Revised Figures and Tables for acp-2010-134

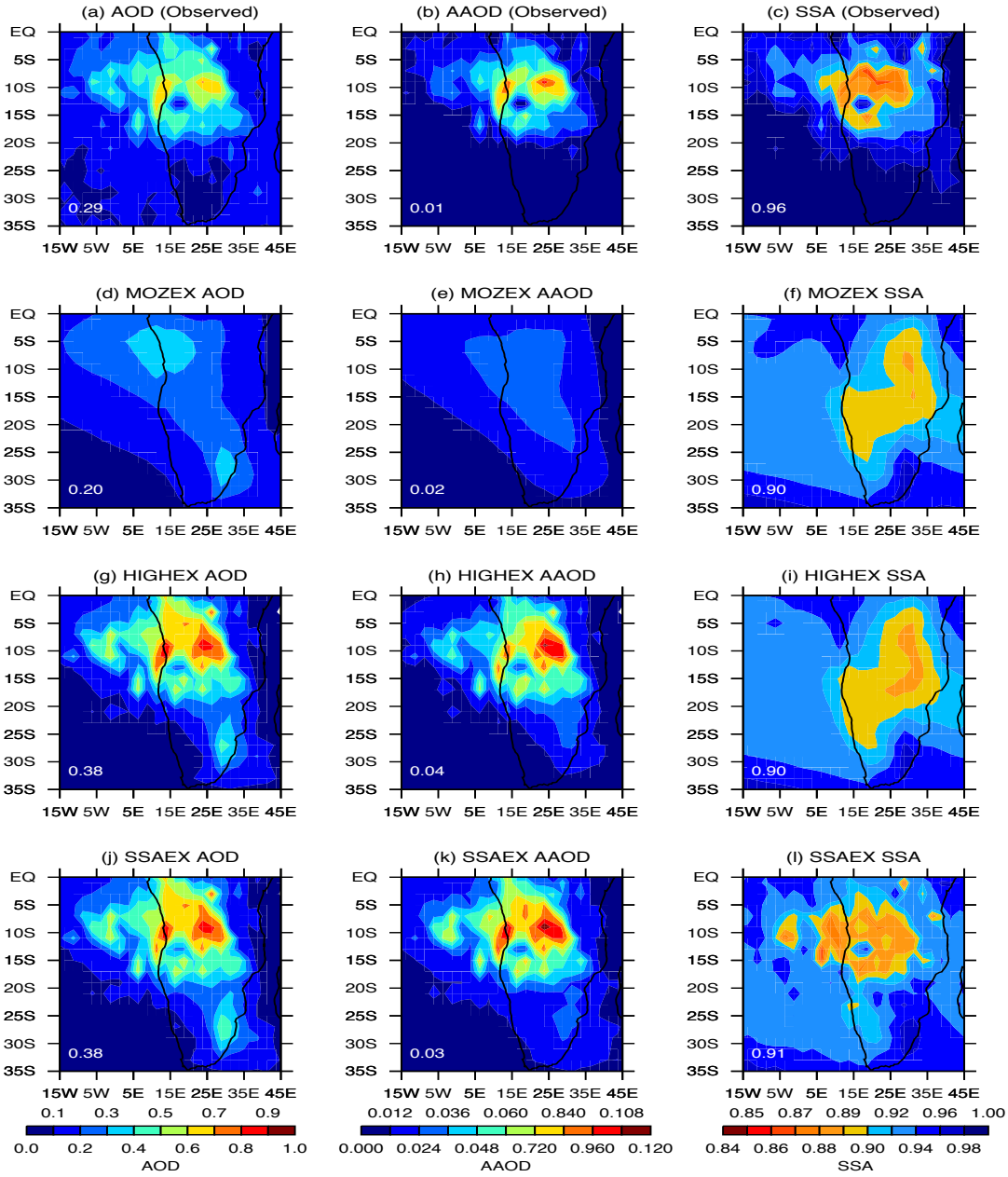

Figure 1: ASO aerosol optical depth (AOD; left column), aerosol absorption optical depth (AAOD; center column), and single scattering albedo (SSA; right column) based on observations from AERONET and *EP*-TOMS (a-c), and for MOZEX (d-f), HIGHEX (g-i), and SSAEX (j-l). Recall that HIGHEX, SSAEX, and WHITE (not shown) have the similar aerosol mass distributions, so (g) and (j) are nearly the same. MOZEX and HIGHEX have the same OC/BC mass ratio, so the single scattering albedos in (f) and (i) are also similar. Differences arise due to changes in relative humidity in each experiment, as described in the text. Land area-averaged (3°N–37°S, 19°W–50°E) optical properties are given in the lower left of each panel. Note that the optical properties here are for the *total* aerosol, which includes not only bb aerosols (OC plus BC), but also sulfate (SO_4), sea salt, and dust.

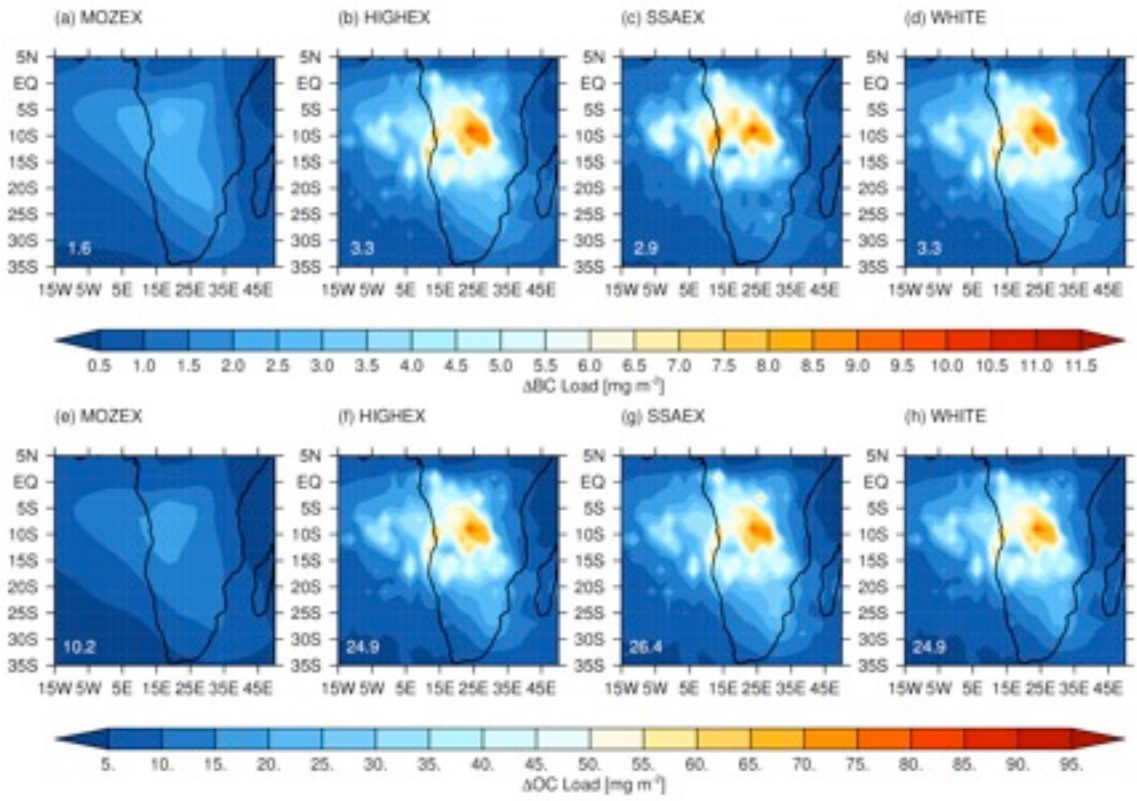

Figure 2: ASO black carbon (BC) column load [mg m^{-3}] for (a) MOZEX, (b) HIGHEX, (c) SSAEX, and (d) WHITE. ASO organic carbon (OC) column load [mg m^{-3}] for (e) MOZEX, (f) HIGHEX, (g) SSAEX, and (h) WHITE. Note that HIGHEX and WHITE have the same BC and OC column loads, but in WHITE both BC and OC are treated optically as scattering-only aerosols as described in the text. Land-area average column load is given in the bottom left of each panel for the boxed region (3°N–37°S, 19°W–50°E) .

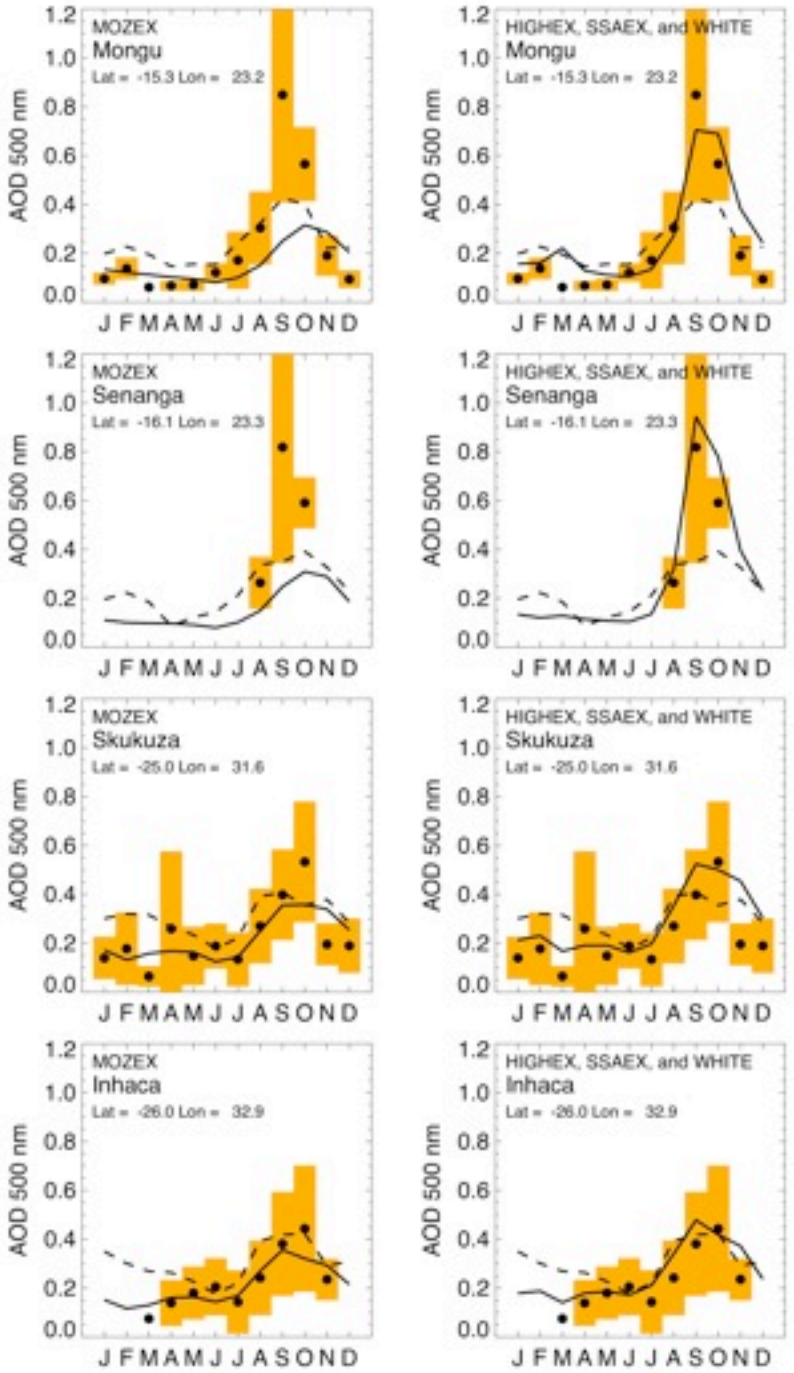

Figure 3: Comparison of simulated (solid black lines) AOD to monthly-mean climatological observations from AERONET (black dots; orange bars are standard deviation) and MODIS retrievals (dashed lines; 2002-2004 average). Left column is for MOZEX and right column is for experiments with OC and BC mass adjusted to match observationally-based maps of column-integrated optical properties (i.e. HIGHEX, SSAEX, and WHITE). Mongu and Senanga lie in the primary biomass burning region (~0-18°S) during the dry season (ASO).

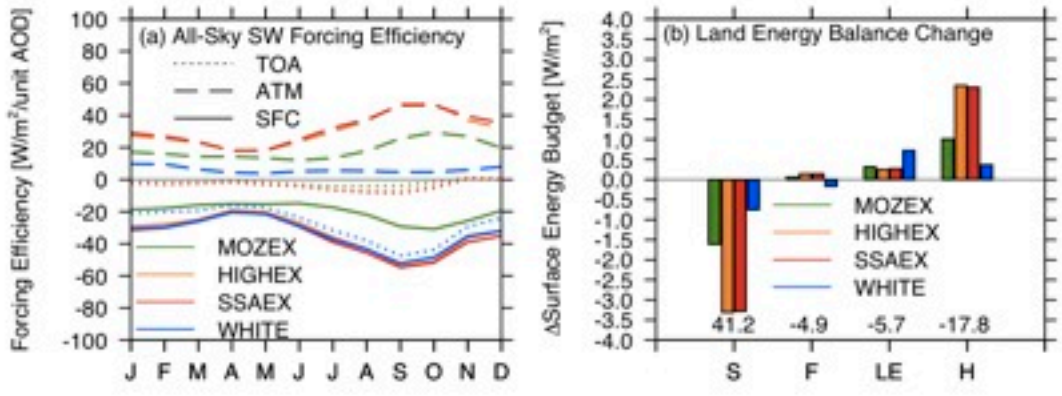

Figure 4: (a) Monthly-mean area-averaged all-sky (cloudy) SFC, ATM, and TOA short-wave (SW) forcing efficiency [W m^{-2} per unit AOD], where TOA = SFC + ATM. (b) ASO area-average equilibrium change in *S*, *F*, *LE*, and *H* fluxes at the surface relative to CTRL from Eq. (1) [W m^{-2}]; positive (negative) changes warm (cool) the surface. Area-average values for CTRL are listed along the lower portion of panel (b).

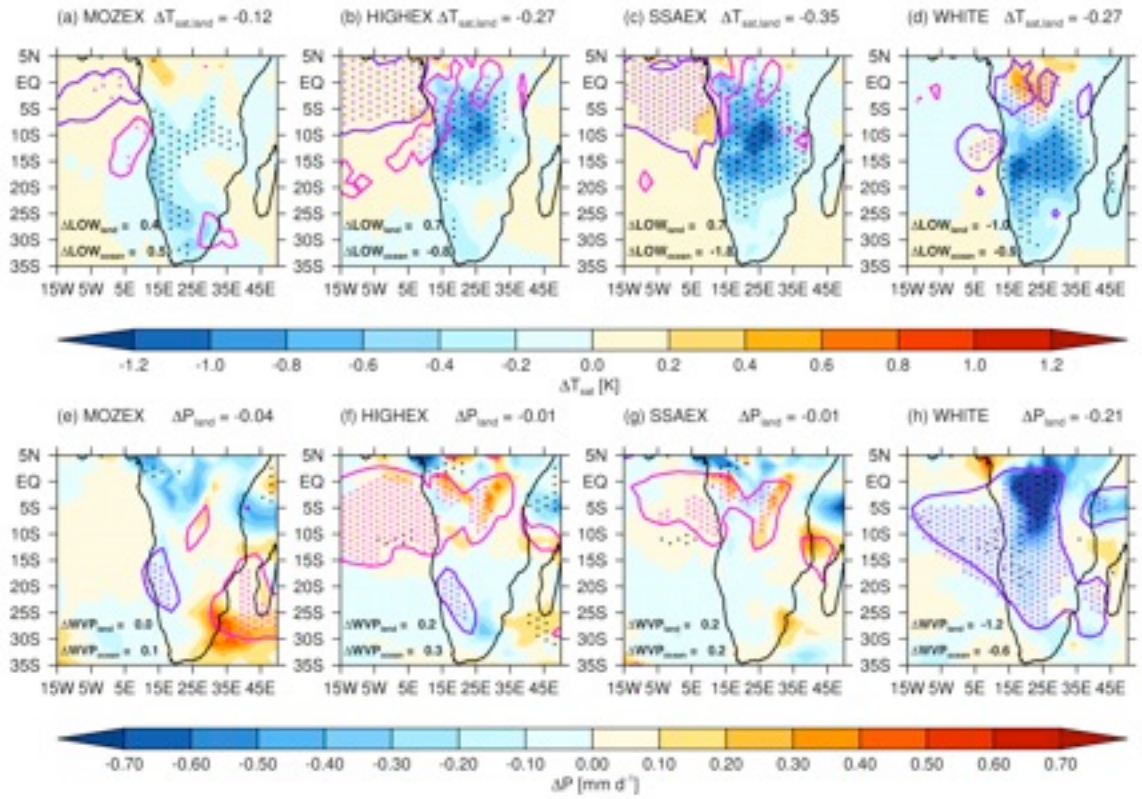

Figure 5: ASO surface air temperature change relative to CTRL (ΔT_{sat}; [K]) (shaded) for (a) MOZEX, (b) HIGHEX, (c) SSAEX, and (d) WHITE with black stippling indicating that changes are significant above 90%. Overlain pink (purple) contours are increased (decreased) low-level cloud above (below) 2.5% with pink (purple) crosses denoting 90% significance. See supplemental material for T_{sat} and low-level cloud distributions from CTRL. Change in total precipitation relative to CTRL (ΔP; [mm d^{-1}]) (shaded) for (e) MOZEX, (f) HIGHEX, (g) SSAEX, and (h) WHITE with black stippling indicating 90% significance. Overlain pink (purple) contours are increased (decreased) column-integrated precipitable water (ΔWVP) above (below) 0.5 mm with pink (purple) crosses denoting 90% significance. See supplemental material for P and column-integrated precipitable water from CTRL.

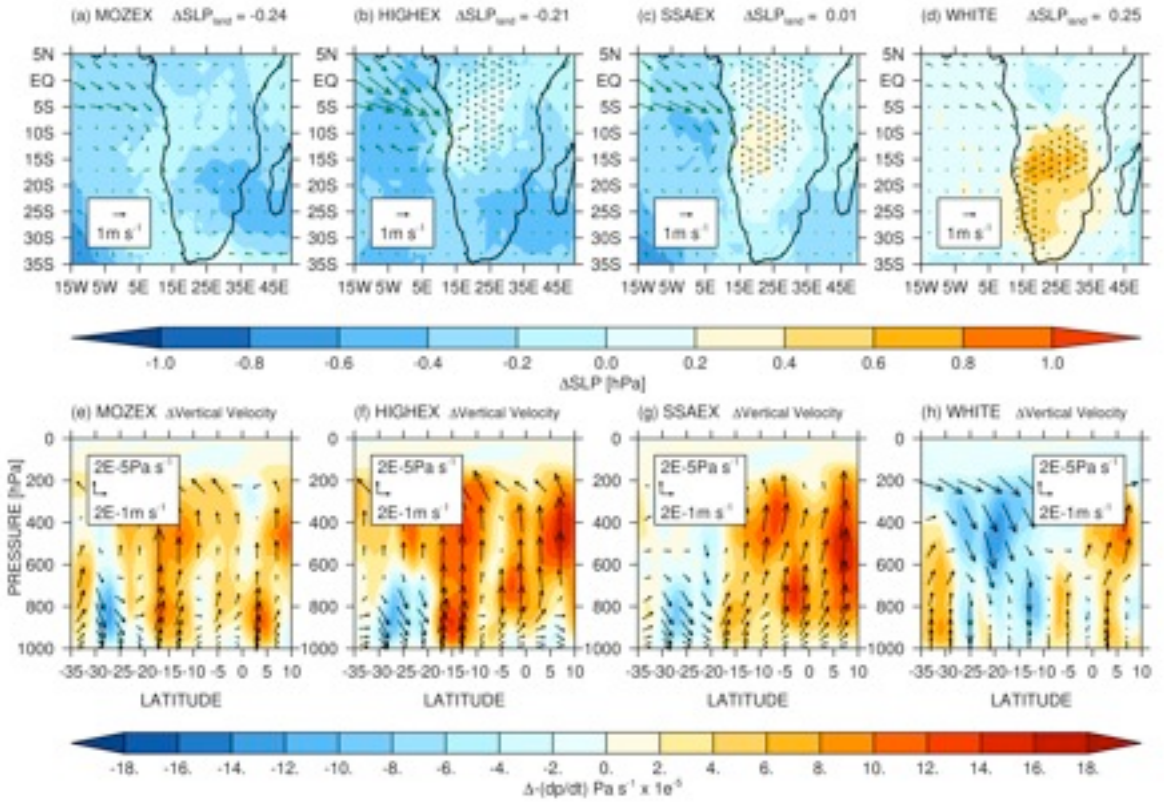

Figure 6: ASO change in sea level pressure (ΔSLP) relative to CTRL [hPa] for (a) MOZEX, (b) HIGHEX, (c) SSAEX, and (d) WHITE overlain with 850-hPa wind anomaly relative to CTRL; black stippling represents ΔSLP above 90% significant. Zonally averaged (0-50°E) change in vertical velocity (-dp/dt) relative to CTRL [Pa s^{-1} x $1e^{-5}$] for (e) MOZEX, (f) HIGHEX, (g) SSAEX, and (h) WHITE overlain with meridional circulation change; note red (blue) shading indicates increased upward motion (relative subsidence). See supplemental material for the CTRL case SLP and 850-hPa wind circulation.

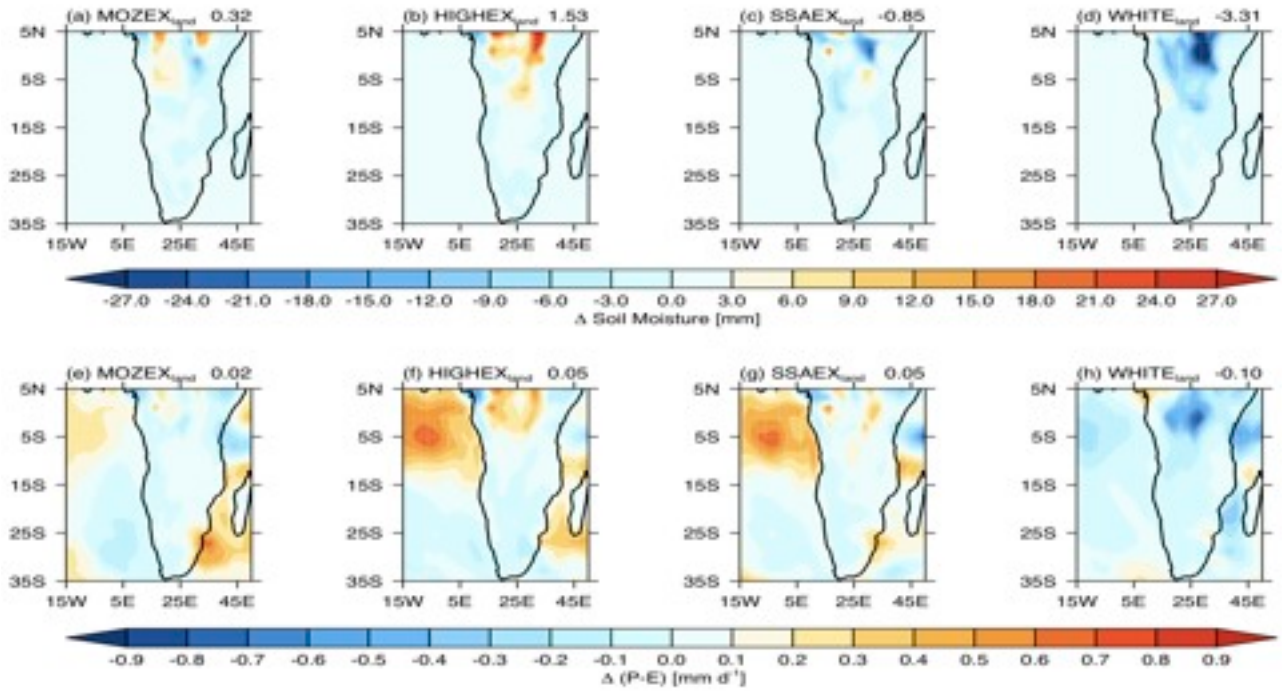

Figure 7: ASO soil moisture change relative to CTRL (Δ Soil Moisture; [mm]) for (a) MOZEX, (b) HIGHEX, (c) SSAEX, and (d) WHITE. ASO change in precipitation minus evaporation (Δ P-E; mm d^{-1}) relative to CTRL for (e) MOZEX, (f) HIGHEX, (g) SSAEX, and (h) WHITE.

Experiment	Natural Aerosols and SO_4	Biomass Burning (BC and OC) aerosols
CTRL	MOZART-2 Y2000	None
MOZEX	MOZART-2 Y2000	MOZART-2 Y2000
HIGHEX	MOZART-2 Y2000	MOZART-2 Y2000 adjusted below ~4km to mimic total aerosol AOD in Figure 1a; ~ same SSA as MOZEX
SSAEX	MOZART-2 Y2000	MOZART-2 Y2000 adjusted below ~4km to mimic total aerosol AOD and SSA in Figs. 1a and b
WHITE	MOZART-2 Y2000	Same as HIGHEX but optical properties of OC and BC treated as dry sulfate (i.e. scattering only)

Table 1. Experimental Design. All experiments have the same natural (sea salt plus dust) and sulfate (SO_4) distributions from MOZART-2 (Horowitz, 2006). Experiments differ based solely on the prescription of OC and BC distributions. All other forcing agents (e.g. long-lived greenhouse gasses, prescribed observed sea surface temperatures) are held constant. Differencing an experiment with respect to the CTRL case indicates the response of the model to biomass burning aerosol forcing.

Experiment	AOD	AAOD	SSA	OC [Mg]	BC [Mg]
Observed	0.29 (0.46)	0.012 (0.041)	0.96 (0.91)	--	--
CTRL	0.1	0.004	0.96	--	--
MOZEX	0.20 (0.25)	0.020 (0.028)	0.90 (0.89)	128.0	19.6
HIGHEX	0.38 (0.66)	0.038 (0.079)	0.90 (0.88)	312.1	41.0
SSAEX	0.38 (0.66)	0.034 (0.073)	0.91 (0.89)	330.3	36.9
WHITE	0.38 (0.65)	0.004 (0.007)	0.99 (0.99)	312.1	41.0

Table 2. Land area-averaged (3ºN-37ºS, 19ºE-50ºW) aerosol optical depth (AOD), single scattering albedo (SSA), and aerosol absorption optical depth (AAOD) for each experiment and the *EP*-TOMS/AERONET observationally-based maps from Figure 1 a-c (Observed). Here AAOD = AOD - SSA × AOD. Land area-averages for the main biomass burning region (7ºS-17ºS, 11ºW-29ºW) are given in parenthesis. ASO total mass loading of BC and OC for each experiment over land for the entire region (3ºN-37ºS, 19ºE-50ºW) is also given. Recall that CTRL does not have BC or OC.

Change Relative to CTRL	MOZEX	HIGHEX	SSAEX	WHITE
ΔT_{sat} [K]	-0.12 (-0.08)	-0.27 (-0.15)	-0.35 (-0.18)	-0.27 (-0.16)
Δ(P-E) [mm d^{-1}]	+0.02 (+0.04)	+0.05 (+0.08)	+0.05 (+0.08)	-0.1 (-0.07)
ΔP [mm d^{-1}]	-0.04 (-0.01)	-0.01 (0)	-0.01 (0)	-0.21 (-0.13)
ΔE [mm d^{-1}]	-0.06 (-0.05)	-0.06 (-0.08)	-0.05 (-0.08)	-0.12 (-0.05)
Δ Precipitable Water [mm]	0 (+0.1)	+0.2 (+0.3)	+0.2 (+0.2)	-1.2 (-0.9)
Δ Low Clouds [%]	+0.4 (+0.4)	+0.7 (+0.1)	+0.7 (-0.3)	-1.0 (-0.9)
Δ Soil Moisture [mm]	+0.32	+1.53	-0.85	-3.31

Table 3: Summary of ASO area-weighted average (3°N-37°S, 19°E-50°W) change in surface air temperature (T_{sat}), precipitation minus evaporation (P-E; [mm d^{-1}]), precipitation (P; [mm d^{-1}]), evaporation (E; [mm d^{-1}]), column-integrated precipitable water (WVP) [mm], low-level clouds [%], and soil moisture [mm]. Land-only averages are given with land plus ocean averages in parenthesis.

Revised Figures and Tables for Supplemental Material:

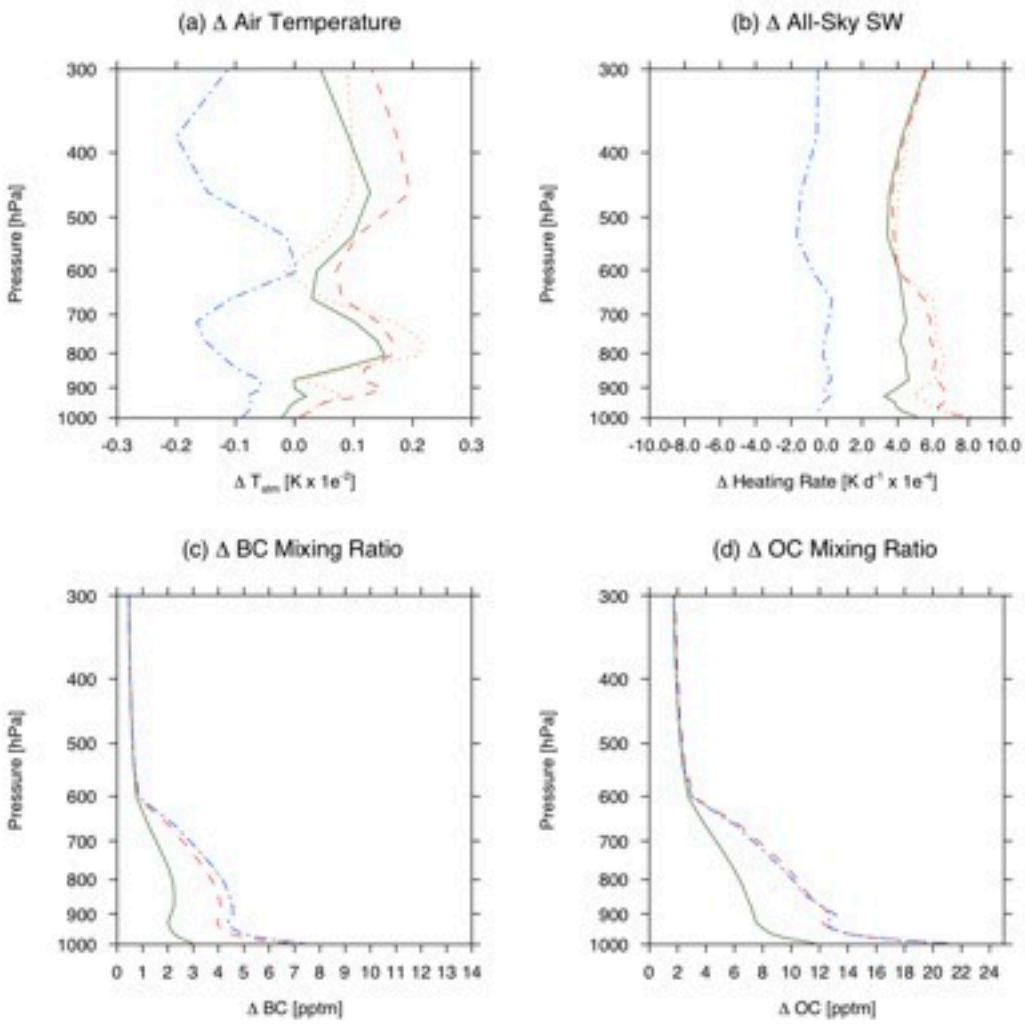

Figure S.1: ASO area-average (3°N-35°S, 0°-50°W) vertical profiles of the change in (a) atmospheric temperature (T_{atm}), (b) all-sky shortwave (SW) heating rate, (c) BC mixing ratio, and (d) OC mixing ratio relative to CTRL for MOZEX (solid green), HIGHEX (dotted orange), SSAEX (dashed red), and WHITE (dash-dotted blue). Recall OC and BC distributions are the same in HIGHEX and WHITE (dotted orange line lies beneath dash-dotted blue in (c) and (d)). However, in WHITE, BC and OC are treated as optically scattering only.

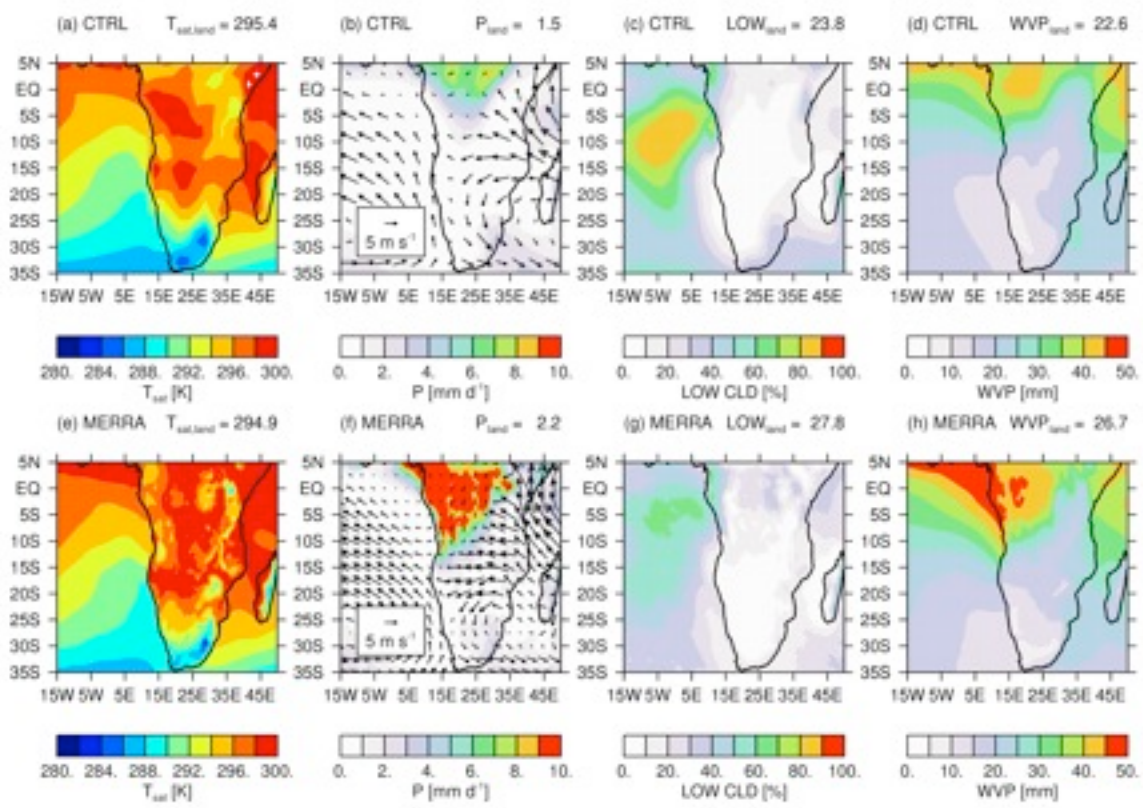

Figure S.2: ASO (a) surface air temperature (T_{sat}), (b) precipitation (P) and 850-hPa winds, (c) low-level cloud amount (LOW), and (d) column-integrated precipitable water (WVP) for the CTRL case. ASO (e) T_{sat}, (f) P and 850-hPa winds, (g) LOW, and (h) WVP from the MERRA reanalysis for the year 2000 described in the text.

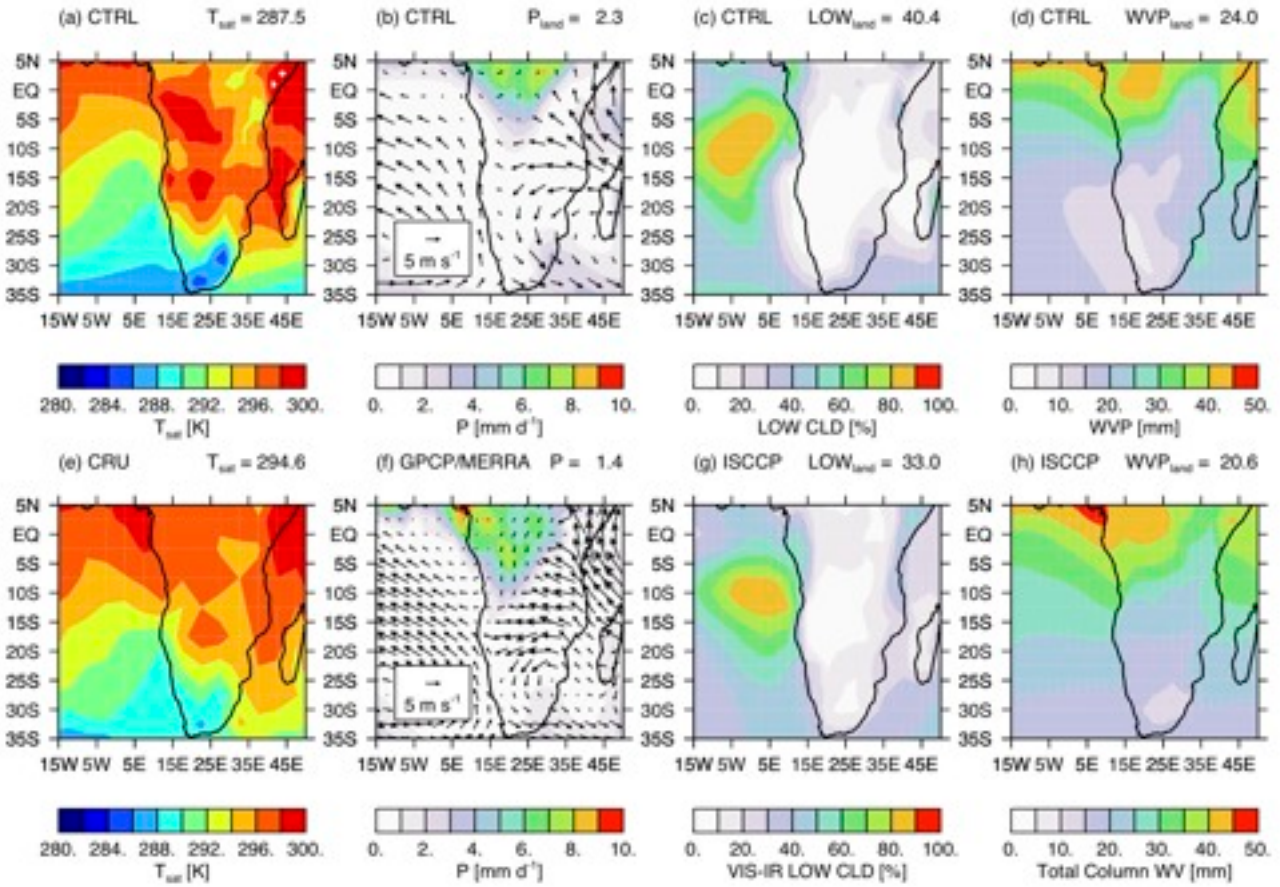

Figure S.3: ASO (a) surface air temperature (T_{sat}), (b) precipitation (P) and 850-hPa winds, (c) low-level cloud amount (LOW), and (d) column-integrated precipitable water (WVP) for the CTRL case. Year 2000 ASO observations of (a) surface air temperature (T_{sat}) from CRU, (b) GPCP precipitation, (c) ISCCP VIS-IR low-level clouds, and ISCCP total column water vapor. See supplemental text for more details about the observational data.

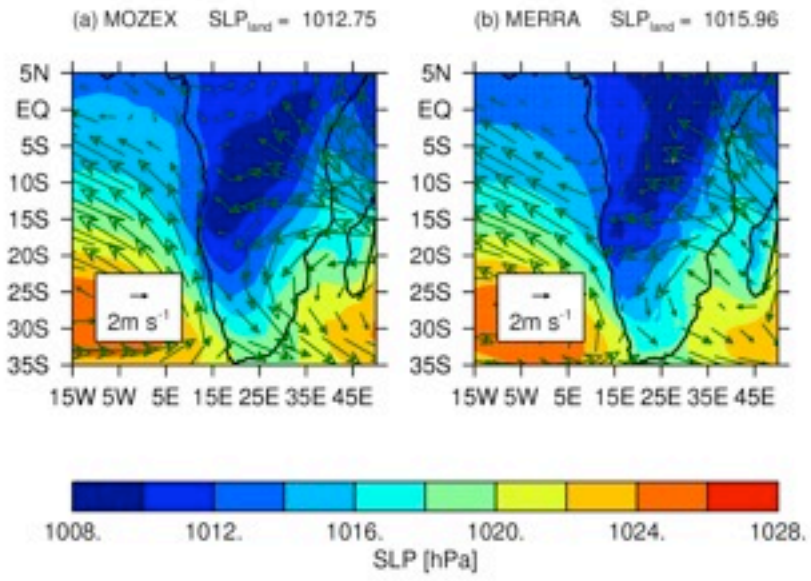

Figure S.4: (a) ASO sea-level pressure (SLP) and 850-hPa winds for the CTRL case. (b) Year 2000 MERRA reanalysis SLP and 850-hPa winds. See supplemental text for more details on the MERRA reanalysis data.

Station	Lat	Lon	Years	Min ASO AOD	Max ASO AOD	Total # Months in ASO	ASO Mean AOD	%Days in ASO (Figure 1a)	
				AERONET Climatology (Figure 3)				*EP*-TOMS	AERONET
Ascension Island	-7	-14	2000-2005	0.12	0.37	15	0.23	**27**	**38**
Bethlehem	-28	28	2000	0.21	0.3	3	0.24	**27**	**51**
Etosha Pan	-19	15	2000	0.23	0.48	3	0.37	**53**	**34**
Illorian	8	4	1998-2009	0.21	0.59	28	0.34	**5**	**2**
Inhaca	-26	32	2000-2001	0.24	0.44	5	0.41	**26**	**56**
Kaoma	-14	24	2000	0.3	1.02	2	0.66	**17**	**2**
Maun Tower	-19	23	2000	0.4	0.59	2	0.50	**32**	**12**
Mongu	-15	23	1995-2006	0.18	0.85	35	0.51	**29**	**66**
Mwinilunga	-11	24	2000	0.72	1.10	2	0.91	**11**	**28**
Ndola	-12	28	2000	0.44	0.75	2	0.60	**25**	**61**
Pietersburg	-23	29	2000-2006	0.22	0.4	2	0.31	**22**	**12**
Senanga	-16	23	1996-2000	0.24	1.04	8	0.53	**33**	**19**
Skukuza	-24	31	1998-2007	0.14	0.53	30	0.31	**17**	**33**
Skukuza Aeroport	-24	31	2000	0.32	0.64	2	0.48	**17**	**15**
Solwezi	-12	26	2000	0.62	0.95	2	0.79	**24**	**32**
Sua Pan	-20	26	2000	0.19	0.64	2	0.42	**25**	**8**
Swakopmund	-22	14	2000	0.15	0.15	1	0.15	**44**	**2**
Zambezi	-13	23	1996-2000	0.35	1.08	8	0.58	**12**	**41**

Table S.1: Locations of AERONET stations over southern Africa used to construct observationally-based maps in Figure 1 (a). Minimum, maximum, and average monthly-mean column integrated AOD (from the AERONET climatology tables, Level 2, Version 2) at each AERONET station during the dry season (August-September-October). The number of monthly-mean observations and the period over which the observations were taken is also given. The last column gives the percent of days in ASO in which *EP*-TOMS AOD data were available for the model gridbox containing a given station and the percent of days in ASO where AERONET AOD data was used. Days with no data for a given model gridbox were not counted in making the monthly averages.