

Using Monsoon Metrics for Model Improvement

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slides prepared by Tomoaki Ose

From MRI-AGCM3.1S To 3.2S

	Previous Model (Mizuta et al. 2006)	New Model
Horizontal Resolution	TL959 (20km)	TL959 (20km)
Vertical Resolution	L60 (top 0.1hPa)	L64 (top 0.01hPa)
Time Step	6minutes	10minutes
Cumulus Convection	Prognostic Arakara-Schubert	Yoshimura (in preparation)
Cloud	Smith (1990)	Tiedtke (1993)
Radiation	Shibata and Aoki (1989) Shibata and Uchiyama (1992)	NPD/JMA (2007)
GWD	Iwasaki et al. (1989)	Iwasaki et al. (1989)
Land Surface	Sato et al. (1989)	Sato et al. (1989)
Boundary Layer	MellorYamada Level2	MellorYamada Level2
Aerosol (direct)	Sulfate aerosol	5 species
Aerosol (indirect)	No	No

Target: high-resolution MRI-AGCM3.1 to 3.2

- To improve frequency of tropical cyclones in the western North Pacific
- To improve East Asian Summer Monsoon
 - (1) Seasonal change of Baiu and Precipitation
 - (2) Seasonal change of the Pacific subtropical High

Evaluation under Model Construction

U850 / Z500 / Precip / SLP / T850

Asia (60-150E, 0-30N), East Asia (120-150E, 20-40N)

2009年5月7日		* Taylor Indexの2 を利用																			
60km	Model	U850	Z500 eddy	Precipitation				Precipitation				SLP		T850		Z500		Sub Total (3)	Total		
	Taylor_Index_2 for FIELD	1yr Global	1yr Global	1yr Global	JJA Asia	Sub Total (1)	JJA East Asia	SON East Asia	Sub Total (2)	East Asia	East Asia	East Asia	East Asia	East Asia	East Asia						
		JRA25	JRA25	GPCP	CMAP	GPCP	CMAP	GPCP	CMAP	GPCP	CMAP	JJA	SON	JJA	SON	JJA	SON				
	2 HPOA_AMIP	0.93	0.83	0.73	0.73	0.41	0.41	4.04	0.22	0.26	0.51	0.54	1.53	0.82	0.92	0.94	0.99	0.97	0.99	5.63	11.20
	113 HPAIY_skn_amip	0.93	0.82	0.74	0.77	0.41	0.47	4.14	0.35	0.44	0.51	0.57	1.87	0.82	0.89	0.82	0.98	0.89	0.98	5.38	11.39
	112 HPAH_conv5_jmoi2_akdz0714_skn	0.90	0.67	0.69	0.73	0.37	0.45	3.81	0.52	0.50	0.48	0.54	2.04	0.89	0.88	0.74	0.96	0.93	0.98	5.38	11.23
	101 HPAF_conv5_jmoi2_akdz0714	0.91	0.70	0.68	0.72	0.32	0.36	3.69	0.35	0.42	0.49	0.47	1.73	0.82	0.89	0.90	0.97	0.93	0.96	5.47	10.89
	92 HPAD_conv5_jmoi2_ord2	0.90	0.71	0.68	0.71	0.25	0.25	3.50	0.25	0.30	0.53	0.54	1.62	0.83	0.93	0.83	0.97	0.87	0.97	5.40	10.52
	93 HPAD_conv5_jmoi2_ord2_cmt1_pf1	0.91	0.67	0.68	0.70	0.17	0.15	3.28	0.30	0.26	0.44	0.43	1.43	0.87	0.93	0.89	0.98	0.91	0.99	5.57	10.28
	94 HPAE_tune1,AGCM+tune1	0.89	0.68	0.65	0.66	0.24	0.31	3.43	0.30	0.38	0.40	0.38	1.46	0.73	0.89	0.75	0.98	0.76	0.98	5.09	9.98
	87 HPAA	0.91	0.69	0.65	0.64	0.19	0.19	3.27	0.24	0.23	0.22	0.26	0.95	0.83	0.93	0.77	0.97	0.90	0.97	5.37	9.59
	3 MPDC_AMIP	0.93	0.83	0.71	0.73	0.40	0.48	4.08	0.23	0.29	0.45	0.51	1.48	0.86	0.94	0.90	0.99	0.96	0.99	5.64	11.20
	115 MPAG_YS_MYNN	0.90	0.65	0.68	0.72	0.44	0.48	3.87	0.29	0.30	0.44	0.47	1.50	0.81	0.85	0.76	0.97	0.83	0.95	5.17	10.54
	100 HPAF_conv5_jmoi2_akdz0714	0.89	0.70	0.69	0.73	0.44	0.45	3.90	0.40	0.52	0.37	0.51	1.80	0.85	0.82	0.83	0.98	0.85	0.96	5.29	10.99
	96 HPAE_tune1,AGCM+tune1	0.87	0.65	0.66	0.66	0.26	0.36	3.46	0.35	0.43	0.26	0.32	1.36	0.73	0.86	0.68	0.96	0.55	0.95	4.73	9.55
	4 LPOA_m01_AMIP	0.93	0.81	0.70	0.71	0.43	0.42	4.00	0.20	0.25	0.38	0.40	1.23	0.83	0.91	0.90	0.99	0.92	0.99	5.54	10.77
	86 KF (jmoi1_dtcl=1.0,dtrh=1.0)	0.88	0.70	0.62	0.69	0.29	0.35	3.53	0.24	0.28	0.38	0.38	1.28	0.90	0.82	0.85	0.97	0.94	0.93	5.41	10.22
	46 AERO+ICE20	0.89	0.68	0.63	0.65	0.16	0.19	3.20	0.30	0.35	0.26	0.35	1.26	0.87	0.86	0.85	0.98	0.95	0.94	5.45	9.91
	29 SmithANDDcape	0.89	0.70	0.63	0.68	0.24	0.33	3.47	0.23	0.29	0.16	0.19	0.87	0.80	0.80	0.77	0.96	0.93	0.93	5.19	9.53
	5 LPOA_climatologicalSST	0.90	0.64	0.62	0.71	0.36	0.35	3.58	0.20	0.27	0.19	0.25	0.91	0.78	0.84	0.73	0.95	0.79	0.96	5.05	9.54

Gray shading: MRI-AGCM3.1

Evaluation under Model Construction

Western North Pacific (110.0-160.0E, 5,0-25.0N)

Western Japan (130.0-135.0E, 30.0-35.0N), Eastern Japan (135.0-142.5E, 35.0-37.5N)

Model		Precipitation												Total
		JJA Western North Pacific RMSE		JJA Western JAPAN RMSE		JJA Eastern JAPAN RMSE		SON Western North Pacific RMSE		SON Western JAPAN RMSE		SON Eastern JAPAN RMSE		
		GPCP	CMAF	GPCP	CMAF	GPCP	CMAF	GPCP	CMAF	GPCP	CMAF	GPCP	CMAF	
2	HPOA_AMIP	2.07	3.32	2.33	2.30	0.75	0.60	1.99	2.23	1.24	1.16	1.04	0.85	19.88
113	HPAI_Y_skn_amip	3.29	2.84											
112	HPAH_cnv5_imoI2_akdz0714_skn	2.57	2.85	0.64	0.82	0.82	1.02	3.31	2.53	1.06	0.98	0.42	0.10	17.12
101	HPAF_cnv5_imoI2_akdz0714	2.77	3.56	1.28	1.46	0.82	1.16	2.90	2.83	0.52	0.45	0.42	1.02	19.19
92	HPAD_cnv5_imoI2_ord2	2.51	4.21	2.37	2.52	0.85	1.13	2.55	3.05	0.53	0.52	0.36	0.65	21.25
93	HPAD_cnv5_imoI2_ord2_cmt1_pgf1	2.84	4.81	1.95	1.96	1.22	1.39	2.07	2.73	1.08	1.04	1.24	1.28	23.61
94	HPAE_tune1_AGCM+tune1	3.36	3.26	2.59	2.75	1.34	1.26	2.70	2.60	1.61	1.52	1.14	1.06	25.19
87	HPAA	2.72	4.16	1.48	1.51	0.67	0.87	2.93	3.07	1.71	1.64	1.28	1.06	23.10
3	MPOC_AMIP	2.36	3.08	2.08	2.10	0.95	0.72	2.07	2.13	0.83	0.79	0.97	0.68	18.76
115	MPAG_YS_MYNN	3.31	2.93											
100	MPAF_cnv5_imoI2_akdz0714	2.74	3.03	0.95	1.01	0.93	1.17	3.55	2.56	0.63	0.67	0.92	1.16	19.32
96	MPAE_tune1_AGCM+tune1	3.86	3.50	1.88	1.97	1.51	1.29	2.99	2.82	2.21	2.21	1.52	1.50	27.26
4	LPOA_m01_AMIP	2.35	3.51	1.83	1.86	1.12	1.15	1.95	2.46	1.03	0.93	1.02	0.72	19.93
86	KF (imoI1_dtcF=1.0,dtrh=1.0)	3.39	3.43	4.50	4.42	2.05	2.08	2.98	2.52	0.86	0.81	0.94	1.14	29.12
46	AERO+ICE20	2.63	4.08	2.49	2.55	1.32	1.02	3.01	2.68	1.25	1.25	1.24	0.91	24.43
29	SmithANDDcape	3.53	3.33	2.63	2.74	1.17	1.48	3.34	2.65	2.03	1.94	1.85	1.58	28.27
5	LPOA_climatologicalSST	2.84	4.09	2.76	2.82	0.64	0.52	2.55	3.20	1.26	1.17	1.12	1.02	23.99

Model Skills over Japan and East Asia

 New model has higher skills

RMSE

Taylor Index 2

		Precipitation (CMAP)					
AREA	Western North Pacific		Western JAPAN		Eastern JAPAN		
	JJA	SON	JJA	SON	JJA	SON	
MRI AGCM 3.1S	2.94	2.03	1.67	0.43	1.13	0.42	
MRI AGCM 3.2S	2.30	1.53	0.58	1.06	0.51	1.11	

		Precipitation (CMAP)			SLP		T850	
AREA	Global	Asia	East Asia		East Asia		East Asia	
	1yr	JJA	JJA	SON	JJA	SON	JJA	SON
MRI AGCM 3.1S	.78	.44	.31	.55	.79	.91	.97	.99
MRI AGCM 3.2S	.82	.57	.52	.62	.91	.95	.93	.99

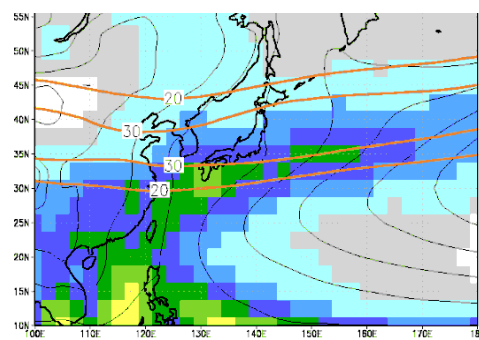
Western North Pacific (110.0-160.0E, 5.0-25.0N)

Western Japan (130.0-135.0E, 30.0-35.0N), Eastern Japan (135.0-142.5E, 35.0-37.5N)

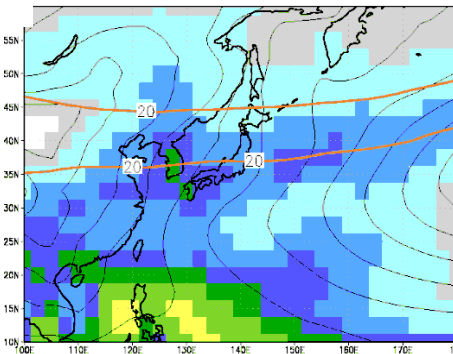
Asia (60-150E, 0-30N), East Asia (100-170E, 20-60N)

East Asia Climatology (Precipitation, SLP, U200)

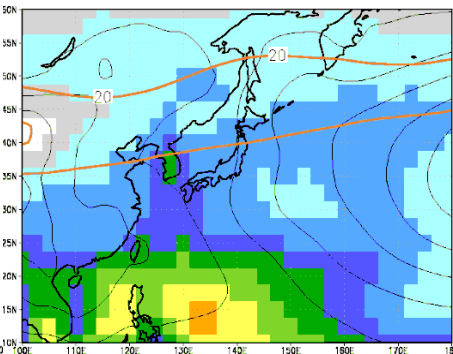
OBS(JRA-25+CMAP)



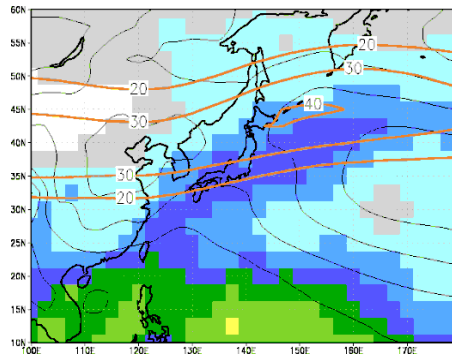
S.D & clim JRA25 mm=7



S.D & clim JRA25 mm=8

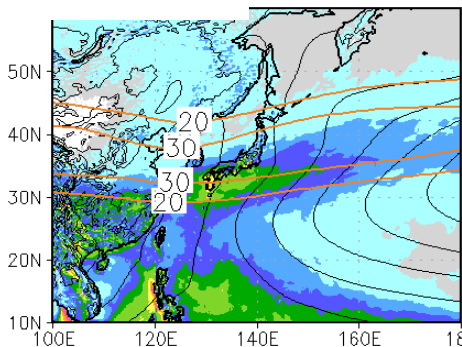


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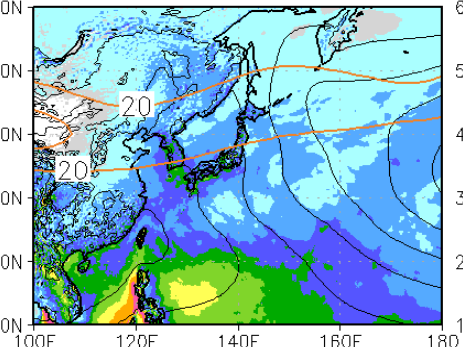


AGCM-3.2S

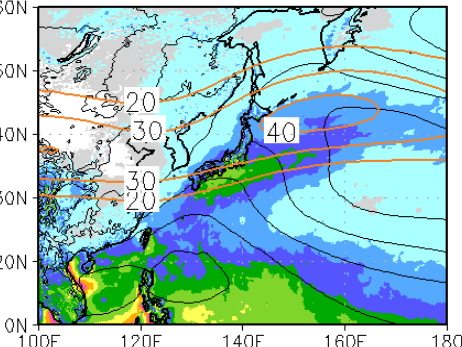
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mon=8

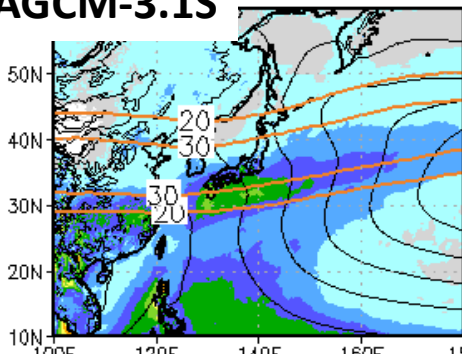


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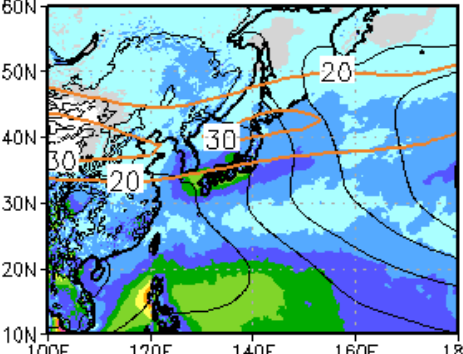


AGCM-3.1S

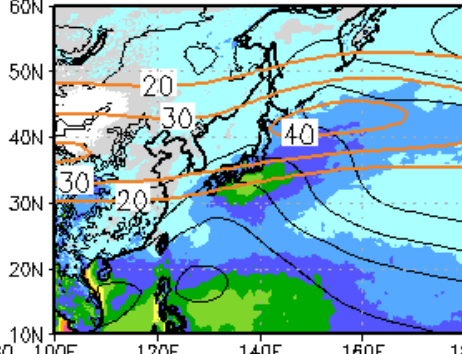
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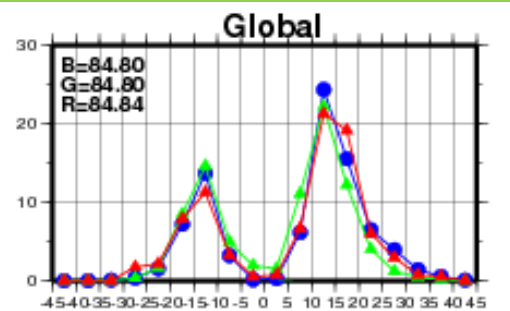
mon=9



Frequency of Tropical cyclones at each latitudes

Total number of Tropical cyclones over the globe is tuned to the observed one.

abscissa: latitude
ordinate: annual averaged number

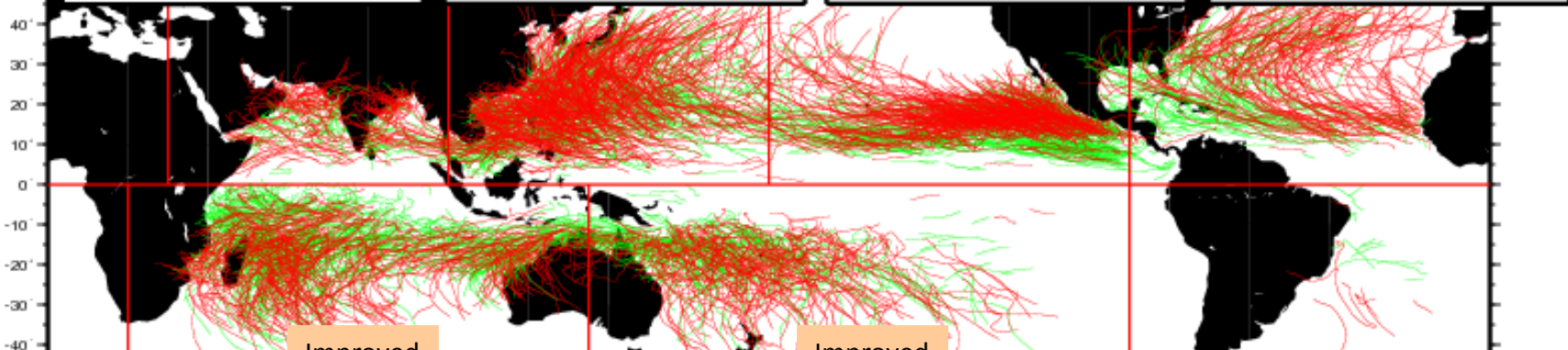
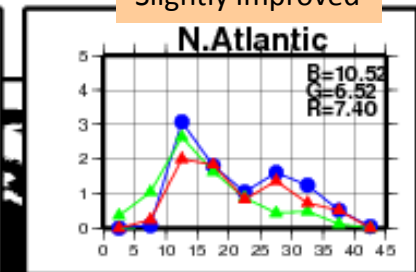
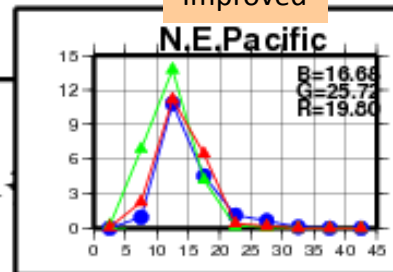
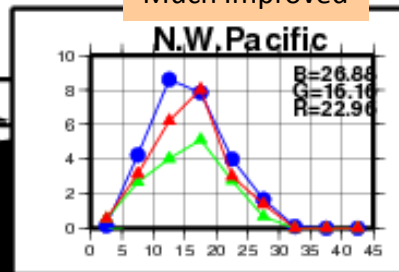
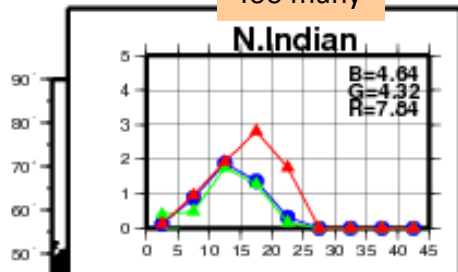


Too many

Much Improved

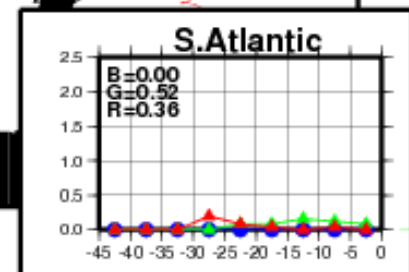
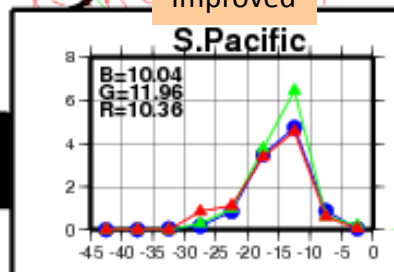
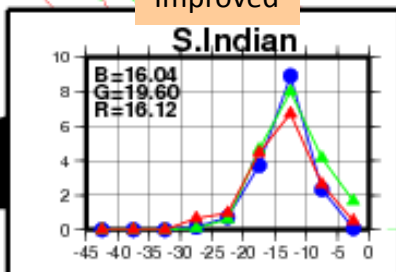
Improved

Slightly Improved

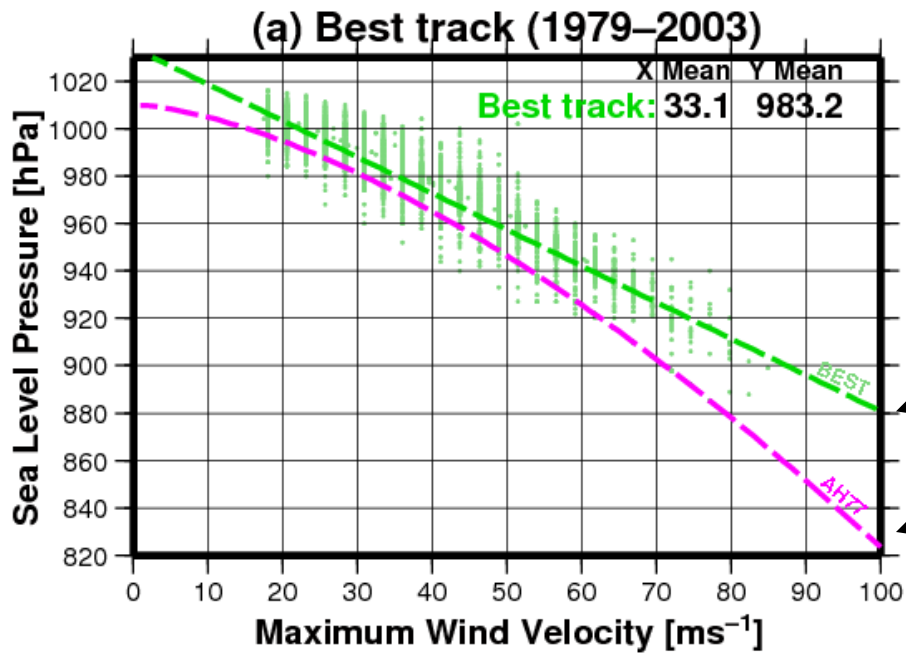


Improved

Improved

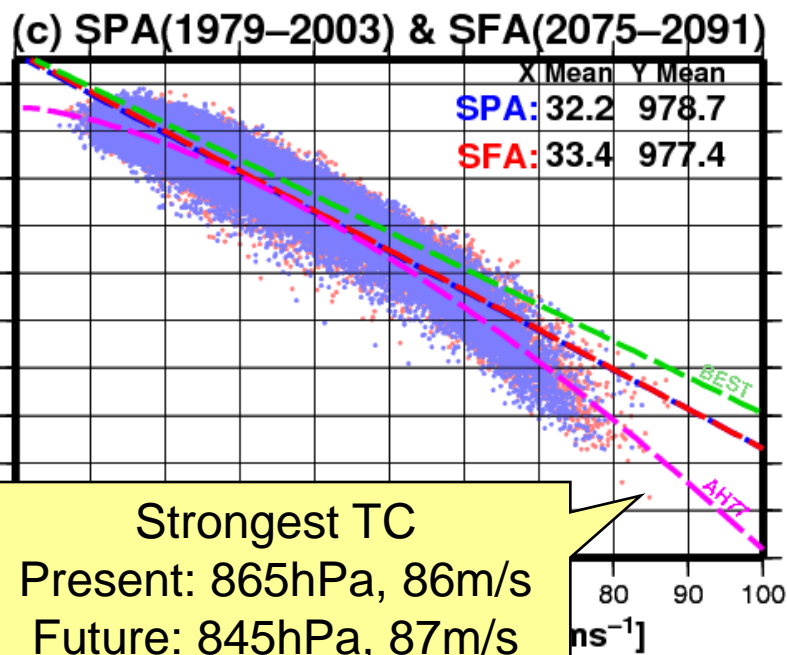
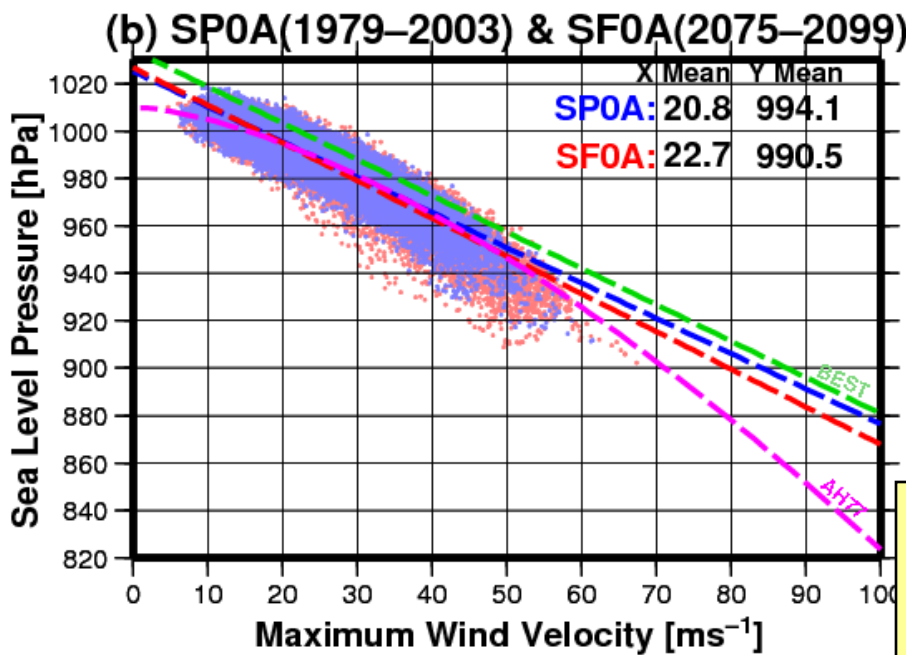


Wind-SLP Relation



Best track

Atkinson and Holliday (1977, MWR)
Western North Pacific



Strongest TC
Present: 865hPa, 86m/s
Future: 845hPa, 87m/s