



*Supplement of*

## **Implications of differences between recent anthropogenic aerosol emission inventories for diagnosed AOD and radiative forcing from 1990 to 2019**

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Table S1: Top row gives global, annual mean burdens [ $\text{mg m}^{-2}$ ] of BC, primary and secondary organic aerosol (POA, SOA), sulfate, fine mode nitrate and fine mode ammonium in 2014 as simulated with the original release of the CEDS emissions. Also provided is the BC and POA burden originating from fossil and biofuel combustion only, i.e. excluding biomass burning. The two bottom rows give the ratio between simulations with CEDS21 and ECLv6, and CEDS, respectively.

	<b>BC</b>	<b>BC (fossil+ biofuel)</b>	<b>POA</b>	<b>POA (fossil+ biofuel)</b>	<b>SOA</b>	<b>Sulfate</b>	<b>Nitrate (fine)</b>	<b>NH<sub>4</sub> (fine)</b>
<b>CEDS</b>	0.22	0.17	2.00	0.63	1.11	5.39	0.16	0.69
<b>CEDS21/CEDS</b>	0.96	0.94	0.89	0.71	0.97	0.92	1.15	0.99
<b>ECLv6/ CEDS</b>	0.92	0.89	0.86	0.60	0.96	0.85	1.24	0.93

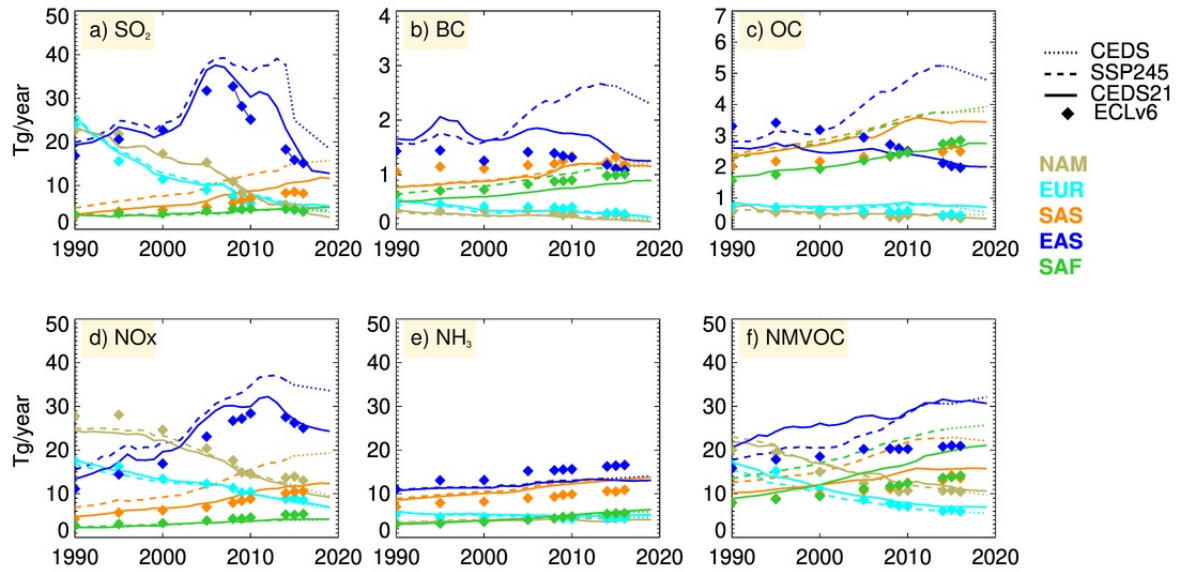


Figure S1: Regional anthropogenic emissions of SO<sub>2</sub>, BC, OC, NO<sub>x</sub>, NH<sub>3</sub>, and NMVOC in the CEDS21, ECLv6, CEDS17 inventories, for the period 1990 to the most recent inventory year (2019, 2016 and 2014, respectively). Dotted lines show emissions from the SSP2-4.5 scenario, linearly interpolated from 2015 to 2019. Regions follow the naming and geographical definition of the HTAP2: NAM = North America, EUR = Europe, SAS = South Asia, SAF = Sub-Saharan Africa.

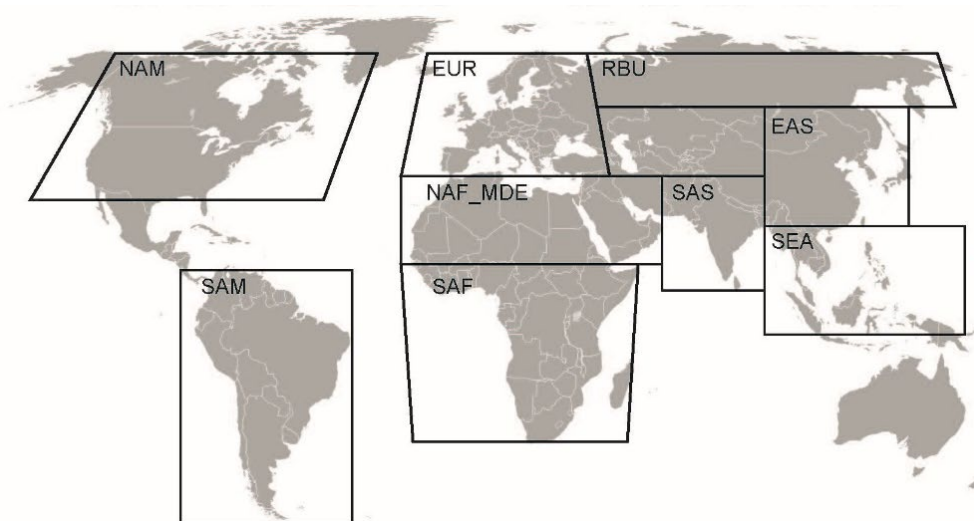


Figure S2: Geographical extent of regions discussed in the study. Adapted from Lund et al. (2019).

Percent difference in year 2014 regional mean burdens from CEDS

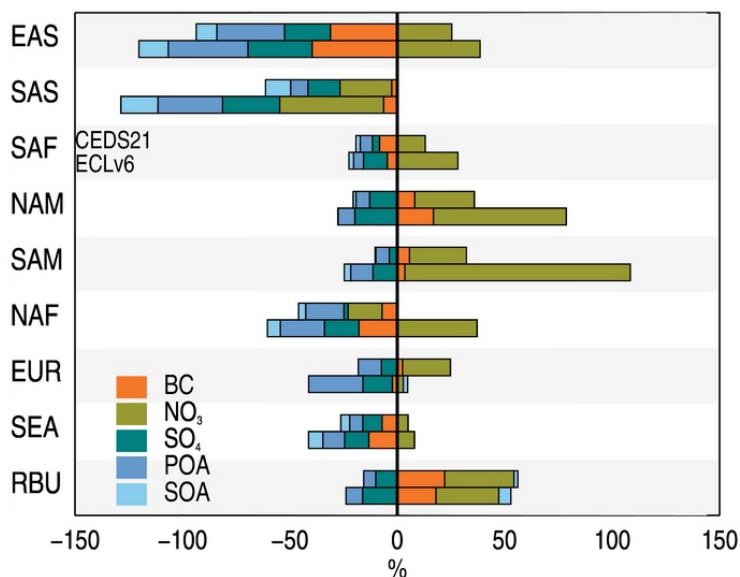


Figure S3: Percentage difference in regional mean burdens of the key anthropogenic aerosol species in 2014 between simulations with CEDS21 and CEDS emissions (upper bar) and ECLv6 and CEDS (lower bar). Regions are: EAS = East Asia, SAS = South Asia, SAF = Sub-Saharan Africa, NAM = North America, SAM = South America, NAF = North Africa and the Middle East, EUR = Europe, SEA = South East Asia, RBU = Russia.

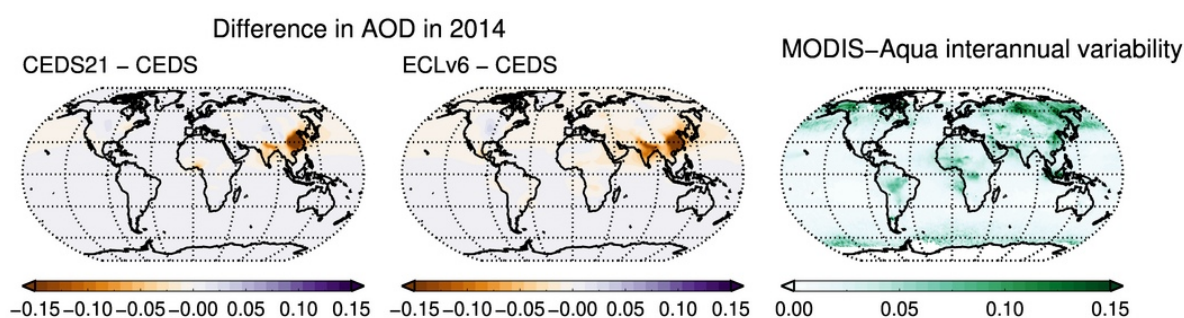


Figure S4: Difference in AOD in 2014 between simulations using the CEDS21 and ECLv6 inventories, respectively, and CEDS. Also shown for context of is the interannual variability in AOD retrieved from MODIS-Aqua.

Table S2 Regional mean trend (per decade) in total in total AOD over the 1990-2017 period as simulated using CEDS, CEDS21 and ECLv6 emissions. Trends defined as statistically significant from no trend when the linear Pearsons correlation coefficient is significant at the 0.05 level with significance indicated in the parenthesis. A dash shows that our set of calculated trends (see methods section) include both significant and non-significant trends.

Region	CEDS	CEDS21	ECLv6
Global mean	0.00 (no)	-0.001 (yes)	-0.002 (yes)
EAS	0.017 (yes)	0.002 (no)	-0.0003 (no)
EUR	-0.024 (yes)	-0.025 (yes)	-0.025 (yes)
NAF	0.005 (yes)	0.004 (yes)	-0.0004 (no)
NAM	-0.006 (yes)	-0.008 (yes)	-0.01 (yes)
RBU	-0.012 (yes)	-0.013 (yes)	-0.012 (yes)
SAF	0.004 (yes)	0.004 (yes)	0.003 (yes)
SAM	0.004 (yes)	0.003 (-)	0.003 (-)
SAS	0.029 (yes)	0.023 (yes)	0.013 (yes)
SEA	-0.002 (no)	-0.005 (-)	0.005(-)

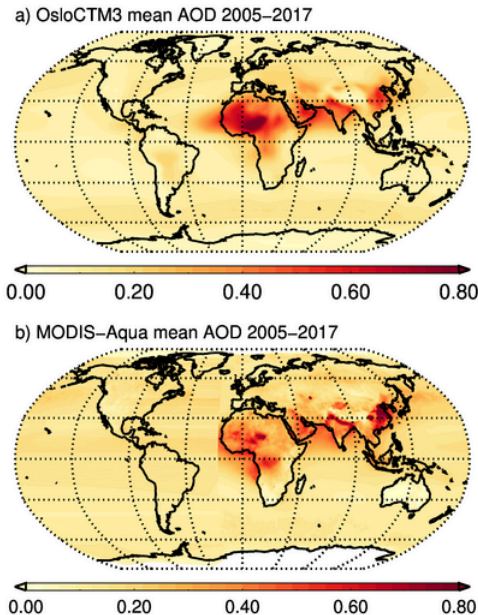


Figure S5: Annual AOD averaged from 2005 to 2017 as a) simulated by the OsloCTM3 and b) retrieved from MODIS-Aqua.

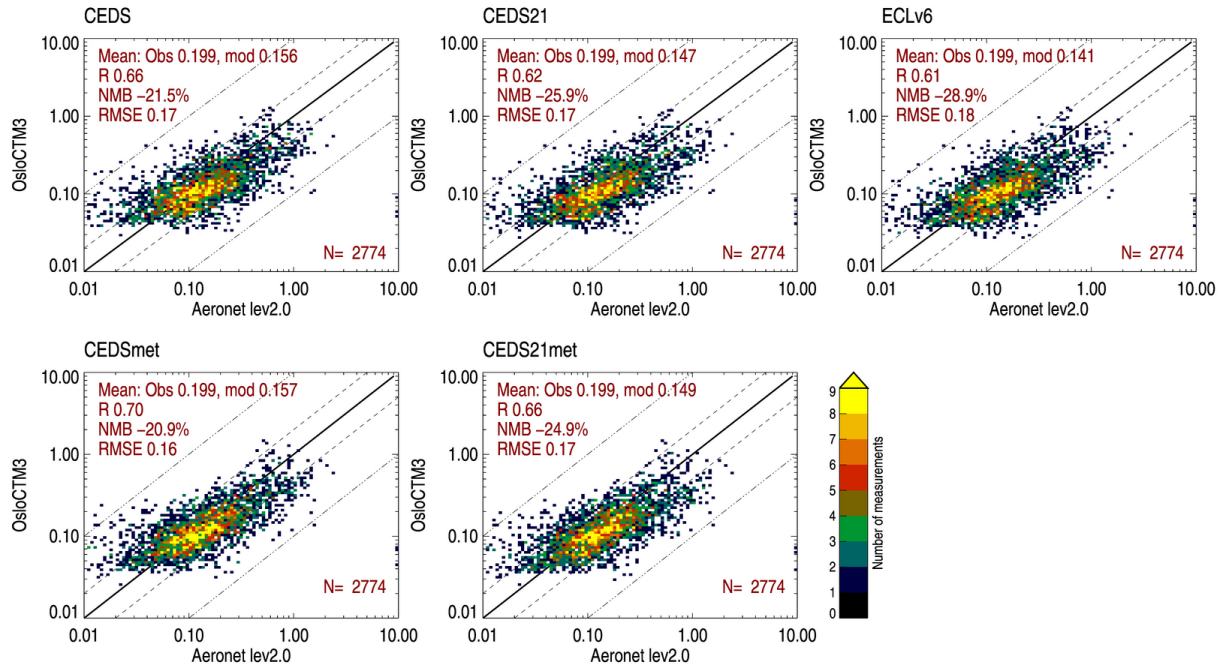
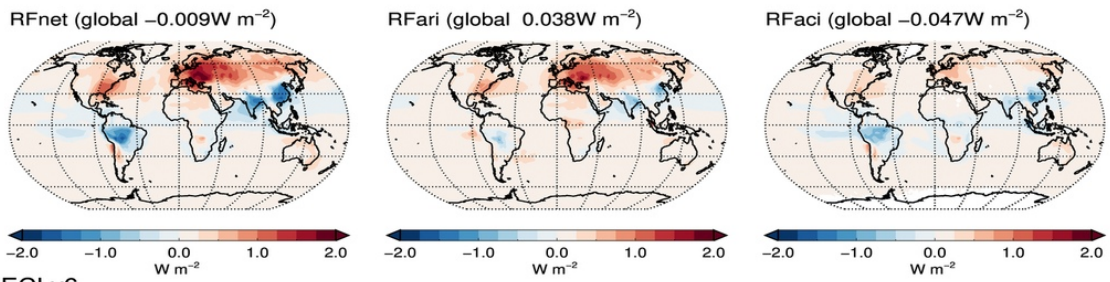


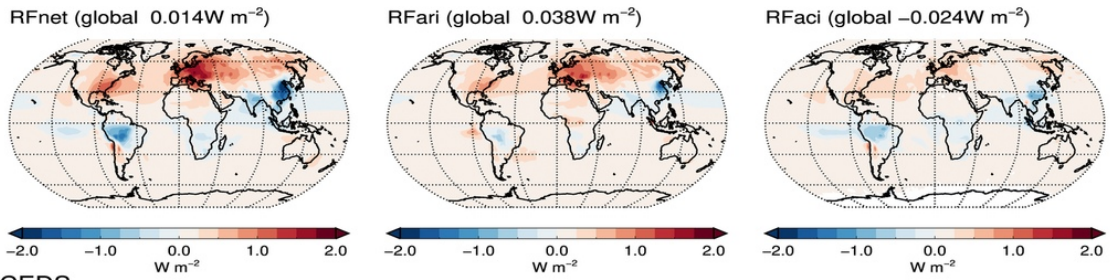
Figure S6: Scatter density plots of year 2014 AERONET versus OsloCTM3 AOD with the emission inventories and fixed meteorology (top) or actual meteorology (bottom).



a) CESDS21



b) ECLv6



c) CEDS

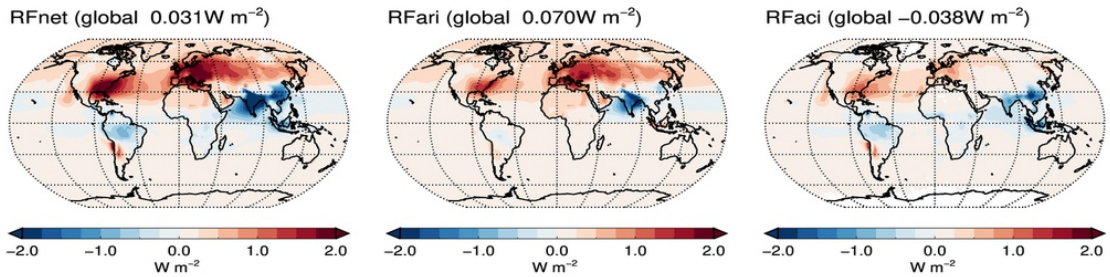


Figure S7: *RFnet*, *RFari* and *RFaci* in 2014 relative to 1990 from simulation with a) CESDS21 emissions, b) ECLv6 emissions, and c) CEDS emissions.

## References

Lund M. T., Myhre G. & Samset B. H. Anthropogenic aerosol forcing under the Shared Socioeconomic Pathways, *Atmos. Chem. Phys.* 19(22), 13827-13839, 10.5194/acp-19-13827-2019, 2019.