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Supplementary Material: Comment on "Quantitative performance metrics for stratospheric-resolving chemistry-climate models" by Waugh and Eyring

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1 Introduction

In the following the parameter settings for the random models and diagnostics used in Fig. 5 as well as the results concerning the grades and s-grades are shown in the following 7 tables.

Table 1. Number of years available for individual diagnostics, i.e. sample sizes $N = M$

Diagnostic	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
Number of years	40	40	40	40	20	20	10	10	10	10	10	10	5	5	5	5

Table 2. Value of α for error definition of the expectation of $E(Z)$ (observation) and $E(X(i))$ ($i=1,\dots,13$ models) for 16 diagnostics.

Diag- nostic	Obs.	α of model number												
		1	2	3	4	5	6	7	8	9	10	11	12	13
1	0.64	0.42	0.28	2.65	2.97	3.40	3.54	0.29	0.53	0.36	3.89	4.01	0.38	3.32
2	0.75	3.68	4.34	0.39	3.05	3.32	0.31	2.65	2.70	0.29	3.10	0.40	0.20	0.33
3	1.13	0.39	4.01	0.27	0.34	3.63	1.60	2.46	2.86	0.38	0.41	0.26	0.17	0.31
4	0.81	3.69	2.98	0.51	3.94	0.38	0.32	2.10	0.30	2.10	0.31	3.57	0.24	0.38
5	0.81	0.47	0.42	0.31	0.33	2.88	0.20	4.27	0.25	0.41	0.26	0.37	3.47	0.29
6	0.60	3.93	0.32	4.57	0.54	0.50	0.34	3.59	0.31	2.42	0.45	0.22	0.49	0.32
7	0.83	0.40	0.21	3.17	0.42	2.13	2.36	2.33	0.27	4.18	0.24	2.65	3.52	0.54
8	1.45	0.28	2.80	2.08	0.24	2.80	0.37	0.36	0.36	3.29	3.03	0.39	2.91	0.37
9	0.51	4.05	0.42	0.31	0.22	3.79	0.35	2.65	0.20	2.02	1.67	0.27	2.84	2.20
10	0.59	0.23	0.26	4.51	0.35	2.49	0.45	2.32	4.27	0.26	2.64	0.31	0.38	2.50
11	1.98	2.59	2.33	2.48	2.06	2.99	0.25	3.25	3.31	2.89	0.23	0.25	1.64	0.47
12	1.17	5.53	0.25	2.85	2.47	2.88	2.25	0.31	0.56	0.40	0.27	2.94	3.01	5.34
13	1.43	0.25	0.22	0.25	2.39	0.41	4.90	3.15	0.38	3.99	2.55	0.41	2.44	0.60
14	1.00	1.87	2.39	2.46	3.77	0.25	3.21	1.74	4.55	2.29	3.02	0.22	2.69	0.35
15	0.52	1.65	2.00	2.80	0.33	0.38	0.28	3.23	2.02	0.42	0.30	0.25	3.20	4.80
16	0.70	0.26	0.23	3.18	3.29	3.43	0.26	3.91	3.70	3.93	4.41	2.33	0.26	0.44

Table 3. Value of β for error definition of the standard deviation of $S(Z)$ (observation) and $S(X(i))$ ($i=1,\dots,13$ models) for 16 diagnostics.

Diag- nostic	Obs.	β of model number												
		1	2	3	4	5	6	7	8	9	10	11	12	13
1	1.86	0.96	1.03	1.75	0.83	0.67	0.90	0.87	0.51	1.25	0.61	1.01	0.52	0.61
2	0.80	0.77	1.38	0.71	1.05	0.77	0.85	1.48	1.21	0.85	1.10	0.60	1.25	1.76
3	0.77	0.84	1.21	1.13	0.62	1.06	1.06	0.57	0.61	0.80	0.73	0.90	1.15	0.90
4	1.45	0.59	0.87	0.97	1.13	0.92	1.35	1.77	1.52	0.87	1.55	0.85	1.17	1.44
5	0.79	0.90	1.89	0.96	0.73	0.97	1.14	0.58	0.95	1.56	0.66	1.06	0.90	0.62
6	0.90	0.54	0.99	1.32	0.66	1.04	1.17	0.81	1.15	0.65	1.68	1.29	1.28	1.02
7	0.89	0.53	1.18	1.19	1.27	0.75	0.86	0.79	0.67	0.76	1.36	1.11	1.79	0.81
8	0.52	0.87	1.02	1.18	0.72	1.76	1.21	0.76	0.92	1.60	1.72	0.77	0.71	0.99
9	1.01	0.68	1.89	0.88	0.98	0.76	1.59	0.61	1.07	0.89	1.51	1.03	0.71	0.98
10	0.87	1.21	0.56	0.94	1.01	1.50	1.78	0.52	0.91	1.94	1.02	0.74	1.03	1.41
11	0.79	0.96	1.65	0.82	0.56	1.08	0.87	0.98	0.92	0.77	0.78	1.87	0.92	0.72
12	0.70	1.93	1.45	0.50	0.70	1.25	1.40	0.78	0.55	0.63	1.60	1.06	0.87	1.31
13	0.52	0.80	1.62	0.70	1.55	0.60	1.95	1.58	0.55	0.87	0.74	1.57	1.87	0.86
14	1.12	1.15	0.64	1.80	1.77	1.48	0.79	1.77	1.08	0.73	1.15	1.04	0.84	1.54
15	1.13	1.68	1.13	1.65	0.77	0.99	0.72	1.74	1.69	0.57	0.84	1.81	0.95	0.72
16	0.69	0.57	0.82	0.58	1.12	1.01	1.17	0.55	0.76	0.76	0.82	1.29	1.61	0.97

Table 4. Expectations E^r (reality), $E(Z)$ (observation) and $E(X(i))$ ($i=1,\dots,13$ models) for 16 diagnostics.

Diag- nostic	Real. E^r	Obs. $E(Z)$	Expectation of model number												
			1	2	3	4	5	6	7	8	9	10	11	12	13
1	0.00	0.62	0.41	0.27	2.56	2.87	3.28	3.42	0.28	0.52	0.35	3.76	3.88	0.36	3.21
2	0.00	0.68	3.31	3.89	0.35	2.74	2.98	0.28	2.38	2.43	0.26	2.78	0.36	0.18	0.30
3	0.00	0.94	0.32	3.34	0.22	0.28	3.02	1.33	2.05	2.39	0.31	0.34	0.21	0.14	0.26
4	0.00	1.20	5.45	4.40	0.75	5.82	0.57	0.47	3.10	0.44	3.11	0.45	5.28	0.36	0.57
5	0.00	1.26	0.74	0.65	0.49	0.51	4.51	0.32	6.69	0.38	0.64	0.40	0.59	5.44	0.45
6	0.00	0.55	3.59	0.29	4.17	0.49	0.46	0.31	3.28	0.28	2.21	0.41	0.20	0.45	0.29
7	0.00	1.10	0.53	0.28	4.19	0.56	2.81	3.11	3.07	0.35	5.51	0.32	3.50	4.65	0.71
8	0.00	1.40	0.27	2.71	2.02	0.23	2.72	0.36	0.34	0.35	3.19	2.94	0.38	2.82	0.36
9	0.00	0.68	5.37	0.56	0.41	0.29	5.03	0.46	3.52	0.26	2.68	2.22	0.35	3.77	2.91
10	0.00	0.54	0.21	0.24	4.09	0.32	2.26	0.41	2.10	3.87	0.23	2.39	0.28	0.35	2.27
11	0.00	3.42	4.48	4.02	4.28	3.56	5.18	0.43	5.62	5.72	5.00	0.39	0.44	2.83	0.81
12	0.00	2.03	9.63	0.44	4.96	4.30	5.02	3.93	0.54	0.97	0.70	0.48	5.12	5.24	9.31
13	0.00	1.51	0.27	0.23	0.26	2.51	0.44	5.16	3.31	0.39	4.20	2.69	0.43	2.57	0.63
14	0.00	0.61	1.14	1.45	1.49	2.29	0.15	1.95	1.06	2.77	1.39	1.83	0.13	1.63	0.21
15	0.00	1.03	3.26	3.95	5.54	0.65	0.75	0.55	6.38	4.00	0.84	0.59	0.50	6.33	9.49
16	0.00	0.80	0.30	0.26	3.61	3.74	3.90	0.29	4.45	4.20	4.47	5.02	2.65	0.29	0.50

Table 5. Standard deviation S^r (reality), $S(Z)$ (observation) and $S(X(i))$ ($i=1,\dots,13$ models) for 16 diagnostics.

Diag- nostic	Real. S^r	Obs. $S(Z)$	Standard deviation of model number												
			1	2	3	4	5	6	7	8	9	10	11	12	13
1	0.97	1.79	0.92	1.00	1.69	0.80	0.64	0.87	0.84	0.49	1.21	0.59	0.97	0.50	0.59
2	0.90	0.72	0.69	1.24	0.64	0.94	0.69	0.77	1.32	1.09	0.76	0.99	0.54	1.12	1.58
3	0.83	0.65	0.70	1.01	0.94	0.52	0.88	0.89	0.47	0.51	0.67	0.61	0.75	0.96	0.75
4	1.48	2.14	0.87	1.28	1.44	1.66	1.35	1.99	2.61	2.25	1.29	2.29	1.26	1.73	2.13
5	1.57	1.24	1.40	2.95	1.50	1.14	1.52	1.79	0.91	1.49	2.45	1.03	1.66	1.41	0.96
6	0.91	0.82	0.49	0.90	1.21	0.61	0.95	1.07	0.74	1.05	0.60	1.54	1.18	1.17	0.93
7	1.32	1.17	0.70	1.56	1.56	1.68	0.99	1.13	1.05	0.89	1.00	1.79	1.47	2.37	1.06
8	0.97	0.50	0.84	0.98	1.15	0.70	1.71	1.17	0.74	0.89	1.55	1.66	0.75	0.69	0.96
9	1.33	1.34	0.91	2.51	1.17	1.30	1.01	2.11	0.81	1.42	1.17	2.00	1.37	0.94	1.30
10	0.91	0.79	1.10	0.51	0.85	0.92	1.36	1.62	0.47	0.83	1.76	0.92	0.67	0.93	1.28
11	1.73	1.37	1.66	2.85	1.42	0.96	1.86	1.50	1.70	1.58	1.32	1.35	3.23	1.60	1.24
12	1.74	1.21	3.36	2.53	0.87	1.21	2.17	2.44	1.36	0.96	1.09	2.79	1.85	1.52	2.27
13	1.05	0.55	0.84	1.70	0.74	1.63	0.64	2.05	1.67	0.58	0.91	0.78	1.65	1.97	0.91
14	0.61	0.68	0.70	0.39	1.09	1.08	0.90	0.48	1.08	0.66	0.44	0.70	0.63	0.51	0.94
15	1.98	2.23	3.32	2.23	3.26	1.52	1.95	1.43	3.44	3.34	1.14	1.66	3.58	1.89	1.43
16	1.14	0.78	0.64	0.94	0.66	1.27	1.15	1.33	0.62	0.86	0.87	0.93	1.47	1.84	1.10

Table 6. Grading of the models $G(X(i))$ ($i=1,\dots,13$ models) for 16 diagnostics and the grading threshold for the 5%-percentile ($g^{real}(p = 0.05)$).

Diag- nostic	Grading of model number													$g^{real}(p = 0.05)$
	1	2	3	4	5	6	7	8	9	10	11	12	13	
1	0.98	0.96	0.60	0.55	0.44	0.38	0.96	0.96	0.98	0.39	0.32	1.00	0.46	0.86
2	0.00	0.00	0.78	0.02	0.00	0.71	0.08	0.15	0.78	0.00	0.75	0.72	0.71	0.00
3	0.69	0.00	0.65	0.63	0.00	0.84	0.47	0.26	0.66	0.72	0.64	0.62	0.61	0.52
4	0.44	0.62	0.92	0.33	0.91	0.86	0.77	0.88	0.70	0.90	0.51	0.87	0.91	0.15
5	0.89	0.95	0.67	0.77	0.09	0.64	0.00	0.71	0.88	0.76	0.78	0.00	0.75	0.65
6	0.00	0.90	0.00	0.98	0.93	0.82	0.00	0.77	0.26	0.94	0.59	0.94	0.91	0.00
7	0.76	0.78	0.00	0.90	0.39	0.35	0.10	0.80	0.00	0.98	0.14	0.00	0.82	0.57
8	0.07	0.25	0.93	0.00	0.21	0.00	0.15	0.00	0.00	0.25	0.18	0.00	0.00	0.00
9	0.00	0.95	0.92	1.00	0.00	0.96	0.16	0.86	0.32	0.42	0.90	0.00	0.24	0.00
10	0.86	0.87	0.00	0.91	0.17	0.82	0.24	0.00	0.48	0.34	0.70	0.53	0.00	0.50
11	0.57	0.93	0.65	0.87	0.65	0.00	0.41	0.00	0.17	0.00	0.00	0.74	0.15	0.34
12	0.00	0.62	0.37	0.50	0.42	0.72	0.58	0.81	0.89	0.85	0.32	0.42	0.00	0.00
13	0.04	0.00	0.00	0.88	0.00	0.00	0.22	0.00	0.00	0.06	0.00	0.54	0.51	0.00
14	0.94	0.63	0.81	0.65	0.71	0.15	0.99	0.00	0.64	0.48	0.41	0.48	0.54	0.08
15	0.00	0.00	0.00	0.95	0.81	0.96	0.00	0.34	0.82	0.62	0.81	0.00	0.00	0.00
16	0.63	0.76	0.00	0.00	0.00	0.57	0.00	0.00	0.00	0.00	0.00	0.42	0.27	0.22

Table 7. S-grading of the models, i.e. 1 for any grading larger than the grading threshold of the 5% percentile and 1 minus the difference to the 5% confidence interval of $G(X)$ else.

Diag- nostic	s-Grading of model number												
	1	2	3	4	5	6	7	8	9	10	11	12	13
1	1.00	1.00	0.74	0.69	0.58	0.52	1.00	1.00	1.00	0.53	0.46	1.00	0.60
2	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
3	1.00	0.48	1.00	1.00	0.48	1.00	0.95	0.73	1.00	1.00	1.00	1.00	1.00
4	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
5	1.00	1.00	1.00	1.00	0.44	0.99	0.35	1.00	1.00	1.00	1.00	0.35	1.00
6	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
7	1.00	1.00	0.43	1.00	0.82	0.78	0.53	1.00	0.43	1.00	0.57	0.43	1.00
8	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
9	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
10	1.00	1.00	0.50	1.00	0.67	1.00	0.74	0.50	0.98	0.84	1.00	1.00	0.50
11	1.00	1.00	1.00	1.00	1.00	0.66	1.00	0.66	0.83	0.66	0.66	1.00	0.81
12	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
13	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
14	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.92	1.00	1.00	1.00	1.00	1.00
15	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
16	1.00	1.00	0.78	0.78	0.78	1.00	0.78	0.78	0.78	0.78	0.78	1.00	1.00