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A continued role of short-lived climate forcers under the Shared Socioeconomic Pathways

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Section S1 Sensitivity of our results to choice of IRF

The AGTP depends on the choice of impulse response function for CO_2 (IRF_{CO2}) and climate response (IRF_T). To explore this sensitivity in more detail, we repeat our calculations using alternative climate and CO_2 IRF combinations. Figure S1 show the resulting AGTPs as a function of time for CO_2, CH_4 and SO_2. The largest difference is seen between results using the B&R08 IRF_T (Boucher & Reddy, 2008) and the G13 (Geoffroy et al., 2013) (default in our study) or G17 (Gasser et al., 2017) IRF_T. Unless otherwise stated, the IRF_{CO2} from Joos et al. (2013) is used. The longer time scales of the climate system response in B&R08 compared to both G13 and G17, results in an AGTP that is lower up to approx. 15 years and higher thereafter for CH_4 and CO_2, and stronger (i.e., more negative) for SO_2 already after 5 years. Although we do not present normalized metrics here, we note that they would differ from values reported by the Fifth Assessment Report by the IPCC (AR5), who used the B&R08 IRF_T (Myhre et al., 2013). As an illustration, Table S1 shows the GTP for methane for time horizons 10, 20 and 100 years (a detailed comparison for the other SLCFs is difficult due to different underlying radiative efficiencies). We also show values taken from the IPCC AR5. The difference between AR5 and values calculated using the B&R08 IRF_T in the present study arises from the 14% increase in the radiative efficiency of methane that we apply based on (Etminan et al., 2016). Using G13 or G17 IRF_T results in 4-18% lower GTPs compared to those based on B&R08 for two short time horizons, and increased metric values on the 100-year horizon. Using the CO_2 IRF from G17 without the carbon-climate feedback included increases the methane GTP by 2, 5 and 11% for 10, 20 and 100 years, respectively, compared to using the G17 IRF_{CO2} with carbon climate feedback. As noted by G17 this difference can be larger for shorter-lived species like BC and SO_2.

We also investigate what the choice of IRFs mean for our global and regional near- and long-term temperature responses. Figure S2 shows the global-mean surface temperature response following global present-day emissions using results with the B&R08, G13 and G17 IRF_T. The two latter yields similar results, while the total effect after 10 years is lower with B&R08 due to a combination of smaller contributions from CH_4 and CO_2 and stronger cooling contributions. We also note that while the overall picture of regional and sectoral SLCF and CO_2 contributions largely remains the same, the differences between B&R08 and G13 are sufficiently large to affect the ranking by total net near-term temperature impact of some regions and sectors compared to our main Fig.2. For instance, stronger cooling contributions with the B&R08 IRF_T reduces the net warming of the ENE sectors, moving AGR up as the sectors with the largest net temperature impact. Similarly, SAS and MDE, regions with significant cooling emissions and relatively small CO2 emissions, are moved down. The net temperature response to emissions in SAS switches from to a small net negative on the 10-year timescale.

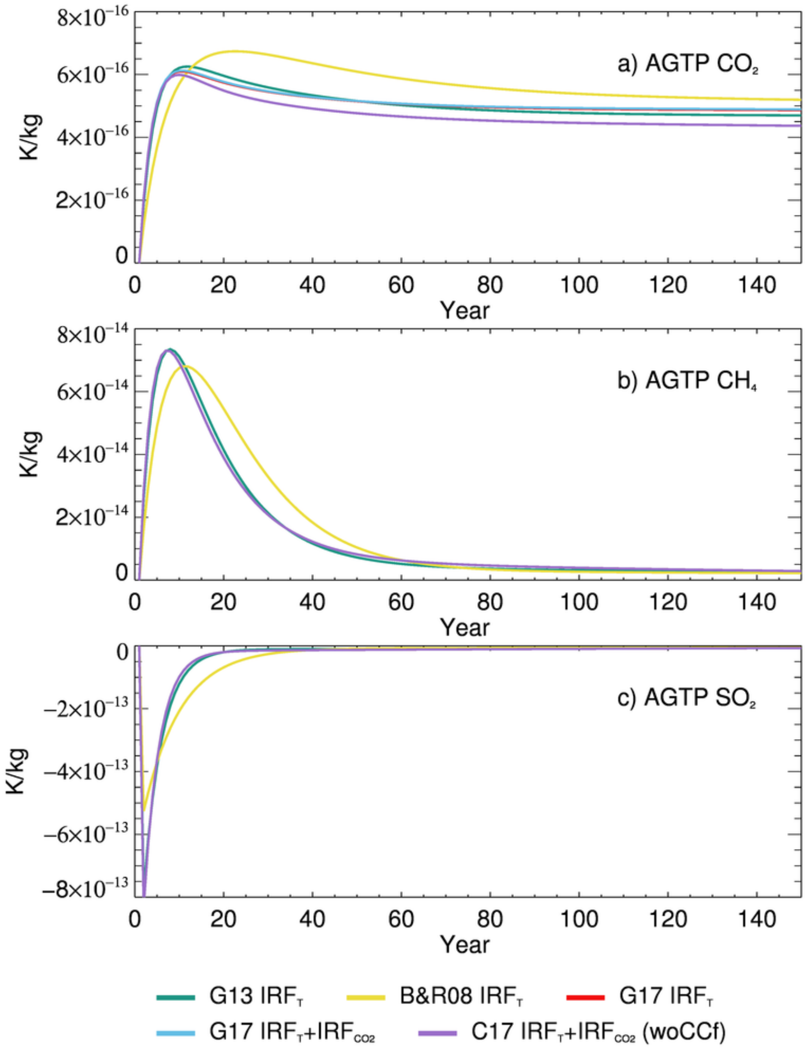

Figure S1: AGTP(t) for CO_2, CH_4 and SO_2 as calculated using different combinations of climate response and carbon dioxide impulse response functions: B&R08 (Boucher & Reddy, 2008), G13 (Geoffroy et al., 2013) and G17 (Gasser et al., 2017) (all with the Joos et al. (2013) CO_2 IRF), and G17 with corresponding CO_2 IRFs with and without the carbon-climate feedback included.

Table S1: GTPs for methane using different combinations of climate response and CO_2 IRFs.

	GTP of methane		
Time horizon	10	20	100
AR5	100	64	4
B&R08 IRF_T	114	77	5
G13 IRF_T	109	65	6
G17 IRF_T	108	63	8
G17 IRF_T+IRF_{CO2}	108	63	8
G17 IRF_T+IRF_{CO2} (noCCf)	110	67	9

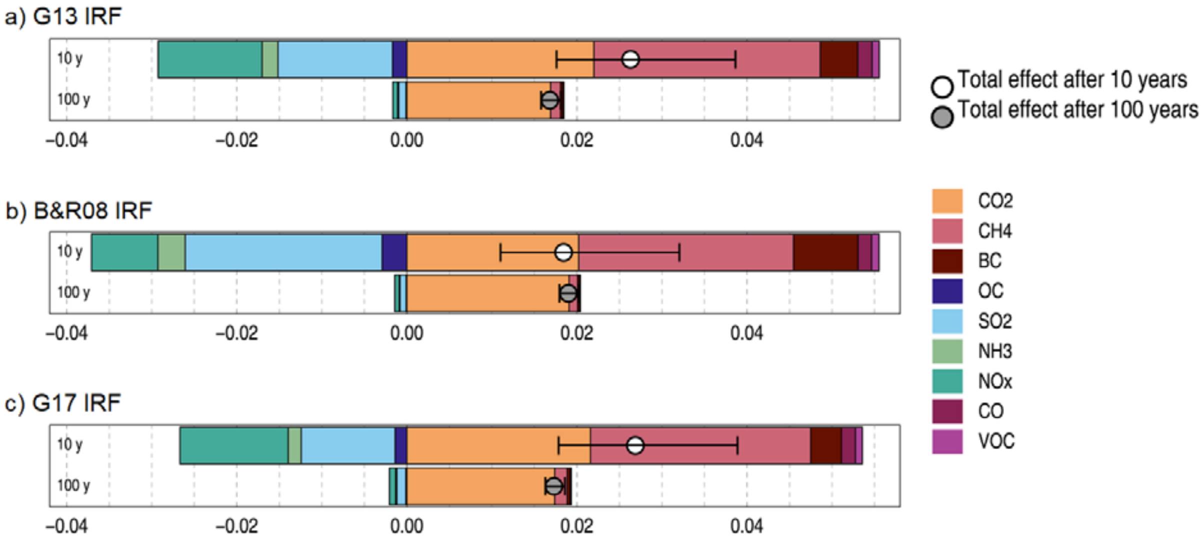

Figure S2: Global-mean surface temperature impact 10 and 100 years after one year of global present-day (i.e., year 2014) emissions of SLCFs and CO_2, calculated using different combinations of climate response.

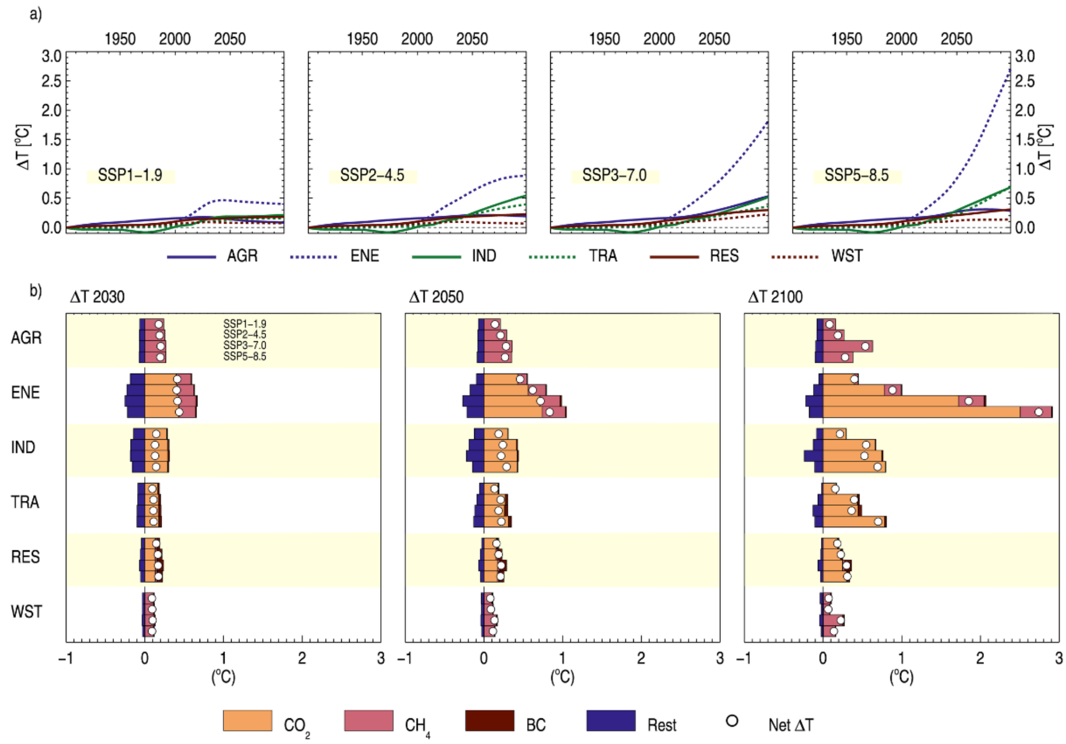

Figure S3: Global mean temperature response to historical emissions and future SSP pathways: a) Net (i.e., sum over all species and regions) response over the period 1900 to 2100 for each sector and scenario and b) net response in 2030, 2050 and 2100 to emissions in six of our seven sectors (excluding shipping, which remains much smaller than the rest), broken down by contributions from CO_2, BC, methane and the sum of SO_2, OC, NH_3 and ozone precursors ("Rest").

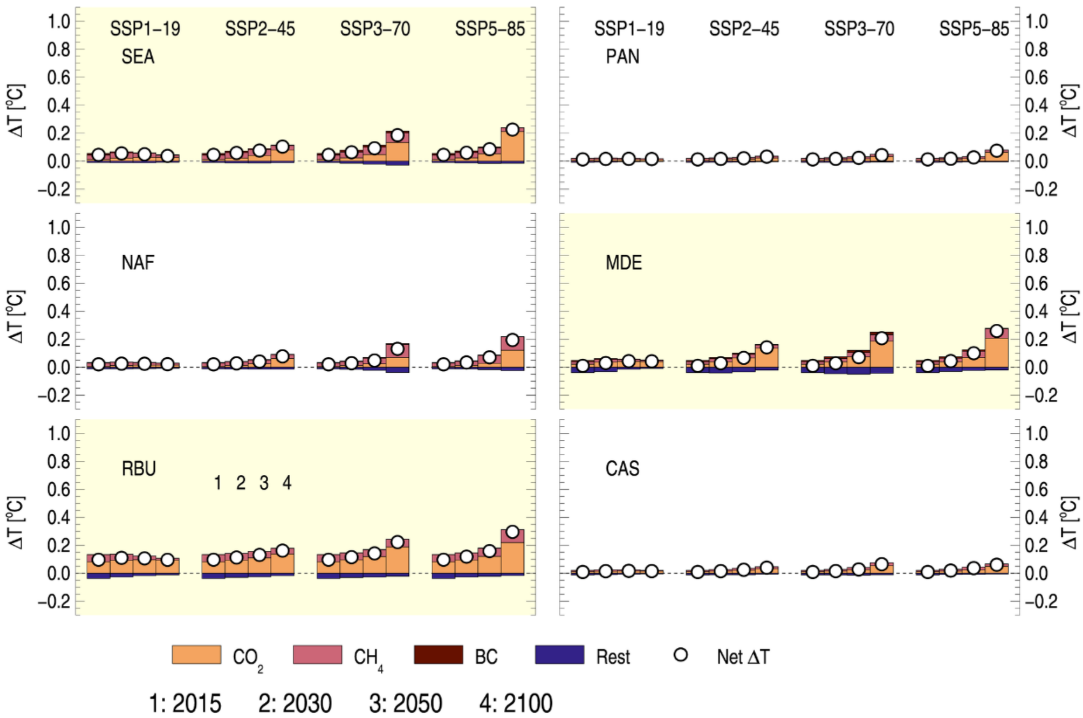

Figure S4: Global mean temperature response to historical emissions and future SSP pathways: Net response in 2015, 2030, 2050 and 2100 to emissions in six regions broken down by contributions from CO_2, BC, methane and the sum of SO_2, OC, NH_3 and ozone precursors (i.e., "Rest").

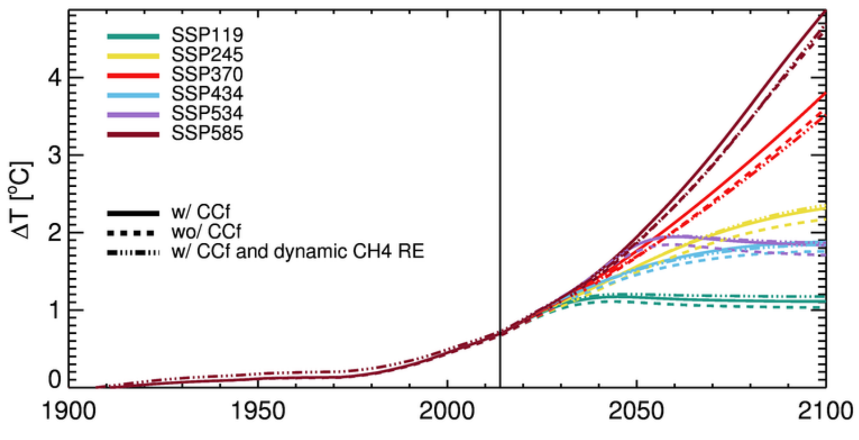

Figure S5: Impact of including carbon-climate feedback and dynamical methane radiative efficiency in the AGTP calculation on global mean total net temperature response to total emissions (i.e. sum of our sectors and regions) under 6 of the SSP-RCPs.

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