How reliable are CMIP5 models in simulating dust optical depth?

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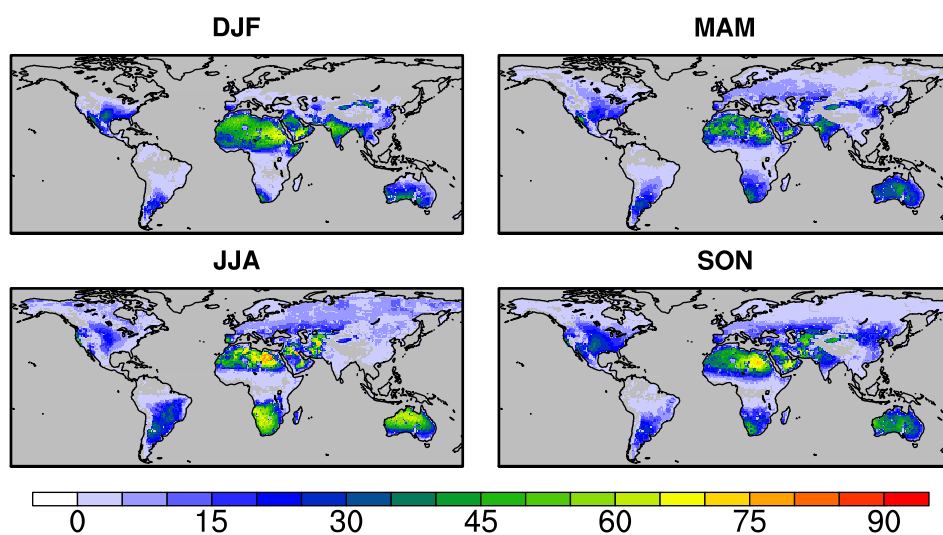
Supplement

Table S1 Correlation between reconstructed DOD (using three controlling factors) and MODIS DOD for nine regions in four seasons from 2004 to 2016. All coefficients are significant at the 95% confidence level except those in Italic.

	N. Africa	Middle East	N. China	N. America	India	SE. Asia	S. Africa	S. America	Australia
DJF	0.94	0.91	0.79	0.84	0.89	0.86	*0.35*	0.70	0.97
MAM	0.90	0.95	0.92	0.91	0.92	0.72	0.79	*0.54*	0.95
SON	0.68	0.95	0.79	0.90	0.87	0.77	0.92	0.68	0.77
JJA	0.89	0.96	0.88	0.93	0.74	0.86	0.88	0.58	0.89

Mean available days (Aqua2004-2016)

Mean available days (Aqua+Terra2004-2016)

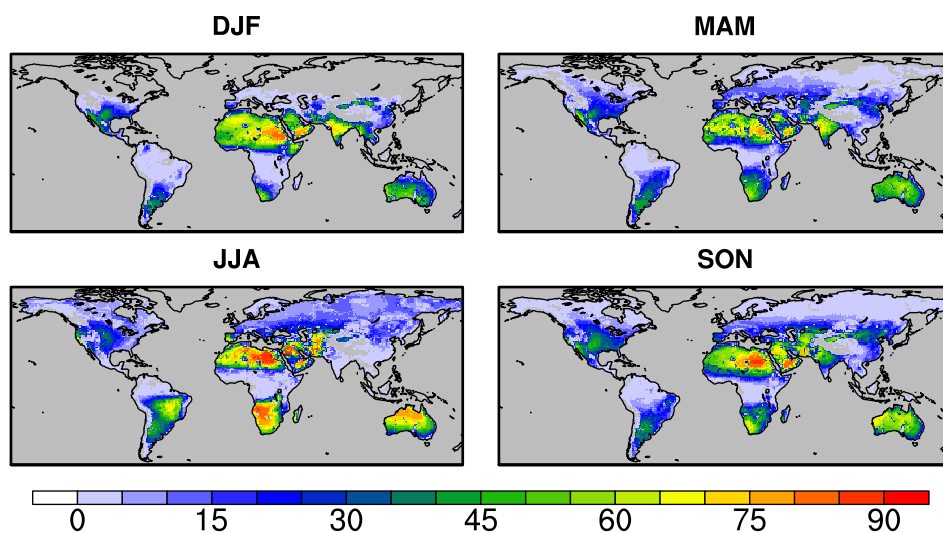



Figure S1. Number of days with available DOD record in each season from Aqua (top) and from Aqua-Terra combined DOD (i.e., MODIS DOD as referred in text; bottom) averaged over 2004-2016.

MODIS DOD (2004-2016)

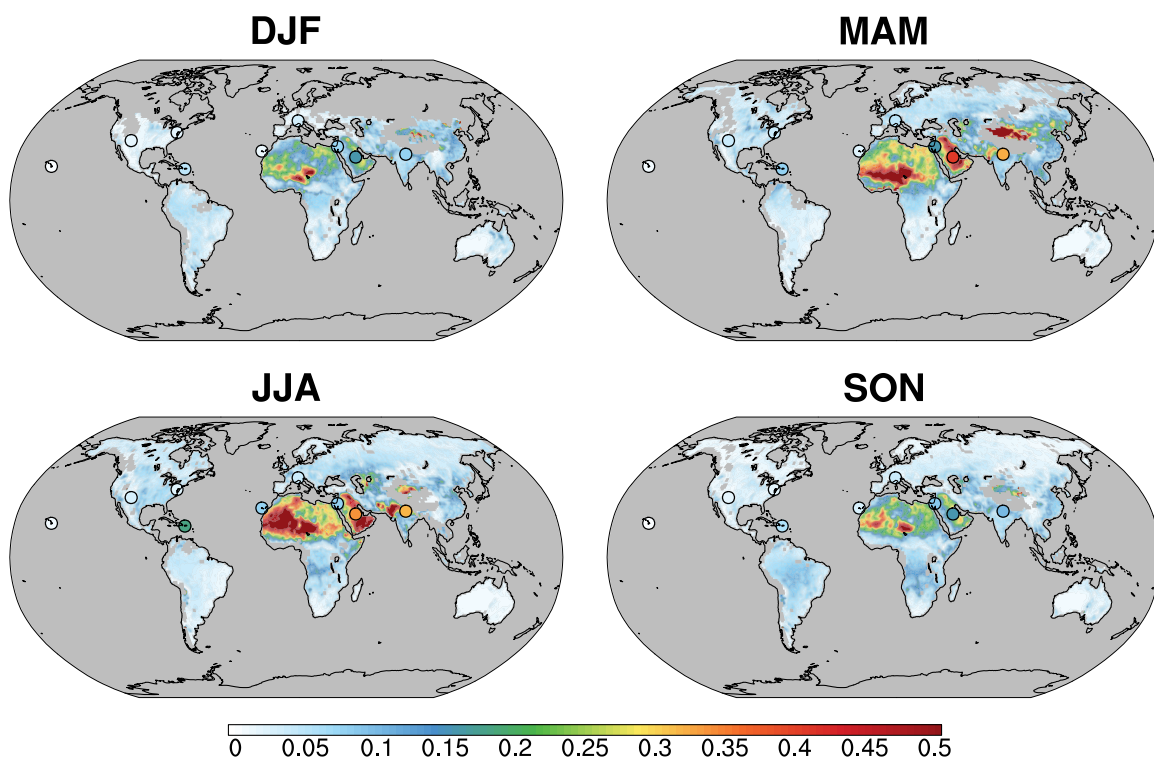
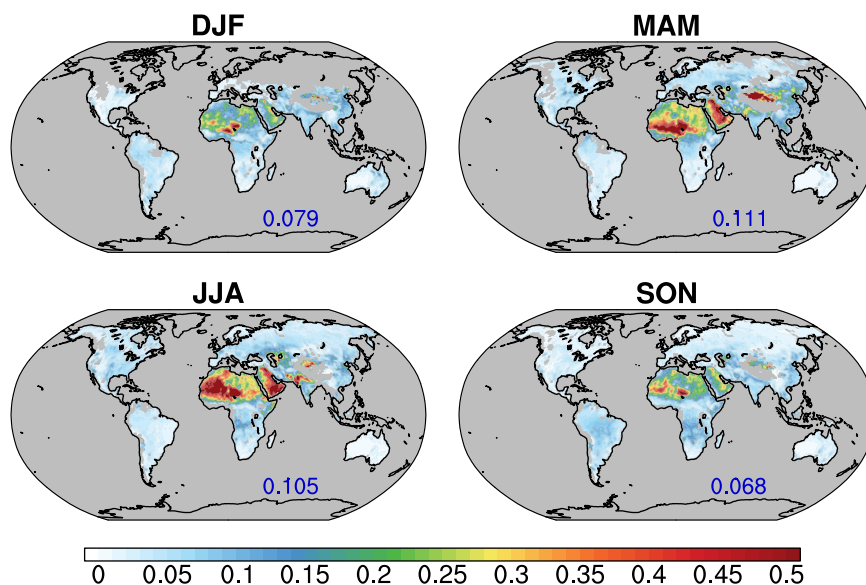



Figure S2. Climatology (2004-2016) of MODIS DOD (shading) and coarse mode aerosol optical depth (COD) at 500 nm from AERONET long-term stations (filled colorful circles).

MODIS DOD (2007-2016)

CALIOP dust (2007-2016)

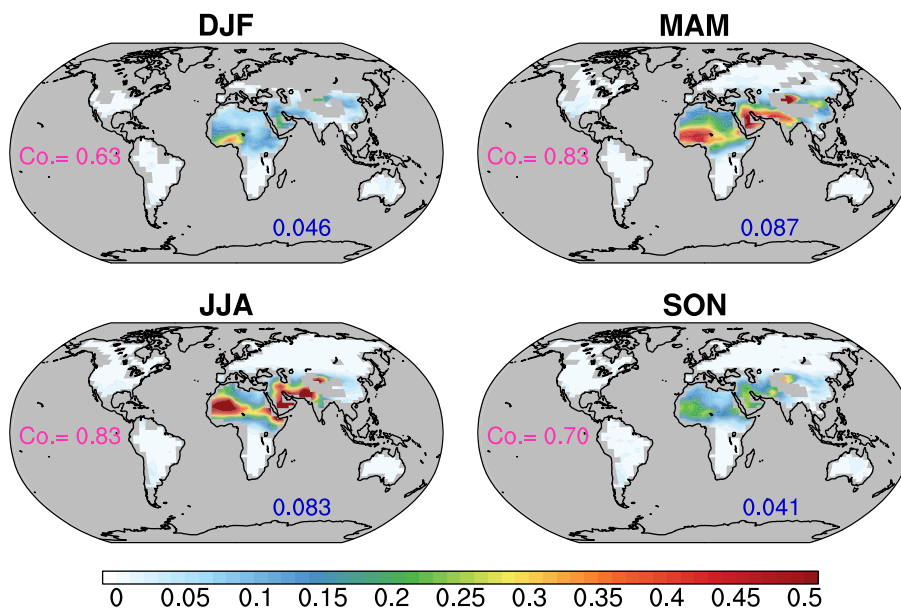



Figure S3. Climatology of MODIS DOD (2004-2016) versus CALIOP DOD (2007-2016). The global mean over land are listed at bottom right of each plot in blue, the pattern correlations (calculated after interpolating MODIS DOD to CALIOP grids) between MODIS and CALIOP DOD are also shown in the bottom panel in pink.

Precipitation (CMIP5 vs. PRECL)

1) CanESM2
4) MIROC-ESM-CHEM
7) HadGEM2-ES

2) GFDL-CM3
5) NorESM1-M
8) Ensemble mean

3) MIROC-ESM
6) HadGEM2-CC

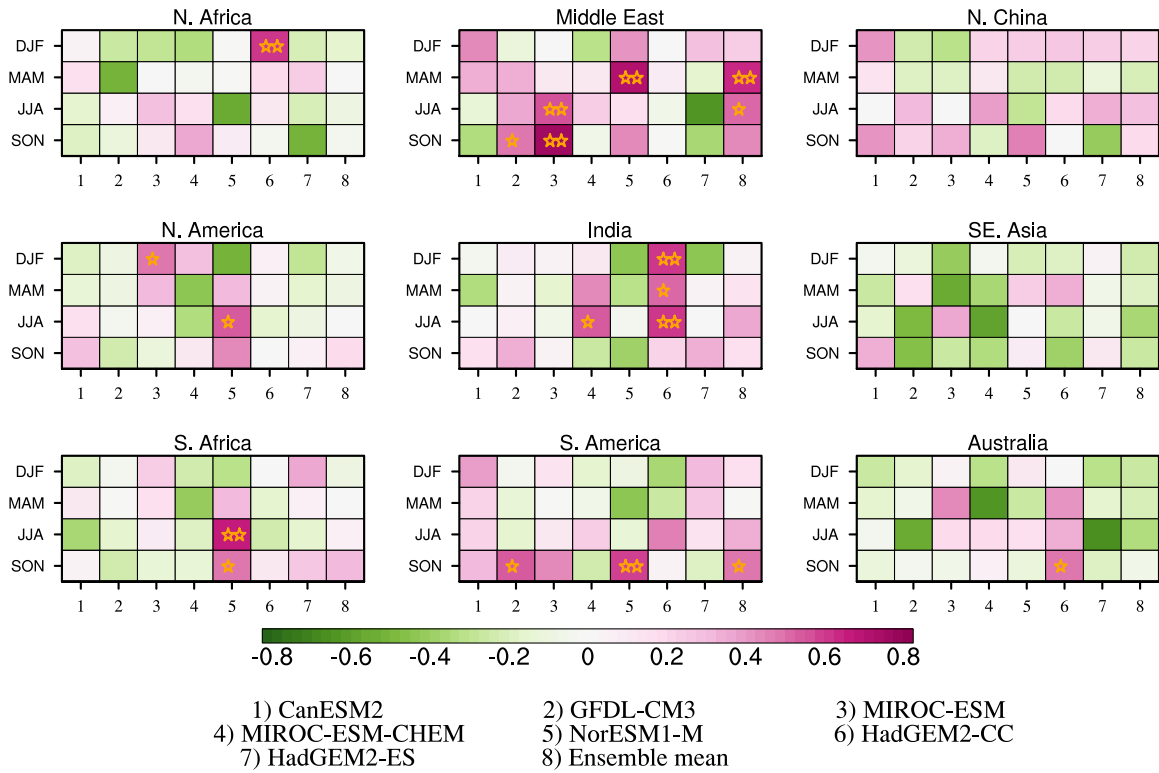



Figure S4. Correlations (color) of regional averaged time series of precipitation between CMIP5 output and the PRECL from 2004 to 2016 for four seasons in nine regions. Numbers in the X-axis denotes each model (1-7) and multi-model mean (8). Correlations significant at the 90% confidence level are marked by a star and significance at the 95% confidence level by two stars.

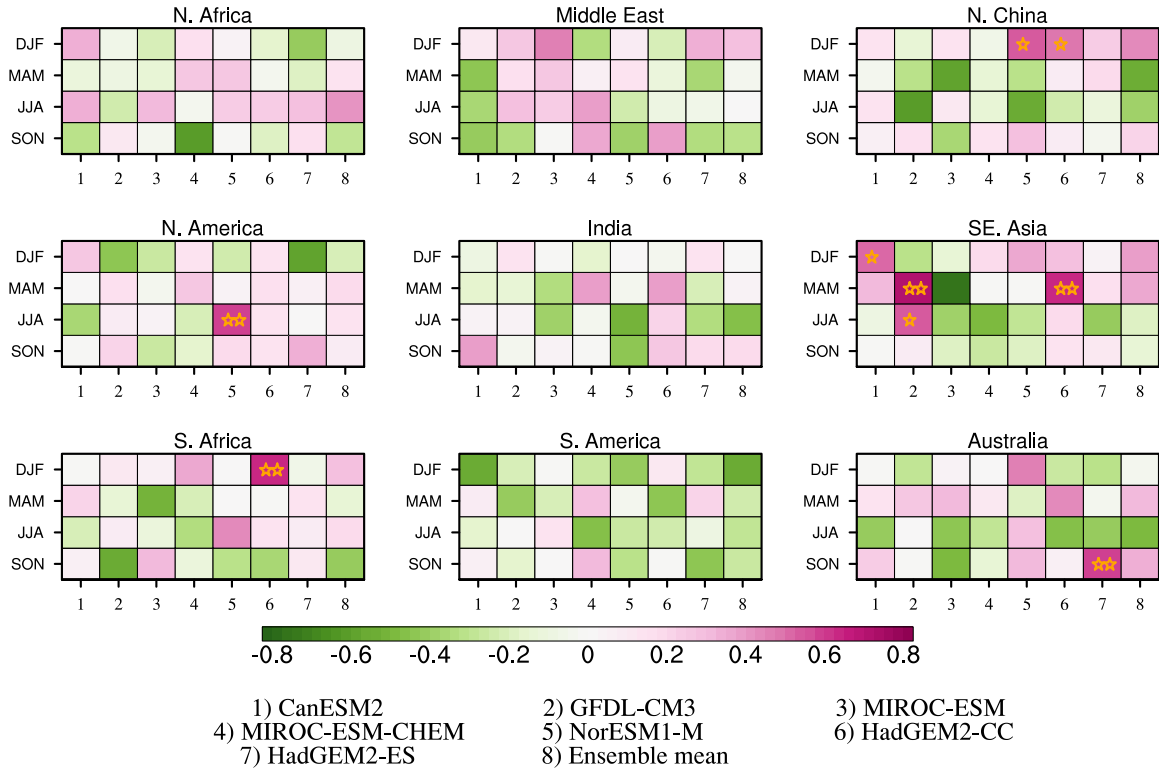



Figure S5. Same as Fig. S4 but for correlations of regional averaged time series of surface wind speed between CMIP5 output and the ERA-Interim.

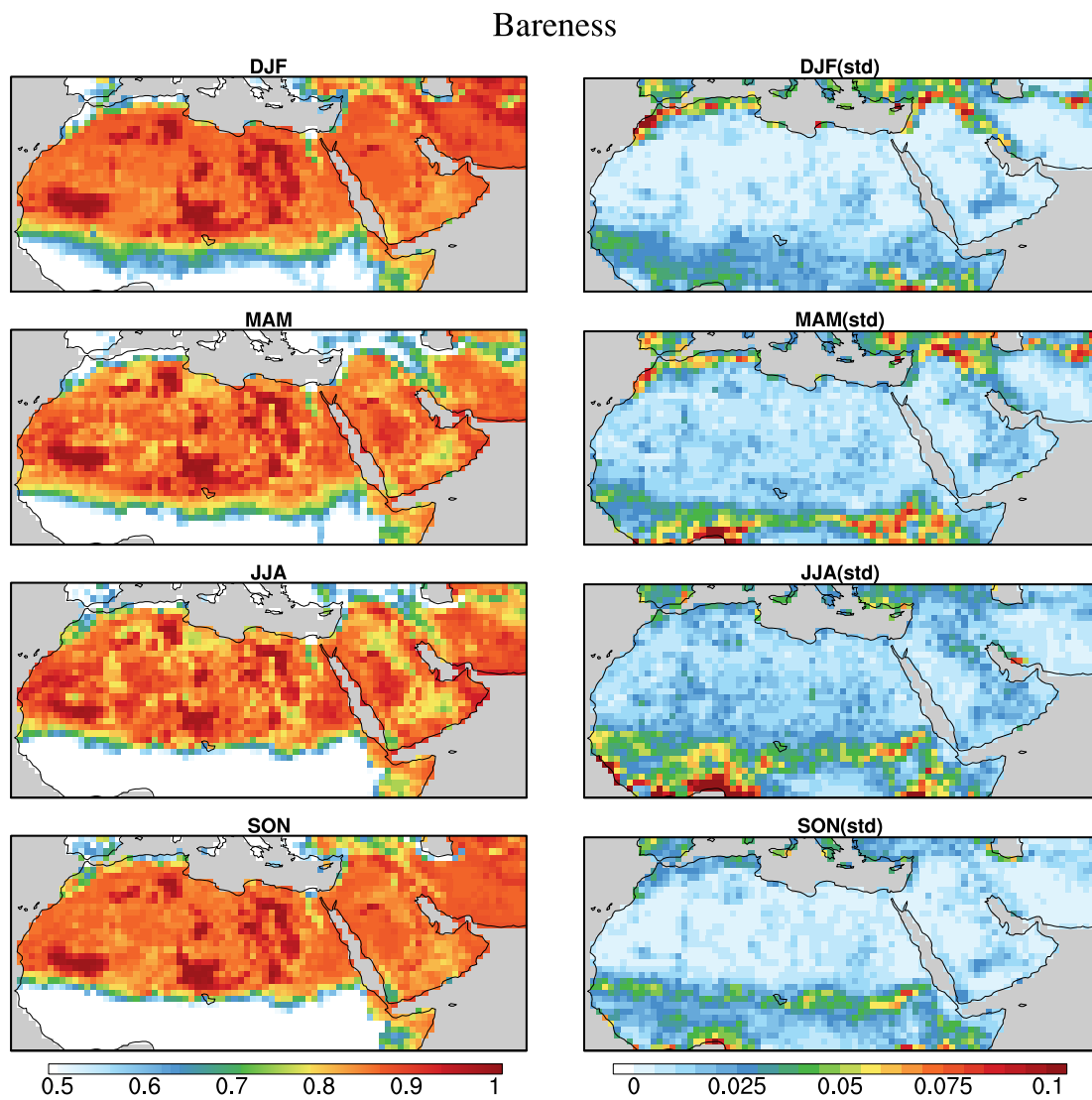
Figure S6. Same as Fig. S4 but for correlations of regional averaged time series of surface wind speed between CMIP5 output and the ERA-Interim.

Bareness

Figure S7. Seasonal mean (left) and standard deviation (right) of bareness over North Africa and the Arabian Peninsula from AVHRR during 2004-2016.

Changes of regDOD (2051-2100 minus 1861-2005)

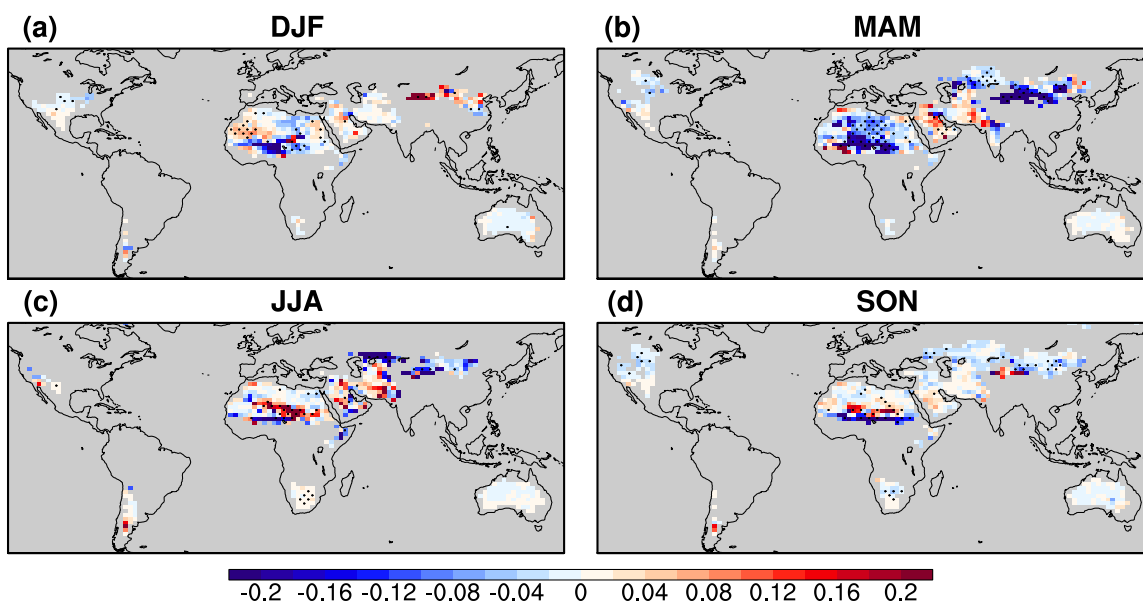



Figure S8. Same as Fig. 9, but used the output of seven models (Table 1). Dotted areas are regions with sign agreement among the models above 71.4% (i.e., at least five out seven models have the same sign as the multi-model mean).

Changes of regDOD (2051-2100 minus 1861-2005)

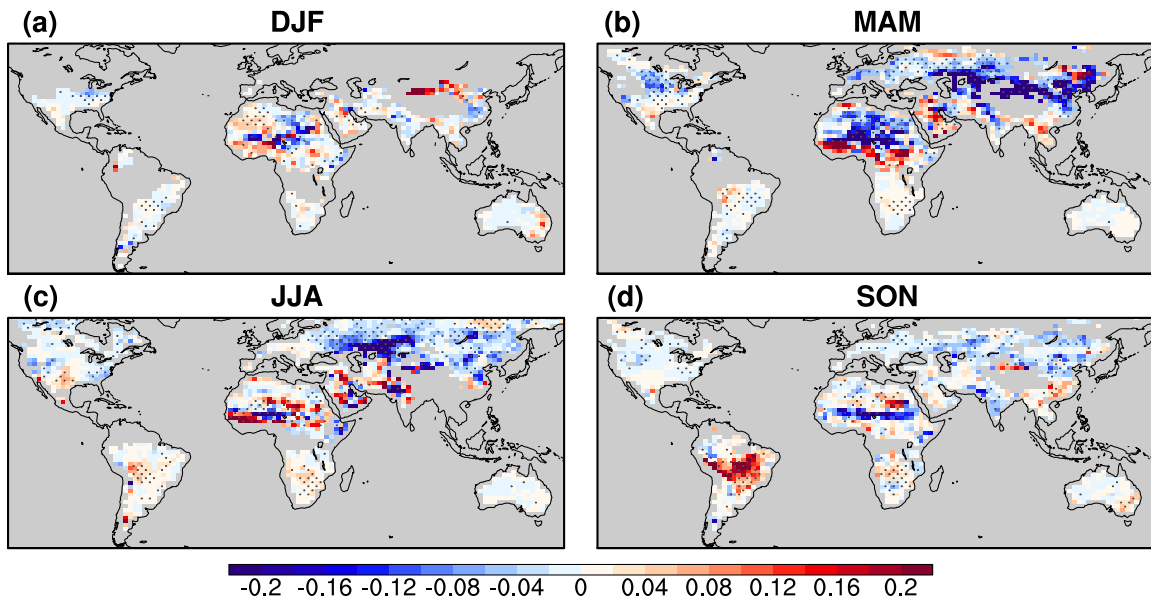



Figure S9. Same as Fig. 9 but without applying the LAI mask.