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Regional emission metrics for short-lived climate forcers from multiple models

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Not all details are given in the article. Emission metric values and additional figures are provided below. There is no single emission metric and time horizon that fits all applications, and the selection will depend on what aspects of climate change are considered to be most important (Aamaas et al., 2013).

1. Emission metric values and comparison with literature

Emission metric values for GWP and GTP with time horizons 20 years and 100 years are given in Table SI1. We provide also emission metric values for emissions on land outside of Europe and East Asia. This category is labelled “rest of the world”. Both values from our study and the literature are given.

Table SI1: Emission metric values for a few selected emission metrics and time values. A comparison with other studies is included. The units used are given in the brackets, such as NO_x are based on N basis.

Species	GWP(20)	GWP(100)	GTP(20)	GTP(100)
BC [C], this study				
BC, Europe, summer	2100	580	620	79
BC, Europe, winter	1800	500	530	69
BC, East Asia, summer	2100	580	610	79
BC, East Asia, winter	1100	310	330	43
BC, Rest of the world, summer	3100	840	900	120
BC, Rest of the world, winter	2600	720	760	99
BC, Shipping, NH summer	1300	360	390	50
BC, Shipping, NH winter	1600	440	470	60
BC, Global, NH summer	2800	760	810	100
BC, Global, NH winter	2100	560	600	77
BC, other studies				
Bond et al. (2013), BC, total, global. Metric values are given for total effect	3200	900	920	130
Collins et al. (2013), BC (four regions)	1200	345	420	56
Collins et al. (2013), BC, Europe	N/A	N/A	530	71
Collins et al. (2013), BC, East Asia	N/A	N/A	410	55
Bond et al. (2011), BC, aerosol-radiation interaction + albedo, global	2900	830	N/A	N/A
Fuglestvedt et al. (2010), BC, global	1600	460	470	64
OC [C], this study				
OC, Europe, summer	-760	-210	-220	-28
OC, Europe, winter	-390	-110	-110	-15
OC, East Asia, summer	-490	-130	-140	-18
OC, East Asia, winter	-180	-48	-51	-6.6
OC, Rest of the world, summer	-1000	-280	-300	-39
OC, Rest of the world, winter	-900	-240	-260	-34
OC, Shipping, NH summer	-2100	-580	-620	-80
OC, Shipping, NH winter	-1100	-290	-310	-40
OC, Global, NH summer	-900	-250	-260	-34
OC, Global, NH winter	-650	-180	-190	-24
OC, other studies				
Bond et al. (2011), OC	-160	-46	N/A	N/A
Collins et al. (2013), OC (four regions)	-160	-46	-55	-7.3
Collins et al. (2013), OC, Europe	N/A	N/A	-58	-7.7
Collins et al. (2013), OC, East Asia	N/A	N/A	-50	-6.7
Fuglestvedt et al. (2010), OC, global	-240	-69	-71	-10

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Table SI1 (continued)

Species	**GWP(20)**	**GWP(100)**	**GTP(20)**	**GTP(100)**
SO2 [SO2], this study				
SO2, Europe, summer	-430	-120	-130	-16
SO2, Europe, winter	-130	-34	-36	-4.7
SO2, East Asia, summer	-300	-81	-87	-11
SO2, East Asia, winter	-110	-30	-31	-4.1
SO2, Rest of the world, summer	-500	-140	-150	-19
SO2, Rest of the world, winter	-320	-88	-94	-12
SO2, Shipping, NH summer	-560	-150	-160	-21
SO2, Shipping, NH winter	-390	-110	-110	-15
SO2, Global, NH summer	-430	-120	-120	-16
SO2, Global, NH winter	-230	-63	-67	-8.6
SO2, other studies				
Collins et al. (2013), SO2 (four regions)	N/A	N/A	-38	-5.1
Collins et al. (2013), SO2, Europe	N/A	N/A	-43	-5.7
Collins et al. (2013), SO2, East Asia	N/A	N/A	-31	-4.1
Fuglestvedt et al. (2010), SO2, global	-140	-40	-41	-5.7
NH3 [NH3], this study				
NH3, Europe, summer	-55	-15	-16	-2.0
NH3, Europe, winter	-36	-9.7	-10	-1.3
NH3, East Asia, summer	-27	-7.2	-7.7	-1.0
NH3, East Asia, winter	-51	-14	-15	-1.9
NH3, Rest of the world, NH summer	-21	-5.7	-6.0	-0.78
NH3, Rest of the world, NH winter	-32	-8.8	-9.4	-1.2
NH3, Global, NH summer	-25	-6.7	-7.2	-0.9
NH3, Global, NH winter	-37	-10	-11	-1.4
NH3, other studies				
NH3, Shindell et al. (2009)	-80	-23	-23	-3.2

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Table SI1 (continued)

Species	GWP(20)	GWP(100)	GTP(20)	GTP(100)
NOx [N], this study				
NOx, Europe, summer	-110	-36	-90	-5.1
NOx, Europe, winter	-61	-19	-40	-2.7
NOx, East Asia, summer	-63	-22	-75	-3.3
NOx, East Asia, winter	-140	-41	-75	-5.8
NOx, Rest of the world, summer	-120	-44	-160	-6.6
NOx, Rest of the world, winter	-180	-61	-190	-8.9
NOx, Shipping, NH summer	79	-2.2	-230	-1.3
NOx, Shipping, NH winter	-250	-98	-400	-15
NOx, Global, NH summer	-120	-42	-150	-6.2
NOx, Global, NH winter	-170	-56	-160	-8.1
NOx, other studies				
Collins et al. (2013), NOx (four regions), based on Fry et al. (2012) with including stratospheric H2O	-15.9	-11.6	-62.1	-2.2
Collins et al. (2013), NOx, Europe, based on Fry et al. (2012) with including stratospheric H_2O	-39.4	-15.6	-48.0	-2.5
Collins et al. (2013), NOx, East Asia, based on Fry et al. (2012) with including stratospheric H_2O	6.4	-5.3	-55.6	-1.3
Shindell et al. (2009), NOx, global, including direct and indirect aerosol effects	-560	-159	N/A	N/A
Surface				
Naik et al. (2005), Tropics, as given by Fuglestvedt et al. (2010)	43	-28	-260	-6.6
Wild et al. (2001), Tropics, as given by Fuglestvedt et al. (2010)	130	-9.7	-220	-5.4
Naik et al. (2005), Mid-lat, as given by Fuglestvedt et al. (2010)	-43	-18	-54	-2.9
Berntsen et al. (2005), UiO, Mid-lat, as given by Fuglestvedt et al. (2010)	23	1.6	-37	-0.024
Berntsen et al. (2005), LMDz, Mid-lat, as given by Fuglestvedt et al. (2010)	23	-6.3	-55	-2.4
Wild et al. (2001), Mid-lat, as given by Fuglestvedt et al. (2010)	-3.7	-9.3	-48	-2.0
Wild et al. (2001), Global, as given by Fuglestvedt et al. (2010)	19	-11	-87	-2.9
Shipping				
NOx, Shipping, Collins et al. (2010)	-107	-73	-135	N/A
Eyring et al. (2007), as given by Fuglestvedt et al. (2010)	-76	-36	-130	-6.1
Endresen et al. (2003), as given by Fuglestvedt et al. (2010)	-47	-32	-190	-5.3
Fuglestvedt et al. (2008), as given by Fuglestvedt et al. (2010)	-31	-25	-160	-4.2

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Table SI1 (continued)

Species	GWP(20)	GWP(100)	GTP(20)	GTP(100)
Aircraft				
Stevenson et al. (2004), as given by Fuglestvedt et al. (2010)	120	-2.1	-240	-2.2
Wild et al. (2001) (as in Stevenson et al. (2004)), as given by Fuglestvedt et al. (2010)	410	71	-200	7.6
Köhler et al. (2008), as given by Fuglestvedt et al. (2010)	470	6.9	-590	-9.5
CO [CO], this study				
CO, Europe, summer	7.3	2.2	4.3	0.31
CO, Europe, winter	7.9	2.4	4.9	0.34
CO, East Asia, summer	8.3	2.4	4.5	0.34
CO, East Asia, winter	8.5	2.5	5.0	0.36
CO, Rest of the world, summer	7.5	2.2	4.4	0.31
CO, Rest of the world, winter	8.1	2.4	4.9	0.34
CO, Shipping, NH summer	8.4	2.5	4.7	0.35
CO, Shipping, NH winter	8.6	2.6	5.9	0.37
CO, Global, NH summer	7.6	2.3	4.4	0.32
CO, Global, NH winter	8.2	2.4	4.9	0.35
CO, other studies				
Collins et al. (2013), CO (four regions), based on Fry et al. (2012) with including stratospheric H_2O	5.4	1.8	3.5	0.26
Collins et al. (2013), CO, Europe, based on Fry et al. (2012) with including stratospheric H_2O	4.9	1.6	3.2	0.24
Collins et al. (2013), CO, East Asia, based on Fry et al. (2012) with including stratospheric H_2O	5.4	1.8	3.5	0.26
Shindell et al. (2009), CO, global, including direct and indirect aerosol effects	18.6	5.3	N/A	N/A
CO, surface, Berntsen et al. (2005) UiO Mid-lat, as given by Fuglestvedt et al. (2010)	7.2	2.3	4.1	0.33
CO, surface, Berntsen et al. (2005) LMDz Mid-lat, as given by Fuglestvedt et al. (2010)	9.3	3.3	6.1	0.55
Derwent et al. (2001), as given by Fuglestvedt et al. (2010), CO, surface	6.0	2.0	3.7	0.27

(continued on next page)

Table SI1 (continued)

Species	GWP(20)	GWP(100)	GTP(20)	GTP(100)
VOC [C], this study				
VOC, Europe, summer	41	12	23	1.7
VOC, Europe, winter	27	7.9	14	1.1
VOC, East Asia, summer	42	12	19	1.7
VOC, East Asia, winter	11	3.6	8.9	0.51
VOC, Rest of the world, summer	38	11	22	1.6
VOC, Rest of the world, winter	40	12	25	1.7
VOC, Shipping, NH summer	47	14	32	2.1
VOC, Shipping, NH winter	45	14	30	1.9
VOC, Global, NH summer	38	11	22	1.6
VOC, Global, NH winter	35	10	21	1.5
VOC, other studies				
Collins et al. (2013), VOC (four regions), based on Fry et al. (2012) with including stratospheric H_2O	18.7	5.8	10.0	0.9
Collins et al. (2013), VOC, Europe, based on Fry et al. (2012) with including stratospheric H_2O	18.0	5.6	9.5	0.8
Collins et al. (2013), VOC, East Asia, based on Fry et al. (2012) with including stratospheric H_2O	16.3	5.0	8.4	0.7
Collins et al. (2002), as given by Fuglestvedt et al. (2010), VOC, surface	14	4.5	7.5	0.66
CH4 [CH4], this study				
CH4, Global	76	23	48	3.3
CH4, other studies				
Myhre et al. (2013)	84	28	67	4.3

GWP(100) values for the species not shown in Fig. 3 are given for all regions and seasons, decomposed by processes in Fig. SI1.

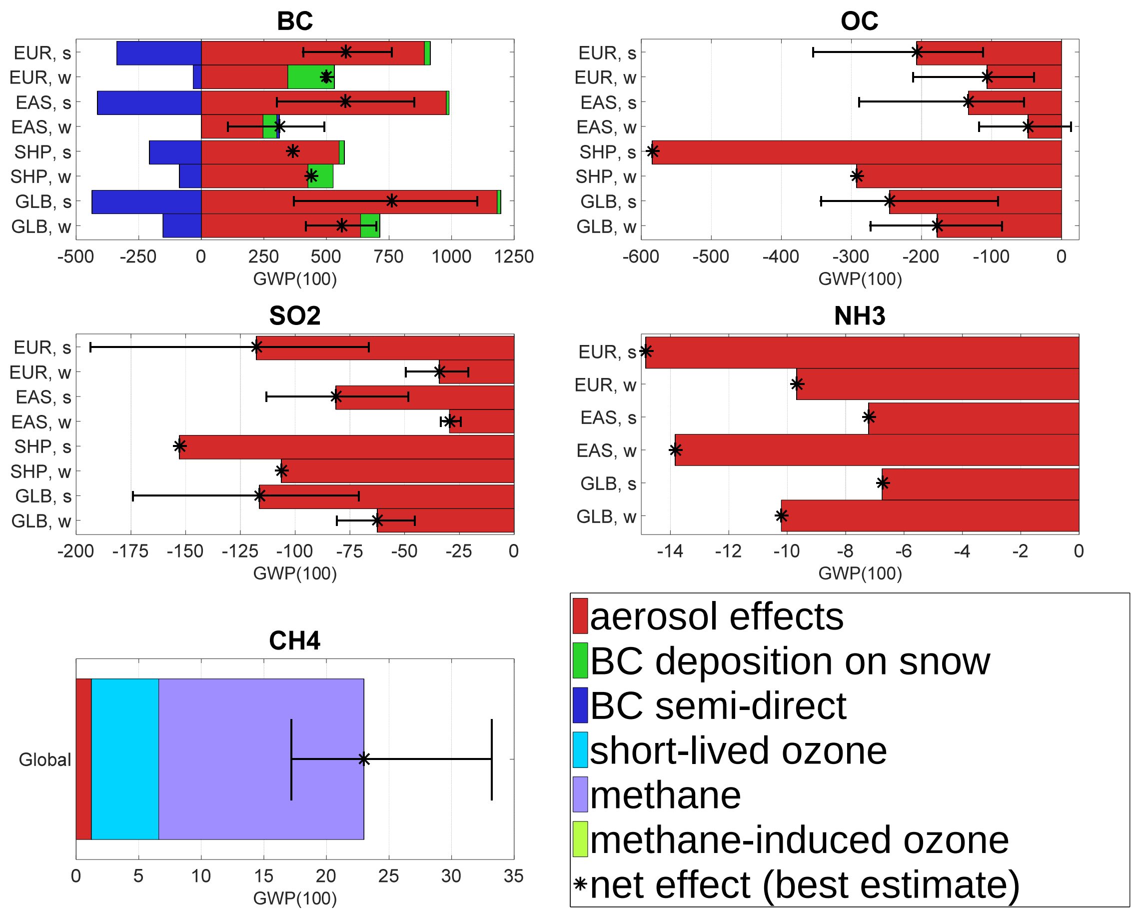

Figure SI1: GWP(100) values for the species not shown in the article, for all regions and seasons, decomposed by processes. The regions included are Europe (EUR), East Asia (EAS), shipping (SHP), and global (GLB), all for both NH summer, May-October, (s) and NH winter, November-April, (w).

2. Variations with time horizon

Emission metric values for the first 50 years are given for the species not shown in Figure 7 for GTP in Figure SI2 and GWP in Figure SI3.

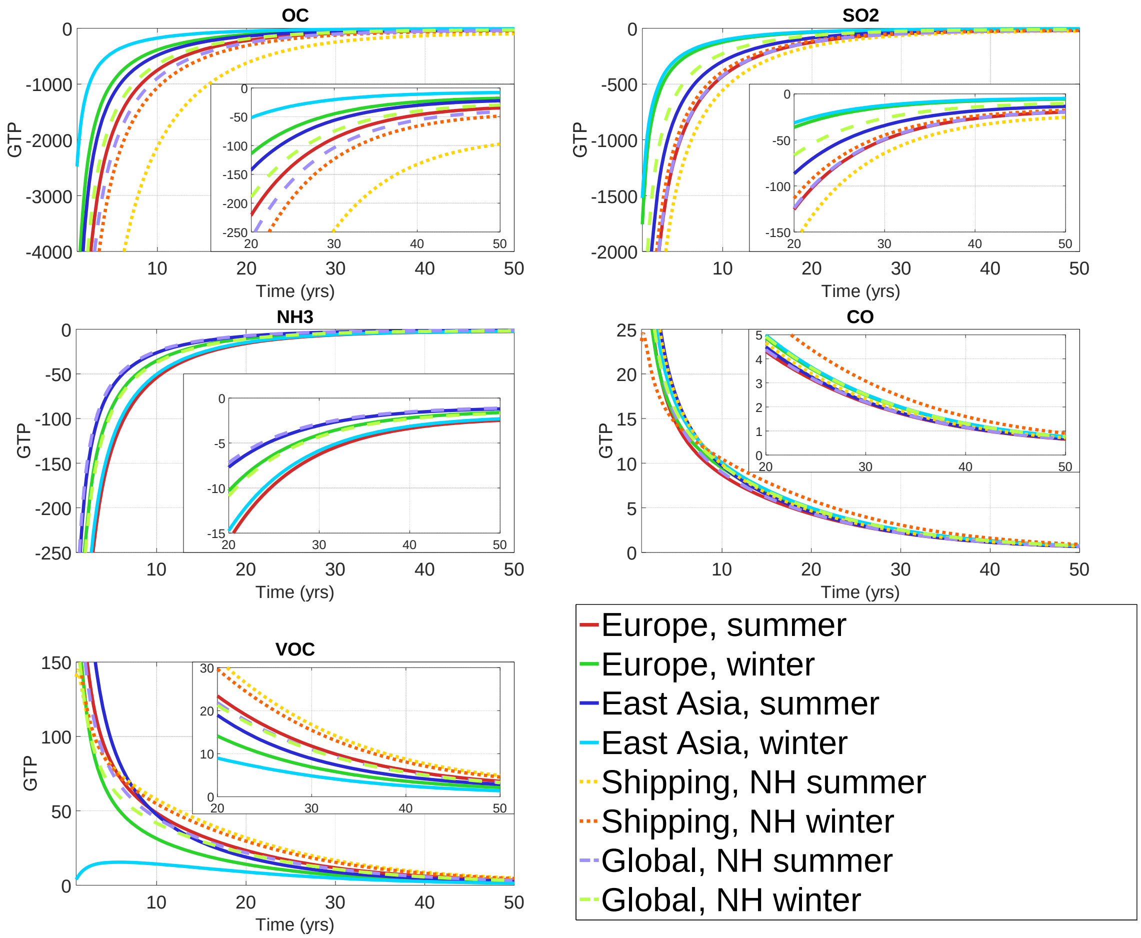

Figure SI2: GTPs for the species.

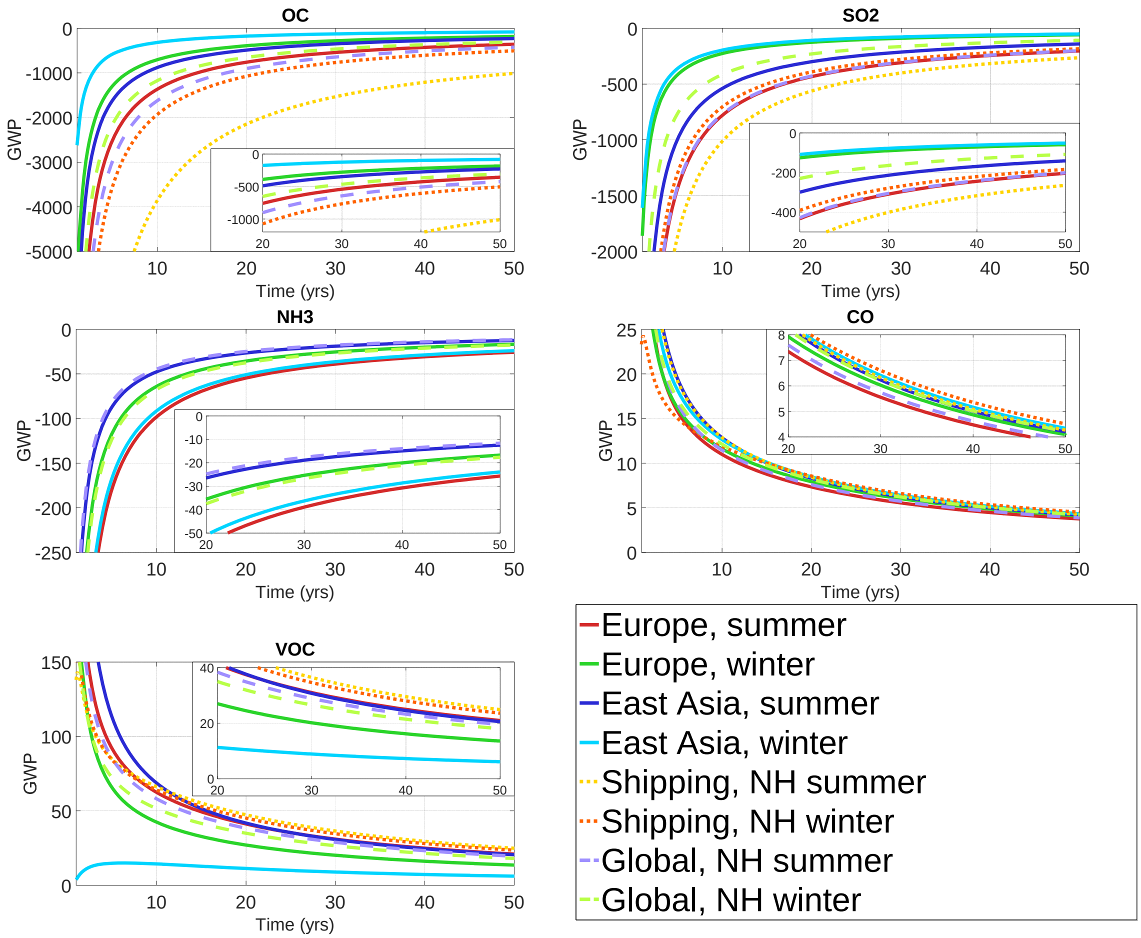

Figure SI3: GWPs for the species.

3. Gradual implementation of mitigation

Figure 9 presented how the emission metric values evolve with pulse emissions, sustained emissions, and a case of 15 years of ramp-up to illustrate a gradual implementation of mitigation policy. We present the same in Figure SI4 for the species not shown in the article. The ramp-up case is given for the different regions and seasons in Figure 10. Here, we include for those species not presented in the article, see Figure SI5 and Figure SI6.

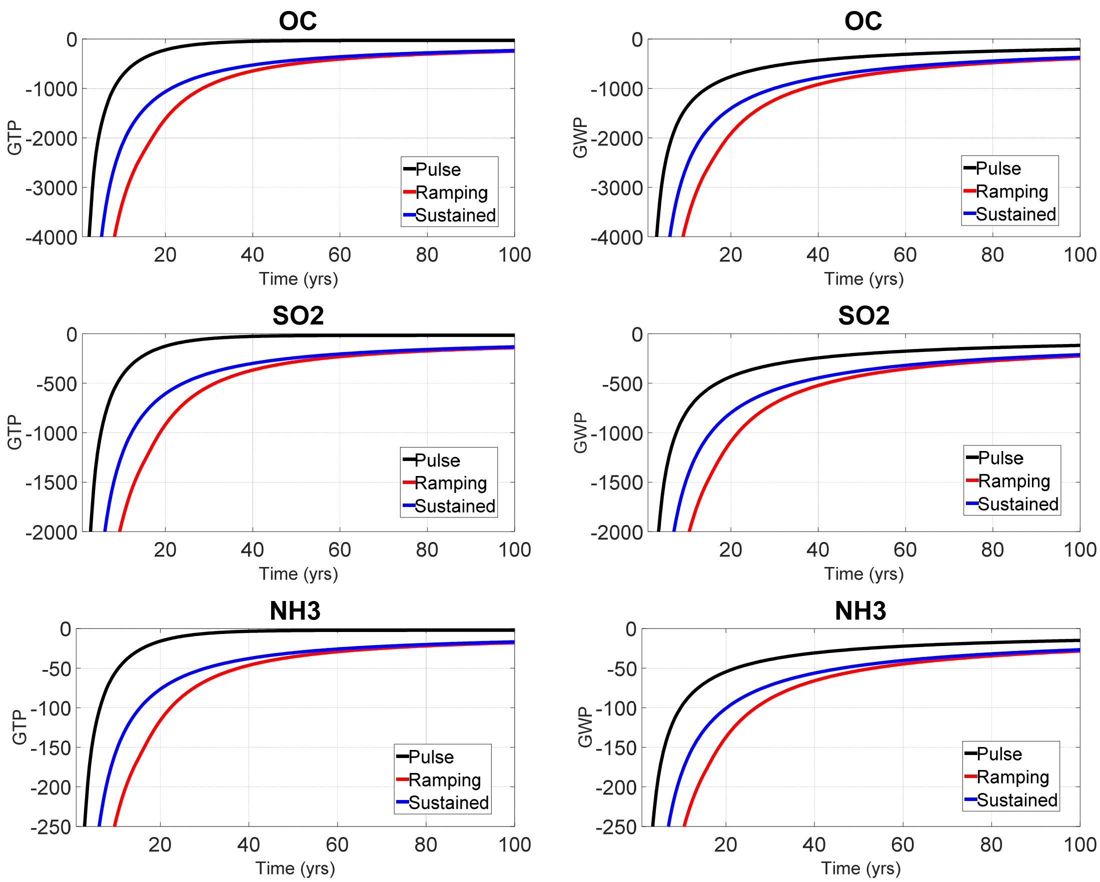

Figure SI4: The emission metric values for different types of emission profiles. GTP to the left and GWP to the right.

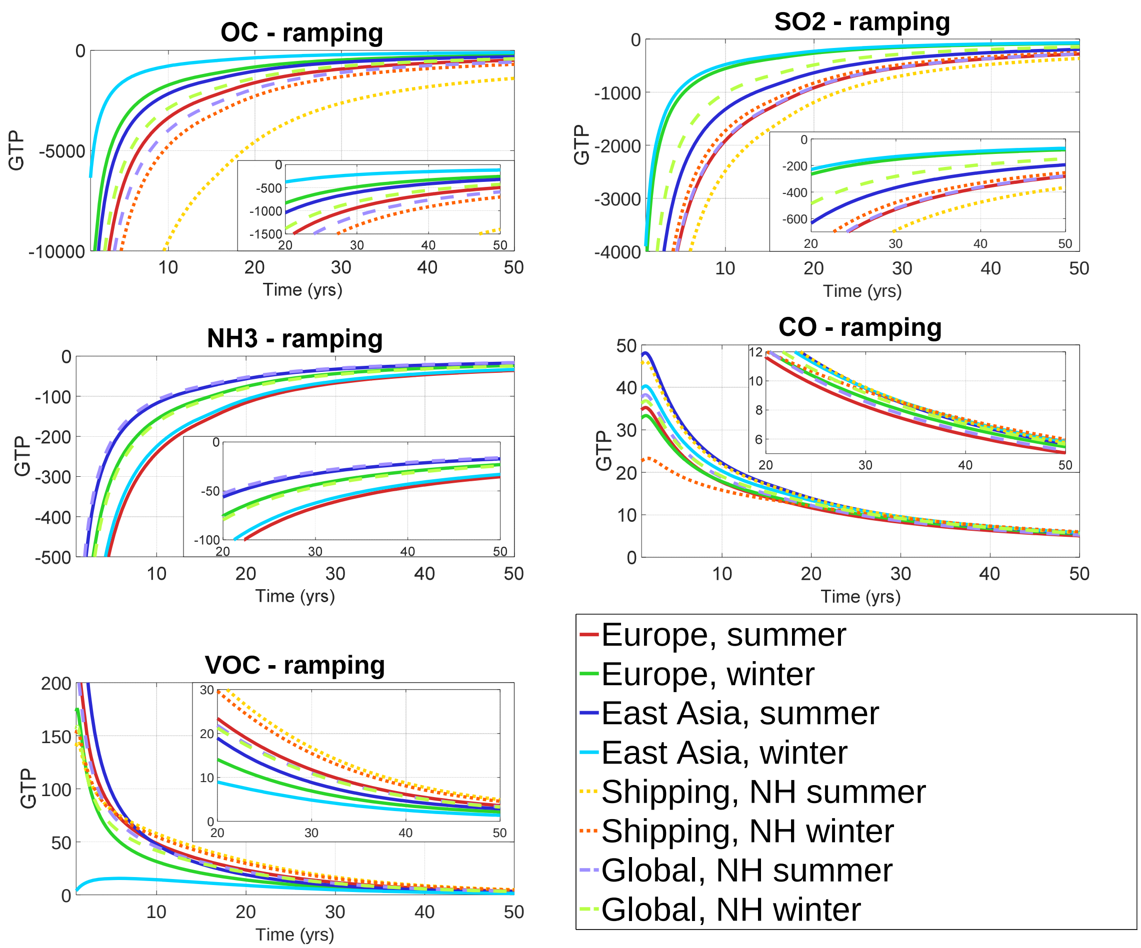

Figure SI5: GTPs for species with ramp-up emissions over 15 years.

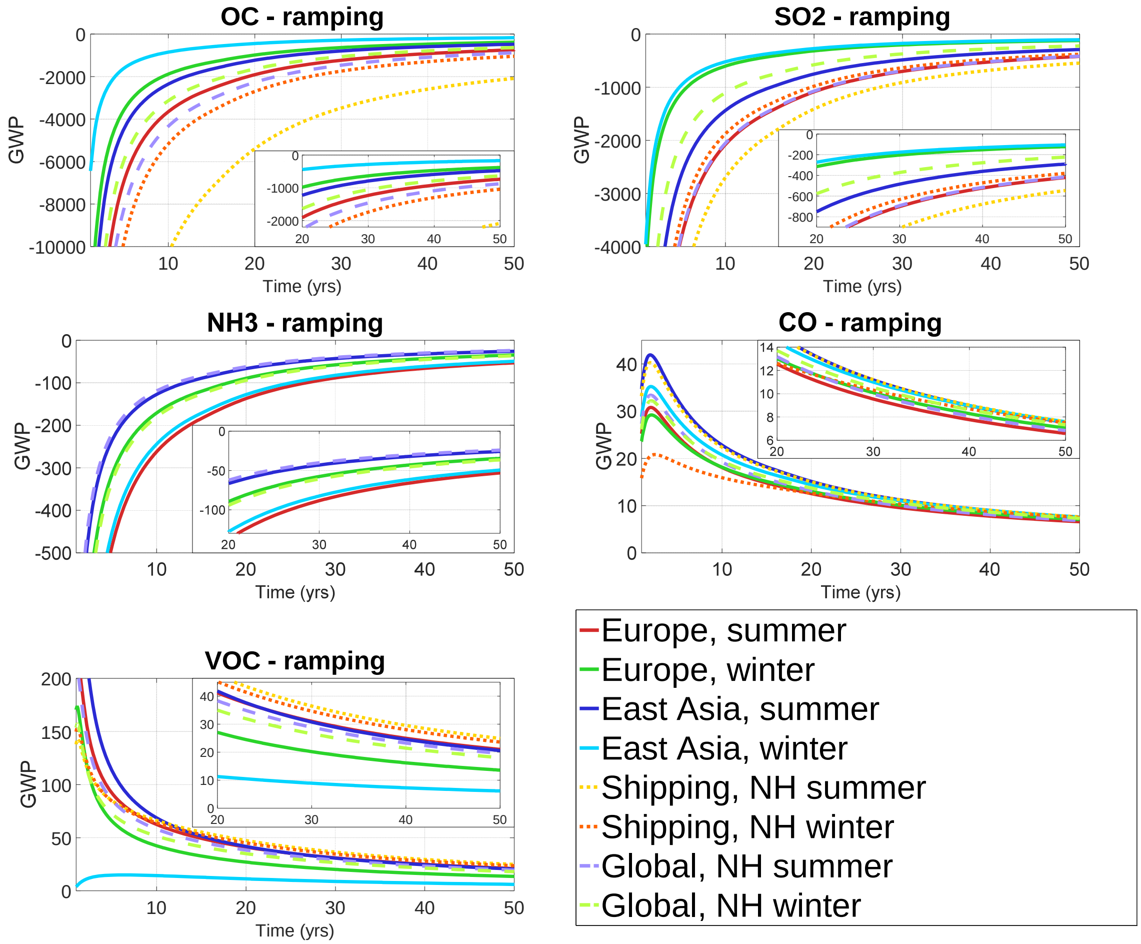

Figure SI6: GWPs for species with ramp-up emissions over 15 years.

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