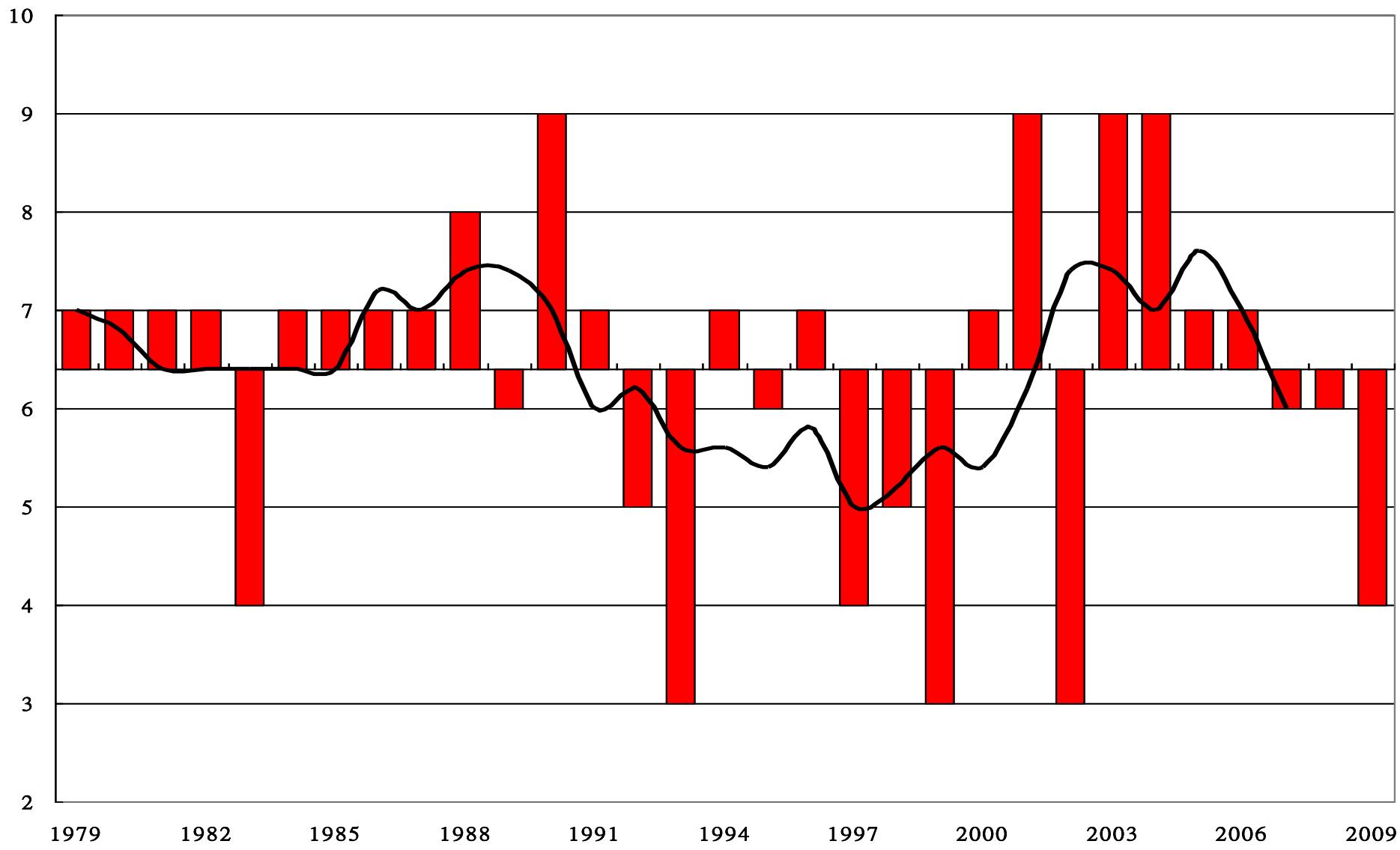


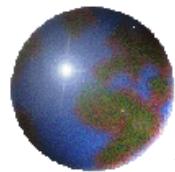
Annual Tropical Storms from 1979 to 2009 over WNP(LTM:26.4)





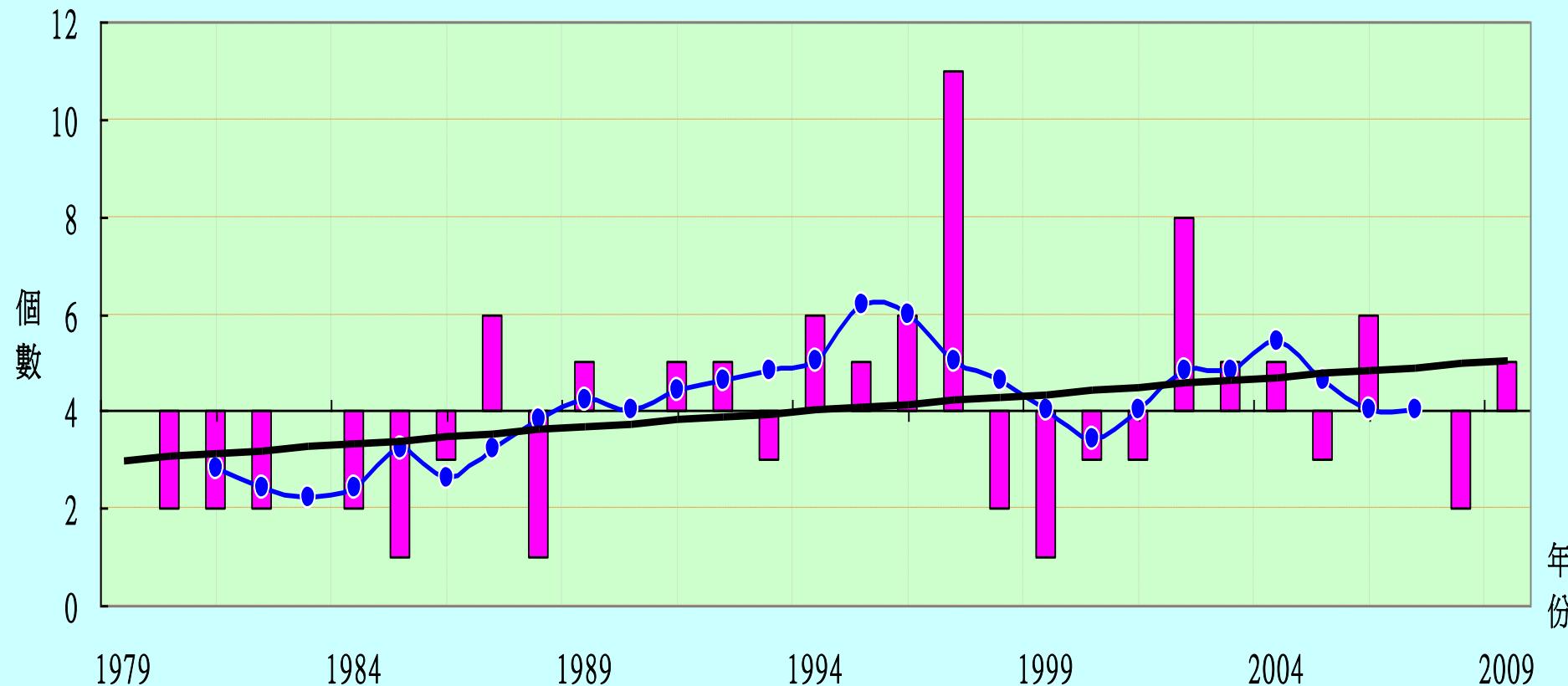
Annual Total Warning Typhoon Number(LTM:6.4)





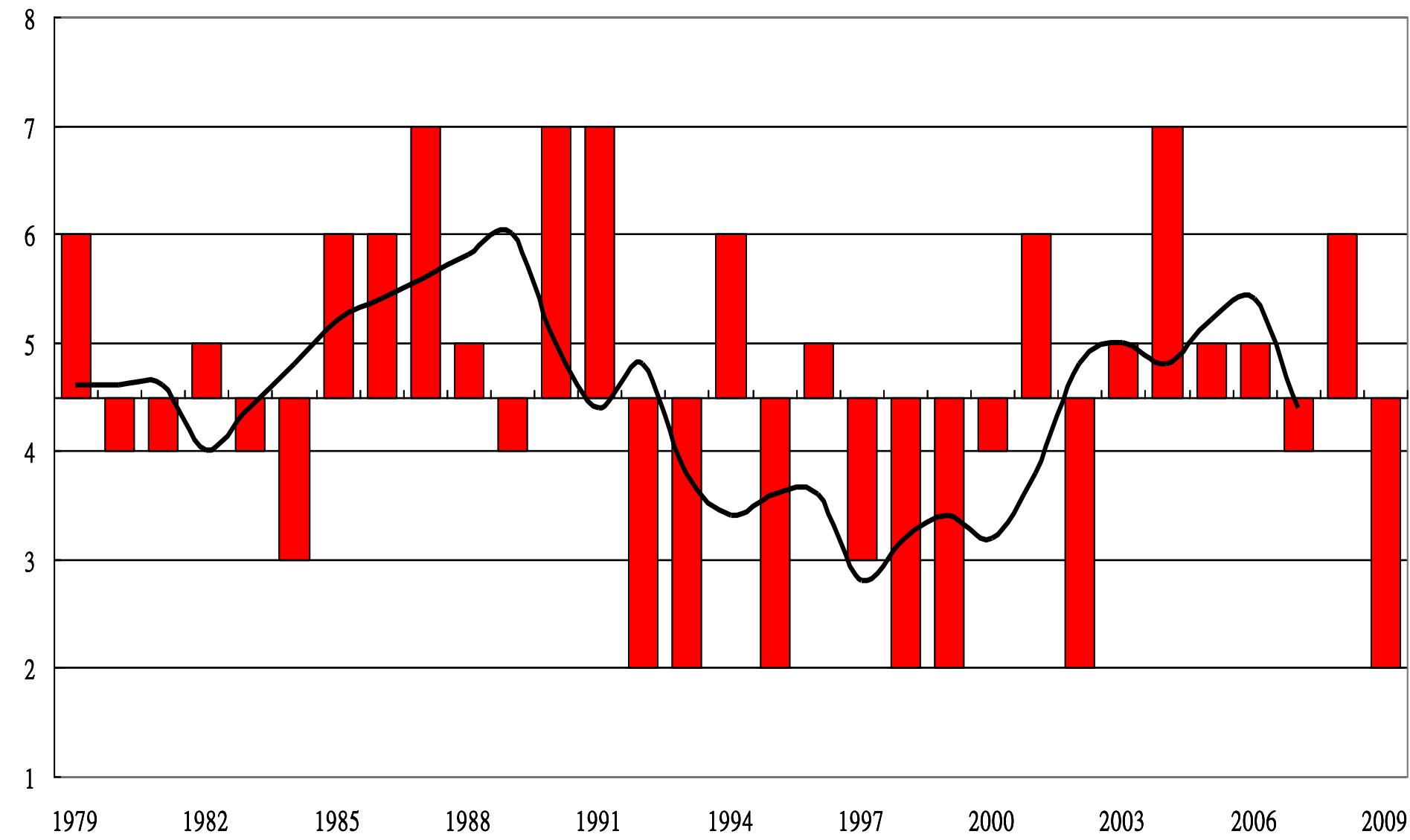
Super typhoon: Vmax >= 67 m/s

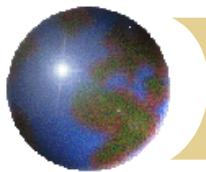
Annual super Typhoons from 1979 to 2009 over WNP(LTM:4)



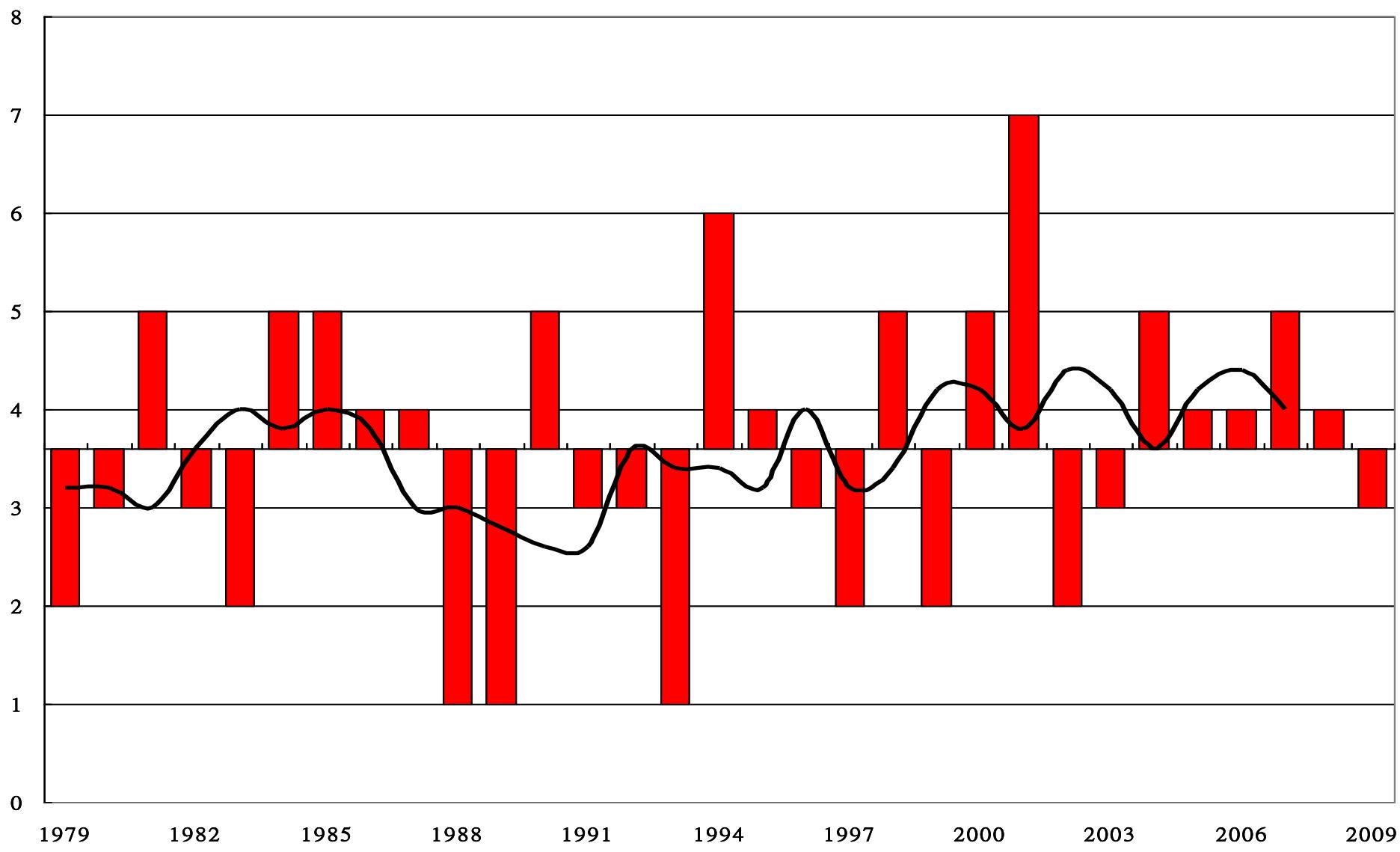


Medium and Strong Warning Typhoon Number(LTM:4.5)



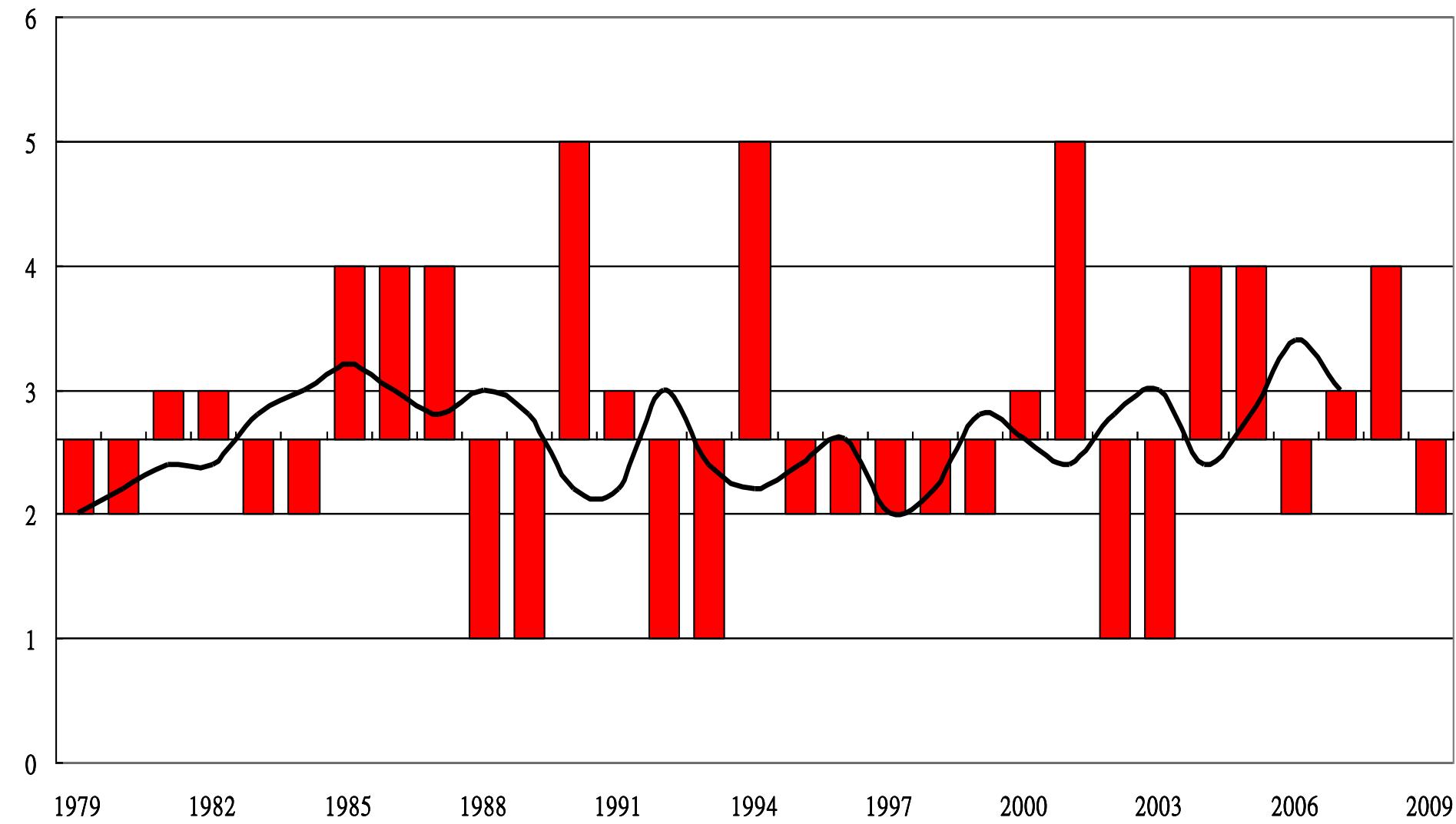


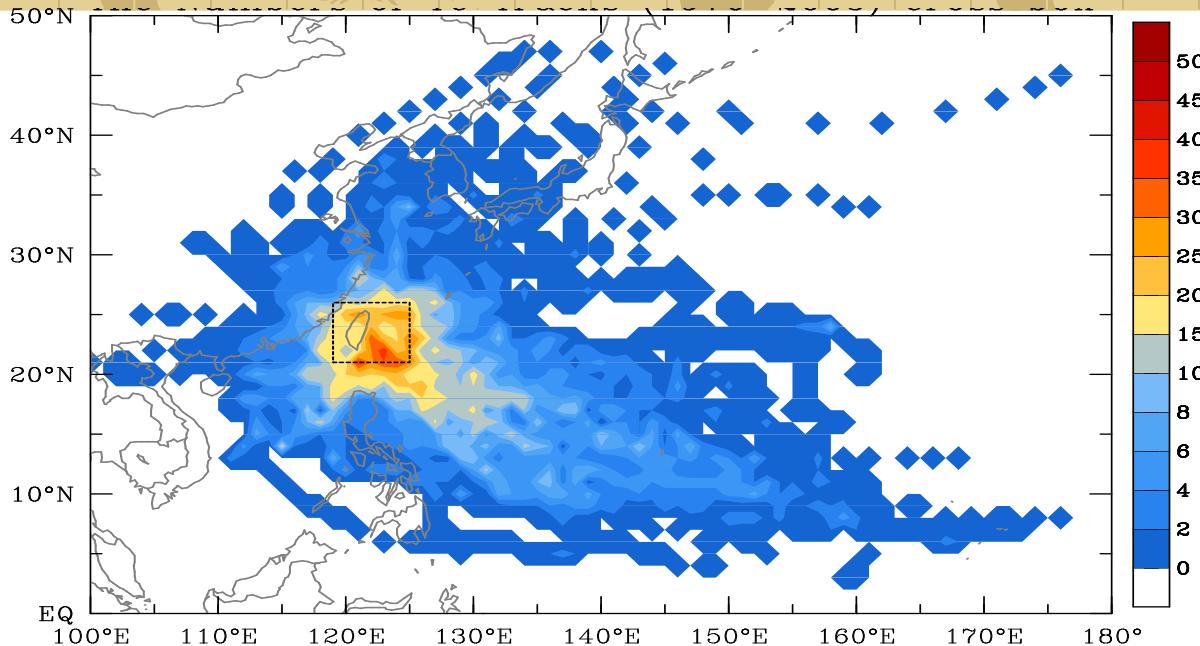
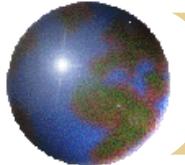
Annual Total Invaded Typhoon Number(LTM:3.6)





Medium and Strong Invaded Typhoon Number(LTM:2.6)



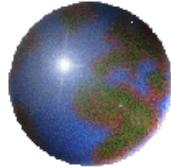


 **TC counts in the vicinity of Taiwan is identified by the TC track that counts in the vicinity of Taiwan, which cover an area between 21 - 26° N and 119 - 125° E. Only the TC intensity above 33m/s was counted.**

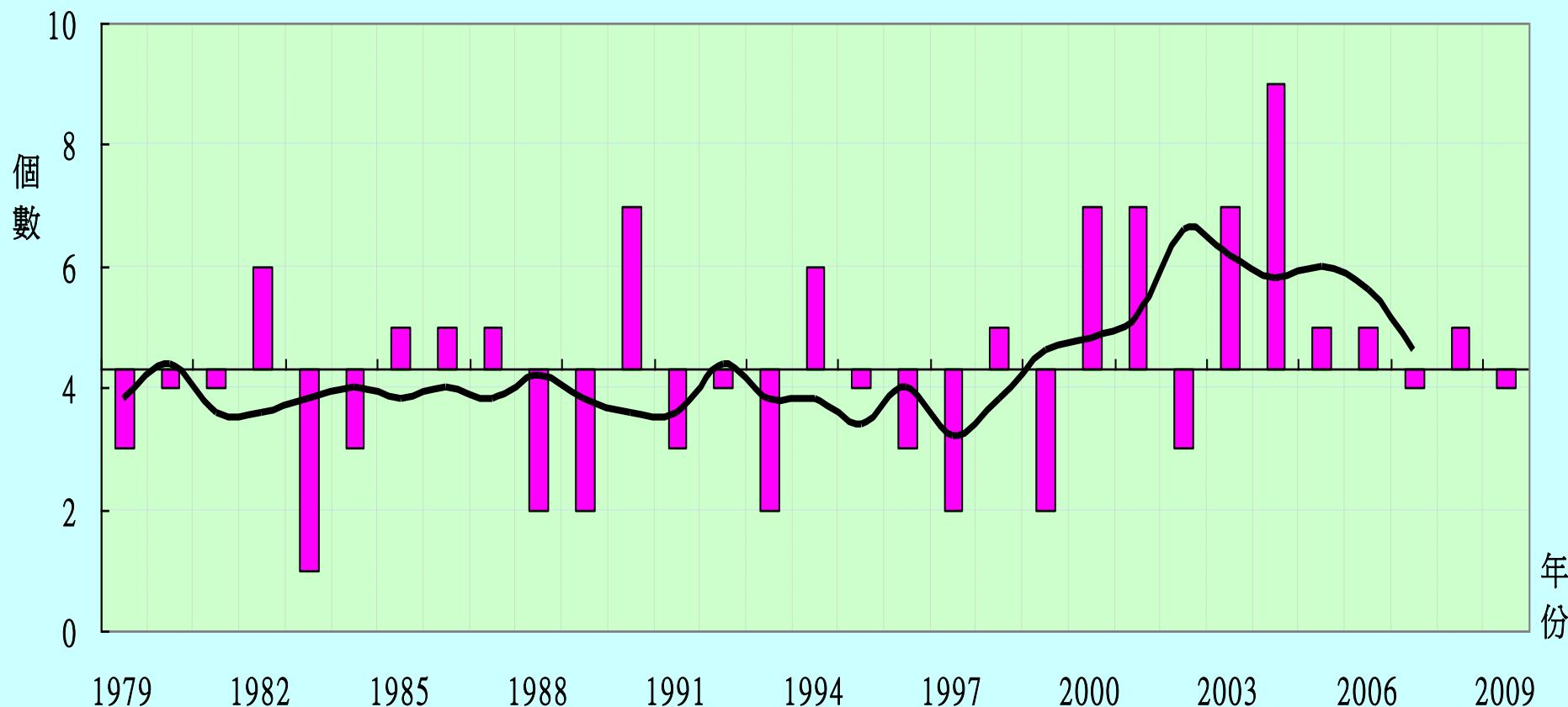
Terr. Atmos. Ocean. Sci., Vol. 18, No. 4, 805-825, October 2007

Climate Prediction of Tropical Cyclone Activity in the Vicinity of Taiwan Using the Multivariate Least Absolute Deviation Regression Method

Pao-Shin Chu^{1,*}, Xin Zhao², Ching-Teng Lee³, and Mong-Ming Lu³

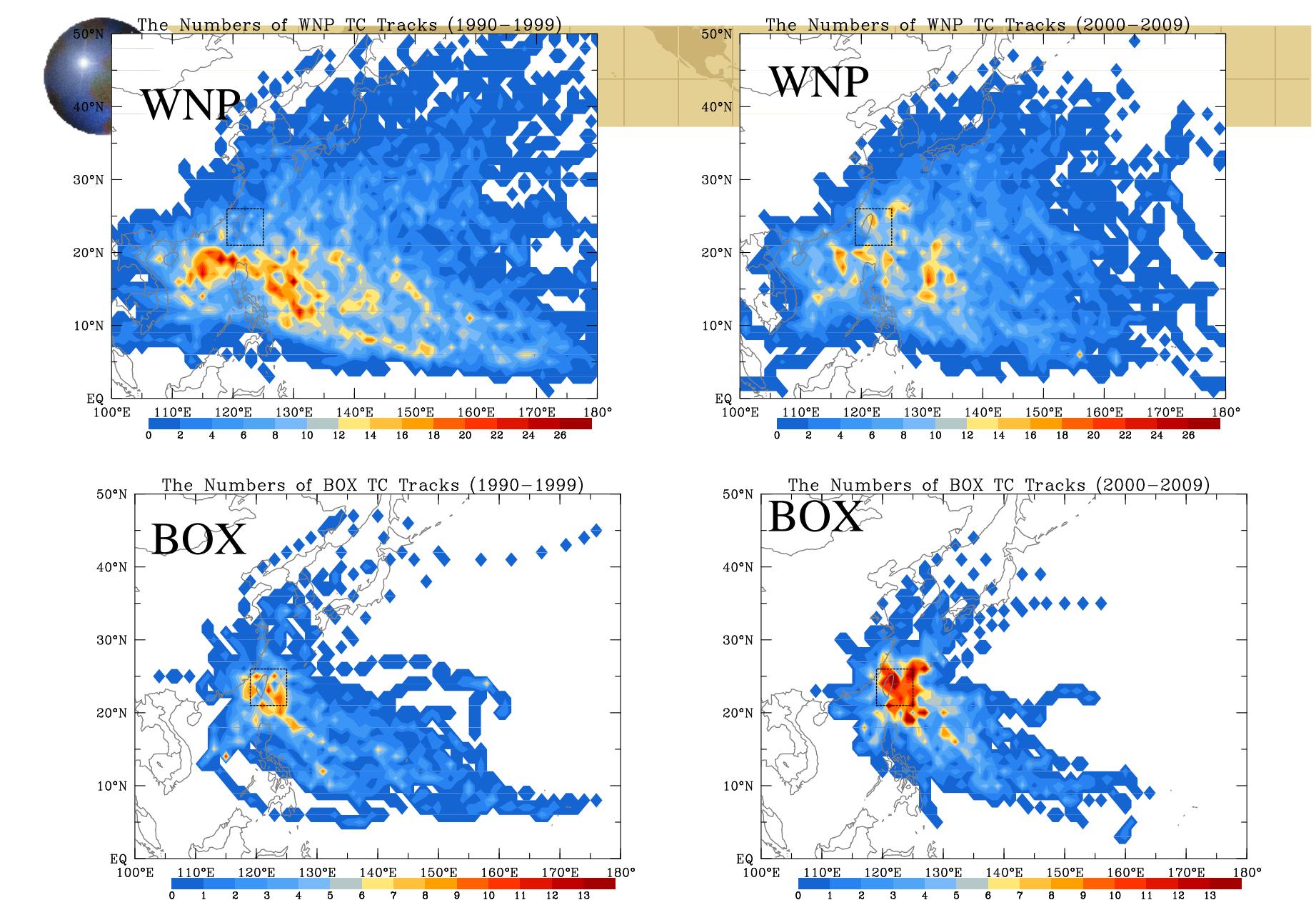


Annual Number of Typhoon pass over 119E-125E; 21-26N from 1979 to 2009 (LTM:4.3)

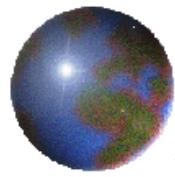




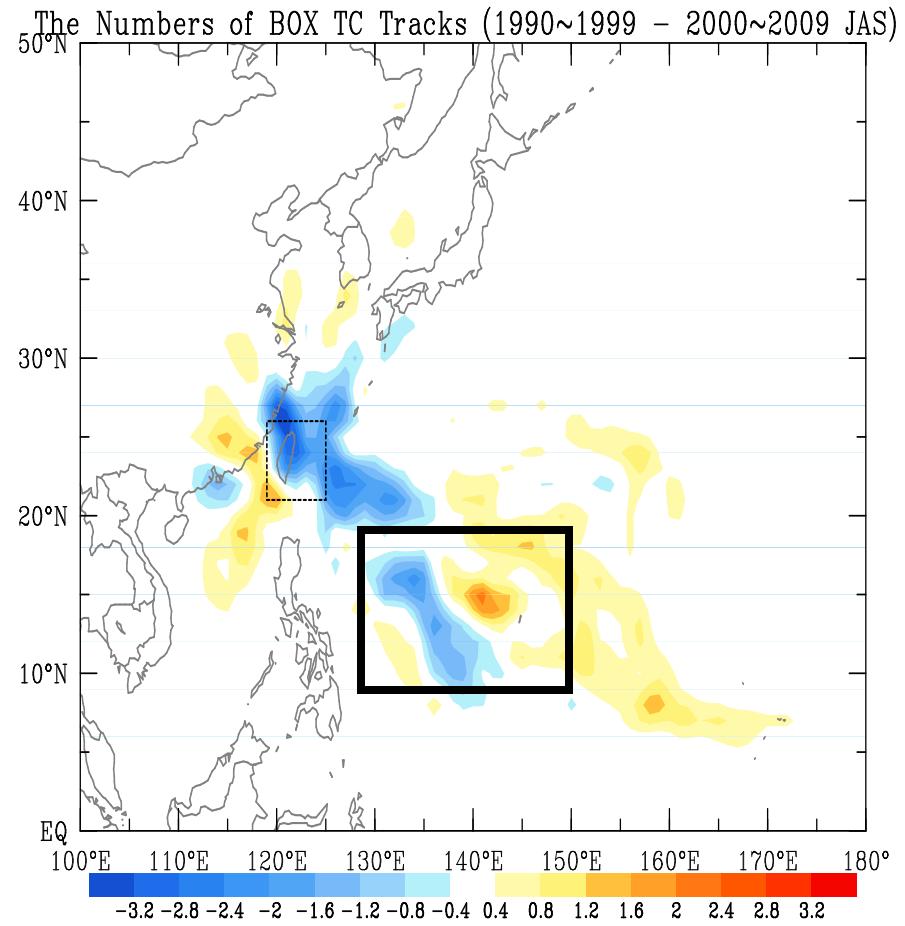
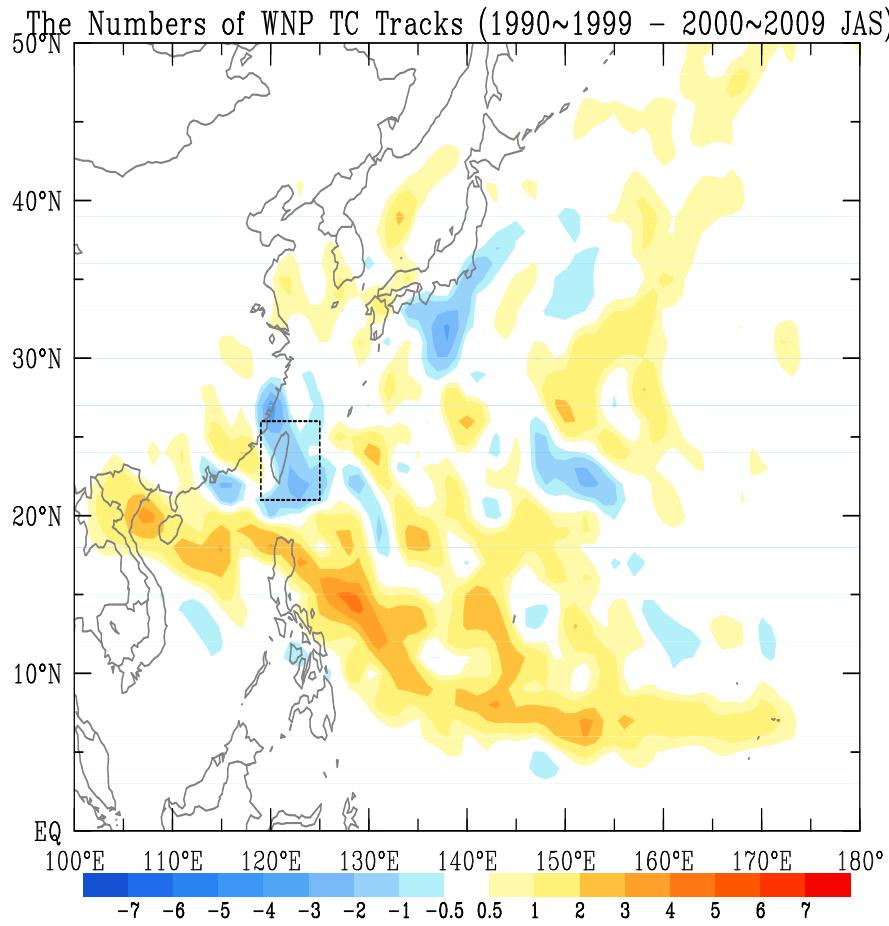
	BOX	WARN	INVADED
BOX		0.67	0.72
WARN	0.67		0.52
INVADED	0.72	0.52	

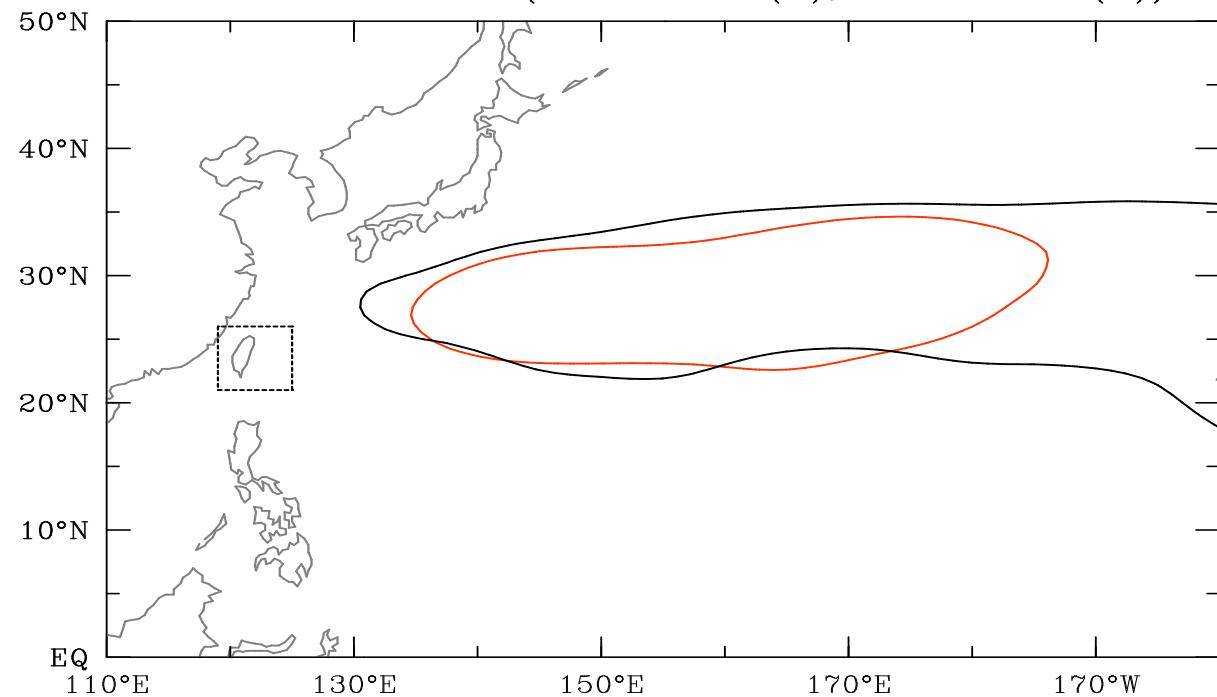
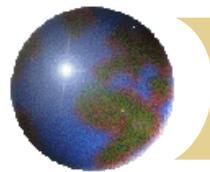


The typhoon tracks in WNP and typhoon approaching
Taiwan's tracks in two decade(1990-1999; 2000-20009)

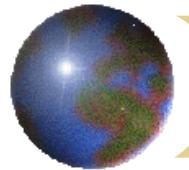


The difference's of Tropical Storm tracks in WNP and Tropical Storm approaching Taiwan tracks between 1990's and 2000's in JAS

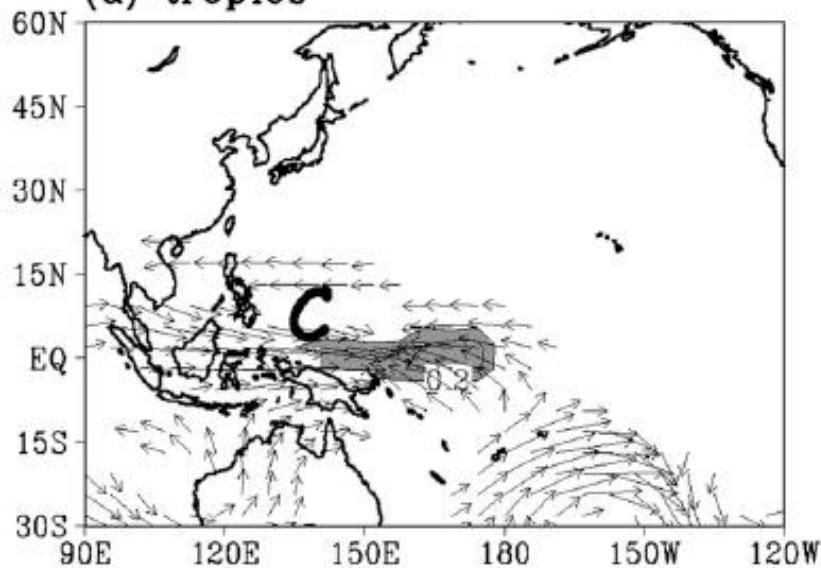




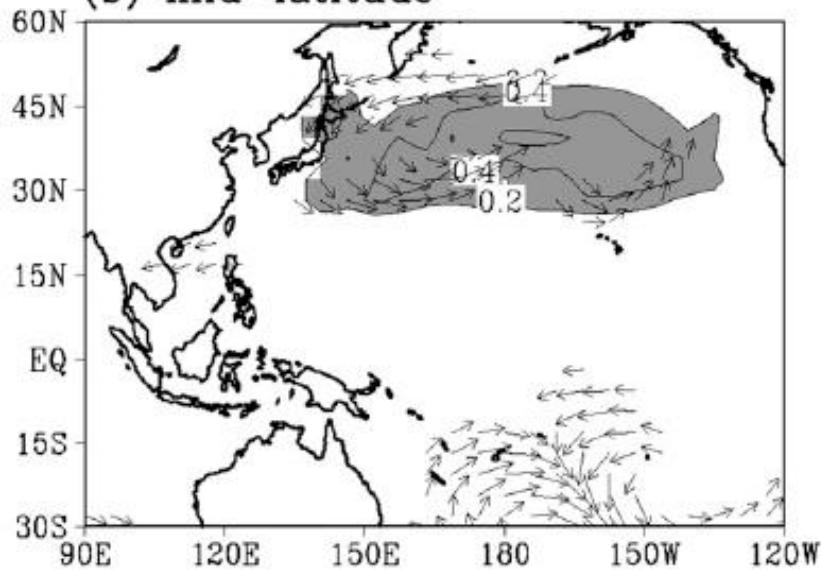
The 5880 contour line of H500 ,(1990-1999(R)); (2000-2009(B))



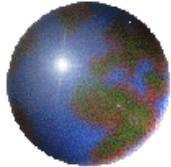
(a) tropics



(b) mid-latitude

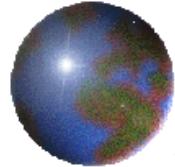


Tu et al. (2009)

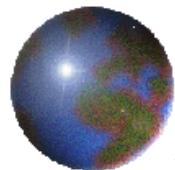


Summary

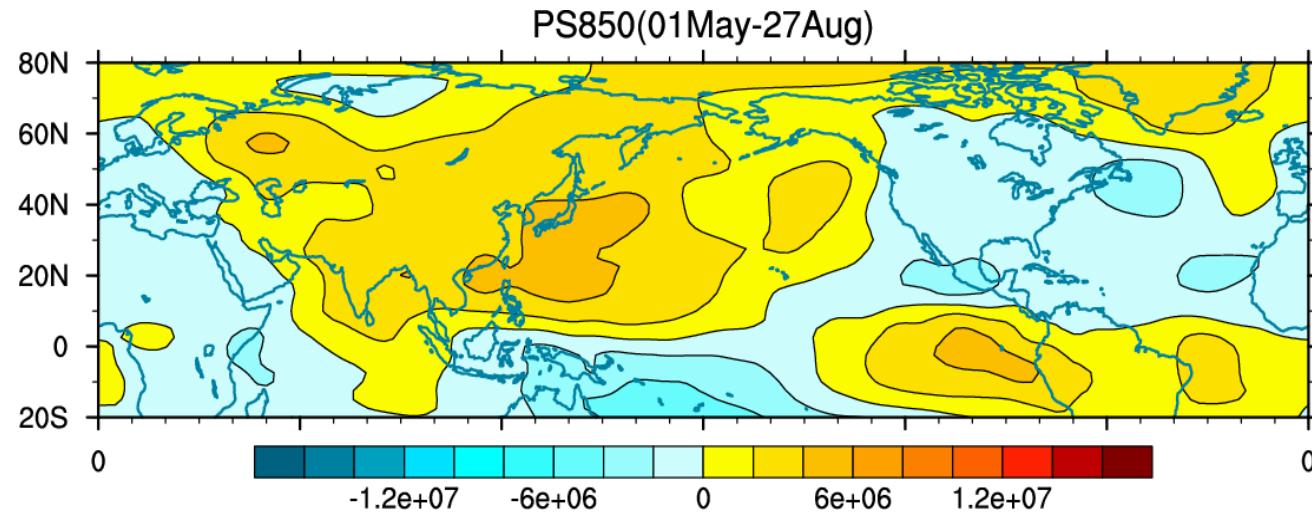
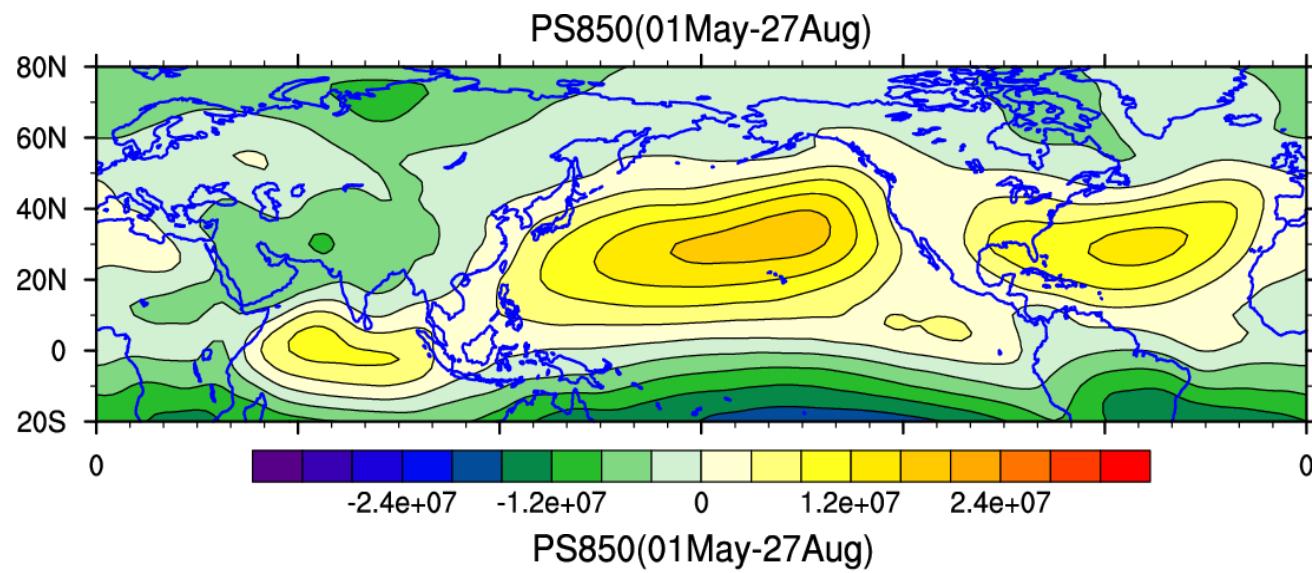
- ◆ The close relationship between the TC cyclone activity over the WNP and the typhoon approaching Taiwan in this decade is identified.
- ◆ The TC activity frequency was higher (lower) in 1990-1999 (2000-2009), which corresponded to the inactive (active) phase of the invaded typhoon, typhoon passing nearby Taiwan and warning issued.
- ◆ These changes in environmental conditions collectively favor the TC genesis for the period of 1990-1999

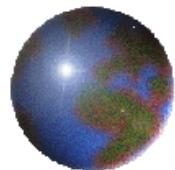


Annual	TS+TY	TS	TY	Invaded	MTY	STY	MTY+STY
1990-1999	290	106	184	34(12%)	17(50%)	8(24%)	25(74%)
2000-2009	251	86	165	42(17%)	21(50%)	8(19%)	29(69%)

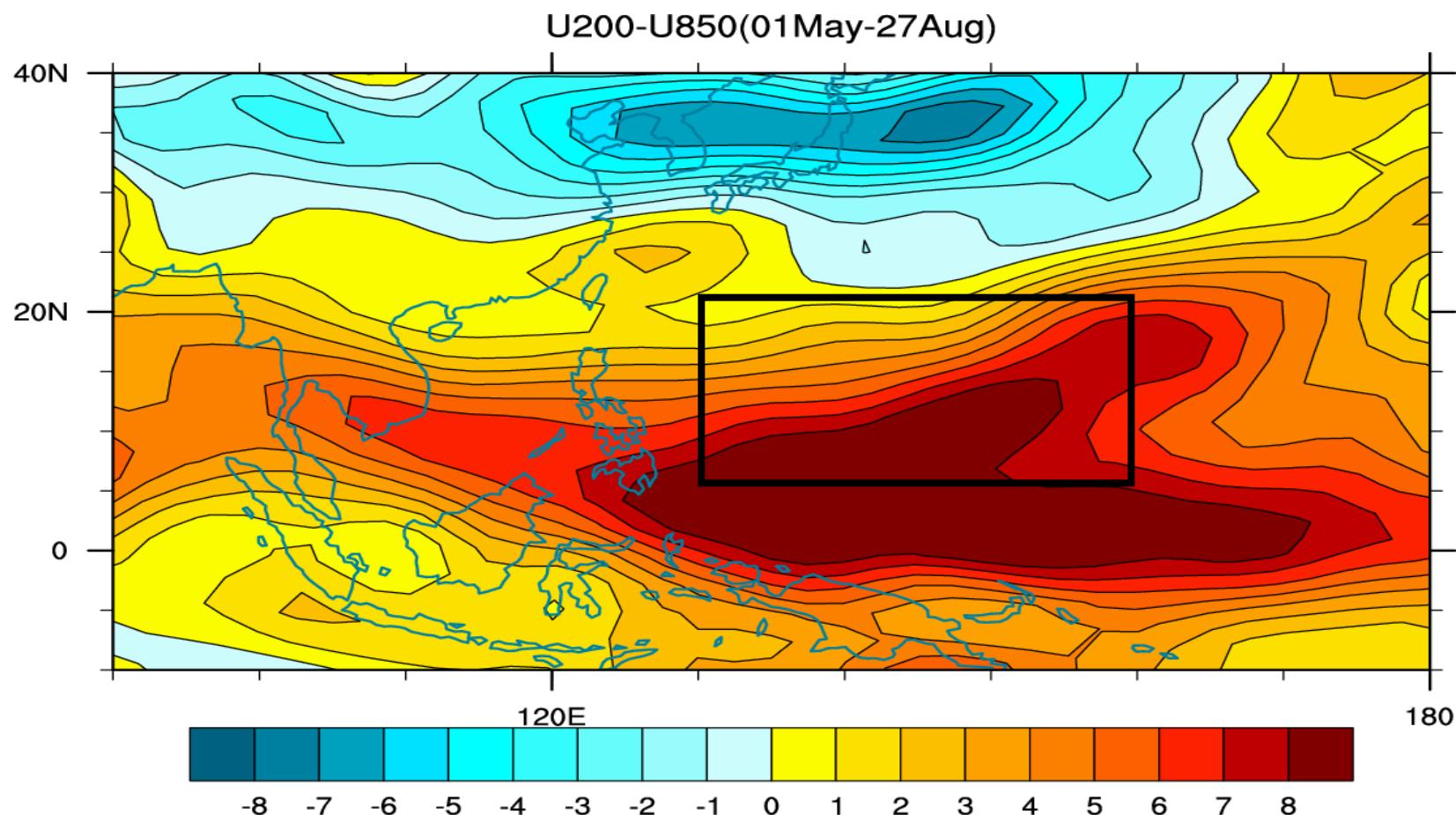


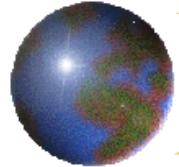
Strong Subtropical High and weak monsoon trough May to Aug 2010



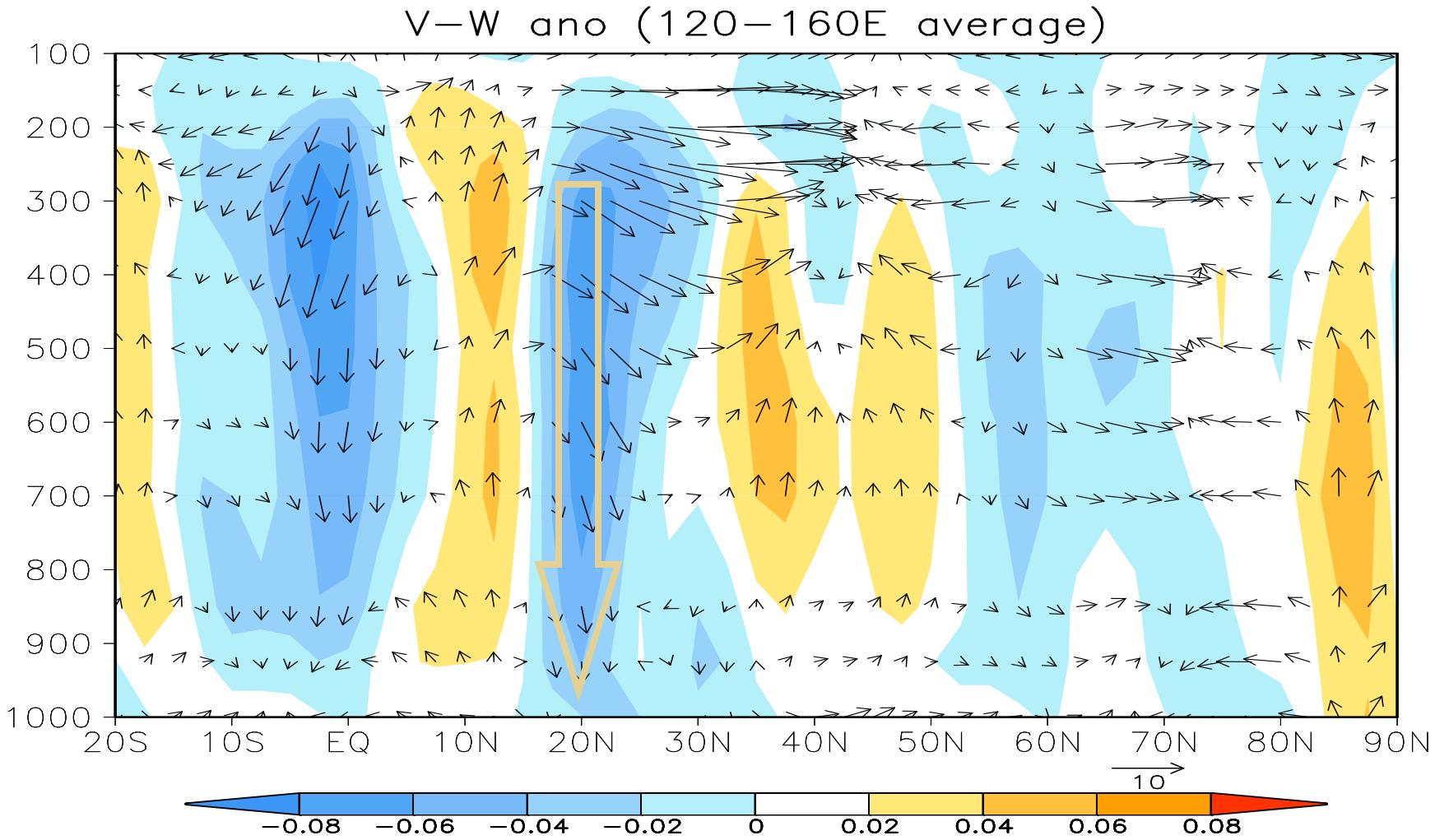


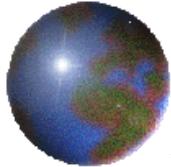
Strong Vertical wind shear in the typhoon genesis regions in May-Aug 2010





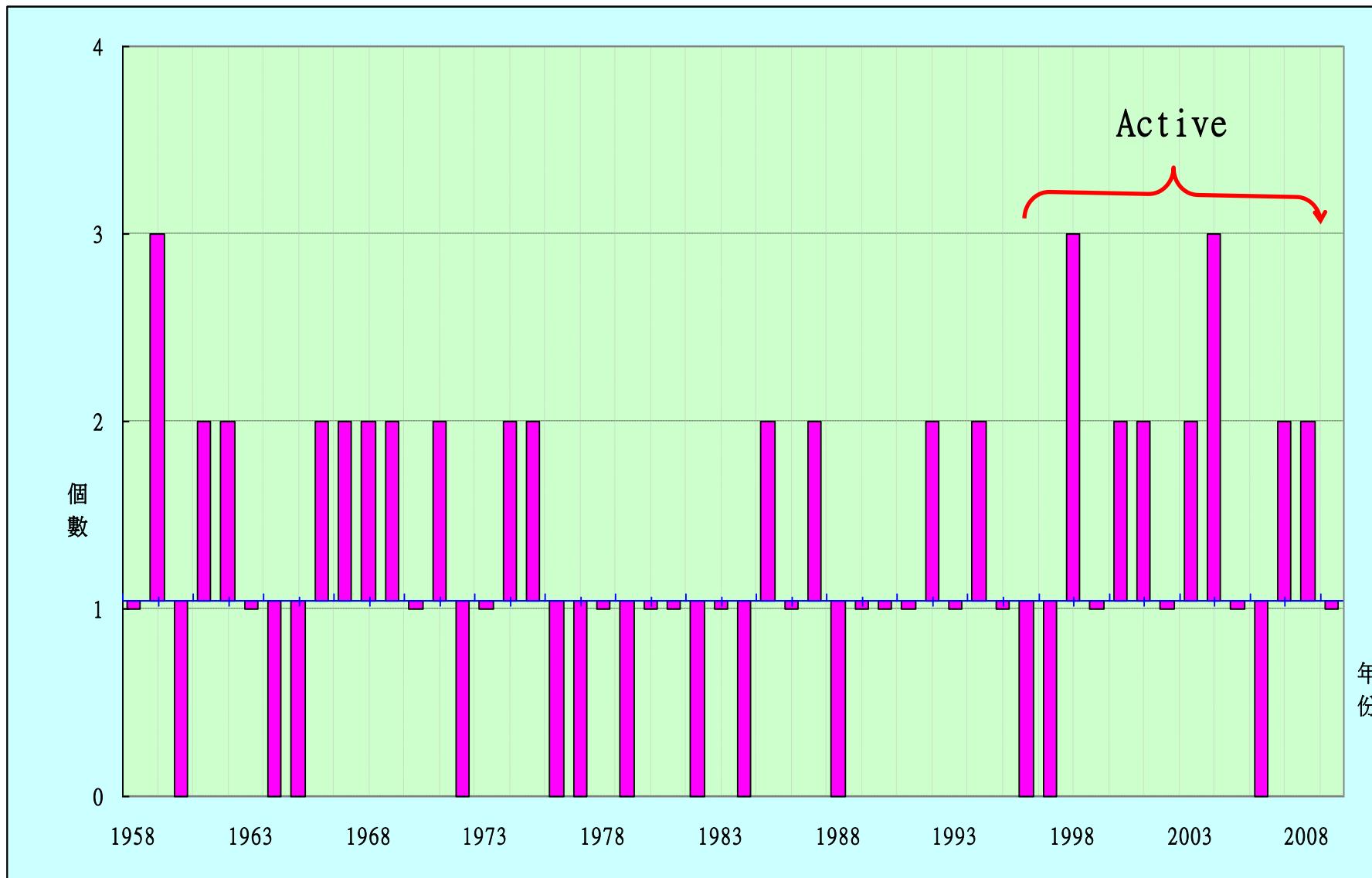
Strong downward(subsidence) motion in typhoon genesis regions in May-Aug 2010

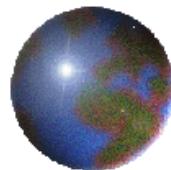




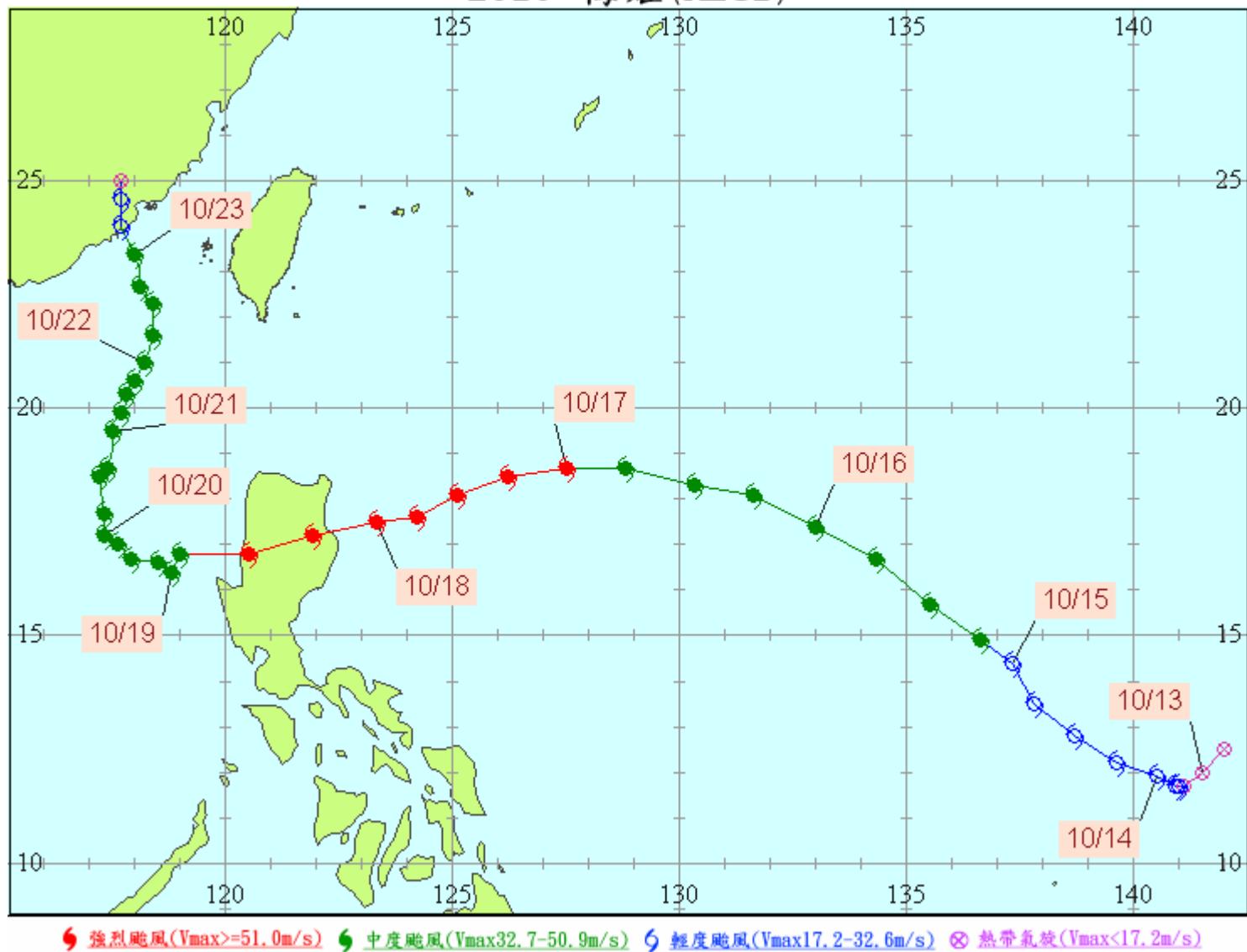
The most active years are 1959, 1998 and 2004 have three typhoons invading Taiwan (climate average 1.04 in SOND)

Data also showed that since 1998, except for no typhoon invading Taiwan in 2006, the number of typhoon invading Taiwan in SOND, have above normal trend.





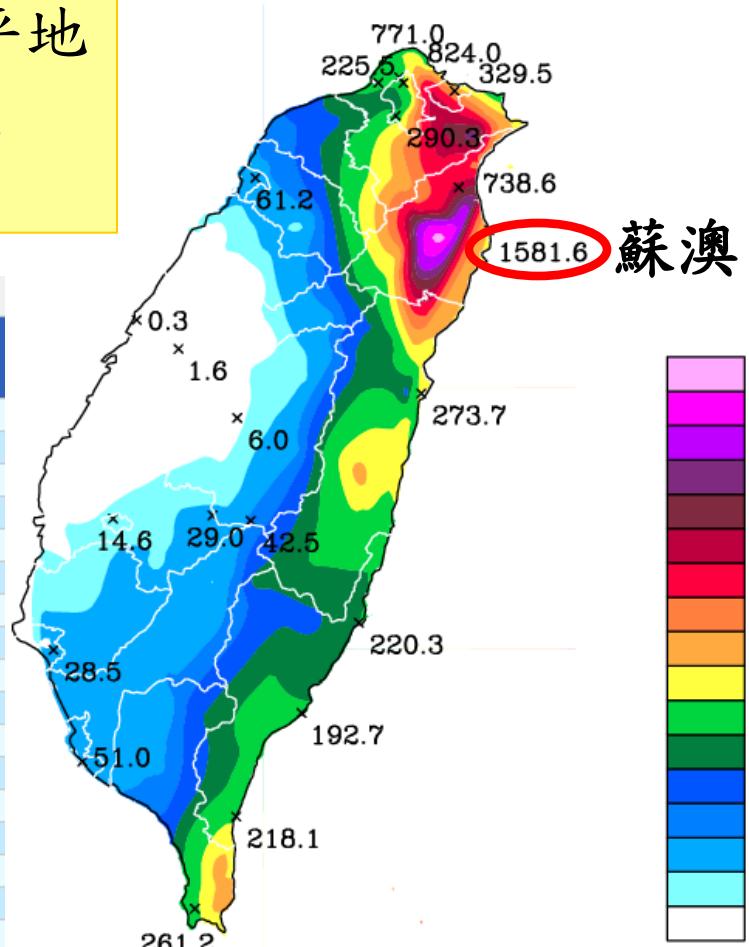
2010 梅姬(MEGI)



梅姬颱風外圍環流影響期間(18~22日)

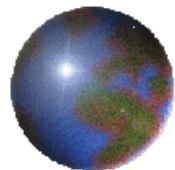
以宜蘭地區雨量最多，單日雨量以21日蘇澳站降下939.5毫米為最多(所有平地站的1st名)，該日14時時雨量更高達181.5毫米(台灣氣象史上的3th名)。

10月18日~22日累積雨量

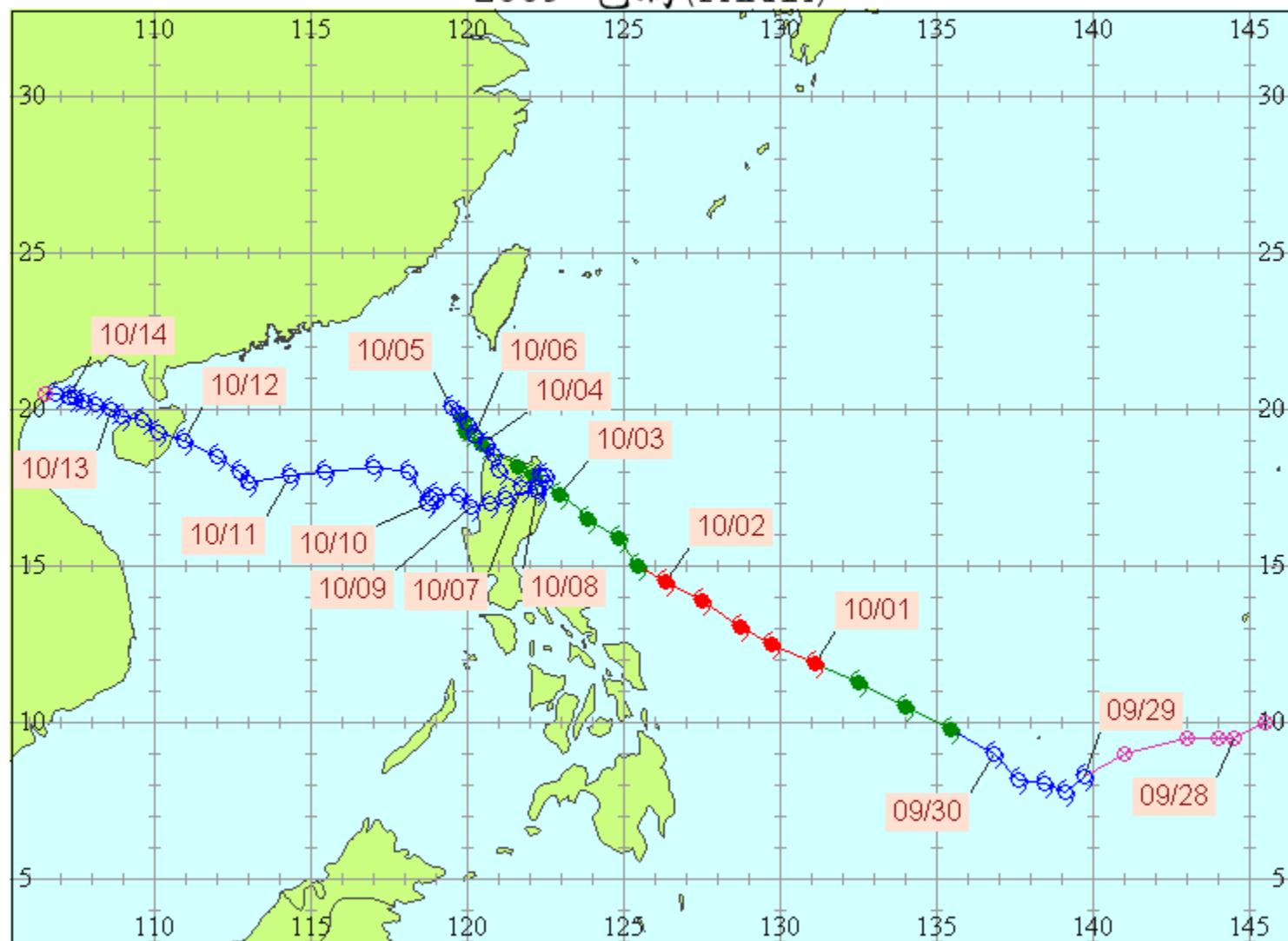


2010年10月18日~2010年10月22日累積雨量百大資料排行

名次	累積值	測站名稱	測站代碼	縣市
1	1743.00	古魯	C1U511	宜蘭縣
2	1313.00	東澳	C0U760	宜蘭縣
3	1183.00	新寮	C1U690	宜蘭縣
4	1045.00	羅東	C0U640	宜蘭縣
5	1017.00	泰平	C0A550	臺北縣
6	963.50	寒溪	C1U670	宜蘭縣
7	927.50	牛鬥	C1U501	宜蘭縣
8	802.00	大尖山	C0A590	臺北縣
9	786.50	坪林	C0A530	臺北縣
10	696.00	五指山	C0A870	臺北縣
11	683.00	三星	C1U660	宜蘭縣
12	675.50	桶後	C0A570	臺北縣
13	671.50	四堵	C0A540	臺北縣
14	667.00	大坪	C0A860	臺北縣
15	647.00	大礁溪	C1U610	宜蘭縣
16	639.50	南澳	C0U770	宜蘭縣
17	637.00	礁溪	C0U600	宜蘭縣
18	627.00	玉蘭	C0U650	宜蘭縣
19	611.50	大屯山	C0AC40	臺北市
20	598.00	再連	C1U630	宜蘭縣



2009 芭瑪 (PARMA)



◆ 強烈颱風(Vmax>=51.0m/s) ◆ 中度颱風(Vmax32.7-50.9m/s) ◆ 輕度颱風(Vmax17.2-32.6m/s) ⊗ 热帶氣旋(Vmax<17.2m/s)

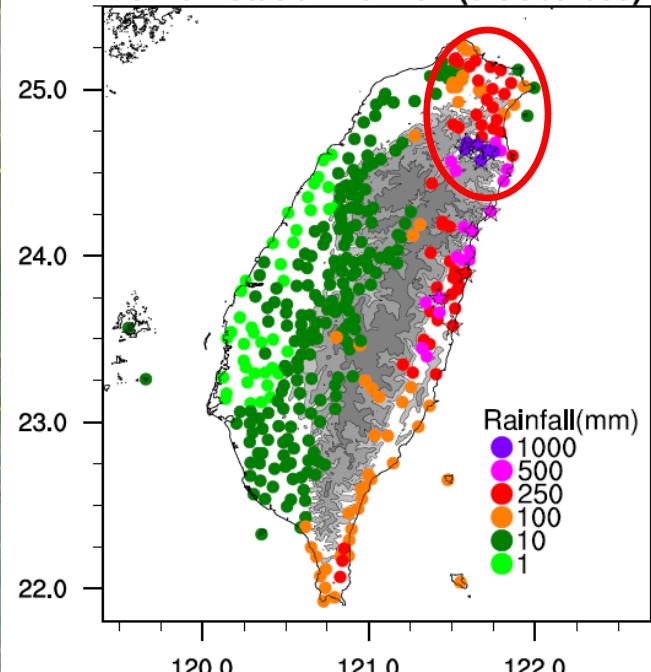
芭瑪颱風外圍環流+東北季風雙重影響期間(10月3-6日)

2009年10月3日~2009年10月6日累積雨量百大資料排行

名次	累積值	測站名稱	測站代碼
1	1629.00	古魯	C1U511
2	1330.50	牛門	C1U501
3	1329.00	寒溪	C1U670
4	1240.00	三星	C1U660
5	1161.00	新寮	C1U690
6	1042.50	玉蘭	C0U650
7	949.50	和中	C0T9D0
8	945.50	東澳	C0U760
9	706.00	土場	C1U700
10	661.00	富世	C0T9C0
11	647.00	太平山	C0U710
12	626.50	布洛灣	C1T830
13	619.00	冬山	C1U680
14	592.00	大觀	C1T940
15	581.00	新城	C0T840



Taiwan Station Rainfall (3-6Oct2009)



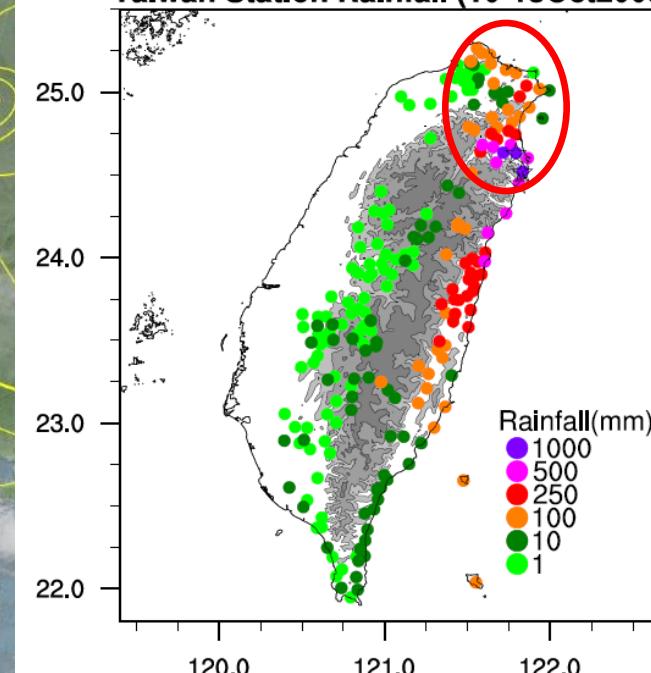
大範圍東南風提供水汽+東北季風雙重影響期間(10-13日)

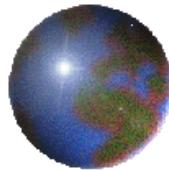
2009年10月10日~2009年10月13日累積雨量百大資料排行

名次	累積值	測站名稱	測站代碼
1	1317.50	寒溪	C1U670
2	1077.50	冬山	C1U680
3	1013.00	東澳	C0U760
4	873.00	三星	C1U660
5	852.50	羅東	C0U640
6	749.00	南澳	C0U770
7	734.00	和中	C0T9D0
8	689.50	古魯	C1U511
9	614.00	富世	C0T9C0
10	589.00	玉蘭	C0U650
11	490.50	牛門	C1U501
12	490.00	再連	C1U630
13	479.00	新城	C0T840
14	461.50	水源	C0T9B0
15	431.00	吉安	C1T850



Taiwan Station Rainfall (10-13Oct2009)



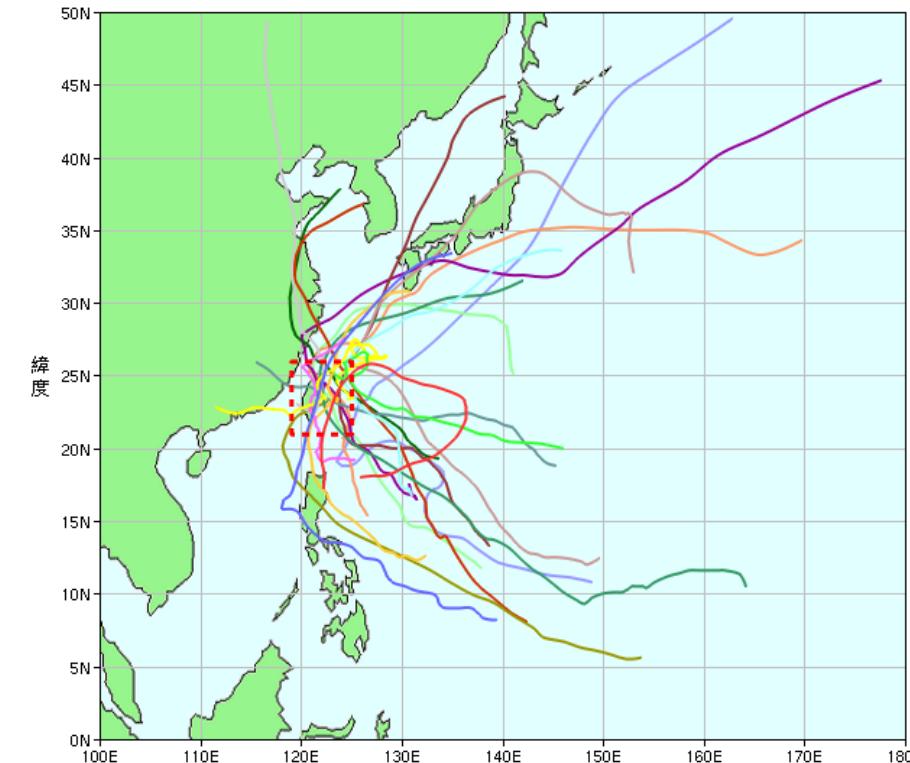
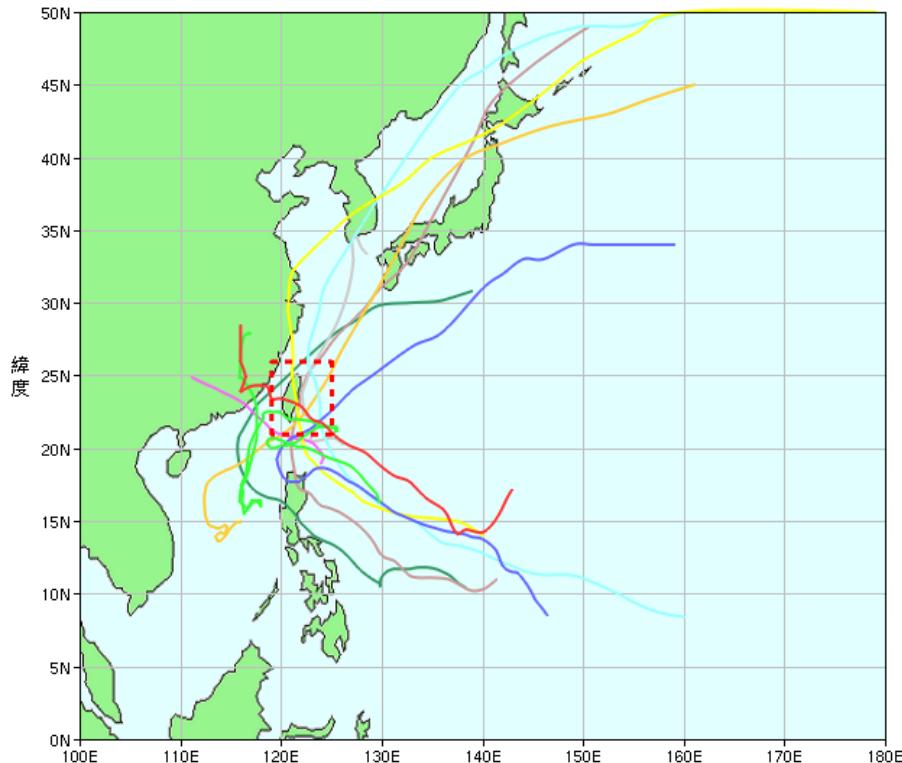


1990-1999(SON)

[RSMC] 1990-1999; 9月-11月 所有強度 侵台(119E~125E, 21N~26N) 路徑圖

2000-2009(SON)

[RSMC] 2000-2009; 9月-11月 所有強度 侵台(119E~125E, 21N~26N) 路徑圖



SON	超級 TS+TY	TS	TY	Invaded	中度	強烈	中度以上
1990-1999	128	44	84	12(9%)	6(50%)	3(25%)	9(75%)
2000-2009	97	29	68	15(15%)	7(46%)	3(20%)	10(67%)