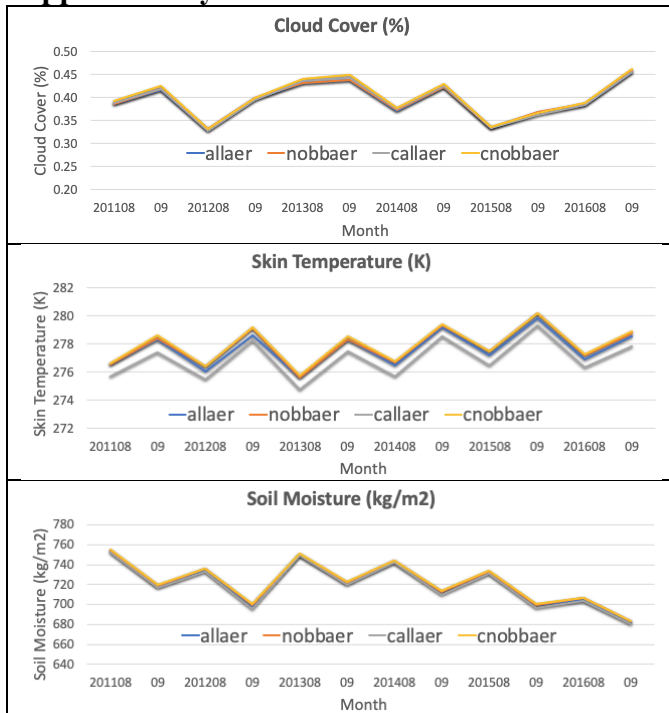1   **Supplementary material**

Figure S1: Cloud cover, skin temperature, and soil moisture during 2011-2016 over the Amazon region from all pari1 and pari2 experiments.
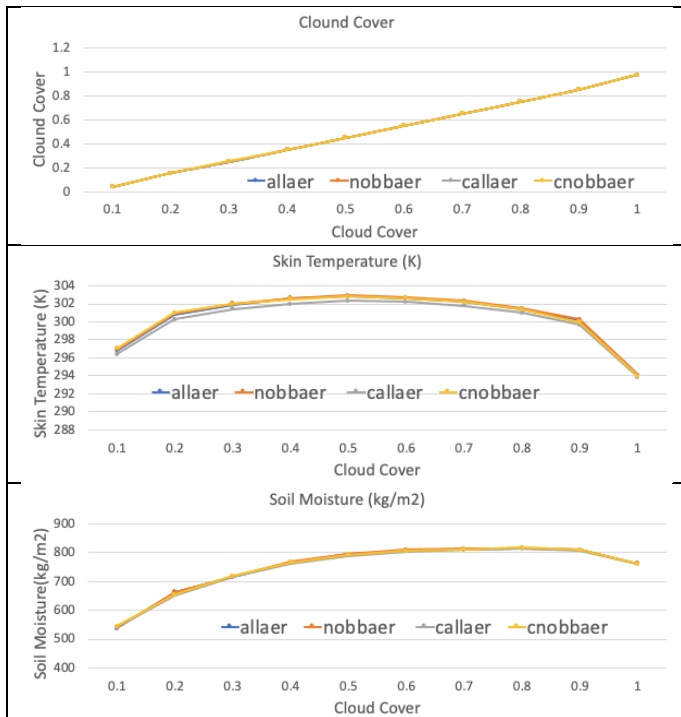
2

Figure S2: Cloud cover, skin temperature, and soil moisture over the Amazon region, which are sorted out based on the values of grid box cloud fraction on a daily basis during the Aug-Sept 2013, from all the pair1 and pair2 experiments.

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Table S1a. monthly data of DRPAR, DFPAR, GPP, CLDFRC, BBAOD from a pair of experiments (allaer vs nobbaer) at the clear sky conditions during 2010-2016.

Clear Sky												
Year	Mon	GPP			DRPAR			DFPAR			CLDFRC	BBAOD	Frequency[*]
		Pg/Amazon/mon		%	W/m^2		%	W/m^2		%			
		nobbaer	allaer	diff	nobbaer	allaer	diff	nobbaer	allaer	diff	allaer	allaer	
2010	8	1.05	1.28	22.4	96.3	76.6	-20.5	26.4	31.9	20.8	0.04	0.229	0.121
	9	0.63	0.73	17.4	108.4	90.9	-16.1	27.6	33.1	19.8	0.04	0.177	0.088
2011	8	1.05	1.07	1.8	95.2	93.3	-2.0	25.4	26.2	3.3	0.05	0.015	0.109
	9	0.69	0.73	6.8	107.9	100.9	-6.5	26.7	29.5	10.7	0.04	0.057	0.094
2012	8	1.14	1.19	4.2	97.6	93.4	-4.3	24.2	26.0	7.3	0.04	0.032	0.161
	9	0.78	0.85	8.6	106.5	95.3	-10.5	28.6	32.6	14.0	0.05	0.101	0.089
2013	8	0.93	0.96	2.9	98.7	96.1	-2.7	24.1	25.3	5.0	0.04	0.020	0.086
	9	0.74	0.77	4.1	110.8	105.7	-4.7	27.3	29.6	8.4	0.04	0.038	0.082
2014	8	1.00	1.05	5.0	96.3	90.8	-5.8	25.3	27.5	8.6	0.04	0.048	0.125
	9	0.77	0.80	4.2	107.0	102.2	-4.5	27.3	29.3	7.5	0.05	0.038	0.074
2015	8	1.03	1.06	3.6	94.2	90.0	-4.4	25.8	27.5	6.4	0.04	0.037	0.153
	9	0.74	0.79	7.3	104.9	96.0	-8.5	29.8	33.2	11.2	0.04	0.077	0.119
2016	8	0.95	1.00	5.5	93.6	87.3	-6.7	25.4	27.9	9.8	0.04	0.055	0.135
	9	0.54	0.58	6.8	105.9	97.9	-7.5	27.5	30.7	11.9	0.04	0.066	0.072

*Frequency: the occurrence frequency of clear sky condition over the Amazon region in the interested period

Table S1b. similar as Table S1a but at cloudy sky condition with CLDFRC between 0.1-0.3.

CLDFRC: 0.1-0.3												
Year	Mon	GPP			DRPAR			DFPAR			CLDFRC	BBAOD	Frequency
		Pg/Amazon/mon		%	W/m^2		%	W/m^2		%			
		nobbaer	allaer	diff	nobbaer	allaer	diff	nobbaer	allaer	diff	allaer	allaer	
2010	8	1.50	1.71	14.5	91.9	75.5	-17.8	28.2	33.3	18.2	0.19	0.210	0.194
	9	0.99	1.13	13.4	100.7	85.6	-15.0	30.2	35.0	15.9	0.19	0.181	0.148
2011	8	1.58	1.61	1.6	91.0	89.1	-2.1	28.4	29.2	2.9	0.19	0.019	0.213
	9	1.26	1.32	4.3	99.7	94.0	-5.8	31.3	33.7	7.7	0.19	0.059	0.171
2012	8	1.64	1.73	5.1	92.4	86.8	-6.1	27.8	30.2	8.4	0.19	0.055	0.264
	9	1.25	1.33	6.8	100.2	90.8	-9.4	31.6	35.1	11.2	0.19	0.101	0.189
2013	8	1.53	1.56	1.9	91.1	89.0	-2.3	27.8	28.7	3.4	0.19	0.019	0.189
	9	1.32	1.36	3.0	101.1	97.2	-3.8	30.8	32.6	5.7	0.19	0.038	0.173
2014	8	1.61	1.67	3.9	90.4	85.0	-6.0	29.1	31.3	7.5	0.19	0.058	0.217
	9	1.22	1.26	3.4	98.4	93.8	-4.6	31.4	33.4	6.2	0.19	0.046	0.198
2015	8	1.57	1.61	2.9	88.2	83.9	-4.9	29.9	31.6	5.8	0.19	0.047	0.237
	9	1.27	1.34	5.5	96.7	88.9	-8.0	33.7	36.6	8.5	0.19	0.088	0.192
2016	8	1.38	1.45	4.8	89.1	82.7	-7.1	29.4	31.8	8.4	0.19	0.072	0.197
	9	1.06	1.13	6.2	99.2	91.7	-7.6	31.3	34.3	9.6	0.19	0.080	0.155

Table S1c. similar as Table S1a but at cloudy sky condition with CLDFRC between 0.3-0.6.

CLDFRC: 0.3-0.6													
Year	Mon	GPP			DRPAR			DFPAR			CLDFRC	BBAOD	Frequency
		Pg/Amazon/mon		%	W/m^2		%	W/m^2		%			
		nobbaer	allaer	diff	nobbaer	allaer	diff	nobbaer	allaer	diff	allaer	allaer	
2010	8	1.87	2.05	9.9	79.5	67.5	-15.1	32.1	35.4	10.5	0.41	0.199	0.336
	9	1.53	1.67	9.3	86.1	73.8	-14.4	36.1	39.5	9.4	0.42	0.210	0.322
2011	8	1.96	1.99	1.5	77.6	75.8	-2.3	33.6	34.3	2.1	0.41	0.023	0.357
	9	1.67	1.72	3.1	83.7	79.0	-5.6	36.1	37.9	5.1	0.41	0.066	0.337
2012	8	1.95	2.03	4.3	77.1	71.5	-7.2	33.1	35.2	6.4	0.40	0.075	0.338
	9	1.61	1.68	4.4	83.0	75.3	-9.2	36.7	39.3	7.2	0.41	0.120	0.353
2013	8	2.03	2.06	1.5	76.5	74.9	-2.1	33.4	34.1	2.1	0.41	0.021	0.372
	9	1.75	1.79	1.9	81.6	78.5	-3.8	36.6	37.8	3.5	0.42	0.046	0.353
2014	8	1.94	1.99	2.7	76.3	72.4	-5.2	33.8	35.3	4.5	0.41	0.056	0.349
	9	1.65	1.69	2.2	81.2	77.3	-4.7	37.4	38.9	4.0	0.41	0.060	0.362
2015	8	1.85	1.90	2.5	73.8	70.0	-5.2	35.0	36.4	4.0	0.40	0.056	0.346
	9	1.58	1.63	3.2	78.6	72.7	-7.5	38.1	40.1	5.2	0.41	0.101	0.337
2016	8	1.73	1.79	3.3	75.1	69.8	-7.0	34.2	36.0	5.5	0.41	0.085	0.333
	9	1.54	1.59	3.3	80.7	75.4	-6.6	37.2	39.2	5.4	0.42	0.087	0.357

Table S1d. similar as Table S1a but at cloudy sky condition with CLDFRC > 0.6.

CLDFRC: > 0.6													
Year	Mon	GPP			DRPAR			DFPAR			CLDFRC	BBAOD	Frequency
		Pg/Amazon/mon		%	W/m^2		%	W/m^2		%			
		nobbaer	allaer	diff	nobbaer	allaer	diff	nobbaer	allaer	diff	allaer	allaer	
2010	8	2.17	2.28	5.0	59.8	52.7	-12.0	37.6	38.8	3.1	0.69	0.174	0.349
	9	1.92	1.99	3.9	54.5	46.0	-15.6	43.7	44.2	1.2	0.69	0.282	0.442
2011	8	2.29	2.30	0.6	57.3	55.9	-2.4	39.9	40.3	1.0	0.67	0.029	0.321
	9	2.15	2.16	0.8	53.4	50.6	-5.3	44.2	44.8	1.2	0.69	0.088	0.398
2012	8	2.24	2.29	2.3	53.6	49.4	-7.8	40.3	41.3	2.4	0.68	0.093	0.237
	9	2.07	2.10	1.4	51.9	47.4	-8.9	43.7	44.6	2.0	0.69	0.144	0.369
2013	8	2.43	2.45	0.8	52.1	50.8	-2.4	41.9	42.2	0.7	0.70	0.026	0.353
	9	2.23	2.25	0.9	53.1	50.8	-4.3	44.8	45.4	1.3	0.69	0.063	0.391
2014	8	2.31	2.34	1.6	51.1	48.8	-4.5	41.2	41.7	1.1	0.69	0.061	0.309
	9	1.92	1.94	0.9	53.5	50.5	-5.5	45.1	45.8	1.5	0.68	0.083	0.365
2015	8	2.01	2.05	1.6	51.6	48.6	-5.8	42.7	43.3	1.4	0.68	0.079	0.263
	9	1.83	1.85	1.2	50.7	46.9	-7.6	44.2	44.9	1.6	0.67	0.133	0.352
2016	8	2.05	2.08	1.1	48.3	45.3	-6.2	40.6	41.0	1.0	0.69	0.116	0.335
	9	1.96	1.99	1.4	49.3	46.0	-6.8	43.5	44.1	1.4	0.70	0.114	0.416

Table S1e. similar as Table S1a but at all sky condition.

All Sky													
Year	Mon	GPP			DRPAR			DFPAR			CLDFRC	BBAOD
		Pg/Amazon/mon		%	W/m^2		%	W/m^2		%		
		nobbaer	allaer	diff	nobbaer	allaer	diff	nobbaer	allaer	diff	allaer	allaer
2010	8	1.91	2.10	9.9	78.3	66.0	-15.7	32.2	35.5	10.29	0.38	0.190
	9	1.70	1.83	7.5	77.6	66.5	-14.3	37.6	40.2	6.99	0.45	0.206
2011	8	2.01	2.04	1.2	76.0	74.3	-2.2	33.5	34.1	1.90	0.39	0.022
	9	1.79	1.83	2.5	78.9	74.7	-5.3	36.7	38.3	4.23	0.42	0.061
2012	8	1.94	2.01	3.7	79.3	74.6	-6.0	31.4	33.2	5.78	0.33	0.063
	9	1.68	1.75	3.9	79.7	72.5	-9.1	36.4	38.8	6.64	0.40	0.113
2013	8	2.13	2.16	1.3	72.6	71.0	-2.3	34.3	35.0	1.87	0.43	0.021
	9	1.87	1.91	1.7	77.0	74.0	-4.0	37.7	38.9	3.19	0.44	0.046
2014	8	1.97	2.03	2.7	75.0	71.2	-5.1	33.3	34.7	4.19	0.37	0.053
	9	1.73	1.77	1.9	76.9	73.4	-4.6	38.0	39.3	3.41	0.42	0.059
2015	8	1.86	1.90	2.3	76.0	72.4	-4.8	33.5	34.8	3.93	0.33	0.052
	9	1.59	1.64	3.2	80.0	74.2	-7.3	37.2	39.2	5.33	0.37	0.093
2016	8	1.77	1.82	2.9	73.4	68.7	-6.4	33.8	35.4	4.79	0.38	0.076
	9	1.68	1.72	2.7	73.7	68.7	-6.7	37.8	39.5	4.40	0.46	0.089

Table S2a. similar as Table S1a but for a pair of experiments of callaer and cnobbaer.

Clear Sky													
Year	Mon	GPP			DRPAR			DFPAR			CLDFRC	BBAOD	Frequency
		Pg/Amazon/mon		%	W/m²		%	W/m²		%			
		cnobbaer	callaer	diff	cnobbaer	callaer	diff	cnobbaer	callaer	diff	callaer	callaer	
2010	8	1.05	1.29	22.2	96.2	76.6	-20.4	26.4	31.8	20.7	0.04	0.229	0.123
	9	0.63	0.74	17.3	108.0	90.7	-16.1	27.6	33.1	19.7	0.04	0.176	0.088
2011	8	1.04	1.19	13.5	94.7	80.5	-15.0	25.4	30.0	18.3	0.04	0.152	0.110
	9	0.71	0.85	19.2	106.2	88.0	-17.1	27.7	33.3	20.3	0.04	0.203	0.097
2012	8	1.15	1.30	12.8	97.2	84.6	-13.0	24.4	29.0	18.8	0.04	0.123	0.163
	9	0.79	0.91	15.2	105.6	88.0	-16.7	29.3	34.6	18.0	0.05	0.191	0.091
2013	8	0.93	1.07	14.9	98.6	84.3	-14.4	24.4	29.7	21.5	0.04	0.144	0.087
	9	0.76	0.86	12.3	110.3	95.5	-13.5	27.6	33.4	21.3	0.04	0.138	0.082
2014	8	1.01	1.21	19.4	95.8	79.5	-17.1	25.6	30.9	20.9	0.04	0.179	0.126
	9	0.77	0.88	13.9	105.9	91.1	-14.0	27.8	32.7	17.5	0.04	0.156	0.076
2015	8	1.03	1.17	14.3	93.8	79.5	-15.3	26.0	30.4	16.9	0.04	0.169	0.155
	9	0.76	0.87	14.6	104.1	89.1	-14.4	30.3	35.0	15.5	0.04	0.160	0.122
2016	8	0.95	1.07	11.8	92.9	79.6	-14.3	25.8	30.1	16.5	0.04	0.148	0.138
	9	0.57	0.67	18.4	104.5	85.1	-18.5	28.7	34.9	21.6	0.04	0.212	0.074

Table S2b. similar as Table S2a but at cloudy sky condition with CLDFRC between 0.1-0.3.

CLDFRC: 0.1-0.3													
Year	Mon	GPP			DRPAR			DFPAR			CLDFRC	BBAOD	Frequency
		Pg/Amazon/mon		%	W/m^2		%	W/m^2		%			
		cnobbaer	callaer	diff	cnobbaer	callaer	diff	cnobbaer	callaer	diff	callaer	callaer	
2010	8	1.50	1.72	14.3	91.9	75.6	-17.8	28.2	33.4	18.2	0.19	0.210	0.195
	9	1.00	1.12	12.9	100.7	85.8	-14.9	30.3	35.0	15.5	0.19	0.180	0.148
2011	8	1.56	1.73	11.1	90.4	77.4	-14.4	28.4	32.7	15.2	0.19	0.174	0.209
	9	1.26	1.42	12.3	98.8	82.5	-16.5	31.7	37.1	17.0	0.19	0.222	0.167
2012	8	1.65	1.87	12.9	91.9	78.2	-14.9	28.3	32.9	16.2	0.19	0.177	0.265
	9	1.26	1.40	10.9	99.4	85.0	-14.5	32.1	36.6	14.2	0.19	0.187	0.189
2013	8	1.52	1.73	13.5	90.3	77.2	-14.4	27.7	32.4	16.7	0.19	0.174	0.184
	9	1.31	1.45	10.2	100.2	87.0	-13.2	30.8	35.9	16.5	0.19	0.171	0.168
2014	8	1.59	1.81	14.0	89.9	74.8	-16.8	29.2	34.2	17.0	0.19	0.205	0.212
	9	1.23	1.36	10.6	97.2	84.0	-13.6	31.9	36.1	13.3	0.19	0.188	0.194
2015	8	1.55	1.73	12.0	87.8	74.0	-15.7	30.0	34.0	13.5	0.19	0.206	0.235
	9	1.28	1.41	10.4	96.0	83.0	-13.5	34.0	37.9	11.5	0.19	0.190	0.192
2016	8	1.38	1.54	11.4	88.4	74.5	-15.8	29.7	33.7	13.7	0.19	0.207	0.196
	9	1.07	1.22	14.9	97.5	80.3	-17.7	32.1	37.5	16.8	0.19	0.239	0.153

Table S2c. similar as Table S2a but at cloudy sky condition with CLDFRC between 0.3-0.6.

CLDFRC: 0.3-0.6													
Year	Mon	GPP			DRPAR			DFPAR			CLDFRC	BBAOD	Frequency
		Pg/Amazon/mon		%	W/m^2		%	W/m^2		%			
		cnobbaer	callaer	diff	cnobbaer	callaer	diff	cnobbaer	callaer	diff	callaer	callaer	
2010	8	1.87	2.05	9.8	79.5	67.5	-15.1	32.0	35.4	10.6	0.41	0.198	0.335
	9	1.54	1.67	9.0	86.2	73.7	-14.4	36.1	39.5	9.4	0.42	0.209	0.324
2011	8	1.95	2.12	8.6	77.1	66.1	-14.3	33.3	36.5	9.5	0.41	0.196	0.354
	9	1.68	1.83	8.6	82.9	69.4	-16.2	36.2	40.1	10.7	0.41	0.251	0.333
2012	8	1.95	2.16	10.5	76.6	63.8	-16.8	33.4	36.9	10.5	0.40	0.240	0.333
	9	1.62	1.73	6.8	82.5	70.7	-14.3	37.0	40.3	9.0	0.41	0.216	0.352
2013	8	2.03	2.22	9.2	75.5	63.9	-15.3	33.2	36.6	10.2	0.42	0.214	0.365
	9	1.76	1.88	6.9	80.3	69.4	-13.6	36.3	39.8	9.6	0.42	0.222	0.340
2014	8	1.93	2.11	9.0	75.6	63.4	-16.1	33.8	37.2	10.1	0.41	0.221	0.345
	9	1.66	1.76	6.5	80.3	70.0	-12.9	37.4	40.3	7.8	0.41	0.212	0.355
2015	8	1.85	2.00	8.2	73.5	61.7	-16.1	34.9	37.7	8.2	0.40	0.230	0.348
	9	1.57	1.66	5.9	78.2	67.8	-13.2	38.2	40.9	6.9	0.41	0.223	0.335
2016	8	1.73	1.86	7.6	74.4	63.2	-15.0	34.4	37.2	8.2	0.41	0.229	0.329
	9	1.54	1.66	8.0	79.8	67.0	-16.0	37.2	40.9	9.8	0.42	0.260	0.350

Table S2d. similar as Table S2a but at cloudy sky condition with CLDFRC >0.6.

CLDFRC >0.6													
Year	Mon	GPP			DRPAR			DFPAR			CLDFRC	BBAOD	Frequency
		Pg/Amazon/mon		%	W/m^2		%	W/m^2		%			
		cnobbaer	callaer	diff	cnobbaer	callaer	diff	cnobbaer	callaer	diff	callaer	callaer	
2010	8	2.18	2.28	4.63	59.7	52.5	-12.0	37.6	38.8	3.0	0.69	0.174	0.348
	9	1.91	1.99	4.06	54.4	45.9	-15.6	43.7	44.3	1.3	0.69	0.282	0.441
2011	8	2.28	2.34	2.43	55.3	47.5	-14.0	39.0	40.0	2.8	0.68	0.236	0.329
	9	2.16	2.17	0.48	50.9	43.2	-15.1	43.5	43.3	-0.4	0.69	0.354	0.406
2012	8	2.24	2.36	5.25	52.4	43.7	-16.6	40.5	41.0	1.4	0.68	0.296	0.241
	9	2.08	2.11	1.58	51.1	43.9	-14.1	43.9	44.6	1.5	0.69	0.262	0.370
2013	8	2.38	2.43	2.12	49.1	41.4	-15.6	40.4	40.8	1.0	0.70	0.279	0.365
	9	2.22	2.25	1.18	49.7	42.3	-14.8	43.2	43.5	0.6	0.70	0.322	0.411
2014	8	2.30	2.36	2.32	48.6	41.9	-13.7	40.5	40.7	0.5	0.69	0.248	0.319
	9	1.94	1.98	1.75	51.7	44.4	-14.1	44.5	45.0	1.2	0.68	0.282	0.376
2015	8	1.98	2.06	3.87	50.0	41.4	-17.1	42.1	42.0	-0.1	0.68	0.312	0.264
	9	1.85	1.88	1.58	49.5	42.9	-13.3	44.0	44.4	0.9	0.67	0.283	0.354
2016	8	2.07	2.10	1.33	46.6	40.2	-13.8	40.3	40.3	-0.2	0.69	0.304	0.339
	9	1.94	1.98	2.04	47.5	40.0	-15.8	42.6	42.9	0.7	0.70	0.338	0.424

Table S2e. similar as Table S2a but for a pair of experiments of callaer and cnobbaer.

All Sky												
Year	Mon	GPP			DRPAR			DFPAR			CLDFRC	BBAOD
		Pg/Amazon/mon		%	W/m^2		%	W/m^2		%		
		cnobbaer	callaer	diff	cnobbaer	callaer	diff	cnobbaer	callaer	diff	callaer	callaer
2010	8	1.91	2.10	9.7	78.3	66.0	-15.7	32.2	35.5	10.3	0.38	0.190
	9	1.70	1.83	7.4	77.6	66.4	-14.4	37.6	40.2	7.0	0.45	0.206
2011	8	2.00	2.15	7.2	74.9	64.3	-14.0	33.0	35.9	8.7	0.39	0.191
	9	1.80	1.92	6.7	77.1	65.3	-15.3	36.5	39.5	8.3	0.42	0.238
2012	8	1.93	2.11	9.2	79.0	67.5	-14.5	31.6	35.0	10.7	0.33	0.187
	9	1.69	1.79	6.1	79.1	67.8	-14.3	36.7	39.7	8.3	0.40	0.203
2013	8	2.11	2.26	6.8	70.6	60.3	-14.6	33.7	36.4	7.8	0.44	0.214
	9	1.88	1.98	5.0	74.6	64.5	-13.6	36.9	39.8	7.8	0.44	0.220
2014	8	1.97	2.15	8.9	73.8	62.2	-15.7	33.2	36.3	9.6	0.38	0.207
	9	1.74	1.83	5.5	75.6	65.9	-12.8	37.8	40.3	6.6	0.43	0.210
2015	8	1.85	2.00	8.3	75.5	64.1	-15.1	33.3	36.1	8.7	0.33	0.202
	9	1.59	1.69	6.4	79.8	69.5	-12.9	37.2	39.9	7.3	0.36	0.195
2016	8	1.77	1.88	6.4	72.4	62.3	-14.0	33.8	36.3	7.3	0.38	0.205
	9	1.67	1.77	6.0	72.2	60.8	-15.8	37.6	40.4	7.4	0.46	0.267