Seasonal prediction of tropical cyclone activity using the KMA global model

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Model: KMA GDAPS

(T106 L21)

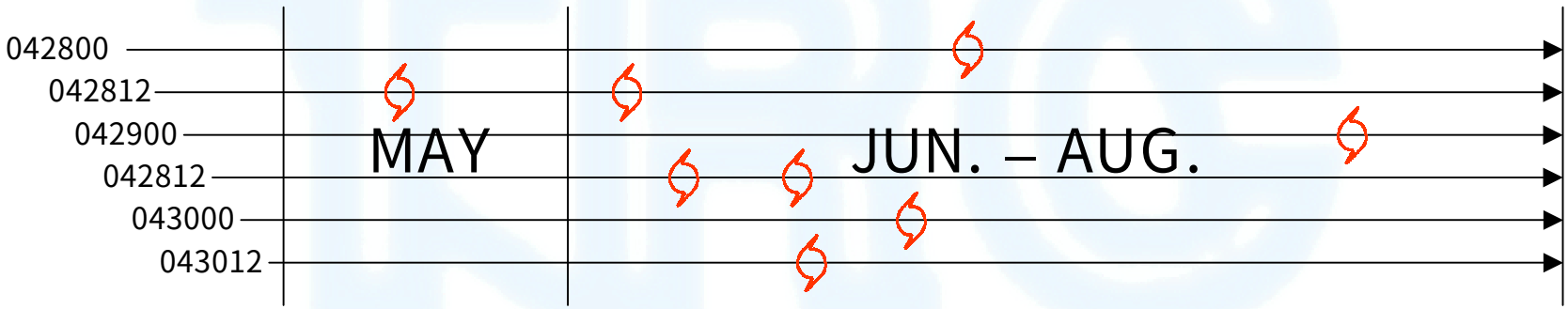
HFP

6 ensemble members with different initial time

April 28 00UTC, 12UTC … April 30 00UTC, 12UTC

Predicted SST prescription, 4 month prediction (5, 6, 7, 8)

1979 – 2004



Purpose

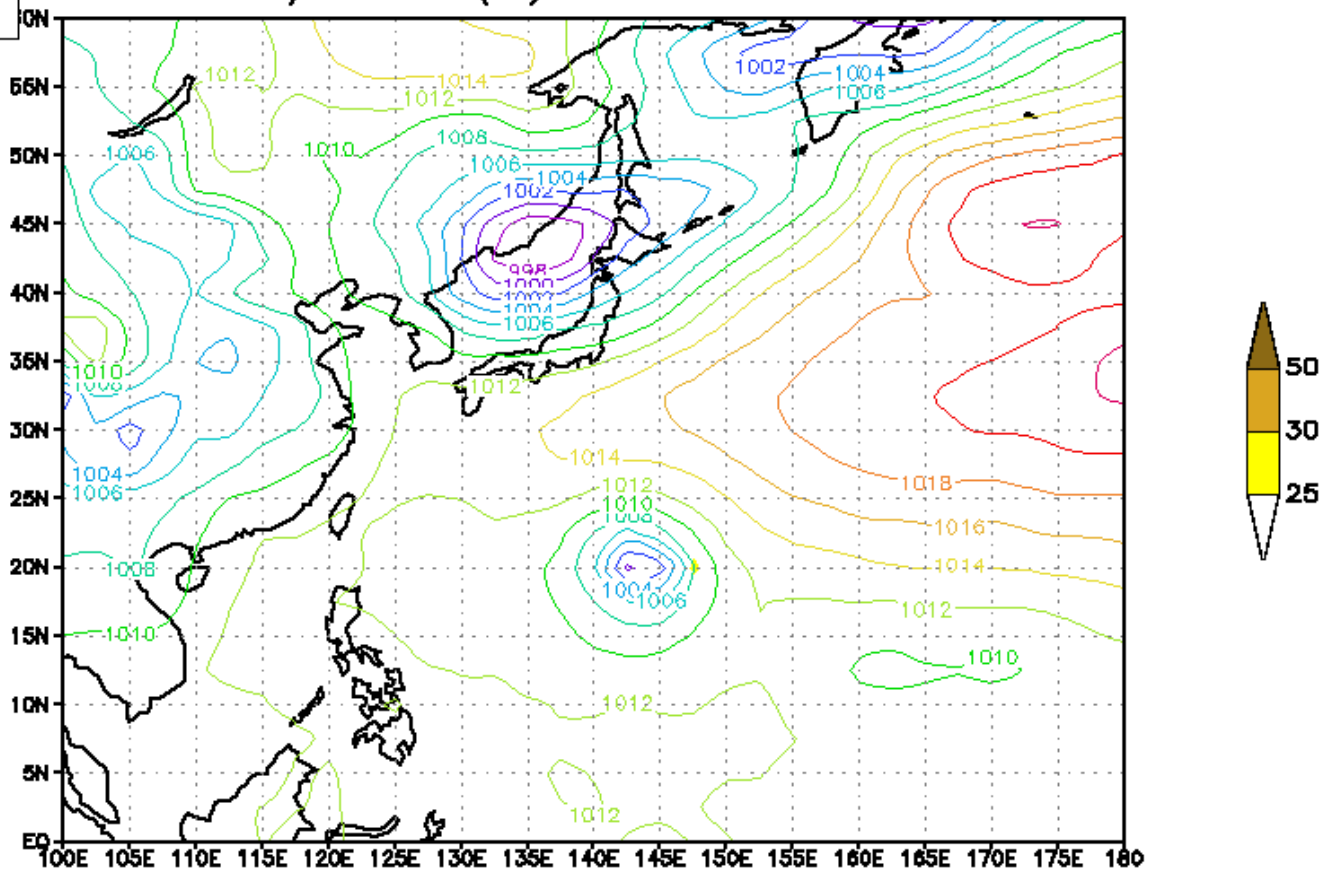
Detecting and tracking the model tropical cyclone.

Attempt for the prediction of the seasonal (JJA) TC activity

042800 Prev 20030902 Next SFC V850 V500 T500 V300

042800
042812
042900
042912
043000
043012

CE PRESSURE/ISOTACH(kt) START=042800 DATE=20030902



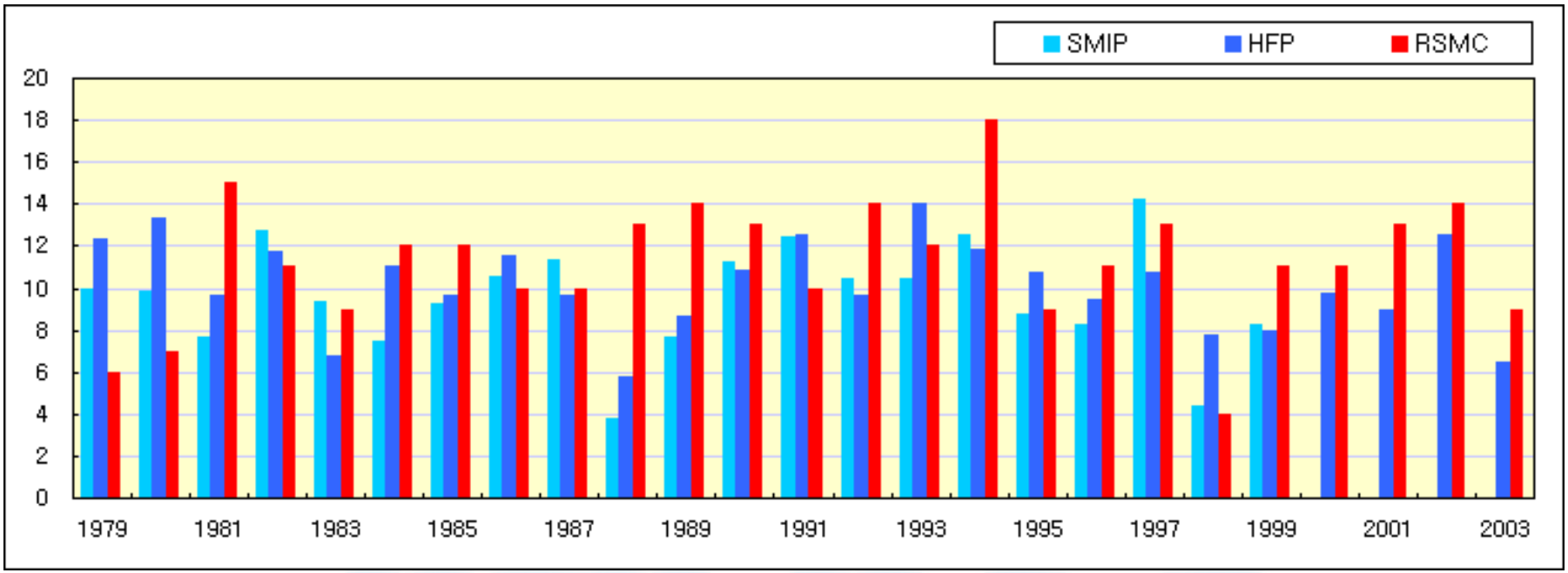
TS (Tropical Storm)

Tropical cyclone, surface wind ≥ 34 kt

TS (Model)

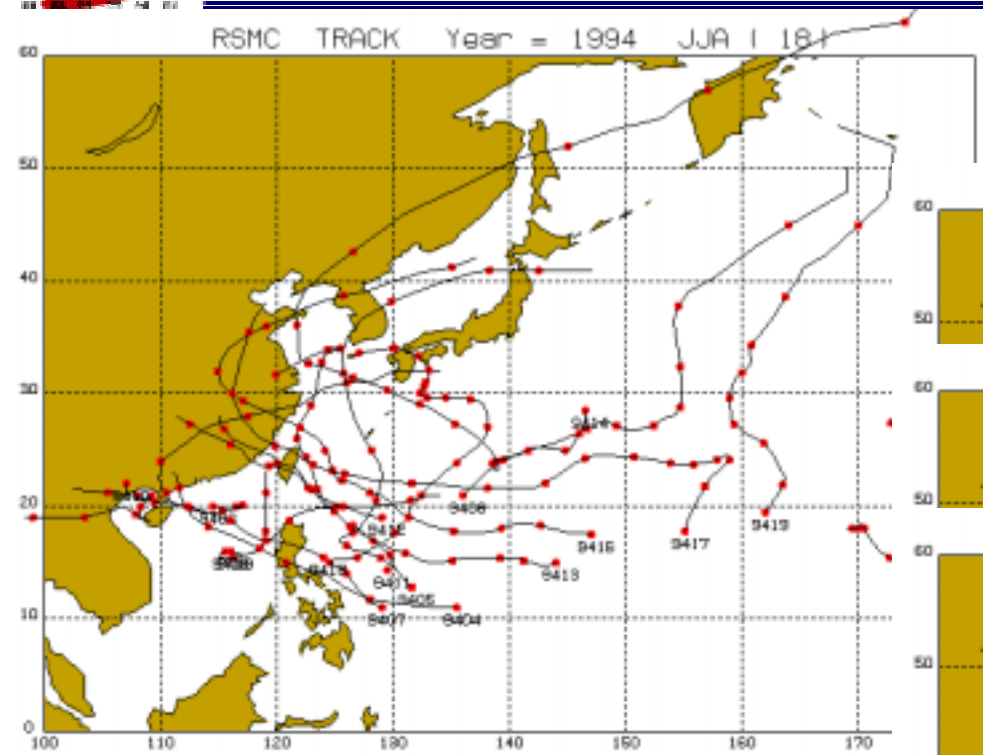
(1) The central pressure at surface lower than 1012 hPa,
(2) the 850 hPa wind greater than 25 kt,
(3) the 500 hPa vorticity greater than 3×10^{-5} s^{-1},
(4) vortex lasts at least for 2 days.

Yearly TC activity (June-August)



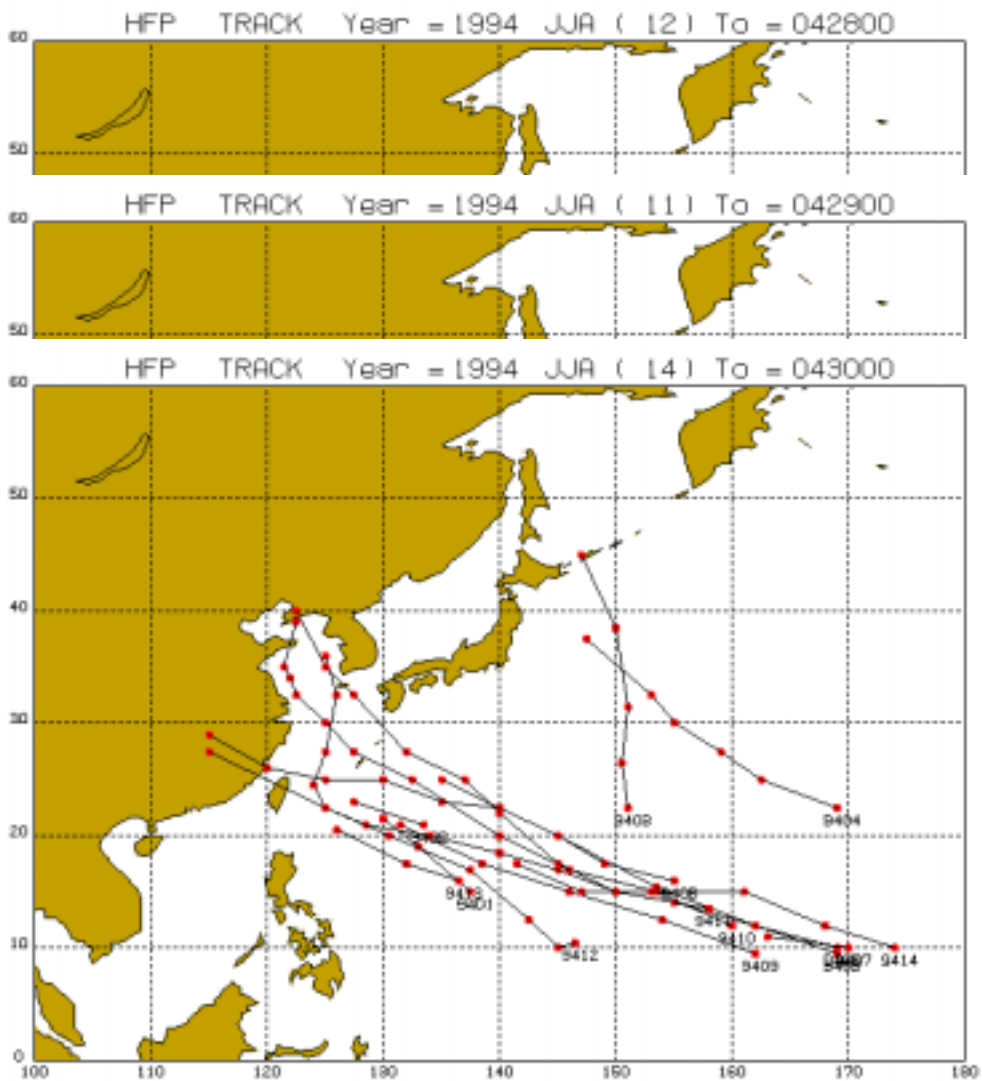
1994 1998

Observed(RSMC) vs. HFP, 1994

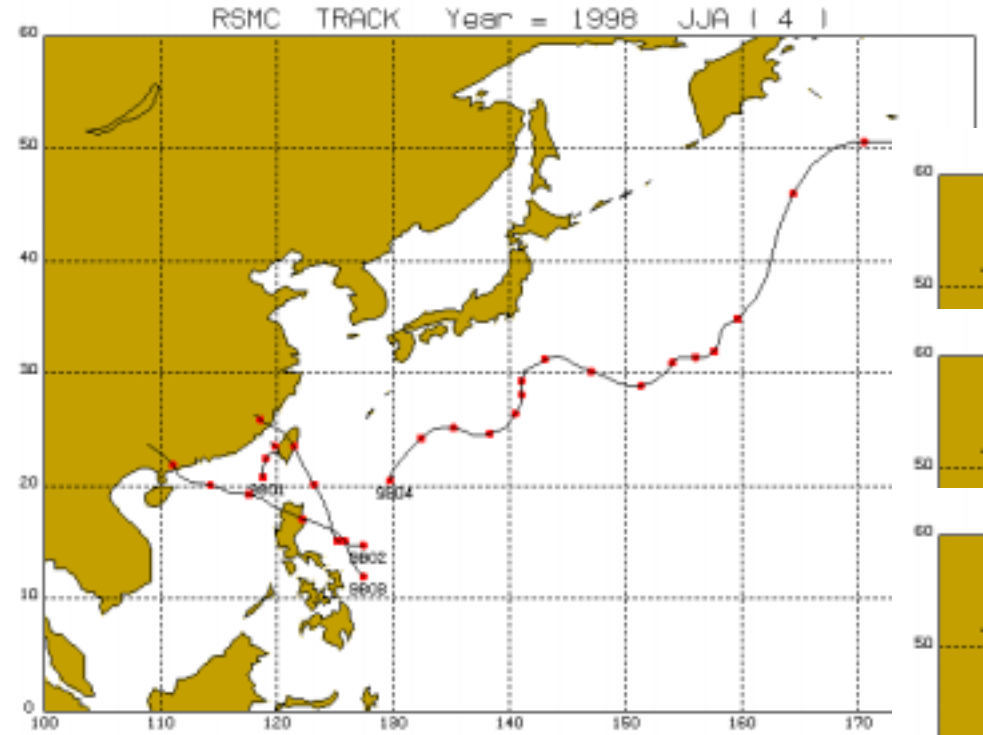


RSMC.1994, JJA

HFP.1994, JJA

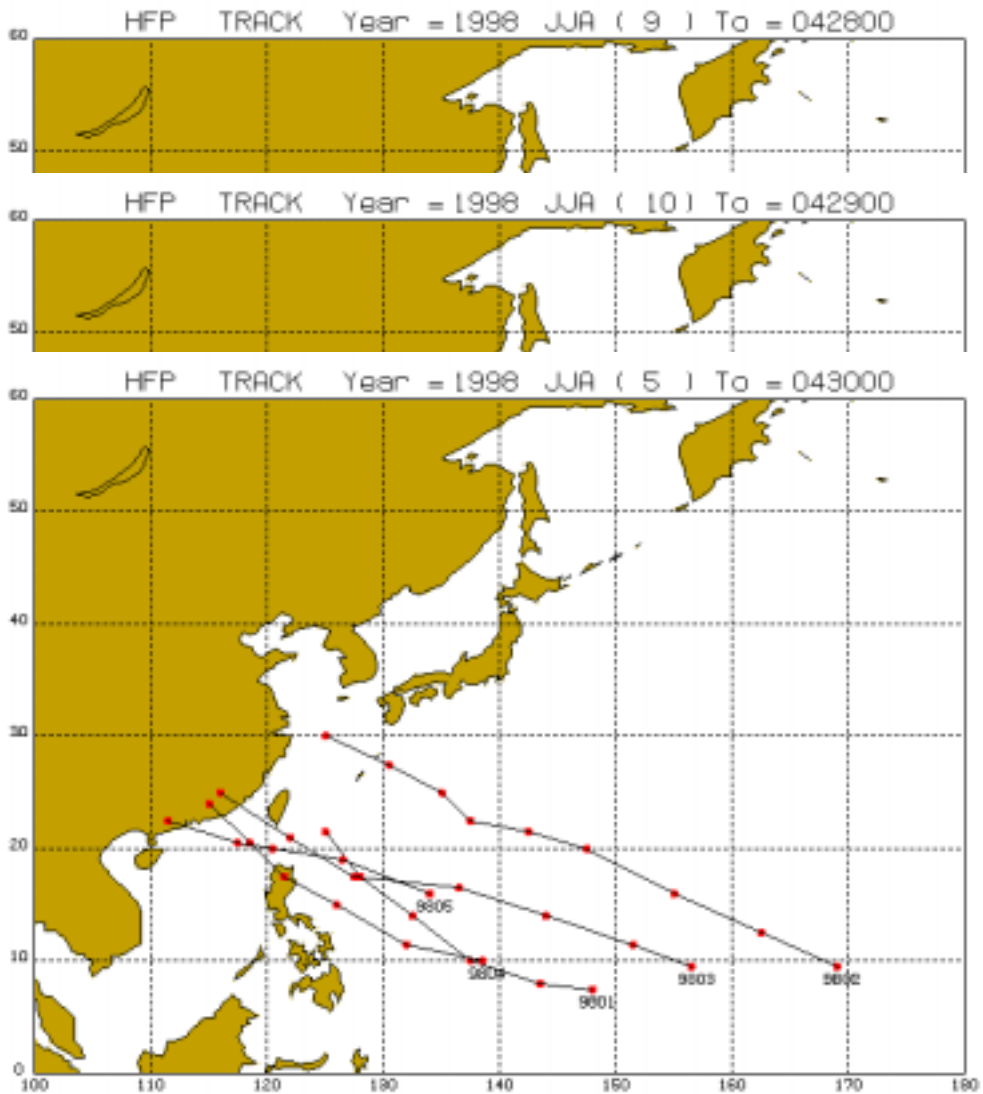


Observed(RSMC) vs. HFP, 1998

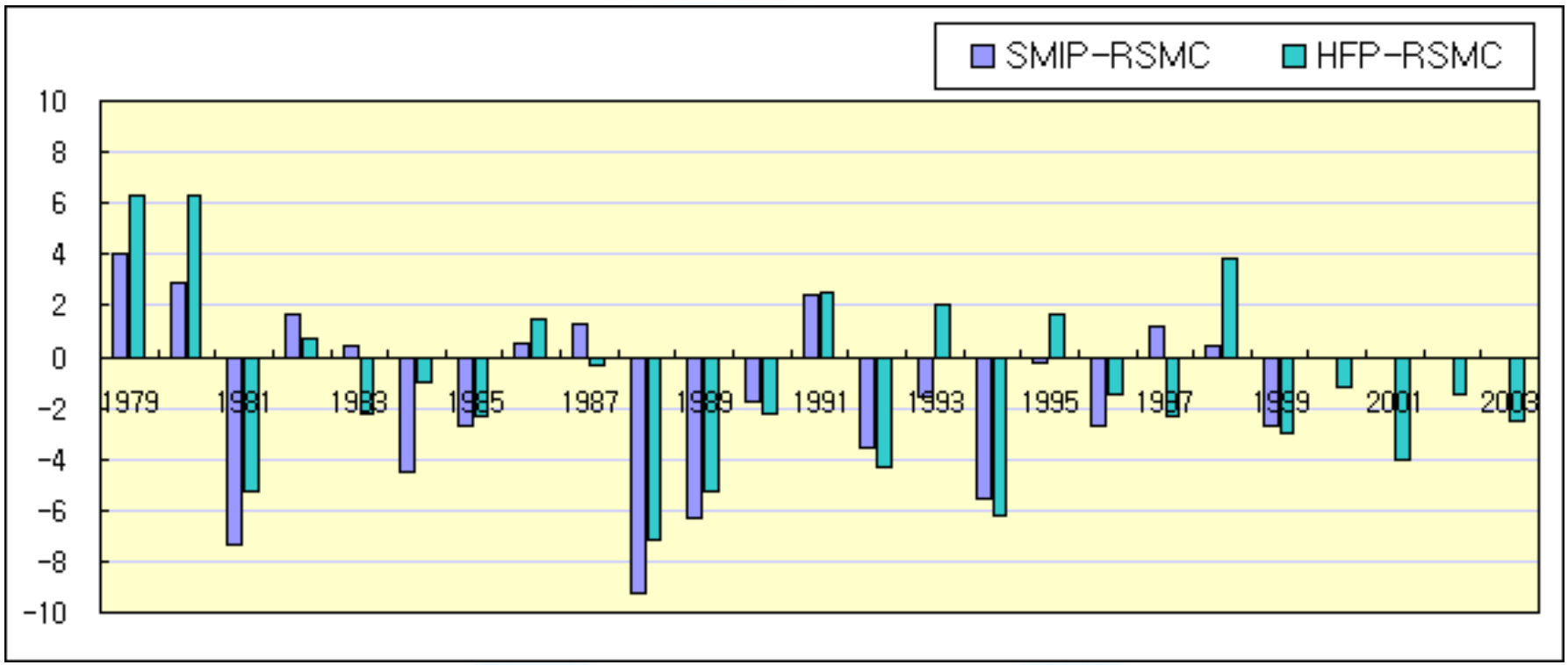


RSMC.1998, JJA

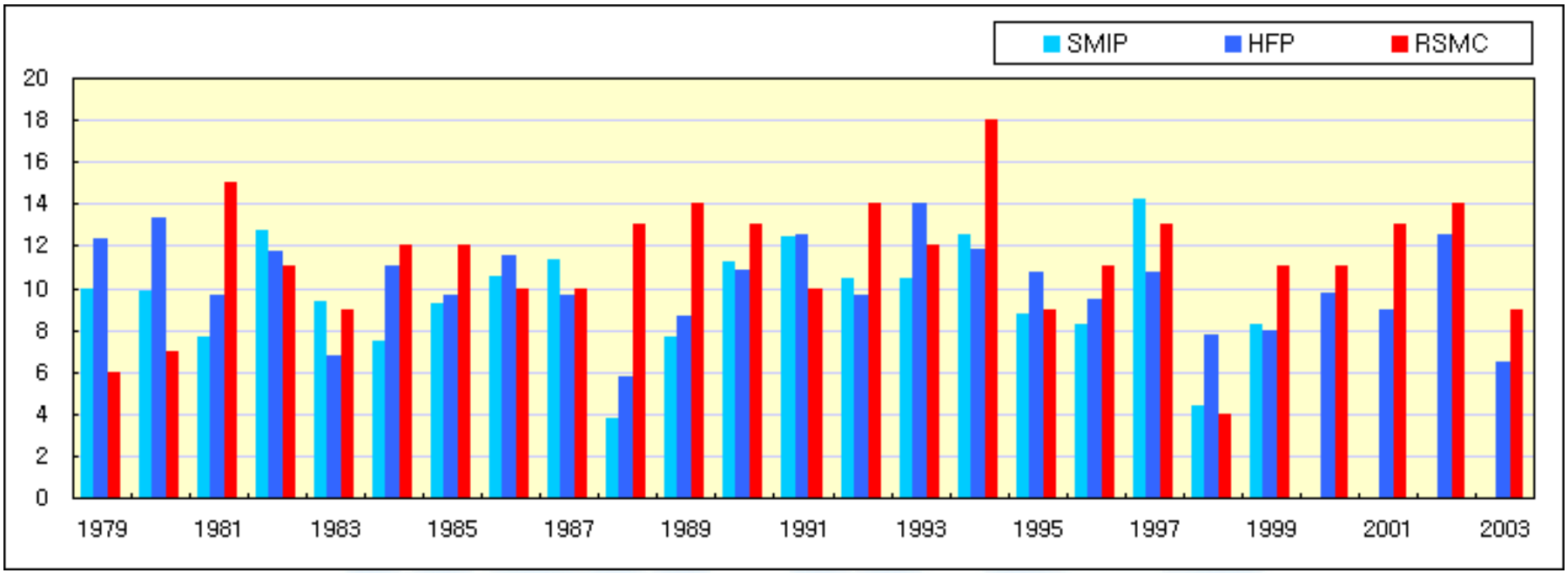
HFP.1998, JJA



Model TC number - Observed



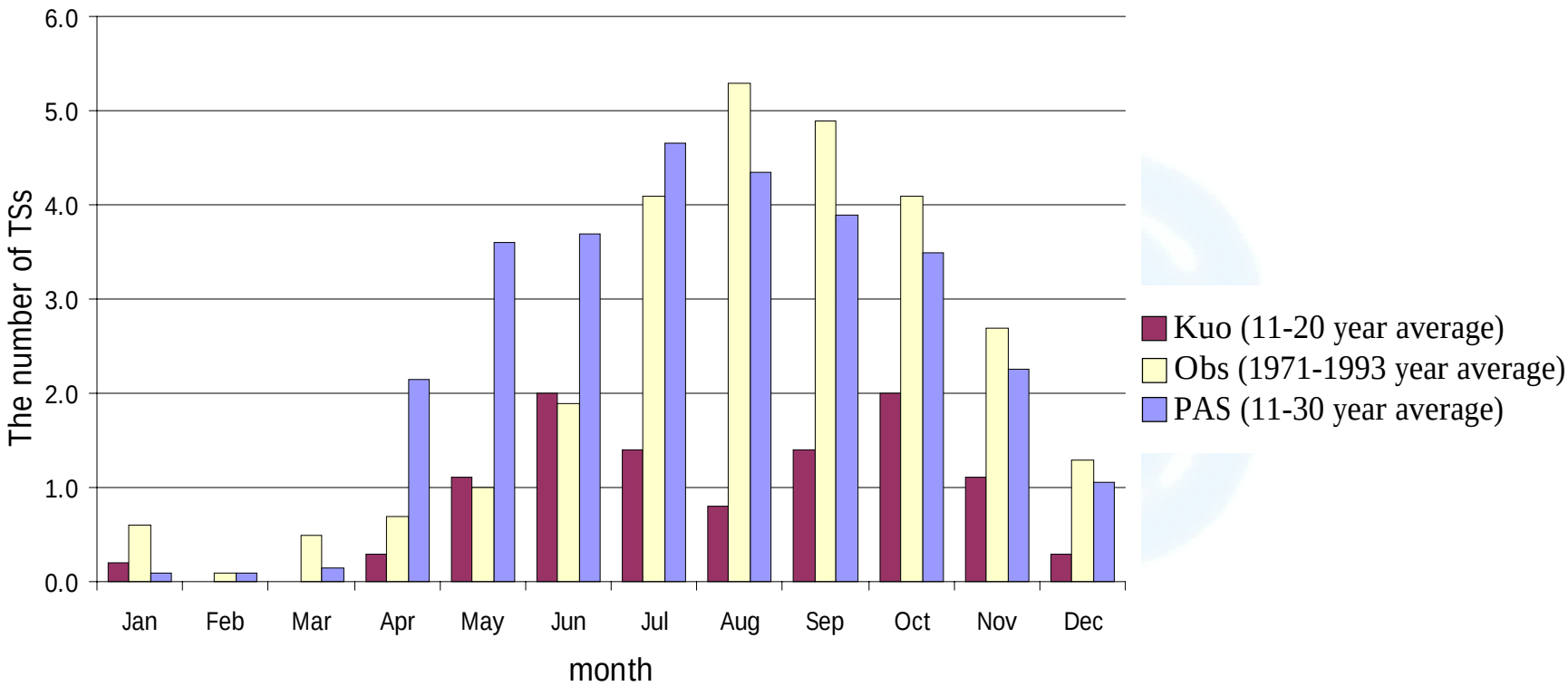
Yearly TC activity (June-August)



Bias correction

Prediction

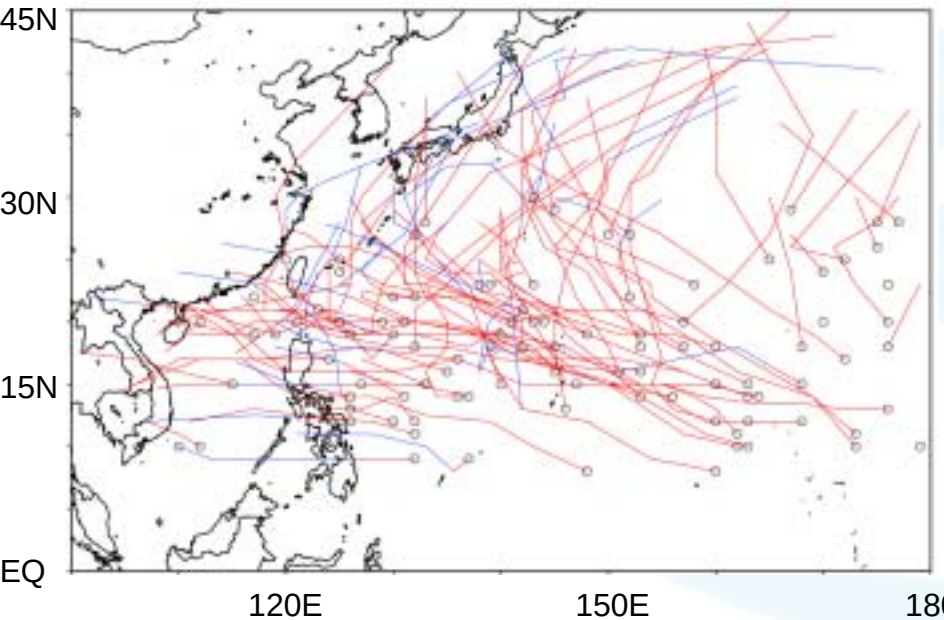
Monthly Tropical Storm Frequency



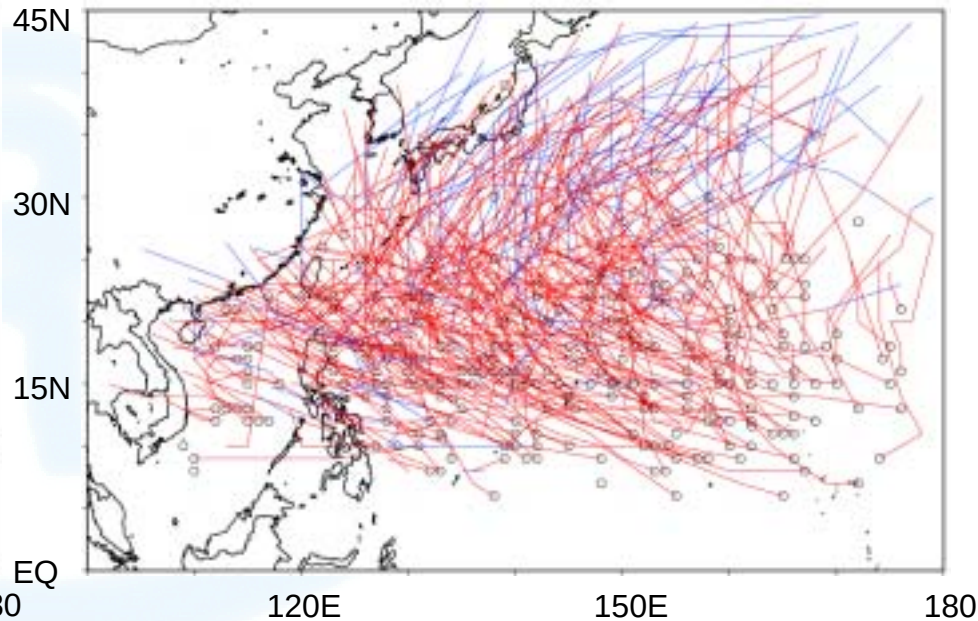
From Dr. Matsuura, National Research Institute for Earth Science and Disaster Prevention(NIED), Japan

Tropical Storm Track during 10 years

KUO (Year 11-20)



PAS (Year 11-20)

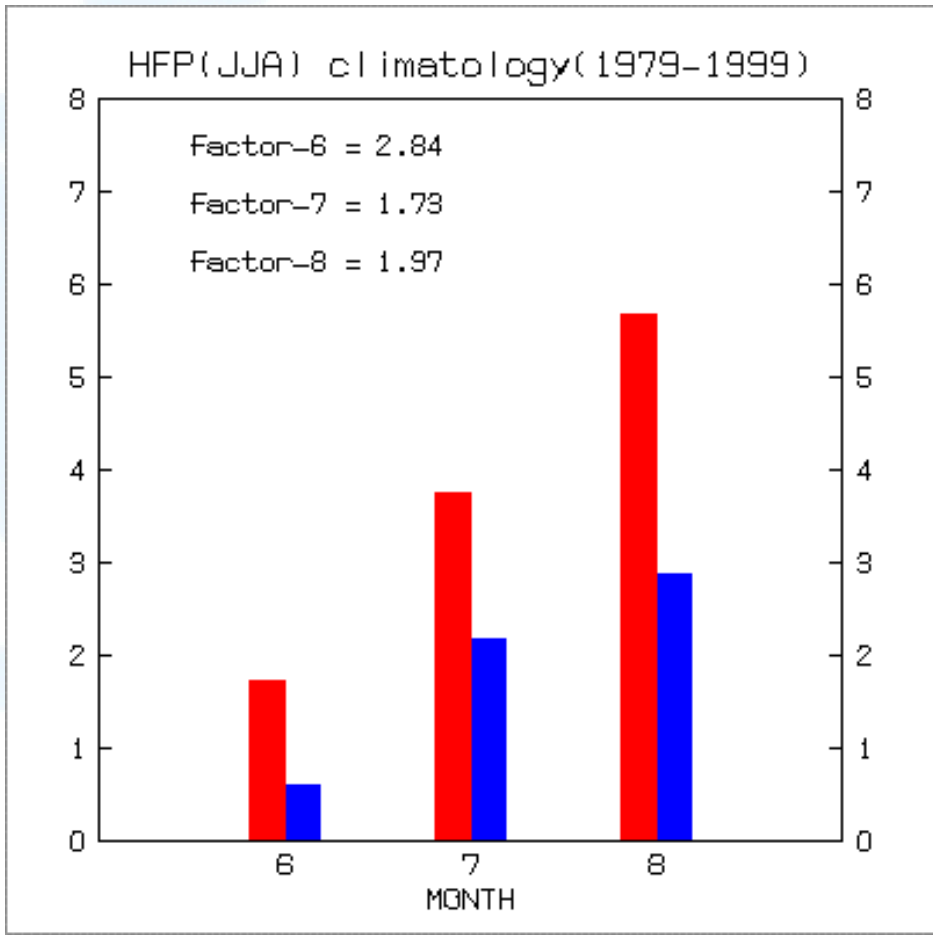


JMA global model (JGSM) T213

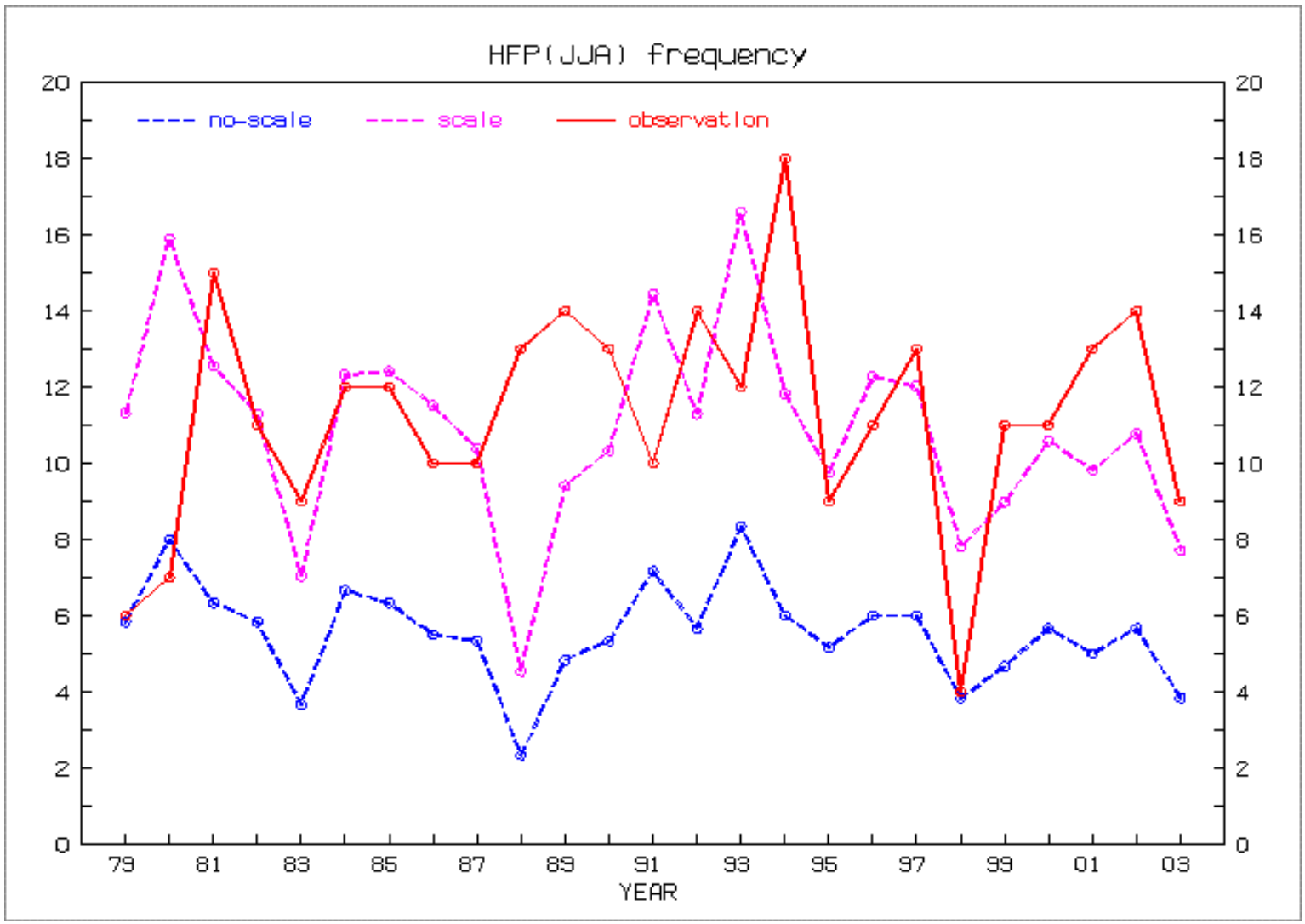
Criteria for vortex detecting and tracking

Sugi, M., A. Noda, and N. Sato, 2002 : Influence of the Global Warming on Tropical Cyclone Climatology: An Experiment with the JMA Global Model. J. Meteor. Soc. Japan, 80, 249-272

1. p(sfc) less than 1020hPa
2. 850hPa vorticity $\geq 3.5 \times 10^{-5}$ sec^{-1}
3. Vmax(850) $\geq$ 15m/sec
4. Last at least for 2 days
5. 300hPa max wind < 850hPa max wind
6. Warm core

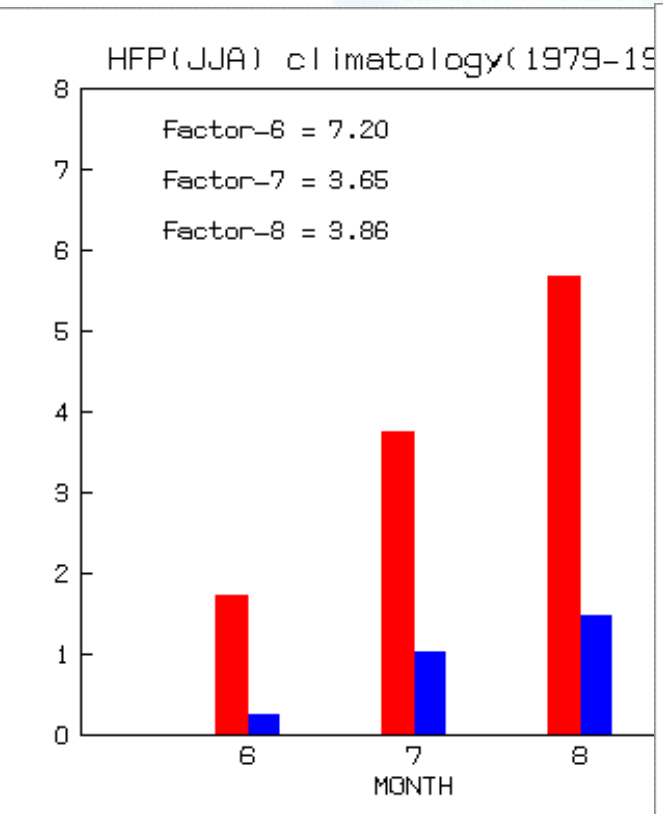


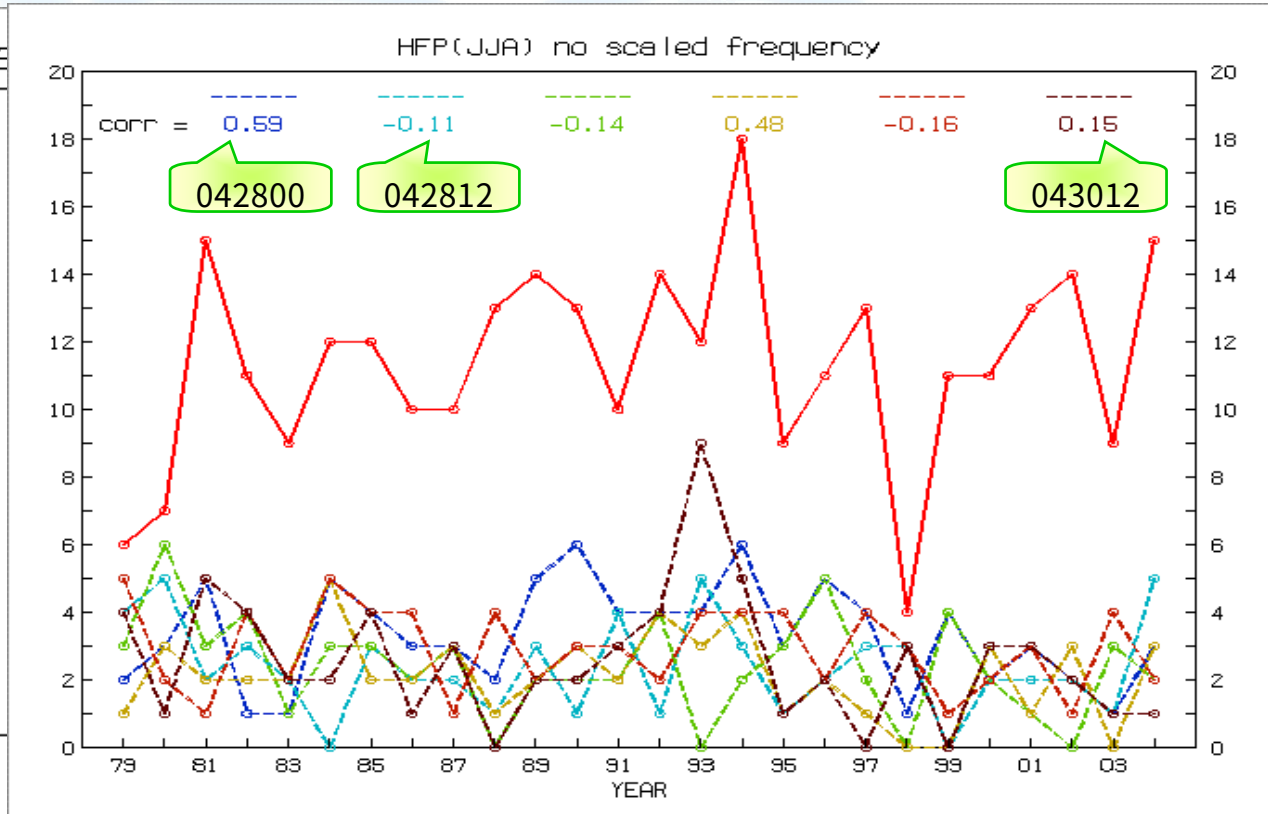
Correlation (Pred, Obs) = 0.09



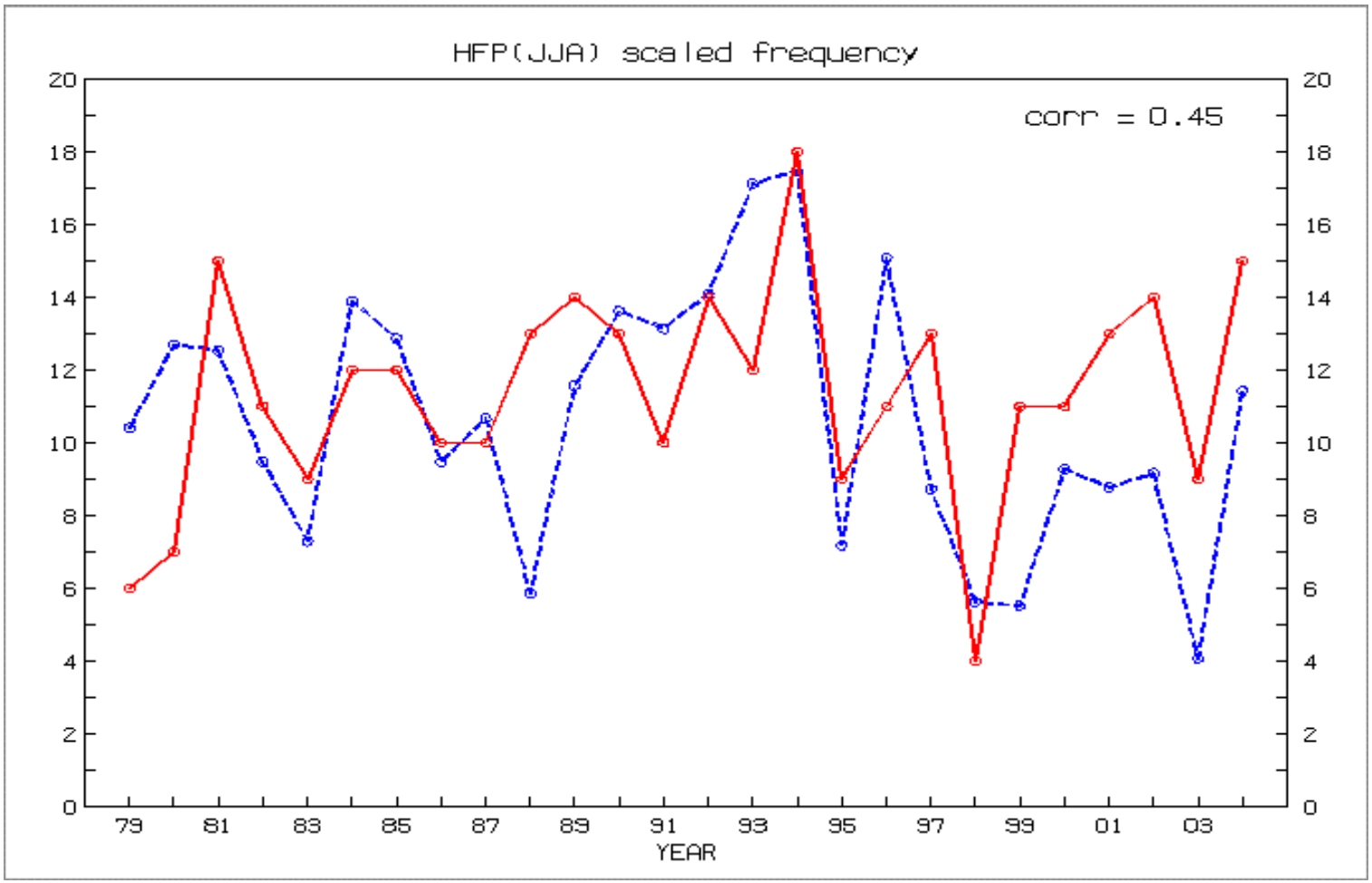
Vortex tracking criteria for the seasonal prediction of tropical cyclone

1. p(sfc) less than 1020hPa → 1008
2. 850hPa vorticity ≥ 3.5×10^{-5} s^{-1}
3. Vmax(850) ≥ 15m/s → 17 m/s
4. Last at least for 2 days
5. 300hPa max wind < 850hPa max wind
6. Warm core





Correlation (Pred. vs. Obs.) = 0.45



Category (Tercile) Forecast

OBS normal : 10 – 13

HFP normal : 7.9 – 14.6

HSS = 0.19

Hit => 14/26 = 53.8%

Year	HFP	RSMC
1979	13.0 (N)	6 (B)
1980	13.1 (N)	7 (B)
1981	11.2 (N)	15 (A)
1982	12.4 (N)	11 (N)
1983	6.9 (B)	9 (B)
1984	12.5 (N)	12 (N)
1985	14.3 (N)	12 (N)
1986	9.3 (N)	10 (N)
1987	10.1 (N)	10 (N)
1988	6.2 (B)	13 (N)
1989	10.1 (N)	14 (A)
1990	11.8 (N)	13 (N)
1991	12.4 (N)	10 (N)
1992	12.6 (N)	14 (A)
1993	16.3 (A)	12 (N)
1994	15.7 (A)	18 (A)
1995	8.7 (N)	9 (B)
1996	14.7 (A)	11 (N)
1997	9.9 (N)	13 (N)
1998	6.9 (B)	4 (B)
1999	5.7 (B)	11 (N)
2000	8.8 (N)	11 (N)
2001	8.8 (N)	13 (N)
2002	6.8 (B)	14 (A)
2003	6.8 (B)	9 (B)
2004	10.6 (N)	15 (A)

Standard verification of Ensemble Prediction

reliability $\frac{1}{n}\sum_{i=1}^{I} N_i (y_i - \overline{o_i})^2$

resolution $-\frac{1}{n}\sum_{i=1}^{I} N_i (\overline{o_i} - \overline{o})^2$

Brier score $\frac{1}{n}\sum_{i=1}^{I} N_i (y_i - \overline{o_i})^2 - \frac{1}{n}\sum_{i=1}^{I} N_i (\overline{o_i} - \overline{o})^2 + \overline{o}(1-\overline{o})$

reliability | resolution | uncertainty

n : Total events

N_i : categorical events

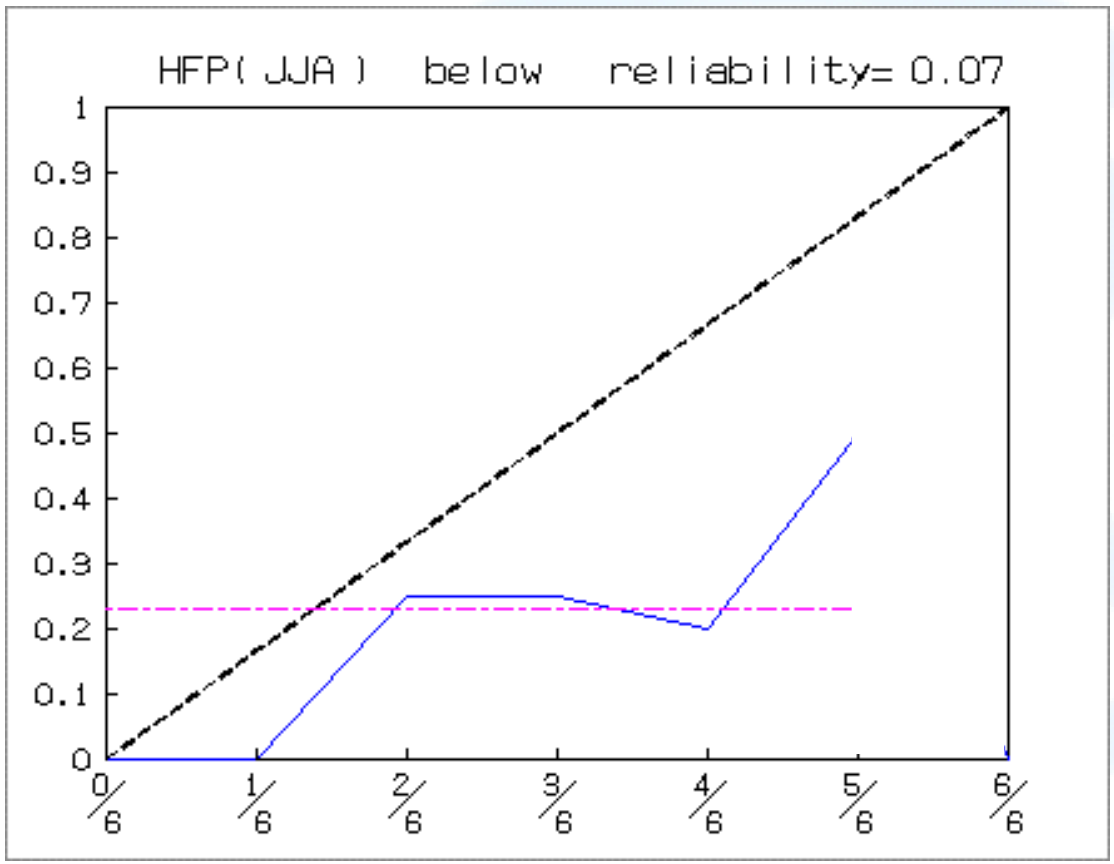
yi : categorical probability

$\overline{o_i}$: Observed events for each categorical probability

$\overline{o}$: Total observed events

Standard verification of Ensemble Prediction

Reliability



$$\frac{1}{n}\sum_{i=1}^{I} N_i (y_i - \overline{o_i})^2$$

Reliability = 0.07

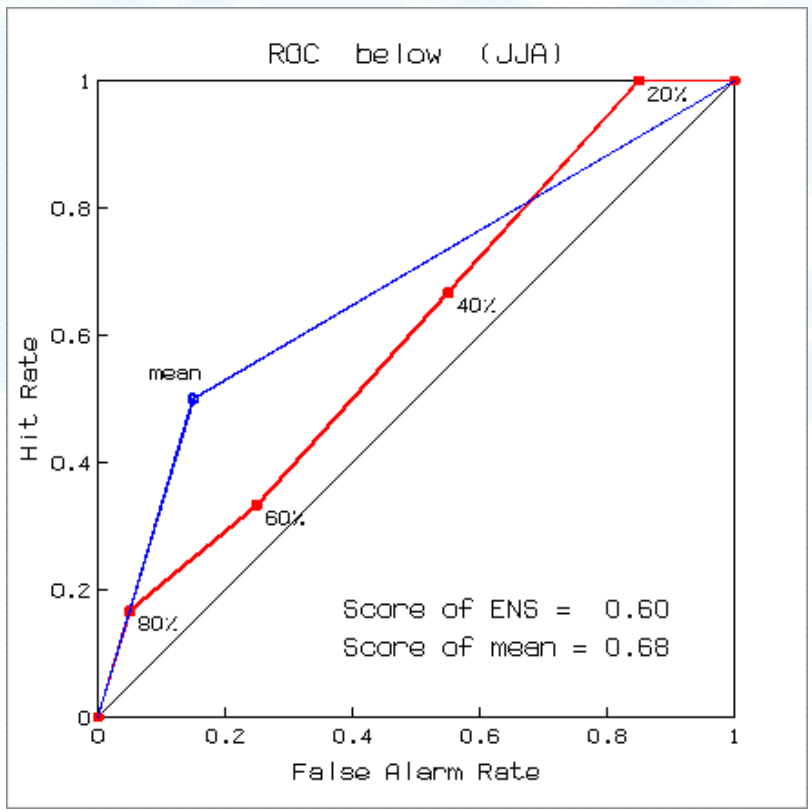
Sharpness = -0.01

Uncertainty = 0.18

Brier score = 0.24

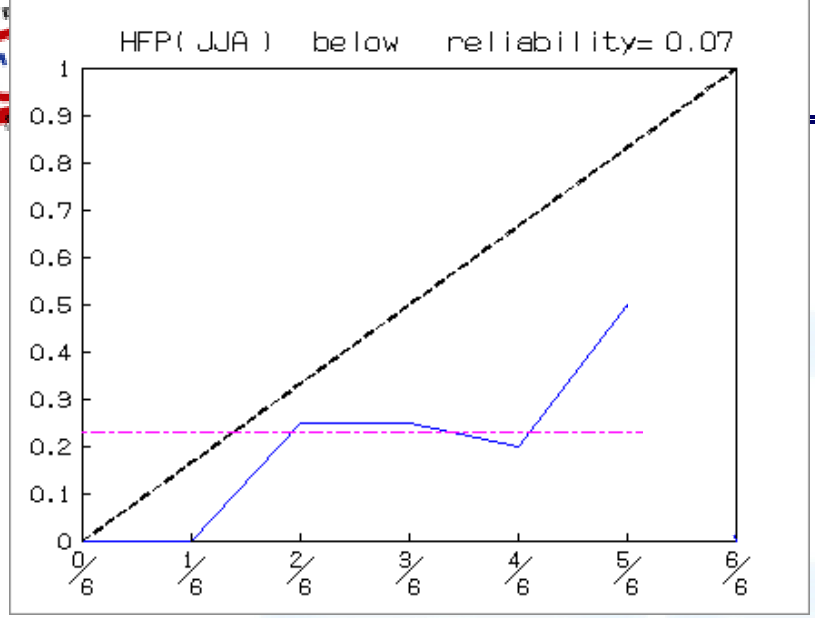
ROC (Relative Operating Characteristics)

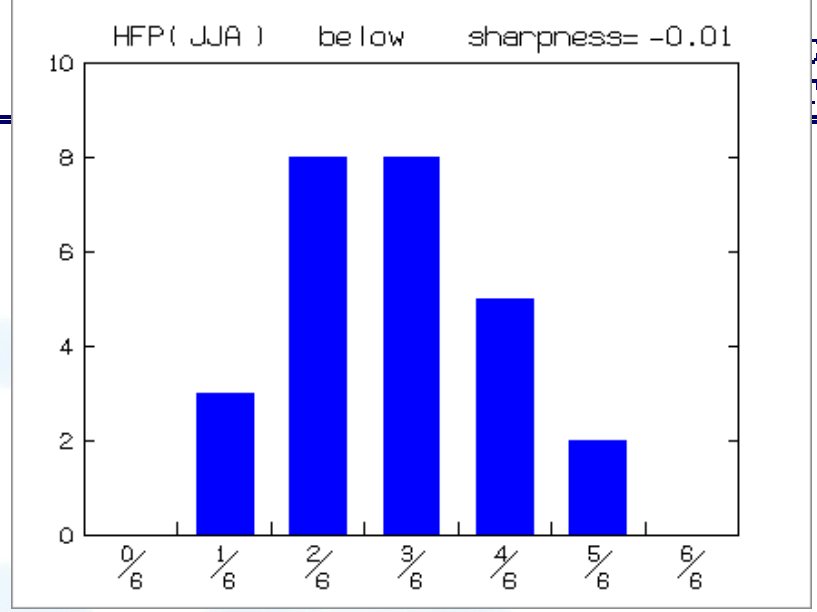
HR = H/(H+M) FAR = F/(F+R)		Observed	
		Yes	No
Forecast	Yes	Hit(H)	False(F)
	No	Missing(M)	correct Rejection(R)

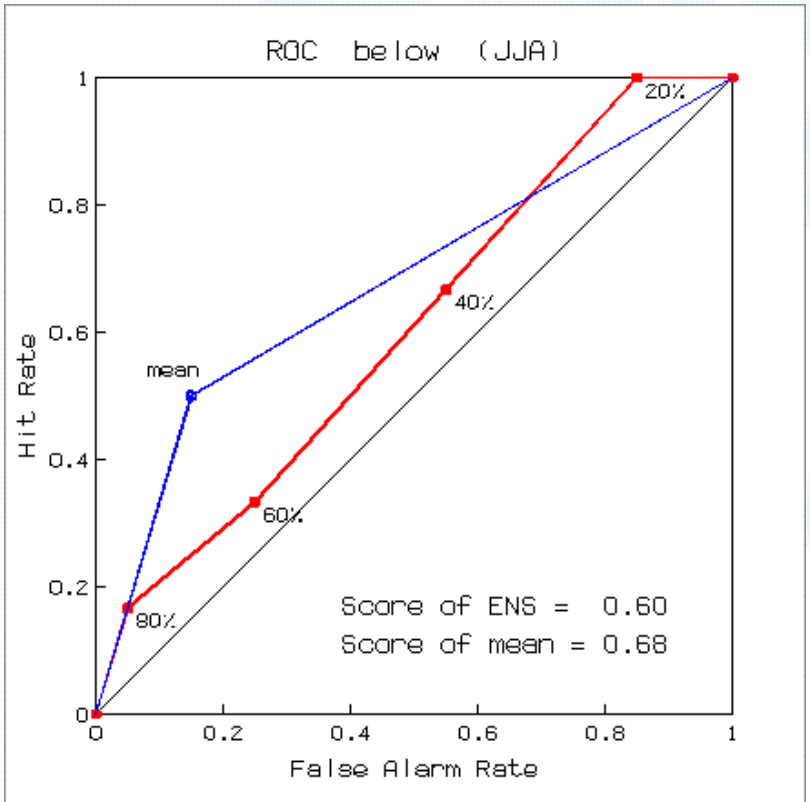


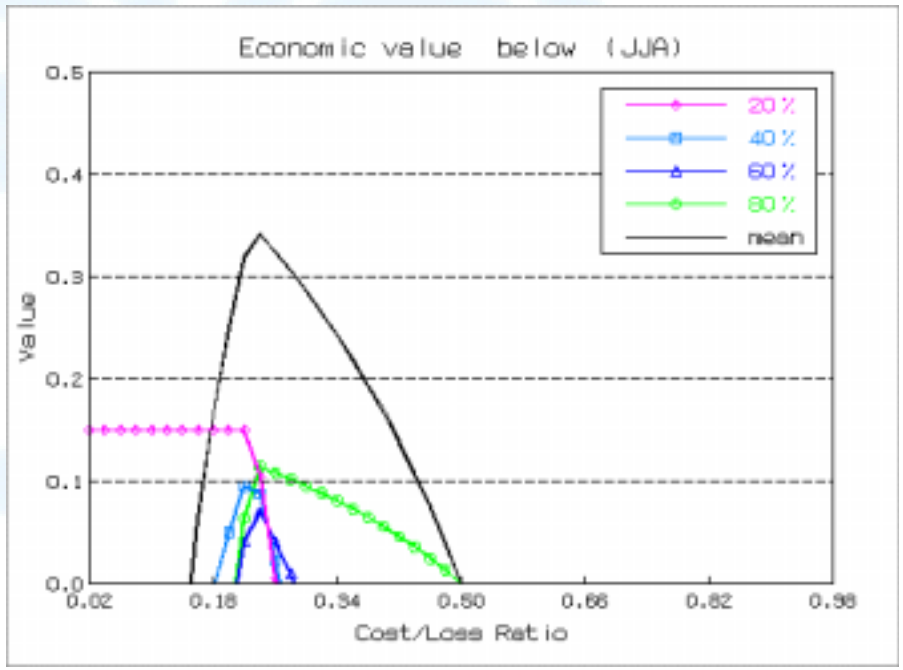
Summary

- KMA global model GDAPS is used in the seasonal prediction of tropical cyclone activity over the western North Pacific.
- Correlation between the predicted and the observed TC number significantly depends on the definition of the model tropical cyclone.
- The model shows some prediction skill in terms of the correlation between the predicted and the observed TC number and in the verification of the standard ensenble prediction such as reliability and the ROC.
- Further investigation is suggested to improve the prediction skill.
  (different model, MME, superensemble, etc.)


HFP(JJA) below reliability= 0.07
0
0.1
0.2
0.3
0.4
0.5
0.6
0.7
0.8
0.9
1
0/6
1/6
2/6
3/6
4/6
5/6
6/6


HFP(JJA) below sharpness= -0.01
0
2
4
6
8
10
0/6
1/6
2/6
3/6
4/6
5/6
6/6


ROC below (JJA)
Hit Rate
False Alarm Rate
0
0.2
0.4
0.6
0.8
1
20%
40%
60%
80%
mean
Score of ENS = 0.60
Score of mean = 0.68


Economic value below (JJA)
Value
Cost/Loss Ratio
0.0
0.1
0.2
0.3
0.4
0.5
0.02
0.18
0.34
0.50
0.66
0.82
0.98
20 %
40 %
60 %
80 %
mean