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Supplement of

Sensitivity of surface solar radiation to aerosol–radiation and aerosol–cloud interactions over Europe in WRFv3.6.1 climatic runs with fully interactive aerosols

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Supplementary Figure S1. Spatial domains used for the WRF simulations. The outer domain (gray shaded) has an horizontal resolution of 1.32° in latitude and longitude; the inner target domain (colored) of 0.44° (Euro-Cordex compliant). The nesting was one-way (outer-to-inner domain).
Supplementary Figure S2. RSDS summer climatologies in the historical period from the GCM (a), ERA5 (b) and the WRF simulations (d to f); units: $\text{Wm}^{-2}$, same colorbar in all cases (the upper one). Panel c depicts relative differences between the GCM and ERA5, panels g to i between each WRF simulation and the GCM, and panels j to l between each WRF simulation and ERA5, squared if statistically significant ($p<0.05$); units: $\%$, same colorbar in all cases (the bottom one).
RSDS, CCT & AOD JJA climatologies for 1991-2010: differences between experiments

(a) RSDS ARI-BASE
(b) RSDS ARCI-BASE
(c) RSDS ARCI-ARI

(d) CCT ARI-BASE
  \(s_{corr}\) with (a) = -0.75
(e) CCT ARCI-BASE
  \(s_{corr}\) with (b) = -0.75
(f) CCT ARCI-ARI
  \(s_{corr}\) with (c) = -0.65

(g) AOD ARI
  \(s_{corr}\) with (a) = -0.15
(h) AOD ARCI
  \(s_{corr}\) with (b) = -0.05
(i) AOD ARCI-ARI
  \(s_{corr}\) with (c) = -0.05

Supplementary Figure S3. As Figure 1 of the main manuscript but with plain differences depicted (non-relative values). Units: RSDS in Wm\(^{-2}\), CCT in % of the grid cell area, AOD dimensionless.
Temporal correlations between RSDS, CCT & AOD differences
JJA-mean series in 1991-2010

(a) RSDS vs CTT
diffs ARI-BASE
(b) RSDS vs CTT
diffs ARCI-BASE
(c) RSDS vs CTT
diffs ARCI-ARI

(d) RSDS vs AOD
diffs ARI-BASE
(e) RSDS vs AOD
diffs ARCI-BASE
(f) RSDS vs AOD
diffs ARCI-ARI

(g) RSDS_{cs} vs AOD_{cs}
diffs ARI-BASE
(h) RSDS_{cs} vs AOD_{cs}
diffs ARCI-BASE
(i) RSDS_{cs} vs AOD_{cs}
diffs ARCI-ARI

Supplementary Figure S4. Temporal correlations between JJA-mean temporal series of differences in RSDS and CTT (a to c), RSDS and AOD (d to f), and RSDS_{cs} and AOD_{cs} (g to i; gray-shaded areas where the number of time steps in the clear-sky series is below 75% of total time steps) between ARI and BASE (first column), ARCI and BASE (second column), and ARCI and ARI experiments (third column) in the historical period (1991-2010). Little stars indicate statistical significance (p<0.05).
RSD$_{cs}$ & AOD$_{cs}$ JJA climatologies for 1991-2010: differences between experiments

(a) RSD$_{cs}$ ARI-BASE  
(b) RSD$_{cs}$ ARCI-BASE  
(c) RSD$_{cs}$ ARCI-ARI

(d) AOD$_{cs}$ ARI  
$\Delta_{corr}$ with (a) = -0.66  
(e) AOD$_{cs}$ ARCI  
$\Delta_{corr}$ with (b) = -0.70  
(f) AOD$_{cs}$ ARCI-ARI  
$\Delta_{corr}$ with (c) = -0.67

Supplementary Figure S5. As Figure 6 of the main manuscript but with plain differences depicted (non-relative values). Units: RSD$_{cs}$ in Wm$^{-2}$, AOD$_{cs}$ dimensionless.
Supplementary Figure S6. As Figure 1 of the main manuscript but for the future period (2031-2050).
Temporal correlations between RSDS, CCT & AOD differences
JJA-mean series in 2031-2050

Supplementary Figure S7. As Supplementary Figure 4 but for the future period (2031-2050).
RSDS$_{cs}$ & AOD$_{cs}$ JJA climatologies for 2031-2050: differences between experiments

(a) RSDS$_{cs}$ ARI-BASE
(b) RSDS$_{cs}$ ARCI-BASE
(c) RSDS$_{cs}$ ARCI-ARI

(d) AOD$_{cs}$ ARI $s_{corr}$ with (a) = -0.77
(e) AOD$_{cs}$ ARCI $s_{corr}$ with (b) = -0.80
(f) AOD$_{cs}$ ARCI-ARI $s_{corr}$ with (c) = -0.61

Supplementary Figure S8. As Figure 6 of the main manuscript but for the future period (2031-2050).
Supplementary Figure S9. As Figure 3 of the main manuscript but for the future period (2031-2050).
Precipitation-related JJA climatologies for 2031-2050: differences between experiments

(a) PR ARI-BASE    (b) PR ARCI-BASE    (c) PR ARCI-ARI

(d) 90pctl PR ARI-BASE    (e) 90pctl PR ARCI-BASE    (f) 90pctl PR ARCI-ARI

(g) RD ARI-BASE    (h) RD ARCI-BASE    (i) RD ARCI-ARI

(j) PRC ARI-BASE    (k) PRC ARCI-BASE    (l) PRC ARCI-ARI

Supplementary Figure S10. As Figure 4 of the main manuscript but for the future period (2031-2050).
Contribution of each aerosol species to the JJA-mean total surface aerosol concentration (period 2031-2050)

Supplementary Figure S11. As Figure 2 of the main manuscript but for the future period (2031-2050).
RSDS, CCT & AOD JJA changes (2031-2050 vs. 1991-2010)

(a) GCM RSDS
(b) BASE RSDS
(c) ARI RSDS
(d) ARCI RSDS

(e) GCM CCT
\( s_{corr} \) with (a) = -0.91
(f) BASE CCT
\( s_{corr} \) with (b) = -0.88
(g) ARI CCT
\( s_{corr} \) with (c) = -0.83
(h) ARCI CCT
\( s_{corr} \) with (d) = -0.77

(i) GCM AOD
\( s_{corr} \) with (a) = -0.57
(j) BASE AOD
\( s_{corr} \) with (b) = N.A.
(k) ARI AOD
\( s_{corr} \) with (c) = 0.21
(l) ARCI AOD
\( s_{corr} \) with (d) = -0.11

Supplementary Figure S12. As Figure 7 of the main manuscript but with plain differences depicted (non-relative values). Units: RSDS in Wm\(^{-2}\), CCT in % of the grid cell area, AOD dimensionless.
RSDS\textsubscript{cs} & AOD\textsubscript{cs} JJA changes (2031-2050 vs. 1991-2010)

(a) BASE RSDS\textsubscript{cs}  
(b) ARI RSDS\textsubscript{cs}  
(c) ARCI RSDS\textsubscript{cs}  

(d) BASE AOD\textsubscript{cs}  
\(s_{corr}\) with (a) = N.A.  
(e) ARI AOD\textsubscript{cs}  
\(s_{corr}\) with (b) = -0.04  
(f) ARCI AOD\textsubscript{cs}  
\(s_{corr}\) with (c) = -0.18

Supplementary Figure S13. As Figure 8 of the main manuscript but with plain differences depicted (non-relative values). Units: RSDS\textsubscript{cs} in Wm\textsuperscript{-2}, AOD\textsubscript{cs} dimensionless.
RSDS, CCT & AOD DJF climatologies for 1991-2010: differences between experiments

(a) RSDS ARI-BASE

(b) RSDS ARCI-BASE

(c) RSDS ARCI-ARI

(d) CCT ARI-BASE

(e) CCT ARCI-BASE

(f) CCT ARCI-ARI

(g) AOD ARI

(h) AOD ARCI

(i) AOD ARCI-ARI

Supplementary Figure S14. As Figure 1 of the main manuscript but for the winter (DJF) season.
Supplementary Figure S15. As Figure 6 of the main manuscript but for the winter (DJF) season.
RSDS, CCT & AOD DJF changes (2031-2050 vs. 1991-2010)

Supplementary Figure S16. As Figure 7 of the main manuscript but for the winter (DJF) season.
Supplementary Figure S17. As Figure 8 of the main manuscript but for the winter (DJF) season.