

In the format provided by the authors and unedited.

Global reduction of solar power generation efficiency due to aerosols and panel soiling

Xiaoyuan Li ^{1,4}✉, Denise L. Mauzerall ^{1,2}✉ and Mike H. Bergin³

¹Department of Civil and Environmental Engineering, Princeton University, Princeton, NJ, USA. ²Woodrow Wilson School of Public and International Affairs, Princeton University, Princeton, NJ, USA. ³Department of Civil and Environmental Engineering, Duke University, Durham, NC, USA. ⁴Present address: Energy and Environmental Economics, Inc., San Francisco, CA, USA. ✉e-mail: Xiaoyuan.Charles.Li@gmail.com; mauzerall@princeton.edu

Global reduction of solar power generation efficiency due to aerosols and panel soiling

Supplementary Information

Xiaoyuan Li^{a,*}, Mike H. Bergin^b and Denise L. Mauzerall^{a,c,*}

^aDepartment of Civil and Environmental Engineering, Princeton University, Princeton, NJ 08544;

^bDepartment of Civil and Environmental Engineering, Duke University, Durham, North Carolina 27708, United States

^cWoodrow Wilson School of Public and International Affairs, Princeton University, Princeton, NJ 08544;

* Correspondence to: Denise L. Mauzerall (mauzerall@princeton.edu) and Xiaoyuan Li (Xiaoyuan.Charles.Li@gmail.com)

Supplementary Figures

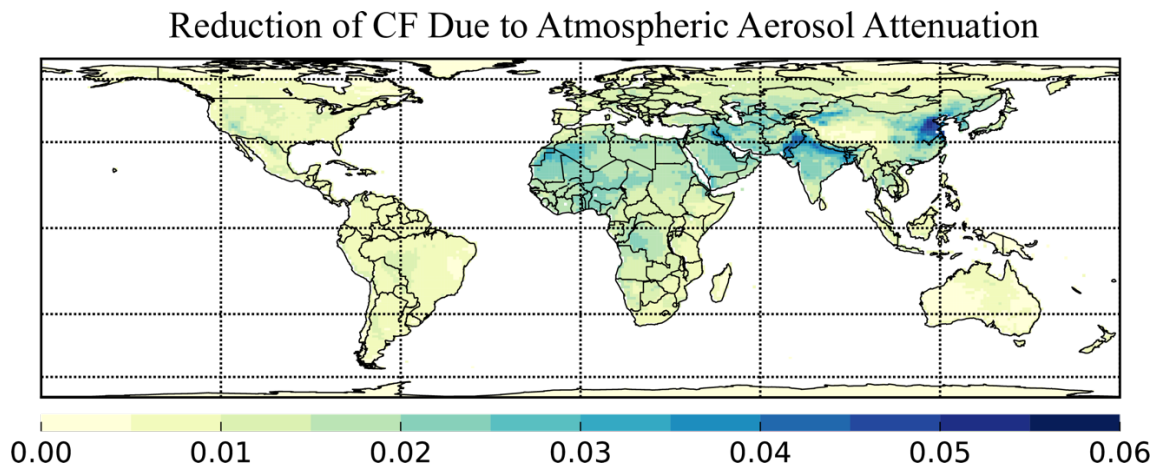


Figure SI-1 2003-2014 average reduction of PV capacity factors (CF) due to atmospheric aerosols. This supplements Figure 2B with detailed spatial distribution of reductions in the CF due to atmospheric aerosols. The North China Plain and the Indo-Gangetic Plain show the largest impacts from atmospheric aerosols.

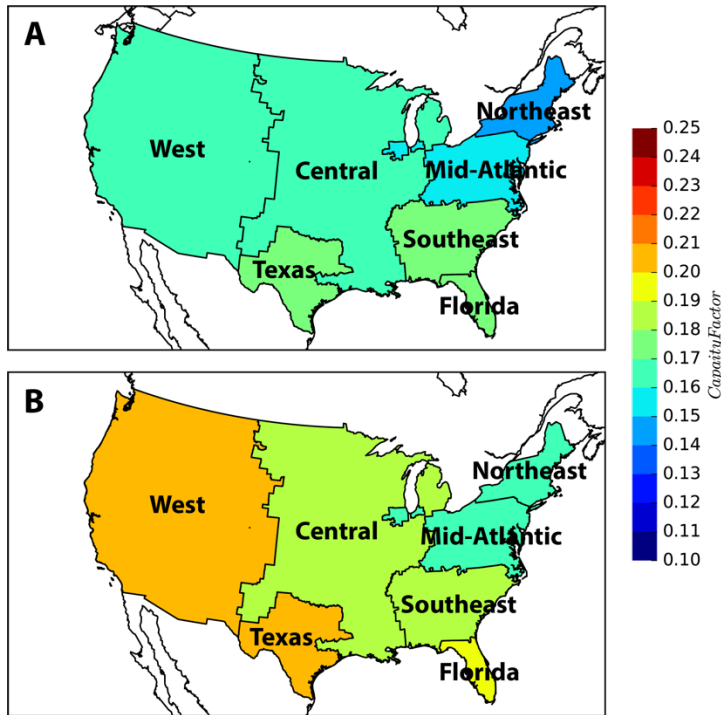


Figure SI-2 2003-2014 average PV capacity factors (CFs) of each major US electricity grid¹. Panel A shows the CFs for uncleaned panels (panels with aerosol deposition without cleaning) and includes the atmospheric aerosol attenuation (total aerosol effect). Panel B shows the CFs for clean panels without atmospheric aerosol impacts (no aerosol).

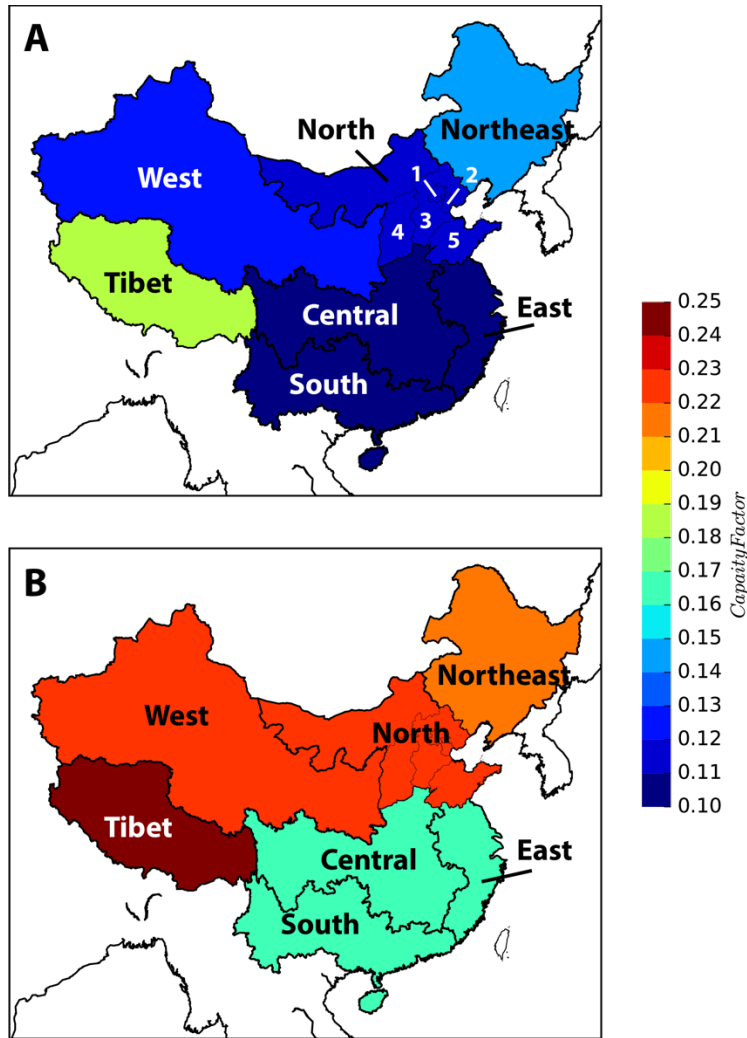


Figure SI-3 2003-2014 average PV capacity factors (CFs) of each major electricity grid in China. Panel A shows the CFs for uncleaned panels (panels with aerosol deposition without cleaning) and includes the atmospheric aerosol attenuation (total aerosol effect)². Panel B shows the CFs for clean panels without atmospheric aerosol impacts (no aerosol). North China Plain, as shown in Figure 3, is the region within the Northern Grid excluding Western Inner Mongolia. North China Plain includes all provinces or cities labeled 1-5 (1-Beijing, 2-Tianjin, 3-Hebei, 4-Shanxi, 5-Shandong). High air pollution levels occur more frequently in this region than other regions in China.

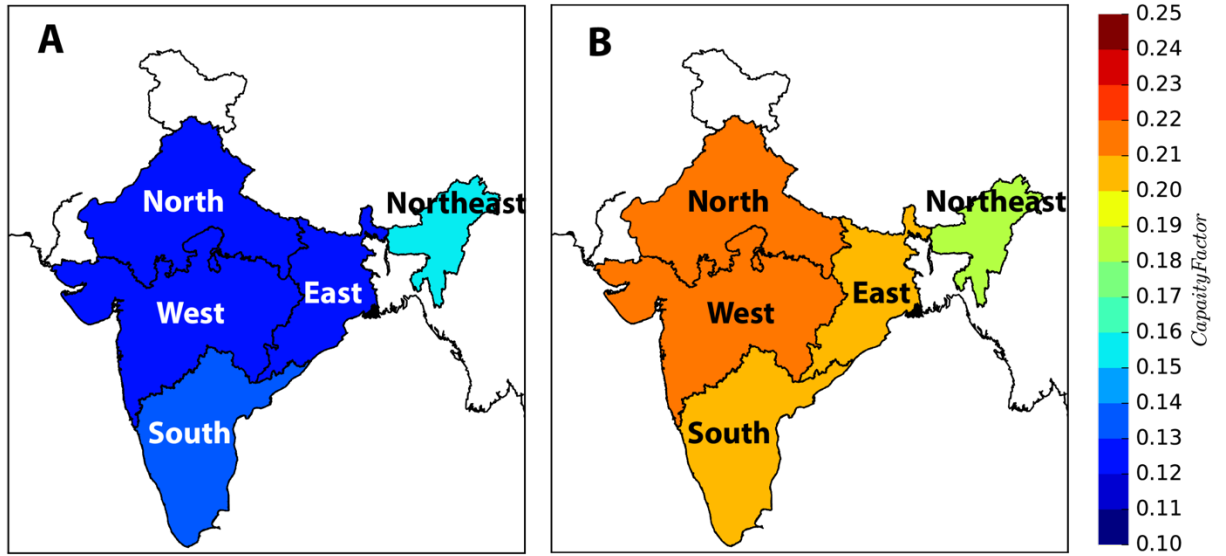
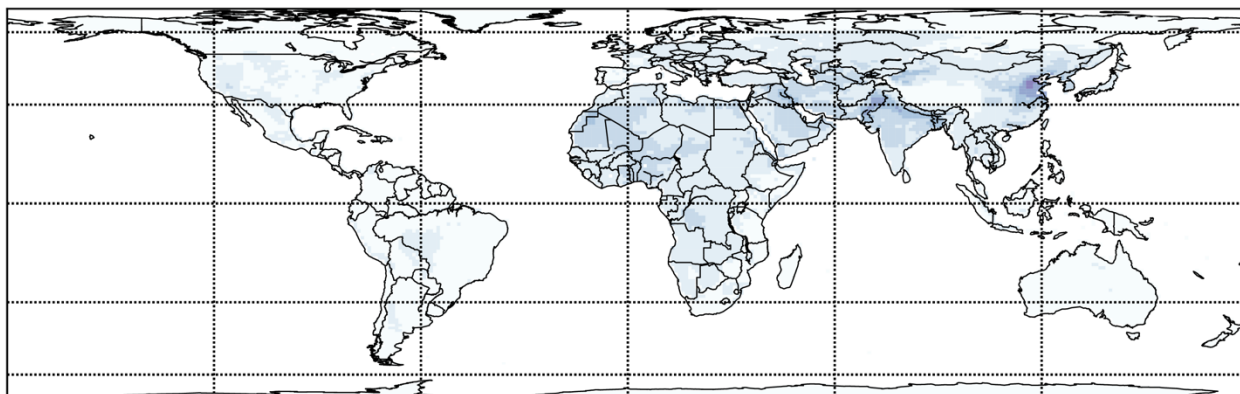
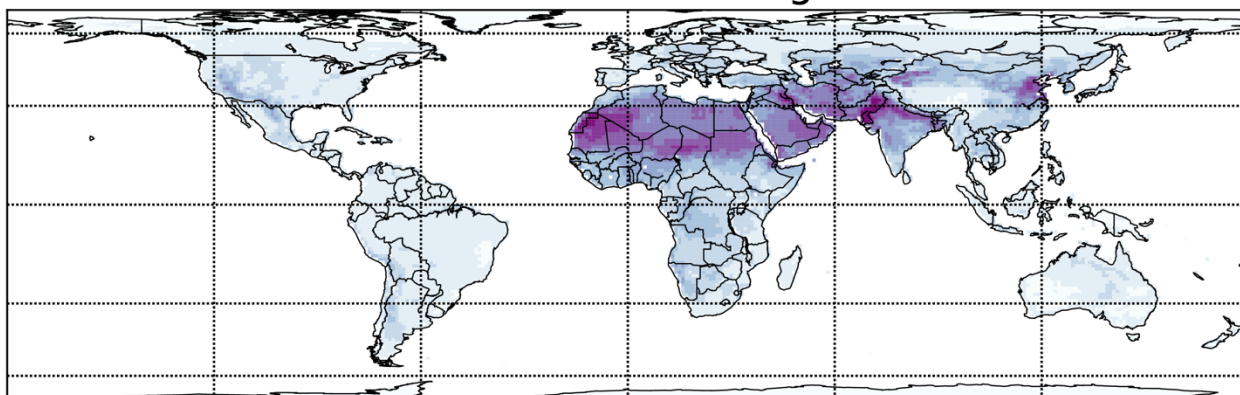


Figure SI-4 2003-2014 average PV capacity factors (CFs) of each major electricity grid in India³. Panel A shows the CFs for uncleaned panels (panels with aerosol deposition without cleaning) and includes the atmospheric aerosol attenuation (total aerosol effect). Panel B shows the CFs for clean panels without atmospheric aerosol impacts (no aerosol). In this study, the North Grid of India is defined as the region in Northern India excluding Kashmir.

Fixed



One-Axis Tracking



Two-Axis Tracking

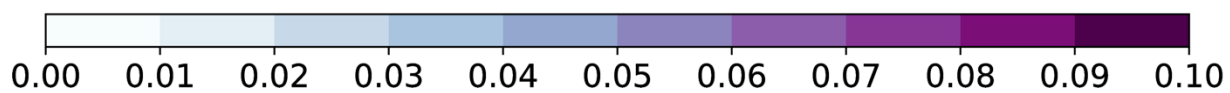
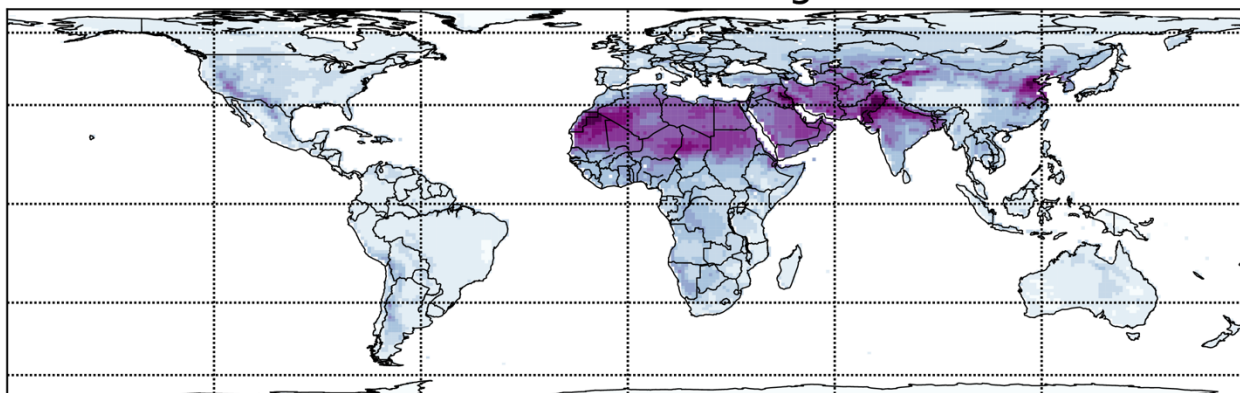


Figure SI-5 Effect of atmospheric aerosols on PV capacity factors. Comparisons of PV capacity factors for fixed and tracking panels with impacts from PM. Panels show increases in PV capacity factors if atmospheric aerosols are removed (i.e. the atmospheric aerosol impacts).

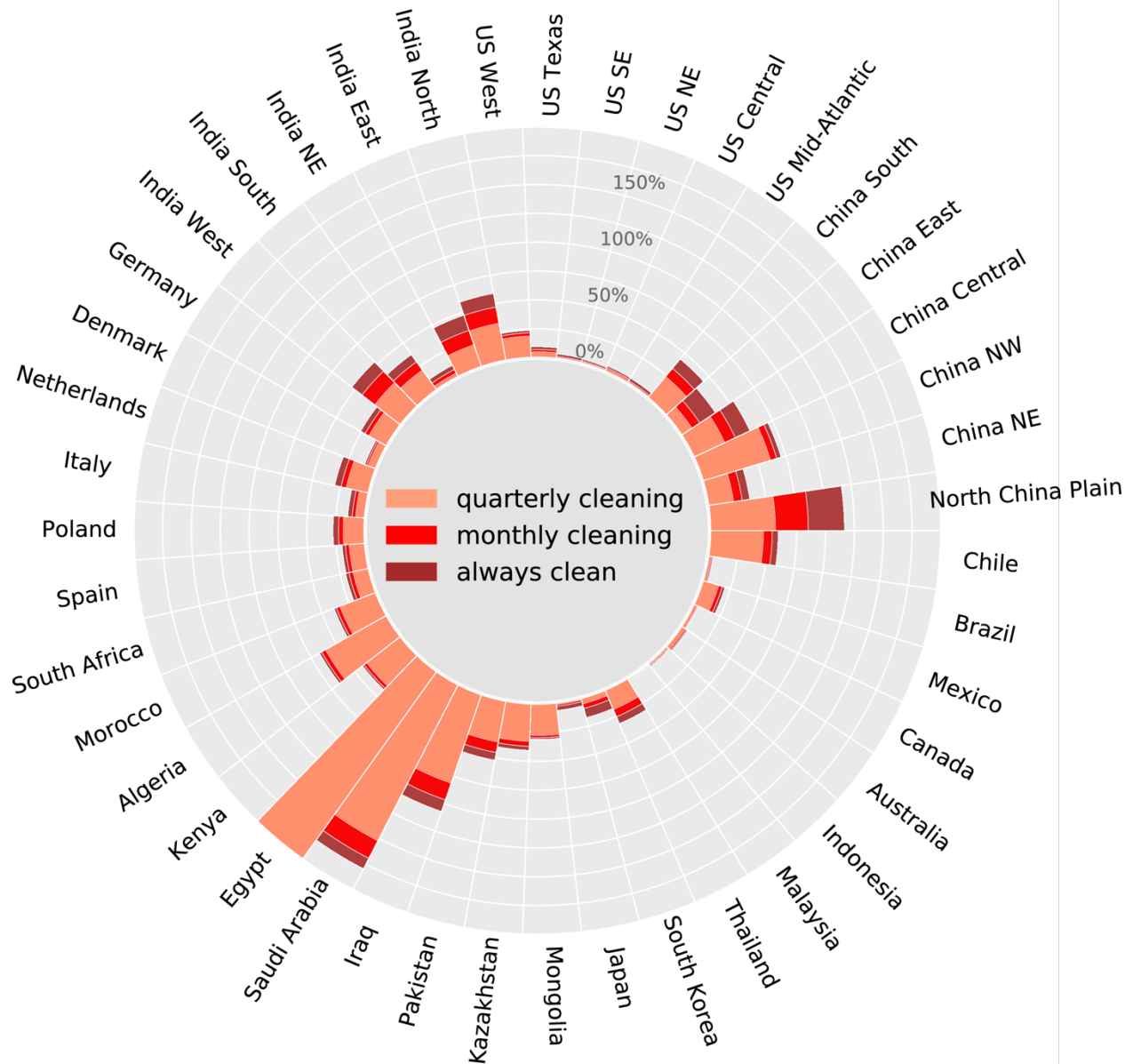
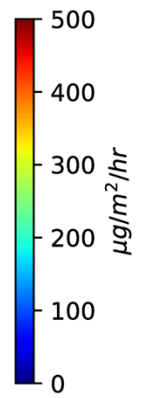
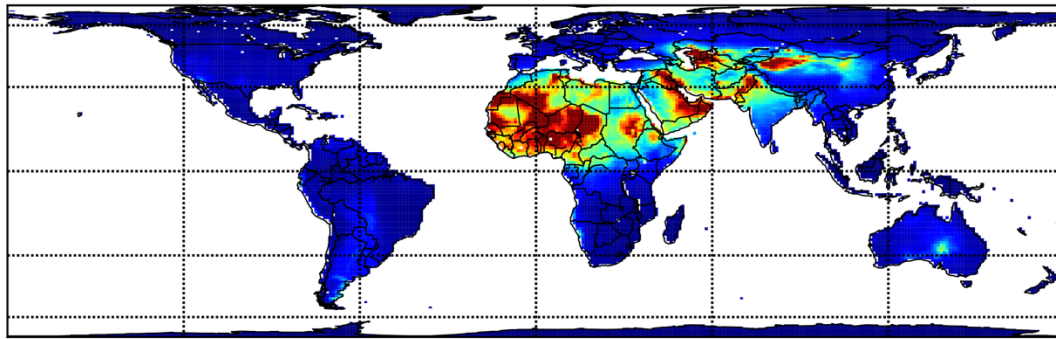
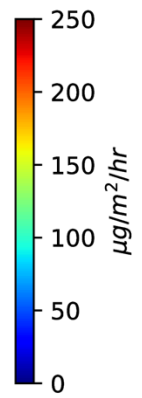
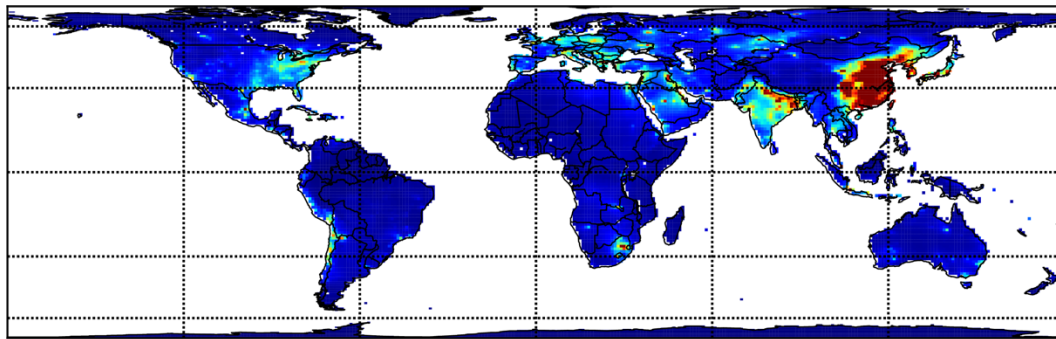


Figure SI-6 Benefits of panel cleaning. % increase in PV capacity factors due to panel cleaning over various world regions. Light salmon (bottom) boxes represent the benefit of quarterly cleaning compared to no cleaning (precipitation only removal). Red (middle) boxes represent the benefit of monthly cleaning compared to quarterly cleaning. Dark brown (top) boxes represent the benefit of panels always being clean compared to monthly cleaning.

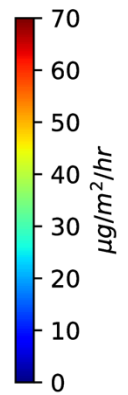
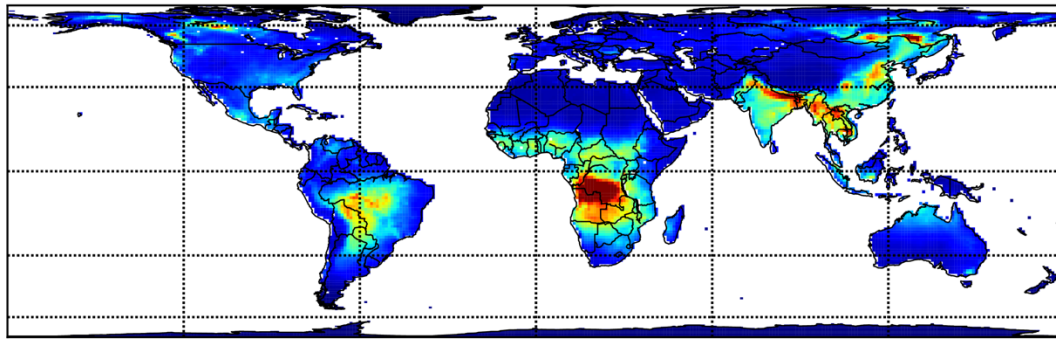
DUST



SULFATE



OC



BC

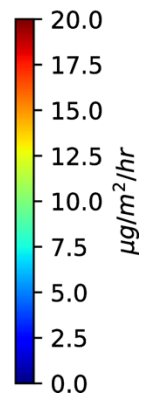
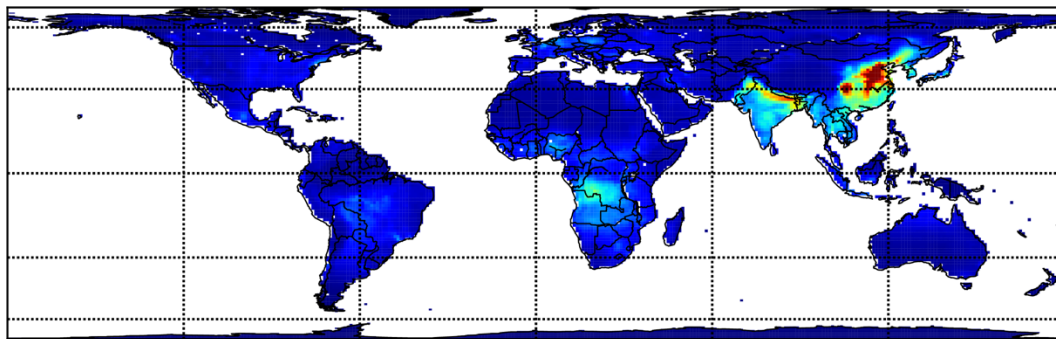


Figure SI-7 2003-2014 annual average deposition rate of each aerosol species: dust, sulfate, organic carbon (OC) and black carbon (BC) at 1x1 resolution.

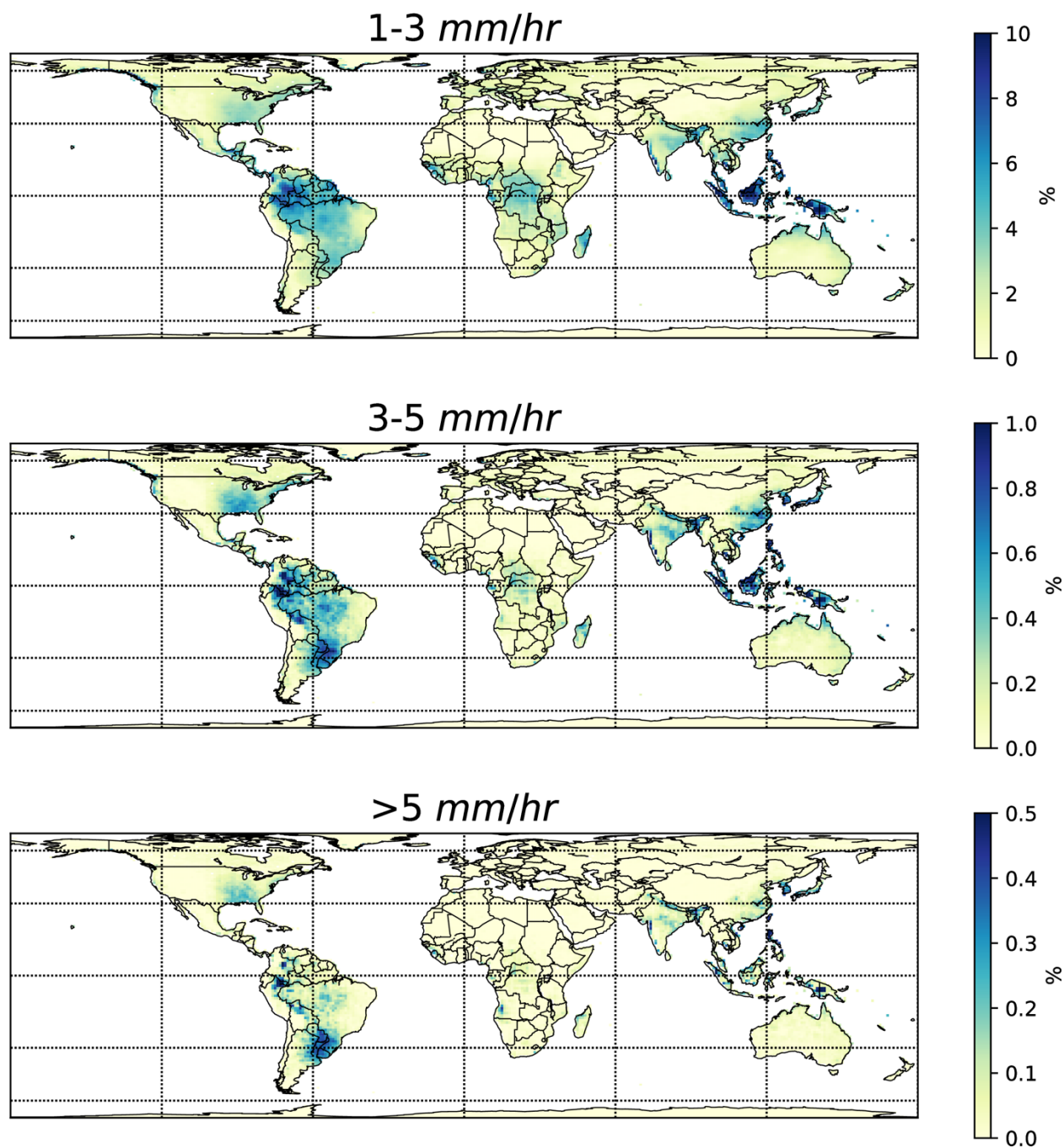


Figure SI-8 Frequency of precipitation at intensities of 1-3 mm/hr, 3-5 mm/hr and >5 mm/hr from MERRA-2 between 2003-2014 .

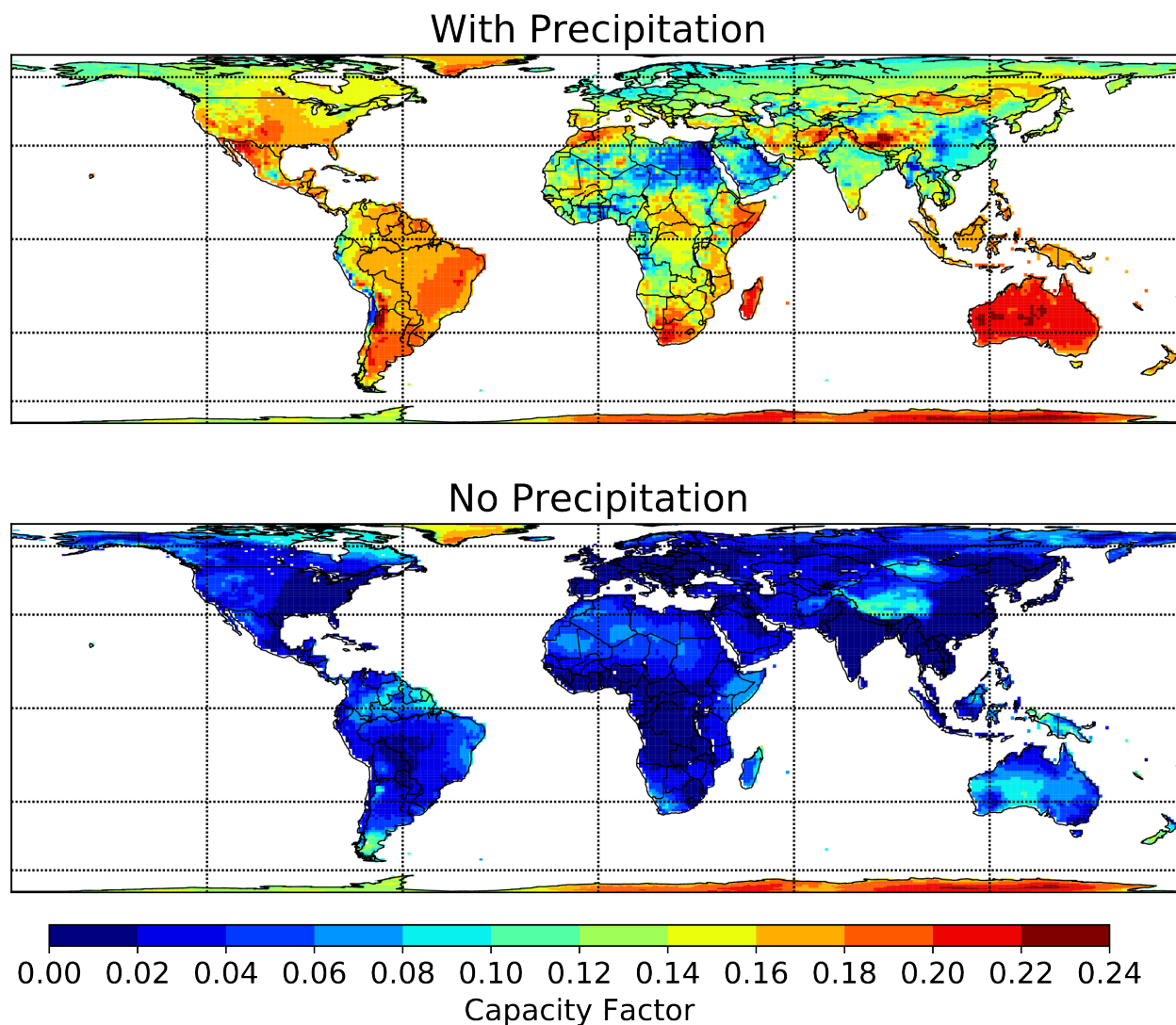
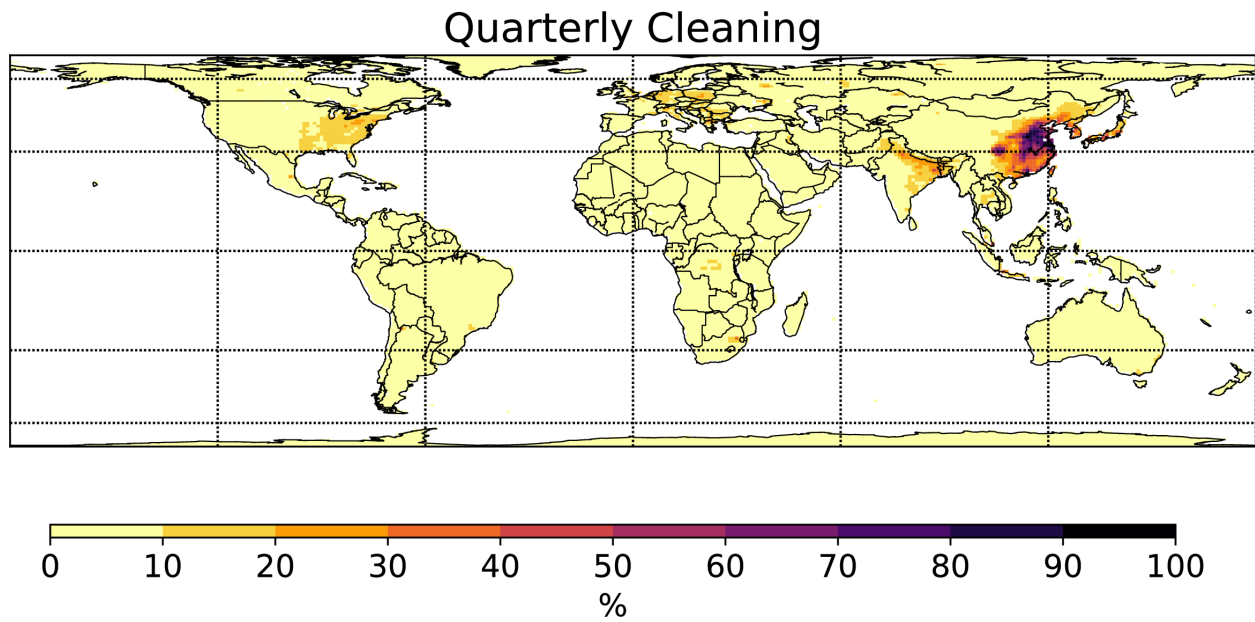


Figure SI-9 2003-2014 average capacity factor for fixed panels at optimal angles. Comparison between two scenarios: with PM removal via local precipitation but no cleaning (top) and without PM removal by local precipitation or cleaning (bottom).

A



B

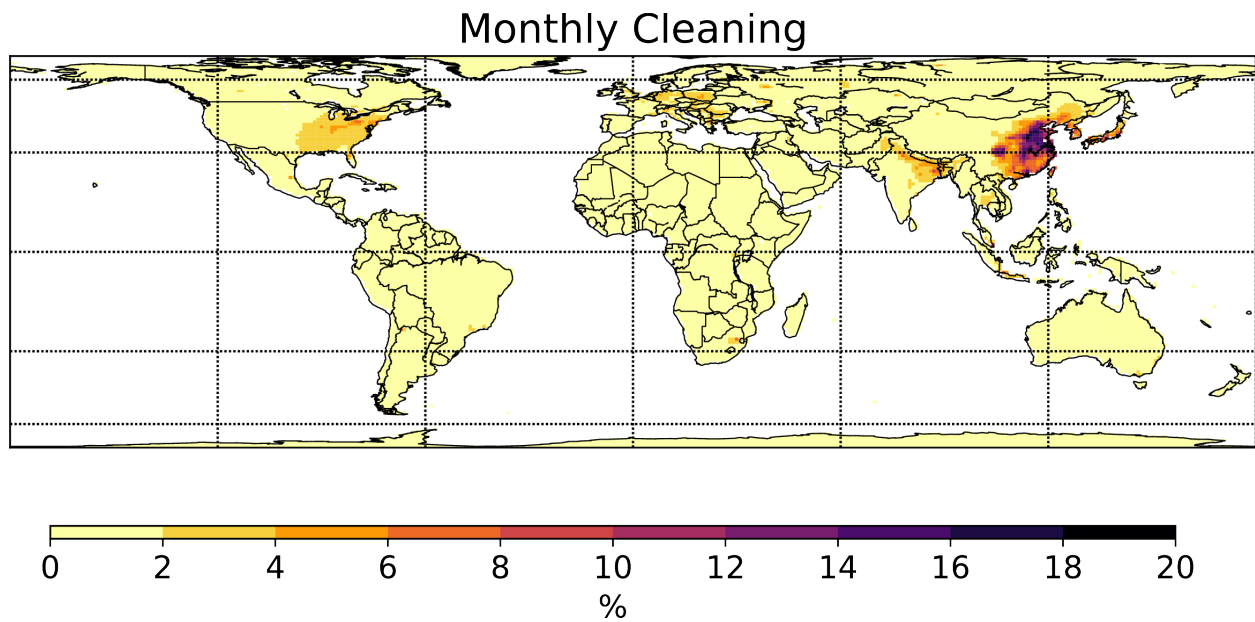


Figure SI-10 Percent increase of 2003-2014 average capacity factors for fixed panels at optimal angles with quarterly cleaning (A) and monthly cleaning (B). Values are calculated by the

difference in capacity factors between with-precipitation-removal and without-precipitation-removal scenarios divided by that in the without-precipitation-removal scenario.

Supplementary Tables

Table SI-1 2003-2014 average regional-mean PV capacity factors with and without aerosols and impacts from aerosols and clouds for **FIXED** panels. The impacts, both in absolute value and percentage, are defined as the increases if aerosols or clouds are removed relative to the case with both aerosols and clouds.

	Capacity Factor with Aerosols	Capacity Factor without Aerosols	Total Aerosol Impact		Atmospheric Aerosol Impact		Soiling Impact		Cloud Impact	
US Alaska	0.123	0.131	0.009	7%	0.006	5%	0.003	2%	0.101	82%
US Mid-Atlantic	0.152	0.168	0.016	11%	0.009	6%	0.006	4%	0.083	55%
US Central	0.169	0.186	0.017	10%	0.009	5%	0.007	4%	0.071	42%
US Florida	0.177	0.195	0.018	10%	0.009	5%	0.009	5%	0.05	28%
US Hawaii	0.184	0.197	0.013	7%	0.007	4%	0.005	3%	0.063	34%
US Northeast	0.148	0.16	0.013	9%	0.008	6%	0.005	3%	0.093	63%
US Southeast	0.171	0.186	0.015	9%	0.009	5%	0.006	4%	0.063	37%
US Texas	0.178	0.203	0.025	14%	0.009	5%	0.015	9%	0.048	27%
US West	0.164	0.207	0.043	27%	0.01	6%	0.033	20%	0.053	32%
India East	0.122	0.204	0.082	67%	0.028	23%	0.054	44%	0.032	26%
India Northeast	0.15	0.184	0.034	23%	0.018	12%	0.016	10%	0.055	37%
India North	0.122	0.219	0.097	79%	0.03	25%	0.066	54%	0.019	16%
India South	0.137	0.205	0.067	49%	0.017	12%	0.05	36%	0.032	23%
India West	0.126	0.212	0.085	68%	0.022	18%	0.063	50%	0.027	21%
China Northeast	0.149	0.21	0.061	41%	0.018	12%	0.043	29%	0.048	32%
China North	0.117	0.225	0.108	92%	0.025	22%	0.082	70%	0.029	25%
China Northwest	0.129	0.227	0.098	76%	0.017	13%	0.082	63%	0.04	31%
China Tibet	0.184	0.246	0.062	34%	0.006	4%	0.055	30%	0.056	30%
China Central	0.095	0.164	0.068	72%	0.022	23%	0.046	49%	0.059	62%

	Capacity Factor with Aerosols	Capacity Factor without Aerosols	Total Aerosol Impact		Atmospheric Aerosol Impact		Soiling Impact		Cloud Impact	
China East	0.107	0.17	0.063	59%	0.029	27%	0.034	32%	0.058	54%
China South	0.106	0.165	0.059	56%	0.016	15%	0.043	40%	0.058	55%
North China Plain	0.091	0.211	0.119	131%	0.031	34%	0.088	97%	0.03	33%
Afghanistan	0.175	0.237	0.062	36%	0.018	10%	0.045	26%	0.03	17%
Albania	0.158	0.185	0.027	17%	0.012	7%	0.016	10%	0.061	38%
Algeria	0.135	0.242	0.107	79%	0.02	15%	0.087	64%	0.012	9%
Andorra	0.14	0.187	0.047	34%	0.009	7%	0.038	27%	0.066	47%
Angola	0.122	0.212	0.09	74%	0.015	12%	0.075	62%	0.026	21%
Antarctica	0.181	0.181	0.001	0%	0.001	0%	0	0%	0.061	34%
Argentina	0.189	0.206	0.017	9%	0.007	4%	0.01	5%	0.054	29%
Armenia	0.105	0.189	0.084	80%	0.017	16%	0.067	64%	0.05	48%
Australia	0.208	0.225	0.018	8%	0.005	3%	0.012	6%	0.03	14%
Austria	0.13	0.154	0.024	18%	0.012	9%	0.012	9%	0.088	68%
Azerbaijan	0.106	0.176	0.07	67%	0.019	18%	0.051	49%	0.049	47%
Bangladesh	0.131	0.196	0.065	50%	0.03	23%	0.034	26%	0.038	29%
Belarus	0.12	0.139	0.019	16%	0.011	9%	0.008	7%	0.085	71%
Belgium	0.098	0.137	0.039	40%	0.011	11%	0.028	28%	0.08	81%
Belize	0.173	0.187	0.014	8%	0.009	5%	0.005	3%	0.055	32%
Benin	0.095	0.211	0.116	123%	0.022	23%	0.094	100%	0.018	20%
Bhutan	0.136	0.189	0.053	39%	0.012	9%	0.041	30%	0.069	51%
Bolivia	0.172	0.2	0.028	16%	0.009	5%	0.019	11%	0.05	29%
Bosnia and Herzegovina	0.138	0.159	0.022	16%	0.01	7%	0.012	9%	0.085	62%
Botswana	0.171	0.232	0.06	35%	0.012	7%	0.048	28%	0.021	12%
Brazil	0.177	0.192	0.015	9%	0.008	4%	0.007	4%	0.051	29%

	Capacity Factor with Aerosols	Capacity Factor without Aerosols	Total Aerosol Impact		Atmospheric Aerosol Impact		Soiling Impact		Cloud Impact	
Brunei Darussalam	0.178	0.187	0.009	5%	0.006	4%	0.003	2%	0.051	29%
Bulgaria	0.139	0.173	0.034	25%	0.012	9%	0.022	16%	0.066	48%
Burkina Faso	0.132	0.225	0.093	71%	0.019	15%	0.074	56%	0.015	11%
Burundi	0.15	0.192	0.042	28%	0.012	8%	0.03	20%	0.053	35%
Cambodia	0.125	0.192	0.067	54%	0.012	10%	0.055	44%	0.033	26%
Cameroon	0.11	0.194	0.084	76%	0.015	14%	0.068	62%	0.032	29%
Canada	0.139	0.149	0.01	7%	0.005	4%	0.005	3%	0.091	65%
Central African Republic	0.162	0.205	0.043	27%	0.013	8%	0.03	18%	0.034	21%
Chad	0.113	0.239	0.126	111%	0.018	16%	0.108	96%	0.009	8%
Chile	0.125	0.2	0.075	60%	0.005	4%	0.07	56%	0.066	53%
Colombia	0.157	0.172	0.015	9%	0.008	5%	0.007	5%	0.068	43%
Congo	0.121	0.178	0.057	48%	0.017	14%	0.04	33%	0.044	37%
Congo DRC	0.145	0.191	0.046	32%	0.016	11%	0.03	21%	0.045	31%
Costa Rica	0.161	0.172	0.011	7%	0.006	4%	0.005	3%	0.071	44%
Cote d'Ivoire	0.089	0.196	0.106	120%	0.018	20%	0.089	100%	0.026	30%
Croatia	0.139	0.161	0.022	16%	0.012	9%	0.01	7%	0.077	55%
Cuba	0.161	0.199	0.039	24%	0.008	5%	0.031	19%	0.038	24%
Czech Republic	0.107	0.143	0.036	33%	0.014	13%	0.022	20%	0.081	76%
Denmark	0.114	0.134	0.02	18%	0.011	10%	0.009	8%	0.085	74%
Djibouti	0.142	0.233	0.09	64%	0.022	15%	0.069	48%	0.011	8%
Dominican Republic	0.166	0.199	0.033	20%	0.007	4%	0.026	16%	0.04	24%
Ecuador	0.127	0.154	0.027	21%	0.006	5%	0.021	16%	0.084	66%
Egypt	0.046	0.252	0.206	451%	0.019	41%	0.188	410%	0.002	5%
El Salvador	0.181	0.215	0.034	19%	0.009	5%	0.025	14%	0.026	14%

	Capacity Factor with Aerosols	Capacity Factor without Aerosols	Total Aerosol Impact		Atmospheric Aerosol Impact		Soiling Impact		Cloud Impact	
Equatorial Guinea	0.124	0.167	0.043	35%	0.015	12%	0.029	23%	0.06	49%
Eritrea	0.123	0.231	0.108	88%	0.019	15%	0.089	73%	0.01	9%
Estonia	0.115	0.13	0.015	13%	0.009	8%	0.006	5%	0.083	72%
Ethiopia	0.157	0.221	0.064	41%	0.011	7%	0.053	34%	0.027	17%
Falkland Islands	0.139	0.148	0.009	7%	0.007	5%	0.002	2%	0.104	75%
Fiji	0.184	0.189	0.004	2%	0.004	2%	0	0%	0.062	33%
Finland	0.099	0.109	0.009	9%	0.006	6%	0.003	3%	0.089	90%
France	0.132	0.159	0.027	20%	0.011	8%	0.016	12%	0.081	61%
French Guiana	0.178	0.187	0.009	5%	0.007	4%	0.002	1%	0.053	30%
French Polynesia	0.196	0.203	0.007	4%	0.004	2%	0.003	2%	0.047	24%
French Southern Territories	0.103	0.108	0.005	5%	0.005	5%	0	0%	0.162	156%
Gabon	0.115	0.165	0.05	43%	0.015	13%	0.035	30%	0.057	49%
Gambia	0.122	0.221	0.099	82%	0.017	14%	0.082	67%	0.015	13%
Georgia	0.145	0.175	0.03	21%	0.012	8%	0.018	12%	0.081	56%
Germany	0.104	0.138	0.034	33%	0.013	12%	0.021	21%	0.081	78%
Ghana	0.081	0.202	0.121	149%	0.021	25%	0.1	124%	0.02	25%
Greece	0.145	0.182	0.037	26%	0.012	8%	0.025	18%	0.06	41%
Greenland	0.161	0.165	0.004	3%	0.003	2%	0.001	1%	0.063	39%
Guatemala	0.168	0.191	0.024	14%	0.008	5%	0.015	9%	0.053	32%
Guinea	0.132	0.21	0.078	59%	0.016	12%	0.062	47%	0.026	19%
Guinea-Bissau	0.157	0.216	0.059	38%	0.015	10%	0.044	28%	0.022	14%
Guyana	0.173	0.183	0.01	6%	0.006	4%	0.004	2%	0.055	32%
Haiti	0.177	0.207	0.03	17%	0.007	4%	0.023	13%	0.033	19%
Honduras	0.168	0.187	0.019	12%	0.007	4%	0.012	7%	0.056	34%
Hungary	0.123	0.16	0.037	30%	0.015	12%	0.022	18%	0.068	55%

	Capacity Factor with Aerosols	Capacity Factor without Aerosols	Total Aerosol Impact		Atmospheric Aerosol Impact		Soiling Impact		Cloud Impact	
Iceland	0.098	0.105	0.007	7%	0.006	6%	0.001	1%	0.106	108%
Indonesia	0.171	0.184	0.013	8%	0.007	4%	0.006	4%	0.057	33%
Iran	0.154	0.231	0.078	51%	0.022	14%	0.056	36%	0.025	16%
Iraq	0.103	0.232	0.128	124%	0.027	27%	0.101	98%	0.013	13%
Ireland	0.111	0.124	0.012	11%	0.008	7%	0.004	4%	0.107	96%
Israel	0.107	0.214	0.107	99%	0.016	15%	0.09	84%	0.023	22%
Italy	0.148	0.18	0.031	21%	0.013	9%	0.018	12%	0.065	44%
Japan	0.141	0.163	0.022	16%	0.014	10%	0.008	6%	0.091	65%
Jordan	0.116	0.243	0.127	110%	0.018	16%	0.109	94%	0.01	9%
Kazakhstan	0.133	0.194	0.061	46%	0.016	12%	0.046	34%	0.048	36%
Kenya	0.145	0.215	0.07	48%	0.009	7%	0.061	42%	0.027	18%
Kuwait	0.049	0.236	0.187	380%	0.029	58%	0.158	322%	0.005	10%
Kyrgyzstan	0.139	0.209	0.07	51%	0.015	11%	0.055	40%	0.057	41%
Laos	0.093	0.183	0.09	96%	0.013	14%	0.077	82%	0.035	38%
Latvia	0.117	0.133	0.016	14%	0.01	8%	0.006	5%	0.084	72%
Lebanon	0.112	0.213	0.102	91%	0.016	14%	0.086	77%	0.033	29%
Liberia	0.129	0.186	0.057	44%	0.017	13%	0.04	31%	0.044	34%
Libya	0.094	0.248	0.154	164%	0.018	19%	0.136	145%	0.006	7%
Lithuania	0.116	0.134	0.018	16%	0.01	9%	0.008	7%	0.084	72%
Madagascar	0.198	0.213	0.015	8%	0.006	3%	0.009	5%	0.039	20%
Malawi	0.166	0.209	0.043	26%	0.01	6%	0.033	20%	0.041	25%
Malaysia	0.171	0.182	0.011	6%	0.007	4%	0.003	2%	0.058	34%
Mali	0.136	0.237	0.101	74%	0.021	15%	0.08	59%	0.01	8%
Mauritania	0.128	0.242	0.114	89%	0.024	19%	0.09	71%	0.008	6%
Mauritius	0.196	0.213	0.017	9%	0.006	3%	0.011	5%	0.04	21%
Mexico	0.177	0.219	0.043	24%	0.01	5%	0.033	19%	0.033	19%

	Capacity Factor with Aerosols	Capacity Factor without Aerosols	Total Aerosol Impact		Atmospheric Aerosol Impact		Soiling Impact		Cloud Impact	
Moldova	0.128	0.161	0.033	26%	0.011	9%	0.022	17%	0.072	56%
Mongolia	0.174	0.23	0.056	32%	0.012	7%	0.044	25%	0.045	26%
Montenegro	0.158	0.176	0.018	12%	0.011	7%	0.007	5%	0.077	49%
Morocco	0.158	0.235	0.077	48%	0.018	11%	0.059	37%	0.021	13%
Mozambique	0.166	0.204	0.038	23%	0.009	5%	0.029	17%	0.04	24%
Myanmar	0.099	0.188	0.089	91%	0.013	13%	0.077	78%	0.035	36%
Namibia	0.157	0.241	0.083	53%	0.012	8%	0.071	45%	0.014	9%
Nepal	0.165	0.213	0.048	29%	0.019	11%	0.029	18%	0.051	31%
Netherlands	0.1	0.137	0.037	37%	0.013	13%	0.024	24%	0.076	76%
New Caledonia	0.194	0.2	0.006	3%	0.005	3%	0.001	1%	0.055	28%
New Zealand	0.167	0.173	0.006	4%	0.005	3%	0.001	1%	0.092	55%
Nicaragua	0.169	0.182	0.013	8%	0.007	4%	0.006	4%	0.06	36%
Niger	0.097	0.246	0.149	154%	0.02	20%	0.13	134%	0.005	5%
Nigeria	0.096	0.211	0.115	120%	0.021	22%	0.094	98%	0.019	20%
North Korea	0.142	0.198	0.056	40%	0.025	18%	0.031	22%	0.059	42%
Norway	0.099	0.107	0.008	8%	0.007	7%	0.002	2%	0.101	102%
Oman	0.115	0.241	0.126	110%	0.019	17%	0.107	94%	0.005	4%
Pakistan	0.136	0.231	0.095	70%	0.029	22%	0.066	48%	0.015	11%
Palestinian Territory	0.069	0.223	0.153	221%	0.016	23%	0.137	198%	0.013	19%
Panama	0.158	0.168	0.01	6%	0.007	5%	0.003	2%	0.074	47%
Papua New Guinea	0.171	0.177	0.005	3%	0.004	2%	0.001	1%	0.069	40%
Paraguay	0.173	0.189	0.016	9%	0.009	5%	0.007	4%	0.052	30%
Peru	0.144	0.188	0.044	31%	0.008	5%	0.037	25%	0.059	41%
Philippines	0.173	0.186	0.012	7%	0.006	4%	0.006	3%	0.057	33%
Poland	0.104	0.14	0.036	35%	0.014	13%	0.023	22%	0.074	71%

	Capacity Factor with Aerosols	Capacity Factor without Aerosols	Total Aerosol Impact		Atmospheric Aerosol Impact		Soiling Impact		Cloud Impact	
Portugal	0.165	0.193	0.029	17%	0.008	5%	0.02	12%	0.056	34%
Romania	0.132	0.164	0.032	25%	0.013	10%	0.02	15%	0.072	55%
Russia Asia	0.13	0.145	0.016	12%	0.007	6%	0.008	6%	0.085	66%
Russia Europe	0.115	0.135	0.019	17%	0.009	8%	0.01	9%	0.085	74%
Rwanda	0.144	0.188	0.044	31%	0.013	9%	0.031	22%	0.059	41%
Samoa	0.189	0.194	0.005	3%	0.004	2%	0.002	1%	0.051	27%
Saudi Arabia	0.084	0.247	0.163	193%	0.021	25%	0.142	168%	0.004	5%
Senegal	0.128	0.224	0.096	75%	0.018	14%	0.078	61%	0.014	11%
Serbia	0.134	0.164	0.03	23%	0.011	9%	0.019	14%	0.076	57%
Sierra Leone	0.126	0.193	0.067	53%	0.017	14%	0.05	40%	0.036	28%
Slovakia	0.115	0.152	0.037	32%	0.015	13%	0.022	19%	0.073	64%
Slovenia	0.138	0.157	0.019	14%	0.011	8%	0.007	5%	0.085	62%
Solomon Islands	0.177	0.181	0.004	2%	0.003	2%	0	0%	0.064	36%
Somalia	0.183	0.229	0.046	25%	0.01	6%	0.036	19%	0.02	11%
South Africa	0.182	0.225	0.043	23%	0.009	5%	0.034	19%	0.033	18%
South Georgia	0.097	0.101	0.005	5%	0.004	4%	0.001	1%	0.157	162%
South Korea	0.142	0.187	0.045	32%	0.024	17%	0.022	15%	0.064	45%
South Sudan	0.129	0.205	0.075	58%	0.014	11%	0.062	48%	0.026	20%
Spain	0.157	0.193	0.036	23%	0.01	6%	0.026	17%	0.057	37%
Sri Lanka	0.176	0.194	0.019	11%	0.009	5%	0.009	5%	0.048	28%
Sudan	0.096	0.243	0.147	152%	0.018	18%	0.129	134%	0.005	6%
Suriname	0.181	0.191	0.009	5%	0.006	3%	0.003	2%	0.048	27%
Svalbard	0.086	0.092	0.006	7%	0.004	4%	0.003	3%	0.077	89%
Swaziland	0.143	0.194	0.051	36%	0.009	7%	0.042	29%	0.047	33%
Sweden	0.107	0.117	0.01	9%	0.007	6%	0.003	3%	0.091	85%
Switzerland	0.148	0.167	0.02	13%	0.011	8%	0.008	6%	0.092	62%

	Capacity Factor with Aerosols	Capacity Factor without Aerosols	Total Aerosol Impact		Atmospheric Aerosol Impact		Soiling Impact		Cloud Impact	
Syria	0.121	0.226	0.106	87%	0.021	17%	0.085	70%	0.021	17%
Tajikistan	0.126	0.219	0.093	73%	0.013	11%	0.079	63%	0.046	37%
Tanzania	0.158	0.208	0.05	32%	0.009	6%	0.041	26%	0.038	24%
Thailand	0.138	0.195	0.057	42%	0.015	11%	0.042	31%	0.038	28%
The Former Yugoslav Republic of Macedonia	0.151	0.179	0.028	18%	0.012	8%	0.016	11%	0.07	47%
Timor-Leste	0.188	0.21	0.022	12%	0.007	4%	0.015	8%	0.037	20%
Togo	0.072	0.207	0.135	187%	0.021	30%	0.113	157%	0.015	21%
Tunisia	0.147	0.224	0.077	52%	0.016	11%	0.06	41%	0.025	17%
Turkey	0.148	0.198	0.05	34%	0.015	10%	0.035	24%	0.054	36%
Turkmenistan	0.124	0.211	0.088	71%	0.022	18%	0.066	53%	0.029	23%
Uganda	0.138	0.203	0.066	48%	0.01	7%	0.056	40%	0.035	26%
Ukraine	0.127	0.155	0.028	22%	0.011	9%	0.017	14%	0.077	61%
United Arab Emirates	0.093	0.236	0.143	154%	0.022	24%	0.121	130%	0.006	6%
UK	0.104	0.123	0.019	18%	0.009	9%	0.01	10%	0.1	97%
Uruguay	0.184	0.191	0.007	4%	0.005	3%	0.002	1%	0.062	34%
Uzbekistan	0.116	0.206	0.091	78%	0.021	18%	0.07	60%	0.032	28%
Vanuatu	0.185	0.193	0.009	5%	0.005	3%	0.004	2%	0.055	30%
Venezuela	0.172	0.188	0.017	10%	0.007	4%	0.01	6%	0.05	29%
Vietnam	0.125	0.169	0.044	36%	0.013	11%	0.031	25%	0.056	45%
Yemen	0.085	0.247	0.162	190%	0.019	22%	0.143	168%	0.005	5%
Zambia	0.148	0.219	0.071	48%	0.012	8%	0.059	40%	0.029	19%
Zimbabwe	0.155	0.218	0.063	41%	0.009	6%	0.054	35%	0.031	20%

Table SI-2 2003-2014 average regional-mean PV capacity factors with and without aerosols and impacts from aerosols for **ONE-AXIS** tracking panels. The impacts, both in absolute value and percentage, are defined as the increases if aerosols or clouds are removed relative to the case with aerosols and clouds.

	Capacity Factor with Aerosols	Capacity Factor without Aerosols	Total Aerosol Impact		Atmospheric Aerosol Impact		Soiling Impact	
US Alaska	0.122	0.138	0.016	13%	0.009	8%	0.006	5%
US Mid-Atlantic	0.17	0.194	0.024	14%	0.018	10%	0.007	4%
US Central	0.189	0.215	0.026	14%	0.017	9%	0.009	5%
US Florida	0.202	0.231	0.029	14%	0.02	10%	0.009	5%
US Hawaii	0.21	0.233	0.023	11%	0.018	9%	0.005	3%
US Northeast	0.164	0.185	0.021	13%	0.015	9%	0.005	3%
US Southeast	0.193	0.218	0.024	13%	0.018	9%	0.007	4%
US Texas	0.207	0.247	0.04	19%	0.021	10%	0.018	9%
US West	0.178	0.25	0.072	41%	0.024	14%	0.048	27%
India East	0.136	0.239	0.103	76%	0.049	36%	0.053	39%
India Northeast	0.16	0.205	0.046	29%	0.03	19%	0.015	9%
India North	0.137	0.267	0.131	96%	0.061	45%	0.069	51%
India South	0.151	0.24	0.089	59%	0.035	23%	0.054	36%
India West	0.143	0.254	0.111	78%	0.045	32%	0.066	46%
China Northeast	0.147	0.226	0.079	54%	0.027	18%	0.052	35%
China North	0.116	0.256	0.14	120%	0.043	37%	0.097	83%
China Northwest	0.128	0.262	0.133	104%	0.033	26%	0.1	78%
China Tibet	0.199	0.287	0.089	45%	0.016	8%	0.073	37%
China Central	0.101	0.184	0.083	82%	0.034	34%	0.049	48%
China East	0.116	0.192	0.076	66%	0.044	38%	0.032	28%
China South	0.111	0.188	0.077	69%	0.028	25%	0.049	44%

	Capacity Factor with Aerosols	Capacity Factor without Aerosols	Total Aerosol Impact		Atmospheric Aerosol Impact		Soiling Impact	
North China Plain	0.095	0.238	0.143	151%	0.049	52%	0.094	100%
Afghanistan	0.194	0.298	0.105	54%	0.05	26%	0.055	28%
Albania	0.176	0.222	0.045	26%	0.024	14%	0.021	12%
Algeria	0.145	0.308	0.162	112%	0.054	37%	0.108	75%
Andorra	0.132	0.211	0.079	60%	0.017	13%	0.062	47%
Angola	0.137	0.251	0.114	83%	0.028	20%	0.086	63%
Antarctica	0.257	0.258	0.001	0%	0.001	0%	0	0%
Argentina	0.221	0.25	0.03	13%	0.017	8%	0.012	6%
Armenia	0.101	0.212	0.111	110%	0.028	28%	0.083	82%
Australia	0.254	0.282	0.028	11%	0.013	5%	0.015	6%
Austria	0.135	0.173	0.038	29%	0.019	14%	0.019	14%
Azerbaijan	0.108	0.205	0.097	90%	0.034	32%	0.063	58%
Bangladesh	0.141	0.223	0.082	59%	0.05	36%	0.032	23%
Belarus	0.129	0.16	0.031	24%	0.019	14%	0.012	9%
Belgium	0.097	0.151	0.055	57%	0.018	19%	0.037	38%
Belize	0.199	0.226	0.027	13%	0.022	11%	0.005	3%
Benin	0.095	0.25	0.155	162%	0.043	45%	0.112	118%
Bhutan	0.129	0.207	0.078	61%	0.02	16%	0.058	45%
Bolivia	0.194	0.237	0.043	22%	0.019	10%	0.024	13%
Bosnia and Herzegovina	0.152	0.184	0.032	21%	0.017	11%	0.016	10%
Botswana	0.197	0.284	0.087	44%	0.026	13%	0.061	31%
Brazil	0.202	0.224	0.023	11%	0.015	7%	0.008	4%
Brunei Darussalam	0.192	0.208	0.016	8%	0.013	7%	0.003	2%
Bulgaria	0.15	0.206	0.055	37%	0.024	16%	0.031	21%
Burkina Faso	0.13	0.274	0.144	111%	0.044	34%	0.101	77%

	Capacity Factor with Aerosols	Capacity Factor without Aerosols	Total Aerosol Impact		Atmospheric Aerosol Impact		Soiling Impact	
Burundi	0.164	0.221	0.057	35%	0.024	15%	0.033	20%
Cambodia	0.131	0.221	0.09	68%	0.024	18%	0.066	50%
Cameroon	0.107	0.221	0.114	107%	0.03	28%	0.085	79%
Canada	0.148	0.166	0.018	12%	0.011	7%	0.008	5%
Central African Republic	0.182	0.242	0.06	33%	0.028	15%	0.032	18%
Chad	0.126	0.304	0.178	141%	0.053	42%	0.125	99%
Chile	0.147	0.248	0.101	68%	0.015	10%	0.086	58%
Colombia	0.168	0.192	0.024	15%	0.015	9%	0.01	6%
Congo	0.126	0.201	0.074	59%	0.03	24%	0.044	35%
Congo DRC	0.157	0.218	0.061	39%	0.029	18%	0.032	21%
Costa Rica	0.178	0.195	0.017	10%	0.012	7%	0.005	3%
Cote d'Ivoire	0.087	0.229	0.142	164%	0.035	41%	0.107	124%
Croatia	0.154	0.188	0.035	23%	0.021	14%	0.013	9%
Cuba	0.186	0.24	0.053	29%	0.019	10%	0.034	18%
Czech Republic	0.109	0.162	0.053	49%	0.023	21%	0.03	28%
Denmark	0.119	0.15	0.032	27%	0.018	15%	0.014	12%
Djibouti	0.171	0.305	0.134	78%	0.059	34%	0.076	44%
Dominican Republic	0.185	0.238	0.053	29%	0.019	10%	0.034	18%
Ecuador	0.132	0.168	0.035	27%	0.012	9%	0.023	18%
Egypt	0.054	0.325	0.272	503%	0.055	101%	0.217	402%
El Salvador	0.213	0.263	0.05	24%	0.02	9%	0.03	14%
Equatorial Guinea	0.114	0.179	0.065	57%	0.024	21%	0.041	36%
Eritrea	0.139	0.296	0.157	114%	0.05	36%	0.107	77%
Estonia	0.128	0.153	0.025	19%	0.016	12%	0.009	7%
Ethiopia	0.174	0.274	0.1	57%	0.029	17%	0.07	41%

	Capacity Factor with Aerosols	Capacity Factor without Aerosols	Total Aerosol Impact		Atmospheric Aerosol Impact		Soiling Impact	
Falkland Islands	0.152	0.167	0.015	10%	0.013	8%	0.003	2%
Fiji	0.209	0.22	0.011	5%	0.011	5%	0	0%
Finland	0.11	0.127	0.017	16%	0.011	10%	0.006	6%
France	0.137	0.179	0.042	31%	0.018	13%	0.025	18%
French Guiana	0.203	0.221	0.017	9%	0.015	7%	0.002	1%
French Polynesia	0.229	0.244	0.015	6%	0.012	5%	0.003	1%
French Southern Territories	0.11	0.119	0.009	8%	0.009	8%	0	0%
Gabon	0.114	0.179	0.065	57%	0.025	22%	0.04	36%
Gambia	0.123	0.271	0.148	121%	0.043	35%	0.105	86%
Georgia	0.147	0.192	0.045	31%	0.019	13%	0.026	18%
Germany	0.104	0.154	0.05	48%	0.02	20%	0.03	29%
Ghana	0.076	0.238	0.162	212%	0.04	53%	0.121	159%
Greece	0.16	0.218	0.058	37%	0.025	16%	0.033	21%
Greenland	0.201	0.21	0.009	4%	0.006	3%	0.003	2%
Guatemala	0.19	0.226	0.036	19%	0.018	9%	0.018	10%
Guinea	0.145	0.248	0.103	72%	0.033	23%	0.07	48%
Guinea-Bissau	0.169	0.262	0.094	56%	0.035	21%	0.058	35%
Guyana	0.194	0.213	0.019	10%	0.015	8%	0.004	2%
Haiti	0.198	0.249	0.051	26%	0.019	10%	0.031	16%
Honduras	0.189	0.222	0.033	17%	0.016	9%	0.016	9%
Hungary	0.125	0.186	0.061	49%	0.025	20%	0.036	29%
Iceland	0.106	0.117	0.01	10%	0.008	8%	0.002	2%
Indonesia	0.184	0.205	0.021	11%	0.014	8%	0.006	3%
Iran	0.171	0.29	0.119	70%	0.054	32%	0.065	38%

	Capacity Factor with Aerosols	Capacity Factor without Aerosols	Total Aerosol Impact		Atmospheric Aerosol Impact		Soiling Impact	
Iraq	0.116	0.29	0.174	151%	0.06	52%	0.115	99%
Ireland	0.11	0.129	0.019	17%	0.012	11%	0.007	6%
Israel	0.124	0.266	0.142	115%	0.036	29%	0.107	86%
Italy	0.158	0.208	0.05	32%	0.024	15%	0.027	17%
Japan	0.149	0.181	0.032	21%	0.023	16%	0.009	6%
Jordan	0.135	0.308	0.173	129%	0.044	33%	0.129	96%
Kazakhstan	0.13	0.222	0.092	71%	0.03	23%	0.062	48%
Kenya	0.166	0.266	0.1	60%	0.024	14%	0.076	46%
Kuwait	0.061	0.297	0.236	386%	0.064	104%	0.172	282%
Kyrgyzstan	0.134	0.239	0.104	78%	0.03	22%	0.074	55%
Laos	0.091	0.206	0.115	127%	0.024	26%	0.092	101%
Latvia	0.128	0.153	0.025	20%	0.017	13%	0.009	7%
Lebanon	0.114	0.259	0.144	126%	0.033	29%	0.111	97%
Liberia	0.135	0.213	0.077	57%	0.032	24%	0.045	33%
Libya	0.103	0.317	0.214	208%	0.054	53%	0.16	156%
Lithuania	0.128	0.156	0.028	22%	0.018	14%	0.01	8%
Madagascar	0.234	0.258	0.024	10%	0.013	6%	0.011	5%
Malawi	0.191	0.251	0.06	31%	0.021	11%	0.039	20%
Malaysia	0.183	0.2	0.017	9%	0.014	8%	0.003	2%
Mali	0.141	0.299	0.159	113%	0.057	40%	0.102	73%
Mauritania	0.134	0.31	0.176	132%	0.069	52%	0.107	80%
Mauritius	0.231	0.259	0.029	12%	0.016	7%	0.013	6%
Mexico	0.203	0.27	0.067	33%	0.023	11%	0.044	22%
Moldova	0.128	0.187	0.059	46%	0.019	15%	0.04	31%
Mongolia	0.169	0.255	0.087	51%	0.024	15%	0.062	37%
Montenegro	0.177	0.207	0.03	17%	0.022	13%	0.008	5%

	Capacity Factor with Aerosols	Capacity Factor without Aerosols	Total Aerosol Impact		Atmospheric Aerosol Impact		Soiling Impact	
Morocco	0.176	0.295	0.119	68%	0.047	27%	0.072	41%
Mozambique	0.188	0.242	0.054	28%	0.018	10%	0.036	19%
Myanmar	0.103	0.212	0.108	105%	0.023	22%	0.086	83%
Namibia	0.184	0.303	0.119	65%	0.029	16%	0.09	49%
Nepal	0.178	0.246	0.068	38%	0.035	20%	0.033	19%
Netherlands	0.097	0.15	0.053	55%	0.019	20%	0.035	36%
New Caledonia	0.225	0.239	0.014	6%	0.013	6%	0.001	1%
New Zealand	0.183	0.195	0.012	7%	0.011	6%	0.001	1%
Nicaragua	0.192	0.214	0.022	12%	0.015	8%	0.007	3%
Niger	0.1	0.318	0.219	219%	0.059	59%	0.16	160%
Nigeria	0.095	0.251	0.157	166%	0.043	45%	0.114	120%
North Korea	0.148	0.217	0.069	47%	0.037	25%	0.032	22%
Norway	0.105	0.118	0.013	12%	0.01	9%	0.003	3%
Oman	0.124	0.311	0.187	150%	0.057	46%	0.129	104%
Pakistan	0.15	0.287	0.138	92%	0.067	45%	0.071	47%
Palestinian Territory	0.078	0.275	0.198	254%	0.035	46%	0.162	208%
Panama	0.172	0.189	0.017	10%	0.014	8%	0.003	2%
Papua New Guinea	0.184	0.194	0.01	6%	0.009	5%	0.001	1%
Paraguay	0.204	0.227	0.024	12%	0.016	8%	0.007	4%
Peru	0.16	0.217	0.057	35%	0.016	10%	0.04	25%
Philippines	0.194	0.214	0.021	11%	0.015	8%	0.006	3%
Poland	0.106	0.16	0.054	51%	0.023	21%	0.032	30%
Portugal	0.186	0.232	0.046	25%	0.018	10%	0.028	15%
Romania	0.141	0.193	0.052	37%	0.022	16%	0.03	21%
Russia Asia	0.133	0.158	0.025	19%	0.012	9%	0.013	10%

	Capacity Factor with Aerosols	Capacity Factor without Aerosols	Total Aerosol Impact		Atmospheric Aerosol Impact		Soiling Impact	
Russia Europe	0.121	0.152	0.03	25%	0.015	12%	0.015	13%
Rwanda	0.155	0.212	0.056	36%	0.024	16%	0.032	21%
Samoa	0.217	0.229	0.012	6%	0.01	5%	0.002	1%
Saudi Arabia	0.1	0.32	0.219	218%	0.056	56%	0.163	162%
Senegal	0.129	0.277	0.148	114%	0.046	36%	0.102	79%
Serbia	0.146	0.194	0.048	33%	0.021	15%	0.027	18%
Sierra Leone	0.137	0.225	0.087	64%	0.034	25%	0.053	39%
Slovakia	0.111	0.174	0.063	57%	0.024	21%	0.039	35%
Slovenia	0.15	0.178	0.027	18%	0.019	13%	0.008	6%
Solomon Islands	0.197	0.206	0.009	5%	0.009	5%	0	0%
Somalia	0.217	0.293	0.076	35%	0.03	14%	0.046	21%
South Africa	0.211	0.274	0.063	30%	0.018	8%	0.045	22%
South Georgia	0.101	0.108	0.007	7%	0.006	6%	0.001	1%
South Korea	0.152	0.21	0.058	38%	0.037	24%	0.021	14%
South Sudan	0.139	0.242	0.103	74%	0.029	21%	0.075	54%
Spain	0.165	0.226	0.061	37%	0.02	12%	0.041	25%
Sri Lanka	0.191	0.221	0.03	16%	0.02	11%	0.01	5%
Sudan	0.108	0.315	0.207	192%	0.054	51%	0.153	142%
Suriname	0.206	0.224	0.017	8%	0.014	7%	0.003	2%
Svalbard	0.106	0.12	0.014	14%	0.007	7%	0.007	7%
Swaziland	0.164	0.226	0.062	38%	0.017	11%	0.045	28%
Sweden	0.116	0.133	0.017	15%	0.011	10%	0.006	5%
Switzerland	0.153	0.184	0.031	21%	0.018	12%	0.014	9%
Syria	0.132	0.283	0.152	115%	0.046	35%	0.106	80%
Tajikistan	0.129	0.259	0.13	101%	0.033	25%	0.097	76%

	Capacity Factor with Aerosols	Capacity Factor without Aerosols	Total Aerosol Impact		Atmospheric Aerosol Impact		Soiling Impact	
Tanzania	0.176	0.252	0.076	43%	0.02	12%	0.055	31%
Thailand	0.148	0.223	0.075	51%	0.028	19%	0.047	32%
The Former Yugoslav Republic of Macedonia	0.168	0.211	0.044	26%	0.022	13%	0.021	13%
Timor-Leste	0.224	0.258	0.033	15%	0.018	8%	0.015	7%
Togo	0.063	0.244	0.181	285%	0.042	66%	0.139	218%
Tunisia	0.159	0.274	0.115	73%	0.039	25%	0.076	48%
Turkey	0.155	0.236	0.081	52%	0.031	20%	0.051	33%
Turkmenistan	0.124	0.259	0.135	109%	0.048	39%	0.087	70%
Uganda	0.143	0.239	0.096	67%	0.021	15%	0.075	53%
Ukraine	0.135	0.18	0.045	33%	0.019	14%	0.026	19%
United Arab Emirates	0.104	0.297	0.193	186%	0.059	57%	0.134	129%
UK	0.101	0.13	0.028	28%	0.013	13%	0.015	15%
Uruguay	0.218	0.231	0.013	6%	0.011	5%	0.002	1%
Uzbekistan	0.114	0.248	0.135	119%	0.044	39%	0.091	80%
Vanuatu	0.21	0.228	0.018	9%	0.014	7%	0.003	2%
Venezuela	0.191	0.219	0.028	15%	0.016	9%	0.012	6%
Vietnam	0.136	0.192	0.057	42%	0.024	18%	0.032	24%
Yemen	0.103	0.321	0.218	211%	0.054	53%	0.164	159%
Zambia	0.163	0.261	0.097	59%	0.023	14%	0.074	45%
Zimbabwe	0.17	0.263	0.093	54%	0.019	11%	0.074	43%

Table SI-3 2003-2014 average regional-mean PV capacity factors with and without aerosols and impacts from aerosols for **TWO-AXIS** tracking panels. The impacts, both in absolute value and percentage, are defined as the increases if aerosols or clouds are removed relative to the case with aerosols and clouds.

	Capacity Factor with Aerosols	Capacity Factor without Aerosols	Total Aerosol Impact		Atmospheric Aerosol Impact		Soiling Impact	
US Alaska	0.154	0.175	0.02	13%	0.014	9%	0.007	4%
US Mid-Atlantic	0.191	0.216	0.025	13%	0.02	11%	0.005	3%
US Central	0.218	0.246	0.028	13%	0.021	10%	0.007	3%
US Florida	0.223	0.252	0.029	13%	0.022	10%	0.007	3%
US Hawaii	0.221	0.247	0.026	12%	0.021	10%	0.004	2%
US Northeast	0.188	0.21	0.022	12%	0.019	10%	0.003	2%
US Southeast	0.217	0.241	0.025	11%	0.019	9%	0.005	3%
US Texas	0.232	0.273	0.04	17%	0.024	10%	0.016	7%
US West	0.207	0.287	0.08	39%	0.03	15%	0.05	24%
India East	0.154	0.259	0.105	68%	0.057	37%	0.048	31%
India Northeast	0.176	0.224	0.048	27%	0.035	20%	0.013	7%
India North	0.16	0.296	0.137	86%	0.073	46%	0.063	40%
India South	0.166	0.253	0.087	52%	0.039	24%	0.048	29%
India West	0.164	0.276	0.111	68%	0.053	32%	0.059	36%
China Northeast	0.204	0.281	0.078	38%	0.035	17%	0.042	21%
China North	0.158	0.305	0.148	94%	0.053	34%	0.095	60%
China Northwest	0.158	0.309	0.151	96%	0.042	27%	0.109	69%
China Tibet	0.229	0.326	0.097	42%	0.019	8%	0.078	34%
China Central	0.116	0.202	0.086	74%	0.041	35%	0.045	39%
China East	0.133	0.211	0.078	59%	0.054	40%	0.025	19%
China South	0.125	0.203	0.078	62%	0.033	26%	0.045	36%

	Capacity Factor with Aerosols	Capacity Factor without Aerosols	Total Aerosol Impact		Atmospheric Aerosol Impact		Soiling Impact	
North China Plain	0.133	0.279	0.145	109%	0.06	45%	0.085	64%
Afghanistan	0.221	0.337	0.116	53%	0.06	27%	0.056	25%
Albania	0.203	0.25	0.048	24%	0.03	15%	0.017	9%
Algeria	0.164	0.339	0.175	106%	0.062	38%	0.113	69%
Andorra	0.156	0.245	0.09	58%	0.022	14%	0.068	44%
Angola	0.152	0.267	0.115	76%	0.032	21%	0.084	55%
Antarctica	0.348	0.351	0.002	1%	0.002	1%	0	0%
Argentina	0.249	0.281	0.032	13%	0.022	9%	0.011	4%
Armenia	0.116	0.243	0.127	109%	0.037	32%	0.089	77%
Australia	0.28	0.308	0.028	10%	0.015	5%	0.013	5%
Austria	0.159	0.2	0.041	26%	0.026	17%	0.015	10%
Azerbaijan	0.124	0.229	0.105	84%	0.042	34%	0.062	50%
Bangladesh	0.157	0.241	0.085	54%	0.058	37%	0.026	17%
Belarus	0.153	0.187	0.034	22%	0.025	16%	0.009	6%
Belgium	0.121	0.175	0.054	45%	0.025	21%	0.029	24%
Belize	0.207	0.234	0.027	13%	0.024	11%	0.004	2%
Benin	0.102	0.26	0.158	155%	0.046	45%	0.112	110%
Bhutan	0.145	0.228	0.083	57%	0.023	16%	0.059	41%
Bolivia	0.209	0.254	0.046	22%	0.022	11%	0.024	11%
Bosnia and Herzegovina	0.174	0.208	0.033	19%	0.021	12%	0.012	7%
Botswana	0.224	0.313	0.09	40%	0.031	14%	0.059	26%
Brazil	0.211	0.234	0.023	11%	0.016	8%	0.007	3%
Brunei Darussalam	0.196	0.212	0.016	8%	0.014	7%	0.002	1%
Bulgaria	0.175	0.233	0.058	33%	0.03	17%	0.028	16%

	Capacity Factor with Aerosols	Capacity Factor without Aerosols	Total Aerosol Impact		Atmospheric Aerosol Impact		Soiling Impact	
Burkina Faso	0.139	0.288	0.149	107%	0.047	34%	0.102	73%
Burundi	0.172	0.228	0.056	33%	0.026	15%	0.03	18%
Cambodia	0.142	0.231	0.089	63%	0.027	19%	0.063	44%
Cameroon	0.112	0.229	0.116	104%	0.032	29%	0.084	75%
Canada	0.184	0.206	0.021	12%	0.015	8%	0.007	4%
Central African Republic	0.192	0.252	0.06	32%	0.031	16%	0.03	15%
Chad	0.137	0.327	0.19	139%	0.061	45%	0.129	94%
Chile	0.166	0.276	0.11	66%	0.019	11%	0.091	55%
Colombia	0.172	0.197	0.025	14%	0.016	9%	0.009	5%
Congo	0.13	0.205	0.075	57%	0.033	25%	0.042	32%
Congo DRC	0.164	0.225	0.061	37%	0.031	19%	0.03	18%
Costa Rica	0.184	0.201	0.017	9%	0.013	7%	0.004	2%
Cote d'Ivoire	0.091	0.237	0.146	161%	0.038	42%	0.108	119%
Croatia	0.177	0.214	0.037	21%	0.027	15%	0.01	6%
Cuba	0.2	0.256	0.056	28%	0.023	11%	0.033	17%
Czech Republic	0.132	0.186	0.054	41%	0.03	23%	0.024	18%
Denmark	0.146	0.181	0.035	24%	0.026	18%	0.01	7%
Djibouti	0.183	0.32	0.137	75%	0.063	34%	0.074	40%
Dominican Republic	0.201	0.254	0.053	26%	0.022	11%	0.03	15%
Ecuador	0.136	0.17	0.035	26%	0.013	9%	0.022	16%
Egypt	0.058	0.36	0.302	524%	0.065	113%	0.237	411%
El Salvador	0.23	0.276	0.046	20%	0.021	9%	0.025	11%
Equatorial Guinea	0.117	0.181	0.064	55%	0.026	22%	0.039	33%
Eritrea	0.152	0.313	0.161	106%	0.054	35%	0.107	70%

	Capacity Factor with Aerosols	Capacity Factor without Aerosols	Total Aerosol Impact		Atmospheric Aerosol Impact		Soiling Impact	
Estonia	0.157	0.185	0.028	18%	0.022	14%	0.006	4%
Ethiopia	0.183	0.285	0.102	56%	0.032	17%	0.071	39%
Falkland Islands	0.174	0.196	0.022	13%	0.02	12%	0.002	1%
Fiji	0.217	0.229	0.012	6%	0.012	6%	0	0%
Finland	0.135	0.155	0.02	15%	0.016	12%	0.004	3%
France	0.163	0.207	0.044	27%	0.024	15%	0.02	12%
French Guiana	0.208	0.226	0.018	9%	0.016	8%	0.002	1%
French Polynesia	0.243	0.258	0.015	6%	0.013	5%	0.002	1%
French Southern Territories	0.116	0.128	0.012	11%	0.012	10%	0	0%
Gabon	0.117	0.181	0.064	55%	0.026	22%	0.038	33%
Gambia	0.136	0.285	0.149	110%	0.047	34%	0.103	76%
Georgia	0.167	0.22	0.053	31%	0.026	15%	0.027	16%
Germany	0.126	0.178	0.052	41%	0.028	22%	0.024	19%
Ghana	0.081	0.247	0.165	204%	0.043	54%	0.122	150%
Greece	0.183	0.244	0.06	33%	0.03	17%	0.03	16%
Greenland	0.272	0.286	0.013	5%	0.01	4%	0.003	1%
Guatemala	0.199	0.234	0.035	18%	0.019	10%	0.016	8%
Guinea	0.155	0.259	0.104	67%	0.036	23%	0.068	44%
Guinea-Bissau	0.183	0.275	0.092	50%	0.038	21%	0.054	29%
Guyana	0.199	0.218	0.019	10%	0.016	8%	0.003	2%
Haiti	0.215	0.266	0.051	24%	0.023	11%	0.028	13%
Honduras	0.198	0.23	0.032	16%	0.017	9%	0.015	7%
Hungary	0.149	0.214	0.065	43%	0.032	21%	0.033	22%
Iceland	0.124	0.138	0.014	12%	0.013	10%	0.002	1%
Indonesia	0.189	0.209	0.02	11%	0.015	8%	0.005	3%

	Capacity Factor with Aerosols	Capacity Factor without Aerosols	Total Aerosol Impact		Atmospheric Aerosol Impact		Soiling Impact	
Iran	0.196	0.326	0.13	67%	0.065	33%	0.065	33%
Iraq	0.137	0.325	0.188	137%	0.072	53%	0.116	84%
Ireland	0.13	0.152	0.022	17%	0.017	13%	0.005	4%
Israel	0.147	0.293	0.146	100%	0.043	29%	0.104	71%
Italy	0.184	0.238	0.054	29%	0.031	17%	0.023	13%
Japan	0.168	0.201	0.033	20%	0.028	17%	0.005	3%
Jordan	0.159	0.343	0.184	116%	0.053	34%	0.131	82%
Kazakhstan	0.162	0.266	0.104	64%	0.038	24%	0.066	40%
Kenya	0.172	0.274	0.102	59%	0.026	15%	0.076	44%
Kuwait	0.081	0.328	0.247	306%	0.075	93%	0.172	213%
Kyrgyzstan	0.154	0.274	0.12	78%	0.039	25%	0.082	53%
Laos	0.103	0.22	0.117	114%	0.027	26%	0.09	88%
Latvia	0.155	0.183	0.028	18%	0.023	15%	0.005	4%
Lebanon	0.138	0.284	0.146	106%	0.04	29%	0.106	77%
Liberia	0.142	0.219	0.077	54%	0.035	25%	0.042	29%
Libya	0.115	0.351	0.236	205%	0.065	56%	0.171	149%
Lithuania	0.153	0.183	0.03	20%	0.024	16%	0.006	4%
Madagascar	0.25	0.274	0.024	10%	0.015	6%	0.009	4%
Malawi	0.205	0.262	0.057	28%	0.022	11%	0.034	17%
Malaysia	0.186	0.203	0.017	9%	0.015	8%	0.002	1%
Mali	0.151	0.318	0.166	110%	0.062	41%	0.104	69%
Mauritania	0.146	0.334	0.188	129%	0.078	54%	0.109	75%
Mauritius	0.25	0.276	0.026	10%	0.018	7%	0.008	3%
Mexico	0.224	0.293	0.069	31%	0.026	12%	0.042	19%
Moldova	0.152	0.215	0.063	42%	0.025	17%	0.038	25%
Mongolia	0.219	0.319	0.101	46%	0.031	14%	0.07	32%

	Capacity Factor with Aerosols	Capacity Factor without Aerosols	Total Aerosol Impact		Atmospheric Aerosol Impact		Soiling Impact	
Montenegro	0.2	0.234	0.034	17%	0.028	14%	0.006	3%
Morocco	0.2	0.326	0.126	63%	0.055	28%	0.071	36%
Mozambique	0.202	0.254	0.052	26%	0.019	10%	0.033	16%
Myanmar	0.116	0.227	0.112	96%	0.025	22%	0.086	74%
Namibia	0.209	0.333	0.125	60%	0.035	17%	0.089	43%
Nepal	0.201	0.273	0.071	36%	0.041	21%	0.03	15%
Netherlands	0.121	0.176	0.054	45%	0.028	23%	0.027	22%
New Caledonia	0.238	0.254	0.016	7%	0.015	6%	0.001	0%
New Zealand	0.207	0.222	0.015	7%	0.014	7%	0.001	1%
Nicaragua	0.2	0.221	0.021	11%	0.017	8%	0.005	3%
Niger	0.107	0.341	0.235	221%	0.067	63%	0.168	157%
Nigeria	0.102	0.262	0.16	157%	0.047	46%	0.113	111%
North Korea	0.187	0.257	0.07	38%	0.049	26%	0.022	12%
Norway	0.126	0.144	0.018	14%	0.015	12%	0.003	2%
Oman	0.141	0.337	0.196	139%	0.065	46%	0.131	93%
Pakistan	0.173	0.322	0.149	86%	0.081	47%	0.068	39%
Palestinian Territory	0.104	0.303	0.199	191%	0.043	41%	0.157	150%
Panama	0.177	0.194	0.018	10%	0.016	9%	0.002	1%
Papua New Guinea	0.187	0.198	0.011	6%	0.01	5%	0.001	1%
Paraguay	0.218	0.243	0.024	11%	0.019	9%	0.005	3%
Peru	0.169	0.227	0.058	34%	0.019	11%	0.039	23%
Philippines	0.201	0.221	0.02	10%	0.016	8%	0.004	2%
Poland	0.131	0.186	0.055	42%	0.03	23%	0.025	19%
Portugal	0.217	0.263	0.046	21%	0.022	10%	0.024	11%
Romania	0.167	0.222	0.055	33%	0.029	18%	0.026	15%

	Capacity Factor with Aerosols	Capacity Factor without Aerosols	Total Aerosol Impact		Atmospheric Aerosol Impact		Soiling Impact	
Russia Asia	0.172	0.201	0.029	17%	0.018	11%	0.011	6%
Russia Europe	0.147	0.182	0.035	24%	0.022	15%	0.013	9%
Rwanda	0.162	0.217	0.055	34%	0.026	16%	0.028	18%
Samoa	0.227	0.24	0.012	5%	0.011	5%	0.001	1%
Saudi Arabia	0.112	0.347	0.235	209%	0.064	57%	0.171	152%
Senegal	0.141	0.292	0.151	107%	0.05	36%	0.101	71%
Serbia	0.171	0.22	0.049	29%	0.027	16%	0.023	13%
Sierra Leone	0.147	0.233	0.086	58%	0.038	26%	0.048	33%
Slovakia	0.133	0.201	0.068	51%	0.032	24%	0.036	27%
Slovenia	0.174	0.205	0.031	18%	0.026	15%	0.005	3%
Solomon Islands	0.201	0.212	0.011	5%	0.011	5%	0	0%
Somalia	0.227	0.304	0.076	34%	0.032	14%	0.044	20%
South Africa	0.242	0.307	0.065	27%	0.022	9%	0.043	18%
South Georgia	0.112	0.123	0.011	10%	0.011	10%	0	0%
South Korea	0.18	0.238	0.058	32%	0.044	25%	0.014	8%
South Sudan	0.146	0.252	0.106	73%	0.032	22%	0.075	51%
Spain	0.193	0.258	0.065	34%	0.024	13%	0.04	21%
Sri Lanka	0.196	0.226	0.029	15%	0.022	11%	0.007	4%
Sudan	0.116	0.339	0.222	191%	0.062	53%	0.16	138%
Suriname	0.212	0.229	0.018	8%	0.015	7%	0.003	1%
Svalbard	0.137	0.158	0.02	15%	0.013	10%	0.007	5%
Swaziland	0.19	0.248	0.058	31%	0.02	10%	0.038	20%
Sweden	0.143	0.163	0.021	15%	0.017	12%	0.004	3%
Switzerland	0.179	0.216	0.037	20%	0.025	14%	0.011	6%
Syria	0.155	0.319	0.163	105%	0.057	37%	0.107	69%
Tajikistan	0.145	0.293	0.148	102%	0.04	28%	0.107	74%

	Capacity Factor with Aerosols	Capacity Factor without Aerosols	Total Aerosol Impact		Atmospheric Aerosol Impact		Soiling Impact	
Tanzania	0.186	0.26	0.075	40%	0.022	12%	0.053	28%
Thailand	0.161	0.235	0.074	46%	0.032	20%	0.042	26%
The Former Yugoslav Republic of Macedonia	0.192	0.239	0.047	24%	0.028	15%	0.019	10%
Timor-Leste	0.237	0.267	0.03	13%	0.02	8%	0.01	4%
Togo	0.067	0.253	0.187	280%	0.045	68%	0.141	212%
Tunisia	0.186	0.308	0.123	66%	0.047	25%	0.076	41%
Turkey	0.176	0.266	0.089	51%	0.039	22%	0.051	29%
Turkmenistan	0.147	0.297	0.149	101%	0.059	40%	0.09	61%
Uganda	0.149	0.246	0.097	65%	0.023	15%	0.074	50%
Ukraine	0.16	0.207	0.047	30%	0.026	16%	0.022	14%
United Arab Emirates	0.119	0.323	0.204	171%	0.068	57%	0.136	114%
UK	0.123	0.154	0.031	25%	0.019	16%	0.012	10%
Uruguay	0.24	0.254	0.014	6%	0.012	5%	0.001	1%
Uzbekistan	0.136	0.287	0.151	112%	0.054	40%	0.097	72%
Vanuatu	0.219	0.237	0.018	8%	0.016	8%	0.002	1%
Venezuela	0.199	0.226	0.028	14%	0.018	9%	0.01	5%
Vietnam	0.146	0.201	0.055	37%	0.028	19%	0.027	18%
Yemen	0.111	0.34	0.229	206%	0.059	53%	0.17	153%
Zambia	0.181	0.278	0.097	54%	0.026	14%	0.071	39%
Zimbabwe	0.189	0.282	0.093	49%	0.021	11%	0.072	38%

Table SI-4 2003-2014 average regional-mean PV capacity factors (CFs) for fixed panels without cleaning and benefits from cleaning. The cleaning benefit represents the increase in CFs due to a manual cleaning cycle relative to the case without cleaning. Both increase in absolute value and percentage are shown for each cleaning frequency.

	CF without cleaning	Quarterly Cleaning Benefits		Monthly Cleaning Benefits		Weekly Cleaning Benefits		Always Clean Benefits	
US Alaska	0.123	0.002	2%	0.002	2%	0.003	2%	0.003	2%
US Mid-Atlantic	0.152	0.001	1%	0.003	2%	0.005	3%	0.006	4%
US Central	0.169	0.003	2%	0.005	3%	0.006	4%	0.007	4%
US Florida	0.177	0.003	2%	0.005	3%	0.007	4%	0.009	5%
US Hawaii	0.184	0.003	2%	0.004	2%	0.005	3%	0.005	3%
US Northeast	0.148	0.001	1%	0.003	2%	0.004	3%	0.005	3%
US Southeast	0.171	0.002	1%	0.003	2%	0.005	3%	0.006	4%
US Texas	0.178	0.008	5%	0.011	6%	0.014	8%	0.015	9%
US West	0.164	0.026	16%	0.03	18%	0.032	20%	0.033	20%
India East	0.122	0.023	19%	0.038	31%	0.049	40%	0.054	44%
India Northeast	0.15	0.005	3%	0.01	7%	0.014	9%	0.016	10%
India North	0.122	0.037	30%	0.053	44%	0.063	51%	0.066	54%
India South	0.137	0.028	20%	0.04	29%	0.047	34%	0.05	36%
India West	0.126	0.034	27%	0.05	39%	0.059	47%	0.063	50%
China Northeast	0.149	0.026	18%	0.035	24%	0.041	27%	0.043	29%
China North	0.117	0.054	46%	0.068	58%	0.078	66%	0.082	70%
China Northwest	0.129	0.071	55%	0.077	60%	0.08	63%	0.082	63%
China Tibet	0.184	0.051	28%	0.054	29%	0.055	30%	0.055	30%
China Central	0.095	0.026	27%	0.035	36%	0.042	44%	0.046	49%
China East	0.107	0.011	10%	0.019	17%	0.028	26%	0.034	32%
China South	0.106	0.024	22%	0.033	31%	0.04	37%	0.043	40%
North China Plain	0.091	0.044	49%	0.066	72%	0.081	89%	0.088	97%
Afghanistan	0.175	0.037	21%	0.042	24%	0.044	25%	0.045	26%

	CF without cleaning	Quarterly Cleaning Benefits		Monthly Cleaning Benefits		Weekly Cleaning Benefits		Always Clean Benefits	
Albania	0.158	0.006	4%	0.01	7%	0.014	9%	0.016	10%
Algeria	0.135	0.079	59%	0.084	62%	0.086	64%	0.087	64%
Andorra	0.14	0.034	24%	0.036	26%	0.037	27%	0.038	27%
Angola	0.122	0.055	45%	0.067	55%	0.073	60%	0.075	62%
Argentina	0.189	0.006	3%	0.008	4%	0.009	5%	0.01	5%
Armenia	0.105	0.06	58%	0.064	62%	0.066	64%	0.067	64%
Australia	0.208	0.007	4%	0.01	5%	0.012	6%	0.012	6%
Austria	0.13	0.008	6%	0.01	8%	0.011	9%	0.012	9%
Azerbaijan	0.106	0.046	43%	0.049	47%	0.051	48%	0.051	49%
Bangladesh	0.131	0.013	10%	0.023	18%	0.031	24%	0.034	26%
Belarus	0.12	0.005	5%	0.007	6%	0.008	7%	0.008	7%
Belgium	0.098	0.02	20%	0.023	24%	0.026	27%	0.028	28%
Belize	0.173	0.002	1%	0.003	2%	0.004	3%	0.005	3%
Benin	0.095	0.078	83%	0.088	94%	0.093	98%	0.094	100%
Bhutan	0.136	0.031	23%	0.036	27%	0.04	29%	0.041	30%
Bolivia	0.172	0.013	7%	0.016	9%	0.018	10%	0.019	11%
Bosnia and Herzegovina	0.138	0.006	5%	0.009	6%	0.011	8%	0.012	9%
Botswana	0.171	0.034	20%	0.042	25%	0.047	27%	0.048	28%
Brazil	0.177	0.003	2%	0.005	3%	0.007	4%	0.007	4%
Brunei Darussalam	0.178	0.001	1%	0.002	1%	0.003	1%	0.003	2%
Bulgaria	0.139	0.013	9%	0.017	12%	0.02	15%	0.022	16%
Burkina Faso	0.132	0.061	47%	0.069	52%	0.072	55%	0.074	56%
Burundi	0.15	0.019	13%	0.025	17%	0.029	19%	0.03	20%
Cambodia	0.125	0.038	30%	0.047	38%	0.053	42%	0.055	44%
Cameroon	0.11	0.056	51%	0.063	58%	0.067	61%	0.068	62%
Canada	0.139	0.003	2%	0.004	3%	0.004	3%	0.005	3%

	CF without cleaning	Quarterly Cleaning Benefits		Monthly Cleaning Benefits		Weekly Cleaning Benefits		Always Clean Benefits	
Central African Republic	0.162	0.017	11%	0.024	15%	0.028	18%	0.03	18%
Chad	0.113	0.098	87%	0.104	93%	0.107	95%	0.108	96%
Chile	0.125	0.055	44%	0.064	51%	0.068	55%	0.07	56%
Colombia	0.157	0.005	3%	0.006	4%	0.007	4%	0.007	5%
Congo	0.121	0.03	25%	0.036	30%	0.039	32%	0.04	33%
Congo DRC	0.145	0.018	12%	0.024	17%	0.028	19%	0.03	21%
Costa Rica	0.161	0.003	2%	0.004	2%	0.005	3%	0.005	3%
Cote d'Ivoire	0.089	0.076	85%	0.084	94%	0.087	98%	0.089	100%
Croatia	0.139	0.005	3%	0.007	5%	0.009	6%	0.01	7%
Cuba	0.161	0.023	14%	0.027	17%	0.03	19%	0.031	19%
Czech Republic	0.107	0.014	13%	0.017	16%	0.02	19%	0.022	20%
Denmark	0.114	0.006	6%	0.008	7%	0.009	8%	0.009	8%
Djibouti	0.142	0.055	39%	0.063	44%	0.067	47%	0.069	48%
Dominican Republic	0.166	0.018	11%	0.022	13%	0.025	15%	0.026	16%
Ecuador	0.127	0.016	13%	0.019	15%	0.02	16%	0.021	16%
Egypt	0.046	0.169	370%	0.181	396%	0.186	407%	0.188	410%
El Salvador	0.181	0.016	9%	0.021	11%	0.024	13%	0.025	14%
Equatorial Guinea	0.124	0.023	19%	0.026	21%	0.028	23%	0.029	23%
Eritrea	0.123	0.076	62%	0.084	69%	0.088	72%	0.089	73%
Estonia	0.115	0.004	3%	0.005	4%	0.006	5%	0.006	5%
Ethiopia	0.157	0.044	28%	0.049	32%	0.052	33%	0.053	34%
Falkland Islands	0.139	0.002	1%	0.002	1%	0.002	1%	0.002	2%
Finland	0.099	0.002	2%	0.003	3%	0.003	3%	0.003	3%
France	0.132	0.01	8%	0.013	10%	0.015	11%	0.016	12%
French Guiana	0.178	0.001	1%	0.002	1%	0.002	1%	0.002	1%

	CF without cleaning	Quarterly Cleaning Benefits		Monthly Cleaning Benefits		Weekly Cleaning Benefits		Always Clean Benefits	
French Polynesia	0.196	0.001	1%	0.002	1%	0.003	1%	0.003	2%
Gabon	0.115	0.028	24%	0.032	28%	0.034	30%	0.035	30%
Gambia	0.122	0.068	56%	0.077	63%	0.081	66%	0.082	67%
Georgia	0.145	0.015	10%	0.016	11%	0.018	12%	0.018	12%
Germany	0.104	0.015	14%	0.018	17%	0.02	19%	0.021	21%
Ghana	0.081	0.084	104%	0.094	116%	0.099	122%	0.1	124%
Greece	0.145	0.012	9%	0.018	12%	0.023	16%	0.025	18%
Greenland	0.161	0.001	1%	0.001	1%	0.001	1%	0.001	1%
Guatemala	0.168	0.008	5%	0.012	7%	0.014	9%	0.015	9%
Guinea	0.132	0.047	36%	0.056	42%	0.06	45%	0.062	47%
Guinea-Bissau	0.157	0.032	20%	0.039	25%	0.043	27%	0.044	28%
Guyana	0.173	0.002	1%	0.003	2%	0.003	2%	0.004	2%
Haiti	0.177	0.017	10%	0.02	11%	0.022	13%	0.023	13%
Honduras	0.168	0.008	5%	0.01	6%	0.012	7%	0.012	7%
Hungary	0.123	0.015	12%	0.018	15%	0.021	17%	0.022	18%
Indonesia	0.171	0.003	2%	0.004	2%	0.005	3%	0.006	4%
Iran	0.154	0.044	28%	0.051	33%	0.055	36%	0.056	36%
Iraq	0.103	0.078	75%	0.092	89%	0.099	95%	0.101	98%
Ireland	0.111	0.002	2%	0.003	3%	0.004	4%	0.004	4%
Israel	0.107	0.056	52%	0.075	70%	0.086	80%	0.09	84%
Italy	0.148	0.01	7%	0.013	9%	0.017	11%	0.018	12%
Japan	0.141	0.002	1%	0.004	3%	0.006	4%	0.008	6%
Jordan	0.116	0.088	76%	0.101	87%	0.107	92%	0.109	94%
Kazakhstan	0.133	0.037	28%	0.042	32%	0.045	34%	0.046	34%
Kenya	0.145	0.054	37%	0.058	40%	0.06	41%	0.061	42%
Kuwait	0.049	0.097	198%	0.134	272%	0.152	309%	0.158	322%

	CF without cleaning	Quarterly Cleaning Benefits		Monthly Cleaning Benefits		Weekly Cleaning Benefits		Always Clean Benefits	
Kyrgyzstan	0.139	0.05	36%	0.053	38%	0.055	40%	0.055	40%
Laos	0.093	0.055	59%	0.067	71%	0.074	79%	0.077	82%
Latvia	0.117	0.004	4%	0.005	5%	0.006	5%	0.006	5%
Lebanon	0.112	0.048	43%	0.069	62%	0.081	73%	0.086	77%
Liberia	0.129	0.031	24%	0.037	28%	0.039	31%	0.04	31%
Libya	0.094	0.124	132%	0.132	140%	0.135	144%	0.136	145%
Lithuania	0.116	0.005	4%	0.006	5%	0.007	6%	0.008	7%
Madagascar	0.198	0.005	3%	0.008	4%	0.009	5%	0.009	5%
Malawi	0.166	0.022	13%	0.028	17%	0.032	19%	0.033	20%
Malaysia	0.171	0.001	1%	0.002	1%	0.003	2%	0.003	2%
Mali	0.136	0.071	52%	0.077	56%	0.079	58%	0.08	59%
Mauritania	0.128	0.083	65%	0.088	69%	0.089	70%	0.09	71%
Mauritius	0.196	0.007	4%	0.009	5%	0.01	5%	0.011	5%
Mexico	0.177	0.024	13%	0.029	16%	0.032	18%	0.033	19%
Moldova	0.128	0.016	13%	0.019	15%	0.021	17%	0.022	17%
Mongolia	0.174	0.039	23%	0.042	24%	0.043	25%	0.044	25%
Montenegro	0.158	0.002	1%	0.004	3%	0.006	4%	0.007	5%
Morocco	0.158	0.051	32%	0.056	35%	0.058	37%	0.059	37%
Mozambique	0.166	0.02	12%	0.025	15%	0.028	17%	0.029	17%
Myanmar	0.099	0.06	60%	0.069	70%	0.075	76%	0.077	78%
Namibia	0.157	0.058	37%	0.066	42%	0.07	44%	0.071	45%
Nepal	0.165	0.015	9%	0.022	14%	0.027	16%	0.029	18%
Netherlands	0.1	0.016	16%	0.02	20%	0.023	23%	0.024	24%
Nicaragua	0.169	0.003	2%	0.005	3%	0.006	3%	0.006	4%
Niger	0.097	0.12	124%	0.127	131%	0.129	133%	0.13	134%
Nigeria	0.096	0.077	80%	0.088	91%	0.093	96%	0.094	98%

	CF without cleaning	Quarterly Cleaning Benefits		Monthly Cleaning Benefits		Weekly Cleaning Benefits		Always Clean Benefits	
North Korea	0.142	0.013	9%	0.021	15%	0.028	19%	0.031	22%
Norway	0.099	0.001	1%	0.001	1%	0.002	2%	0.002	2%
Oman	0.115	0.093	81%	0.102	89%	0.106	93%	0.107	94%
Pakistan	0.136	0.046	34%	0.057	42%	0.064	47%	0.066	48%
Palestinian Territory	0.069	0.098	142%	0.121	174%	0.133	192%	0.137	198%
Panama	0.158	0.001	1%	0.002	1%	0.002	2%	0.003	2%
Paraguay	0.173	0.002	1%	0.004	3%	0.006	4%	0.007	4%
Peru	0.144	0.029	20%	0.033	23%	0.036	25%	0.037	25%
Philippines	0.173	0.002	1%	0.004	2%	0.005	3%	0.006	3%
Poland	0.104	0.015	15%	0.019	18%	0.021	21%	0.023	22%
Portugal	0.165	0.009	6%	0.015	9%	0.019	11%	0.02	12%
Romania	0.132	0.013	10%	0.016	12%	0.019	14%	0.02	15%
Russia Asia	0.13	0.006	4%	0.007	5%	0.008	6%	0.008	6%
Russia Europe	0.115	0.007	6%	0.008	7%	0.009	8%	0.01	9%
Rwanda	0.144	0.019	13%	0.025	18%	0.03	21%	0.031	22%
Samoa	0.189	0.001	1%	0.001	1%	0.002	1%	0.002	1%
Saudi Arabia	0.084	0.121	143%	0.134	159%	0.14	166%	0.142	168%
Senegal	0.128	0.066	52%	0.074	58%	0.077	60%	0.078	61%
Serbia	0.134	0.011	8%	0.014	11%	0.017	13%	0.019	14%
Sierra Leone	0.126	0.035	27%	0.044	35%	0.048	38%	0.05	40%
Slovakia	0.115	0.016	14%	0.019	16%	0.021	18%	0.022	19%
Slovenia	0.138	0.003	2%	0.005	3%	0.006	5%	0.007	5%
Somalia	0.183	0.03	16%	0.033	18%	0.035	19%	0.036	19%
South Africa	0.182	0.023	13%	0.029	16%	0.033	18%	0.034	19%
South Korea	0.142	0.006	5%	0.012	8%	0.018	13%	0.022	15%
South Sudan	0.129	0.049	38%	0.057	44%	0.06	47%	0.062	48%

	CF without cleaning	Quarterly Cleaning Benefits		Monthly Cleaning Benefits		Weekly Cleaning Benefits		Always Clean Benefits	
Spain	0.157	0.018	12%	0.022	14%	0.025	16%	0.026	17%
Sri Lanka	0.176	0.005	3%	0.007	4%	0.009	5%	0.009	5%
Sudan	0.096	0.118	123%	0.125	130%	0.128	133%	0.129	134%
Suriname	0.181	0.002	1%	0.003	1%	0.003	2%	0.003	2%
Svalbard	0.086	0.002	3%	0.002	3%	0.002	3%	0.003	3%
Swaziland	0.143	0.026	18%	0.034	24%	0.04	28%	0.042	29%
Sweden	0.107	0.002	2%	0.003	3%	0.003	3%	0.003	3%
Switzerland	0.148	0.005	3%	0.006	4%	0.008	5%	0.008	6%
Syria	0.121	0.064	53%	0.076	63%	0.082	68%	0.085	70%
Tajikistan	0.126	0.073	57%	0.077	61%	0.079	62%	0.079	63%
Tanzania	0.158	0.031	20%	0.037	23%	0.04	25%	0.041	26%
Thailand	0.138	0.024	18%	0.033	24%	0.04	29%	0.042	31%
The Former Yugoslav Republic of Macedonia	0.151	0.007	5%	0.011	7%	0.014	9%	0.016	11%
Timor-Leste	0.188	0.009	5%	0.012	6%	0.014	8%	0.015	8%
Togo	0.072	0.098	136%	0.107	149%	0.112	155%	0.113	157%
Tunisia	0.147	0.049	33%	0.055	38%	0.059	40%	0.06	41%
Turkey	0.148	0.026	17%	0.031	21%	0.034	23%	0.035	24%
Turkmenistan	0.124	0.057	46%	0.062	50%	0.065	52%	0.066	53%
Uganda	0.138	0.046	33%	0.052	37%	0.055	40%	0.056	40%
Ukraine	0.127	0.011	9%	0.014	11%	0.016	13%	0.017	14%
United Arab Emirates	0.093	0.103	110%	0.114	123%	0.119	128%	0.121	130%
UK	0.104	0.006	6%	0.008	8%	0.009	9%	0.01	10%
Uzbekistan	0.116	0.06	52%	0.066	57%	0.069	59%	0.07	60%
Venezuela	0.172	0.006	3%	0.008	5%	0.009	5%	0.01	6%

	CF without cleaning	Quarterly Cleaning Benefits		Monthly Cleaning Benefits		Weekly Cleaning Benefits		Always Clean Benefits	
Vietnam	0.125	0.017	13%	0.024	19%	0.029	23%	0.031	25%
Yemen	0.085	0.128	150%	0.137	162%	0.141	166%	0.143	168%
Zambia	0.148	0.041	27%	0.051	34%	0.057	38%	0.059	40%
Zimbabwe	0.155	0.041	26%	0.048	31%	0.053	34%	0.054	35%

Reference

1. Geological Survey (U.S.). State Boundaries of the United States, 2005. (2005).
2. All China Marketing Research Co., L. China Province Boundaries, 2000. (2005).
3. GfK MACON. India State Boundaries, 2005. (2005).

Copyright Permissions

Figures SI-1-5 and 6-10 are created using the Matplotlib Basemap Toolkit (<https://github.com/matplotlib/basemap>). Below is the copyright permission required by the developer:

Source code for the GEOS library is included in the geos-3.3.3 directory under the terms given in LICENSE_geos.

The land-sea mask, coastline, lake, river and political boundary data are extracted from datasets provided with the Generic Mapping Tools (GMT) and are included under the terms given in LICENSE_data.

Everything else (including src/_geos.c, and src/_geos.pyx):

copyright (c) 2011 by Jeffrey Whitaker.

Permission to use, copy, modify, and distribute this software and its documentation for any purpose and without fee is hereby granted, provided that the above copyright notices appear in all copies and that both the copyright notices and this permission notice appear in supporting documentation. THE AUTHOR DISCLAIMS ALL WARRANTIES WITH REGARD TO THIS SOFTWARE, INCLUDING ALL IMPLIED WARRANTIES OF MERCHANTABILITY AND FITNESS. IN NO EVENT SHALL THE AUTHOR BE LIABLE FOR ANY SPECIAL, INDIRECT OR CONSEQUENTIAL DAMAGES OR ANY DAMAGES WHATSOEVER RESULTING FROM LOSS OF USE, DATA OR PROFITS, WHETHER IN AN ACTION OF CONTRACT, NEGLIGENCE OR OTHER TORTIOUS ACTION, ARISING OUT OF OR IN CONNECTION WITH THE USE OR PERFORMANCE OF THIS SOFTWARE.