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Supplement of

Radiative effect and climate impacts of brown carbon with the Community Atmosphere Model (CAM5)

Hunter Brown et al.

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Figures:

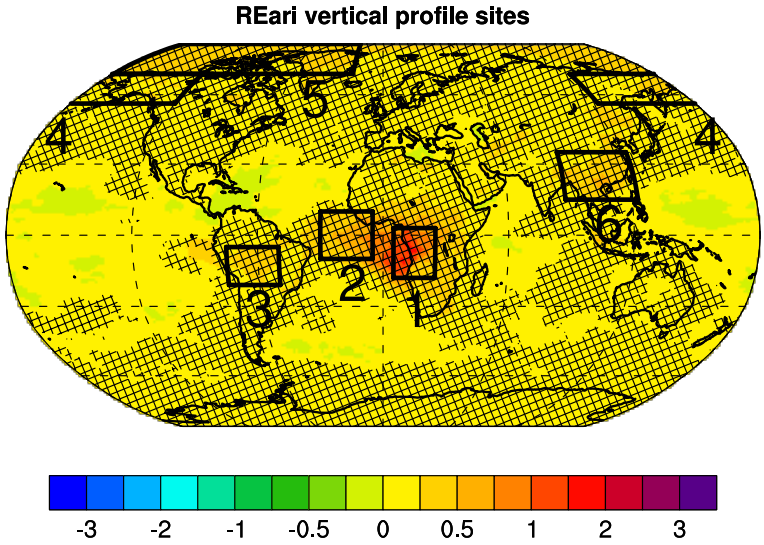

Figure S1: Locations for the vertical profile sites influenced by significant BrC aerosol radiation interactions (REari) in the BRC model run. Sites are: 1) Africa, 2) Africa, aged 3) South America, 4) Boreal, 5) Arctic, and 6) southeastern Asia. Hatching indicates significance in the ensemble year change to the 0.05 level. These sites are used to determine vertical profiles of heating rate, cloud cover, and aerosol concentrations in BrC influenced regions (Fig. S2), and they are used to determine the half-life of BrC in different parts of the world (Table S1).

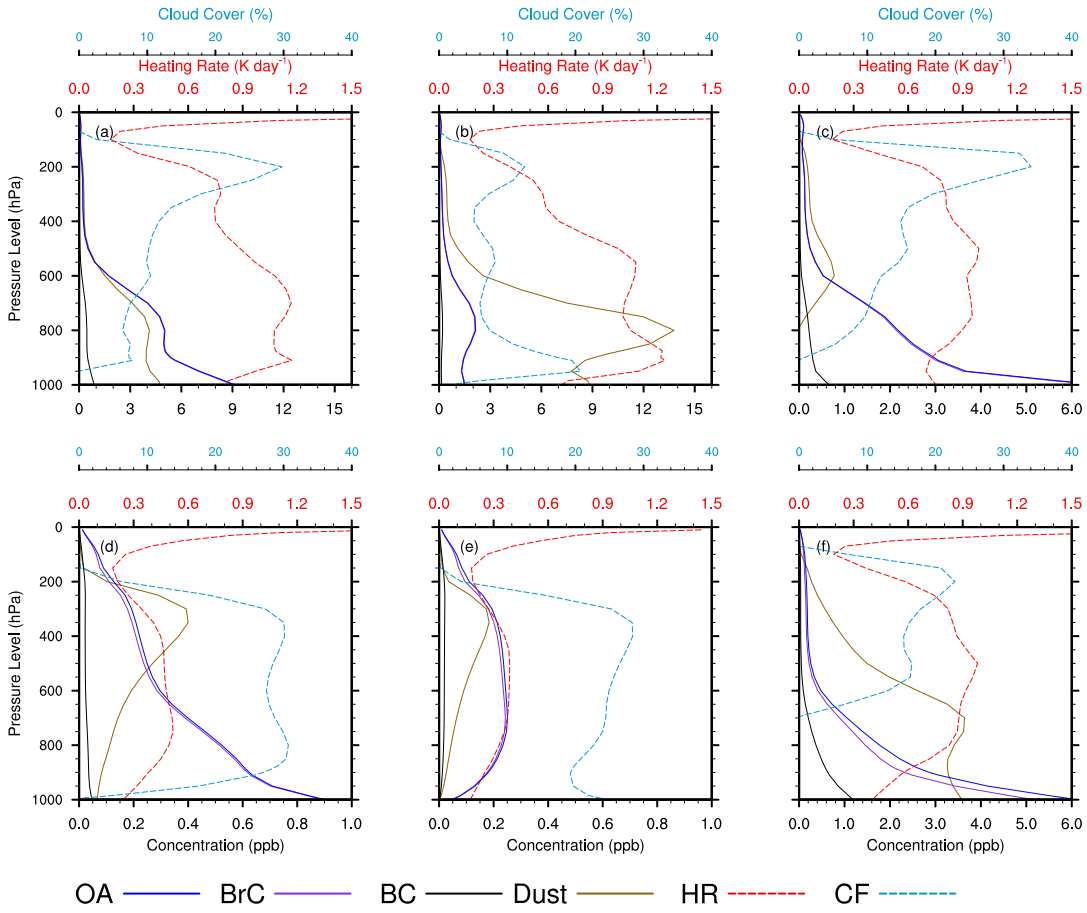

Figure S2: Vertical profiles from the BRC model run of primary organic aerosol mixing ratios (OA), brown carbon (BrC), black carbon (BC), dust, heating rate (HR), and cloud fraction (CF). The different locations are denoted in Fig. S1: (a) Africa; (b) Africa, aged; (c) South America; (d) Boreal; (e) Arctic; (f) Southeast Asia. Note the different scales for the aerosol concentrations.

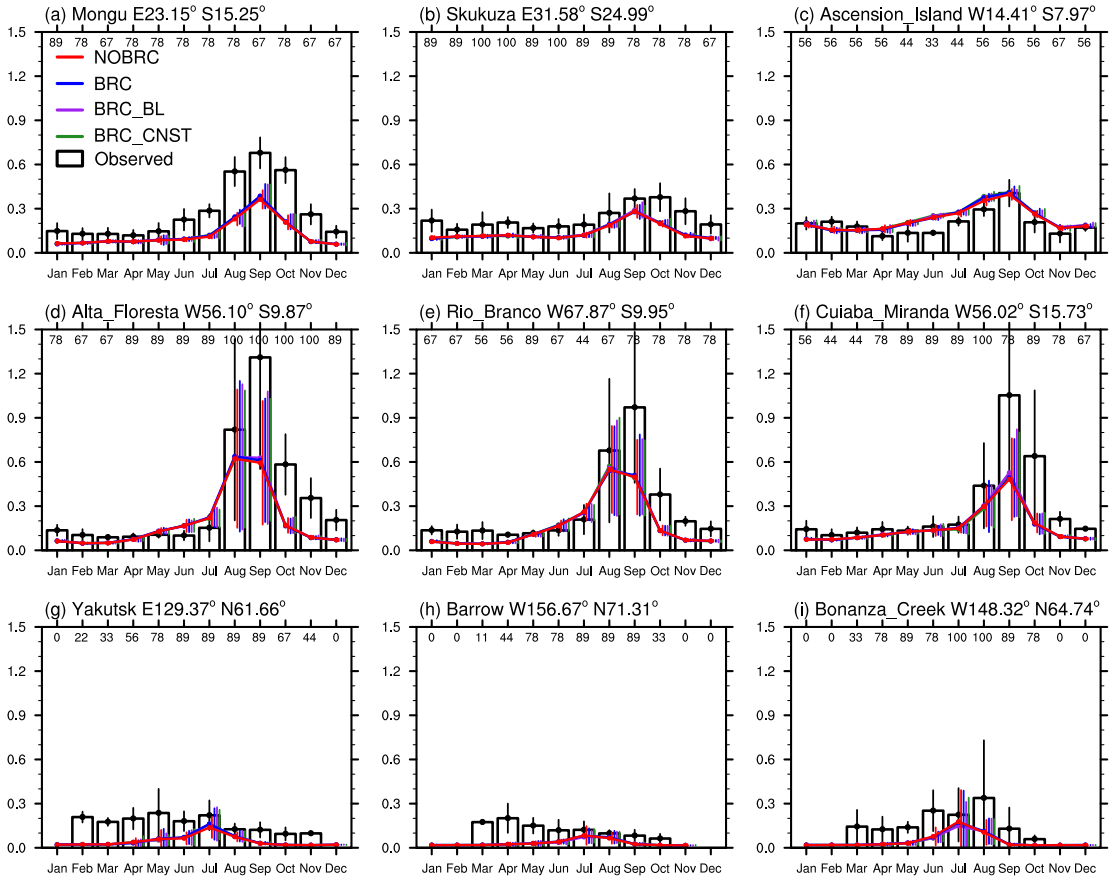

Figure S3: AERONET aerosol optical depth (AOD) compared to CAM5.4 model output AOD, not including brown carbon (NOBRC), including brown carbon (BRC, BRC_CNST), and including brown carbon and a bleaching effect (BRC_BL). Vertical lines are color-coded error bars and run from left to right: Observed, NOBRC, BRC, BRC_BL, BRC_CNST. Values under the upper x-axis indicate percentage of available data in the 9-year period.

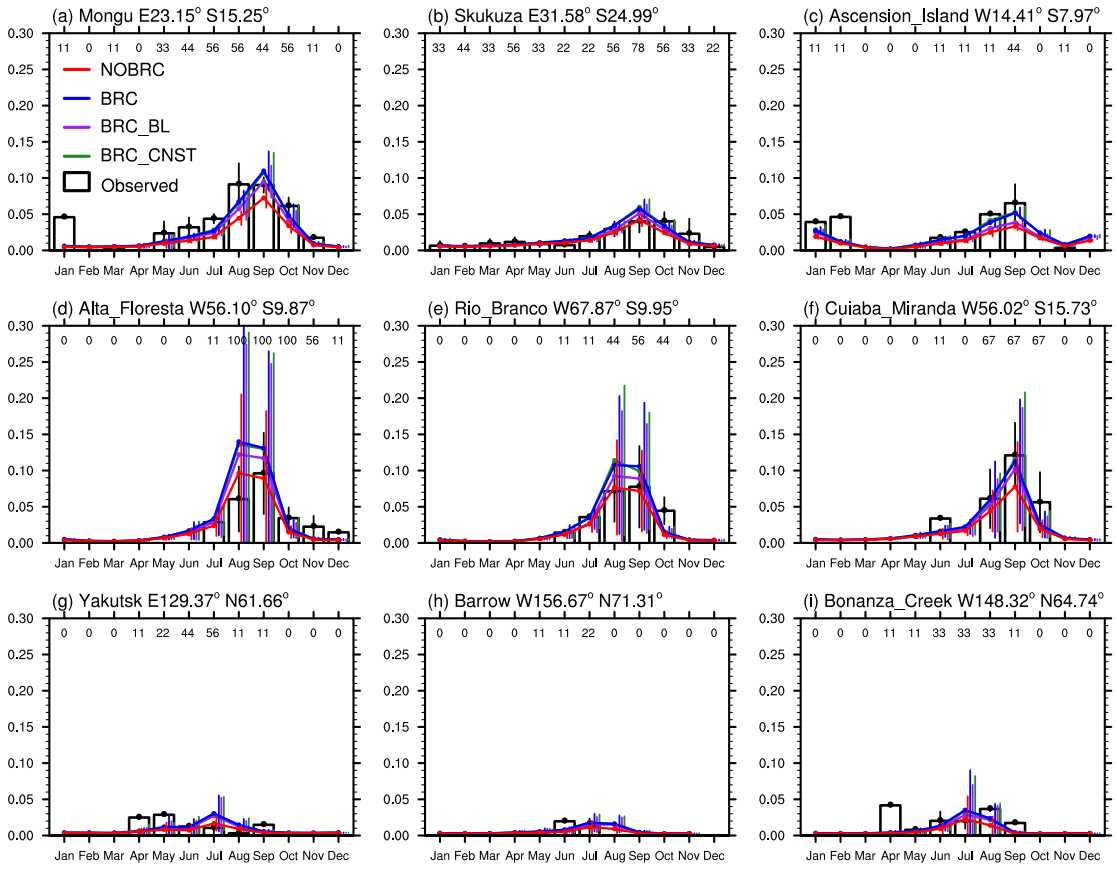

Figure S4: Same as Fig. S3 but for absorption AOD (AAOD).

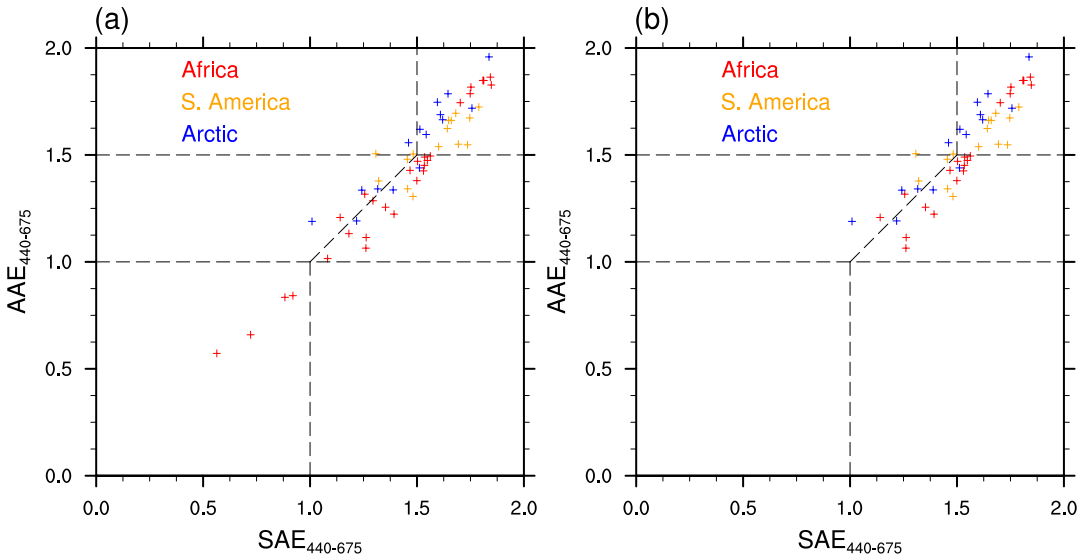

Figure S5: AERONET comparison of AAE and SAE (440-675 nm) with the Ascension island site (a) and without (b). The grid box classifications are described in Cappa et al., 2016.

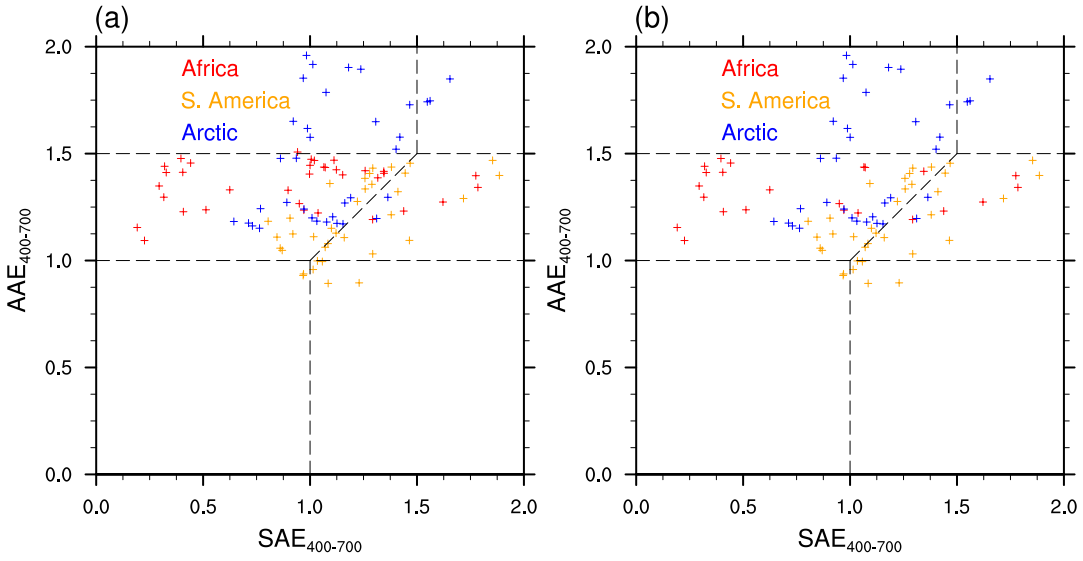

Figure S6: Same comparison as Fig S2 but comparing the BRC model run AAE and SAE (400-700 nm).

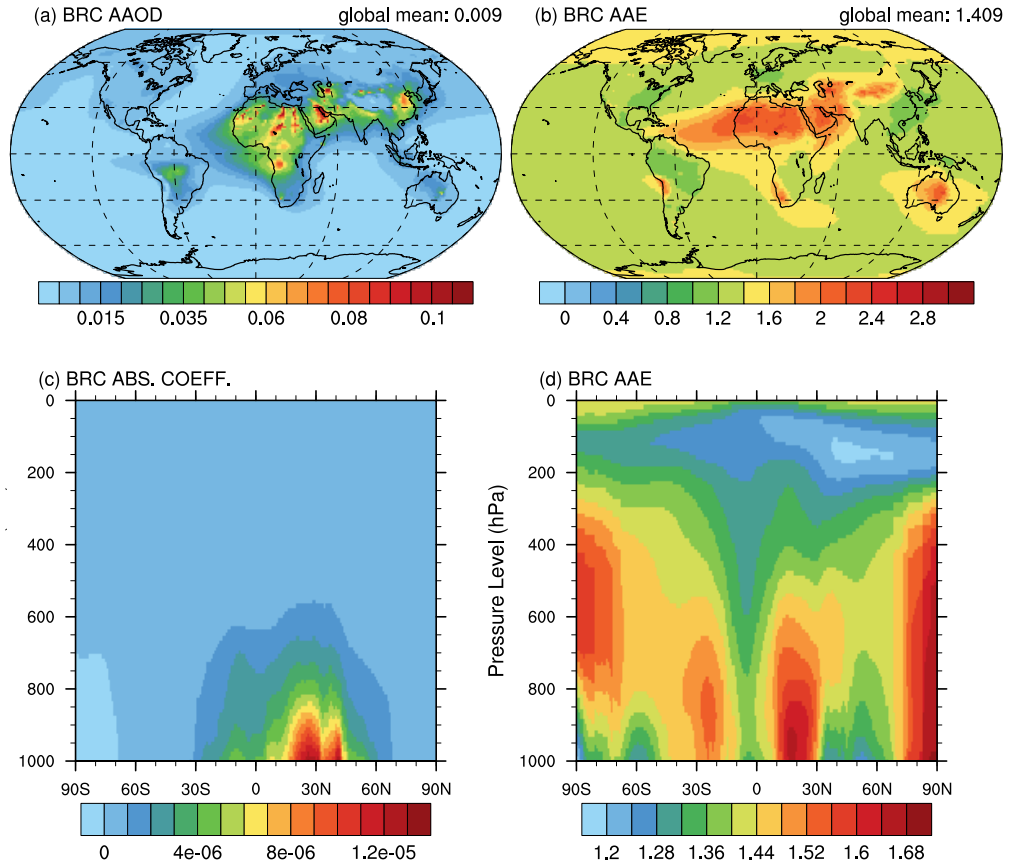

Figure S7: (a) AAOD, (b) AAE, (c) zonally averaged absorption coefficient (m^{-1}), and (d) zonally averaged AAE from the BRC model run.

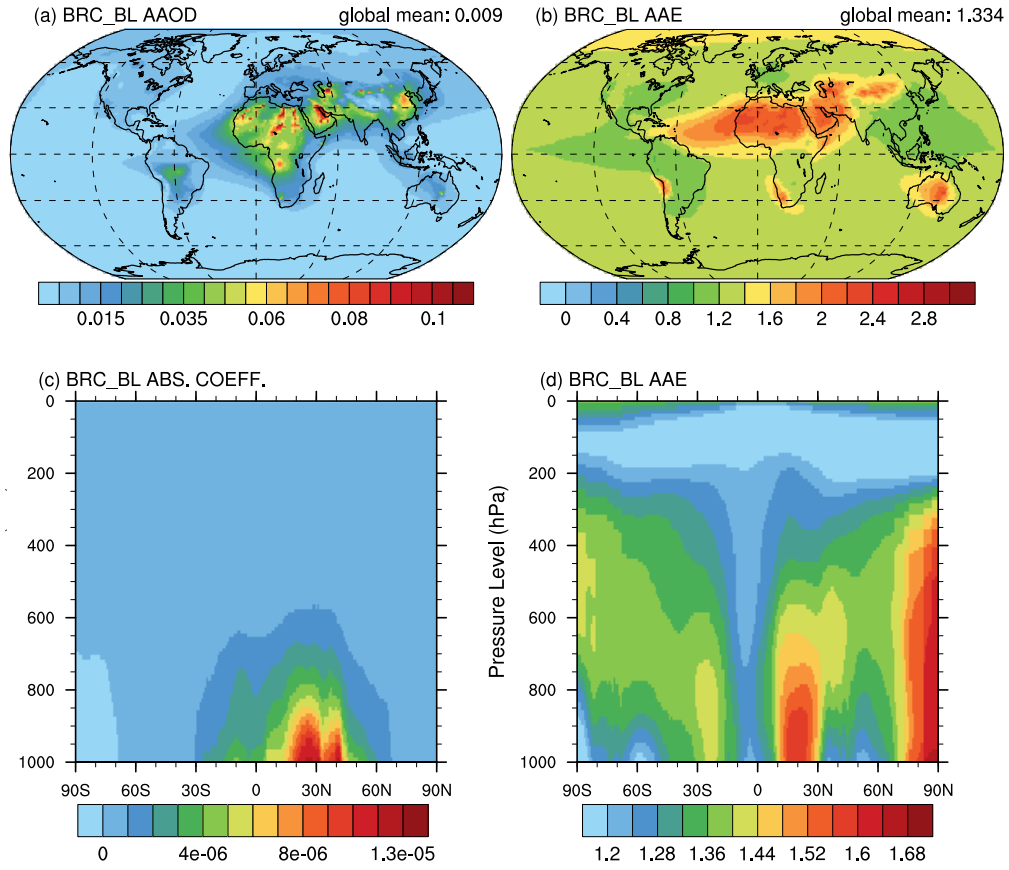

Figure S8: (a) AAOD, (b) AAE, (c) zonally averaged absorption coefficient (m^{-1}), and (d) zonally averaged AAE from the BRC_BL model run.

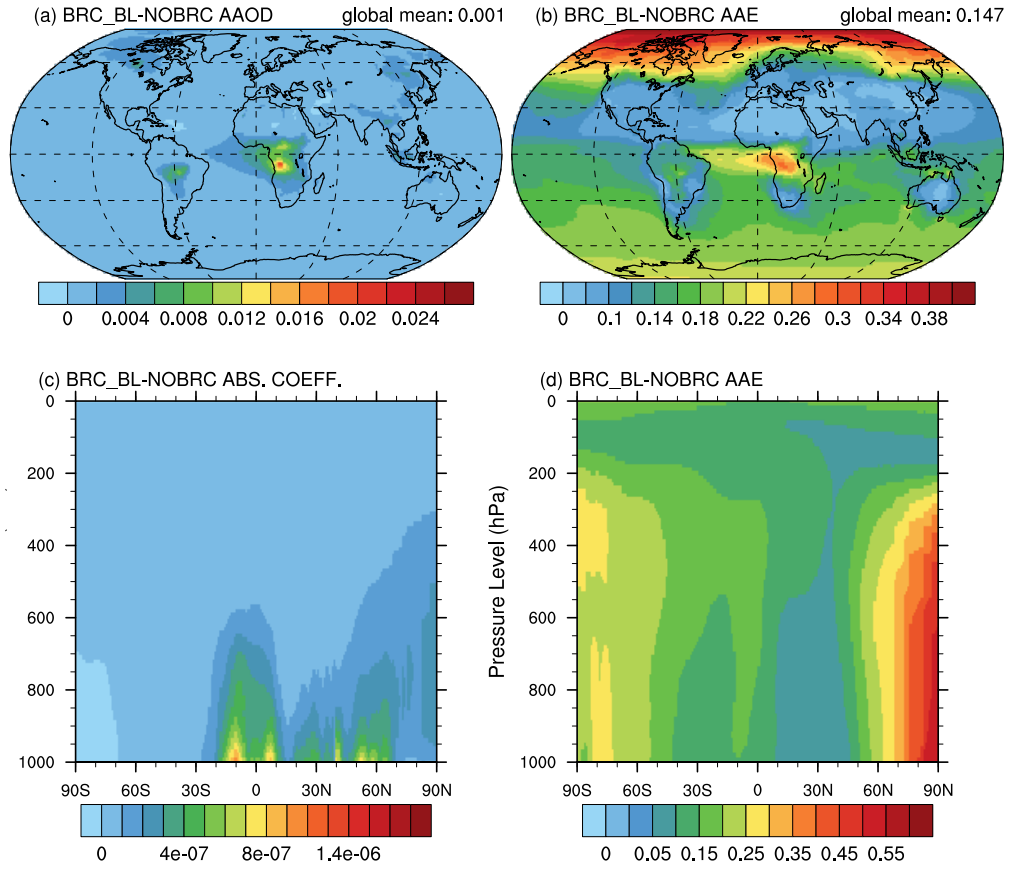

Figure S9: Differences in (a) AAOD, (b) AAE, (c) zonally averaged absorption coefficient (m^{-1}), and (d) zonally averaged AAE between the BRC_BL model run and the NOBRC model run.

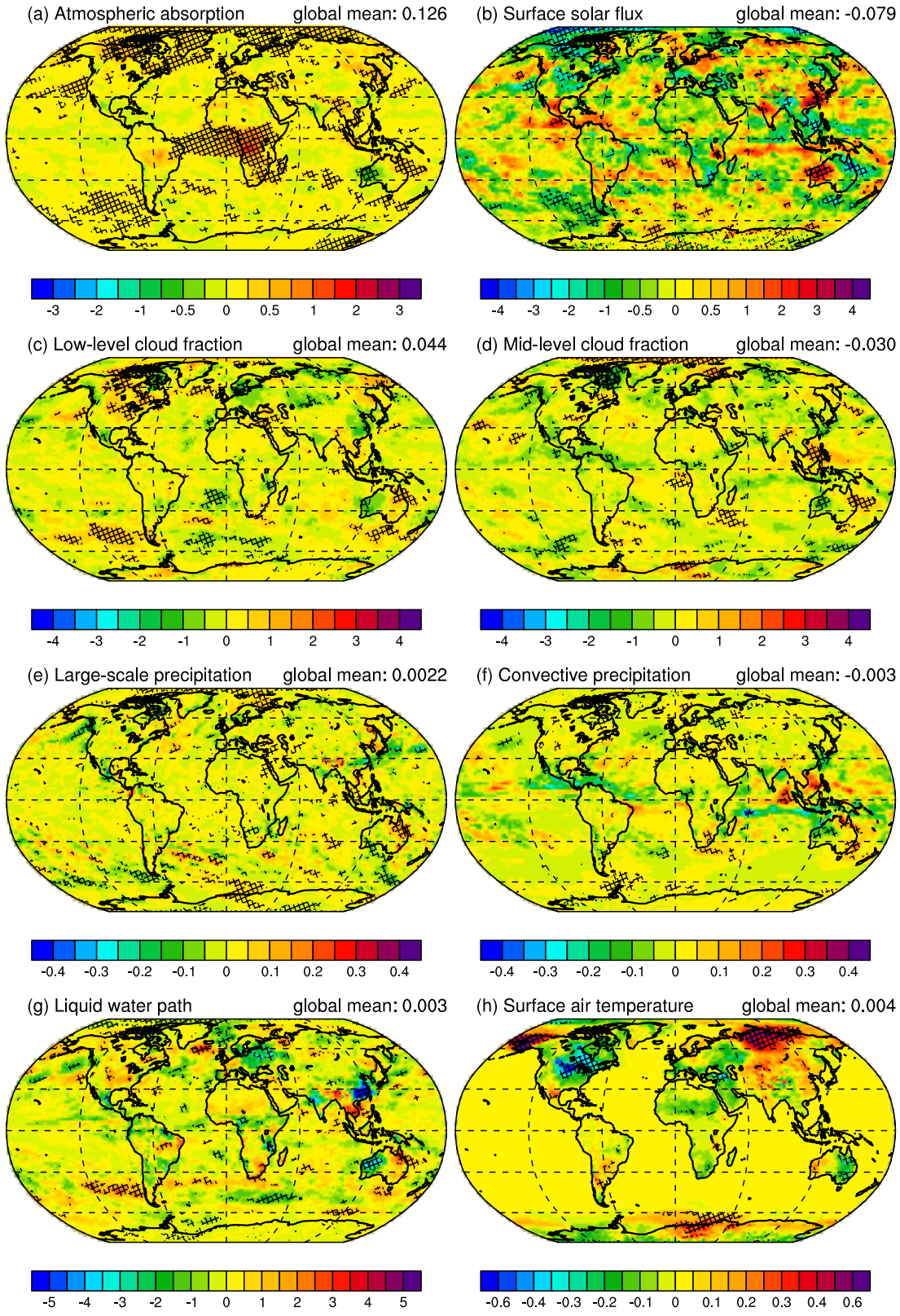

Figure S10: The effect of BrC addition with a bleaching parameterization (BRC_BL) on (a) atmospheric absorption (W m^{-2}), (b) surface solar flux (W m^{-2}), (c) low-level cloud

fraction (%; clouds below 700 mb), (d) Mid-level cloud fraction (%; clouds between 700 and 400 mb), (e) large-scale precipitation (mm day^{-1}), (f) convective precipitation (mm day^{-1}), (g) liquid water path (g m^{-2}), (h) surface air temperature (˚K). Hatching indicates significance in ensemble year change to the 0.1 level.

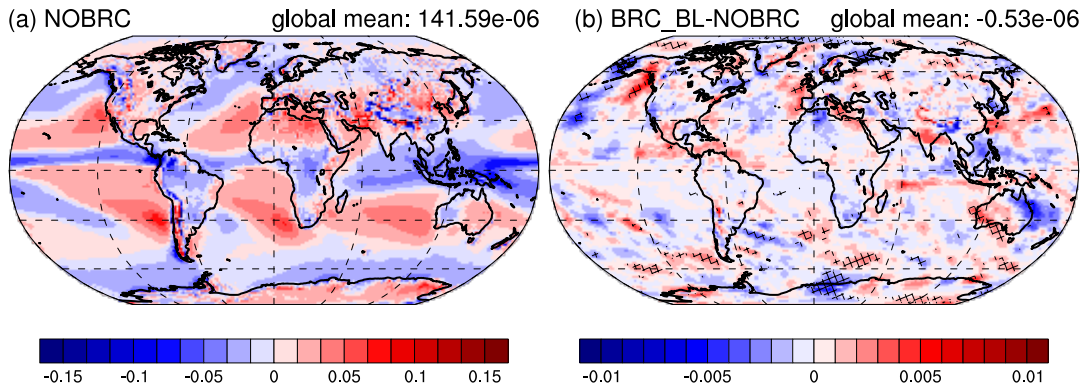

Figure S11: 500 mb omega in Pa s^{-1}: (a) the default annual average and (b) the difference with the incorporation of BrC and BrC bleaching (BRC_BL). Hatching indicates significance in the ensemble year change to the 0.1 level.

Tables:

Table S1: This table shows the average hydroxyl radical ([OH]) concentrations and the BrC half-life globally as well as at 6 different BrC influenced regions denoted in Fig. S1. Average [OH] is taken from the surface to the 200 hPa level to capture levels with high BrC influence.

BrC Influenced Region	[OH] (mol. cm^{-3})	BrC Half-Life (days)
Africa (1)	7.30×10^{5}	0.47
Africa, aged smoke (2)	9.14×10^{5}	0.38
South America (3)	3.96×10^{5}	0.88
Boreal Fires (4)	2.15×10^{5}	1.61
Arctic (5)	1.66×10^{5}	2.09
Southeast Asia (6)	9.35×10^{5}	0.37
Global	$\mathbf{5.83\times10^{5}}$	**0.59**