Supplementary Information

SI Table 1: CAM5 Physics

<table>
<thead>
<tr>
<th>Physics Process</th>
<th>CAM5</th>
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<tbody>
<tr>
<td>Shallow convection</td>
<td>Park et al. (2009)</td>
</tr>
<tr>
<td>Deep convection</td>
<td>Neale et al. (2008)</td>
</tr>
<tr>
<td>Microphysics</td>
<td>Morrison and Gettelman (2008)</td>
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<tr>
<td>Macrophysics</td>
<td>Gettelman et al. (2011)</td>
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<td>Radiation</td>
<td>Iacono et al. (2008)</td>
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<tr>
<td>Aerosols</td>
<td>Ghan et al. (2012)</td>
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<tr>
<td>Dynamics</td>
<td>Finite Volume</td>
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</tbody>
</table>

SI Figure 1: Cloud categories in CAM5 from ISCCP ([http://isccp.giss.nasa.gov/cloudtypes.html](http://isccp.giss.nasa.gov/cloudtypes.html))
SI Figure 2: Scatter AOD plot between CAM simulations and MODIS observations in July, August, and September of 2005 and 2006 at GNR with a linear fit of $y = 1.60x - 0.036$ ($R^2 = 0.83186$) (a) and ITR with a linear fit of $y = 0.36x + 0.13$ ($R^2 = 0.57186$) (b).
SI Figure 3: CAM and CALIPSO (Winker et al. 2009) Aerosol Extinction Coefficient (km$^{-1}$) at 22ºW on August 2006
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SI Figure 5: DOD modeled by CAM in fine resolution at 550nm in August 2005 (a) and August 2006 (b). The cross-section of dust mixing ratio ($10^{-5}$ g kg$^{-1}$) simulated by CAM at 22°N in August 2005 (c) and August 2006 (d). The difference between DOD in 2005 and 2006 is in (e). The difference between AOD and DOD of 2005 is shown in (f).
SI Figure 6: Surface Pressure (hPa) and wind barbs at 870hPa in August 2005 (a-c) and August 2006 (d-f) in fine resolution simulation. The contours levels in (a, b, d, e) range from 1000hPa to 1021hPa with 3hPa intervals, the solid and dashed contours in (c, f) represent positive and negative anomalies of pressure in 1hPa intervals between the dust and non-dust scenarios in 2005 and 2006. The maximum pressure center indicates the SHL.
SI Figure 7: The difference of the input observed SST (°C) in CAM5.1 on JAS of 2005 and 2006

SI Figure 8: Wind speed (m s⁻¹) and wind vector at 600hPa in August 2005 (a-c) and August 2006 (d-f), similarly to Figure 4. The maximum wind speed region indicates the AEJ. The shaded region represents the 95% significant level of the Student’s T-test.
SI Figure 9: Convective Precipitation rate (mm day$^{-1}$) in August 2005 (a-c) and August 2006 (d-f) in fine resolution simulation
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SI Figure 11: Temperature (K) and dust mixing ratio \(10^6 \text{ kg kg}^{-1}\) at 10°W in August 2005 (left) and 2006 (right). (a, b) the dust scenario, (c, d) the difference between dust and non-dust scenarios. The dotted regions label the 95% significant level of the Student-T test.

(a) CAM DUST T (K) 2005-08 at 10W

(b) CAM DUST T (K) 2006-08 at 10W

(c) CAM DIFF T (K) 2005-08 at 10W

(d) CAM DIFF T (K) 2006-08 at 10W
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Figure 16: Entropy deficit ($X_m$) from the fine resolution simulation in August 2005 (a-c) and August 2006 (d-f). The top, middle, and bottom panels correspond to the dust scenario, non-dust scenario, and the difference between the two scenarios, respectively.