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Committed warming inferred from observations

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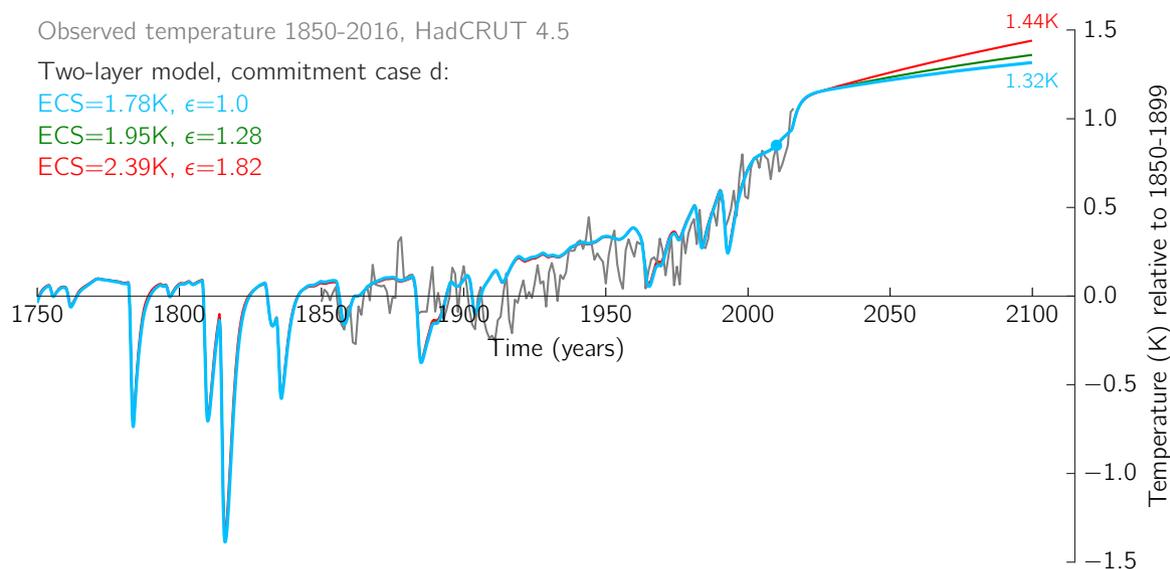


Figure S1: Historical temperature evolution for commitment case d of a two-layer model with ECS, TCR and early 21st Century imbalance close to the observed inferences (see Methods). Blue is the surface temperature and gray is the observed temperature record. After the year 2010 (marked by a dot) a linear greenhouse gas forcing correction up to year 2016 is applied. Thereafter, the aerosol cooling and SLCFs are abruptly removed and the model is run until year 2100. Green and pink lines show cases with increased ocean heat uptake efficacy (ϵ) to the CMIP5 model mean and maximum³⁴, respectively. ECS is then in both cases iterated to give the same 2005-15 warming as in the case with $\epsilon = 1.0$.

Table S1: Input for the observations-based analysis. Changes are between the period 2005–2015 minus 1859–1882. Uncertainties are standard deviations of the assumed gaussian distributions. The lower part of the table specifies the individual contributions to the total forcing change, whereas the total aerosol forcing (F_{aero}) is relative to 1750.

Quantity	Value	Source
Temperature change (ΔT)	0.77 \pm 0.08 K	HadCRUT4 ¹²
Total forcing change (ΔF)	2.16 \pm 0.59 Wm ⁻²	IPCC ¹⁴
Planetary imbalance, 2005–2015 (Q)	0.71 \pm 0.06 Wm ⁻²	Johnson et al. ¹³
Planetary imbalance, 1859–1882	0.15 \pm 0.075 Wm ⁻²	Lewis and Curry ²⁴
Greenhouse gas forcing change	2.53 \pm 0.18 Wm ⁻²	IPCC ¹⁴
Aerosol forcing change	-0.69 \pm 0.55 Wm ⁻²	IPCC ¹⁴
Black carbon on snow change	0.02 \pm 0.02 Wm ⁻²	IPCC ¹⁴
Stratospheric water vapor change	0.06 \pm 0.03 Wm ⁻²	IPCC ¹⁴
Land use change	-0.10 \pm 0.06 Wm ⁻²	IPCC ¹⁴
Ozone change	0.29 \pm 0.12 Wm ⁻²	IPCC ¹⁴
Contrails	0.05 Wm ⁻²	IPCC ¹⁴
Natural forcing change	-0.005 Wm ⁻²	IPCC ¹⁴
Forcing for doubled CO ₂ ($F_{2\times}$)	3.71 \pm 0.26 Wm ⁻²	
Total aerosol forcing, 2005–2015 (F_{aero})	-0.90 \pm 0.55 Wm ⁻²	

Table S2: Input for calculation of short-lived climate forcers associated with fossil fuel burning. Uncertainties are standard deviations calculated from the referenced 5–95 percentiles.

Quantity	Value	Source
Methane (CH ₄)	0.970 \pm 0.10 Wm ⁻²	IPCC ²⁶
Nitrogen oxides (NO _x)	-0.151 \pm 0.11 Wm ⁻²	IPCC ²⁶
Carbon monoxide (CO)	0.234 \pm 0.03 Wm ⁻²	IPCC ²⁶
Fossil fuel fraction of CH ₄ emissions (f_{ff})	0.29 \pm 0.02	IPCC ³³
Weighted sum (F_{slcf})	0.36 \pm 0.12 Wm ⁻²	