Supplementary material: Multi-model effective radiative forcing of the 2020 sulphur cap for shipping.

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Supplementary figures
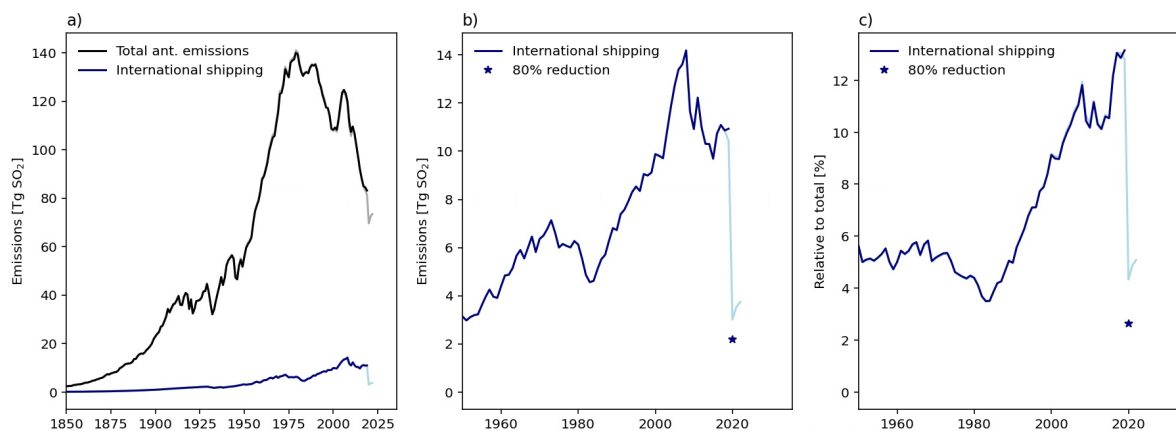
Figure S1: Historical emissions of SO₂ from CEDS (O'Rourke et al., 2021). In a) the total anthropogenic emissions and emissions from international shipping from 1850 to 2019 from CEDS_v2021 (black and blue line) and extended to 2022 from CEDS_v2024_04_01 (Hoesly and Smith, 2024) (gray and lightblue line), b) emissions from international shipping from 1950 to 2019 from CEDS_v2021 (blue line) in addition to a star that indicate an 80% reduction in emissions in 2020 compared to 2019. CEDS_v2024_04_01 extending to 2022 shown in lightblue. In c) same as b) but presented as percentages of total anthropogenic emissions.
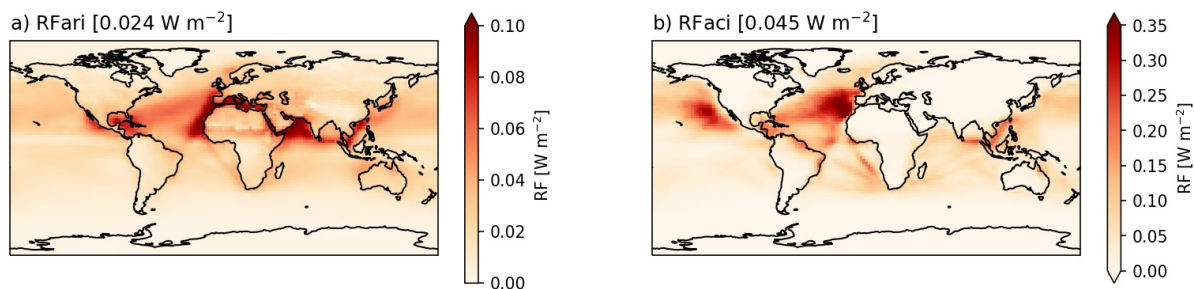
Figure S2: RFari (a) and RFaci (b) from OsloCTM3 for an 80% sulphur shipping emission reduction. Note the different colour scale in the two figures.
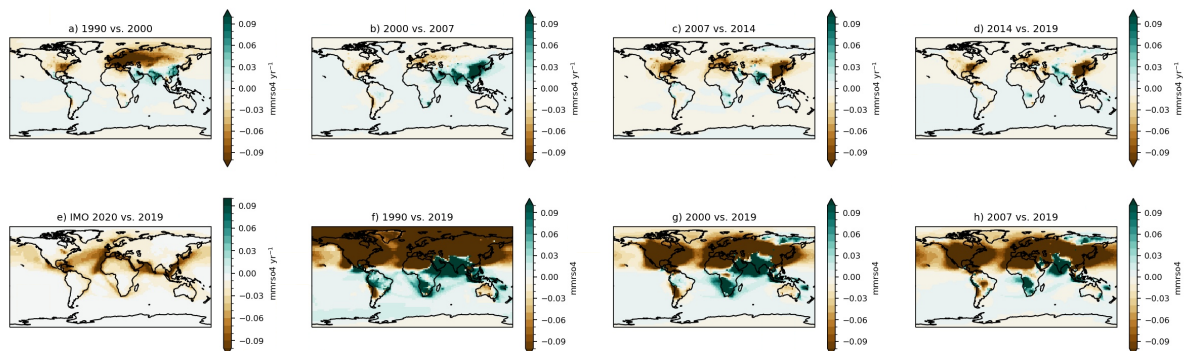
Figure S3: Absolute difference in SO₄ mass mixing ratio in the surface layer as simulated by OsloCTM3. In a) to d) the difference in mmr per year between historical OsloCTM3 simulations with anthropogenic emissions for the years given in the sub-titles. These simulations are driven by fixed meteorological data and described in Skeie et al. (2023). In a) CEDS emissions as provided for CMIP6 are used, and in b) to d) CEDS_v2021 emissions. In e) the absolute difference between the two simulations with and without IMO2020. In f) to g) the absolute difference between 2019 and 1990, 2000 and 2007 simulations respectively.
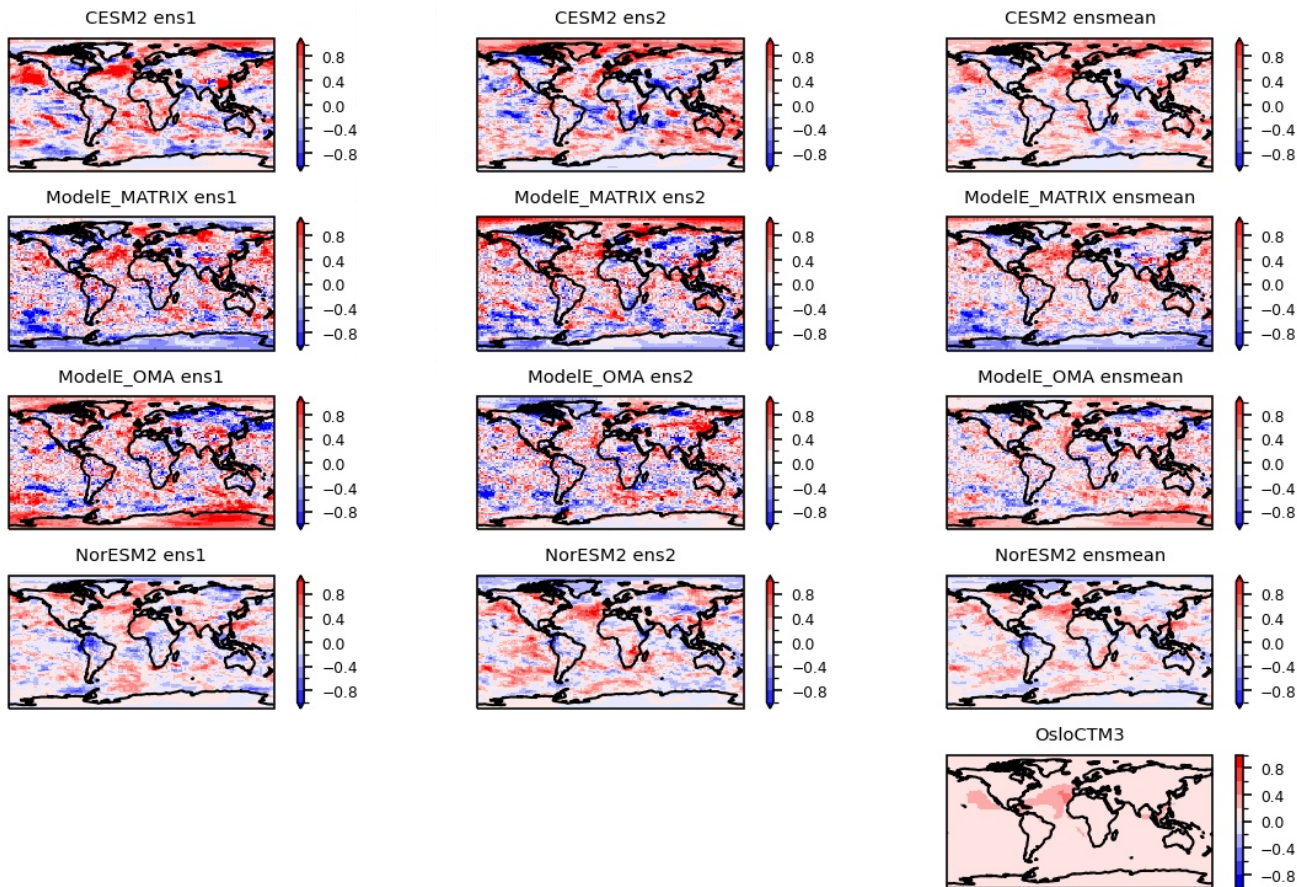
Figure S4: ERF for each ensemble member (left and middle column) and ensemble mean (right column) due to IMO2020. For OsloCTM3 the total aerosol RF (RFari + RFaci) is shown.

References

Hoesly, R., and Smith, S. CEDS v_2024_04_01 Release Emission Data (v_2024_04_01) https://doi.org/10.5281/zenodo.10904361 (2024).

O'Rourke, Patrick R, Smith, S. J., Mott, A., Ahsan, H., McDuffie, Erin E, Crippa, Monica, Klimont, Zbigniew, McDonald, Brian, W., Shuxiao, N., Matthew B, Feng, L., and Hoesly, R. M. CEDS v_2021_04_21 Release Emission Data (v_2021_02_05) https://doi.org/10.5281/zenodo.4741285 (2021).

Skeie, R. B., Hodnebrog, Ø., and Myhre, G.: Trends in atmospheric methane concentrations since 1990 were driven and modified by anthropogenic emissions, Communications Earth & Environment, 4,317, 10.1038/s43247-023-00969-1, 2023.