Implementation of the ORACLE (v1.0) organic aerosol composition and evolution module into the EC-Earth3-AerChem model

Supporting Information

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Number of tables: 1

Number of figures: 13

Table S1: Global average surface concentrations of POA, SOA-sv, SOA-iv, and total OA from standalone TM5-MP simulation using the VBS configuration, presented for annual, DJF, MAM, JJA, and SON periods

OA	Annual ($\mu g\ m^{-3}$)	DJF ($\mu g\ m^{-3}$)	MAM ($\mu g\ m^{-3}$)	JJA ($\mu g\ m^{-3}$)	SON ($\mu g\ m^{-3}$)
TM5-MP					
POA	0.32	0.40	0.24	0.33	0.32
SOA-sv	0.14	0.10	0.14	0.17	0.15
SOA-iv	0.30	0.38	0.27	0.26	0.30
Total OA	1.07	1.09	0.91	1.16	1.11

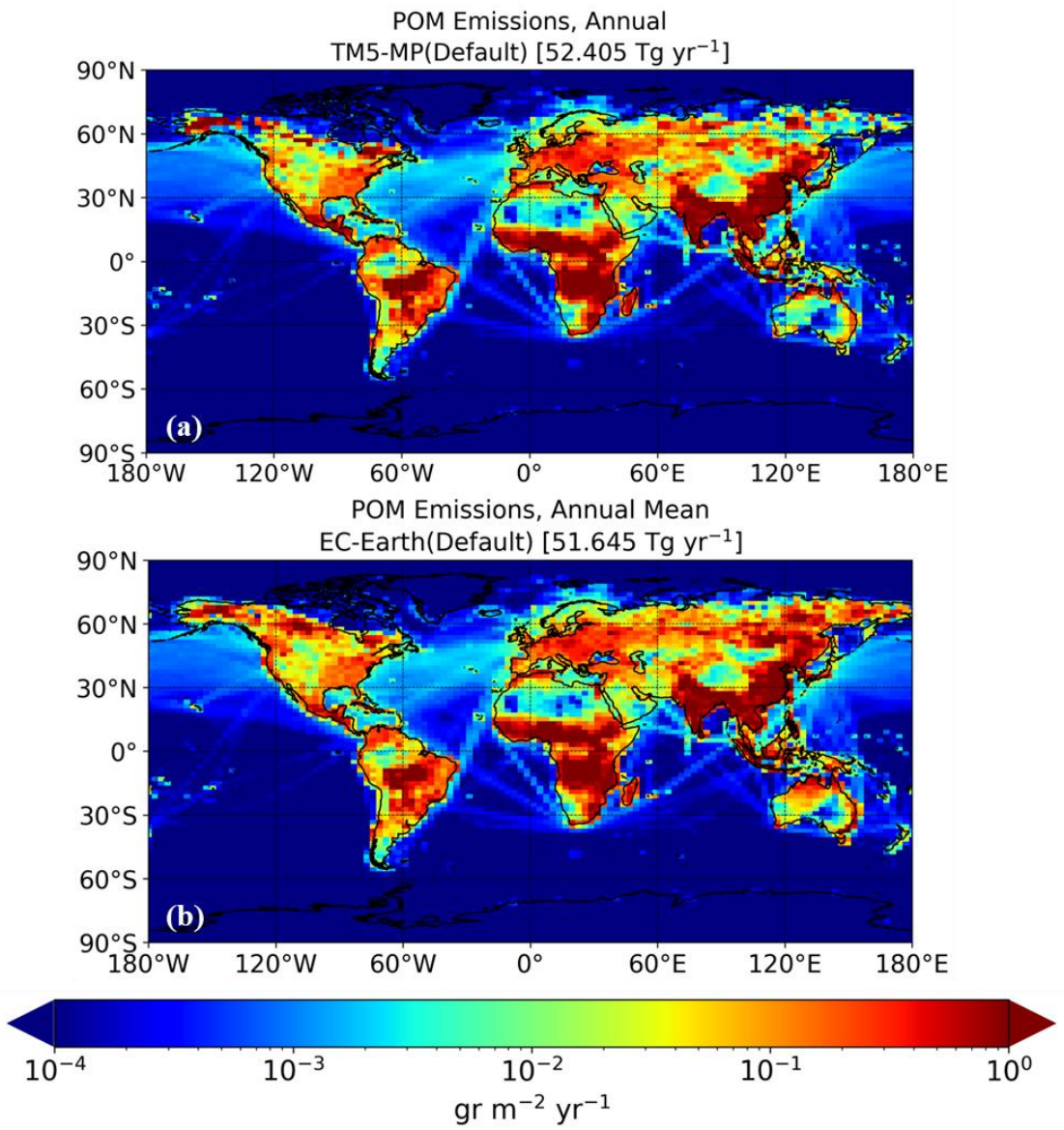

Figure S1. Annual POA emissions (in gr m^{-2} yr^{-1}) applied in the default simulation of: **(a)** standalone TM5-MP during 2005, and **(b)** EC-Earth during 2000-2010.

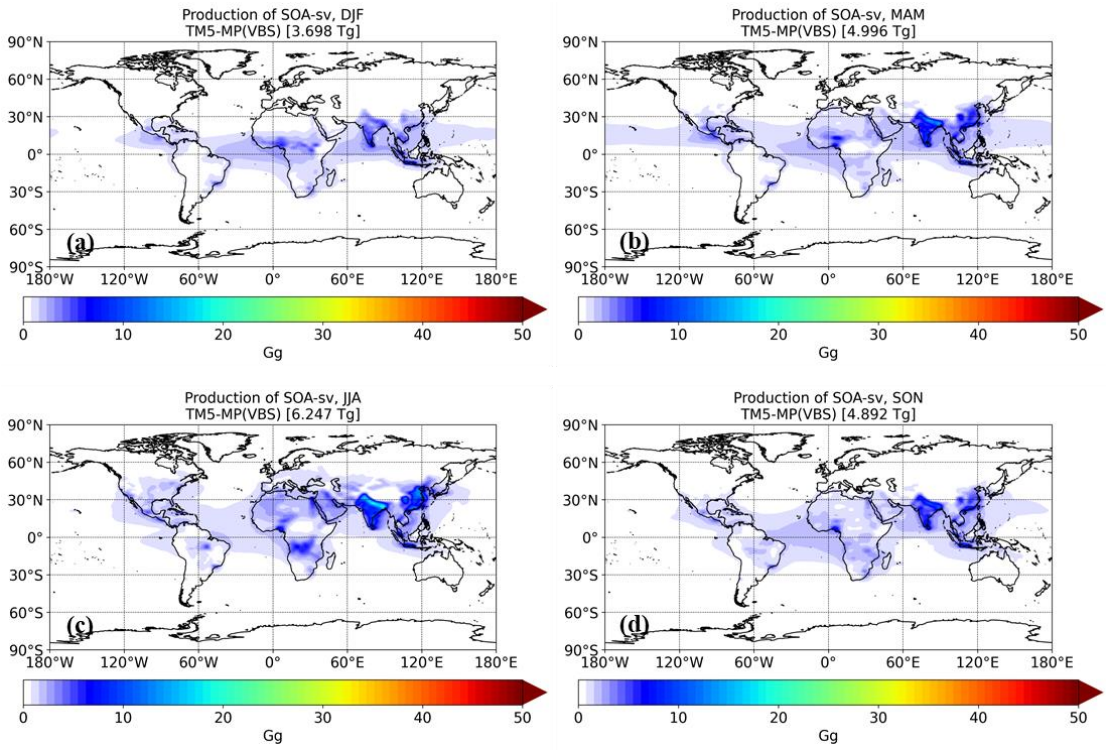

Figure S2. Production of SOA-sv as simulated using the VBS configuration in TM5-MP during 2005 (in Gg) for: **(a)** DJF, **(b)** MAM, **(c)** JJA, and **(d)** SON.

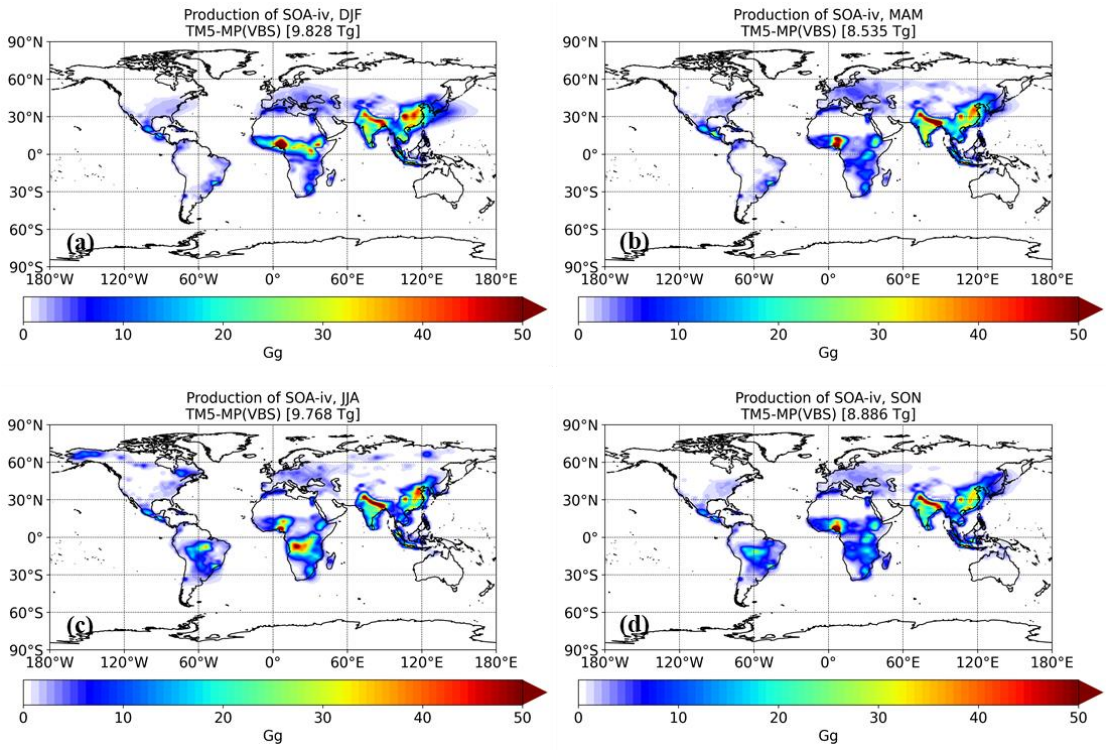

Figure S3. Production of SOA-iv as simulated using the VBS configuration in TM5-MP during 2005 (in Gg) for: **(a)** DJF, **(b)** MAM, **(c)** JJA, and **(d)** SON.

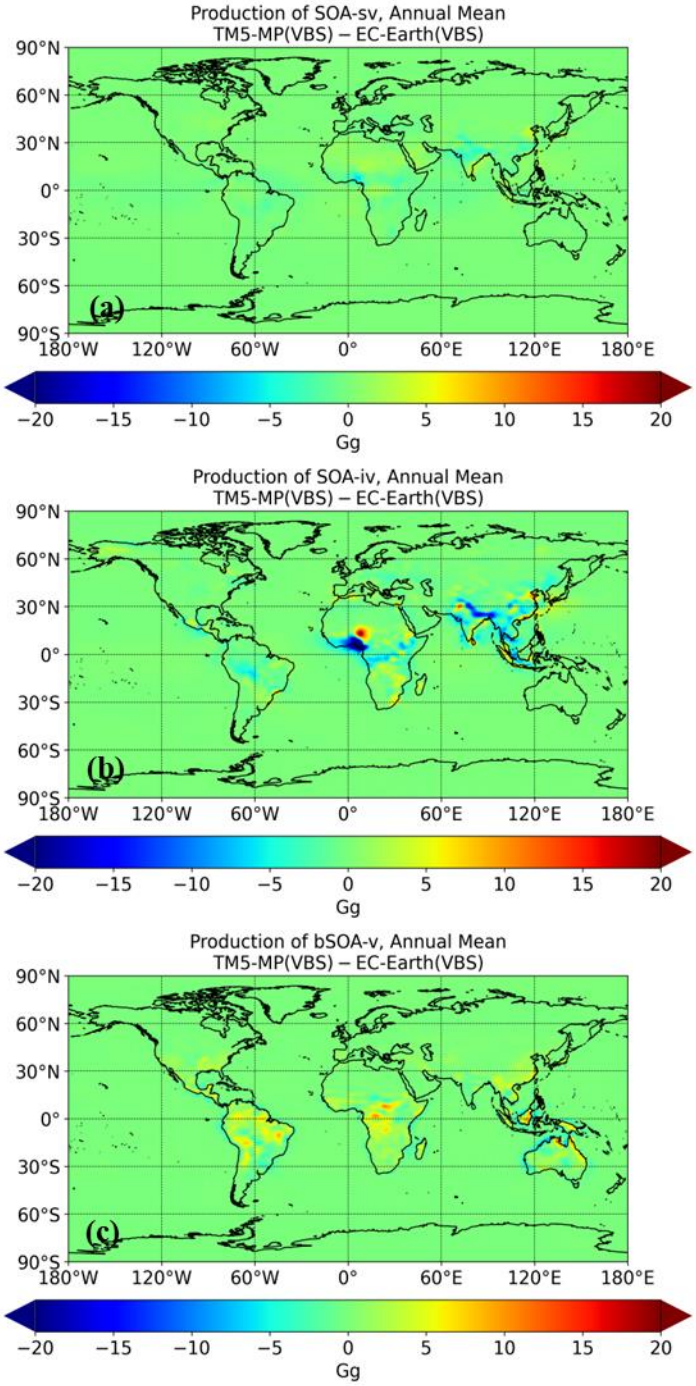

Figure S4. Annual mean differences in SOA production between TM5-MP and EC-Earth simulations during 2005 using the VBS configuration (in Gg) for: **(a)** SOA-sv, and **(b)** SOA-iv. For completeness, the difference in annual SOA production from biogenic VOCs (bSOA-v) in panel **(c)** is also shown. A positive change indicates that the standalone TM5-MP simulation predicts higher production than the EC-Earth.

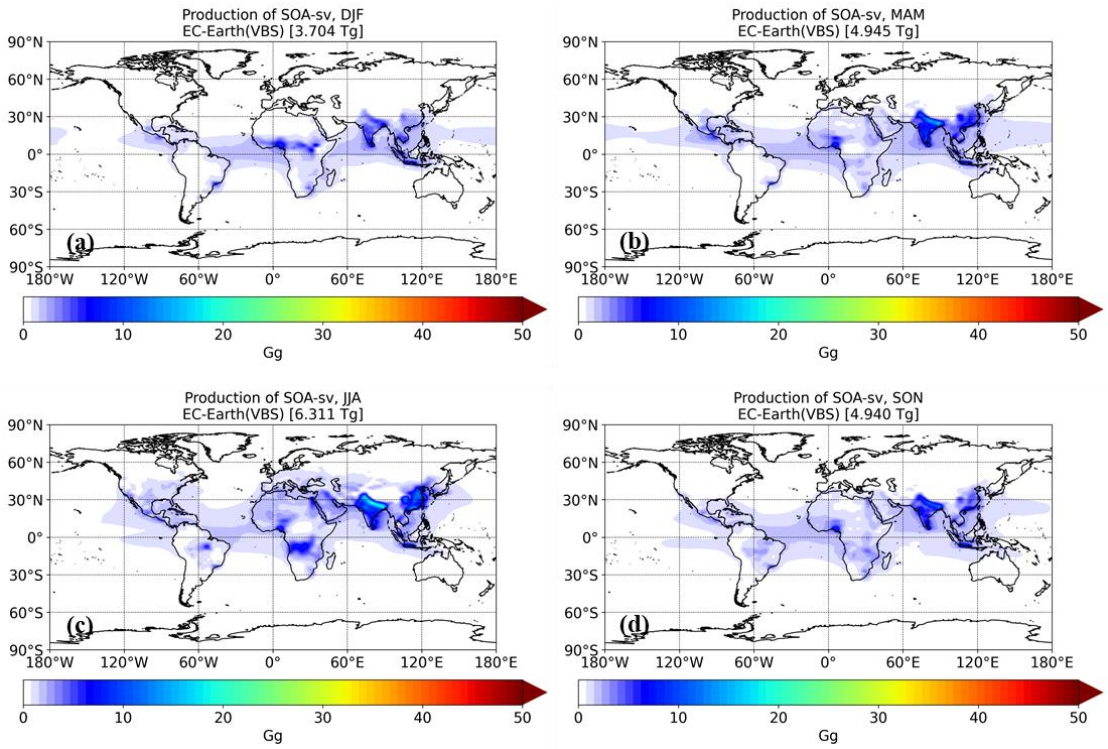

Figure S5. Production of SOA-sv as simulated using the VBS configuration of EC-Earth during 2005 (in Gg) for: **(a)** DJF, **(b)** MAM, **(c)** JJA, and **(d)** SON.

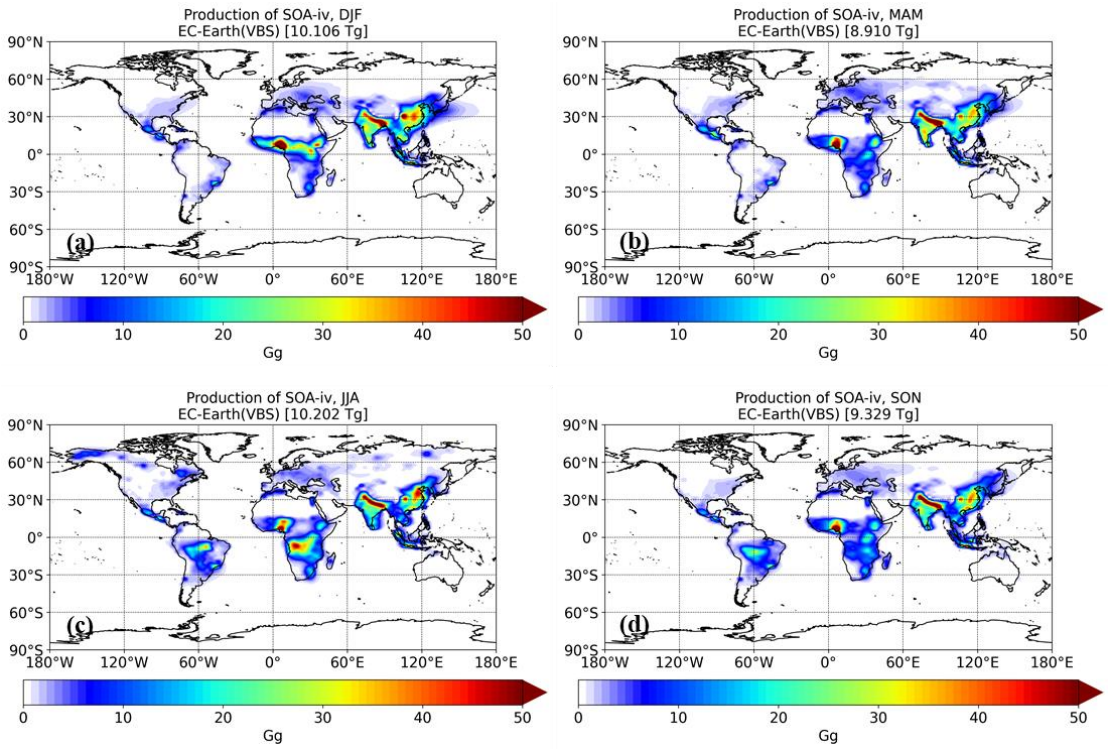

Figure S6. Production of SOA-iv as simulated using the VBS configuration of EC-Earth during 2005 (in Gg) for: **(a)** DJF, **(b)** MAM, **(c)** JJA, and **(d)** SON.

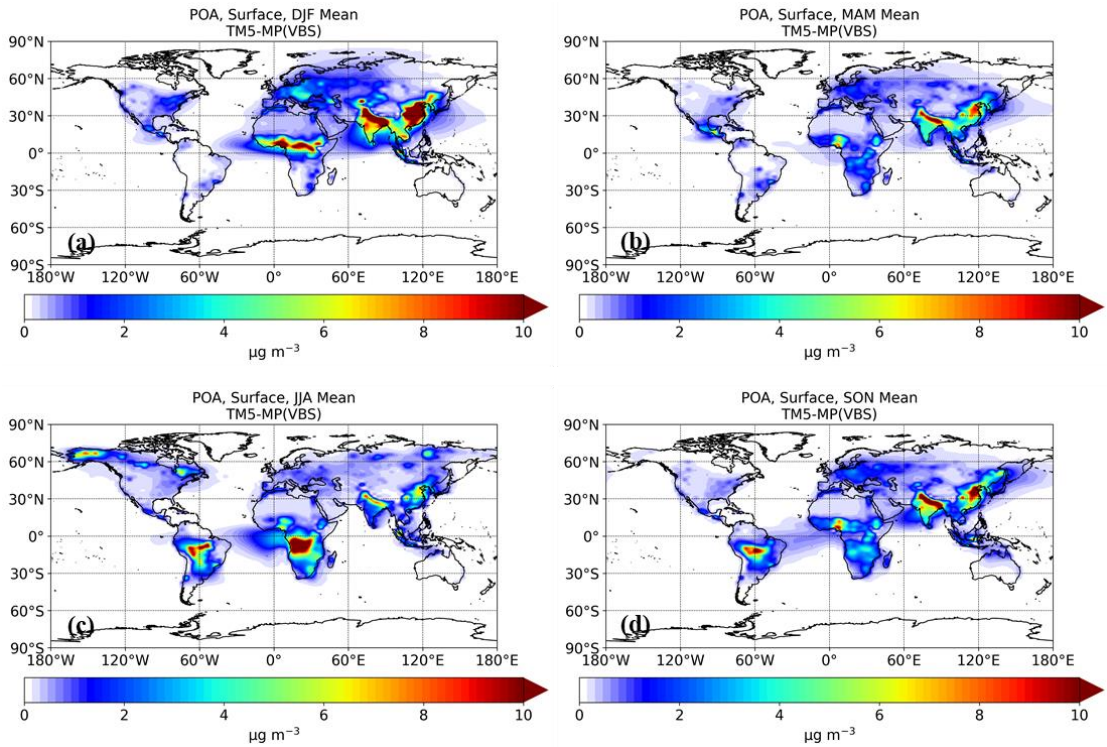

Figure S7. Mean surface concentrations of POA (in µg m^{-3}) during: **(a)** DJF, **(b)** MAM, **(c)** JJA, and **(d)** SON simulated using the VBS configuration in TM5-MP.

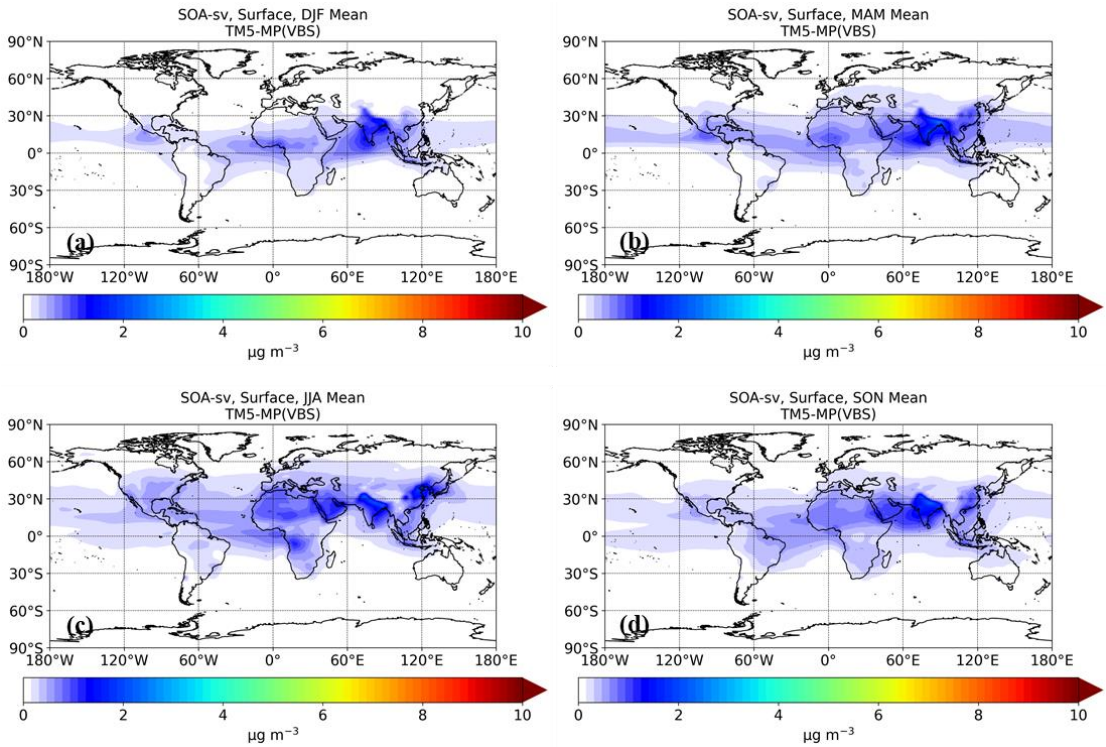

Figure S8. Mean surface concentrations of SOA-sv (in µg m^{-3}) during: **(a)** DJF, **(b)** MAM, **(c)** JJA, and **(d)** SON simulated using the VBS configuration in TM5-MP.

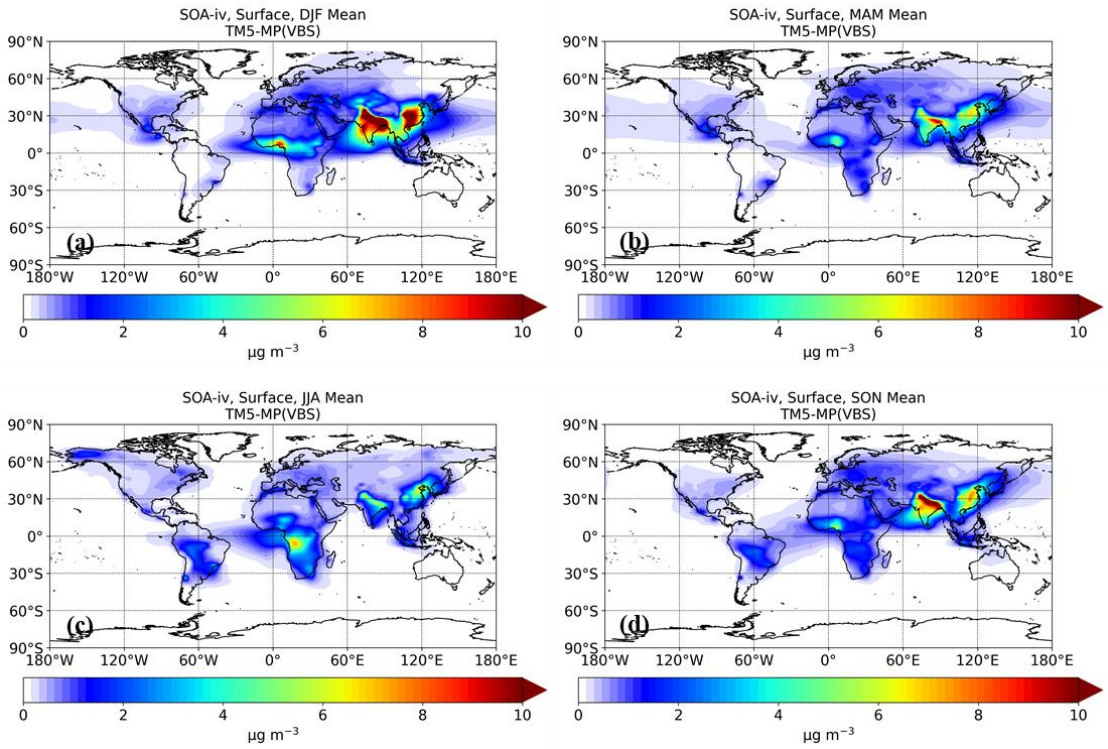

Figure S9. Mean surface concentrations of SOA-iv (in µg m^{-3}) during: **(a)** DJF, **(b)** MAM, **(c)** JJA, and **(d)** SON simulated using the VBS configuration in TM5-MP.

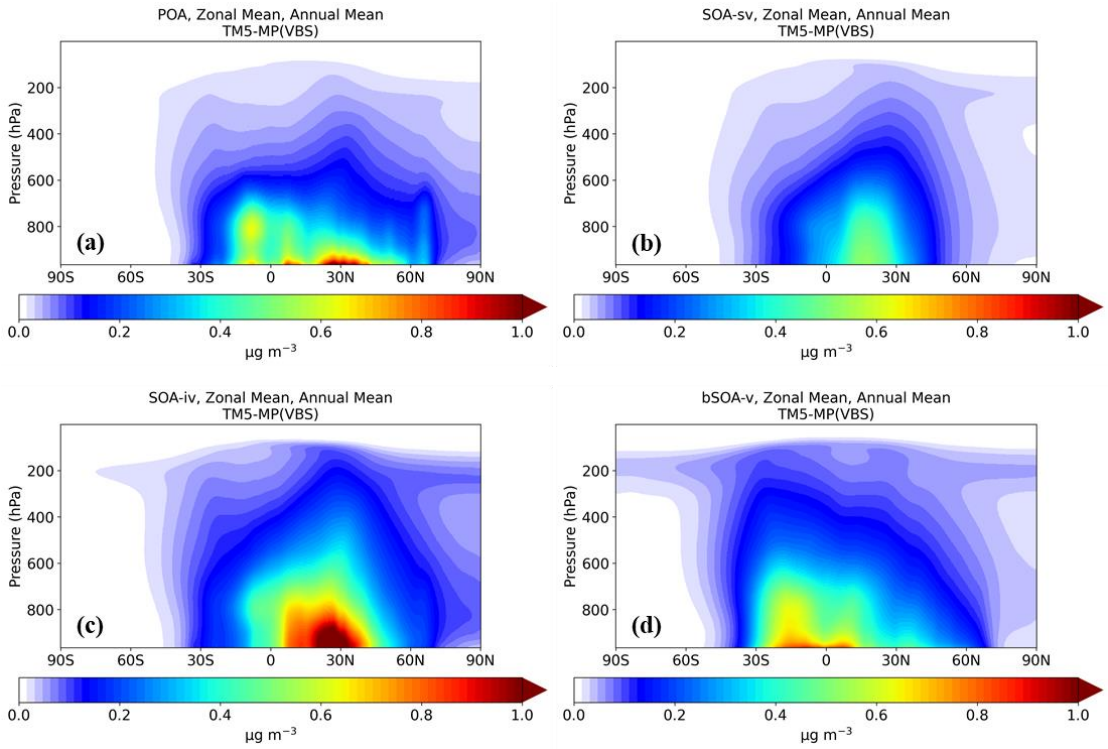

Figure S10. Annual mean zonal concentrations (in µg m^{-3}) of: **(a)** POA, **(b)** SOA-sv, and **(c)** SOA-iv simulated using the VBS configuration in TM5-MP. For completeness, bSOA-v in panel **(d)** is also shown.

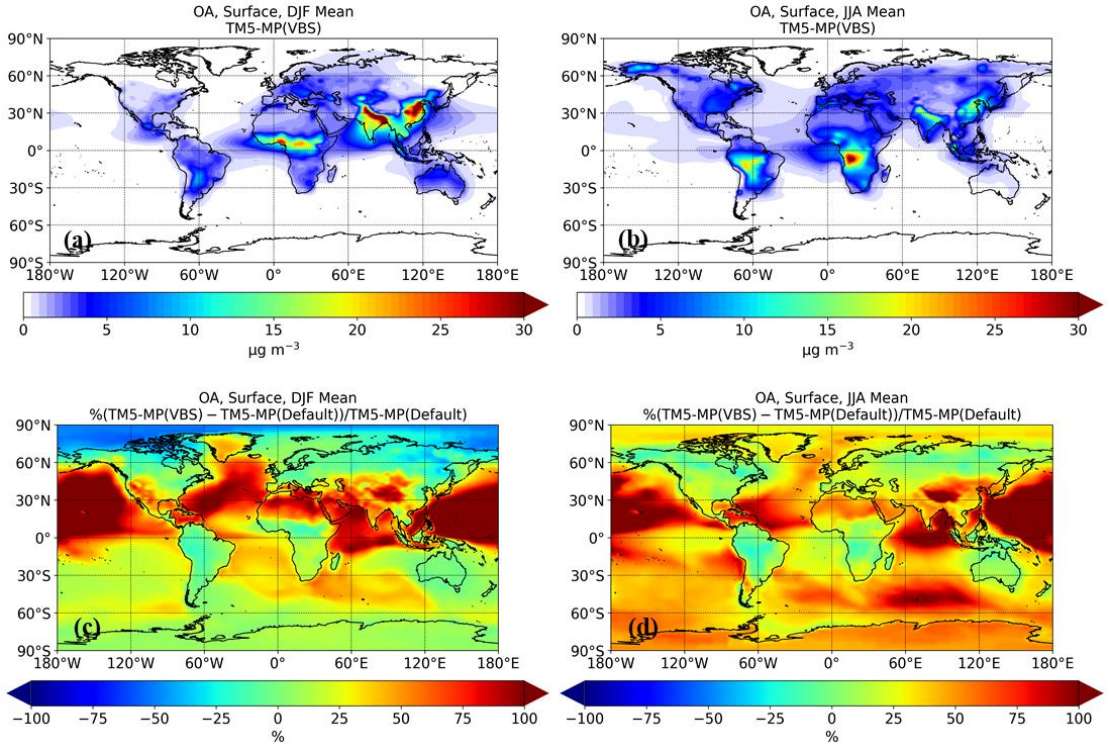

Figure S11. Mean concentrations of total organic aerosol (in μg m^{-3}) during: **(a)** DJF, and **(b)** JJA, simulated using the VBS configuration in TM5-MP. Panels **(c)** and **(d)** show the corresponding relative differences (in %) compared to the previous (default) model configuration. A positive change indicates that the VBS configuration predicts more than the default one.

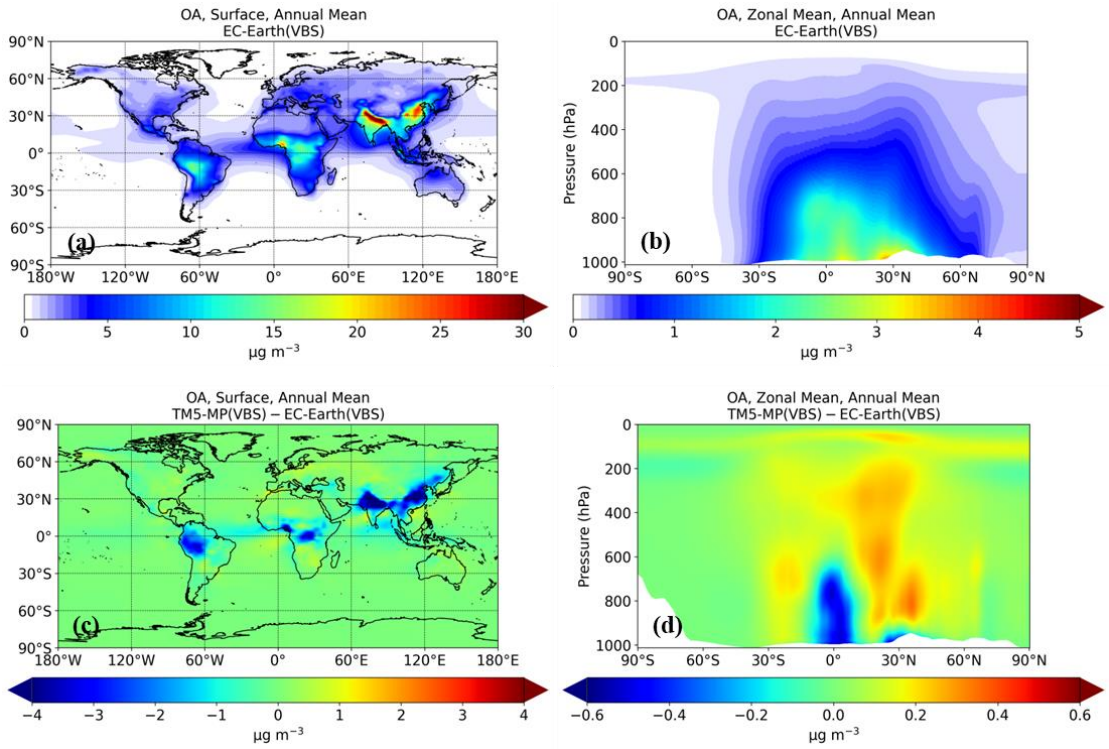

Figure S12. Annual mean concentrations of total organic aerosol (in µg m^{-3}): **(a)** surface concentrations, and **(b)** zonal values as simulated using the VBS configuration of EC-Earth during 2005. Panels **(c)** and **(d)** show the corresponding differences (in µg m^{-3}) compared to the TM5-MP predictions using the VBS configuration. A positive change indicates that the standalone TM5-MP simulation predicts higher concentrations than the EC-Earth.

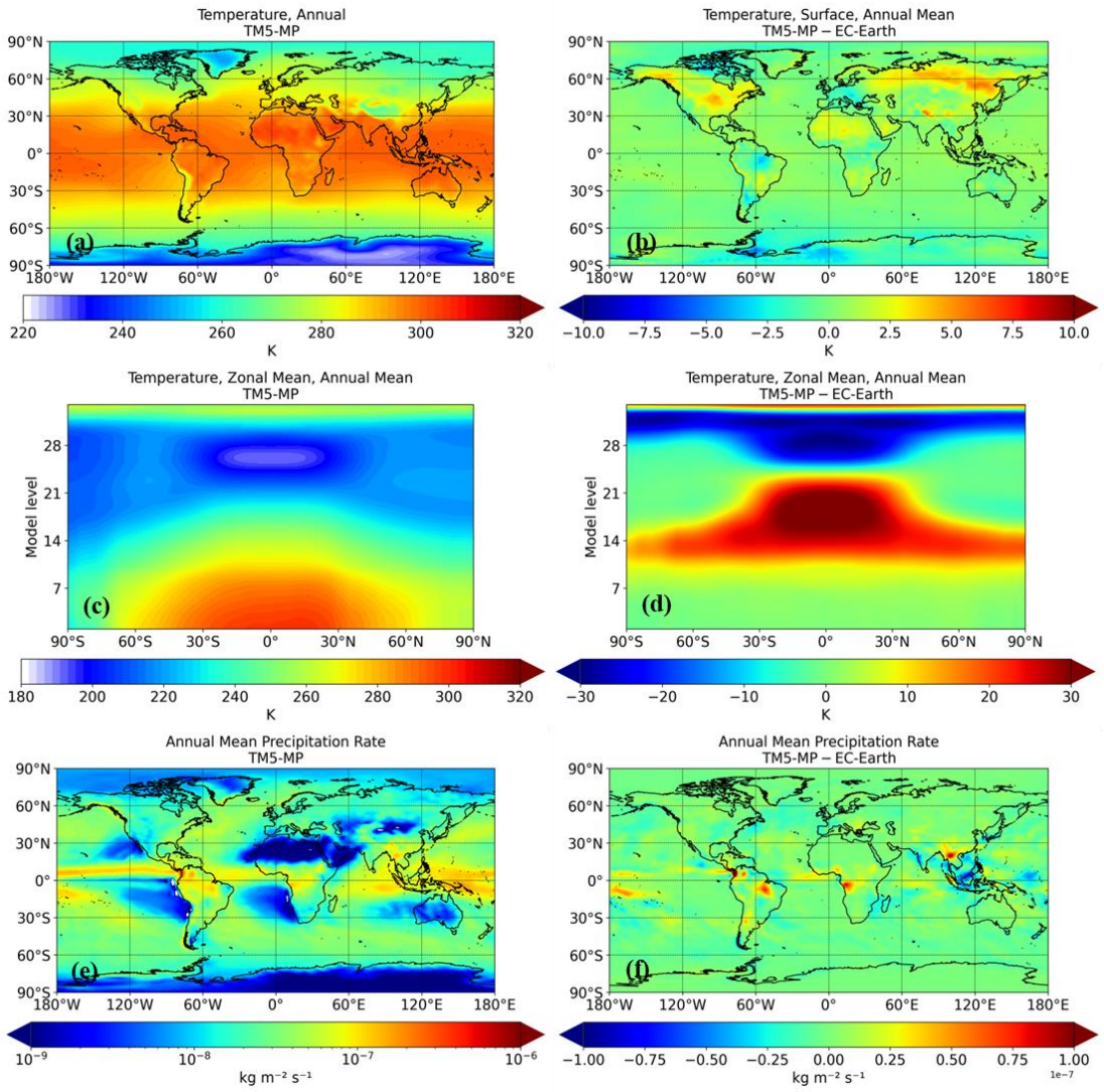

Figure S13. Meteorological fields from TM5-MP and their differences with EC-Earth for: **(a)**, **(b)** annual mean surface temperature (in K), **(c)**, **(d)** annual zonal-mean temperature (in K), and **(e)**, **(f)** annual mean precipitation rate (kg m^{-2} s^{-1}) for 2005. A positive change indicates that the standalone TM5-MP model accounts for higher values than the simulated of EC-Earth.