Supplemental Material

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Supplementary Material: Characteristics of model tropical cyclone climatology and the large-scale environment

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1 Methods

In various of our plots we show a best-fit line that were obtained using the MATLAB functions "polyfit" and "polyval" with an option for a polynomial of order 1. The best-fit is defined as a least-squares regression. First we obtained the coefficients of the line using "polyfit". Then we used these coefficients together with the values of "X" in the range we wanted in "polyval" to obtain the values of the "Y" and plot the line. The end points in each case are defined by which models are selected for the fit and are shown in each figure.

2 Figures and Tables

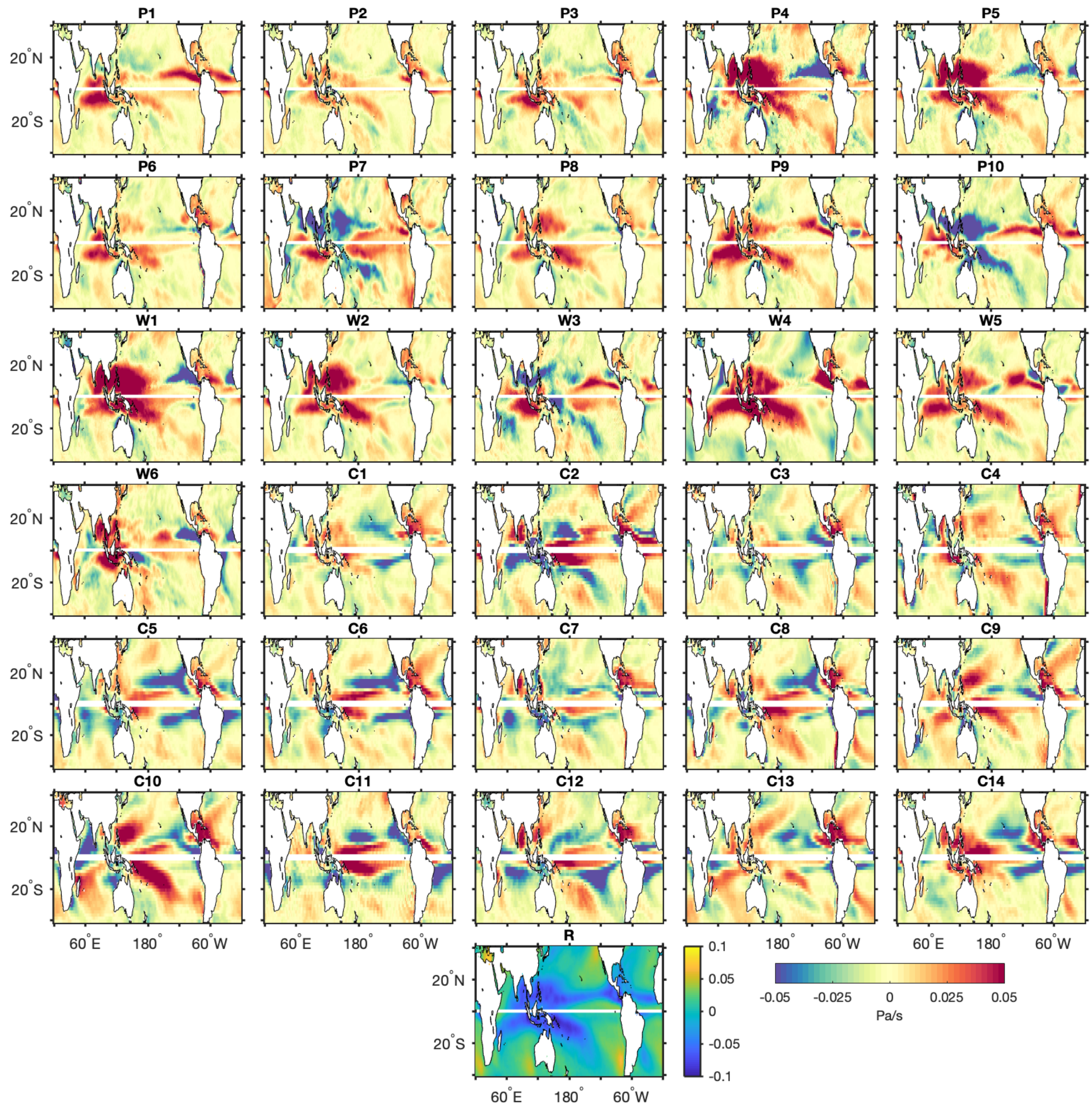

Figure S1: Anomalies of omega at 500hPa (Pa/s) for all models (C1-C14, W1-W6, P1-P14) relative to the ERA-Interim reanalysis climatology (R): ASO in the northern hemisphere, JFM in the southern hemisphere. It should be noted that negative omega means climatological ascent.

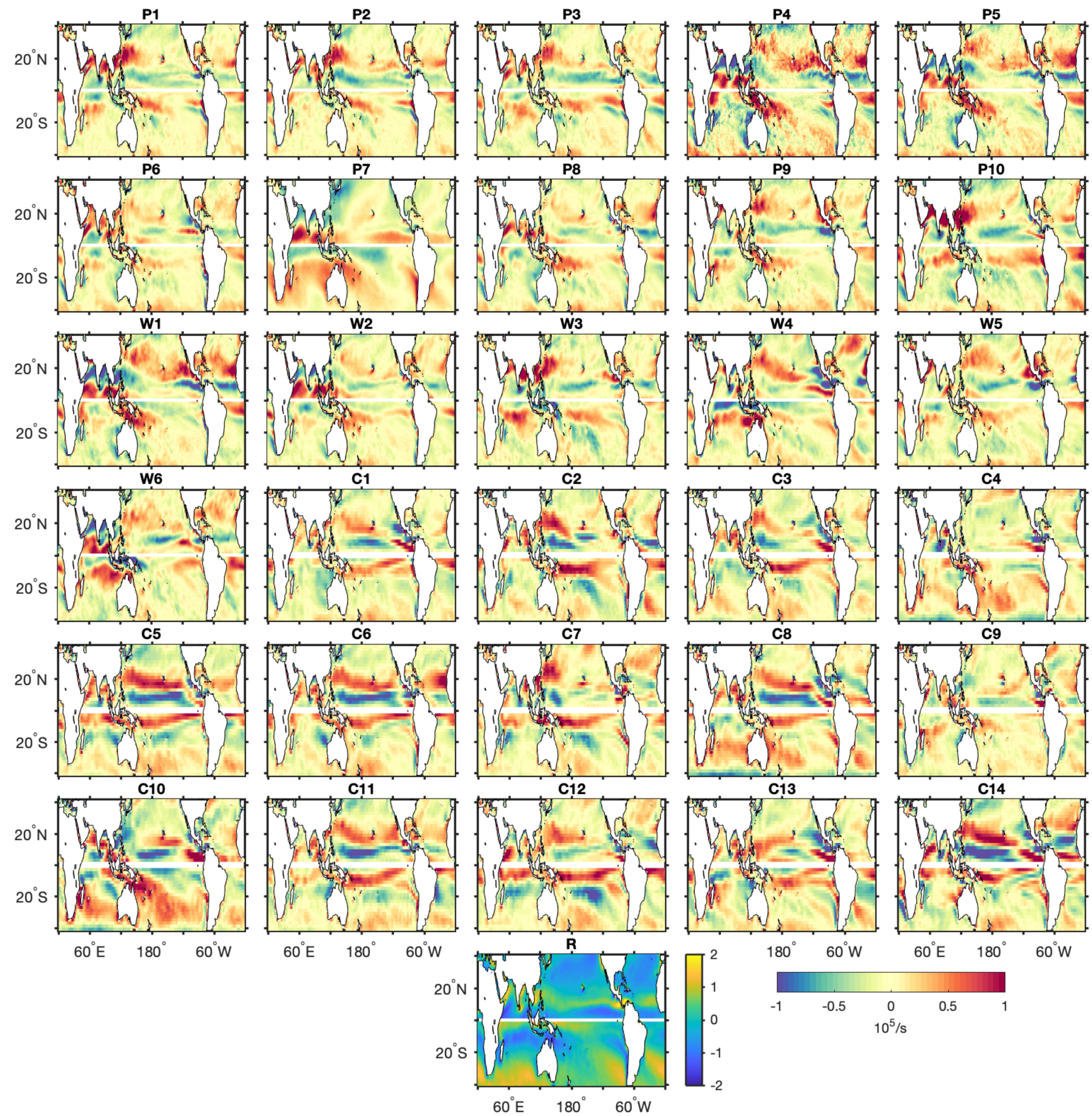

Figure S2: Anomalies of Vorticity at 850hPa (1/s) for all models (C1-C14, W1-W6, P1-P14) relative to the ERA-Interim reanalysis climatology (R): ASO in the northern hemisphere, JFM in the southern hemisphere.

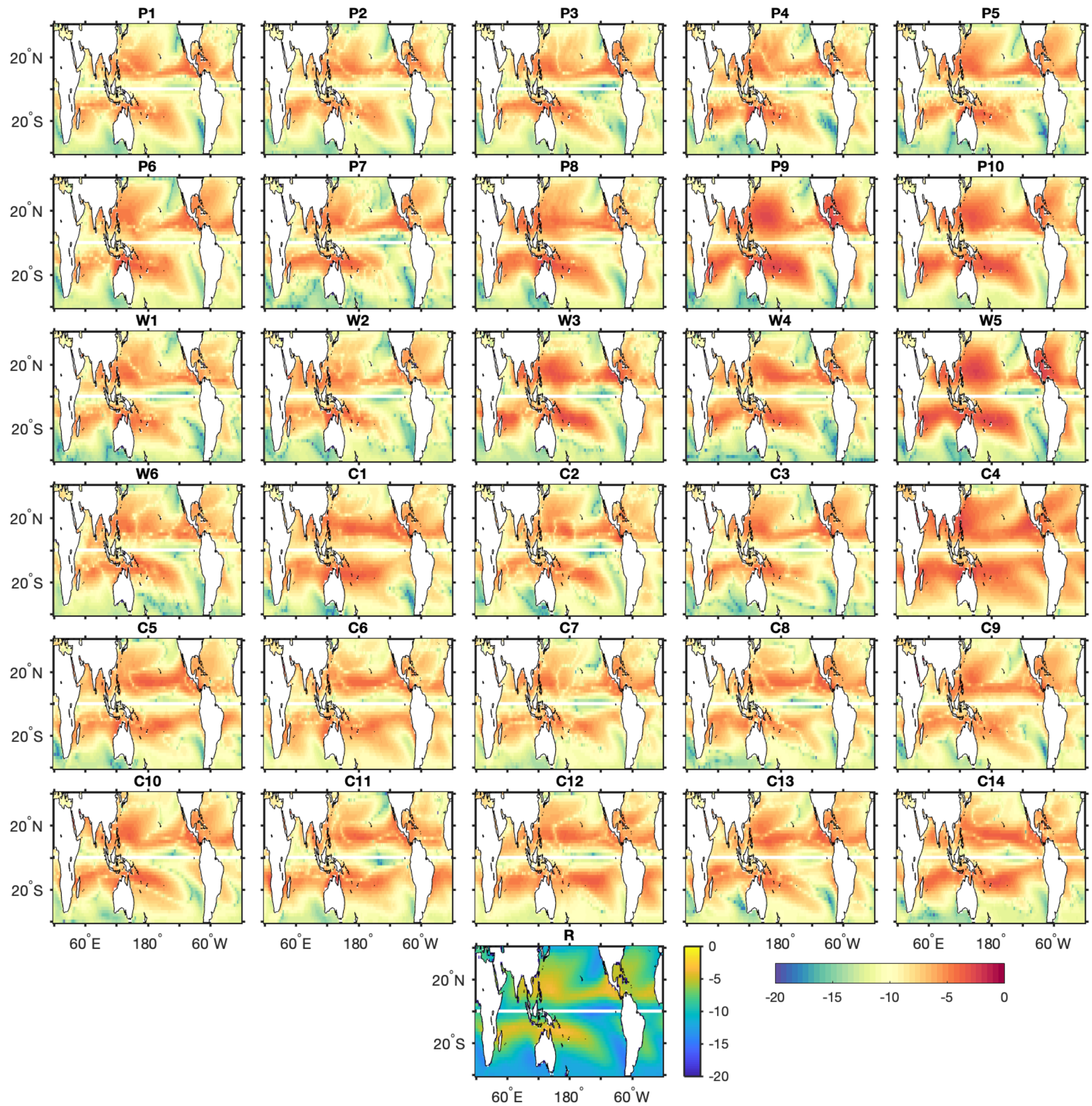

Figure S3: Anomalies of TCGI using as predictors: relative humidity at 600hPa, PI, vertical shear, clipped absolute vorticity, for all models (C1-C14, W1-W6, P1-P14) relative to the ERA-Interim reanalysis climatology (R): ASO in the northern hemisphere, JFM in the southern hemisphere. TCGI is shown in log scale.

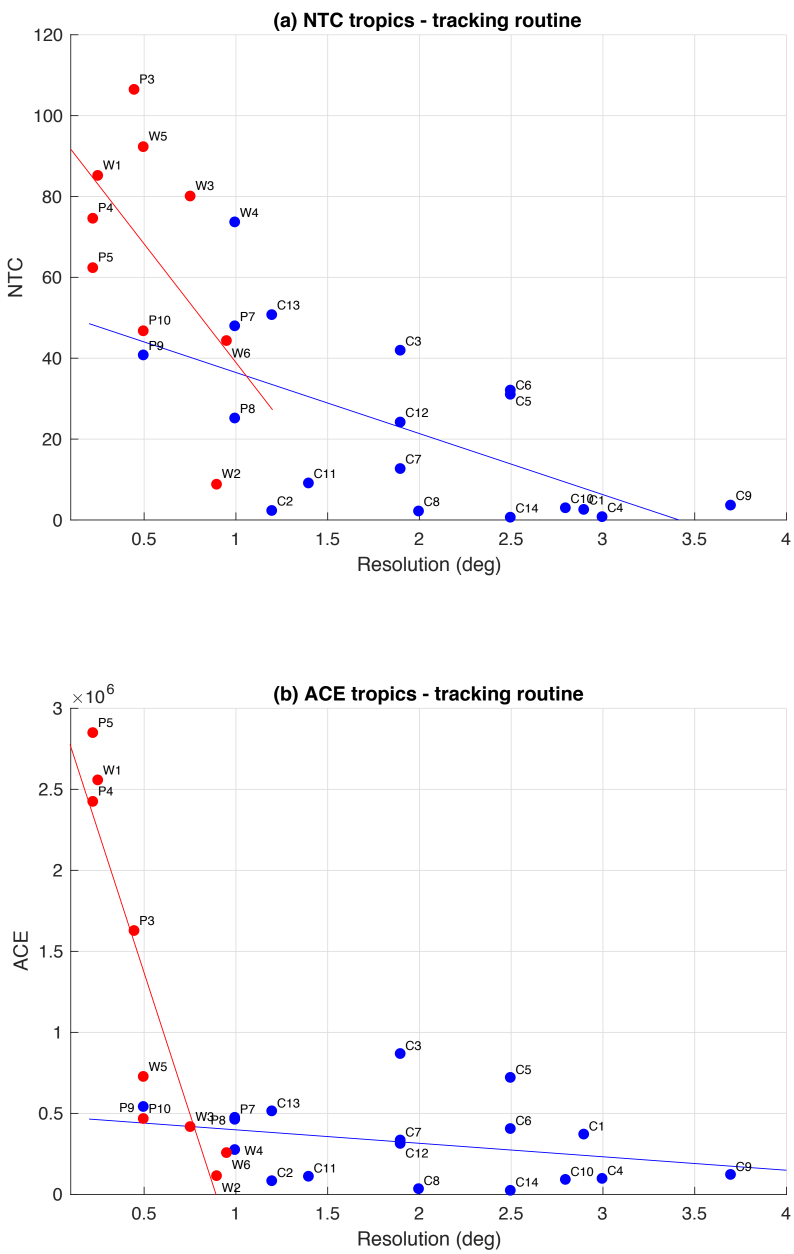

Figure S4: Scatter plots of mean climatological NTC and ACE versus model resolution for the tropical northern hemisphere in ASO. Models tracked with the Camargo-Zebiak model are shown in blue, those tracked with the Zhao/Vitart routine in red (P1, P2 and P6 are not included).

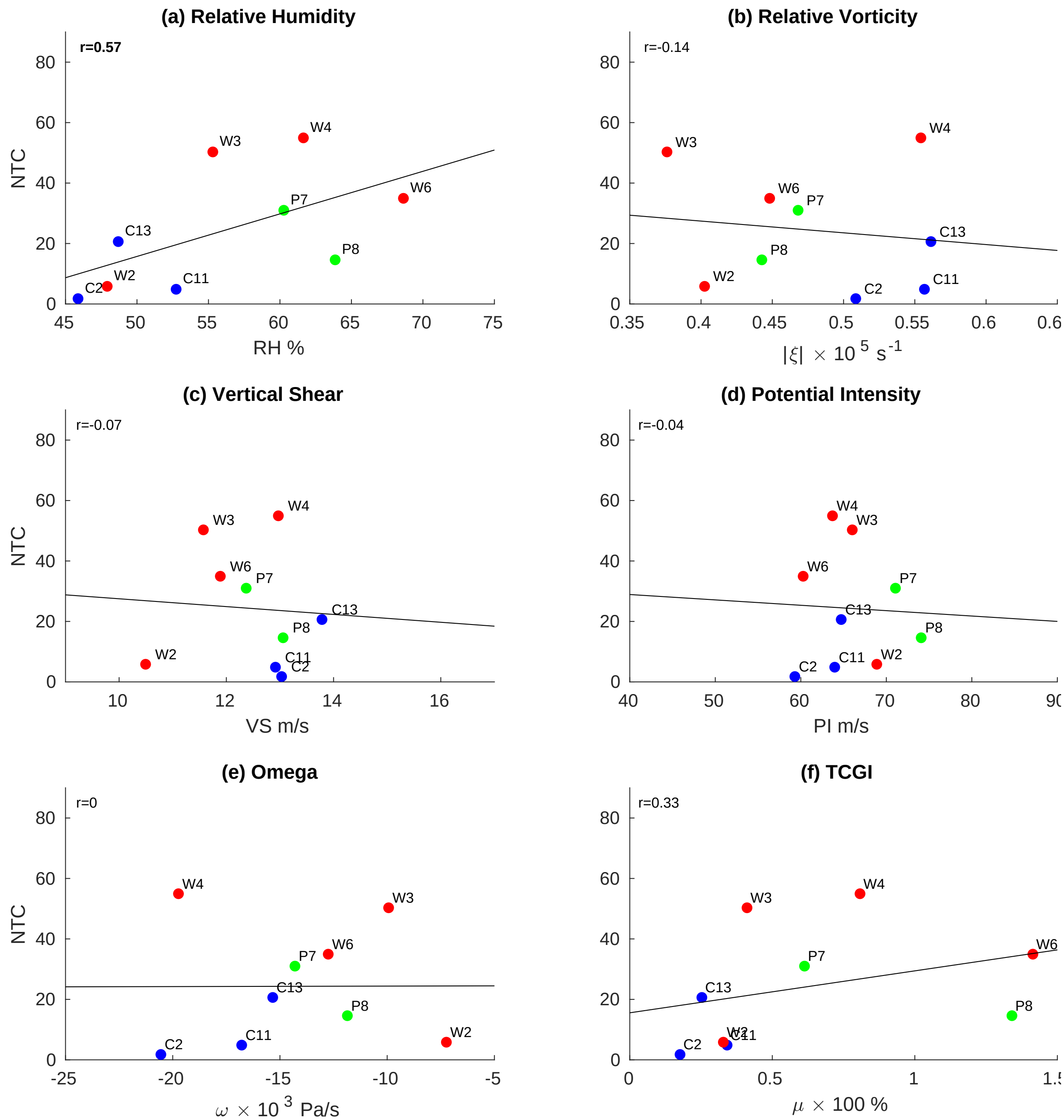

Figure S5: Scatter plots of mean climatological NTC and environmental fields for the tropical northern hemisphere in ASO, for models with resolution close to 1 degree. C (CMIP5) models are shown in blue, W (HWG) models in red, P (Process-Oriented) models in green. Statistically significance correlations at the 95th significance levels are shown in bold.

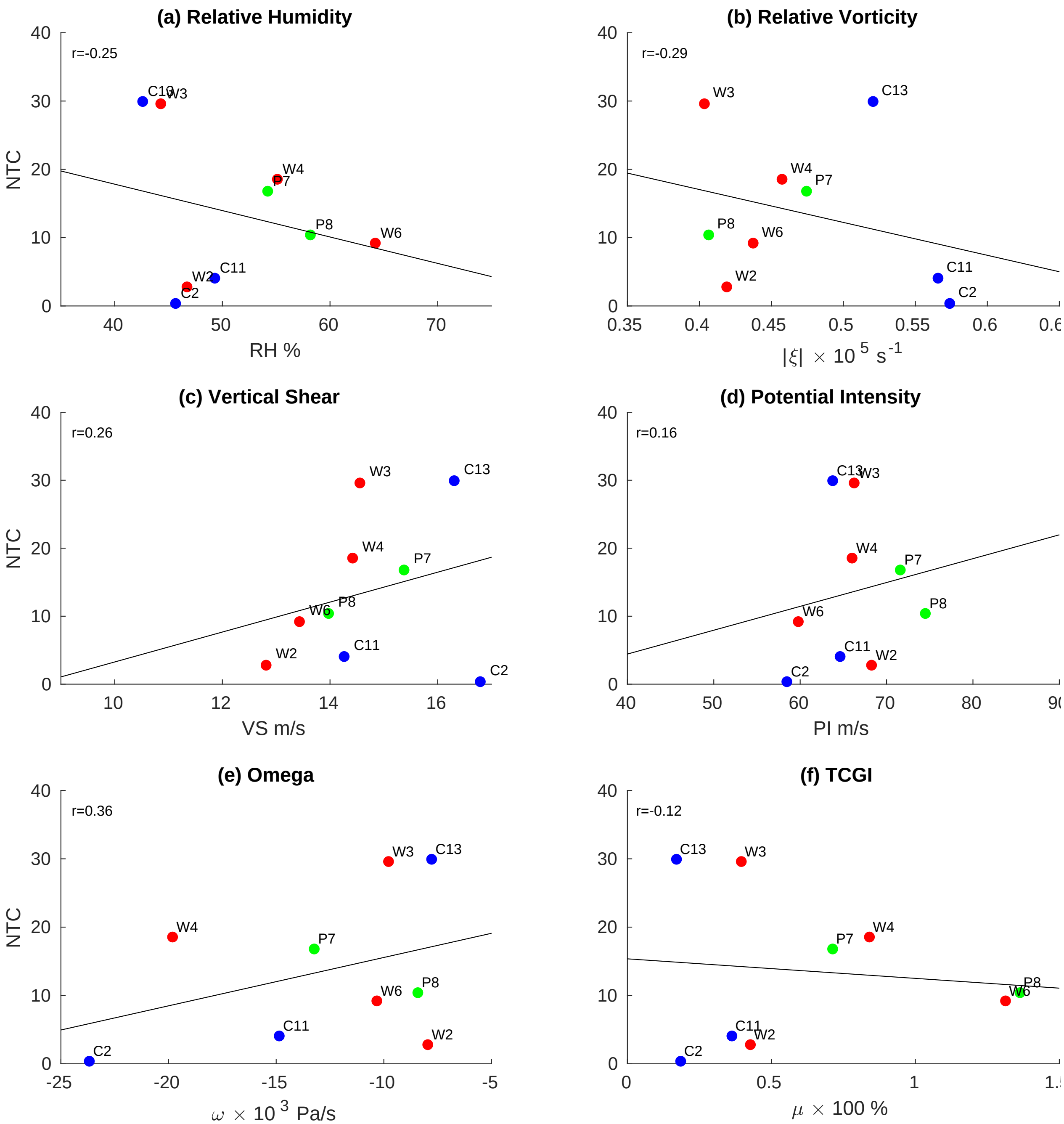

Figure S6: Scatter plots of mean climatological NTC and environmental fields for the tropical southern hemisphere in JFM, for models with resolution close to 1 degree. C (CMIP5) models are shown in blue, W (HWG) models in red, P (Process-Oriented) models in green. Statistically significance correlations at the 95th significance levels are shown in bold.

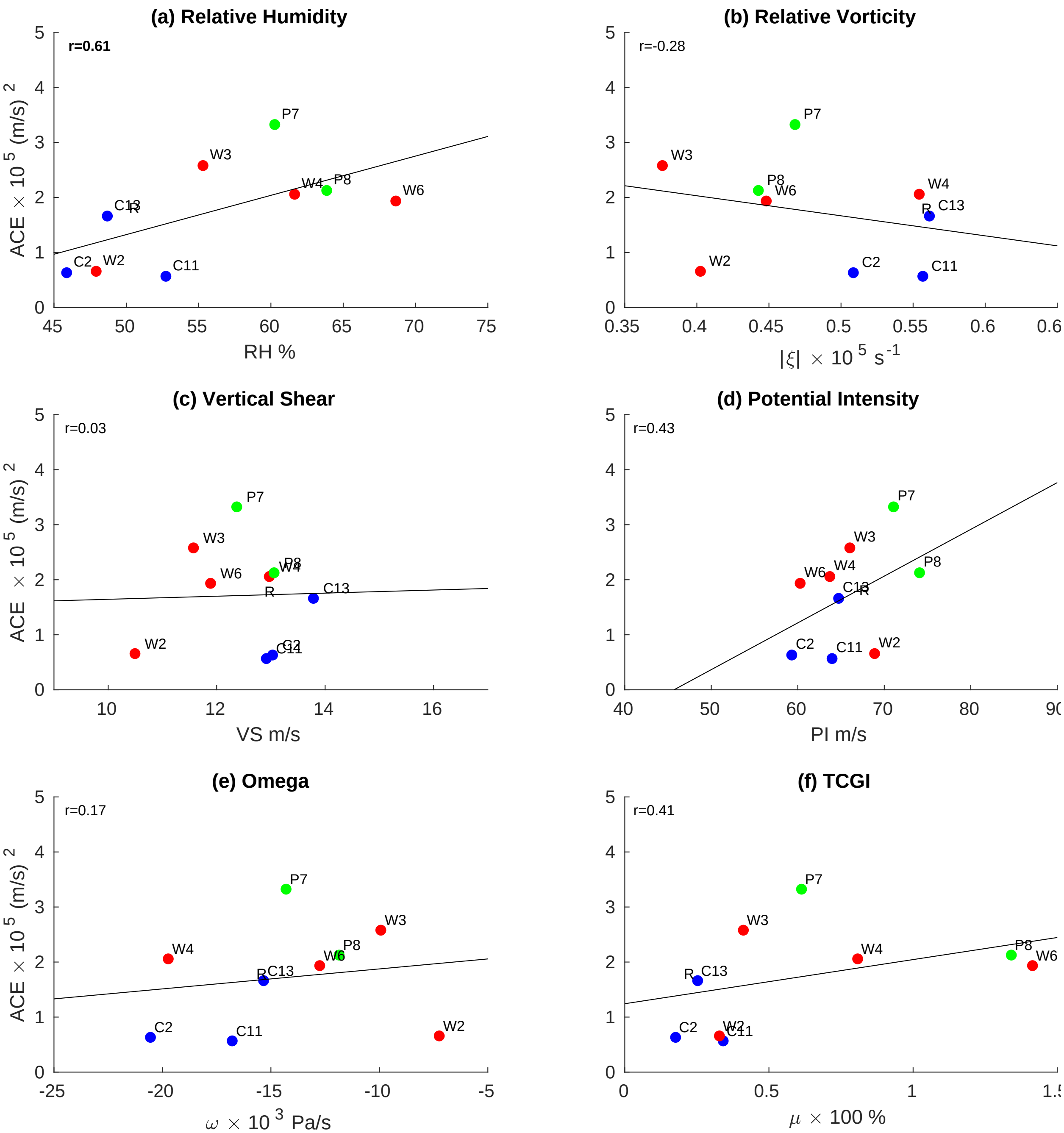

Figure S7: Scatter plots of mean climatological ACE and environmental fields for the tropical northern hemisphere in ASO, for models with resolution close to 1 degree. C (CMIP5) models are shown in blue, W (HWG) models in red, P (Process-Oriented) models in green. Statistically significance correlations at the 95th significance levels are shown in bold.

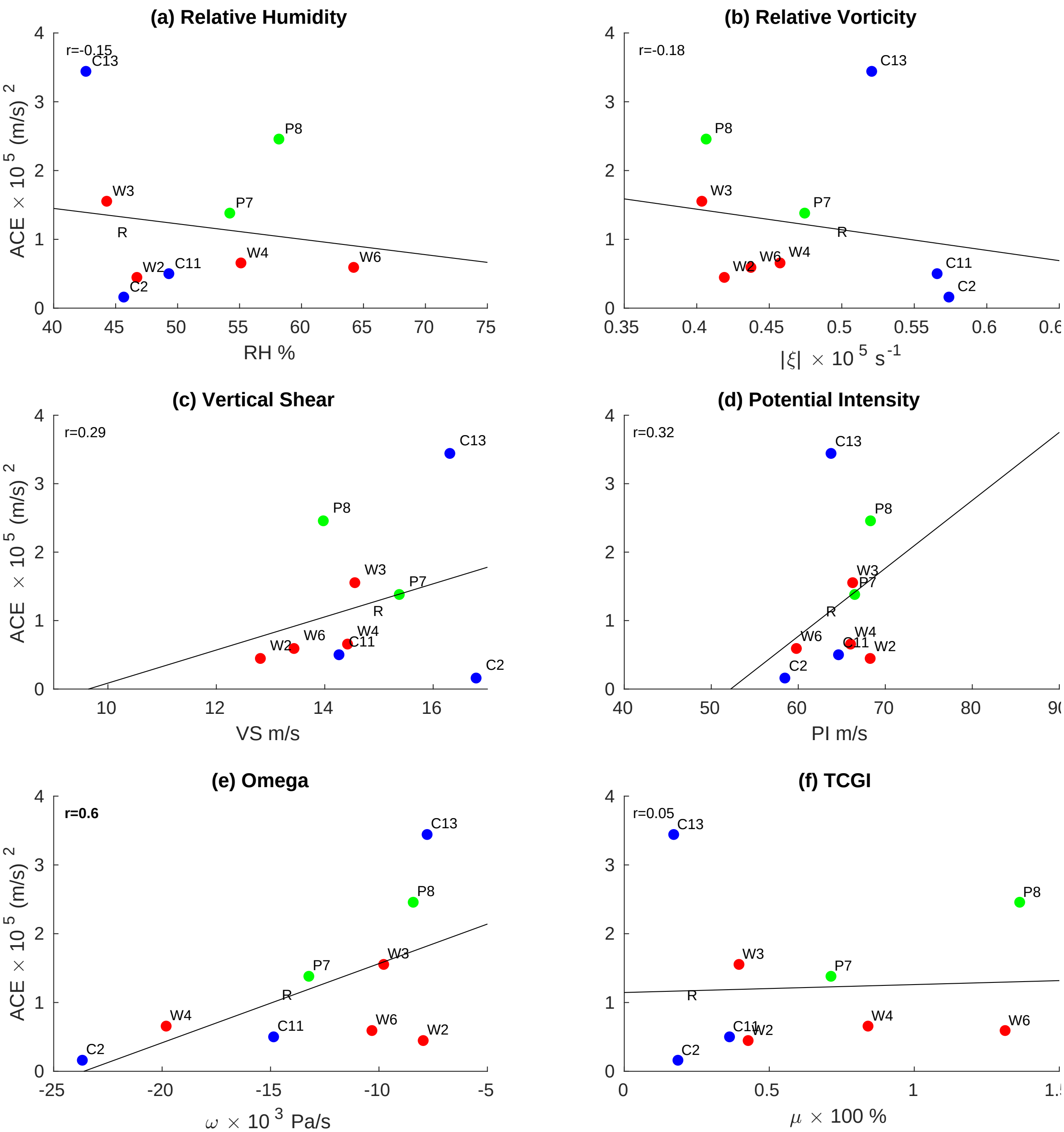

Figure S8: Scatter plots of mean climatological ACE and environmental fields for the tropical southern hemisphere in JFM, for models with resolution close to 1 degree. C (CMIP5) models are shown in blue, W (HWG) models in red, P (Process-Oriented) models in green. Statistically significance correlations at the 95th significance levels are shown in bold.

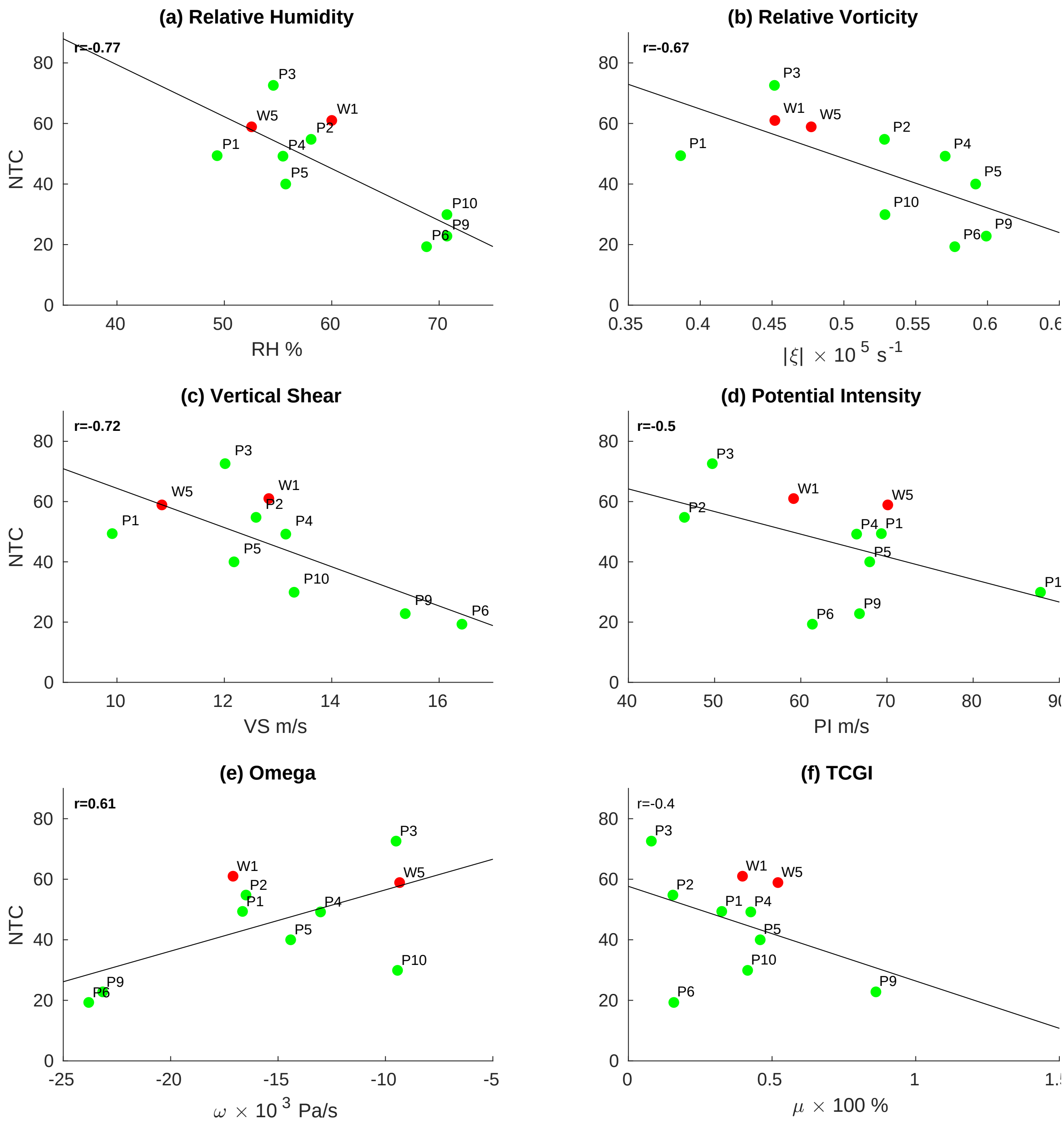

Figure S9: Scatter plots of mean climatological NTC and environmental fields for the tropical northern hemisphere in ASO, for models with resolution 0.5 degree or higher. C (CMIP5) models are shown in blue, W (HWG) models in red, P (Process-Oriented) models in green. Statistically significance correlations at the 95th significance levels are shown in bold.

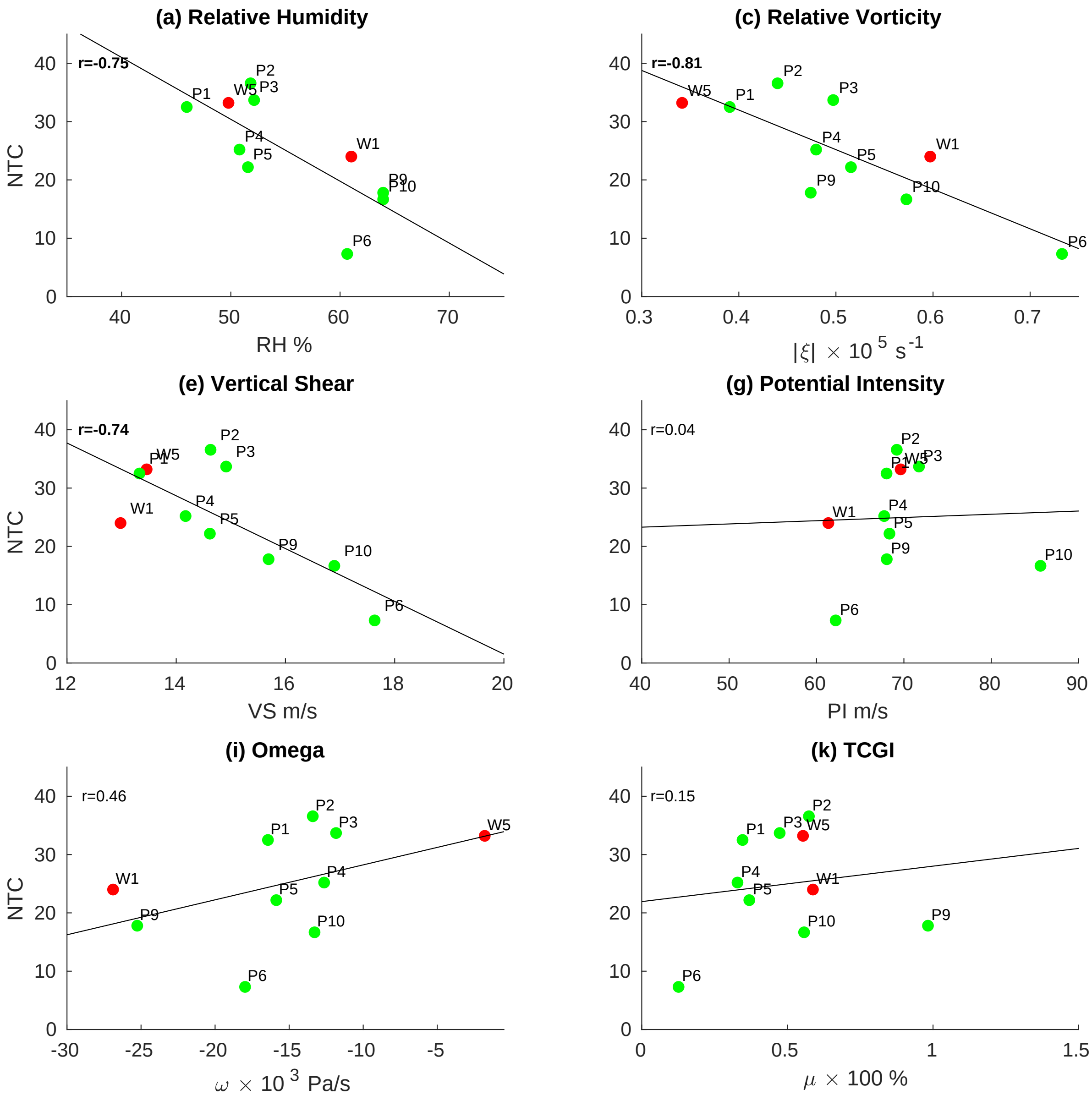

Figure S10: Scatter plots of mean climatological NTC and environmental fields for the tropical southern hemisphere in JFM, for models with resolution 0.5 degree or higher. C (CMIP5) models are shown in blue, W (HWG) models in red, P (Process-Oriented) models in green. Statistically significance correlations at the 95th significance levels are shown in bold.

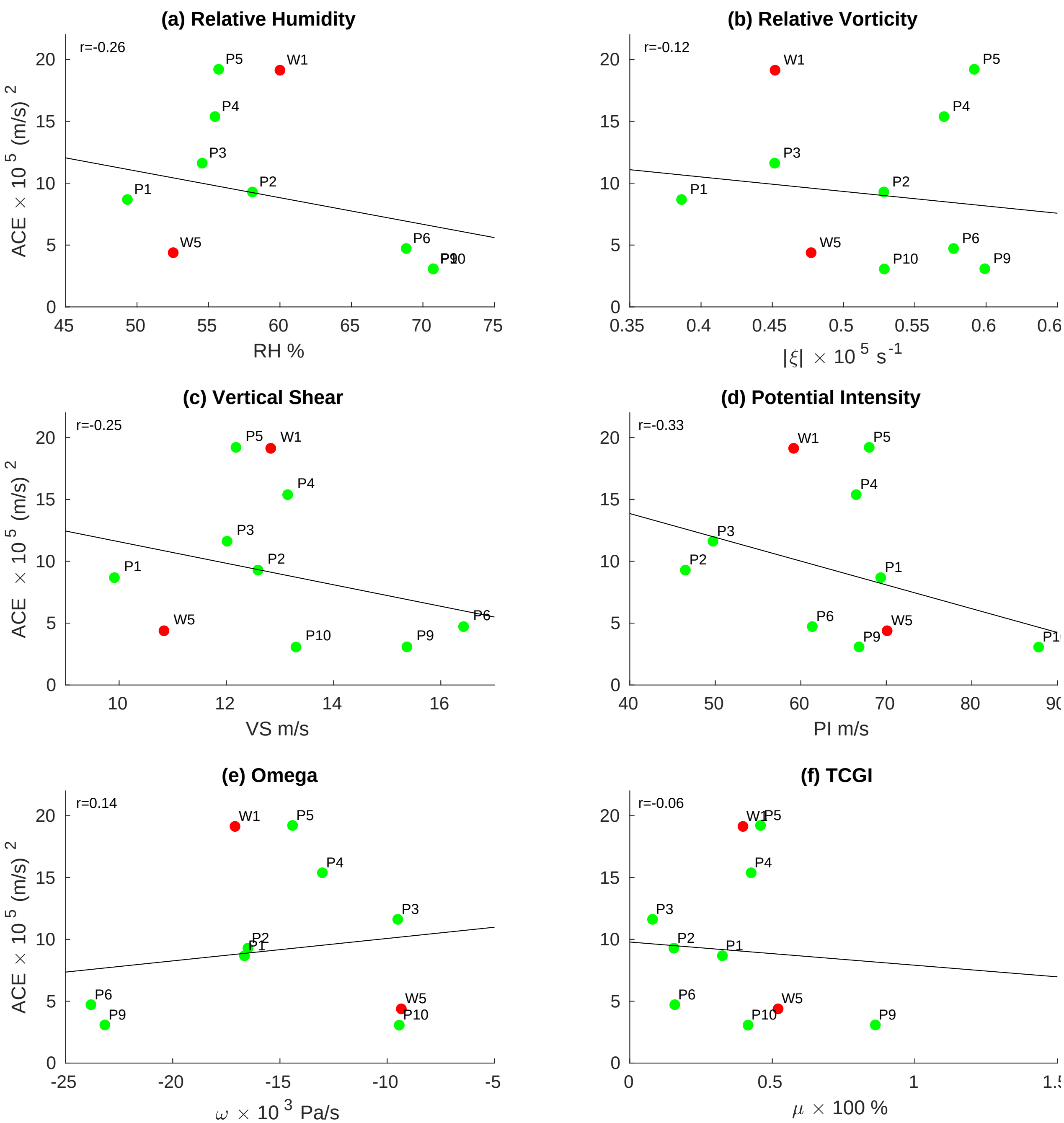

Figure S11: Scatter plots of mean climatological ACE and environmental fields for the tropical northern hemisphere in ASO, for models with resolution 0.5 degree or higher. C (CMIP5) models are shown in blue, W (HWG) models in red, P (Process-Oriented) models in green. Statistically significance correlations at the 95th significance levels are shown in bold.

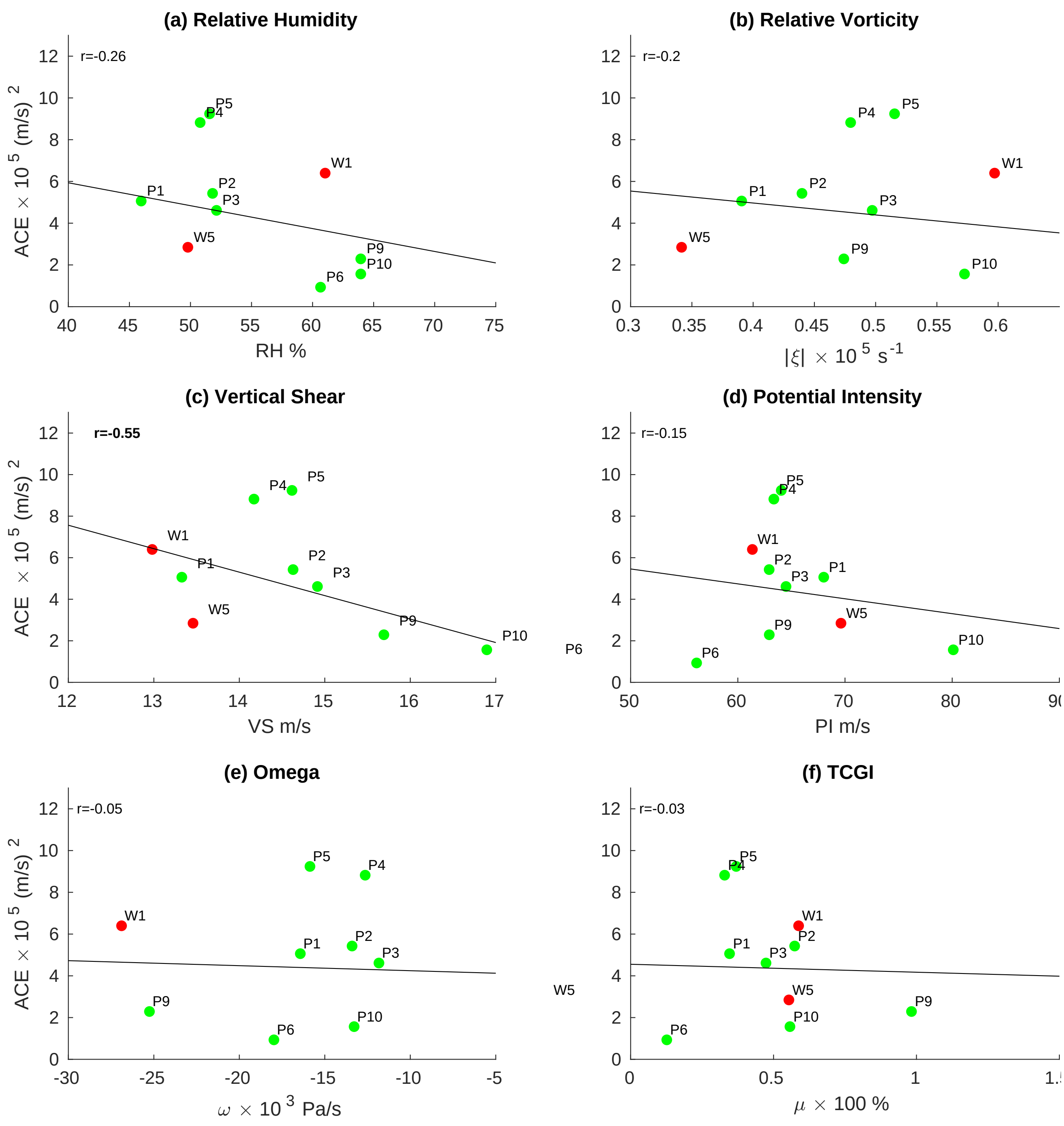

Figure S12: Scatter plots of mean climatological ACE and environmental fields for the tropical southern hemisphere in JFM, for models with resolution 0.5 degree or higher. C (CMIP5) models are shown in blue, W (HWG) models in red, P (Process-Oriented) models in green. Statistically significance correlations at the 95th significance levels are shown in bold.

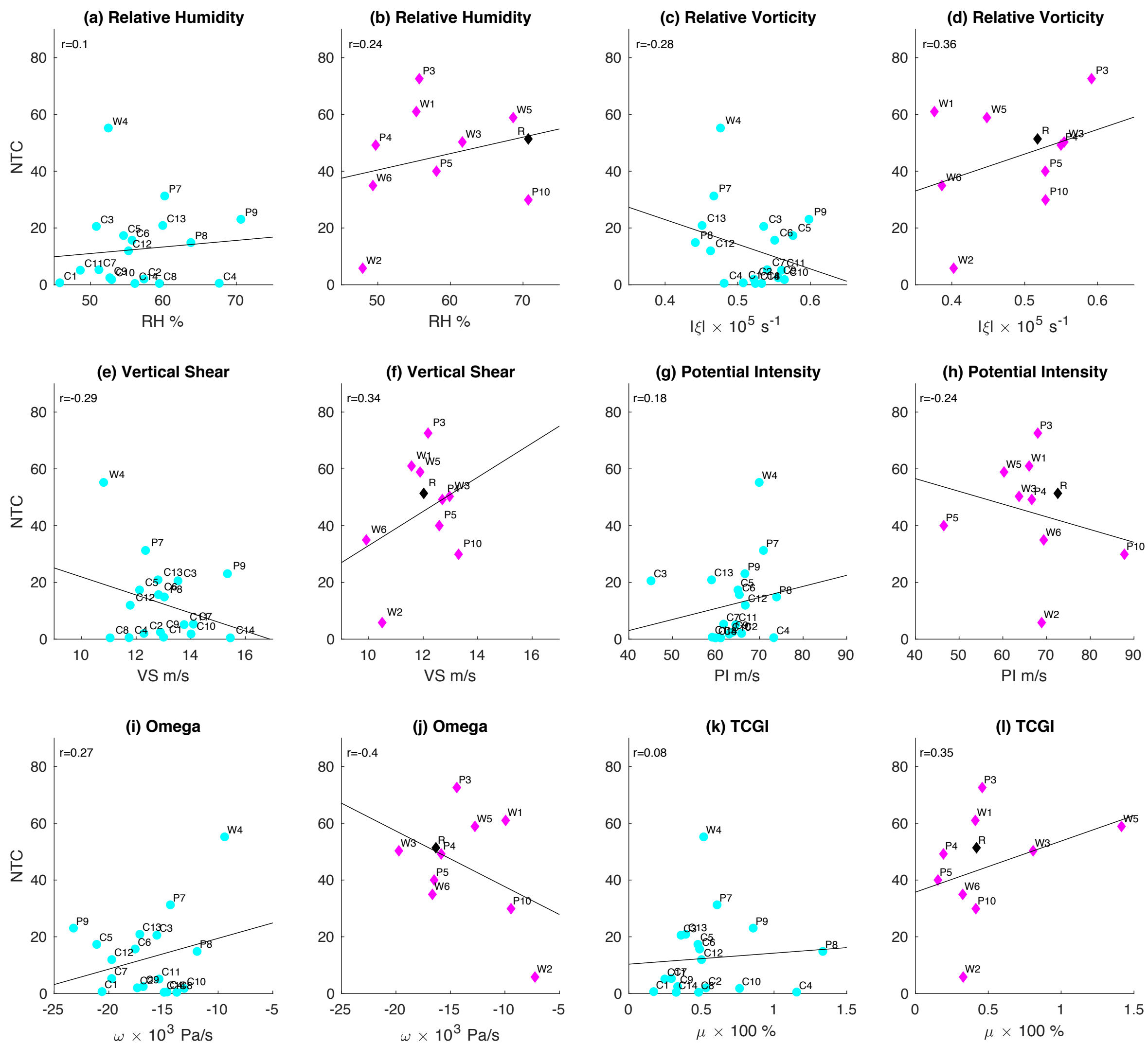

Figure S13: Scatter plots of mean climatological NTC and environmental fields for the tropical northern hemisphere in ASO, separated by tracking schemes for C (CMIP5), W (HWG) and P (Process-Oriented) models. Models tracked using the Camargo-Zebiak scheme are shown in cyan, those tracked by the Zhao/Vitart algorithm in magenta. Models not tracked by these two routines are not included. Statistically significance correlations at the 95th significance levels are shown in bold.

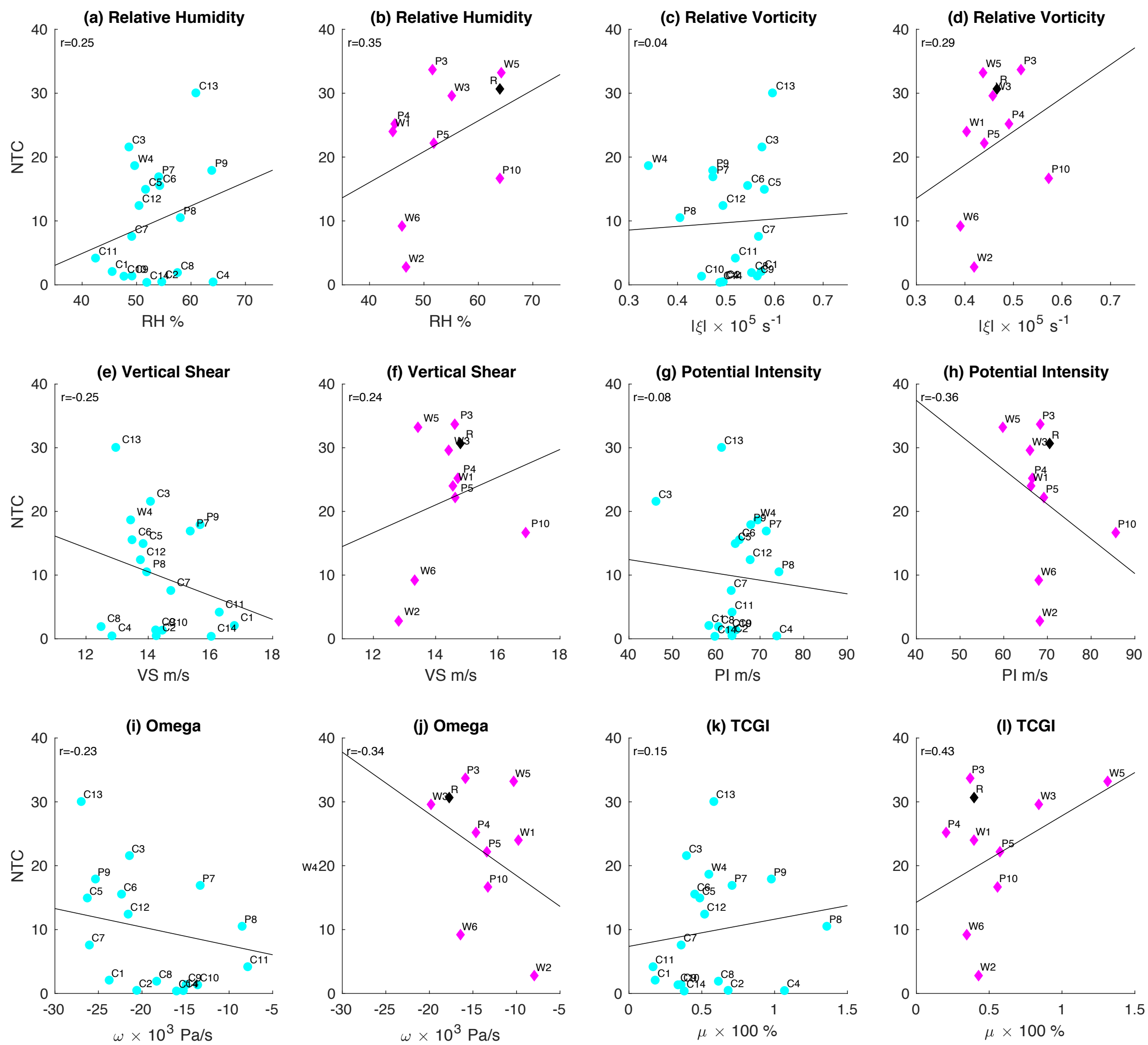

Figure S14: Scatter plots of mean climatological NTC and environmental fields for the tropical southern hemisphere in JFM, separated by tracking schemes for C (CMIP5), W (HWG) and P (Process-Oriented) models. Models tracked using the Camargo-Zebiak scheme are shown in cyan, those tracked by the Zhao/Vitart algorithm in magenta. Models not tracked by these two routines are not included. Statistically significance correlations at the 95th significance levels are shown in bold.

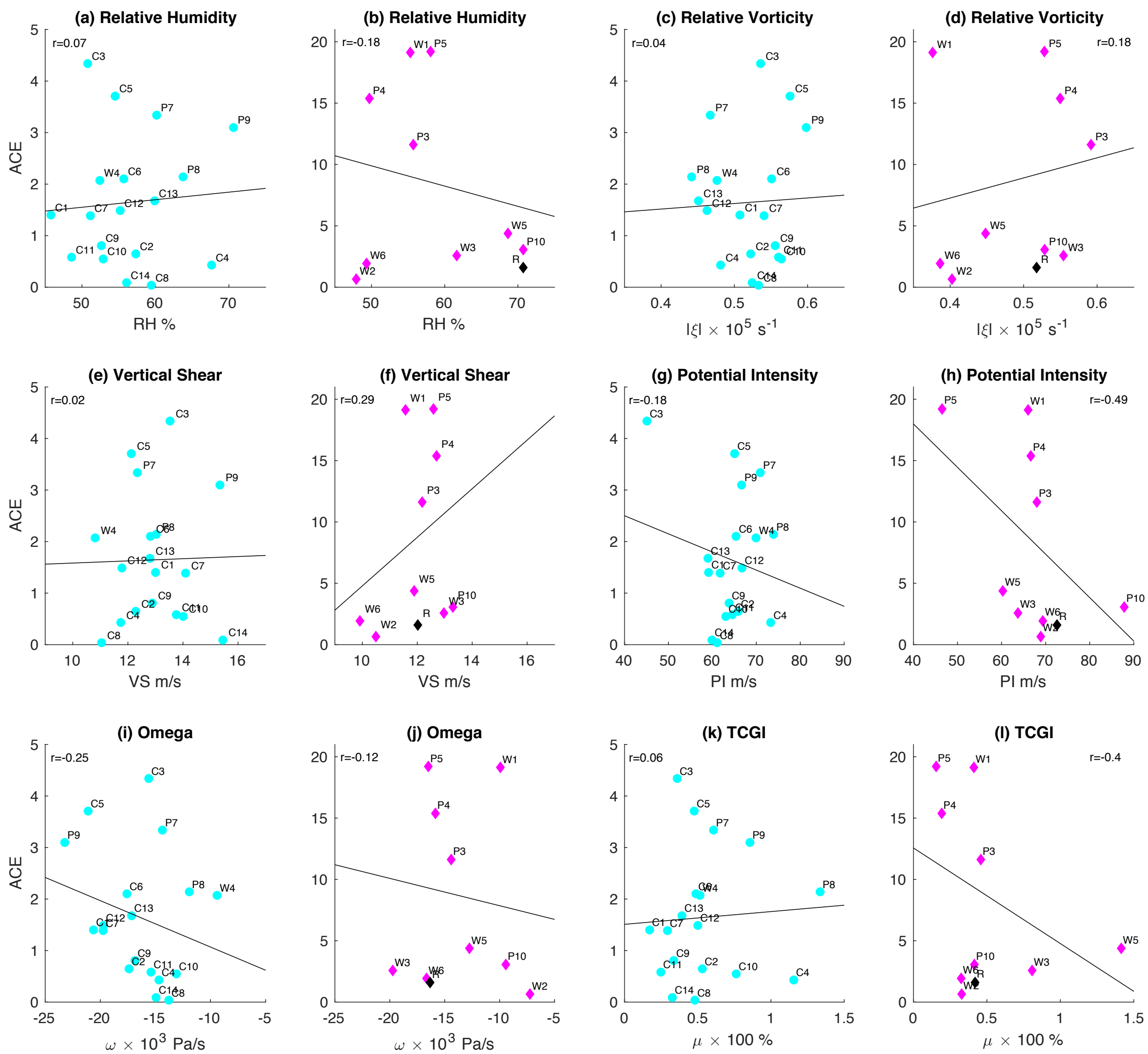

Figure S15: Scatter plots of mean climatological ACE and environmental fields for the tropical northern hemisphere in ASO, separated by tracking schemes for C (CMIP5), W (HWG) and P (Process-Oriented) models. Models tracked using the Camargo-Zebiak scheme are shown in cyan, those tracked by the Zhao/Vitart algorithm in magenta. Models not tracked by these two routines are not included. Statistically significance correlations at the 95th significance levels are shown in bold.

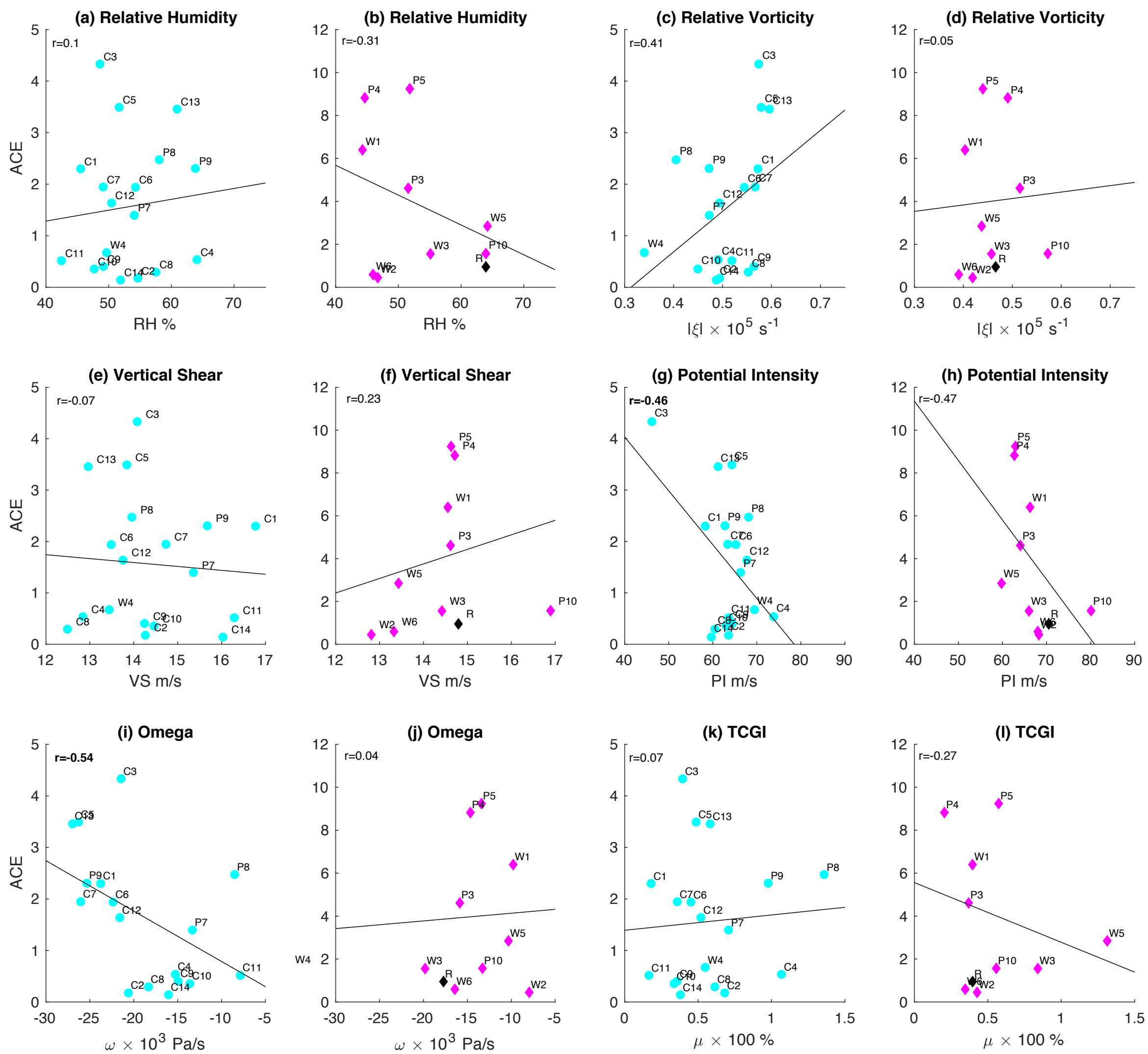

Figure S16: Scatter plots of mean climatological ACE and environmental fields for the tropical southern hemisphere in JFM, separated by tracking schemes for C (CMIP5), W (HWG) and P (Process-Oriented) models. Models tracked using the Camargo-Zebiak scheme are shown in cyan, those tracked by the Zhao/Vitart algorithm in magenta. Models not tracked by these two routines are not included. Statistically significance correlations at the 95th significance levels are shown in bold.

Table S1: Spatial correlations of the environmental fields climatology and reanalysis in the tropics by season: northern hemisphere (0 - 30°N) in ASO and southern hemisphere (30°S - 0) in JFM over the ocean. P and W models and the ERA-Interim reanalysis were interpolated to an uniform 1 degree grid before calculating the spatial correlation. C models and the ERA-Interim reanalysis were interpolated to an uniform 2 degree grid before calculating the spatial correlation. The three cases that are not statistically significant at the 99th significance level are shown in italic.

	VSH		RH		PI		Omega		Vort		TCGI	
Model	ASO	JFM	ASO	JFM	ASO	JFM	ASO	JFM	ASO	JFM	ASO	JFM
P1	0.81	0.96	0.92	0.95	0.94	0.99	0.85	0.91	0.82	0.85	0.76	0.91
P2	0.94	0.94	0.95	0.96	0.94	0.99	0.92	0.94	0.84	0.87	0.82	0.94
P3	0.93	0.92	0.89	0.91	0.97	0.98	0.91	0.91	0.86	0.87	0.80	0.85
P4	0.57	0.82	0.81	0.96	0.97	0.99	0.58	0.82	0.65	0.80	0.73	0.74
P5	0.73	0.85	0.90	0.96	0.49	0.98	0.67	0.86	0.70	0.84	0.78	0.85
P6	0.94	0.96	0.92	0.97	0.49	0.97	0.88	0.85	0.83	0.80	0.69	0.89
P7	0.78	0.94	0.92	0.96	0.92	0.98	0.87	0.88	0.50	0.62	0.74	0.64
P8	0.87	0.94	0.94	0.97	0.98	0.99	0.87	0.90	0.82	0.88	0.86	0.88
P9	0.84	0.91	0.92	0.95	0.98	0.99	0.83	0.85	0.81	0.86	0.75	0.87
P10	0.71	0.83	0.89	0.92	0.98	0.99	0.79	0.91	0.77	0.81	0.89	0.89
W1	0.44	0.77	0.75	0.94	0.97	0.98	0.51	0.80	0.57	0.83	0.76	0.82
W2	0.57	0.92	0.85	0.93	0.98	0.98	0.77	0.87	0.72	0.87	0.82	0.88
W3	0.78	0.89	0.93	0.92	0.98	0.99	0.84	0.85	0.82	0.84	0.88	0.87
W4	0.81	0.82	0.80	0.91	0.96	0.98	0.61	0.70	0.70	0.72	0.67	0.90
W5	0.79	0.97	0.88	0.94	0.90	0.92	0.80	0.88	0.78	0.86	0.73	0.88
W6	0.62	0.90	0.80	0.91	0.98	0.98	0.79	0.83	0.73	0.76	0.80	0.80
C1	0.82	0.80	0.80	0.93	0.88	0.95	0.83	0.90	0.75	0.85	0.68	0.90
C2	0.79	0.77	0.87	0.83	0.73	0.83	0.76	0.79	0.73	0.80	0.71	0.83
C3	0.88	0.70	0.80	0.91	0.84	0.89	0.85	0.90	0.77	0.86	*0.30*	0.86
C4	0.85	0.70	0.89	0.90	0.73	0.81	0.82	0.80	0.78	0.87	0.78	0.84
C5	0.81	0.76	0.80	0.88	0.75	0.93	0.74	0.82	0.72	0.81	0.57	0.85
C6	0.85	0.72	0.82	0.88	0.77	0.86	0.74	0.81	0.69	0.83	0.38	0.88
C7	0.74	0.82	0.90	0.96	0.89	0.93	0.87	0.90	0.79	0.83	0.82	0.90
C8	0.69	0.84	0.80	0.90	0.71	0.90	0.74	0.76	0.70	0.83	0.56	0.90
C9	0.73	0.92	0.91	0.92	0.78	0.92	0.80	0.86	0.83	0.88	*0.13*	0.89
C10	0.62	0.63	0.73	0.84	0.64	0.81	0.64	0.69	0.65	0.72	*0.23*	0.57
C11	0.84	0.86	0.87	0.75	0.82	0.88	0.76	0.70	0.70	0.76	0.74	0.73
C12	0.54	0.54	0.86	0.74	0.83	0.85	0.79	0.69	0.76	0.74	0.66	0.74
C13	0.61	0.86	0.72	0.87	0.80	0.87	0.74	0.84	0.73	0.76	0.52	0.86
C14	0.77	0.60	0.64	0.86	0.71	0.90	0.56	0.81	0.39	0.76	0.51	0.77

Table S2: Root mean square errors (RMSE) of the environmental fields climatology and reanalysis in the tropics by season: northern hemisphere (0 - 30°N) in ASO and southern hemisphere (30°S - 0) in JFM over the ocean. P and W models and the ERA-Interim reanalysis were interpolated to an uniform 1 degree grid before calculating RMSE. C models and the ERA-Interim reanalysis were interpolated to an uniform 2 degree grid before calculating RMSE.

	VSH		RH		PI		Omega		Vort		TCGI	
Model	ASO	JFM	ASO	JFM	ASO	JFM	ASO	JFM	ASO	JFM	ASO	JFM
P1	0.30	0.13	0.13	0.15	0.12	0.08	1.16	1.86	3.12	4.30	1.02	0.91
P2	0.16	0.15	0.11	0.14	0.10	0.08	0.83	1.46	2.94	4.14	0.93	0.82
P3	0.21	0.16	0.15	0.20	0.11	0.10	0.93	1.85	2.65	4.13	1.15	1.30
P4	0.44	0.30	0.25	0.32	0.22	0.24	2.29	2.68	4.10	6.17	1.31	3.21
P5	0.32	0.22	0.13	0.16	0.44	0.09	1.76	2.21	3.54	4.75	1.48	1.94
P6	0.17	0.11	0.17	0.14	0.46	0.09	1.04	2.23	2.89	5.15	1.27	2.50
P7	0.50	0.28	0.36	0.32	0.18	0.15	1.65	2.38	4.44	6.34	1.26	1.91
P8	0.23	0.15	0.19	0.18	0.05	0.05	1.05	1.86	2.34	3.80	1.56	3.56
P9	0.27	0.18	0.28	0.28	0.06	0.08	1.25	2.36	2.79	3.96	5.42	7.89
P10	0.49	0.27	0.38	0.40	0.09	0.07	2.20	2.34	3.71	4.72	2.70	4.98
W1	0.47	0.31	0.21	0.15	0.07	0.07	2.21	2.65	4.02	4.46	1.03	1.80
W2	0.41	0.17	0.17	0.19	0.10	0.09	1.43	2.16	3.24	3.76	1.06	1.78
W3	0.31	0.20	0.22	0.24	0.13	0.08	1.57	2.64	3.05	4.24	3.06	4.85
W4	0.30	0.31	0.18	0.18	0.07	0.07	1.72	3.34	3.47	5.28	1.77	2.52
W5	0.29	0.14	0.37	0.39	0.20	0.20	1.33	2.11	3.04	3.90	6.41	7.73
W6	0.4	0.2	0.18	0.18	0.06	0.07	1.49	2.59	3.17	4.99	0.94	1.41
C1	0.27	0.26	0.21	0.23	0.14	0.14	1.19	2.02	2.68	4.09	1.77	2.97
C2	0.33	0.27	0.16	0.24	0.47	0.45	2.04	3.79	2.91	4.95	1.26	1.55
C3	0.25	0.37	0.21	0.18	0.24	0.24	1.28	2.40	2.56	4.20	1.84	1.40
C4	0.26	0.34	0.34	0.46	0.16	0.24	1.27	2.84	2.48	3.76	4.30	5.15
C5	0.28	0.29	0.20	0.23	0.19	0.15	1.59	3.14	3.15	4.95	1.79	1.80
C6	0.26	0.31	0.18	0.25	0.19	0.18	1.68	3.09	3.18	4.53	3.13	1.37
C7	0.38	0.24	0.15	0.13	0.20	0.16	1.33	2.74	2.62	4.67	0.94	1.01
C8	0.39	0.24	0.17	0.19	0.22	0.18	1.58	3.19	3.11	4.73	1.40	1.01
C9	0.41	0.17	0.13	0.16	0.22	0.17	1.49	2.51	2.42	3.38	8.52	1.07
C10	0.45	0.41	0.21	0.23	0.21	0.21	1.93	3.70	3.32	5.78	2.24	1.88
C11	0.26	0.24	0.17	0.30	0.16	0.16	1.68	3.86	2.84	4.85	1.41	2.46
C12	0.45	0.40	0.23	0.44	0.23	0.21	1.51	4.34	2.47	5.72	1.29	2.54
C13	0.51	0.23	0.25	0.27	0.23	0.23	1.49	2.62	2.84	5.04	1.59	1.46
C14	0.32	0.41	0.28	0.33	0.22	0.19	1.80	2.76	4.34	5.27	1.98	2.94