



Supplement of

emIAM v1.0: an emulator for integrated assessment models using marginal abatement cost curves

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Table S1. Carbon price pathways of different initial levels with a 5% of growth rate

Scenario	2010	2015	2020	2025	2030	2035	2040	2045	2050	2055	2060	2065	2070	2075	2080	2085	2090	2095	2100
T0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
T1	1	1.3	1.6	2.1	2.7	3.4	4.3	5.5	7.0	9.0	11.5	14.6	18.7	23.8	30.4	38.8	49.6	63.3	80.7
T2	2	2.6	3.3	4.2	5.3	6.8	8.6	11.0	14.1	18.0	22.9	29.3	37.4	47.7	60.9	77.7	99.1	126.5	161.5
T3	3	3.8	4.9	6.2	8.0	10.2	13.0	16.5	21.1	27.0	34.4	43.9	56.0	71.5	91.3	116.5	148.7	189.8	242.2
T5	5	6.4	8.1	10.4	13.3	16.9	21.6	27.6	35.2	44.9	57.3	73.2	93.4	119.2	152.1	194.2	247.8	316.3	403.7
T7	7	8.9	11.4	14.6	18.6	23.7	30.3	38.6	49.3	62.9	80.3	102.4	130.8	166.9	213.0	271.8	346.9	442.8	565.1
T10	10	12.8	16.3	20.8	26.5	33.9	43.2	55.2	70.4	89.9	114.7	146.4	186.8	238.4	304.3	388.3	495.6	632.5	807.3
T15	15	19.1	24.4	31.2	39.8	50.8	64.8	82.7	105.6	134.8	172.0	219.5	280.2	357.6	456.4	582.5	743.4	948.8	1211.0
T20	20	25.5	32.6	41.6	53.1	67.7	86.4	110.3	140.8	179.7	229.3	292.7	373.6	476.8	608.5	776.7	991.2	1265.1	1614.6
T25	25	31.9	40.7	52.0	66.3	84.7	108.0	137.9	176.0	224.6	286.7	365.9	467.0	596.0	760.7	970.8	1239.0	1581.4	2018.3
T30	30	38.3	48.9	62.4	79.6	101.6	129.7	165.5	211.2	269.6	344.0	439.1	560.4	715.2	912.8	1165.0	1486.8	1897.6	2421.9
T40	40	51.1	65.2	83.2	106.1	135.5	172.9	220.6	281.6	359.4	458.7	585.4	747.2	953.6	1217.1	1553.3	1982.5	2530.2	3229.2
T50	50	63.8	81.4	103.9	132.7	169.3	216.1	275.8	352.0	449.3	573.4	731.8	934.0	1192.0	1521.3	1941.6	2478.1	3162.7	4036.5
T60	60	76.6	97.7	124.7	159.2	203.2	259.3	331.0	422.4	539.1	688.0	878.1	1120.8	1430.4	1825.6	2330.0	2973.7	3795.3	4843.8
T70	70	89.3	114.0	145.5	185.7	237.0	302.5	386.1	492.8	629.0	802.7	1024.5	1307.5	1668.8	2129.8	2718.3	3469.3	4427.8	5651.1
T80	80	102.1	130.3	166.3	212.3	270.9	345.8	441.3	563.2	718.8	917.4	1170.9	1494.3	1907.2	2434.1	3106.6	3964.9	5060.3	6458.4
T90	90	114.9	146.6	187.1	238.8	304.8	389.0	496.4	633.6	808.7	1032.1	1317.2	1681.1	2145.6	2738.4	3494.9	4460.5	5692.9	7265.7
T100	100	127.6	162.9	207.9	265.3	338.6	432.2	551.6	704.0	898.5	1146.7	1463.6	1867.9	2384.0	3042.6	3883.3	4956.1	6325.4	8073.0
T110	110	140.4	179.2	228.7	291.9	372.5	475.4	606.8	774.4	988.4	1261.4	1609.9	2054.7	2622.4	3346.9	4271.6	5451.8	6958.0	8880.3
T120	120	153.2	195.5	249.5	318.4	406.4	518.6	661.9	844.8	1078.2	1376.1	1756.3	2241.5	2860.8	3651.2	4659.9	5947.4	7590.5	9687.6
T130	130	165.9	211.8	270.3	344.9	440.2	561.9	717.1	915.2	1168.1	1490.8	1902.6	2428.3	3099.2	3955.4	5048.2	6443.0	8223.1	10494.9
T140	140	178.7	228.0	291.0	371.5	474.1	605.1	772.2	985.6	1257.9	1605.4	2049.0	2615.1	3337.6	4259.7	5436.6	6938.6	8855.6	11302.3

Table S2. Equation forms and parameter ranges for fitting MAC curves

	AIM	GEM	MESSAGE	IMAGE	COFFEE	TIAM	REMIND	WITCH	POLES	GET
Equation 1	$f(x) = a \times x^b + c \times x^d$									
<i>a</i>	[0,+inf)	[0,+inf)	[0,+inf)	[0,+inf)	[0,+inf)	[0,+inf)	[0,+inf)	[0,+inf)	[0,+inf)	[0,+inf)
<i>b</i>	[0.01,100]	[0.01,100]	[0.01,100]	[0.01,100]	[0.01,100]	[0.01,100]	[0.01,100]	[0.01,100]	[0.01,100]	[0.01,100]
<i>c</i>	[0,+inf)	[0,+inf)	[0,+inf)	[0,+inf)	[0,+inf)	[0,+inf)	[0,+inf)	[0,+inf)	[0,+inf)	[0,+inf)
<i>d</i>	[0.01,100]	[0.01,100]	[0.01,100]	[0.01,100]	[0.01,100]	[0.01,100]	[0.01,100]	[0.01,100]	[0.01,100]	[0.01,100]
Equation 2	$f(x) = a \times x + b \times (\exp^{cx} - 1)$									
<i>a</i>	-	-	-	-	-	-	-	-	-	-
<i>b</i>	-	-	-	-	-	-	-	-	-	-
<i>c</i>	(-inf,50]	(-inf,50]	(-inf,50]	(-inf,50]	(-inf,50]	(-inf,50]	(-inf,50]	(-inf,50]	(-inf,50]	(-inf,50]
Equation 3	$f(x) = a \times x + b \times x^2 + c \times x^3 + d \times x^4$									
<i>a</i>	-	-	-	-	-	-	-	-	-	-
<i>b</i>	-	-	-	-	-	-	-	-	-	-
<i>c</i>	-	-	-	-	-	-	-	-	-	-
<i>d</i>	-	-	-	-	-	-	-	-	-	-
Equation 4	$f(x) = a \times (b^{cx} - 1)$									
<i>a</i>	[0,+inf)	[0,+inf)	[0,+inf)	[0,+inf)	[0,+inf)	[0,+inf)	[0,+inf)	[0,+inf)	[0,+inf)	[0,+inf)
<i>b</i>	[0.001,+inf)	[0.001,+inf)	[0.001,+inf)	[0.001,+inf)	[0.001,+inf)	[0.001,+inf)	[0.001,+inf)	[0.001,+inf)	[0.001,+inf)	[0.001,+inf)
<i>c</i>	(-inf,100]	(-inf,100]	(-inf,100]	(-inf,100]	(-inf,100]	(-inf,100]	(-inf,100]	(-inf,100]	(-inf,100]	(-inf,100]

Table S3. Statistics for function choices

The count indicates the number of times the corresponding equation was selected as the best-fitting equation for the IAM price-quantity data.

Function	Count	Percentage (%)
Equation 1	126	51.22
Equation 2	15	6.10
Equation 3	45	18.29
Equation 4	60	24.39
Total	246	100

Table S4. Parameter values in global MAC curves for energy-related CO₂, CH₄, and N₂O emissions derived from nine ENGAGE IAMs

No data are available for energy-related CH₄ and N₂O emissions from GEM and TIAM and energy-related N₂O emissions from COFFEE.

Model	Gas	a	b	c	d	MaxABL	Max1st	Max2nd
AIM	CO ₂	192.98	1.25	16.51	18.28	112.7	6.4	1.0
AIM	CH ₄	94.24	0.91	822.81	18.27	94.3	6.2	1.7
AIM	N ₂ O	171.87	1.41	1,249.37	12.65	87.2	5.7	1.1
COFFEE	CO ₂	40.32	1.15	40.48	5.63	147.0	6.3	1.6
COFFEE	CH ₄	14.38	0.35	455.91	5.77	88.9	5.0	3.6
COFFEE	N ₂ O	—	—	—	—	—	—	—
GEM	CO ₂	272.42	1.57	119.95	6.82	108.0	6.0	1.4
GEM	CH ₄	—	—	—	—	—	—	—
GEM	N ₂ O	—	—	—	—	—	—	—
IMAGE	CO ₂	309.98	1.23	83.50	24.63	107.6	6.0	1.1
IMAGE	CH ₄	283.45	1.18	879.73	11.96	91.8	4.8	1.0
IMAGE	N ₂ O	126.54	0.27	2.290 × 10 ⁴	14.02	78.1	5.3	1.3
MESSAGE	CO ₂	471.55	3.02	179.97	30.24	112.0	5.0	0.8
MESSAGE	CH ₄	2,332.36	7.75	1.039 × 10 ⁵	49.10	93.7	5.5	1.4
MESSAGE	N ₂ O	155.77	0.43	3.818 × 10 ⁴	5.95	62.0	3.8	0.9
POLES	CO ₂	2,092.84	3.01	1,785.75	16.24	110.2	4.6	1.1
POLES	CH ₄	4,016.39	7.61	4,016.39	7.61	97.5	6.0	1.2
POLES	N ₂ O	630.22	1.71	1.469 × 10 ⁴	7.56	87.4	5.5	1.0
REMIND	CO ₂	316.94	1.82	591.39	21.77	104.3	6.6	0.9
REMIND	CH ₄	143.80	1.02	2,139.05	14.81	97.7	5.4	1.6
REMIND	N ₂ O	44.00	0.17	5,558.24	2.93	47.8	2.9	1.0
TIAM	CO ₂	394.27	1.39	183.59	11.93	116.2	4.6	0.8
TIAM	CH ₄	—	—	—	—	—	—	—
TIAM	N ₂ O	—	—	—	—	—	—	—
WITCH	CO ₂	421.02	1.40	971.12	7.56	101.4	3.9	1.3
WITCH	CH ₄	153.56	3.52	1,528.23	36.27	99.6	5.9	3.6
WITCH	N ₂ O	97.19	0.73	4.379 × 10 ⁵	8.98	50.8	3.5	1.4

Table S5. Statistical validation of global emission pathways of ECB scenario without INDC reproduced from ACC2-emIAM with original emission pathways from nine ENGAGE IAMs

The table shows two indicators: i) ordinary Pearson's correlation coefficient r_P and ii) Lin's concordance coefficient r_C . The higher the value of the indicator is, the darker the color of the cell is.

		AIM	COFFEE	GEM	IMAGE	MESSAGE	POLES	REMIN	TIAM	WITCH	
r_P	Test 1	CO ₂	0.986	0.990	0.985	0.978	0.986	0.989	0.969	0.994	0.975
		CH ₄	0.980	0.976	0.987	0.987	0.979	0.976	0.989	0.943	0.981
		N ₂ O	0.969	0.979	0.973	0.949	0.989	0.960	0.974	0.601	0.979
	Test 2	CO ₂	0.984	0.994	0.985	0.977	0.990	0.991	0.954	0.997	0.970
		CH ₄	0.820	0.942	0.930	0.919	0.977	0.977	0.945	0.962	0.967
		N ₂ O	0.961	0.982	0.979	0.943	0.988	0.969	0.970	0.652	0.984
	Test 3	CO ₂	0.982	0.992	0.985	0.976	0.980	0.990	0.970	0.767	0.971
		CH ₄	0.759	0.912	0.903	0.929	0.975	0.948	0.893	0.510	0.934
		N ₂ O	0.961	0.959	0.980	0.855	0.981	0.966	0.960	0.498	0.972
	Test 4	CO ₂	0.990	0.992	0.987	0.993	0.988	0.991	0.982	0.995	0.981
		CH ₄	0.915	0.914	0.969	0.983	0.980	0.956	0.960	0.962	0.967
		N ₂ O	0.972	0.959	0.974	0.931	0.981	0.962	0.976	0.705	0.975
r_C	Test 1	CO ₂	0.980	0.981	0.984	0.976	0.986	0.989	0.968	0.994	0.963
		CH ₄	0.978	0.974	0.987	0.983	0.978	0.975	0.989	0.940	0.980
		N ₂ O	0.967	0.974	0.973	0.946	0.988	0.958	0.974	0.535	0.976
	Test 2	CO ₂	0.978	0.989	0.984	0.976	0.990	0.991	0.953	0.997	0.961
		CH ₄	0.757	0.930	0.894	0.879	0.974	0.972	0.925	0.961	0.957
		N ₂ O	0.959	0.978	0.979	0.939	0.988	0.968	0.969	0.607	0.982
	Test 3	CO ₂	0.975	0.987	0.984	0.975	0.980	0.989	0.970	0.760	0.959
		CH ₄	0.660	0.910	0.875	0.905	0.974	0.947	0.855	0.430	0.916
		N ₂ O	0.957	0.956	0.977	0.828	0.981	0.948	0.953	0.453	0.962
	Test 4	CO ₂	0.988	0.986	0.987	0.992	0.986	0.990	0.982	0.994	0.978
		CH ₄	0.901	0.912	0.964	0.966	0.975	0.949	0.949	0.958	0.964
		N ₂ O	0.967	0.956	0.966	0.920	0.978	0.943	0.973	0.598	0.968

Table S7. Available scenarios for each model in the ENGAGE Scenario Explorer

0 means that the model does not provide the corresponding scenario, while 1 means that the model provides the corresponding scenario.

Scenarios	AIM/CGE V2.2	COFFEE 1.1	GEM-E3 V2021	IMAGE 3.0	MESSAGEx-GLOBIOM 1.1	POLES-JRC ENGAGE	REMIND-MagPIE 2.1-4.2	TIAM-ECN 1.1	WITCH 5.0	Count
EN_INDCi2030_300f	0	0	0	0	0	1	1	0	0	2
EN_INDCi2030_400	0	0	0	0	0	0	0	0	0	0
EN_INDCi2030_400f	0	1	0	0	0	1	1	0	0	3
EN_INDCi2030_500	0	1	0	0	0	0	0	0	0	1
EN_INDCi2030_500f	0	1	0	0	0	1	1	0	1	4
EN_INDCi2030_600	0	1	0	0	0	0	0	0	0	1
EN_INDCi2030_600f	0	1	1	0	0	1	1	0	1	5
EN_INDCi2030_700	0	1	0	0	0	0	1	0	0	2
EN_INDCi2030_700f	0	1	0	0	1	1	1	0	1	5
EN_INDCi2030_800	0	1	1	0	0	0	0	0	1	4
EN_INDCi2030_800f	1	1	1	1	1	1	1	0	1	8
EN_INDCi2030_900	0	1	0	0	0	1	1	1	1	5
EN_INDCi2030_900f	1	1	0	0	1	1	1	1	1	7
EN_INDCi2030_1000	0	1	1	1	1	1	1	1	1	8
EN_INDCi2030_1000f	1	1	1	1	1	1	1	1	1	9
EN_INDCi2030_1200	1	1	0	1	1	1	1	1	1	8
EN_INDCi2030_1200f	1	1	0	1	1	1	1	1	1	8
EN_INDCi2030_1400	1	1	1	1	1	1	1	1	1	9
EN_INDCi2030_1400f	1	1	1	1	1	1	1	1	1	9
EN_INDCi2030_1600	1	1	0	0	1	1	1	1	1	7
EN_INDCi2030_1600f	1	1	0	0	1	1	1	1	1	7
EN_INDCi2030_1800	1	1	1	0	1	1	1	0	1	7
EN_INDCi2030_1800f	1	1	1	0	1	1	1	0	1	7
EN_INDCi2030_2000	0	1	0	0	1	1	1	1	1	6
EN_INDCi2030_2000f	0	1	0	0	1	1	1	1	1	6
EN_INDCi2030_2500	0	1	0	0	1	1	1	1	1	6
EN_INDCi2030_2500f	0	1	0	0	1	1	1	1	1	6
EN_INDCi2030_3000	0	0	0	1	1	1	1	1	1	6
EN_INDCi2030_3000f	0	0	0	1	1	1	1	1	1	6
EN_NPi2020_200f	0	0	0	0	1	0	0	0	0	2
EN_NPi2020_300	0	0	0	0	0	0	0	0	0	0
EN_NPi2020_300f	1	0	0	0	1	1	1	0	0	4
EN_NPi2020_400	0	1	0	0	0	0	1	0	0	2
EN_NPi2020_400f	1	1	1	0	1	1	1	0	1	7
EN_NPi2020_450	0	0	0	0	1	0	0	0	1	2
EN_NPi2020_450f	0	0	0	0	1	0	0	0	1	2
EN_NPi2020_500	0	1	1	0	1	1	1	0	1	6
EN_NPi2020_500f	1	1	1	0	1	1	1	0	1	7
EN_NPi2020_600	1	1	1	0	1	1	1	0	1	7
EN_NPi2020_600f	1	1	1	1	1	1	1	0	1	8
EN_NPi2020_700	1	1	0	0	1	1	1	0	1	6
EN_NPi2020_700f	1	1	0	0	1	1	1	0	1	6
EN_NPi2020_800	1	1	1	1	1	1	1	1	1	9
EN_NPi2020_800f	1	1	1	1	1	1	1	1	1	9
EN_NPi2020_900	1	1	0	0	1	1	1	1	1	7
EN_NPi2020_900f	1	1	0	0	1	1	1	1	1	7
EN_NPi2020_1000	1	1	1	1	1	1	1	1	1	9
EN_NPi2020_1000f	1	1	1	1	1	1	1	1	1	9
EN_NPi2020_1200	1	1	0	1	1	1	1	1	1	8
EN_NPi2020_1200f	1	1	0	1	1	1	1	1	1	8
EN_NPi2020_1400	1	1	1	1	1	1	1	1	1	9
EN_NPi2020_1400f	1	1	1	1	1	1	1	1	1	9
EN_NPi2020_1600	1	1	0	0	1	1	1	1	1	7
EN_NPi2020_1600f	1	1	0	0	1	1	1	1	1	7
EN_NPi2020_1800	1	1	1	0	1	1	1	0	1	7
EN_NPi2020_1800f	1	1	1	0	1	1	1	0	1	7
EN_NPi2020_2000	0	1	0	0	1	1	1	1	1	6
EN_NPi2020_2000f	0	1	0	0	1	1	1	1	1	6
EN_NPi2020_2500	0	1	0	0	1	1	1	1	1	6
EN_NPi2020_2500f	0	1	0	0	1	1	1	1	1	6
EN_NPi2020_3000	0	0	0	1	1	1	1	1	1	6
EN_NPi2020_3000f	0	0	0	1	1	1	1	1	1	6
EN_NPi2100	1	1	1	1	1	1	1	1	1	9
Count	33	52	23	21	51	53	57	35	53	

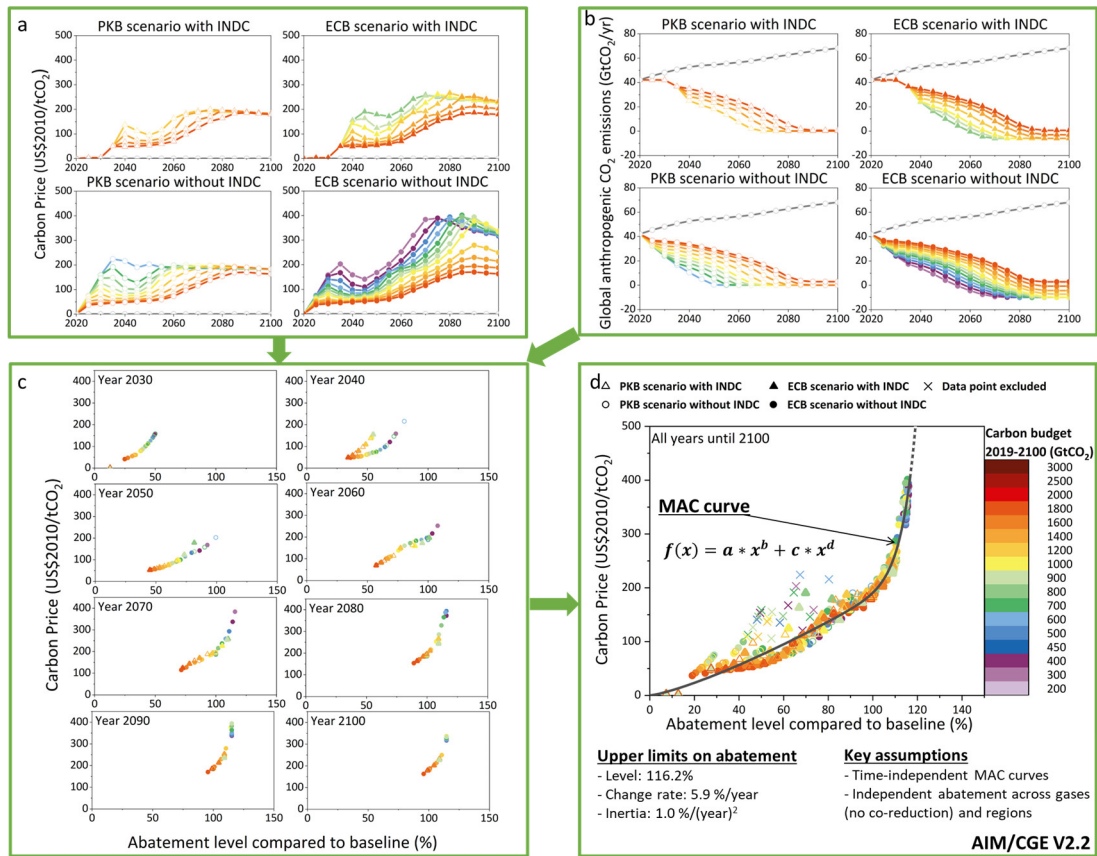


Figure S1. Overview of the methods to derive AIM MAC curves and limits on abatement
 The description of the figure can be found in the caption of Figure 1.

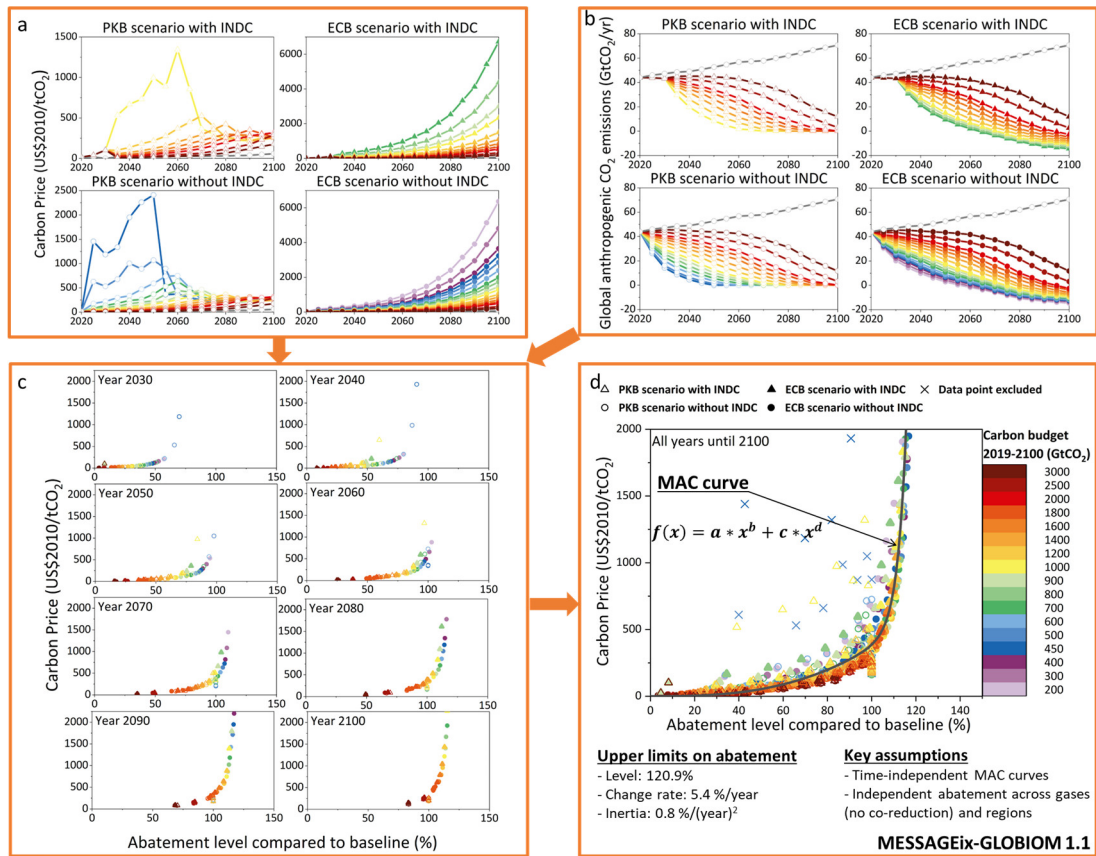


Figure S2. Overview of the methods to derive MESSAGE MAC curves and limits on abatement

The description of the figure can be found in the caption of Figure 1.

MAC curves defined with relative and absolute abatement

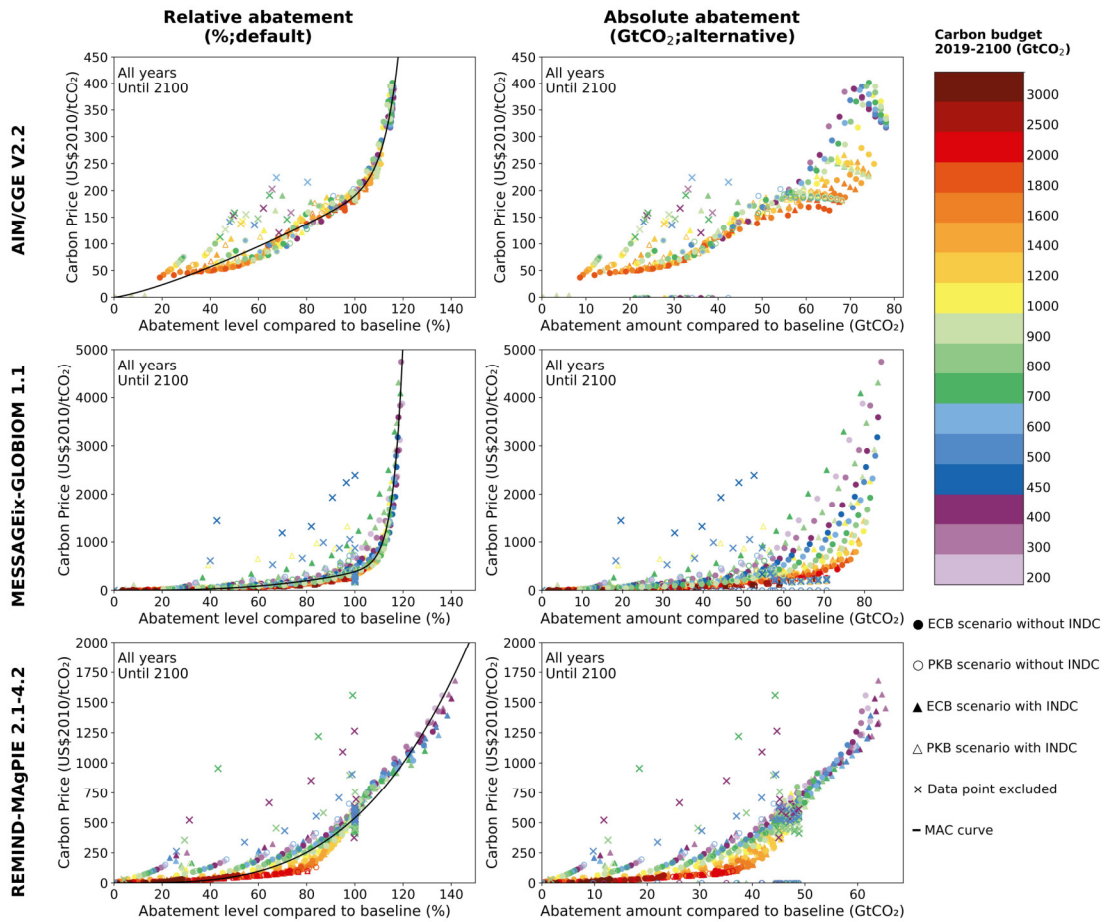


Figure S3. MAC curves defined with relative and absolute abatement for three models
 The left three panels show the relationship between carbon price and relative abatement level, while the right three panels show the relationship between carbon price and absolute abatement level. Black lines in the left three panels are MAC curves in percentage used in our study.

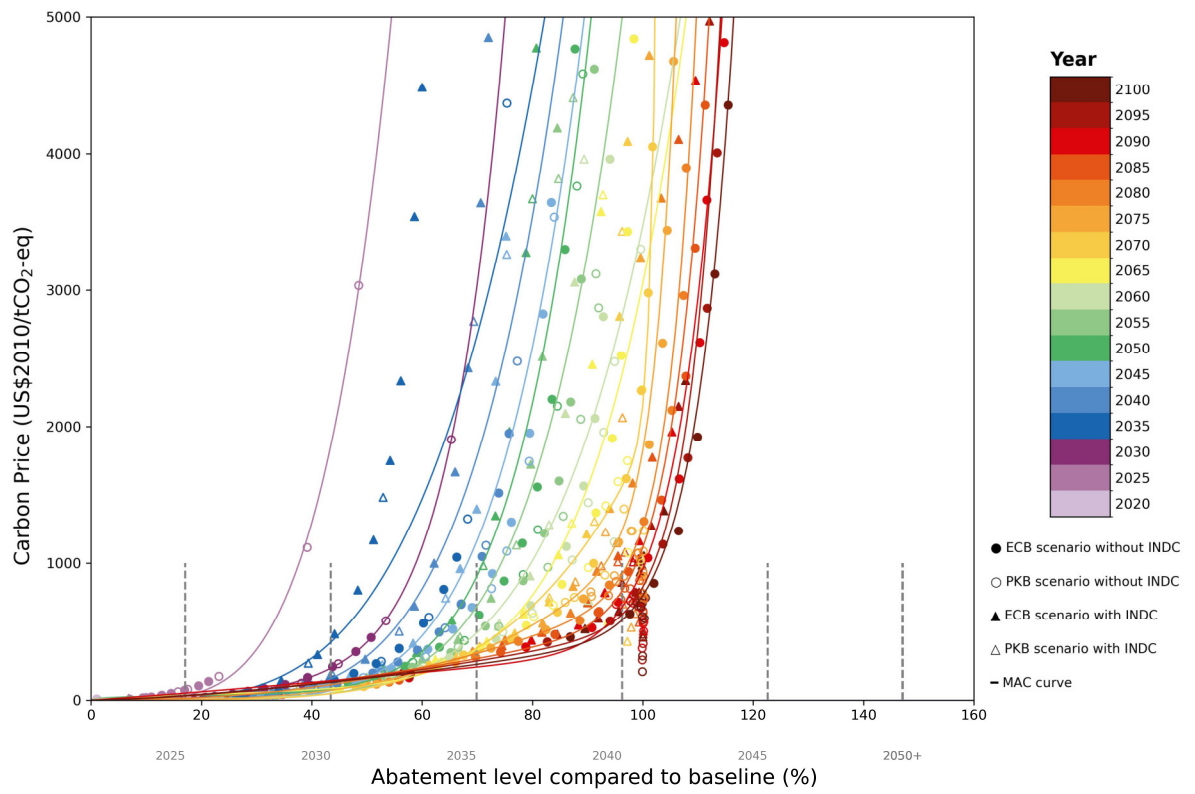


Figure S4. MAC curves of total anthropogenic CO₂ emissions per five years for POLES
 The dots are original data from the POLES model, and the lines are MAC curves derived from these data for different years.

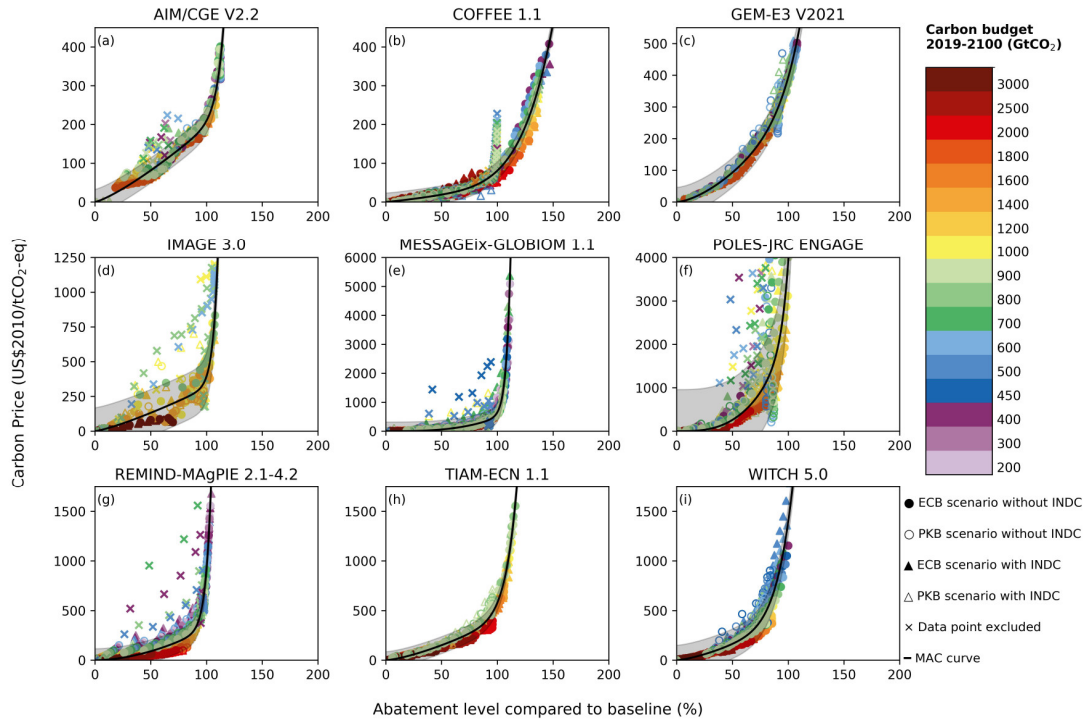


Figure S5. Global energy-related CO₂ MAC curves from nine ENGAGE IAMs
 The description of the figure can be found in the caption of Figure 2. The same below.

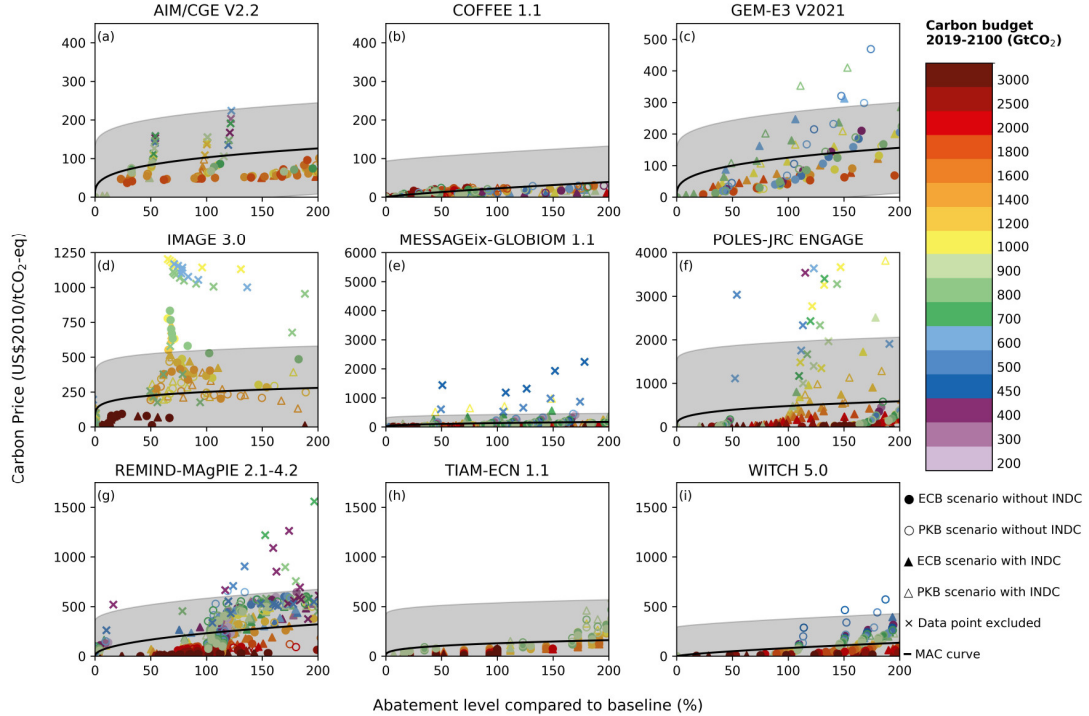


Figure S6. Global non-energy-related CO₂ MAC curves from nine ENGAGE IAMs

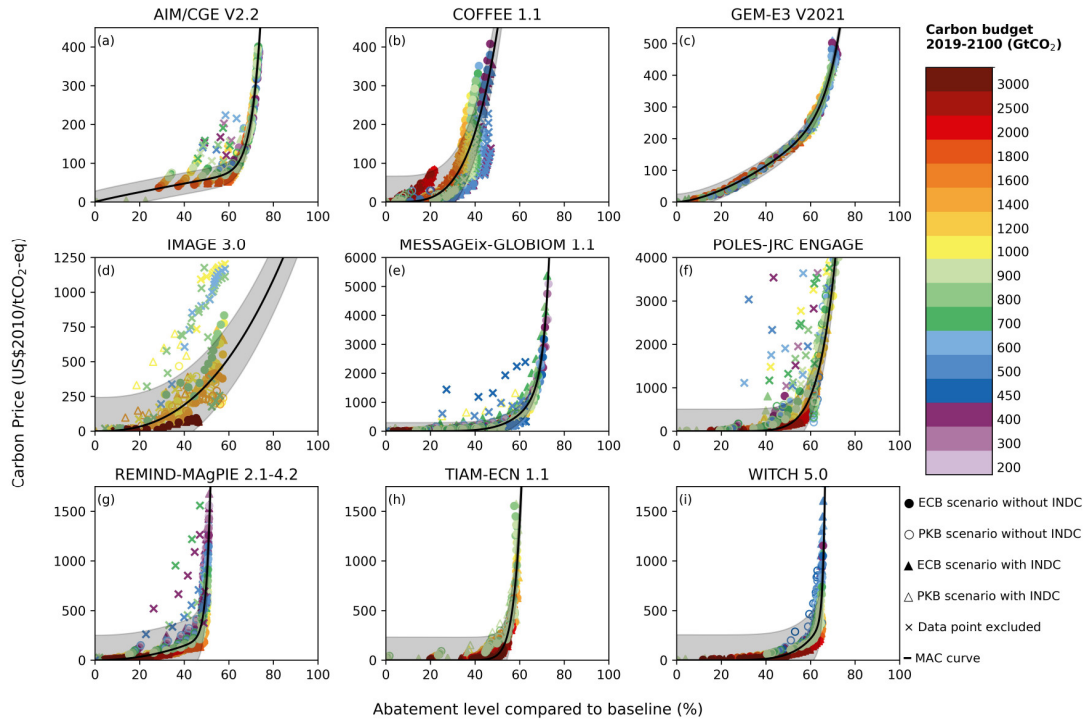


Figure S7. Global total anthropogenic CH₄ MAC curves from nine ENGAGE IAMs

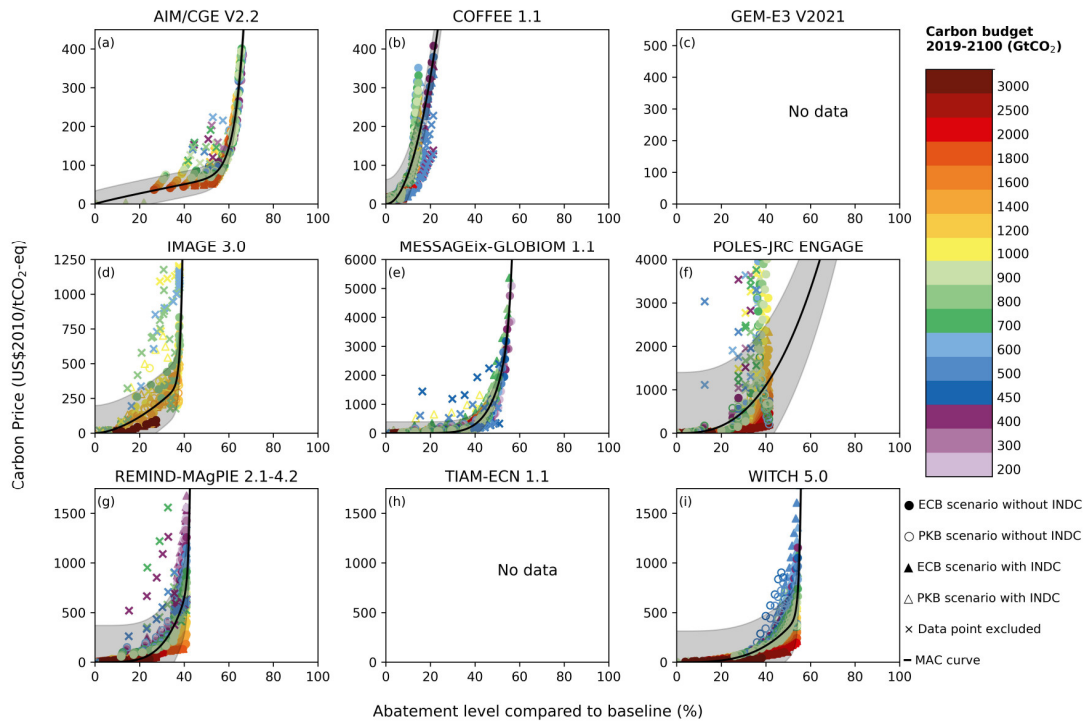


Figure S8. Global energy-related CH₄ MAC curves from nine ENGAGE IAMs

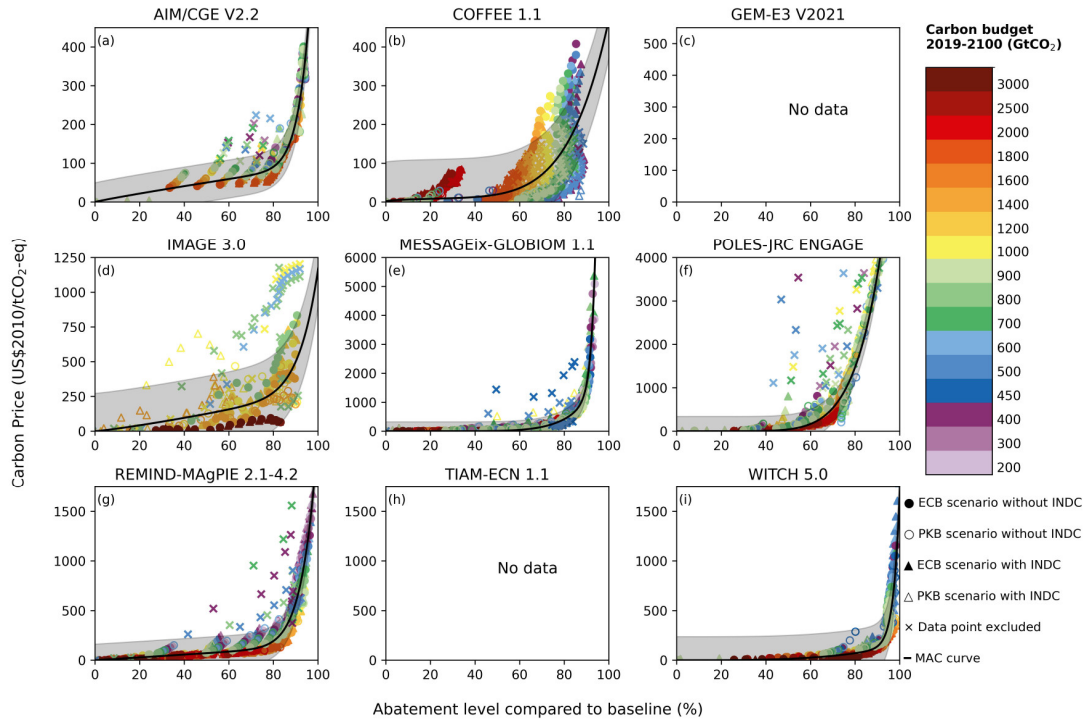


Figure S9. Global non-energy-related CH₄ MAC curves from nine ENGAGE IAMs

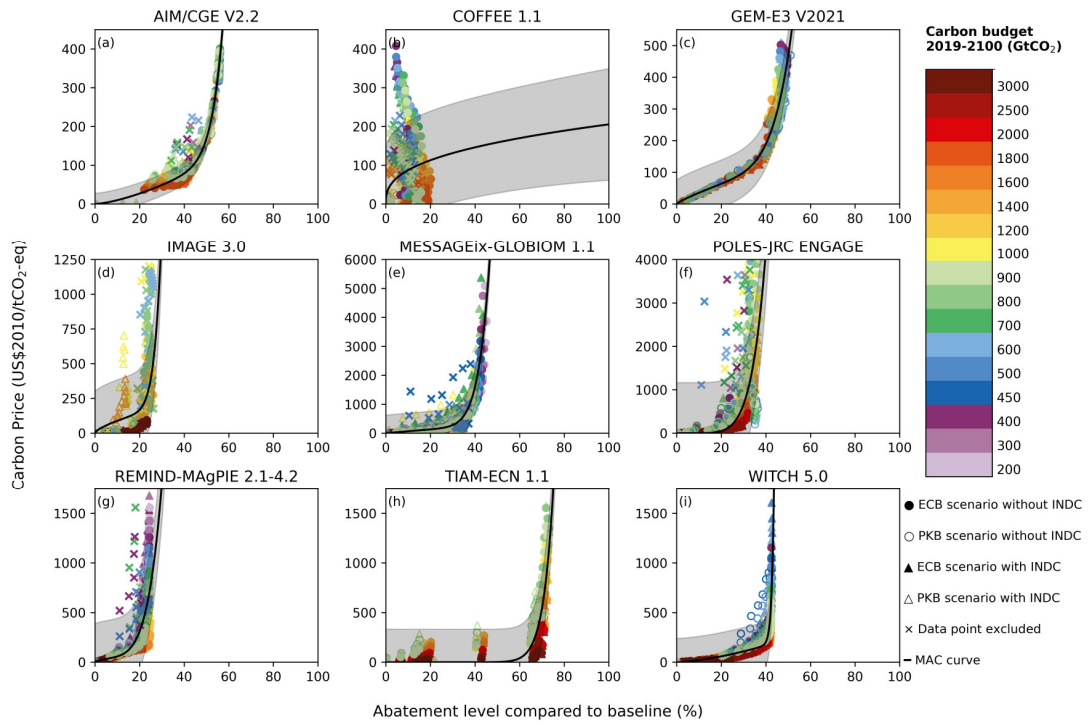


Figure S10. Global total anthropogenic N₂O MAC curves from nine ENGAGE IAMs

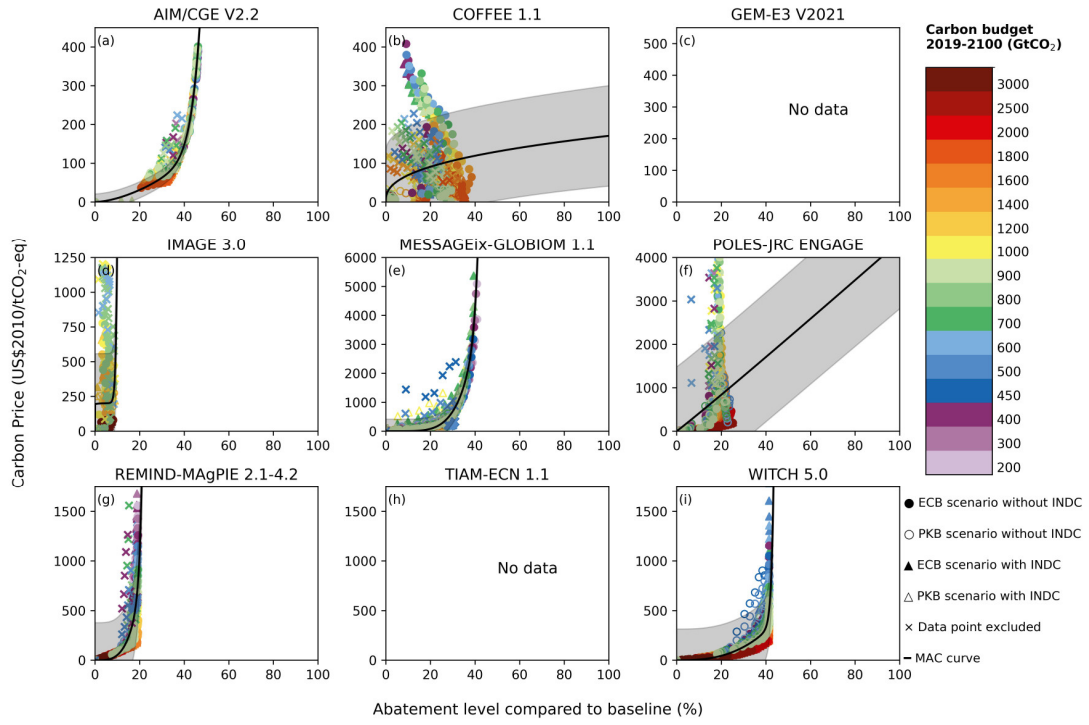


Figure S11. Global energy-related N₂O MAC curves from nine ENGAGE IAMs

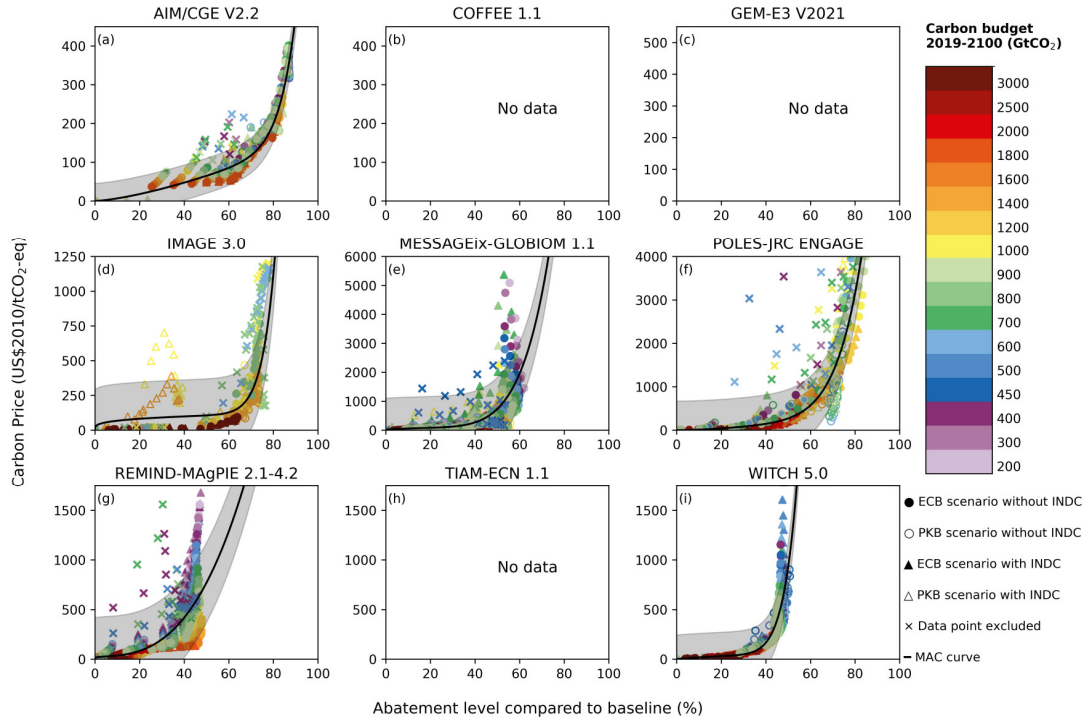


Figure S12. Global non-energy-related N₂O MAC curves from nine ENGAGE IAMs

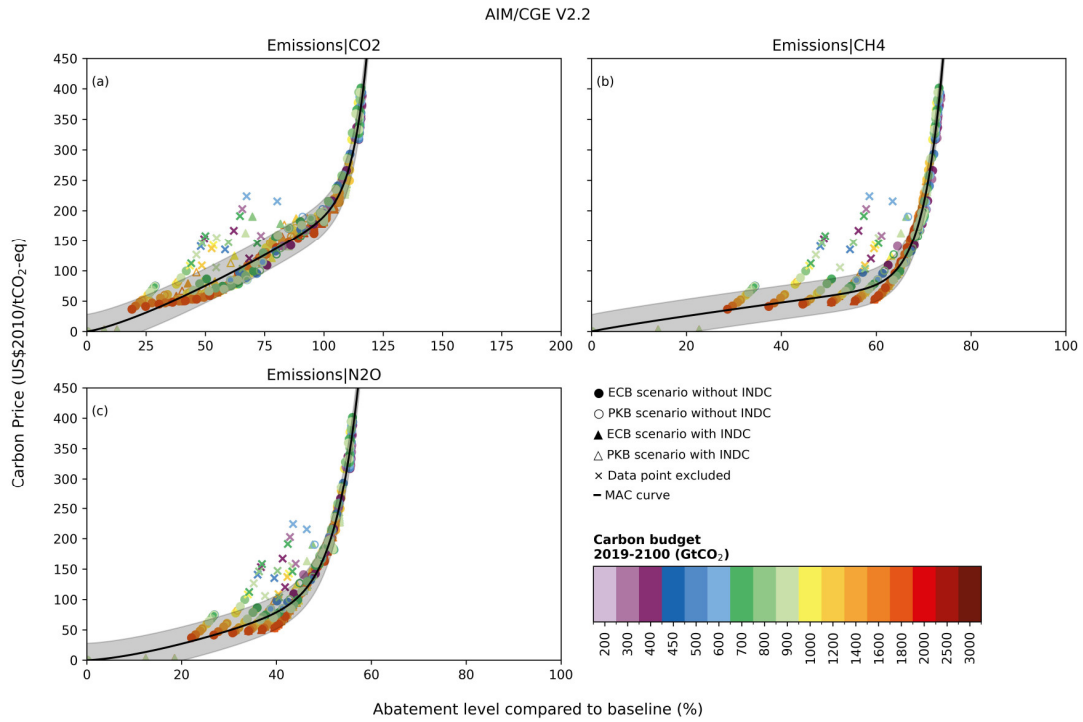


Figure S13. Global AIM MAC curves

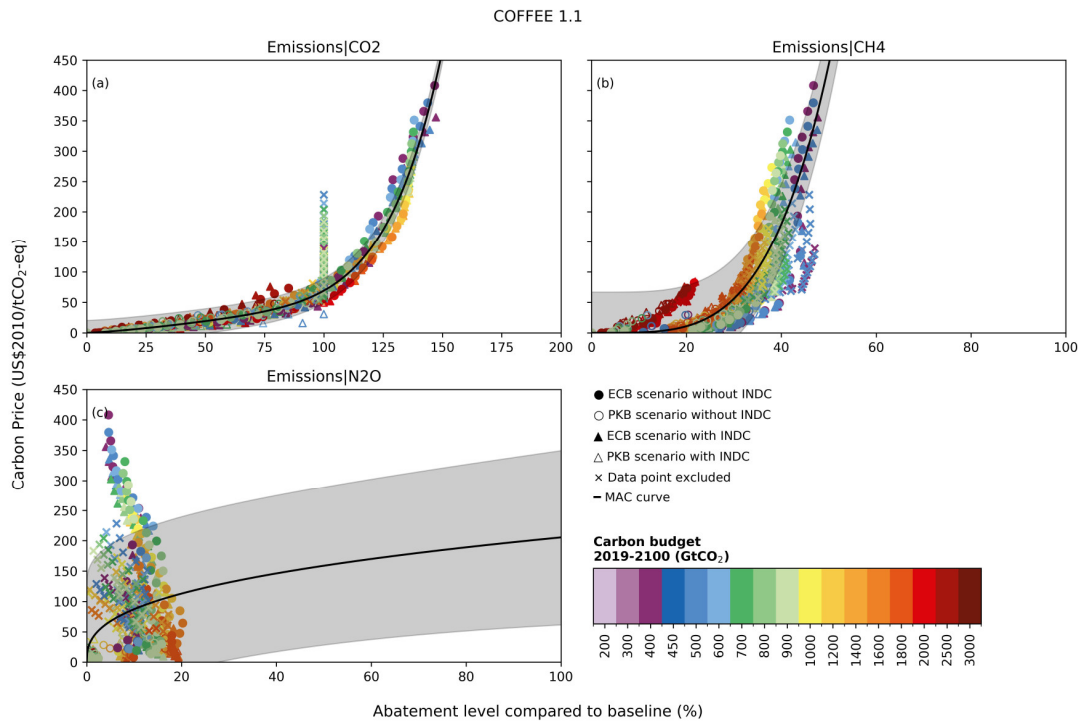


Figure S14. Global COFFEE MAC curves

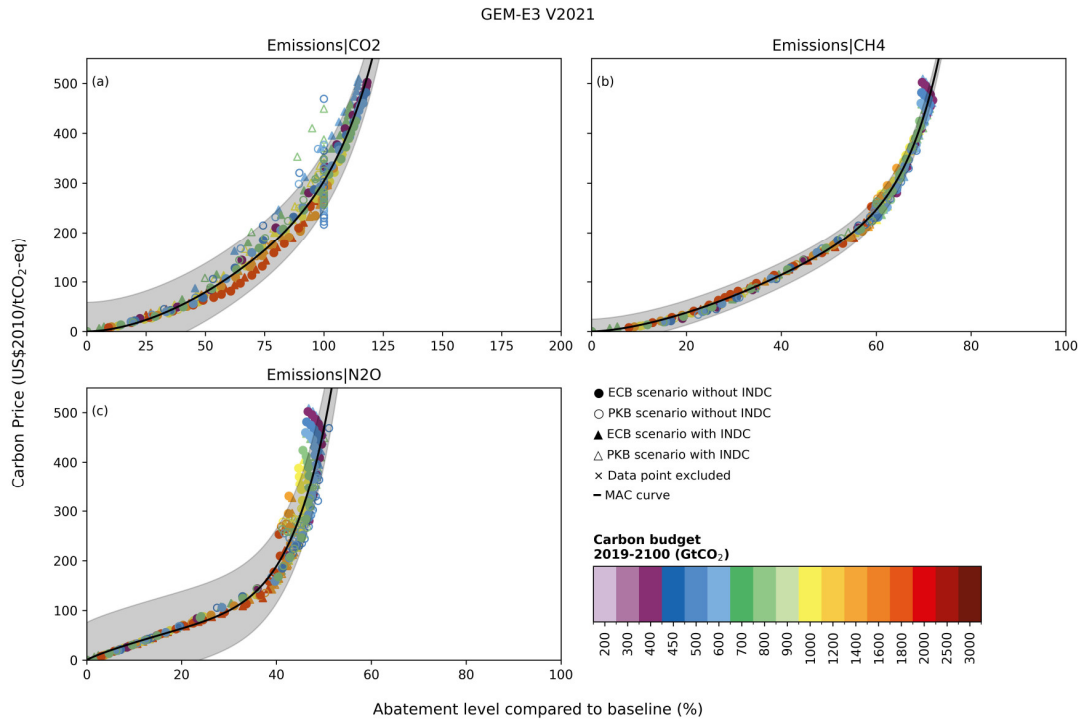


Figure S15. Global GEM MAC curves

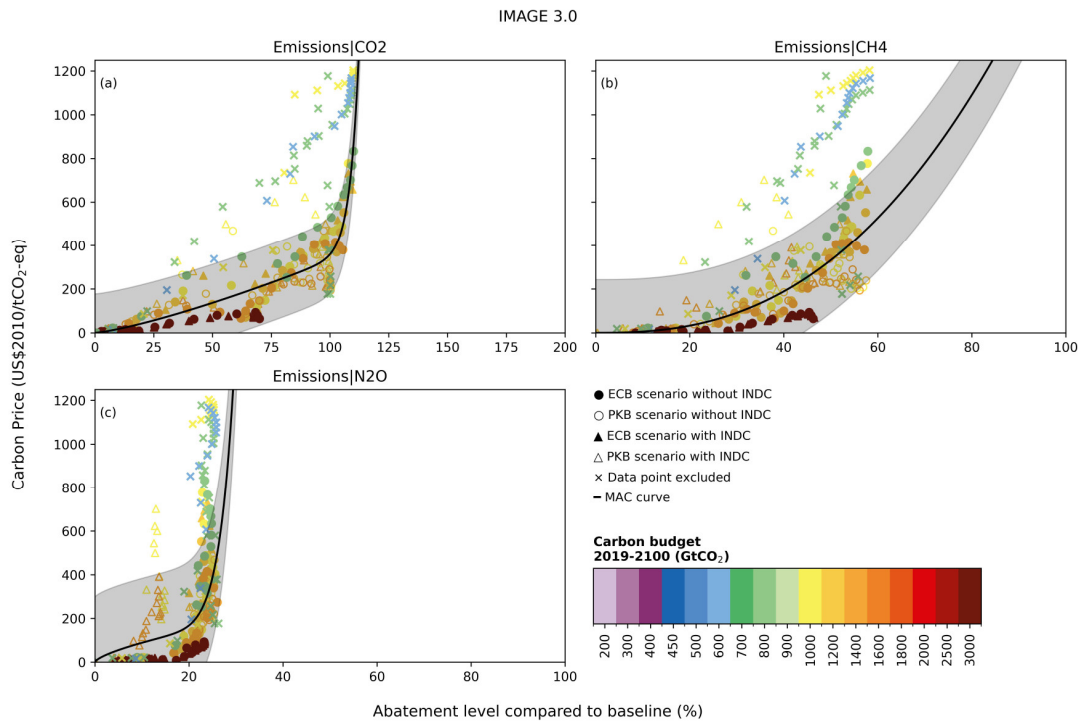


Figure S16. Global IMAGE MAC curves

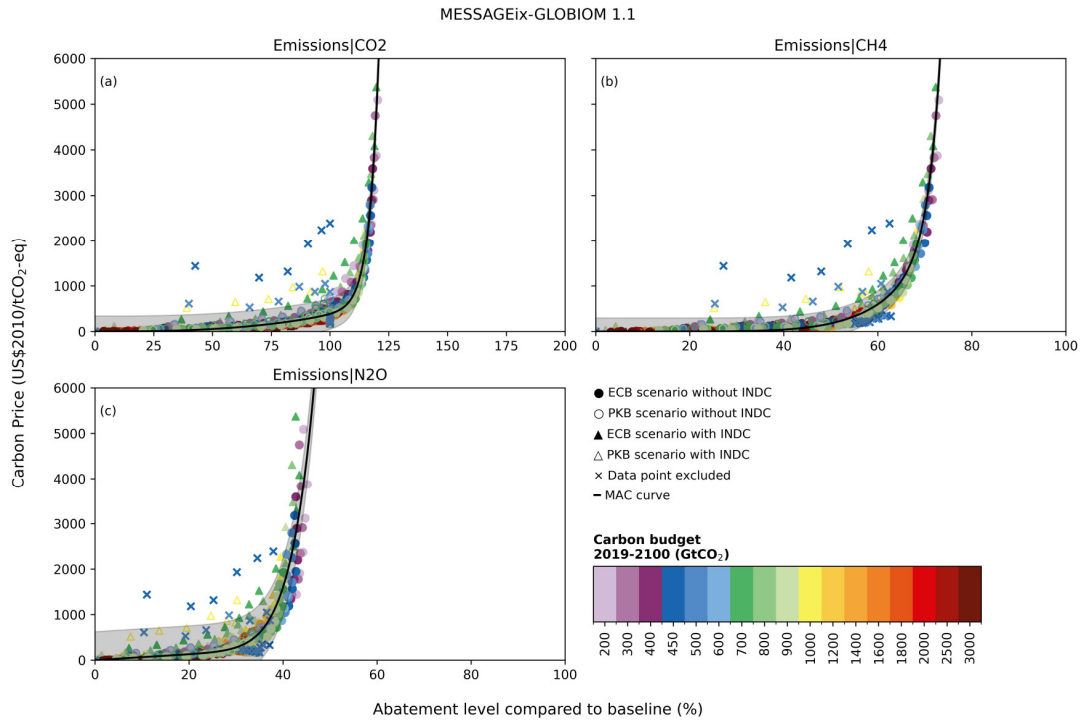


Figure S17. Global MESSAGE MAC curves

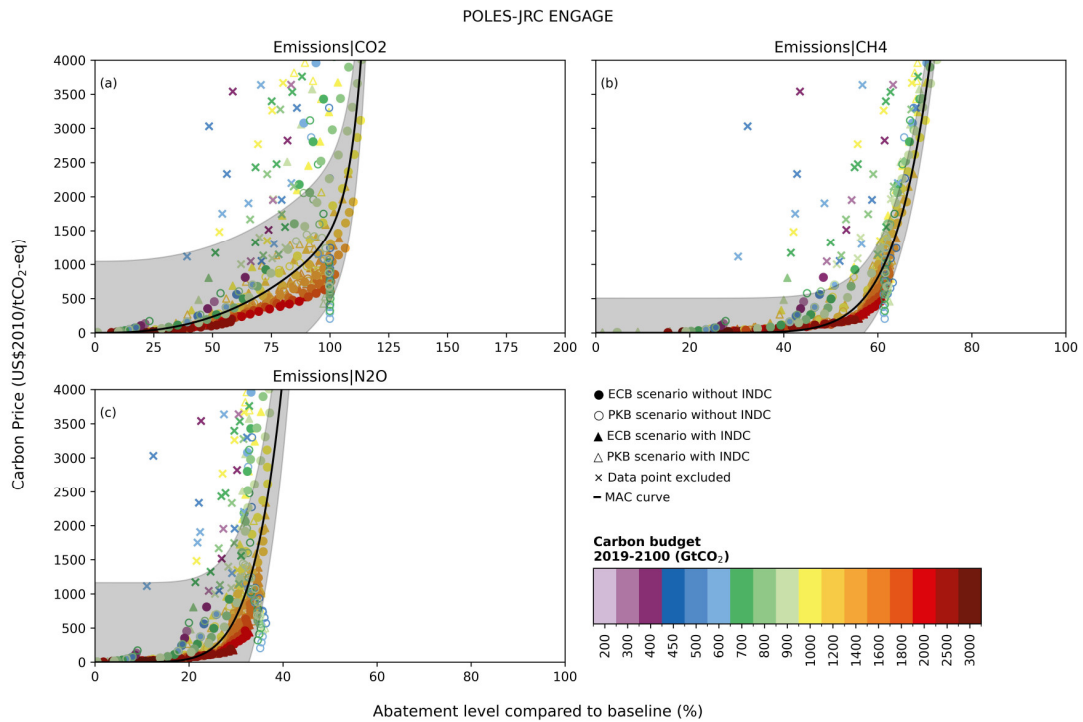


Figure S18. Global POLES MAC curves

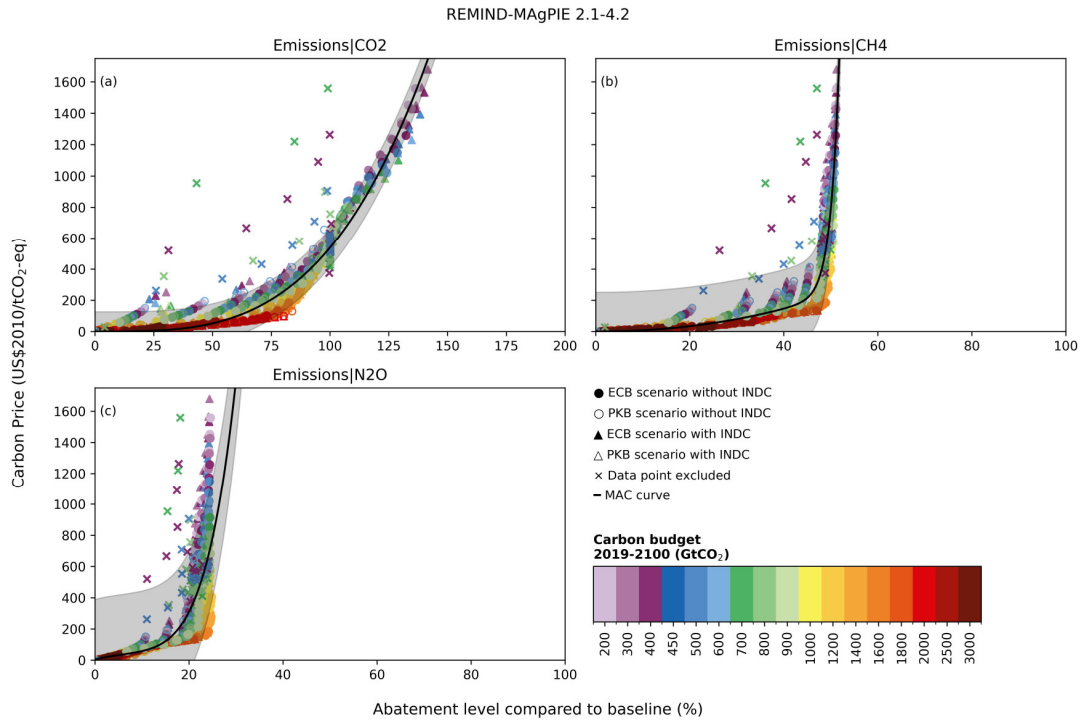


Figure S19. Global REMIND MAC curves

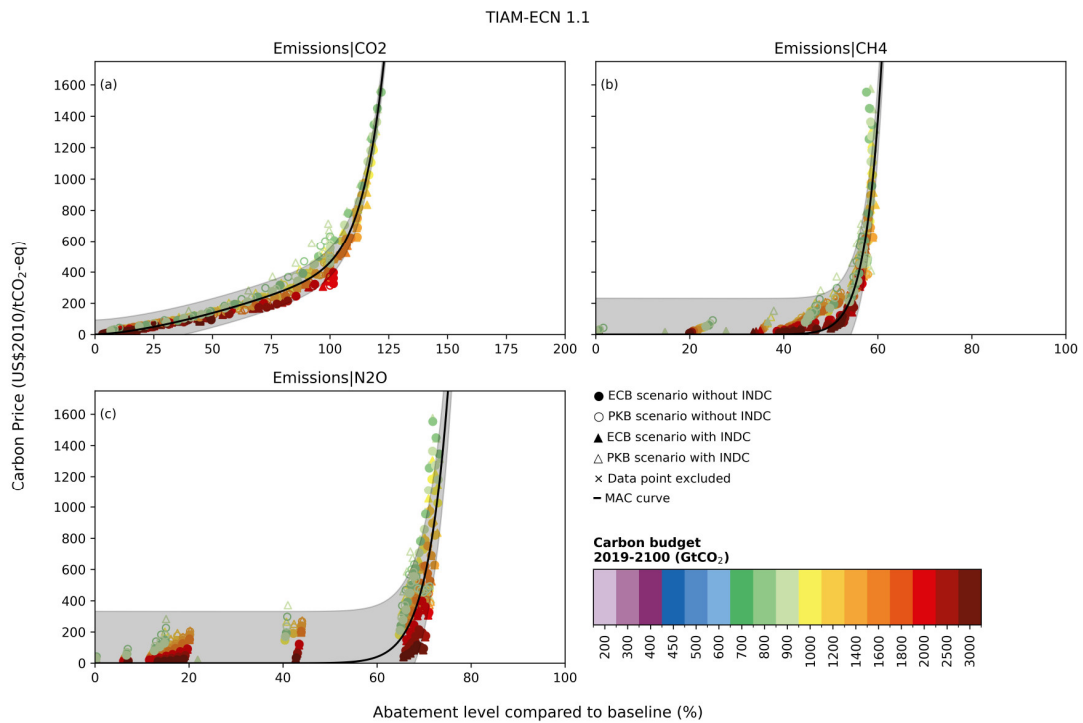


Figure S20. Global TIAM MAC curves

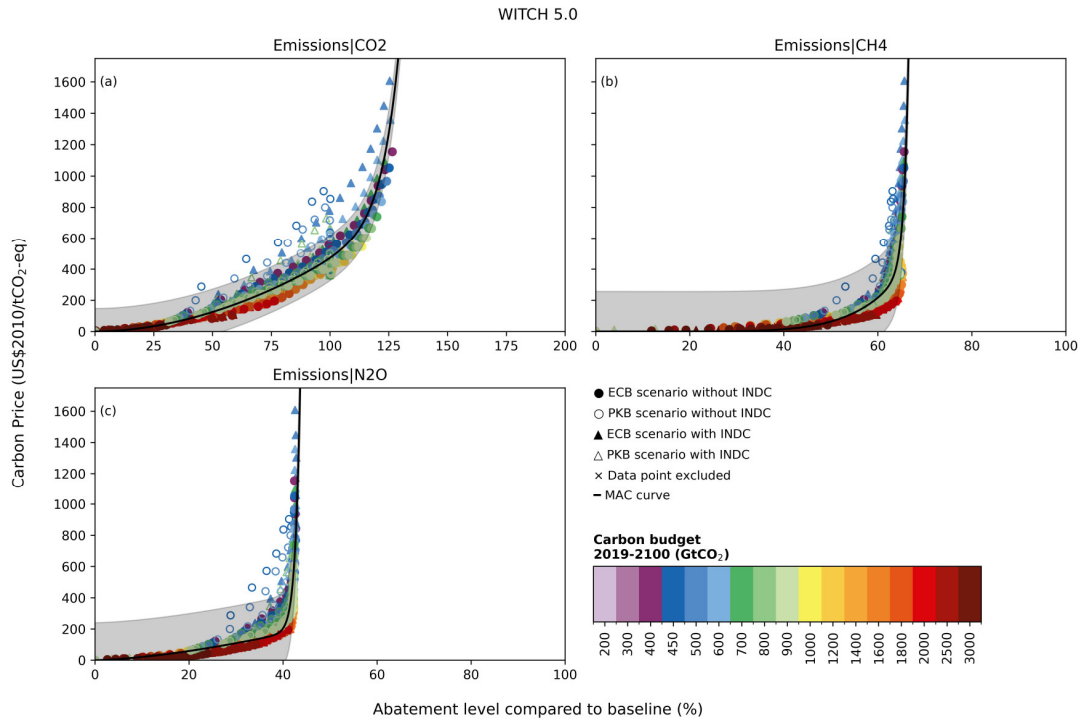


Figure S21. Global WITCH MAC curves

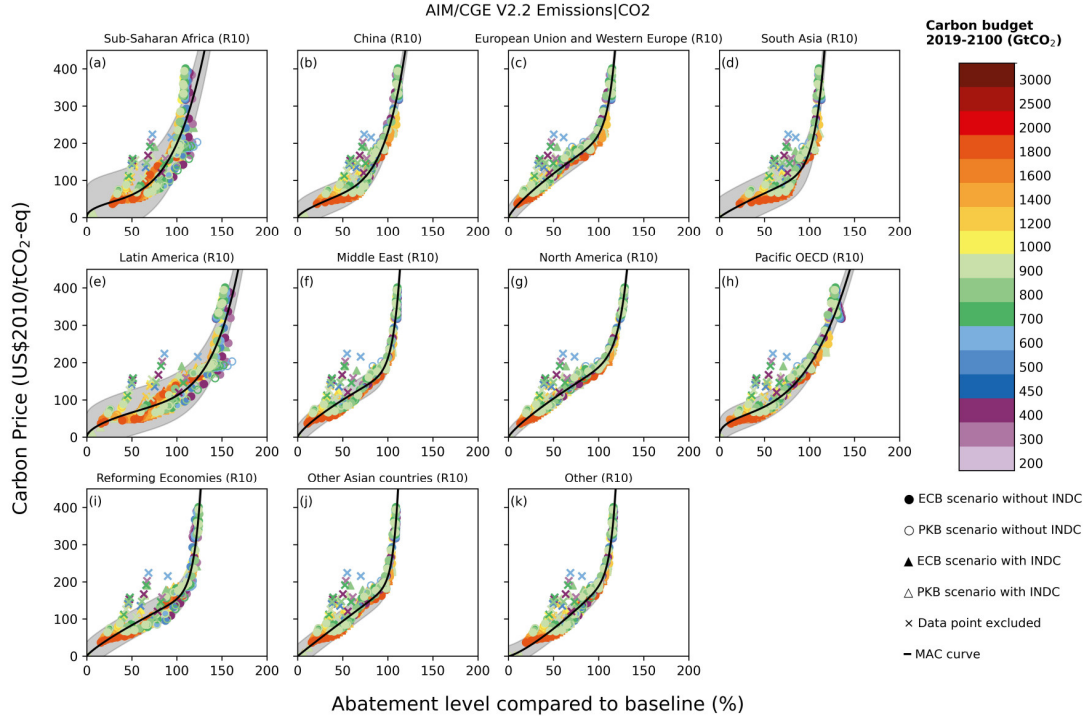


Figure S22. Regional AIM total anthropogenic CO₂ MAC curves

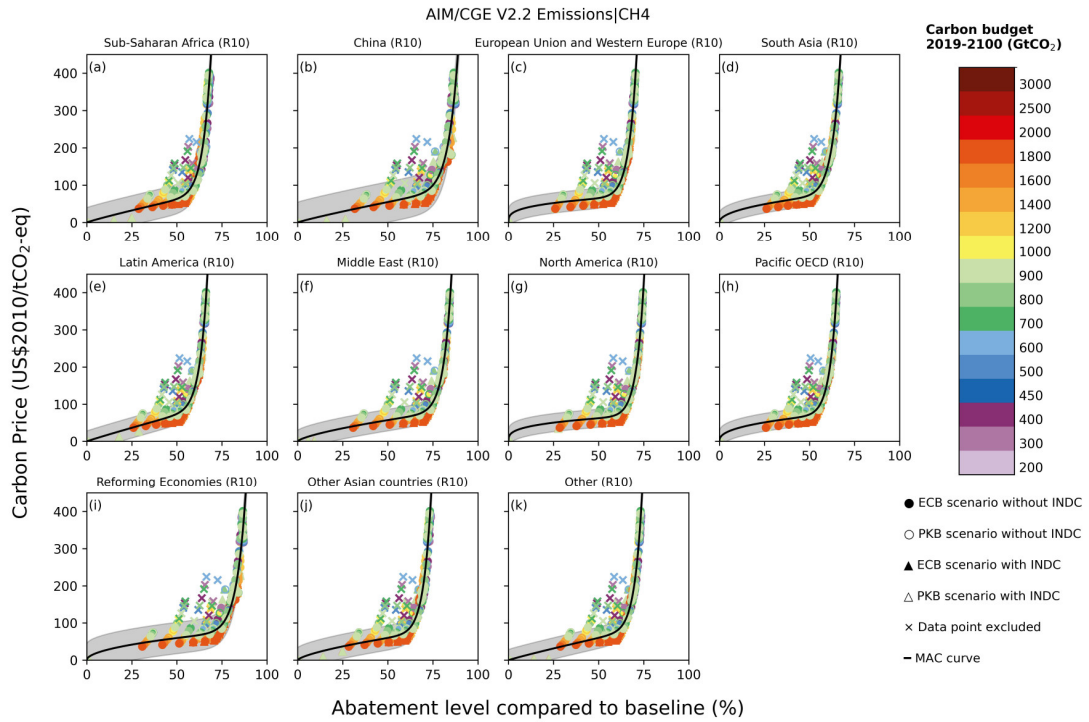


Figure S23. Regional AIM total anthropogenic CH₄ MAC curves

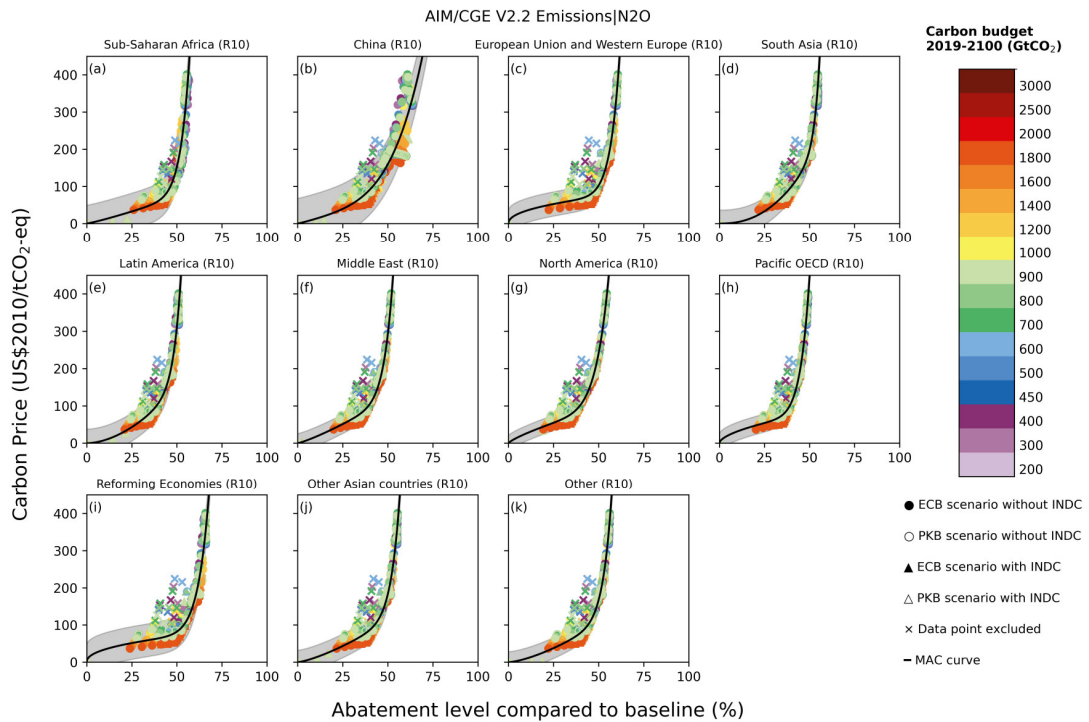


Figure S24. Regional AIM total anthropogenic N₂O MAC curves

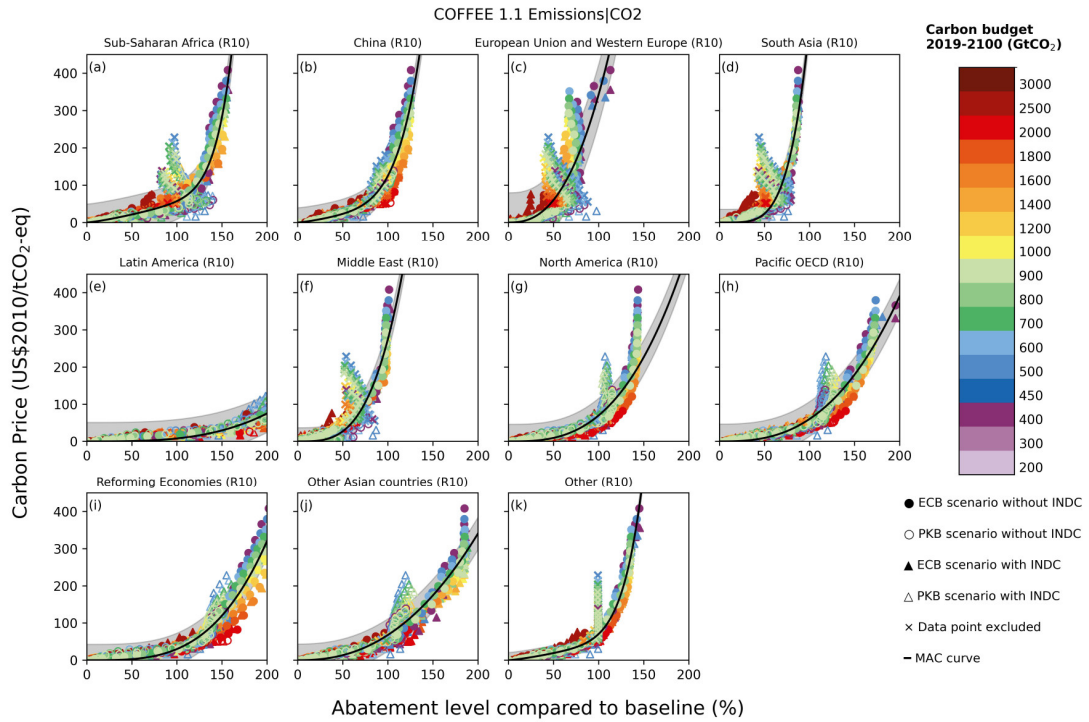


Figure S25. Regional COFFEE total anthropogenic CO₂ MAC curves

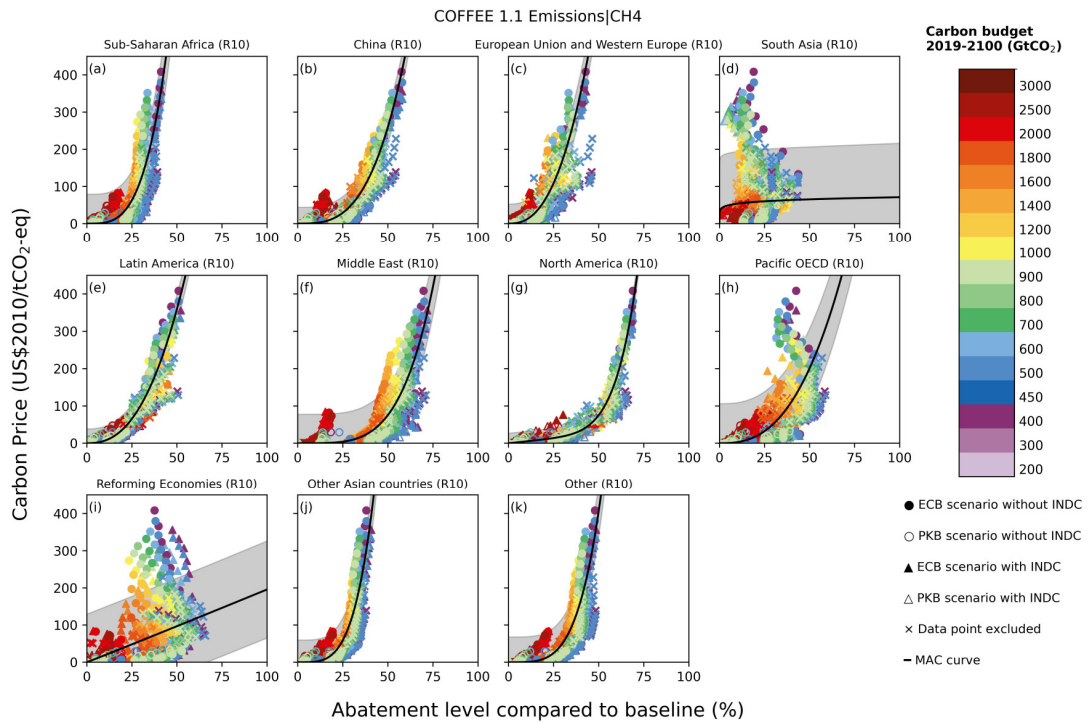


Figure S26. Regional COFFEE total anthropogenic CH₄ MAC curves

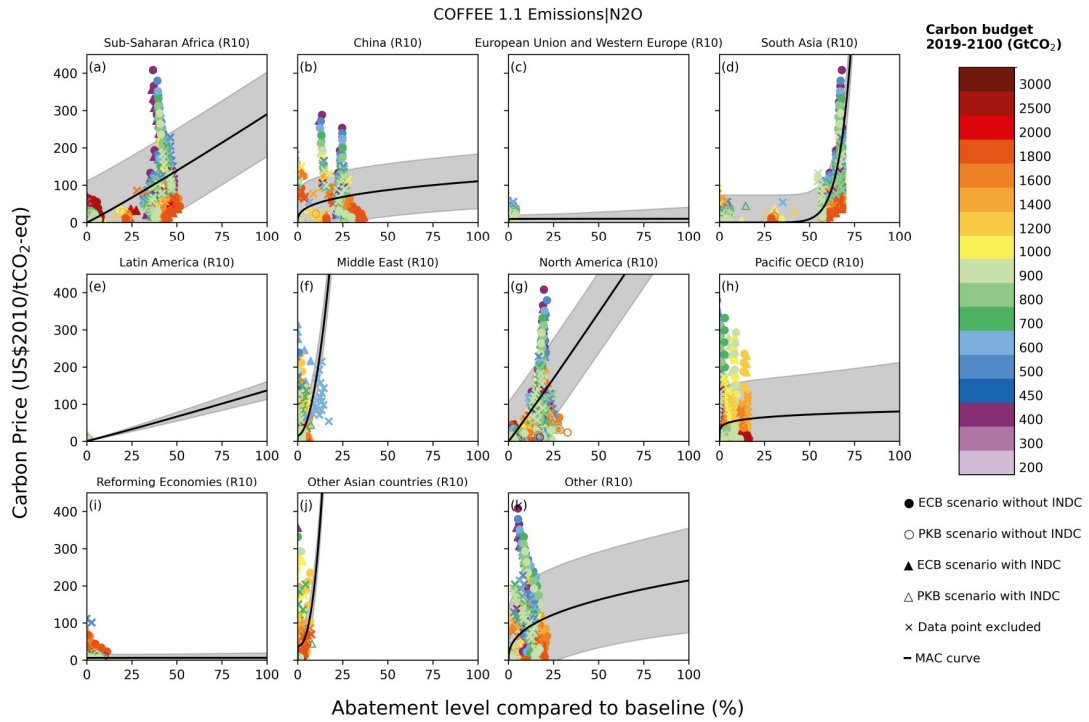


Figure S27. Regional COFFEE total anthropogenic N₂O MAC curves

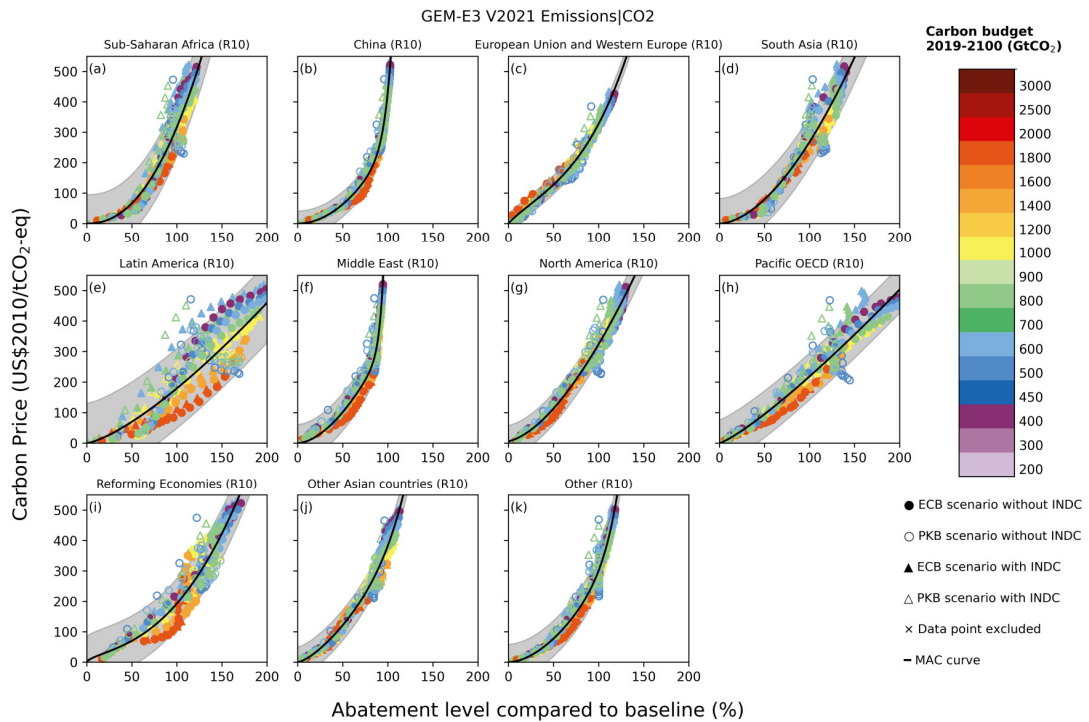


Figure S28. Regional GEM total anthropogenic CO₂ MAC curves

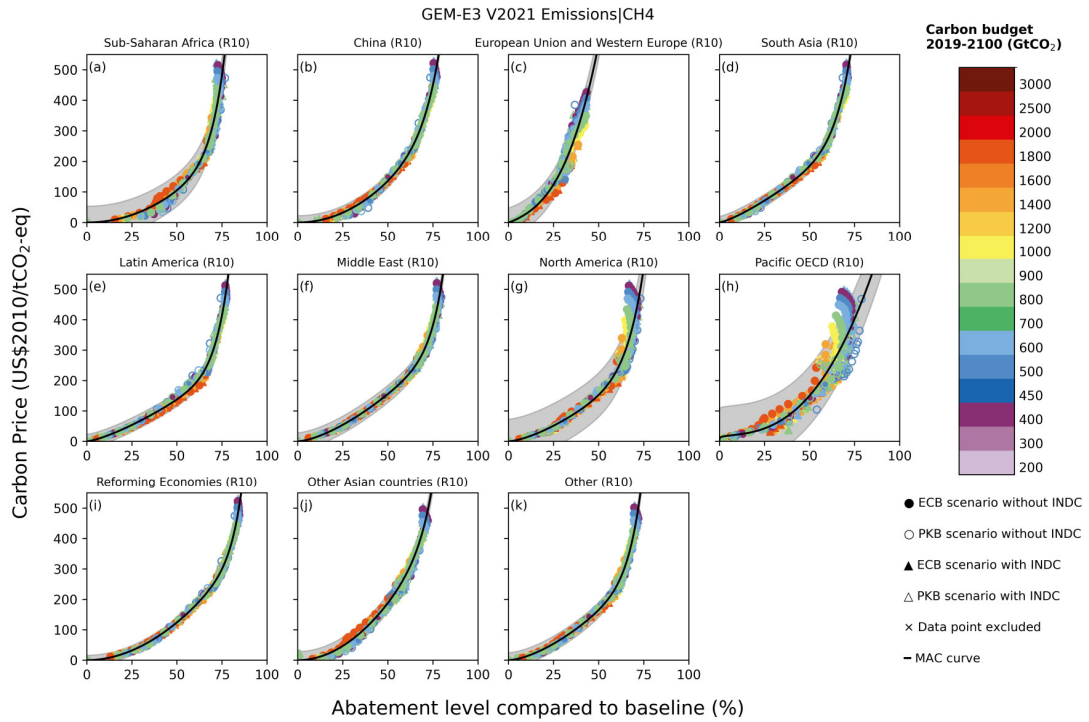


Figure S29. Regional GEM total anthropogenic CH₄ MAC curves

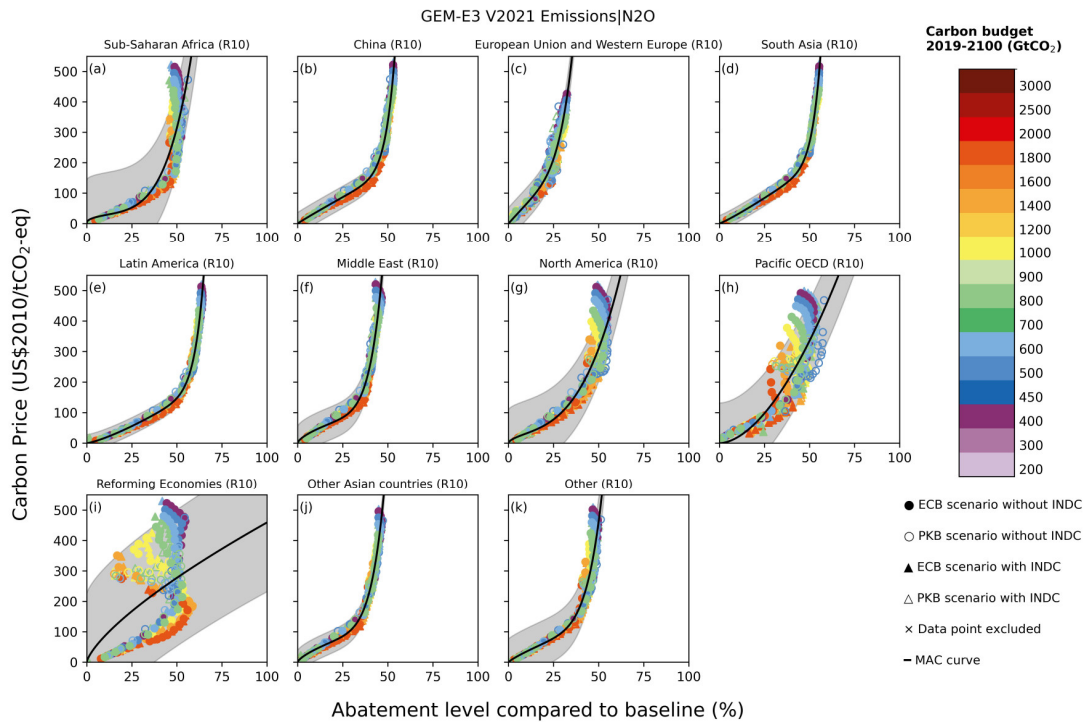


Figure S30. Regional GEM total anthropogenic N₂O MAC curves

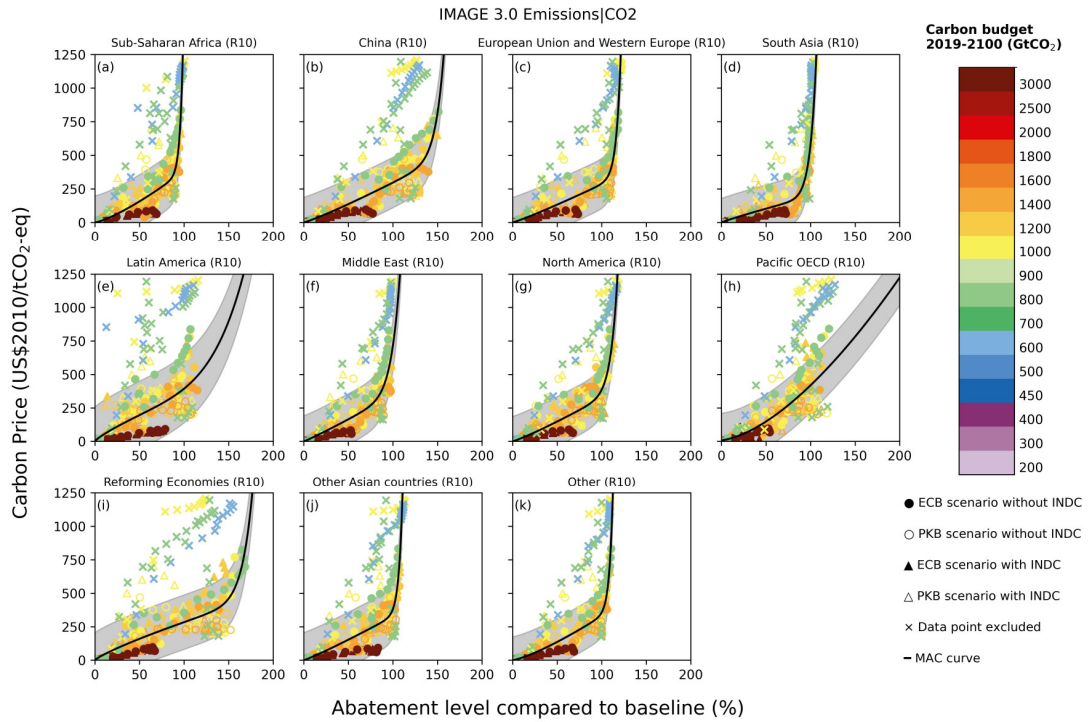


Figure S31. Regional IMAGE total anthropogenic CO₂ MAC curves

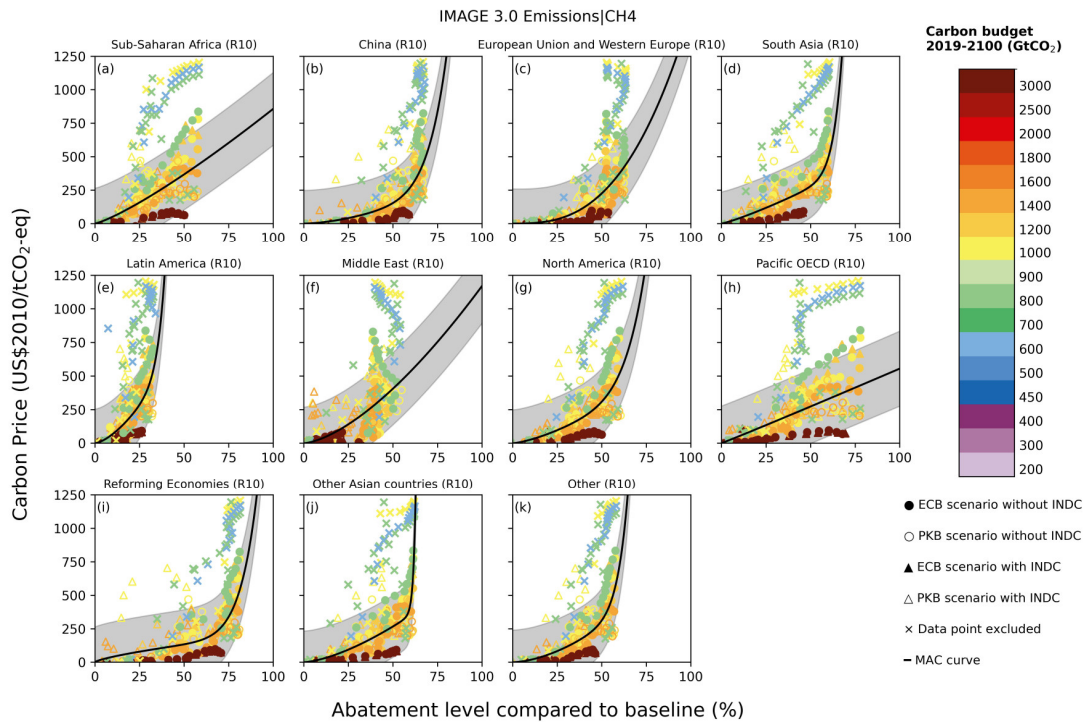


Figure S32. Regional IMAGE total anthropogenic CH₄ MAC curves

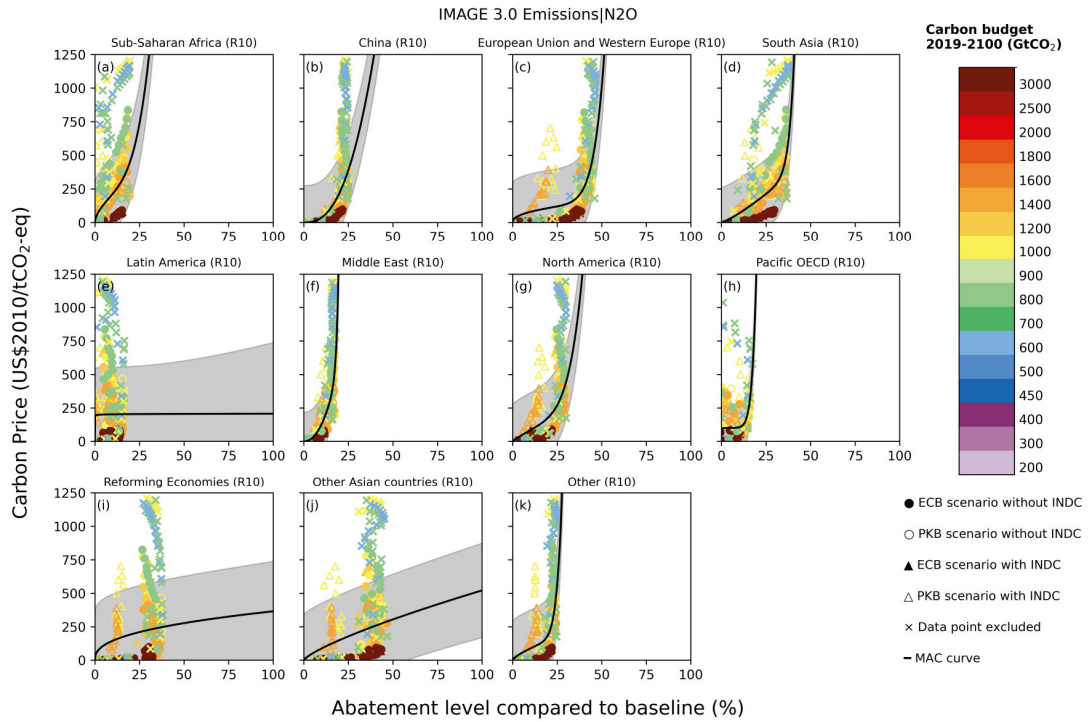


Figure S33. Regional IMAGE total anthropogenic N₂O MAC curves

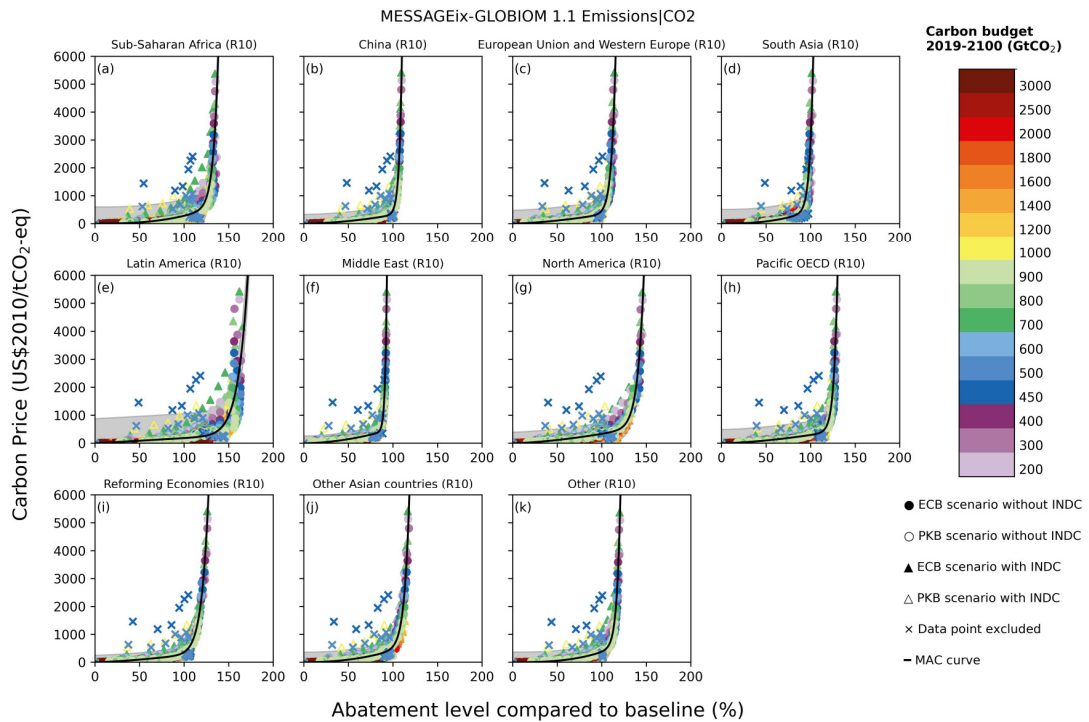


Figure S34. Regional MESSAGE total anthropogenic CO₂ MAC curves

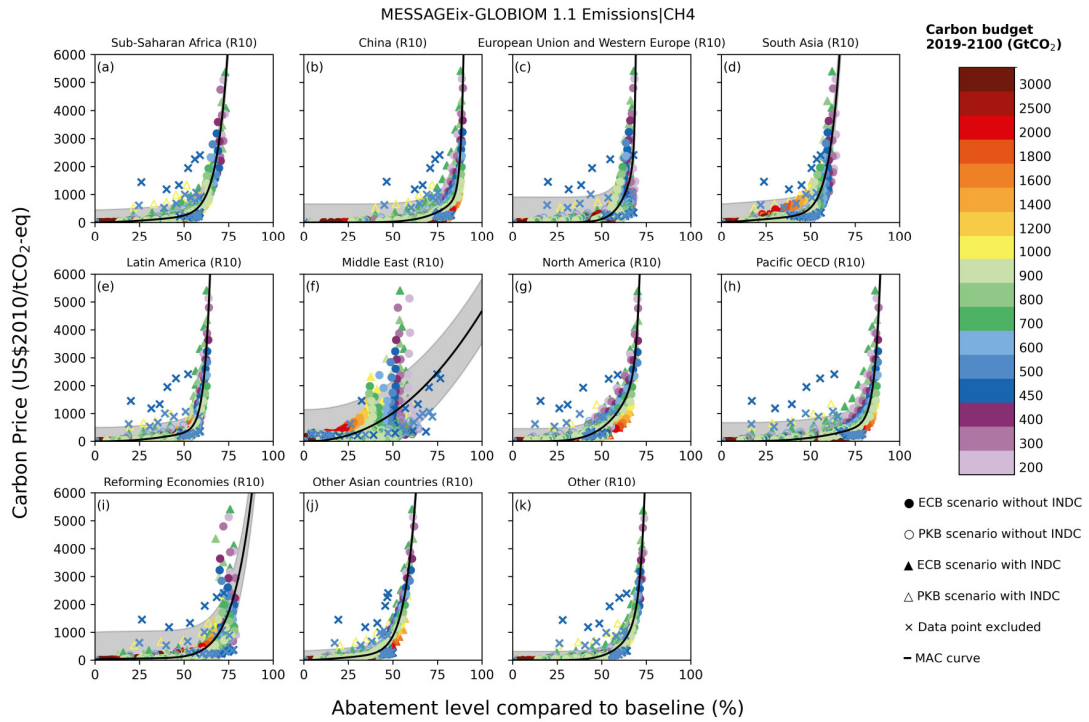


Figure S35. Regional MESSAGE total anthropogenic CH₄ MAC curves

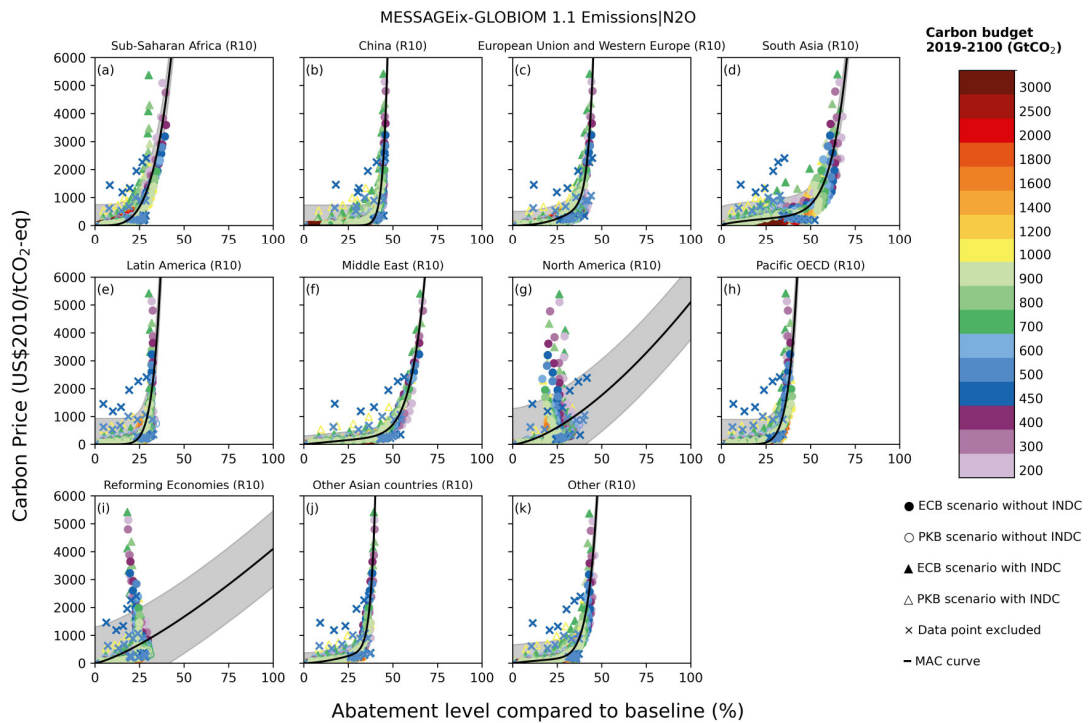


Figure S36. Regional MESSAGE total anthropogenic N₂O MAC curves

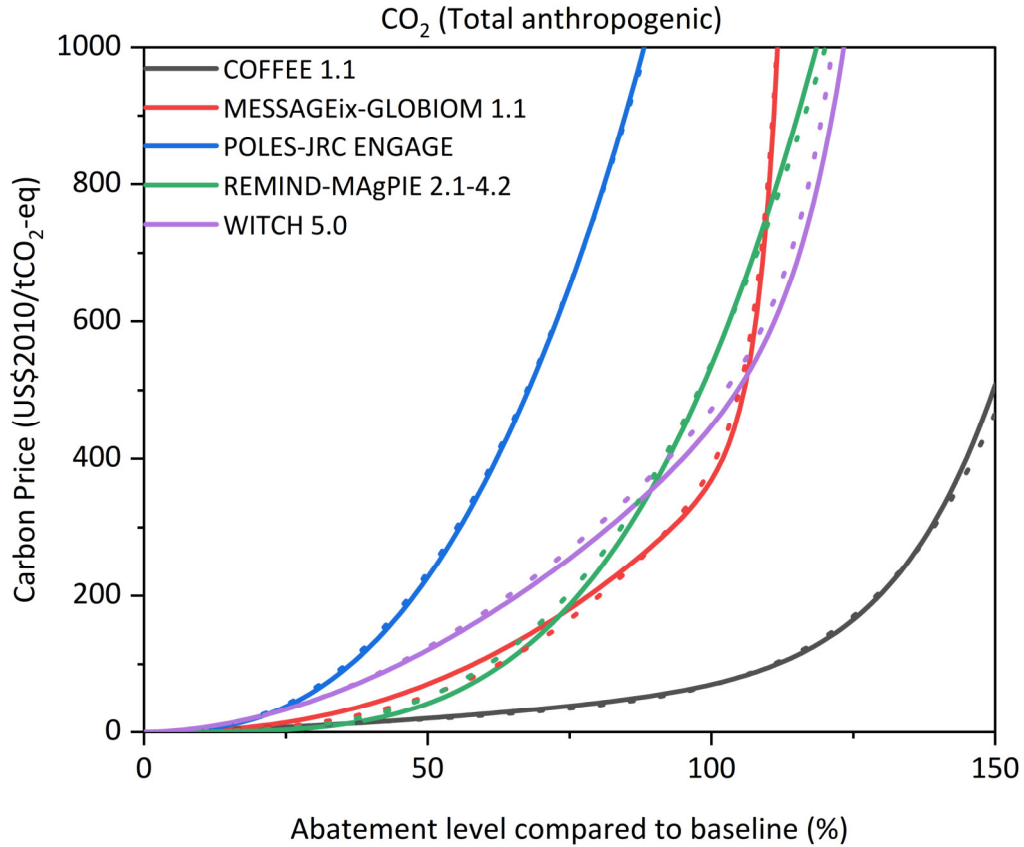


Figure S37. Global MAC curves for total anthropogenic CO₂ emissions derived from the set of scenarios with the same carbon budgets available for five ENGAGE IAMs

The solid lines are MAC curves derived from the subsample (a total of 19 scenarios with the same carbon budgets available commonly for all five IAMs (Table S7)), and the dotted lines are MAC curves derived from the full sample (all scenarios available for each IAM). No upper limit of abatement level is shown for MAC curves.

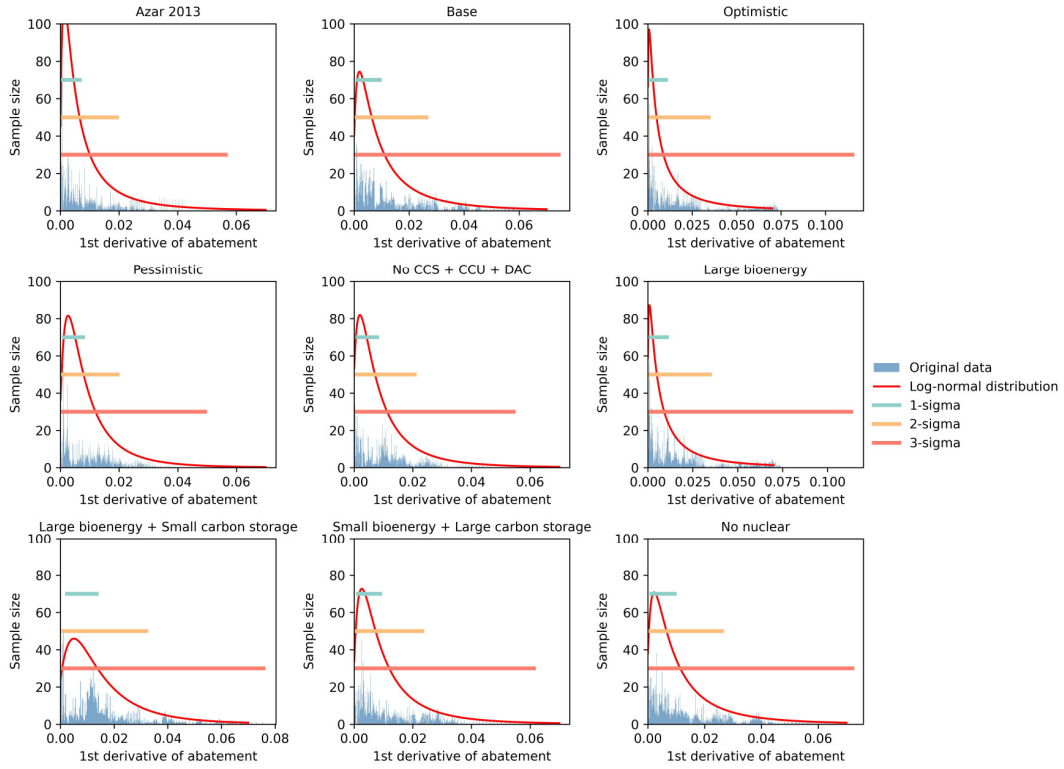


Figure S38. Global GET - Distribution of first derivative of abatement levels

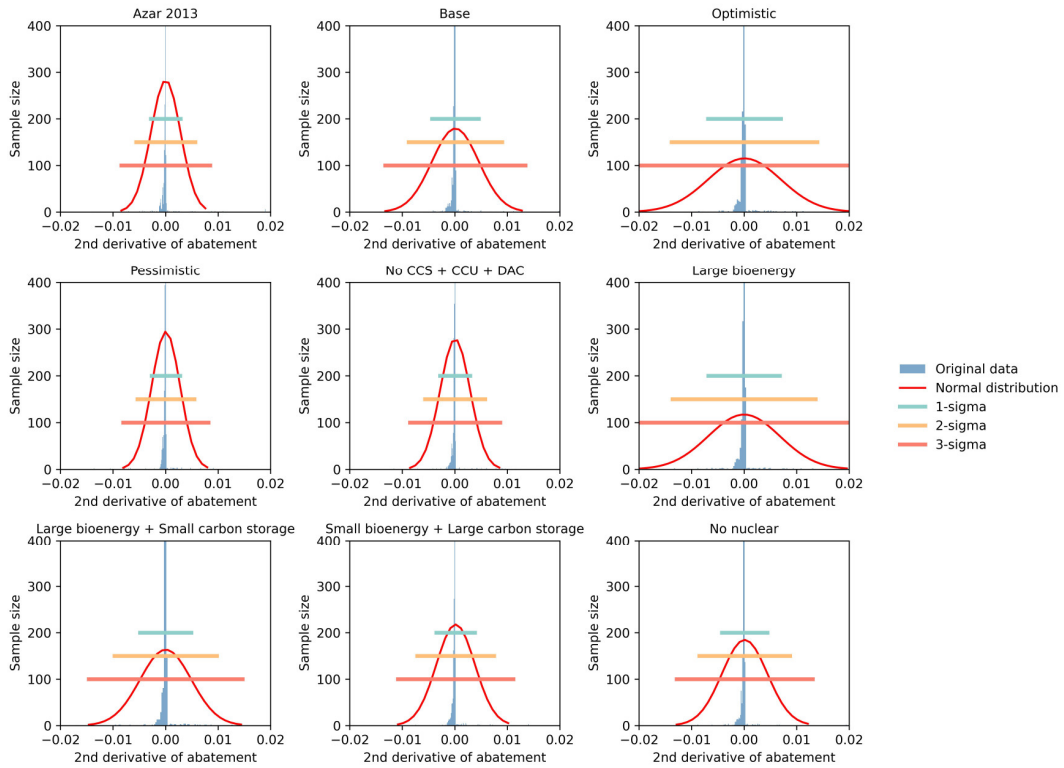


Figure S39. Global GET - Distribution of second derivative of abatement levels

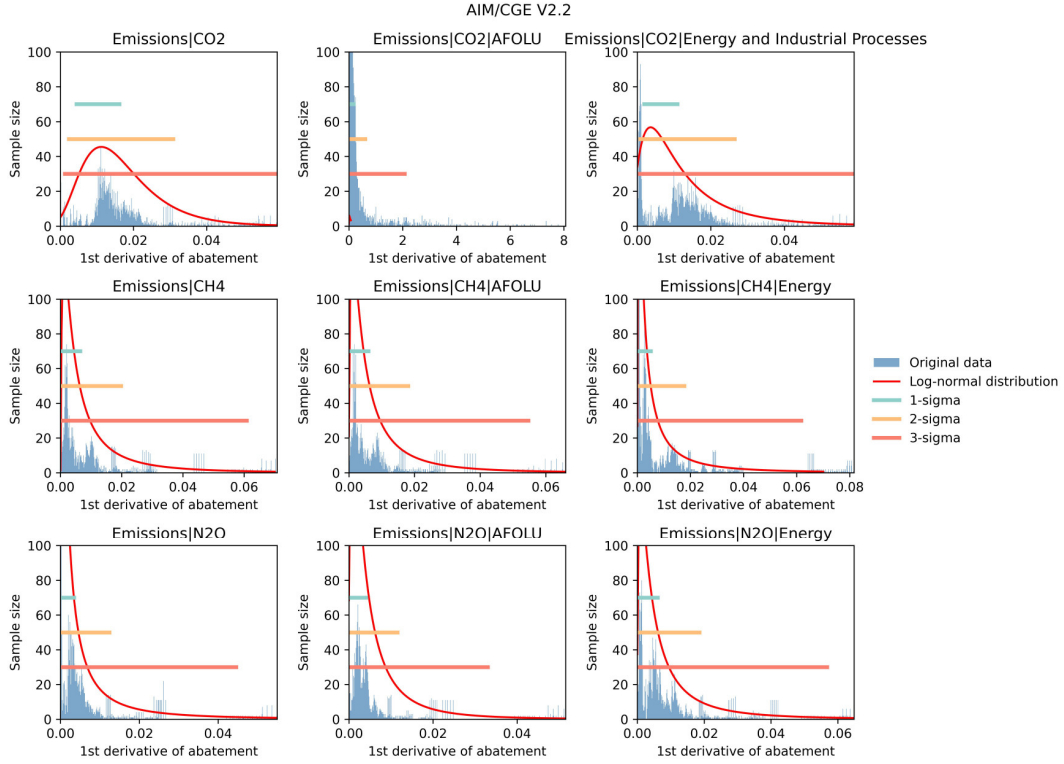


Figure S40. Global AIM - Distribution of first derivative of abatement levels

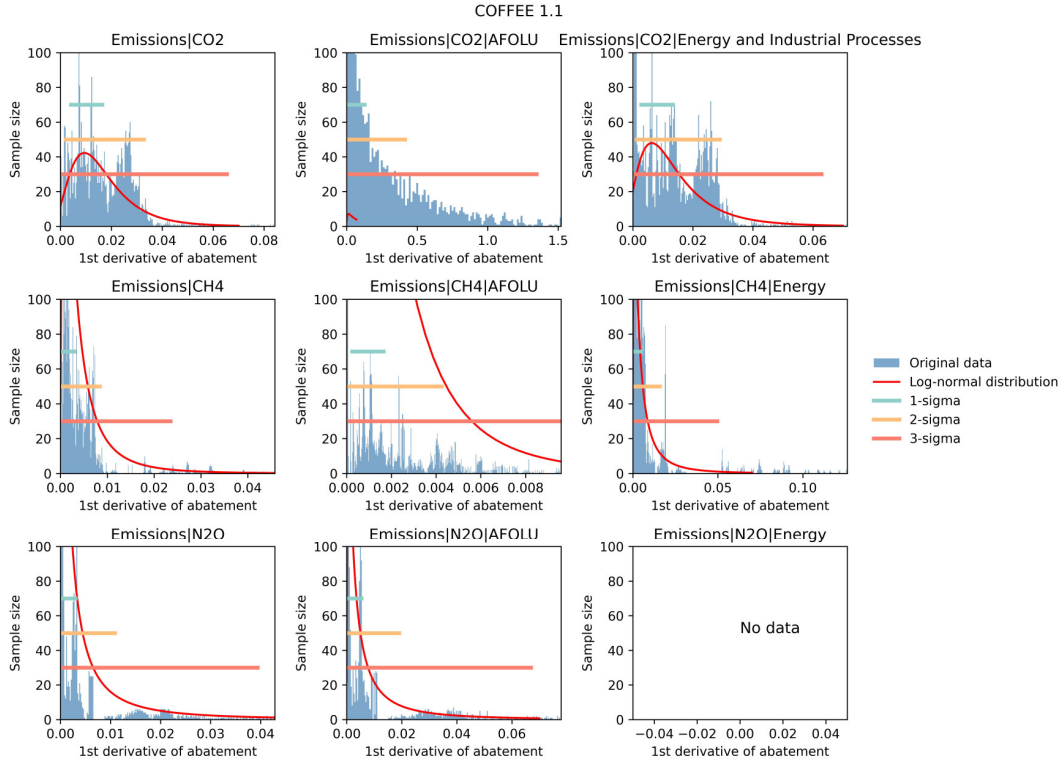


Figure S41. Global COFFEE - Distribution of first derivative of abatement levels

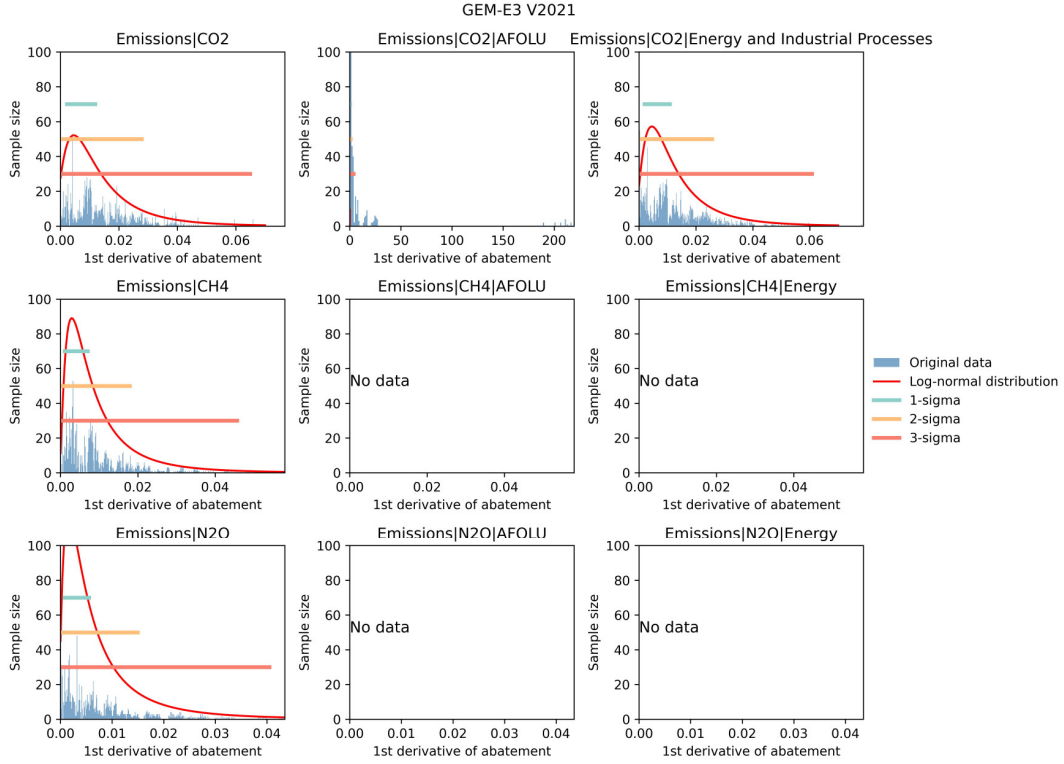


Figure S42. Global GEM - Distribution of first derivative of abatement levels

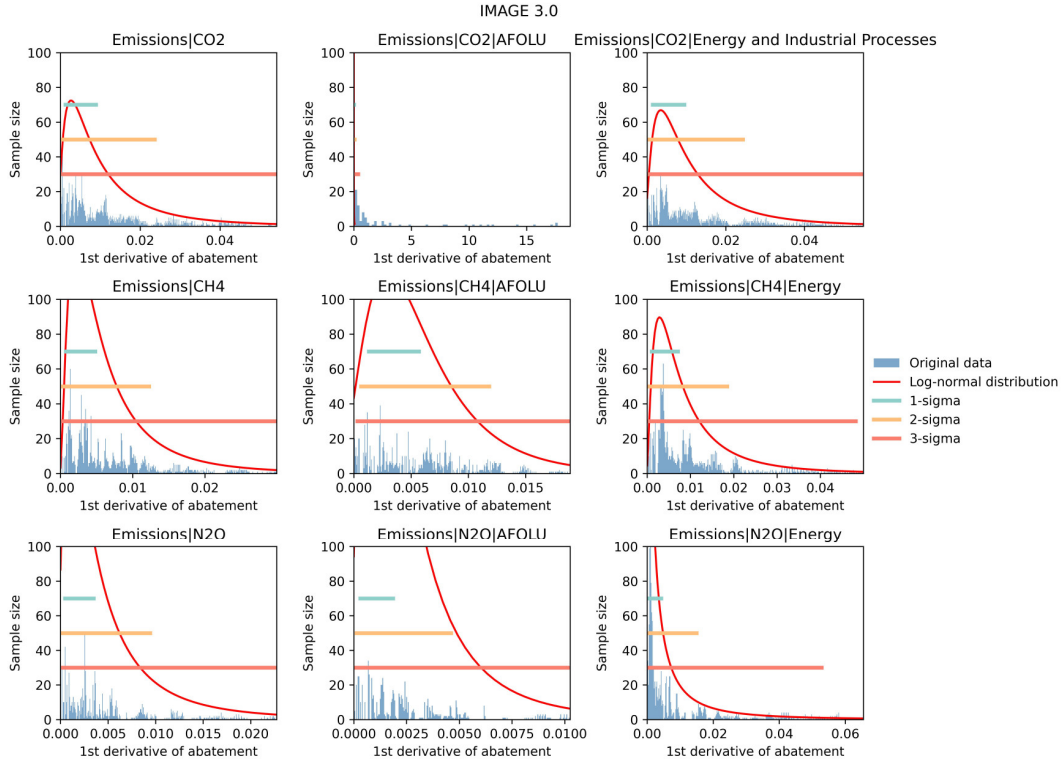
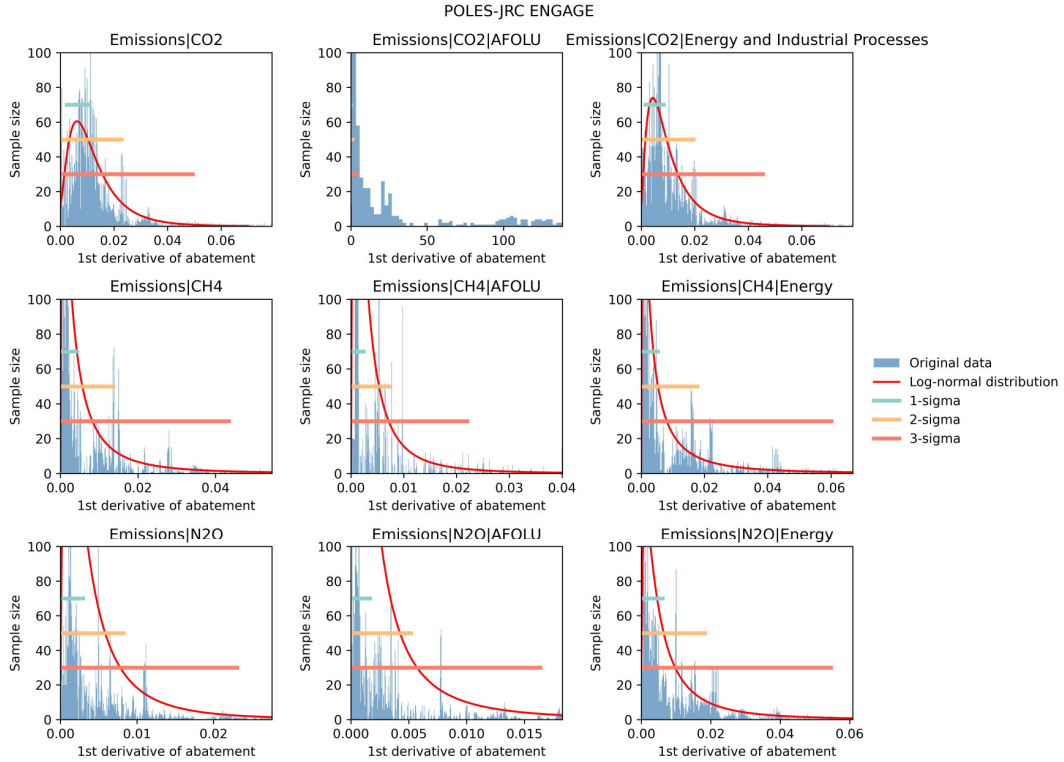
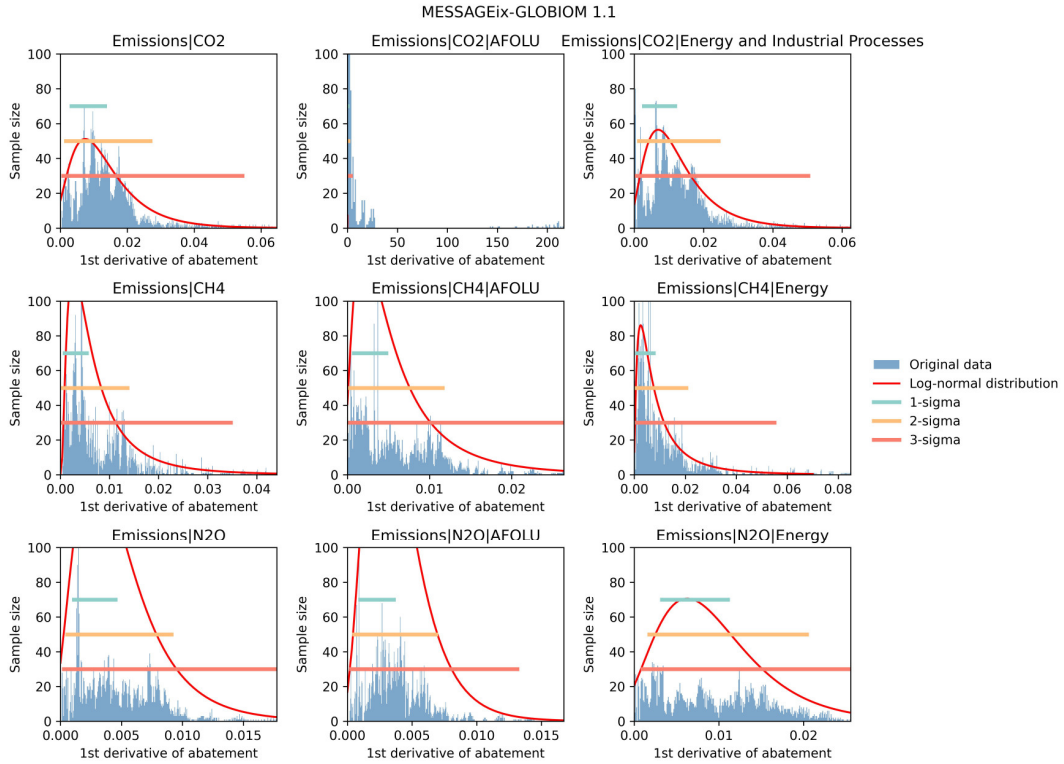
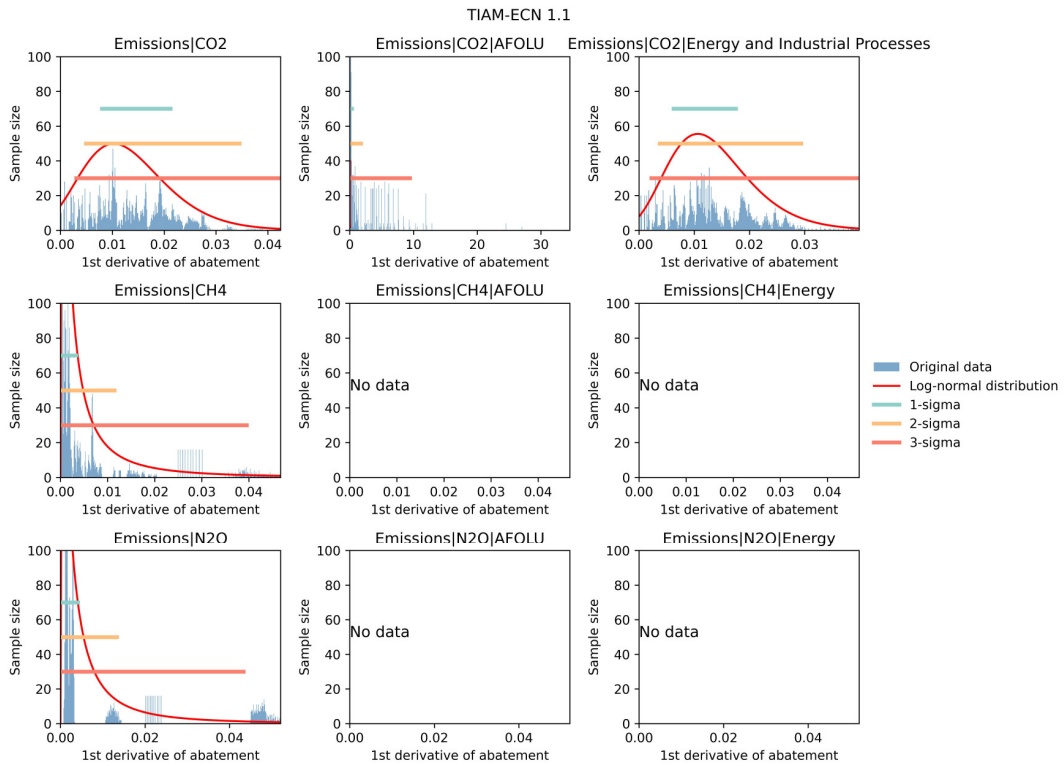
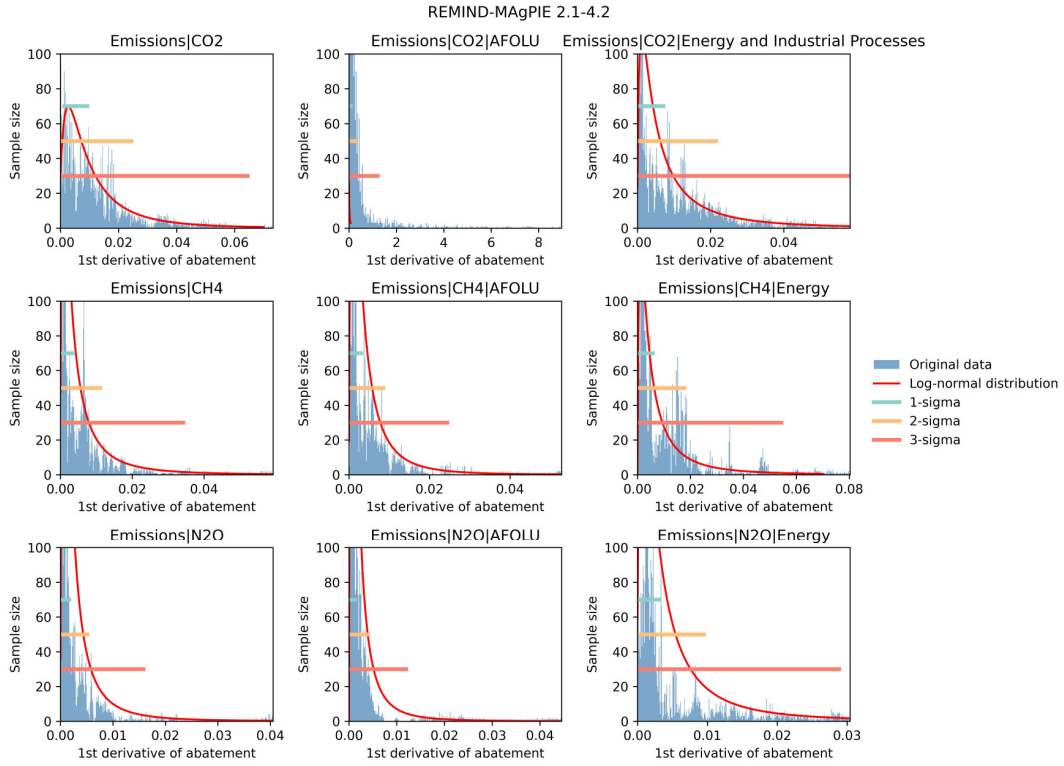


Figure S43. Global IMAGE - Distribution of first derivative of abatement levels





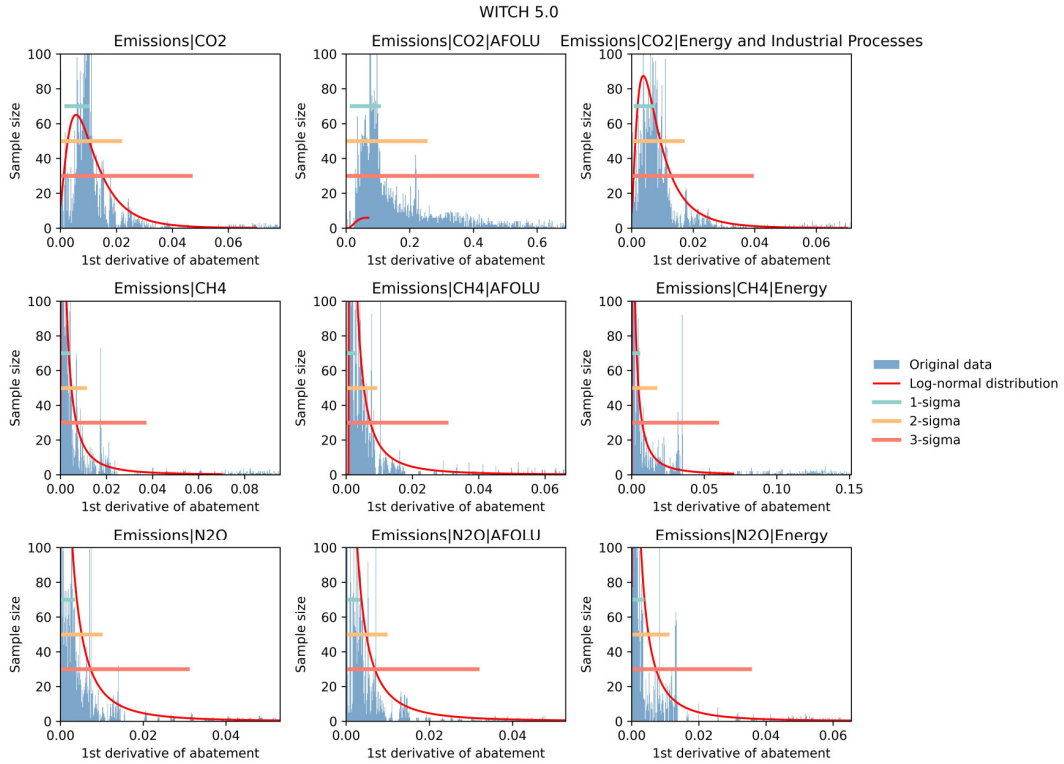


Figure S48. Global WITCH - Distribution of first derivative of abatement levels

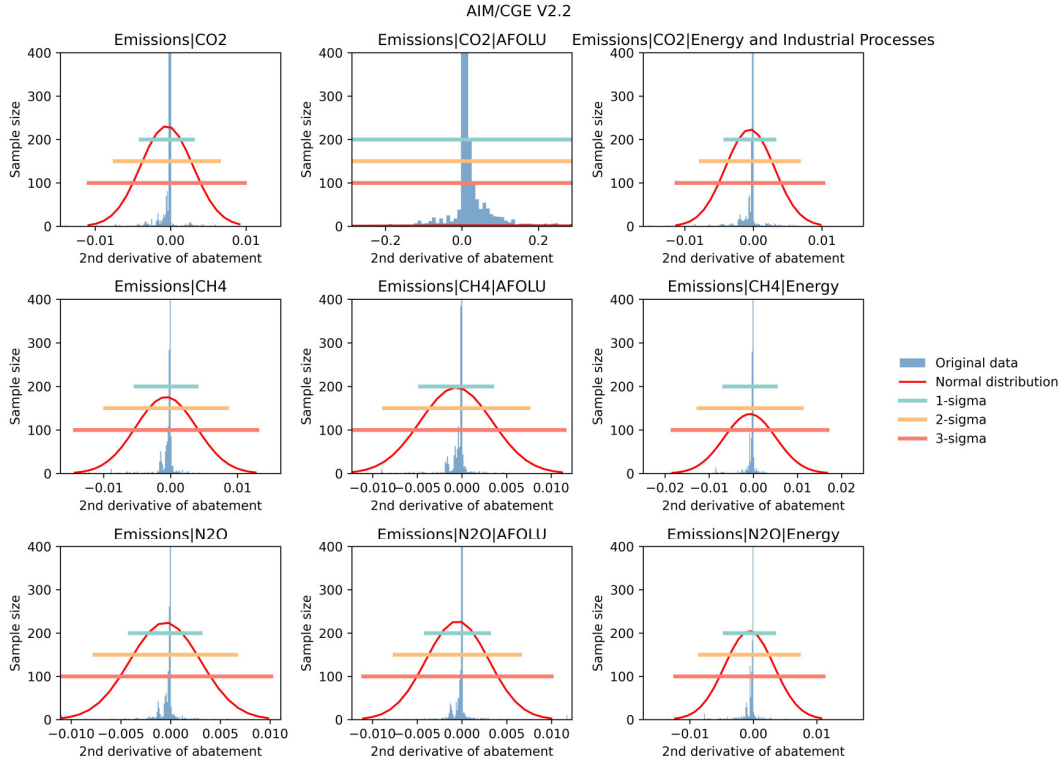


Figure S49. Global AIM - Distribution of second derivative of abatement levels

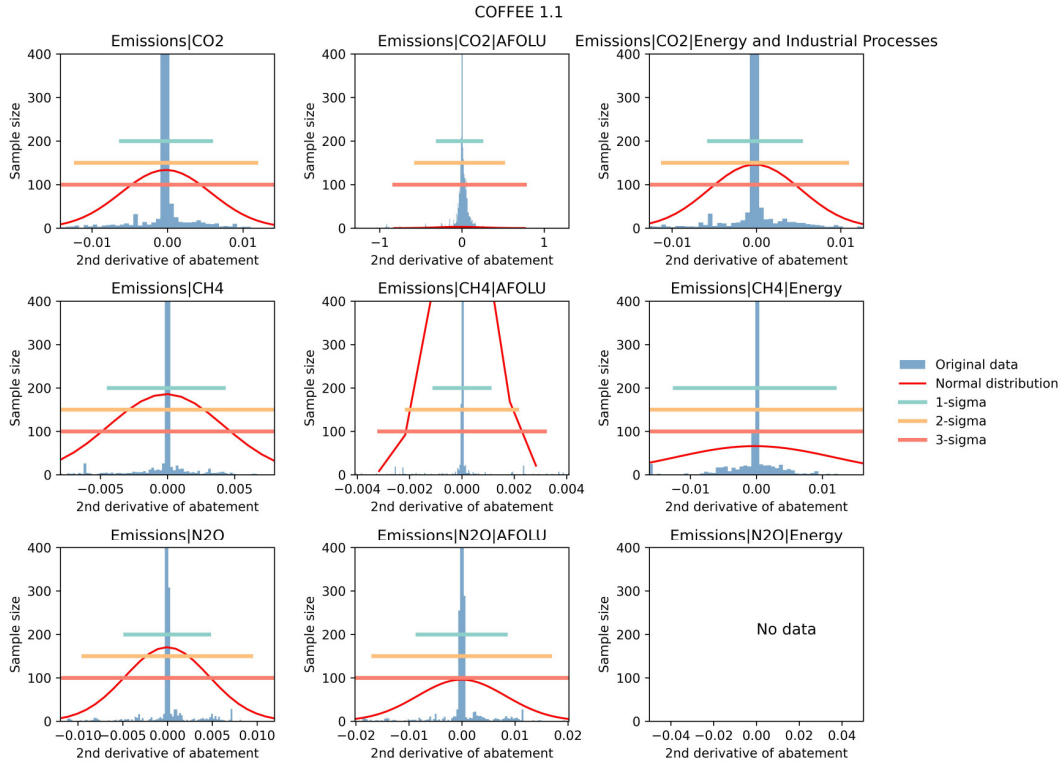


Figure S50. Global COFFEE - Distribution of second derivative of abatement levels

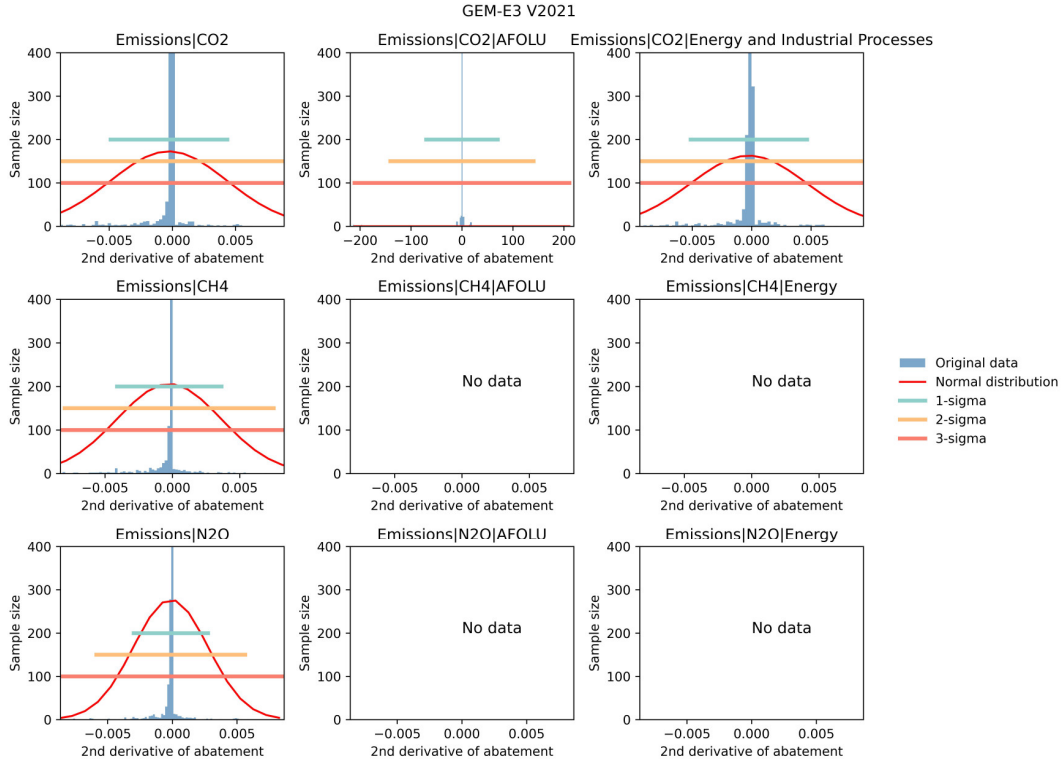


Figure S51. Global GEM - Distribution of second derivative of abatement levels

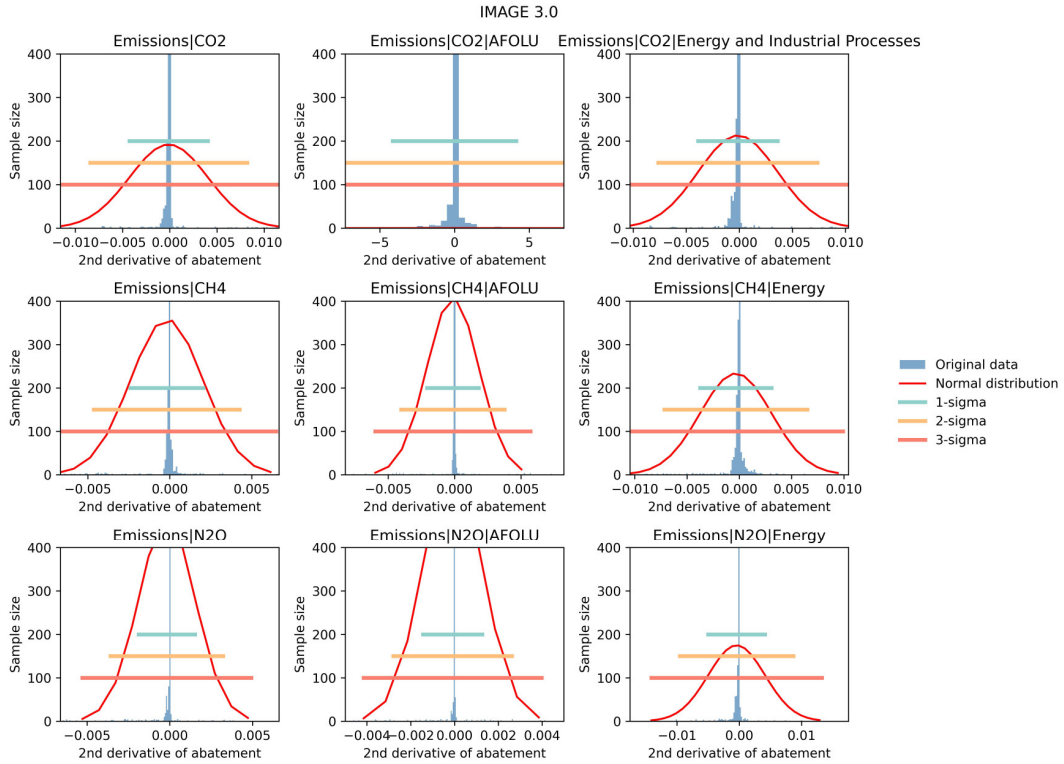


Figure S52. Global IMAGE - Distribution of second derivative of abatement levels

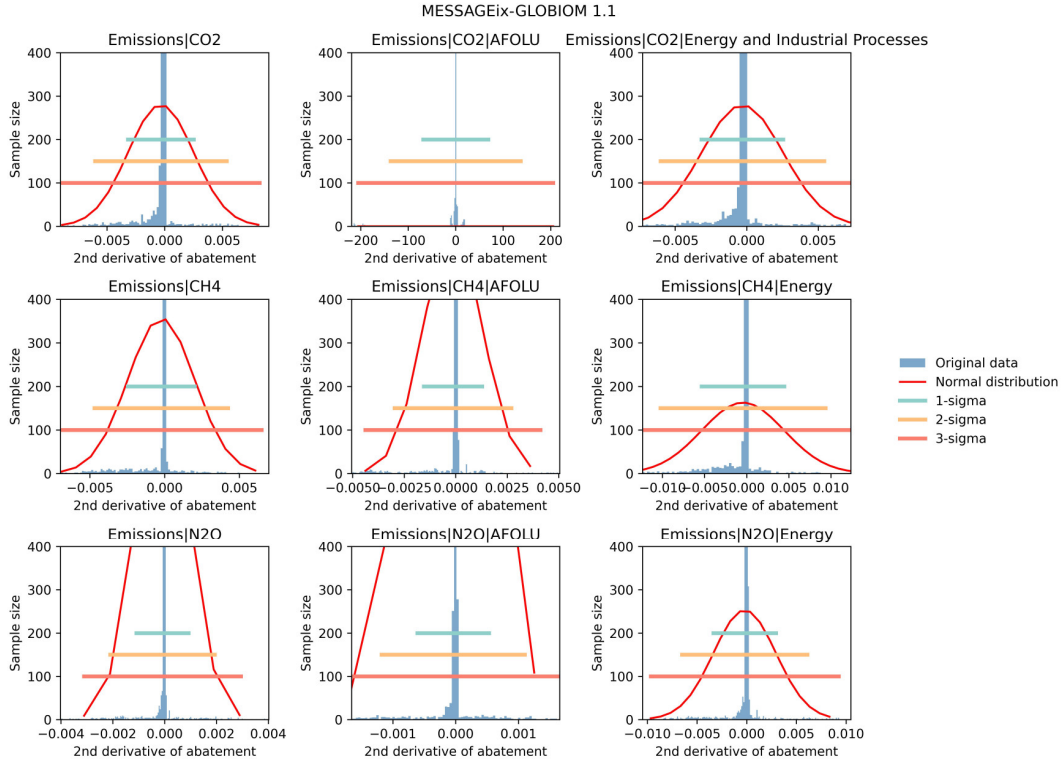


Figure S53. Global MESSAGE - Distribution of second derivative of abatement levels

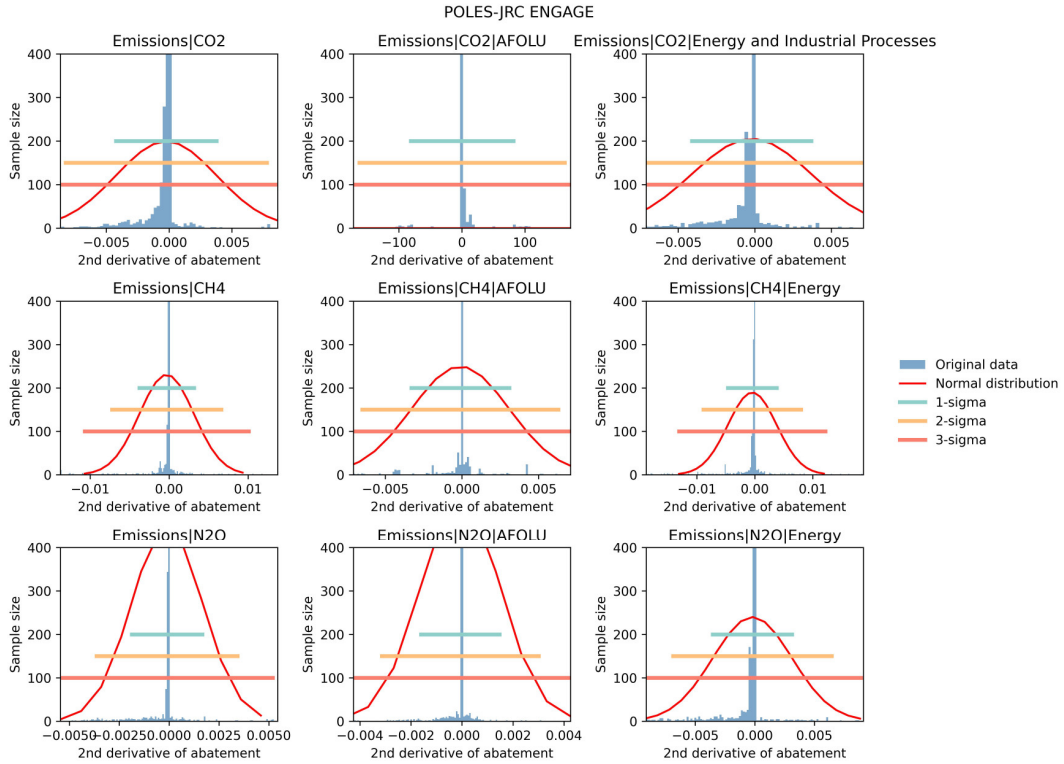


Figure S54. Global POLES - Distribution of second derivative of abatement levels

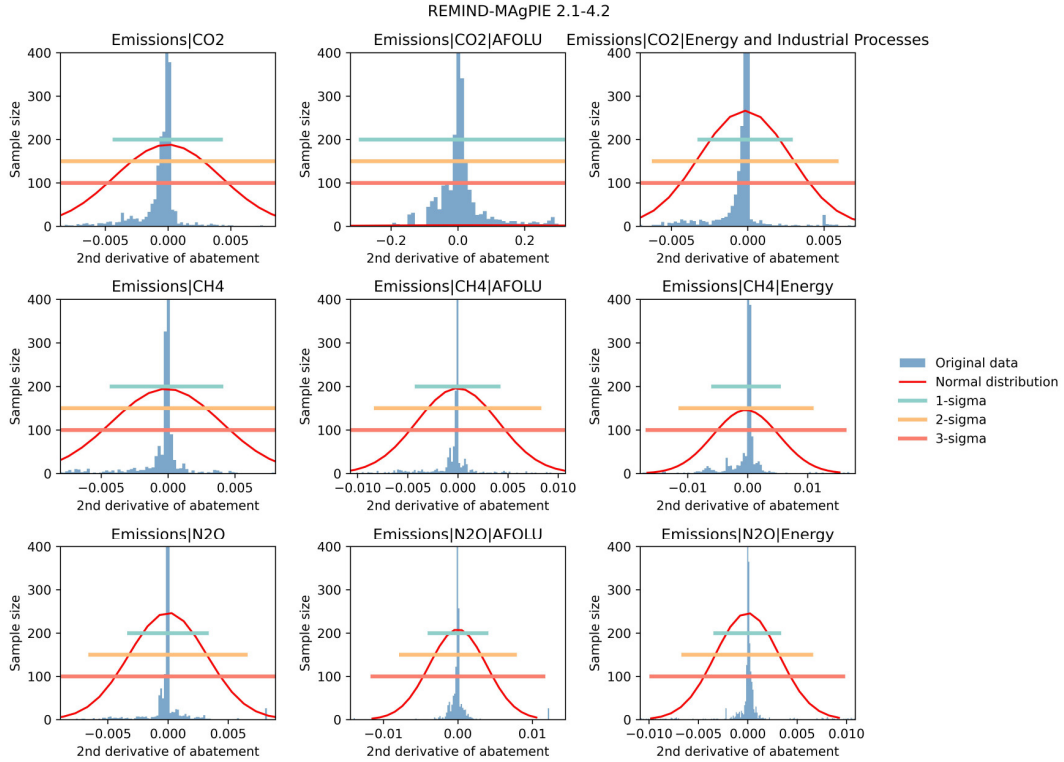


Figure S55. Global REMIND - Distribution of second derivative of abatement levels

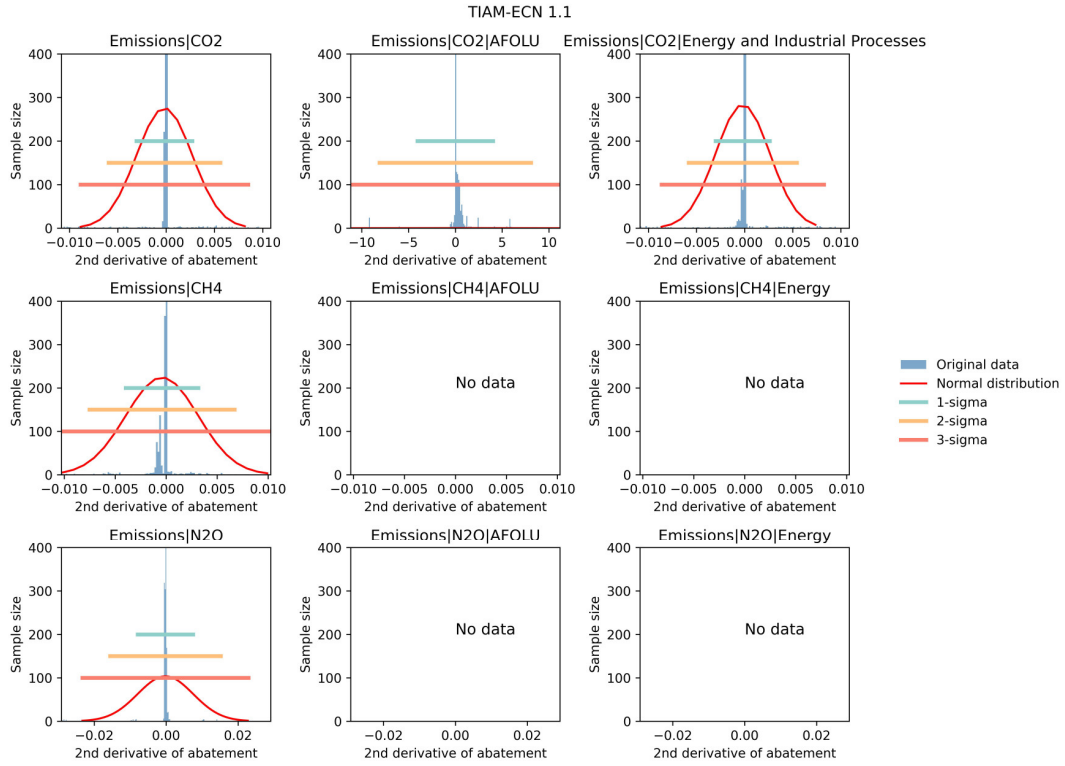


Figure S56. Global TIAM - Distribution of second derivative of abatement levels

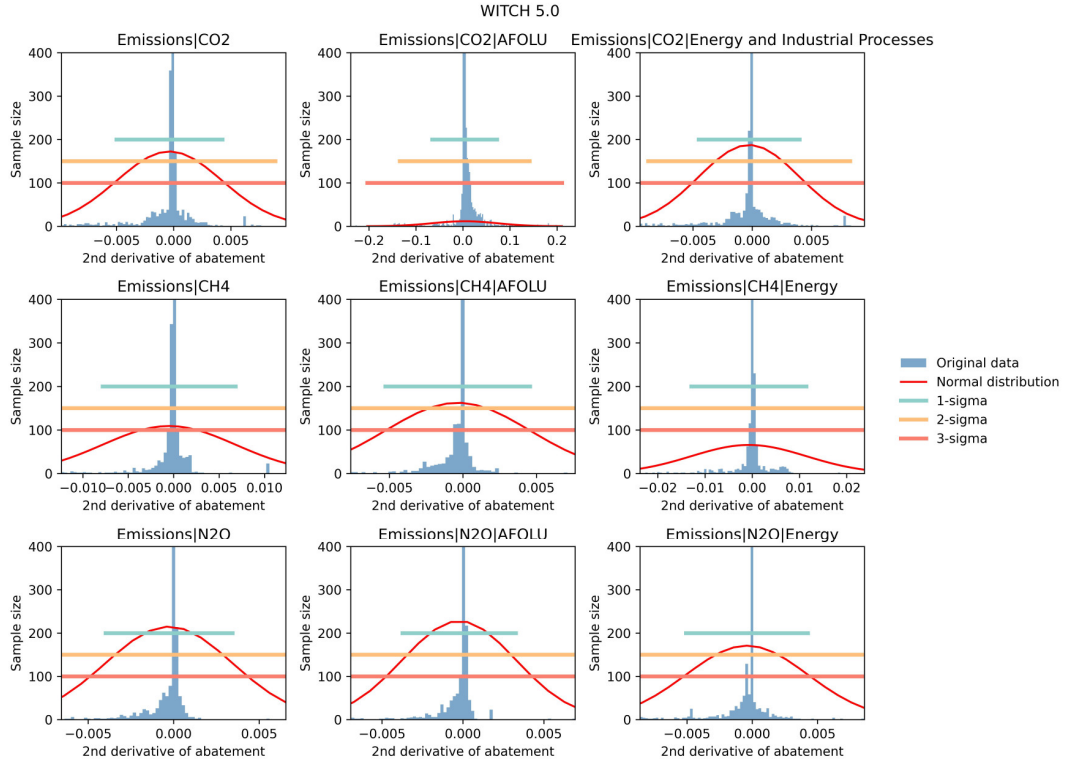


Figure S57. Global WITCH - Distribution of second derivative of abatement levels

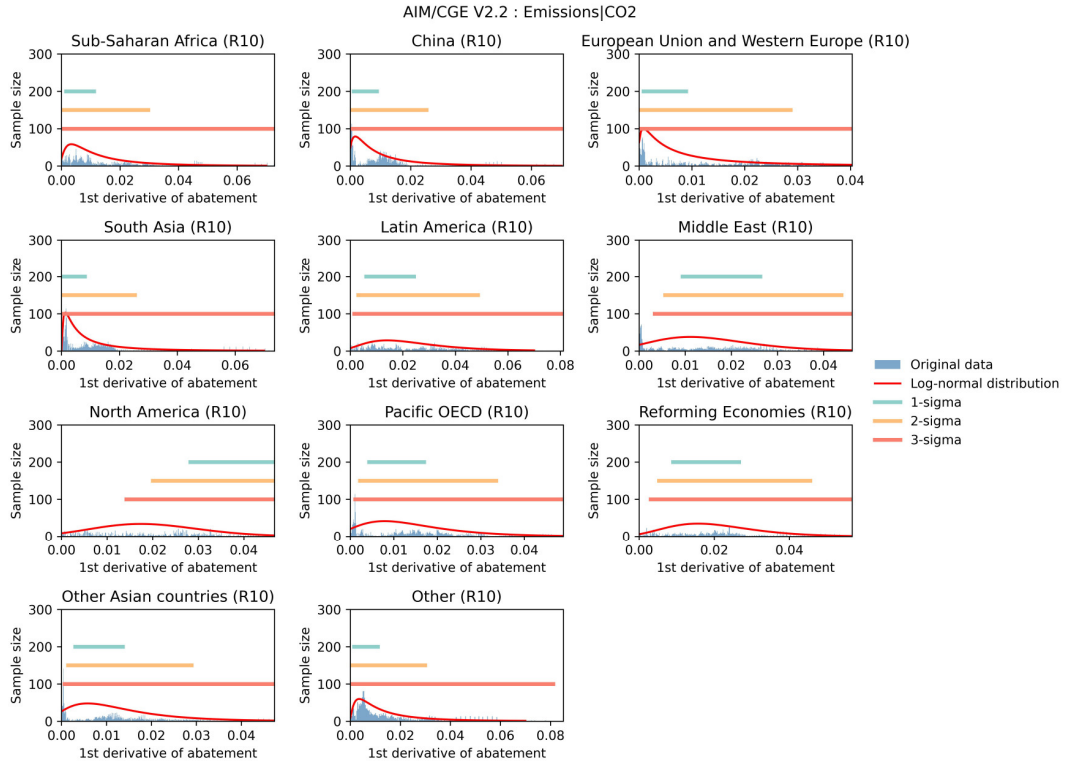


Figure S58. Regional AIM CO₂ - Distribution of first derivative of abatement levels

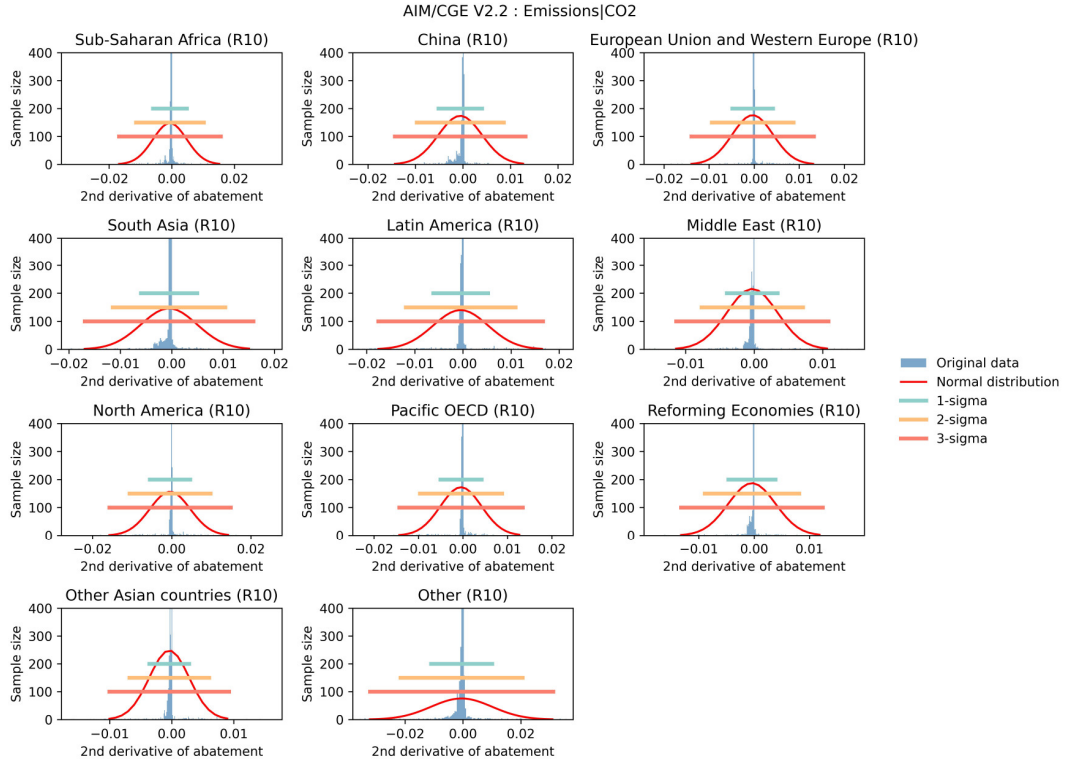


Figure S59. Regional AIM CO₂ - Distribution of second derivative of abatement levels

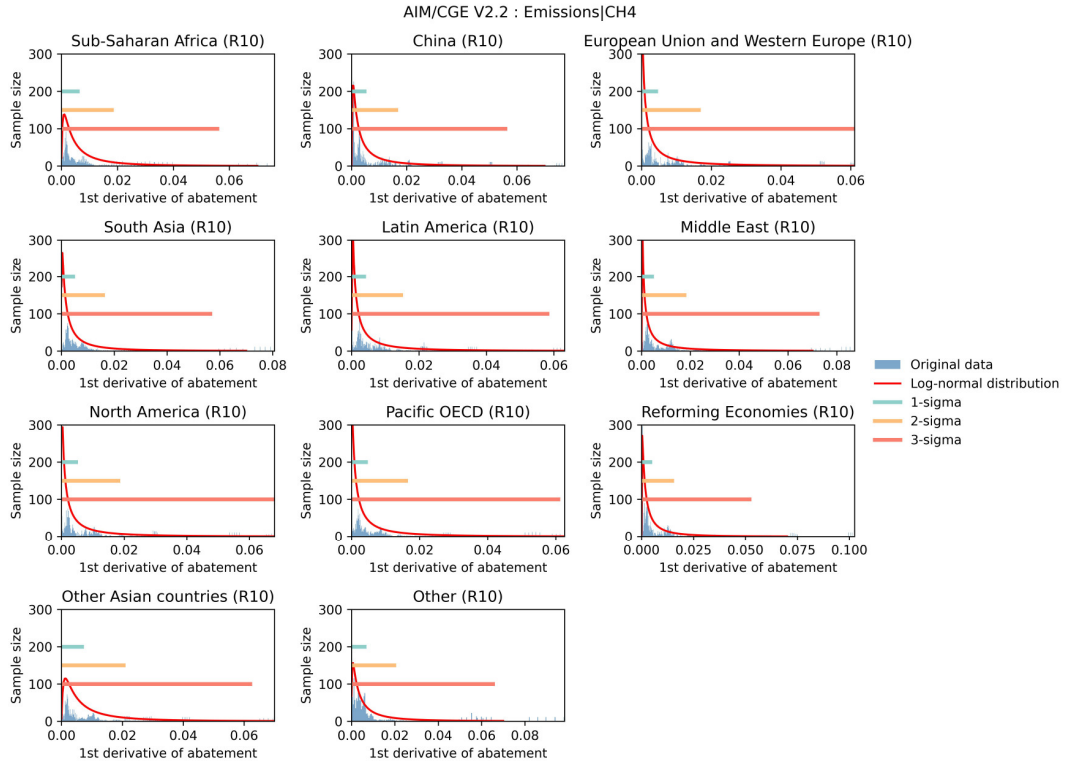


Figure S60. Regional AIM CH₄- Distribution of first derivative of abatement levels

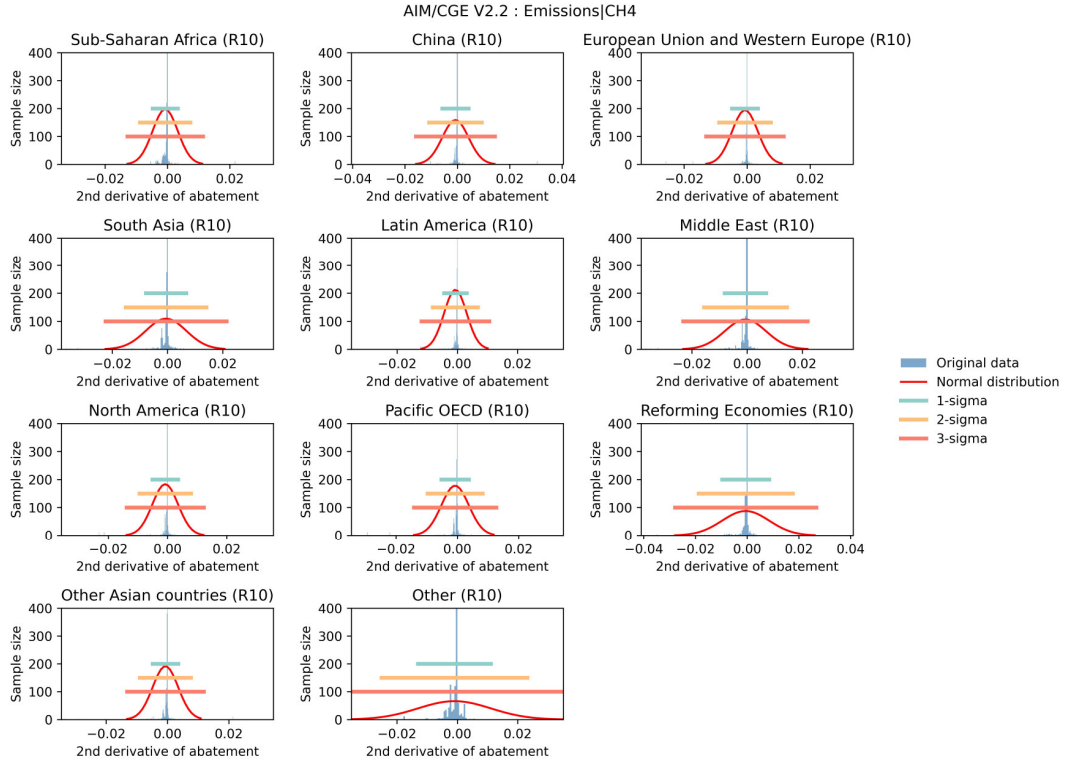


Figure S61. Regional AIM CH₄- Distribution of second derivative of abatement levels

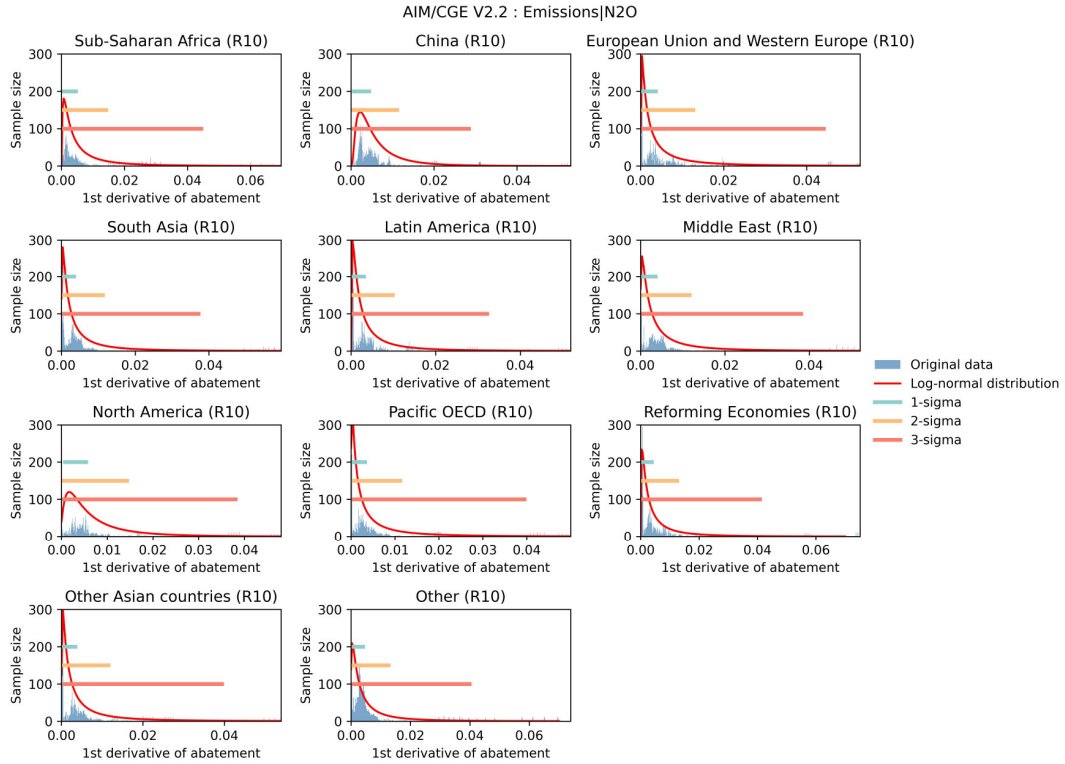


Figure S62. Regional AIM N₂O - Distribution of first derivative of abatement levels

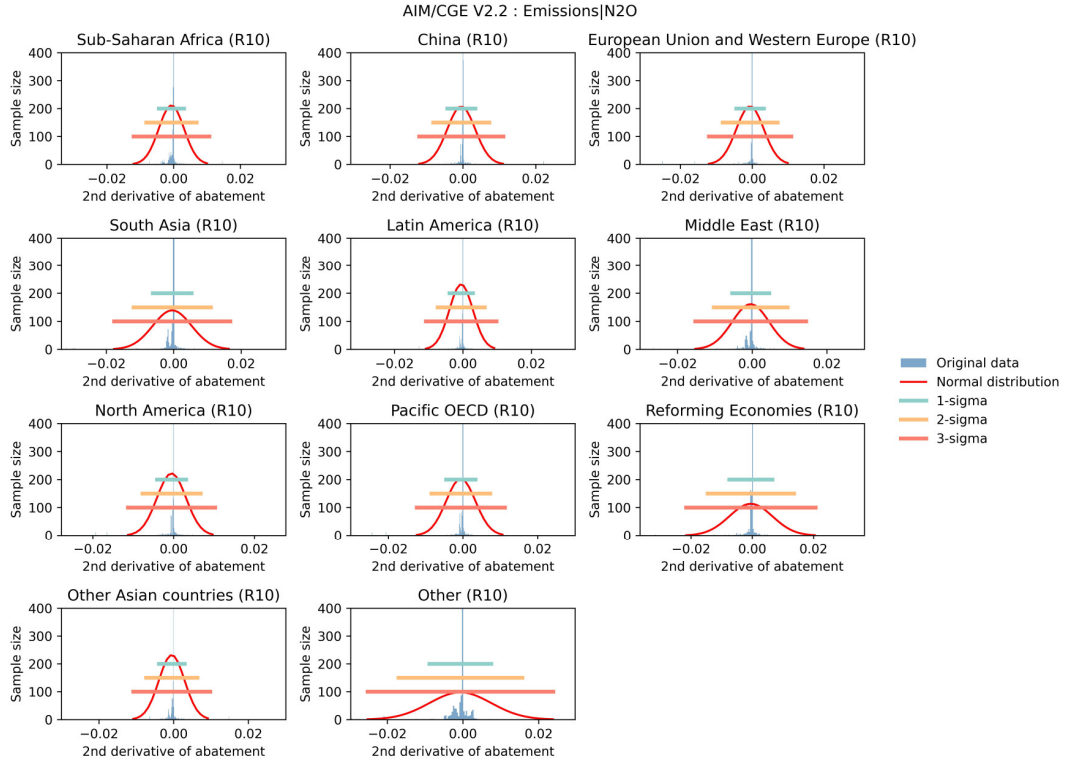


Figure S63. Regional AIM N₂O - Distribution of second derivative of abatement levels

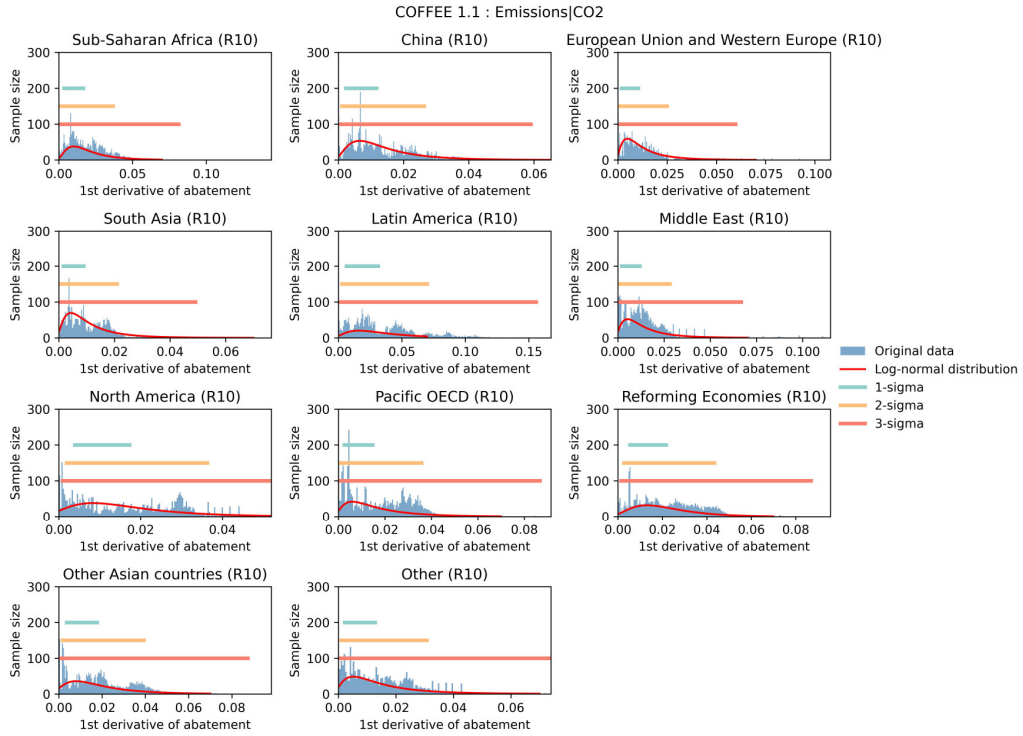


Figure S64. Regional COFFEE CO₂ - Distribution of first derivative of abatement levels

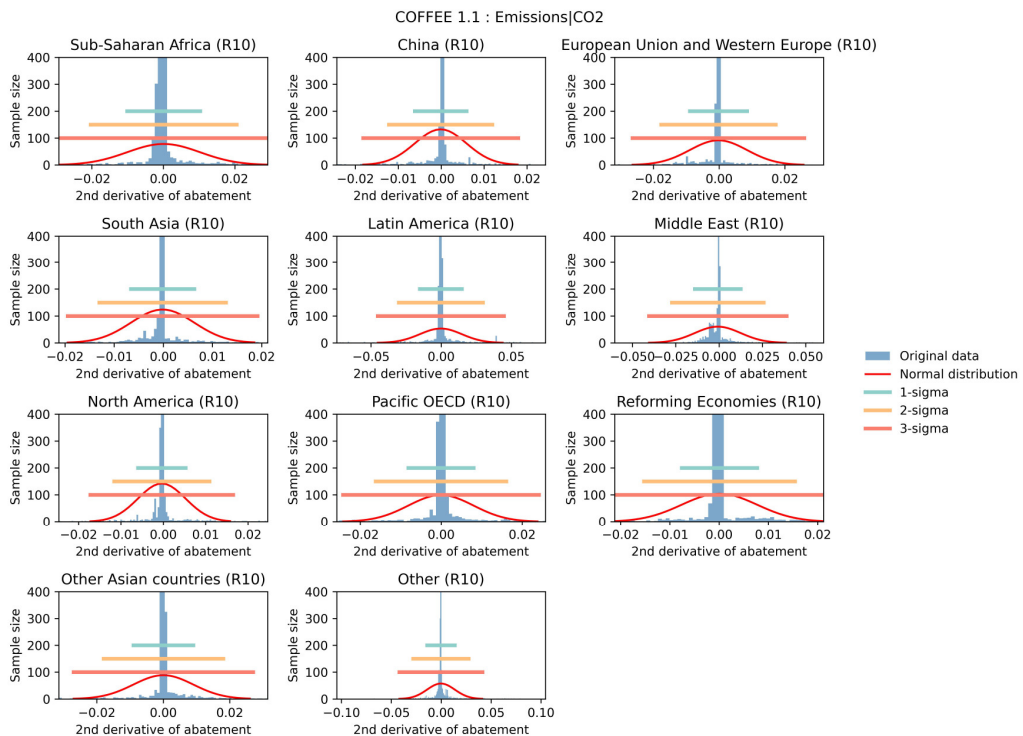


Figure S65. Regional COFFEE CO₂ - Distribution of second derivative of abatement levels

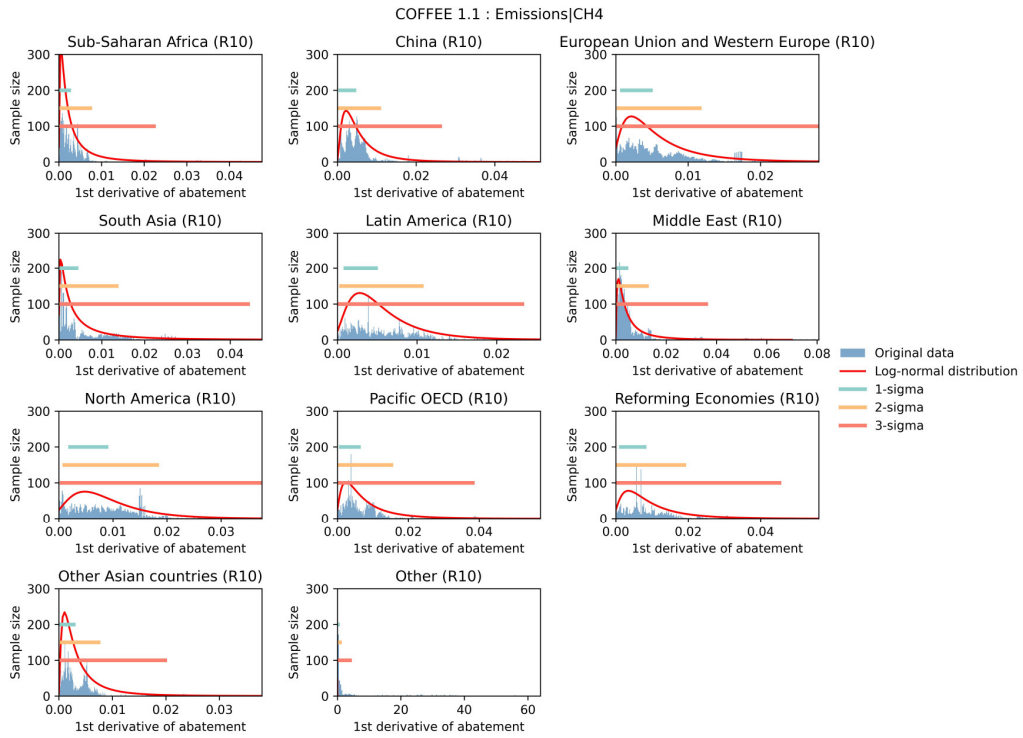


Figure S66. Regional COFFEE CH₄ - Distribution of first derivative of abatement levels

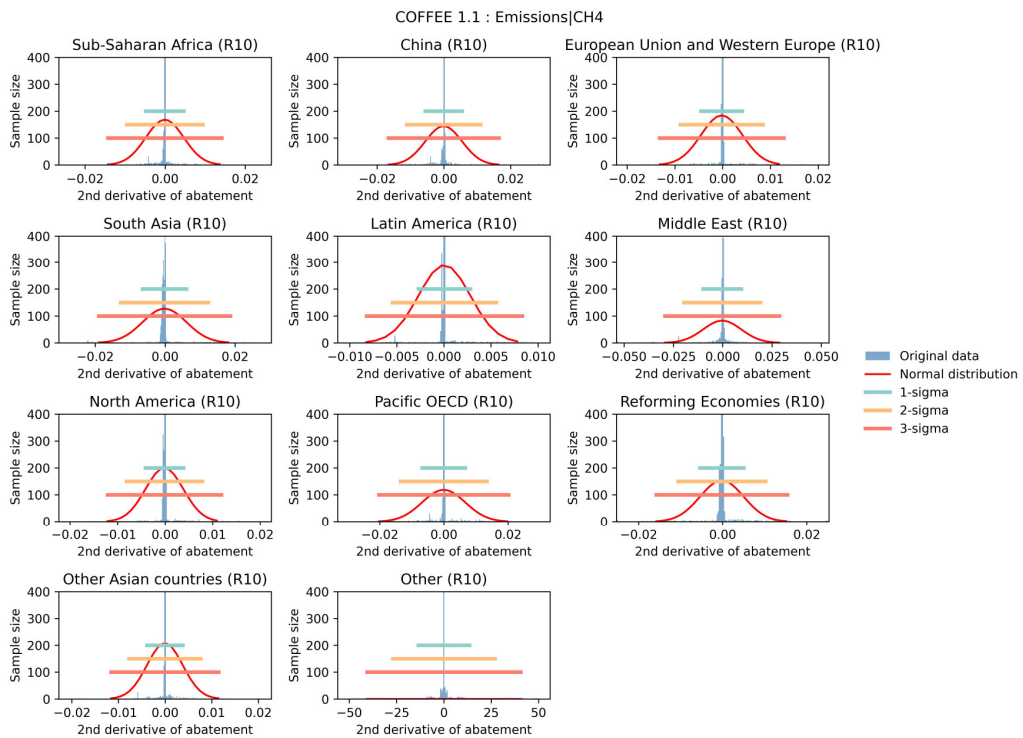


Figure S67. Regional COFFEE CH₄ - Distribution of second derivative of abatement levels

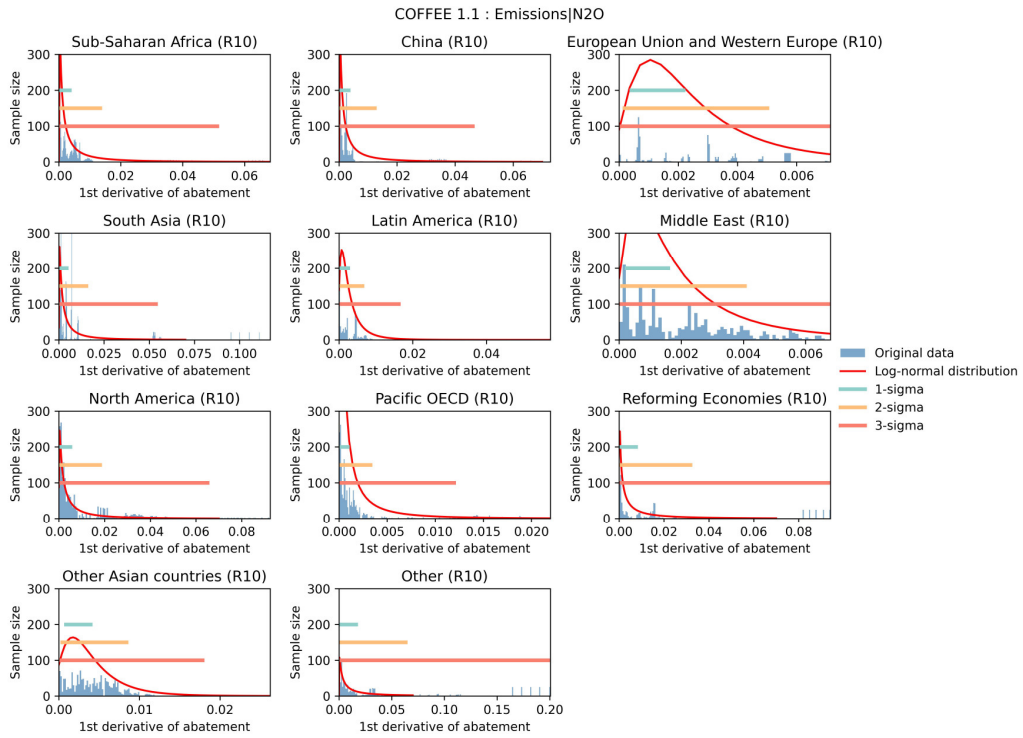


Figure S68. Regional COFFEE N₂O - Distribution of first derivative of abatement levels

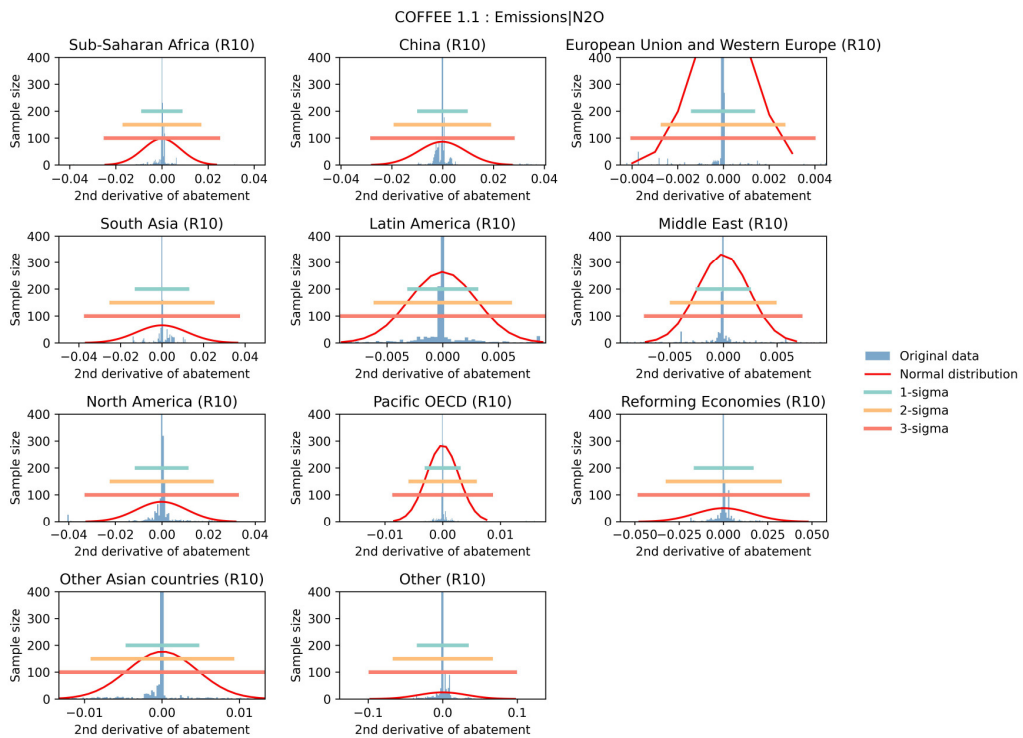
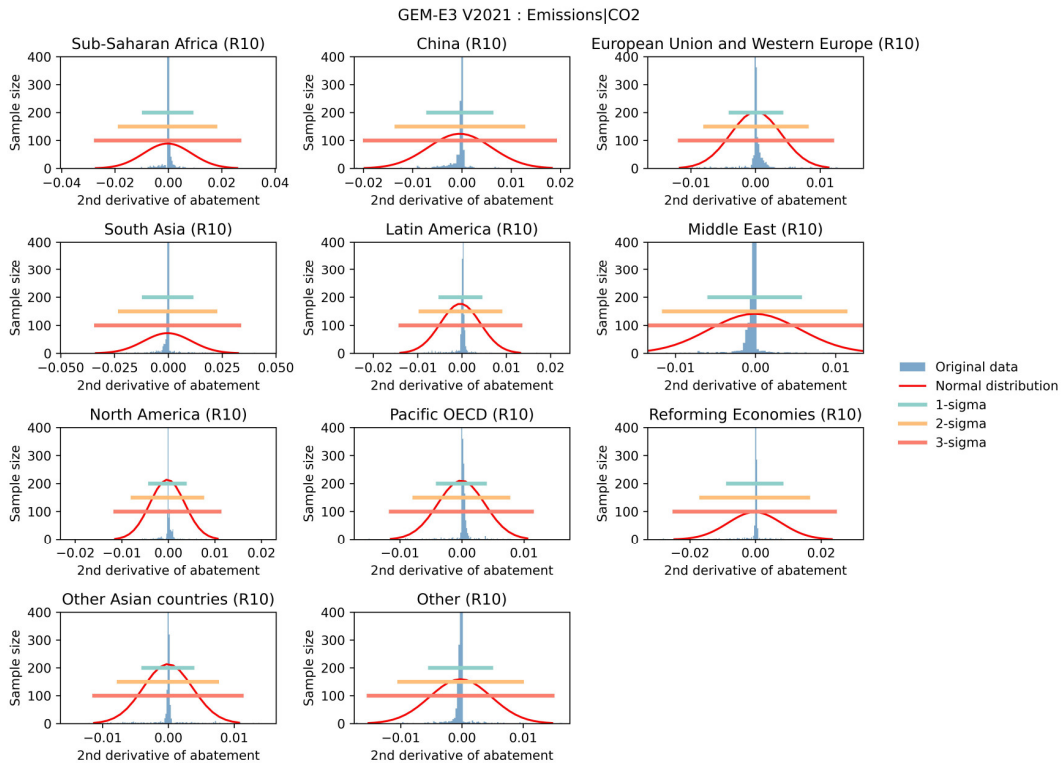
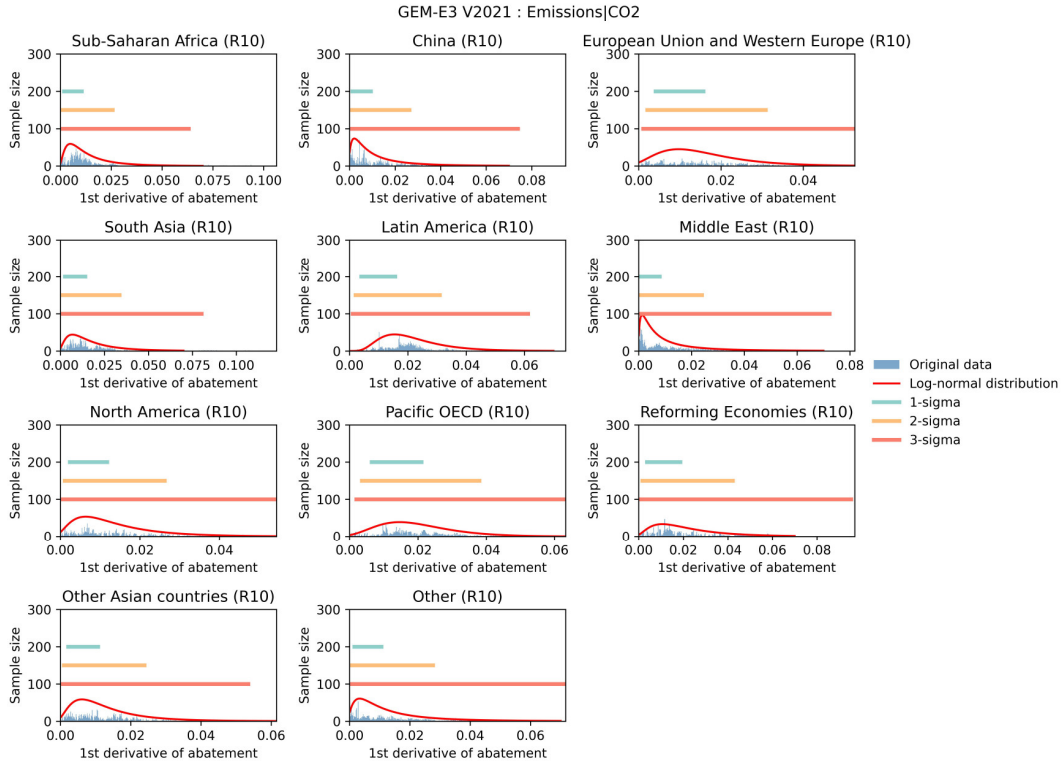


Figure S69. Regional COFFEE N₂O - Distribution of second derivative of abatement levels



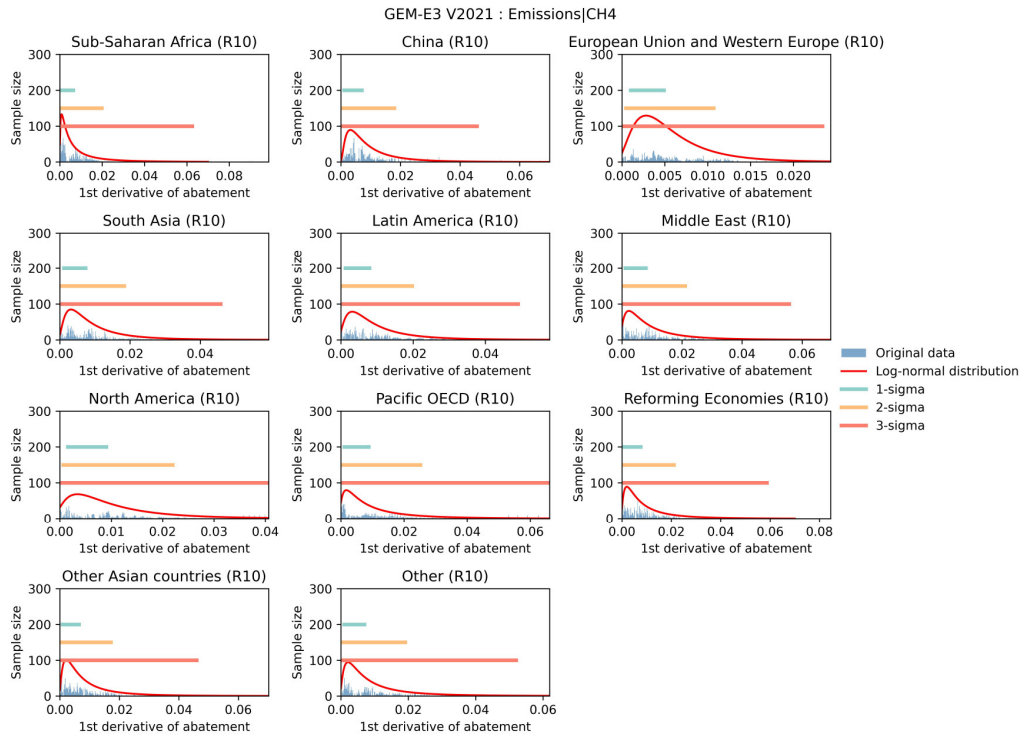


Figure S72. Regional GEM CH₄ - Distribution of first derivative of abatement levels

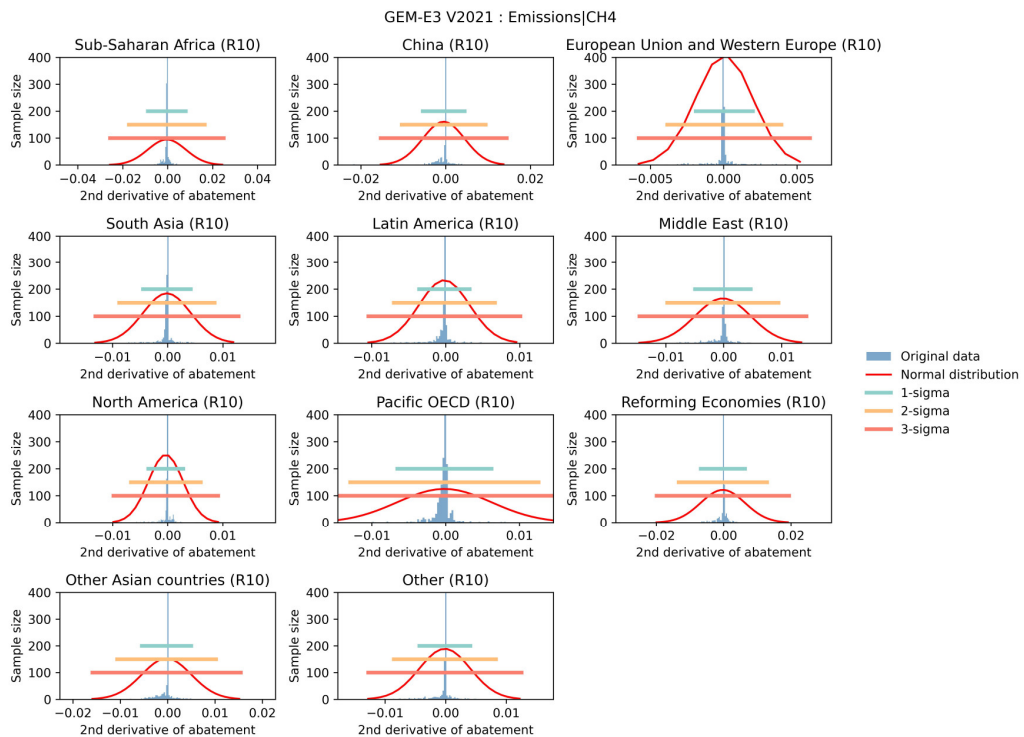


Figure S73. Regional GEM CH₄ - Distribution of second derivative of abatement levels

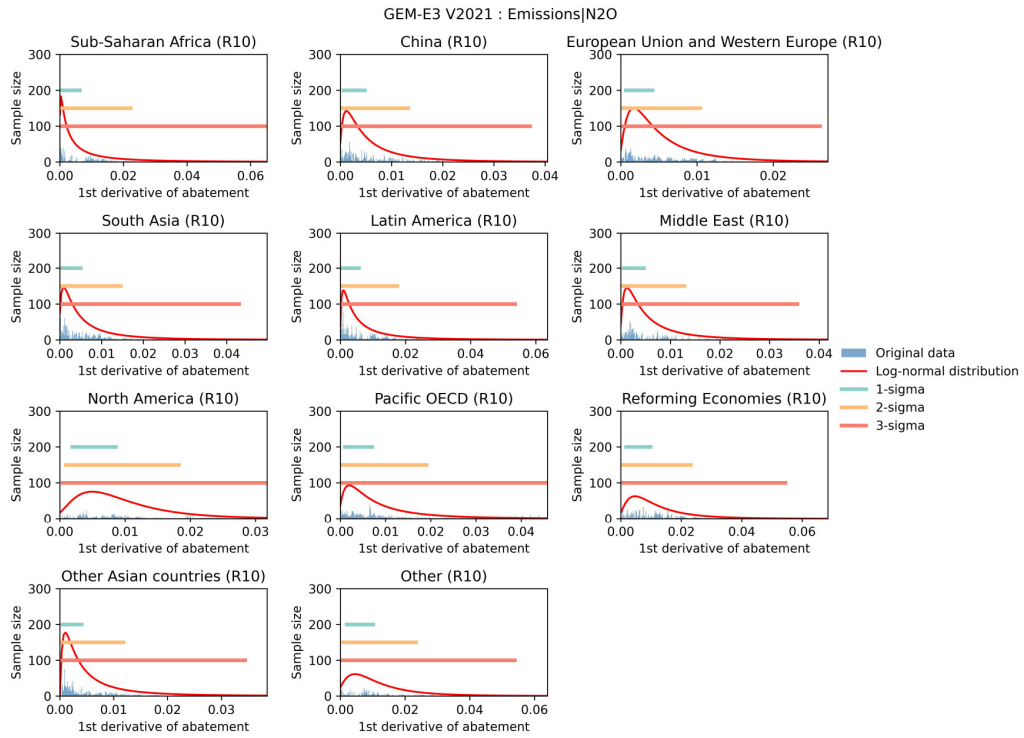


Figure S74. Regional GEM N₂O - Distribution of first derivative of abatement levels

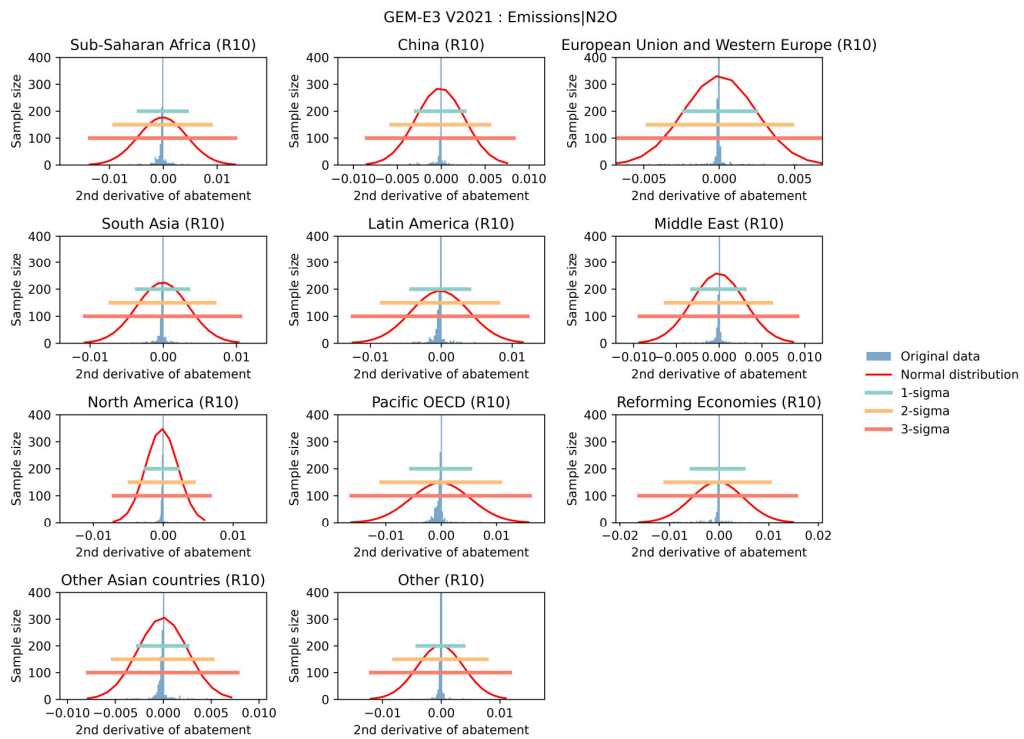


Figure S75. Regional GEM N₂O - Distribution of second derivative of abatement levels

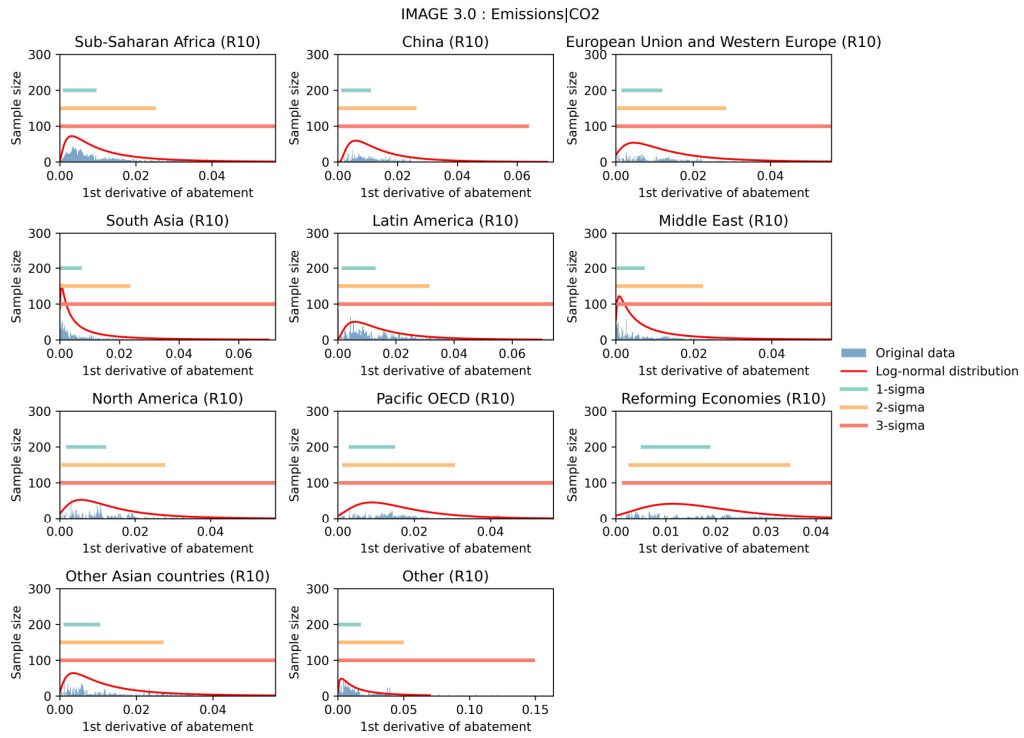


Figure S76. Regional IMAGE CO₂ - Distribution of first derivative of abatement levels

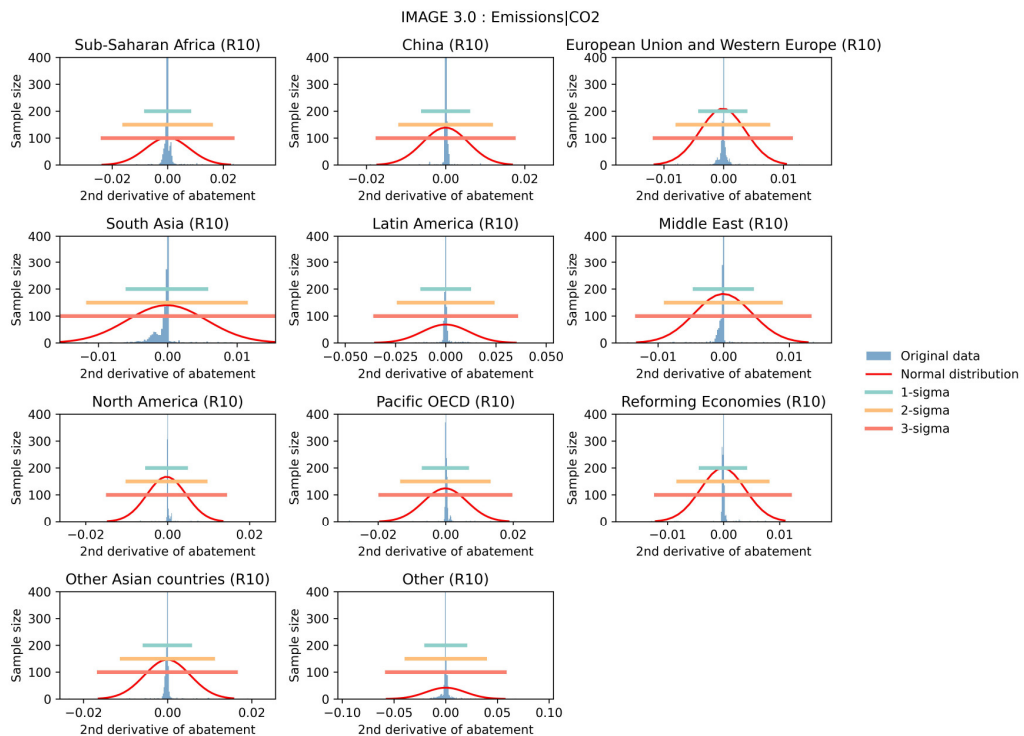


Figure S77. Regional IMAGE CO₂ - Distribution of second derivative of abatement levels

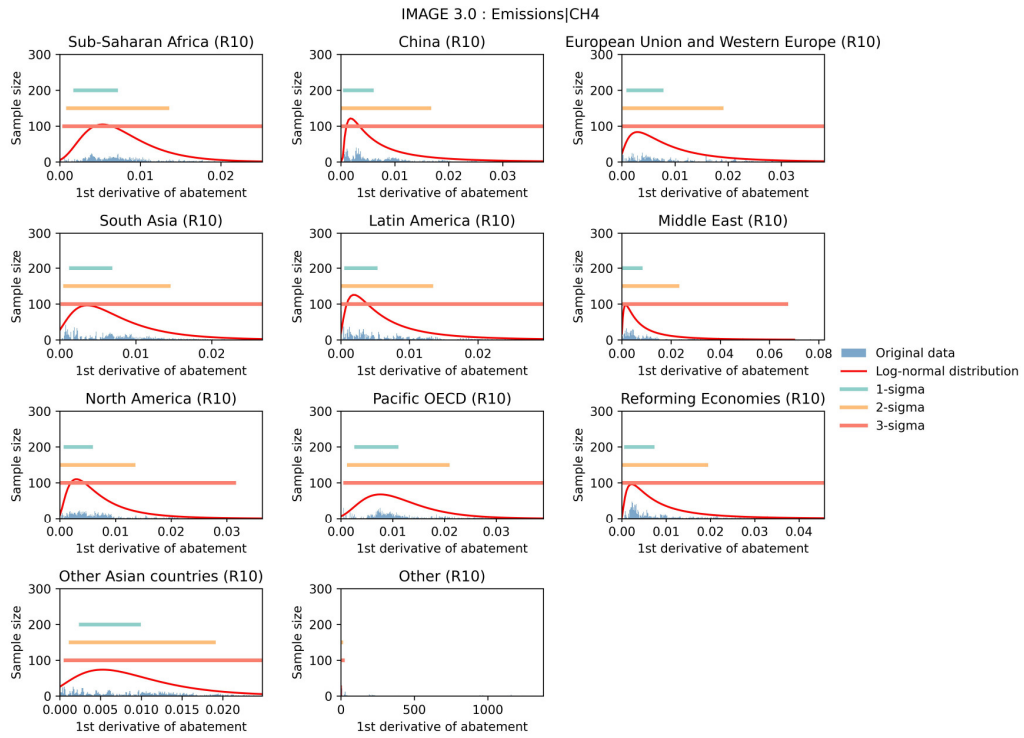


Figure S78. Regional IMAGE CH₄ - Distribution of first derivative of abatement levels

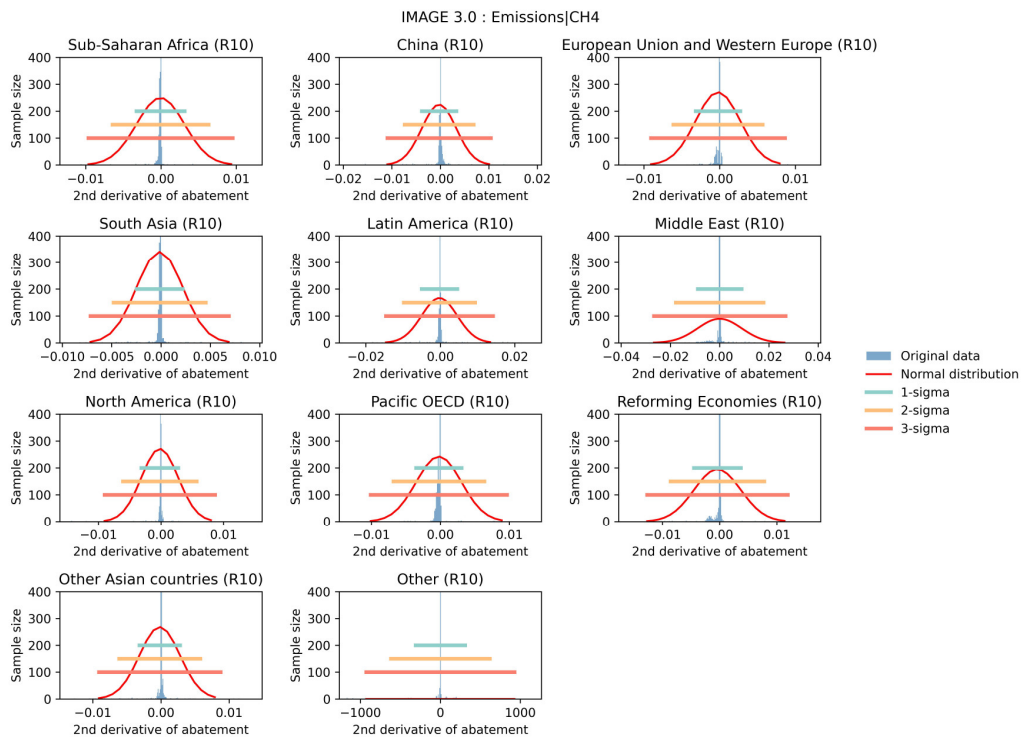


Figure S79. Regional IMAGE CH₄ - Distribution of second derivative of abatement levels

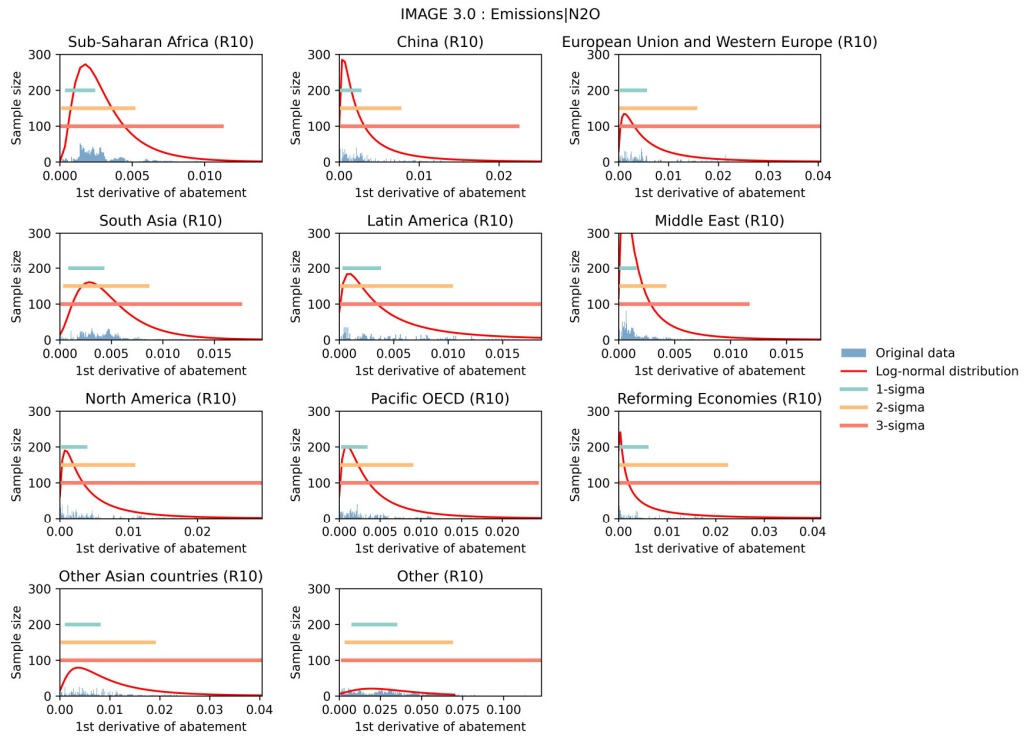


Figure S80. Regional IMAGE N₂O - Distribution of first derivative of abatement levels

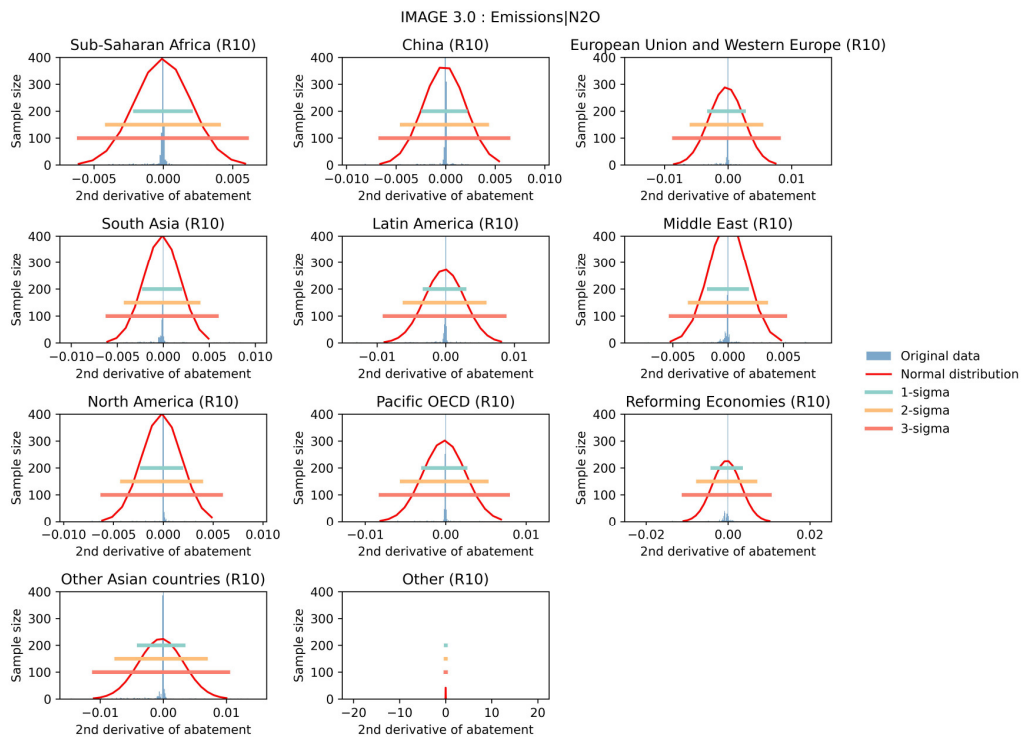


Figure S81. Regional IMAGE N₂O - Distribution of second derivative of abatement levels

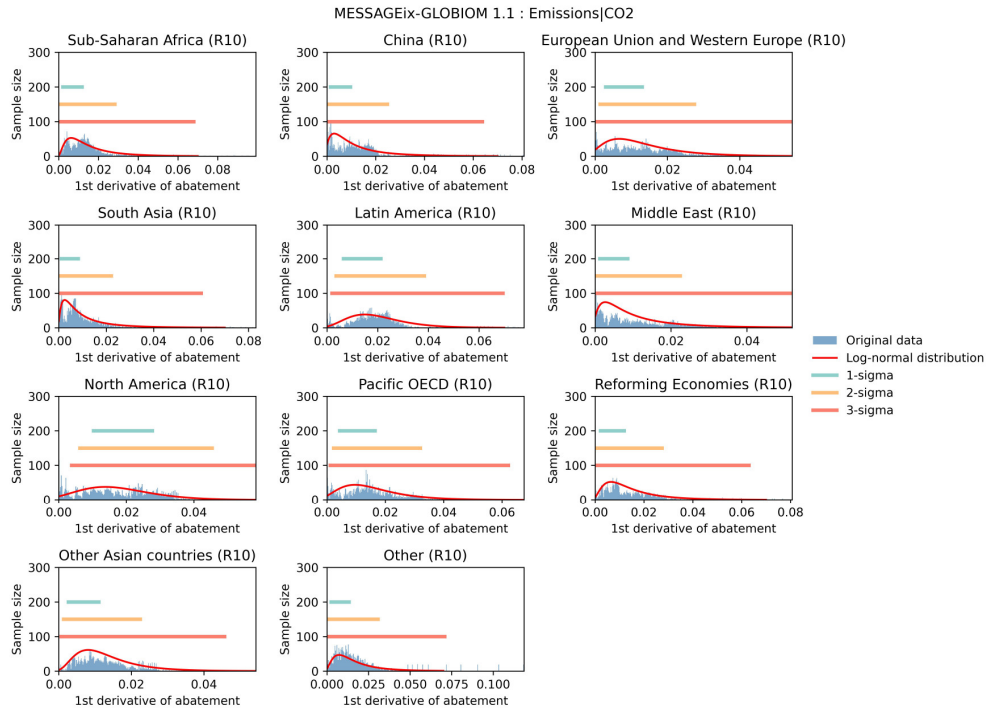


Figure S82. Regional MESSAGE CO₂ - Distribution of first derivative of abatement levels

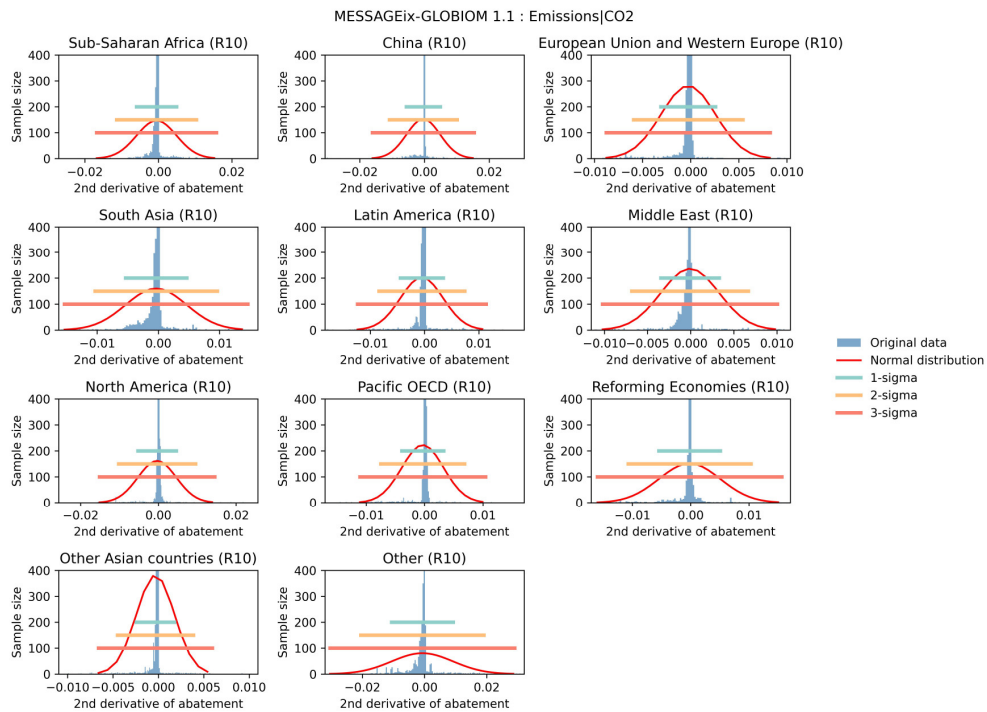


Figure S83. Regional MESSAGE CO₂ - Distribution of second derivative of abatement levels

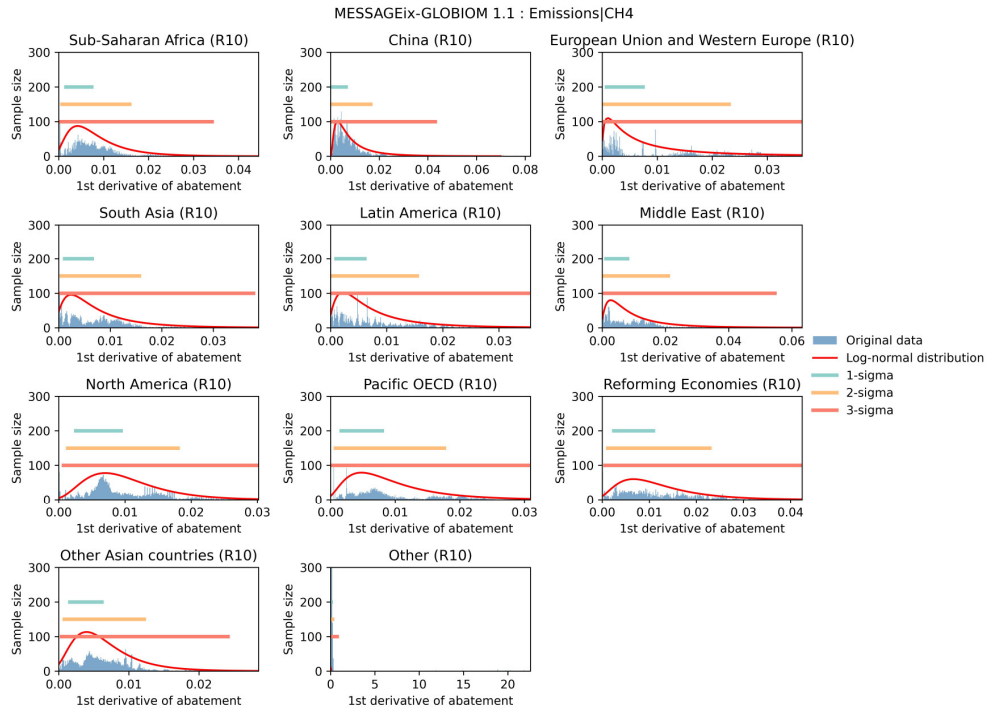


Figure S84. Regional MESSAGE CH₄ - Distribution of first derivative of abatement levels

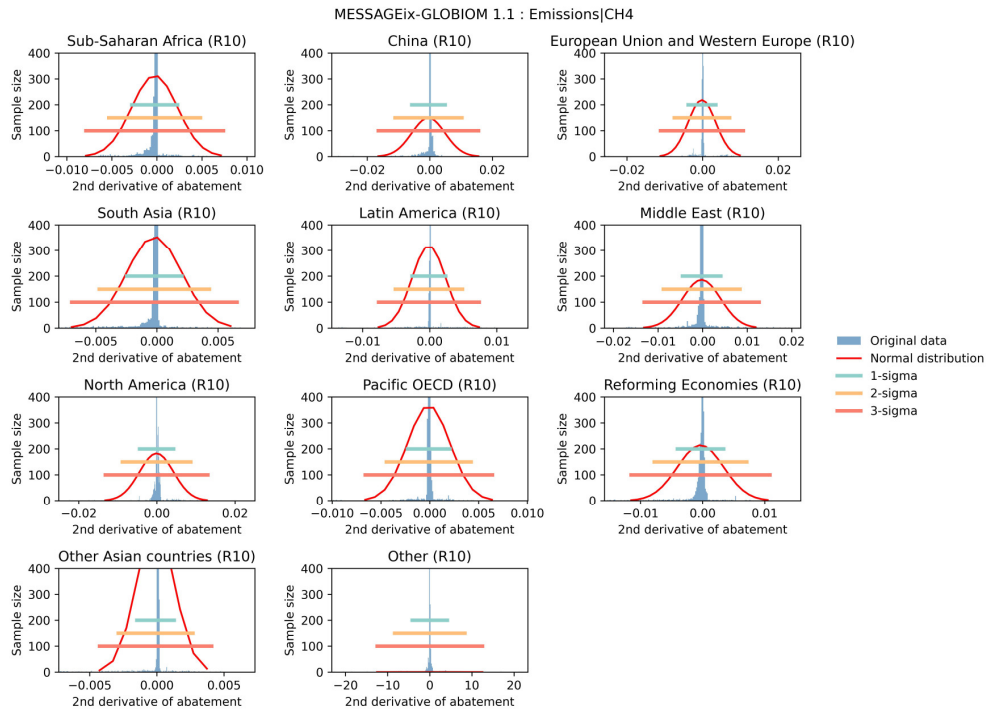


Figure S85. Regional MESSAGE CH₄ - Distribution of second derivative of abatement levels

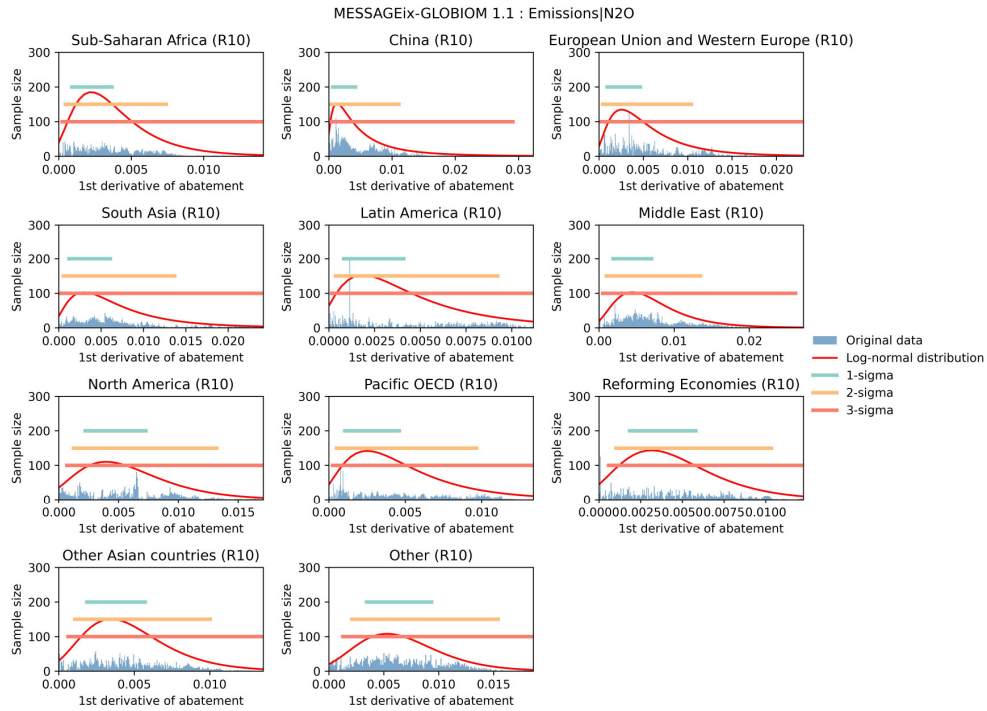


Figure S86. Regional MESSAGE N₂O - Distribution of first derivative of abatement levels

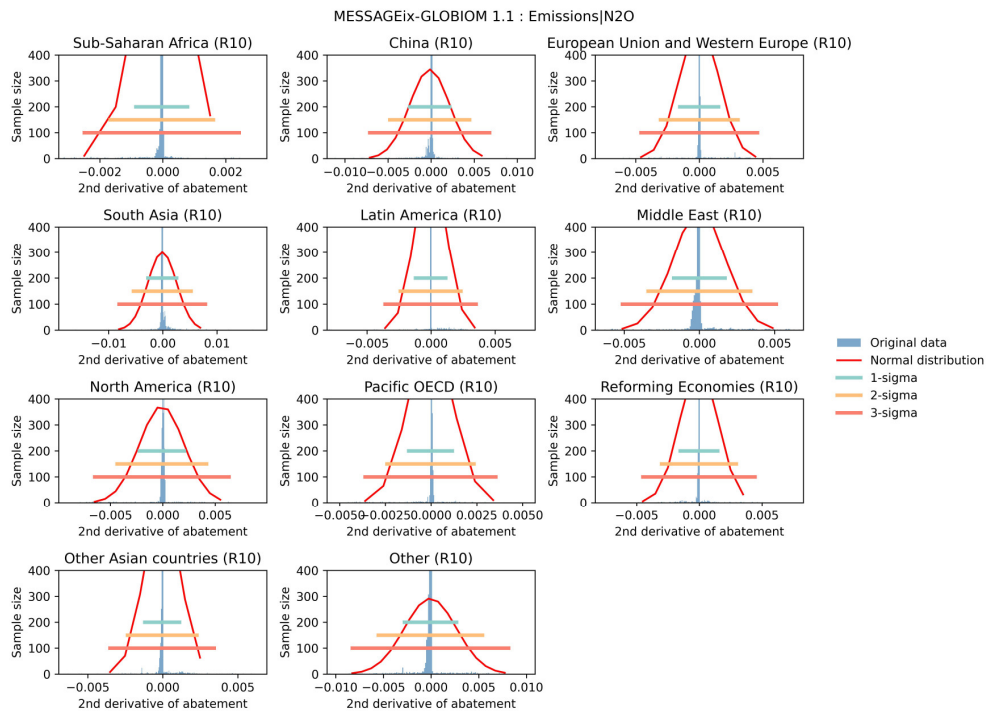


Figure S87. Regional MESSAGE N₂O - Distribution of second derivative of abatement levels

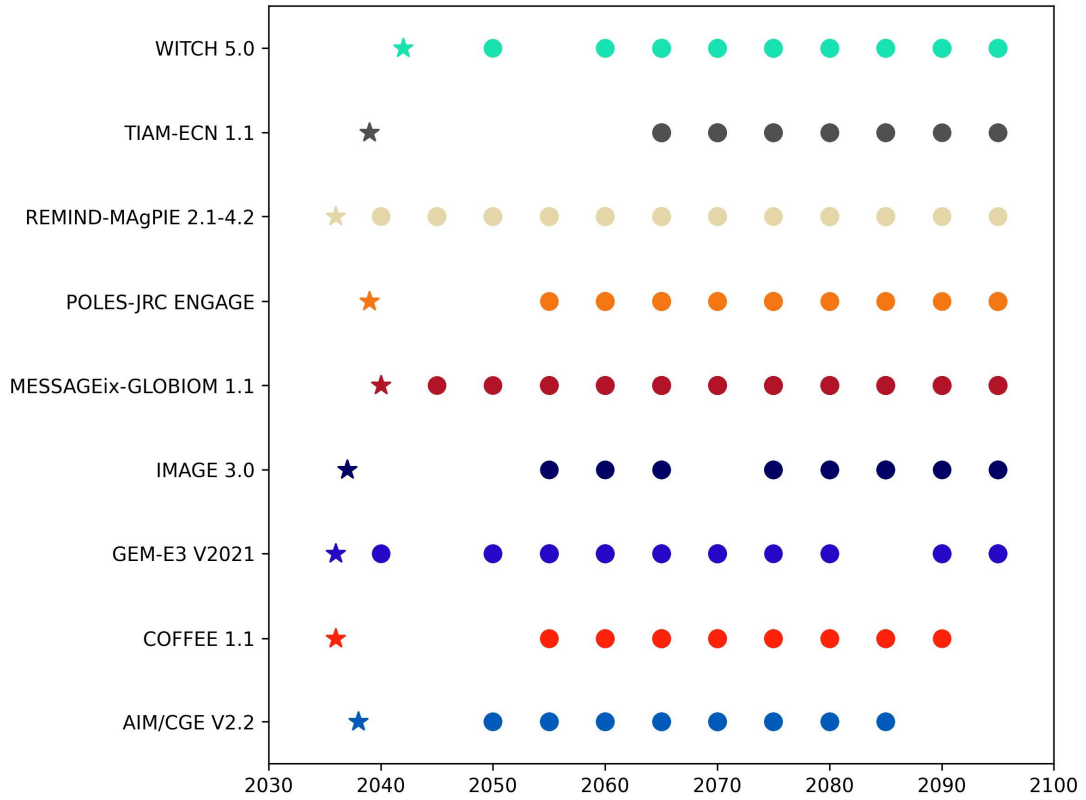


Figure S88. The earliest year of achieving net zero indicated by our emulator

We calculated the earliest year of achieving net zero based on the upper limits of the 1st and 2nd derivatives of abatement changes as shown in stars. The distribution of net-zero years in the carbon budget scenarios of each ENGAGE IAM is shown in circles.

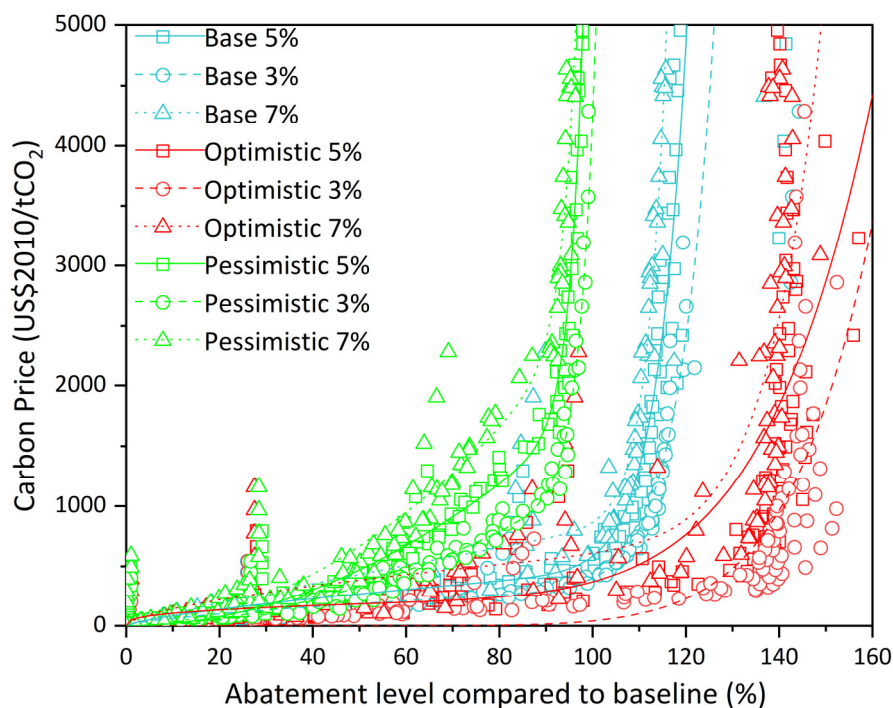


Figure S89. The relationship between abatement level and carbon price with different discount rates for GET with different portfolios

The discount rate in the GET model is changed to 3%, 5% (default), and 7%, respectively.

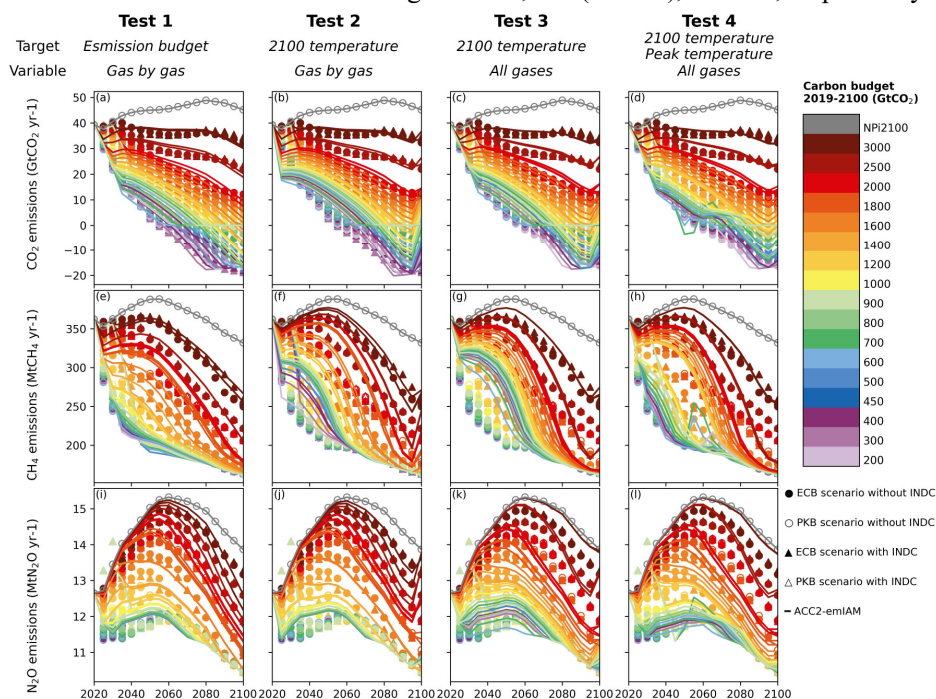


Figure S90. Overview of the validation results for ACC2-emIAM with REMIND as an example

The points show the original emission pathways from REMIND obtained from the ENGAGE Scenario Explorer; the lines show the emission pathways reproduced from ACC2-emIAM. The same color is used for each pair of original and reproduced pathways. The figure shows the comparisons from all scenarios.

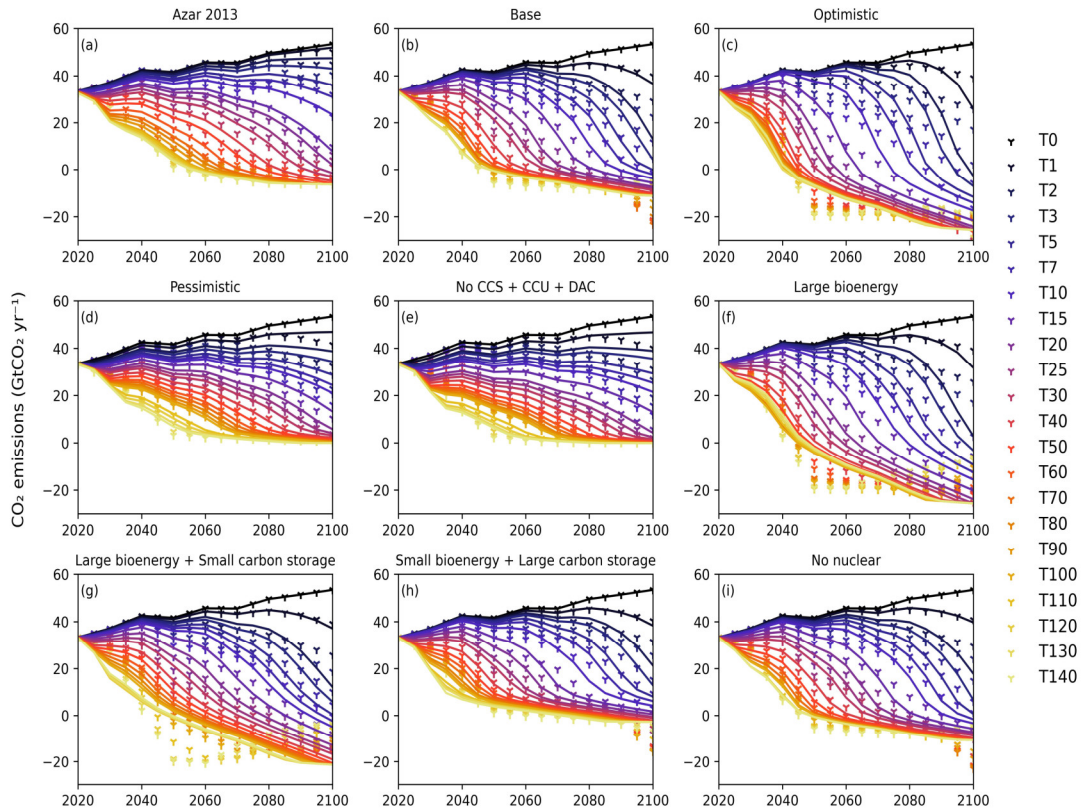


Figure S91. Test 1 – GET nine portfolios energy-related CO₂ validation results

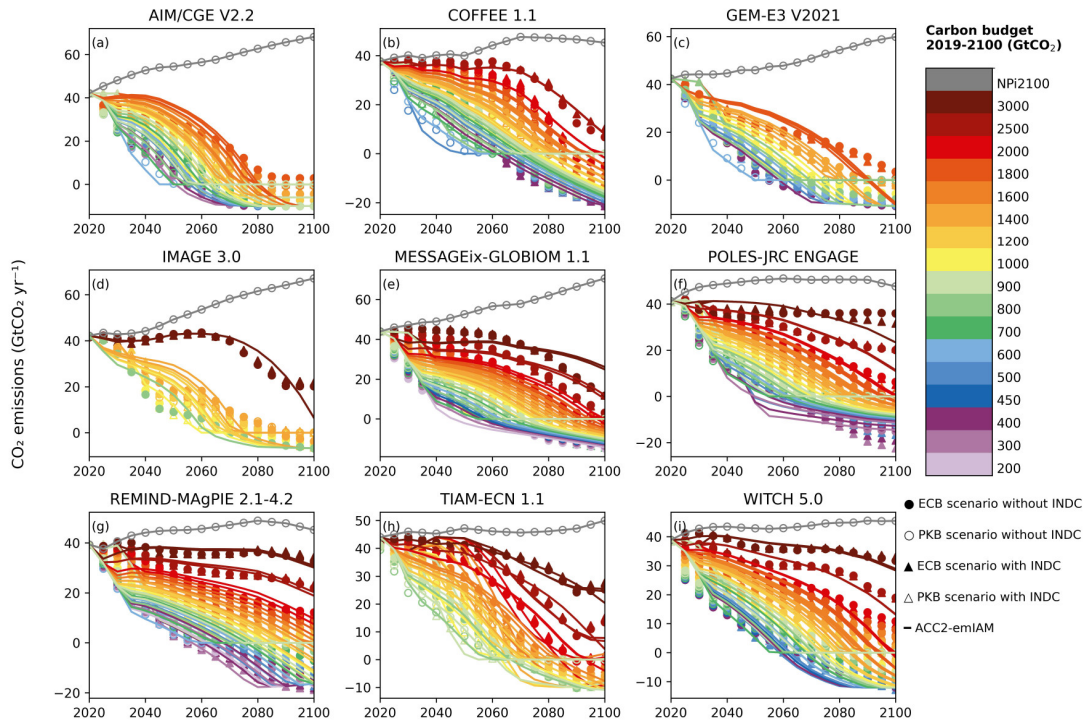


Figure S92. Test 1 – Global nine IAMs total anthropogenic CO₂ validation results

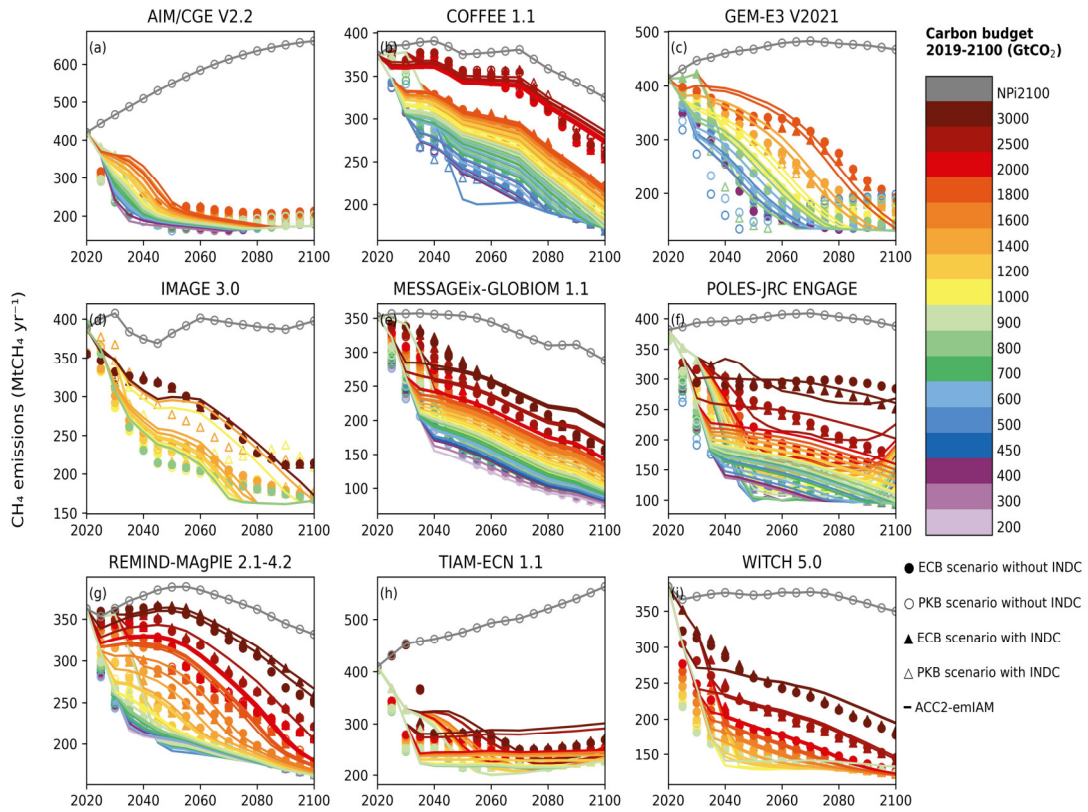


Figure S93. Test 1 – Global nine IAMs total anthropogenic CH₄ validation results

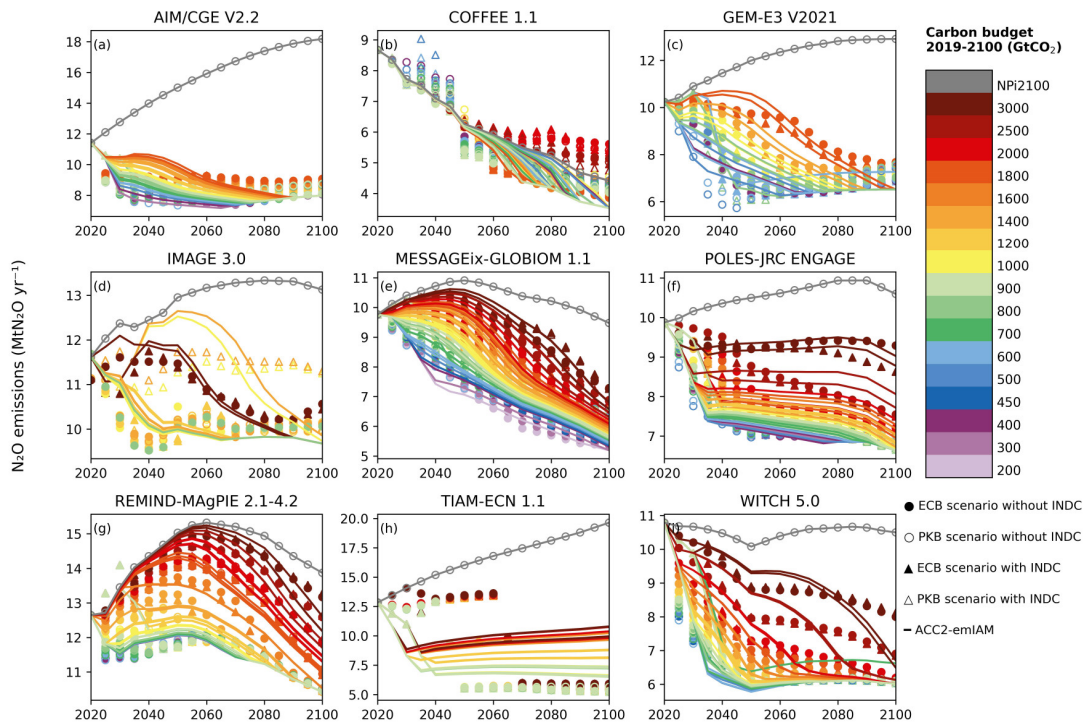


Figure S94. Test 1 – Global nine IAMs total anthropogenic N₂O validation results

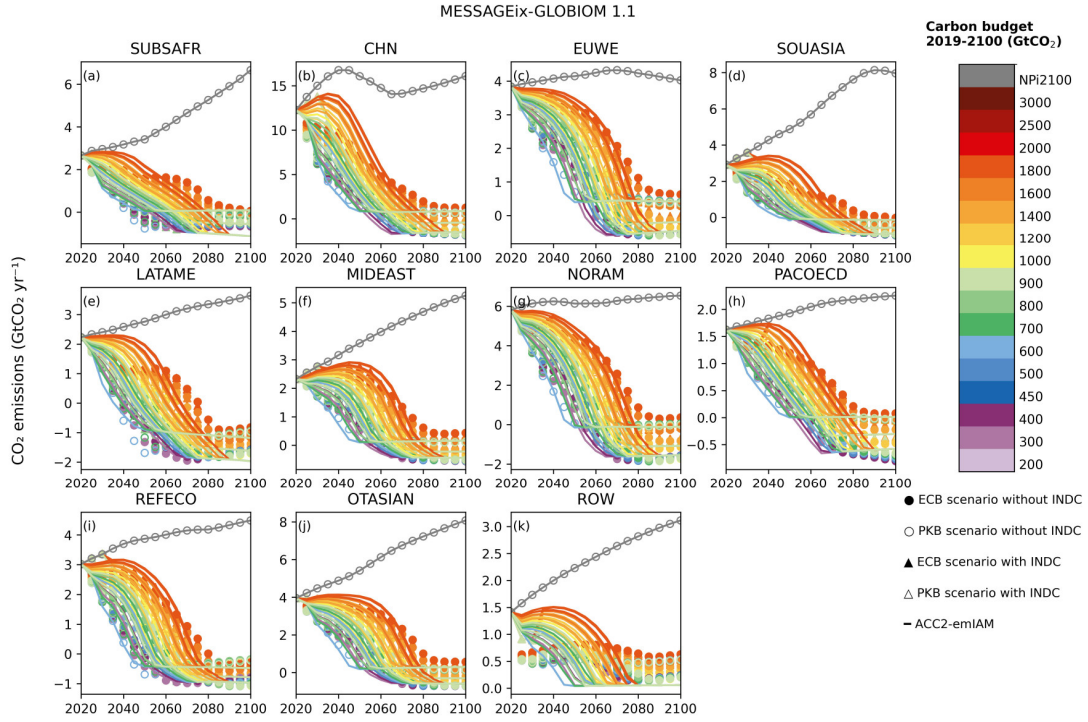


Figure S95. Test 1 - Regional AIM total anthropogenic CO₂ validation results

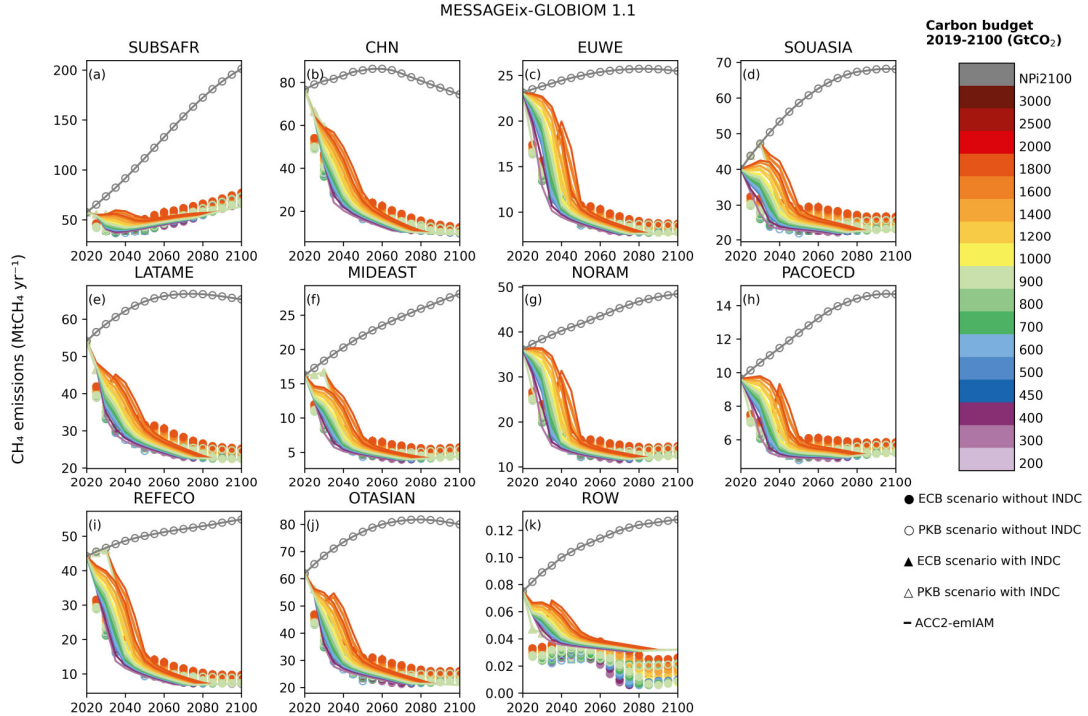


Figure S96. Test 1 - Regional AIM total anthropogenic CH₄ validation results

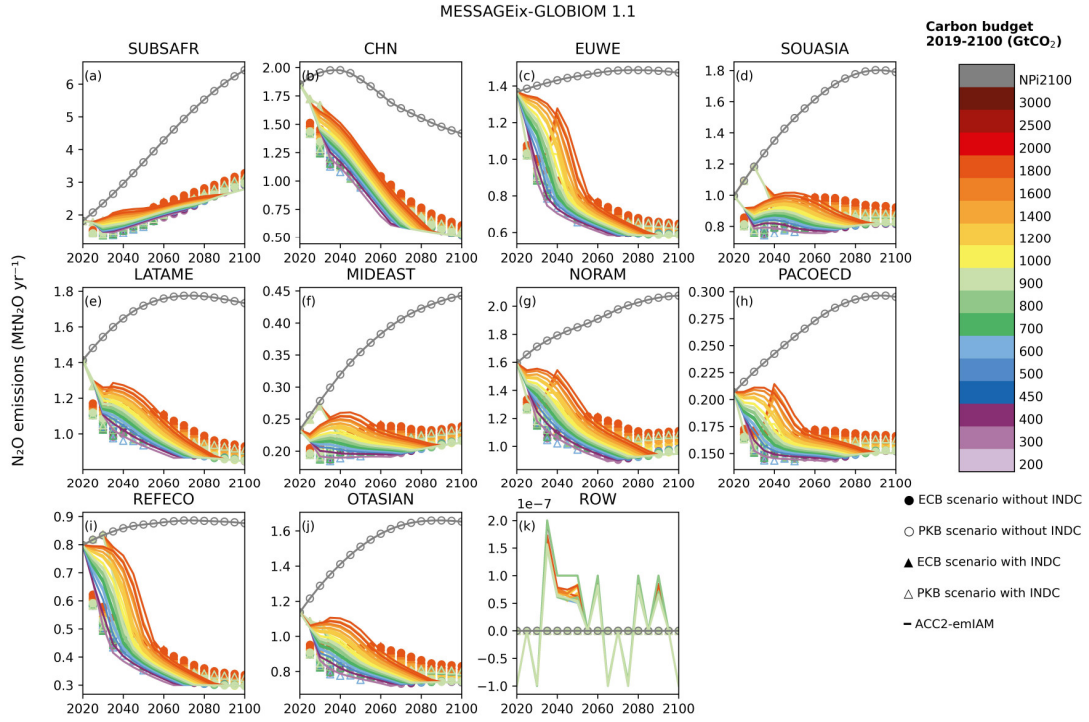


Figure S97. Test 1 - Regional AIM total anthropogenic N_2O validation results

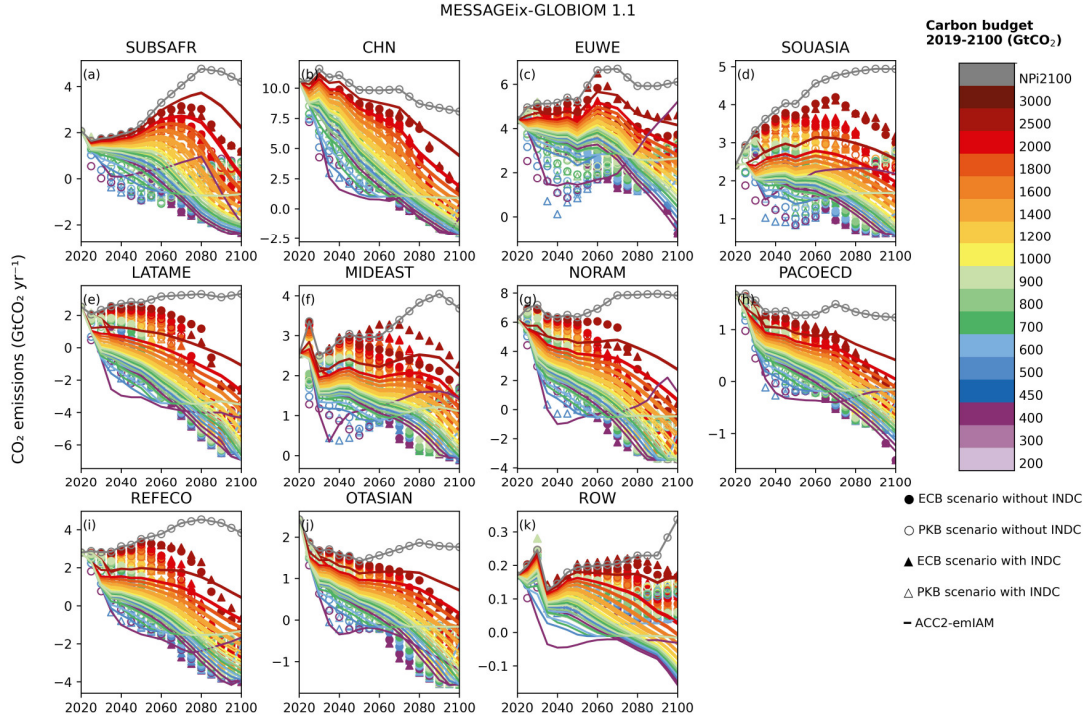


Figure S98. Test 1 - Regional COFFEE total anthropogenic CO_2 validation results

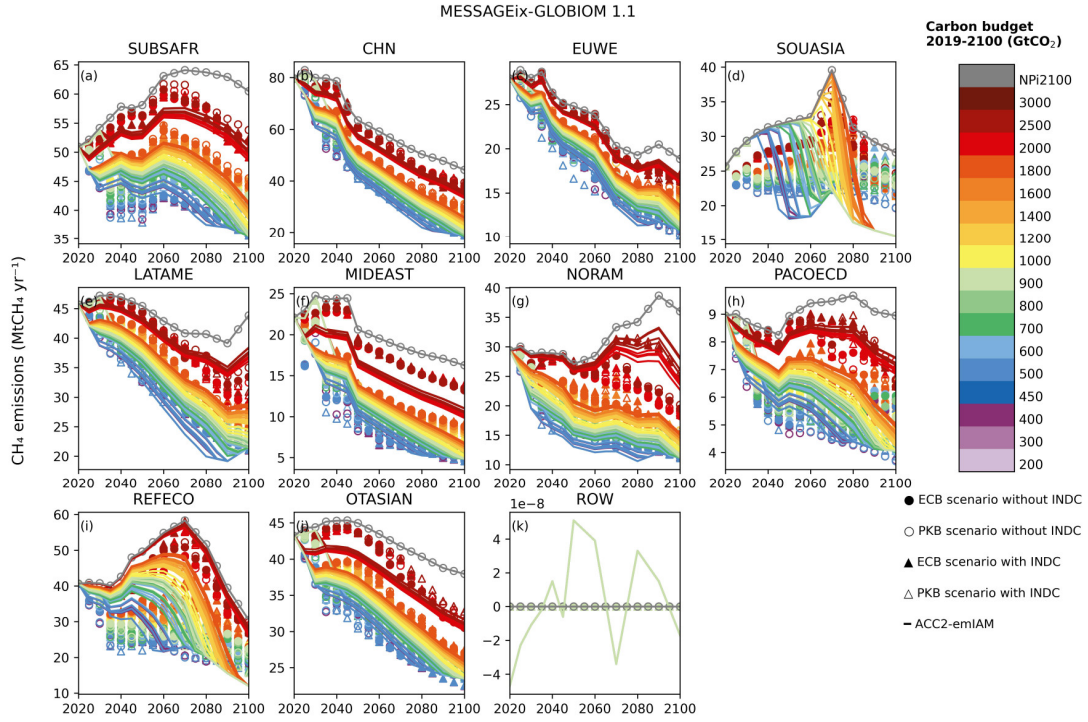


Figure S99. Test 1 - Regional COFFEE total anthropogenic CH₄ validation results

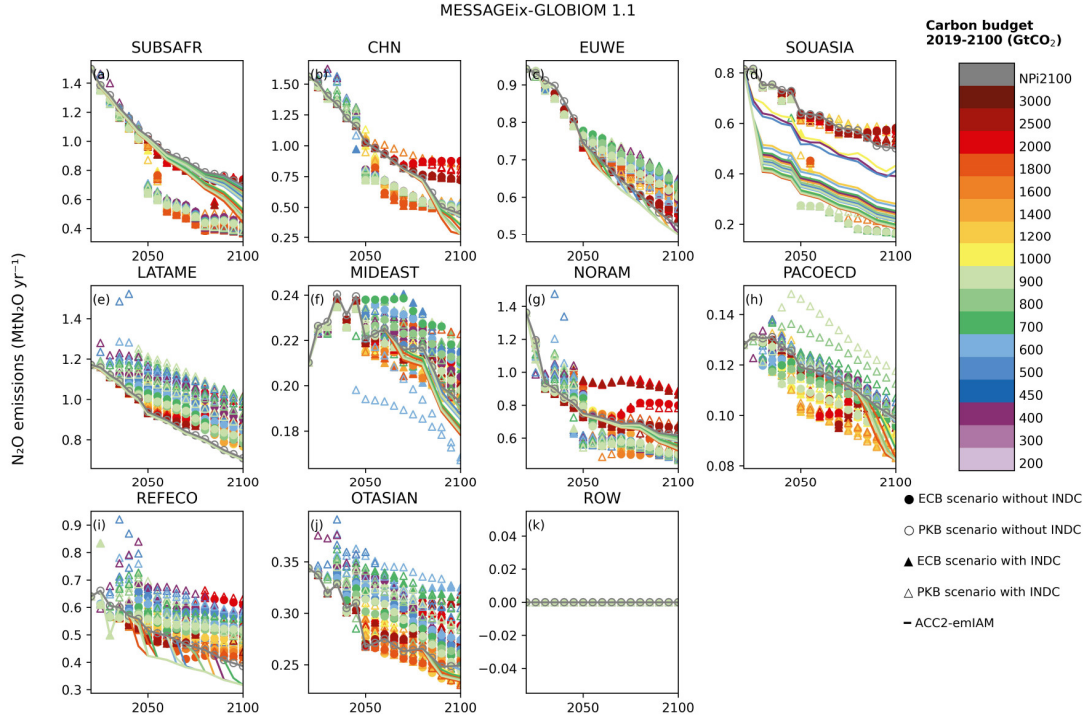


Figure S100. Test 1 - Regional COFFEE total anthropogenic N₂O validation results

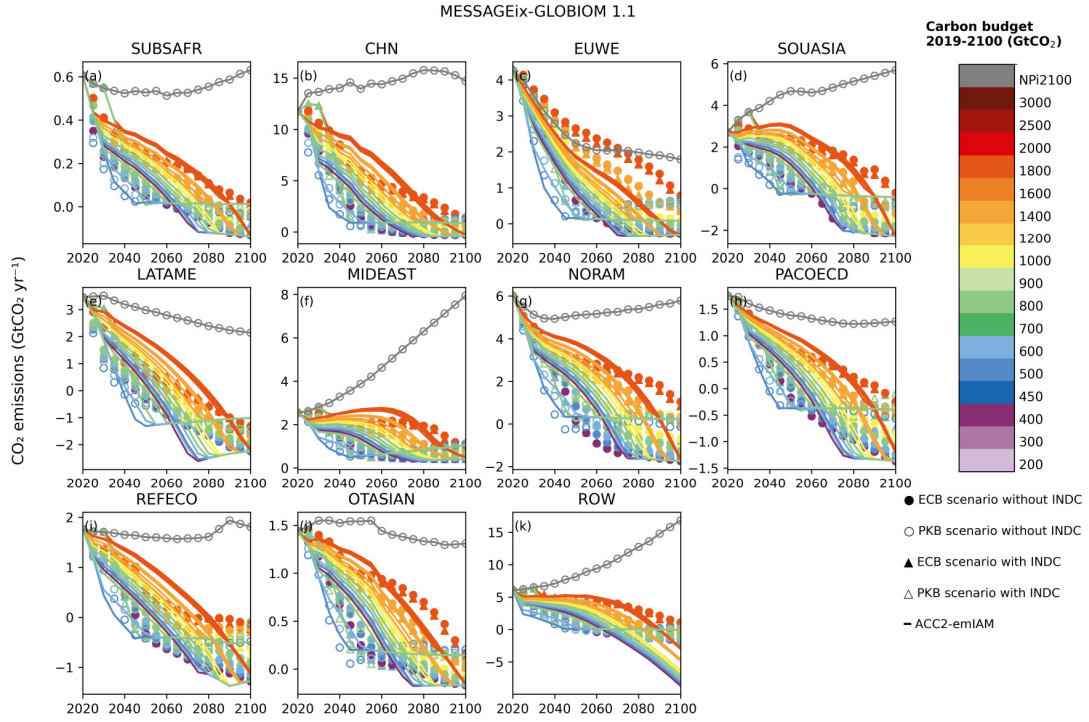


Figure S101. Test 1 - Regional GEM total anthropogenic CO₂ validation results

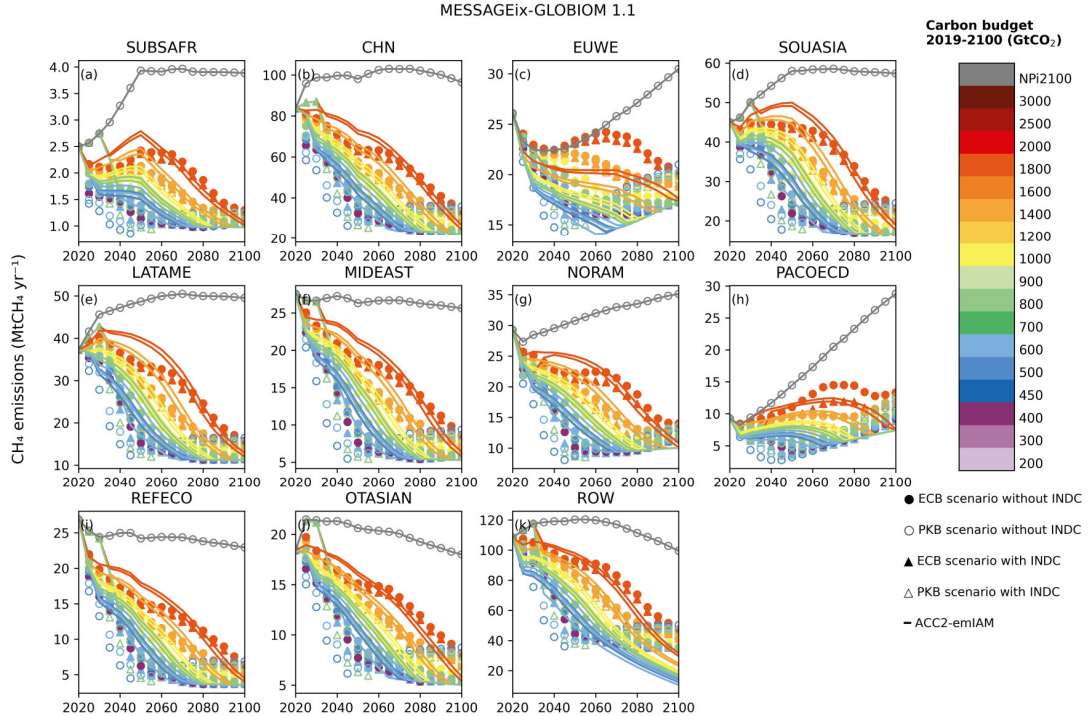


Figure S102. Test 1 - Regional GEM total anthropogenic CH₄ validation results

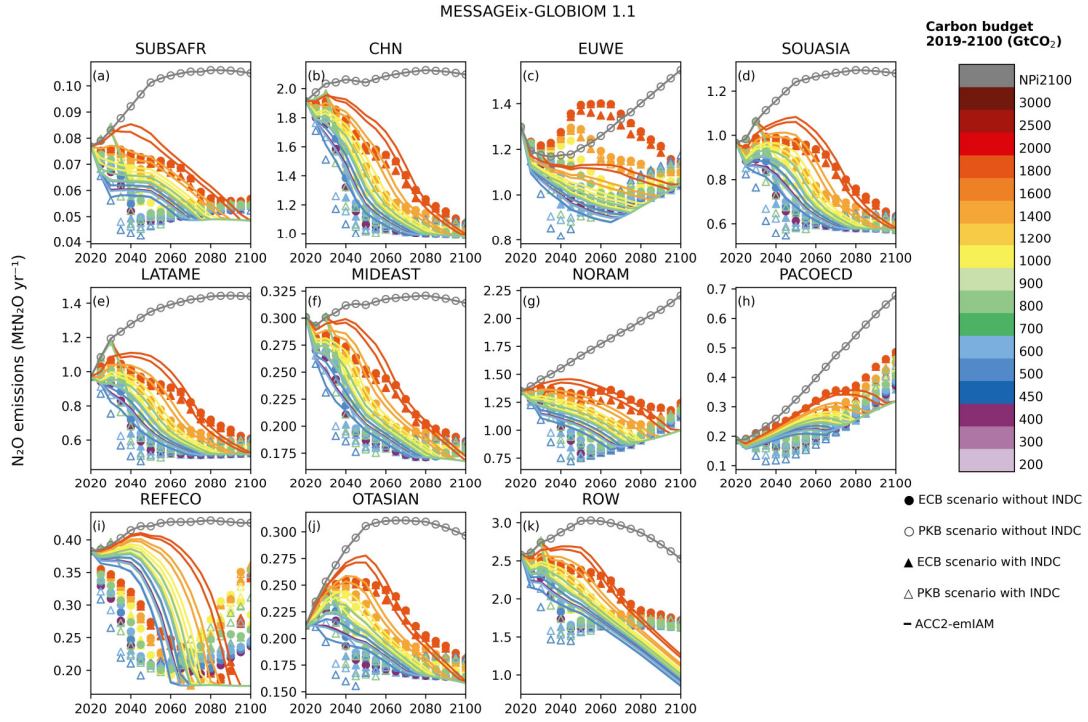


Figure S103. Test 1 - Regional GEM total anthropogenic N₂O validation results

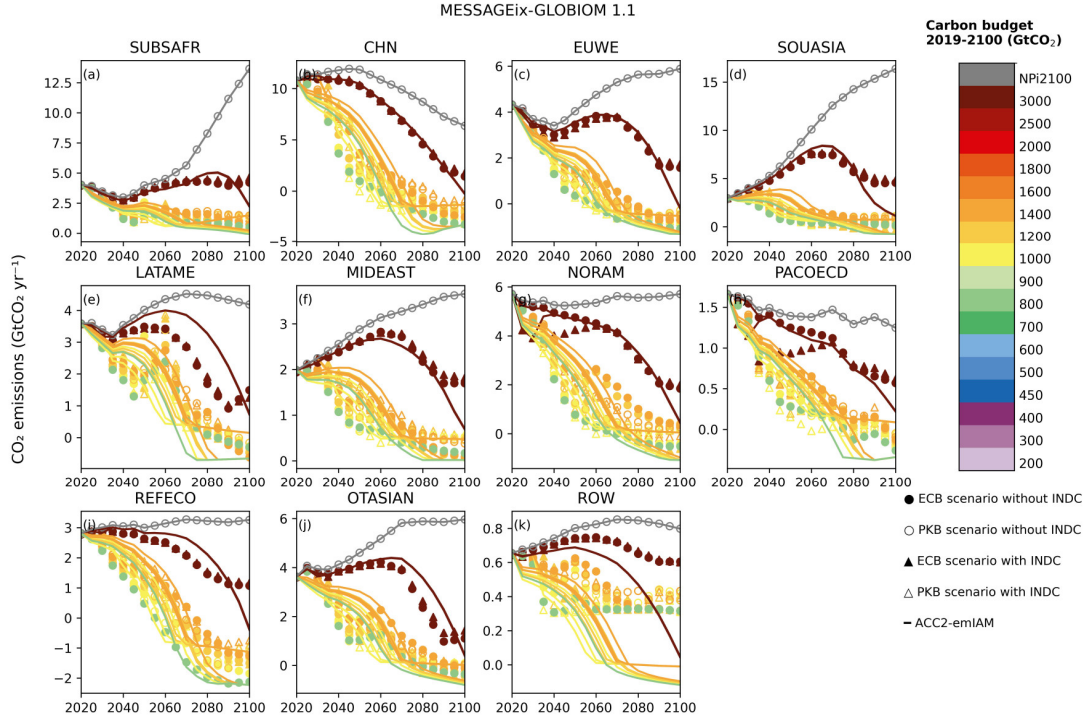


Figure S104. Test 1 - Regional IMAGE total anthropogenic CO₂ validation result

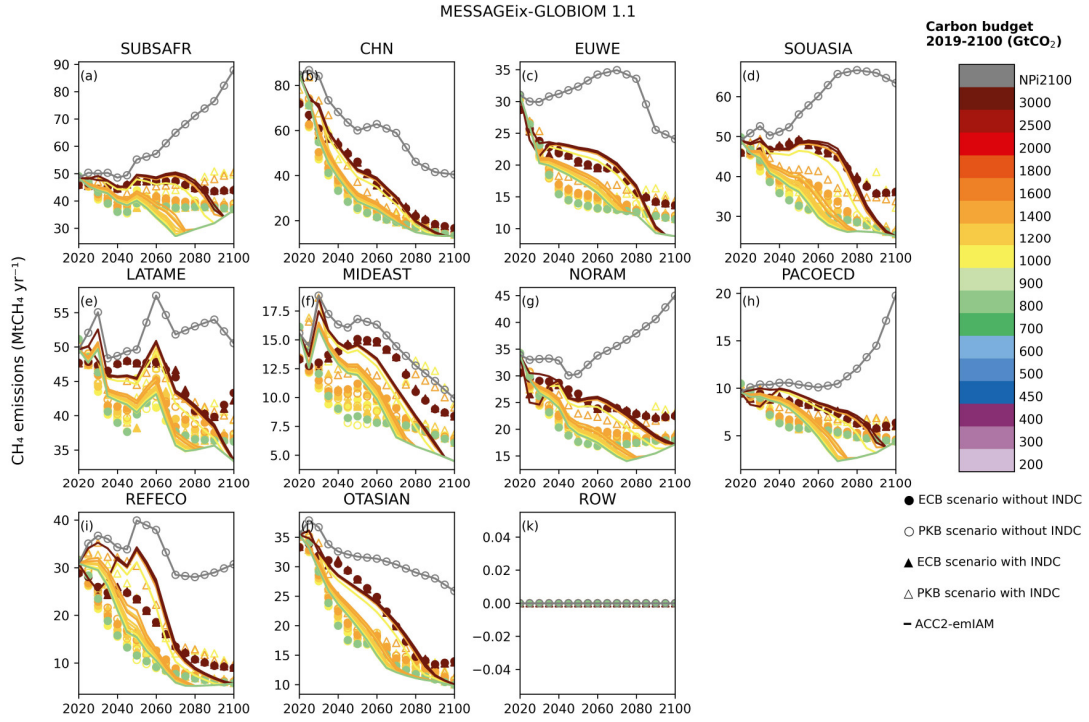


Figure S105. Test 1 - Regional IMAGE total anthropogenic CH₄ validation results

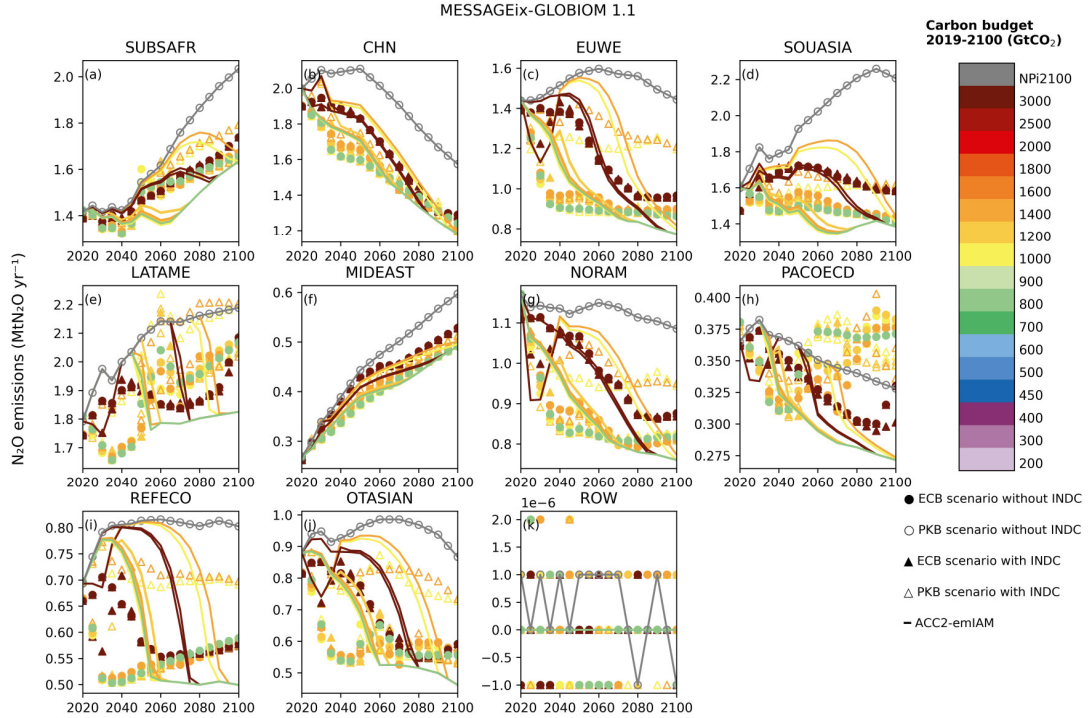


Figure S106. Test 1 - Regional IMAGE total anthropogenic N₂O validation results

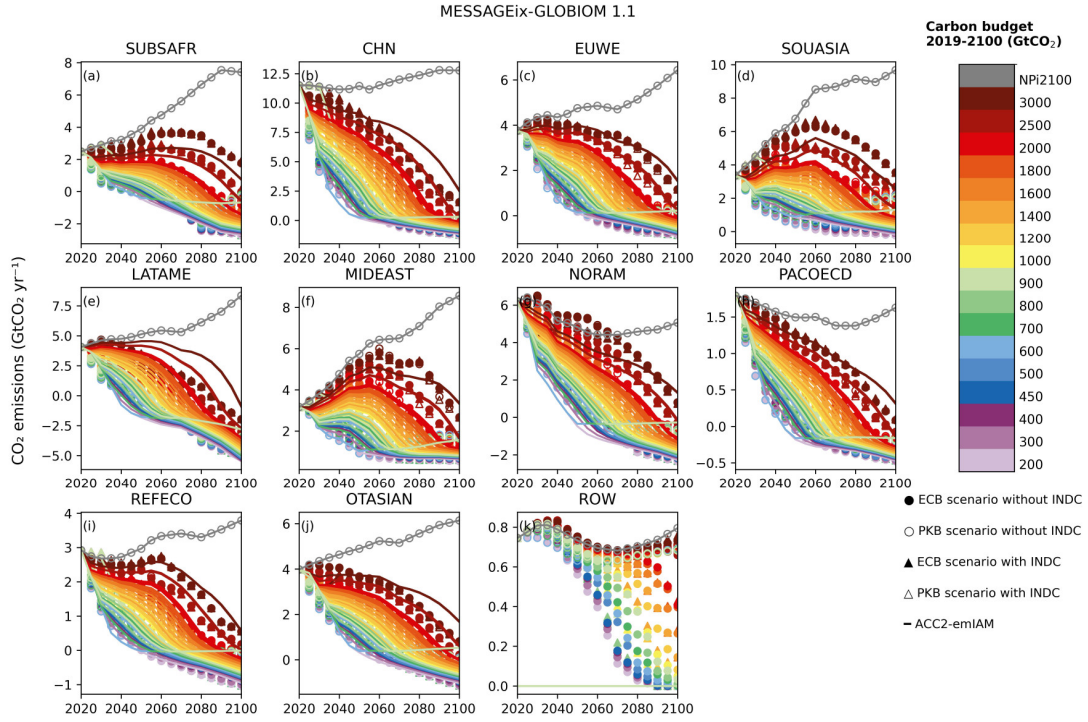


Figure S107. Test 1 - Regional MESSAGE total anthropogenic CO₂ validation results

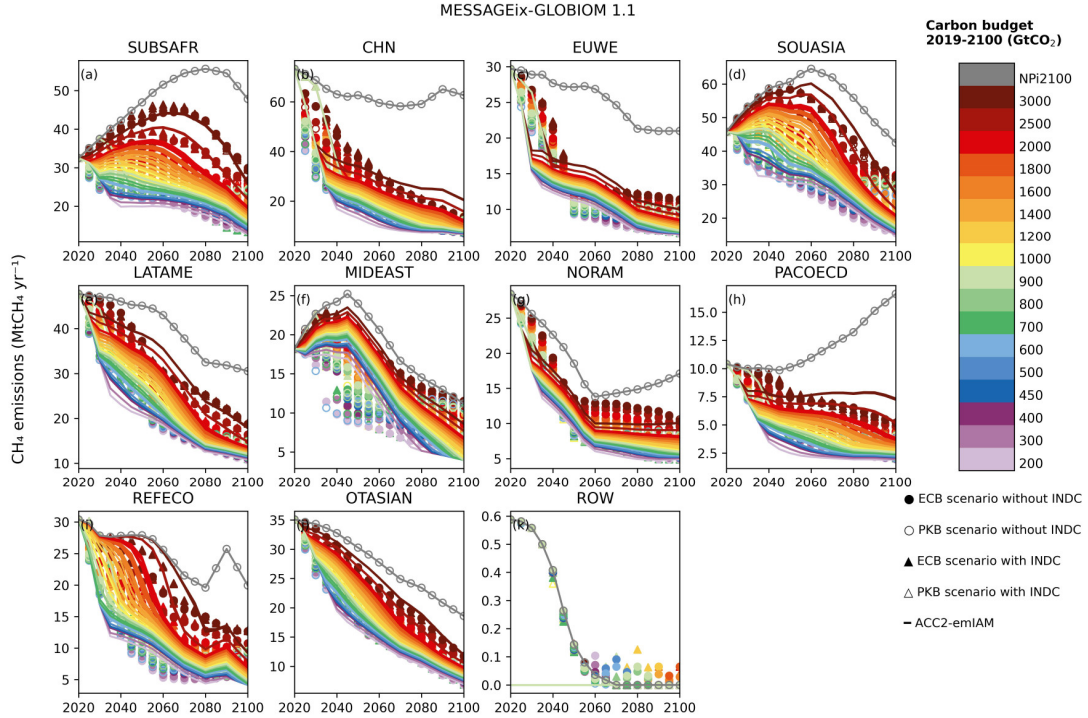


Figure S108. Test 1 - Regional MESSAGE total anthropogenic CH₄ validation results

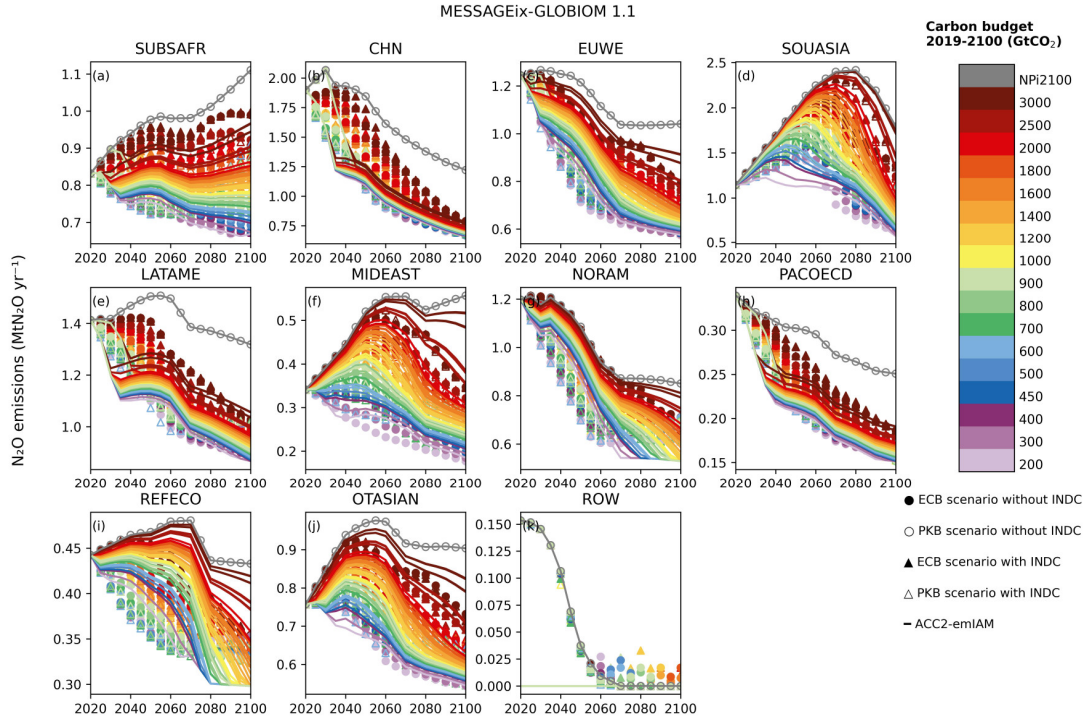


Figure S109. Test 1 - Regional MESSAGE total anthropogenic N₂O validation results

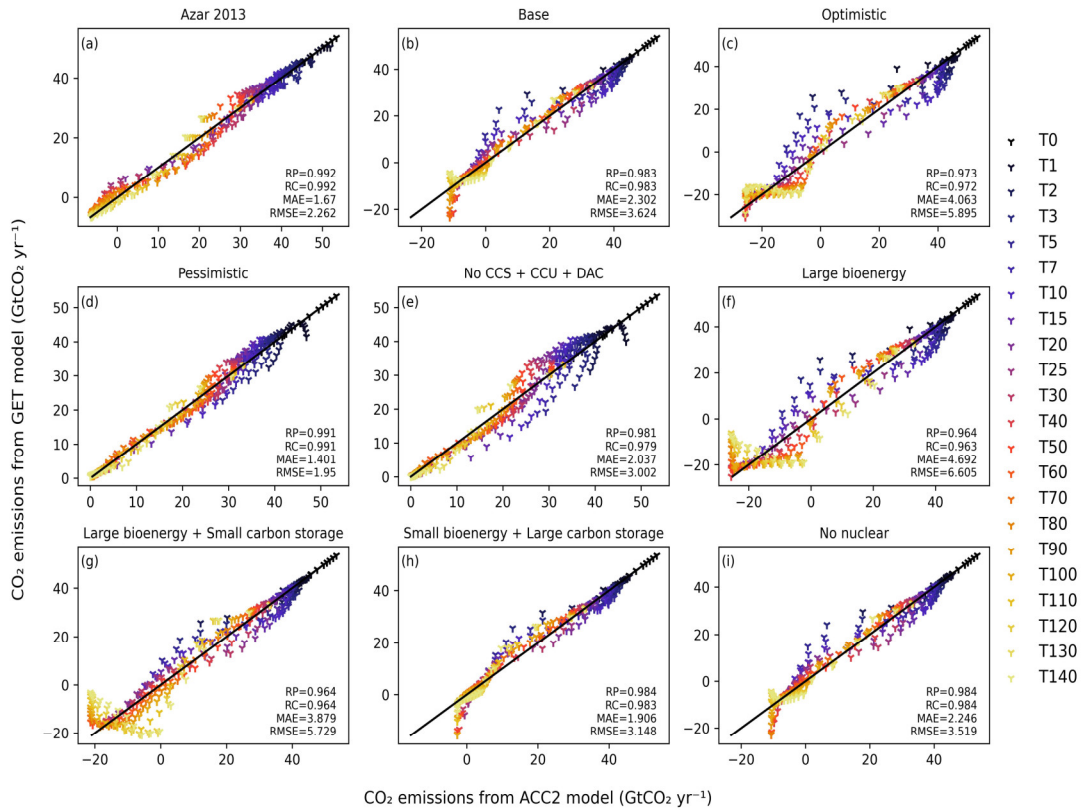


Figure S110. Test 1 – GET - Reproducibility of energy-related CO₂

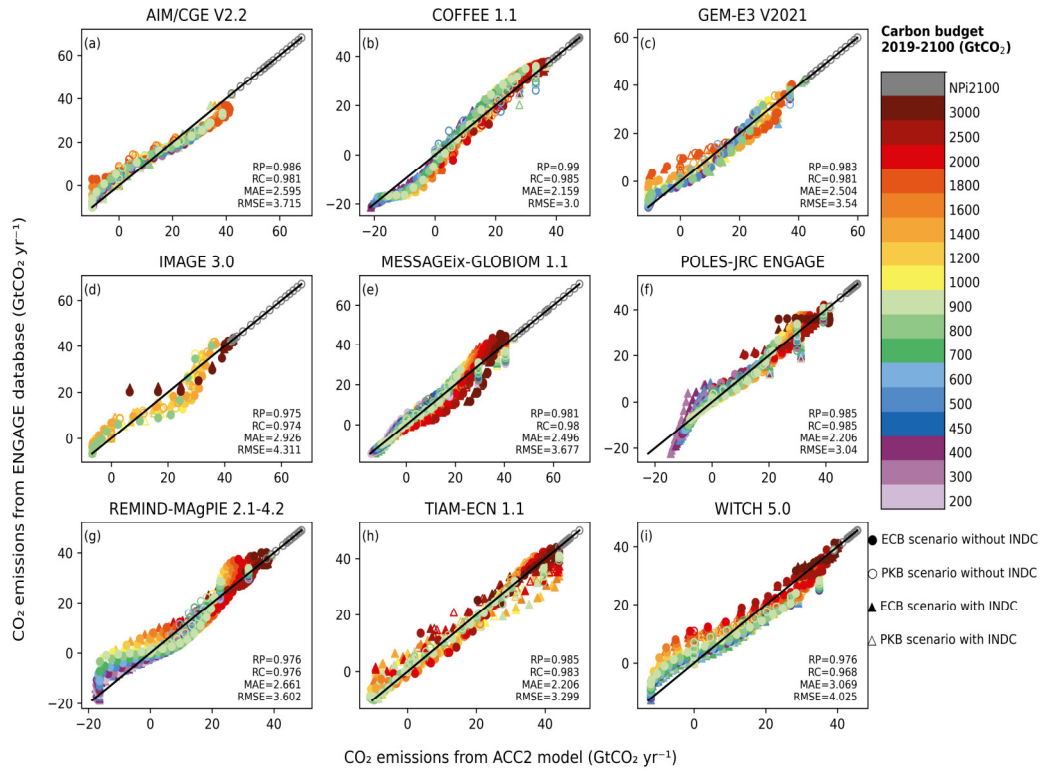


Figure S111. Test 1 - Global nine IAMs - Reproducibility of total anthropogenic CO₂

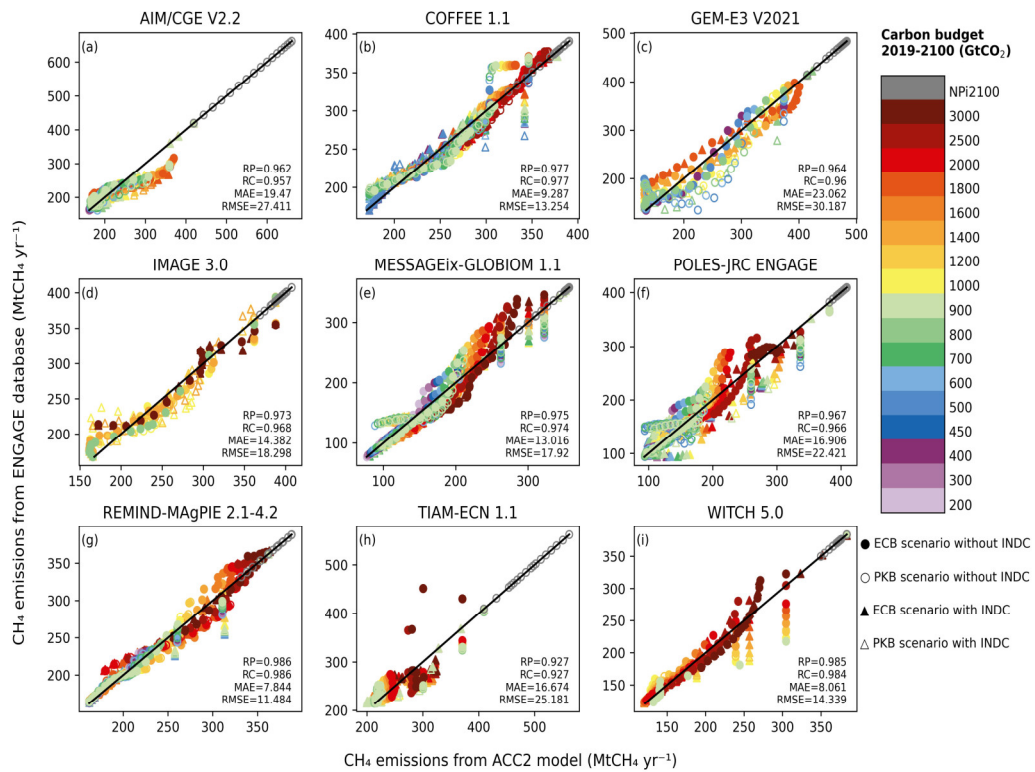


Figure S112. Test 1 - Global nine IAMs - Reproducibility of total anthropogenic CH₄

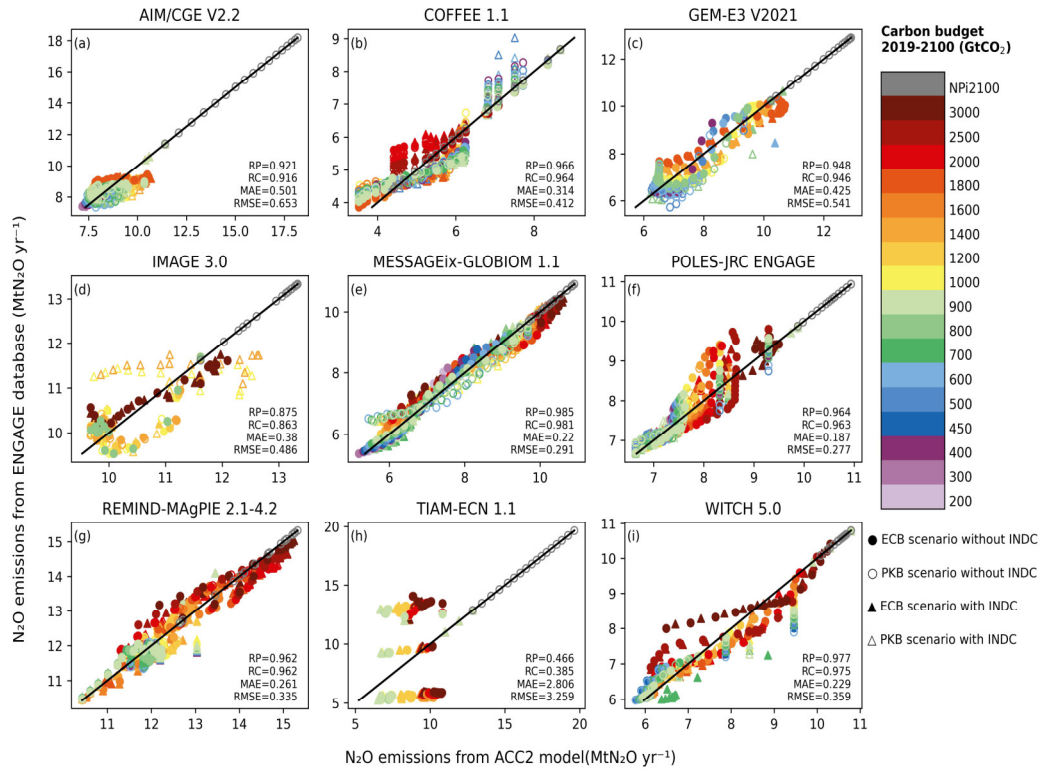


Figure S113. Test 1 - Global nine IAMs - Reproducibility of total anthropogenic N_2O

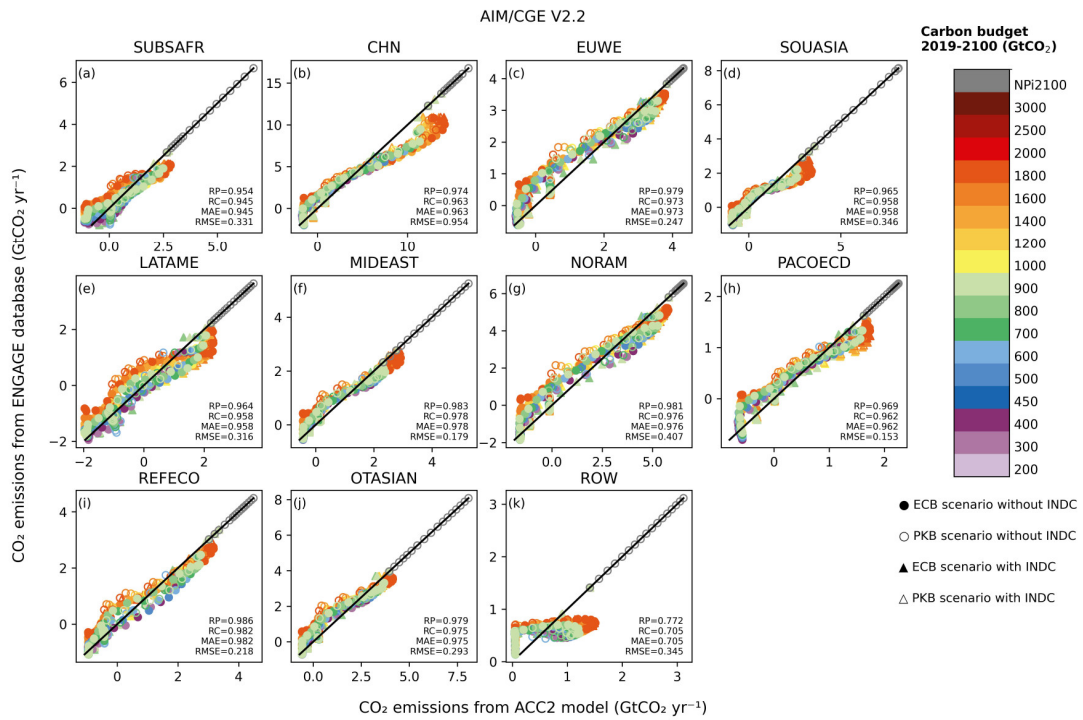


Figure S114. Test 1 - Regional AIM - Reproducibility of total anthropogenic CO_2

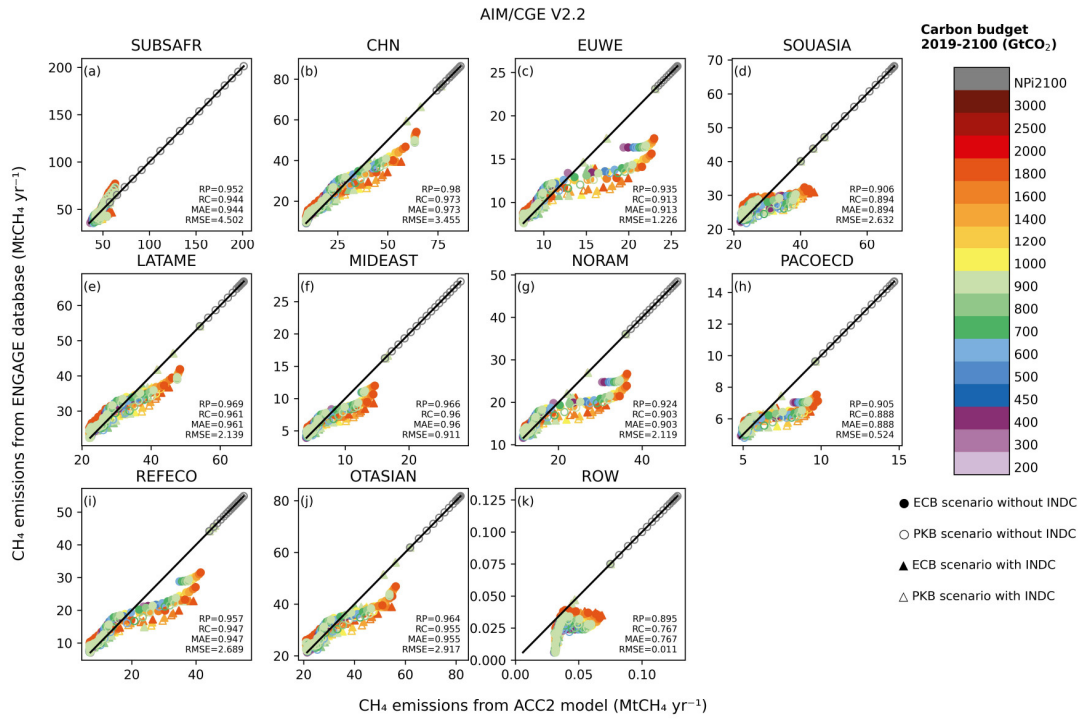


Figure S115. Test 1 - Regional AIM - Reproducibility of total anthropogenic CH₄

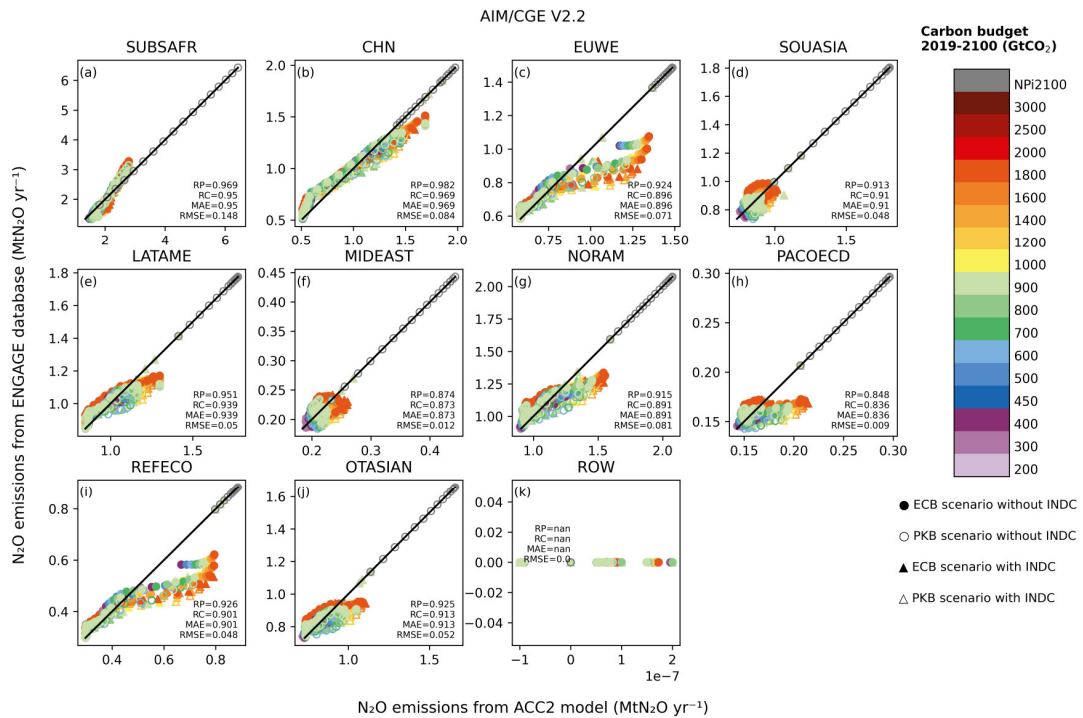


Figure S116. Test 1 - Regional AIM - Reproducibility of total anthropogenic N₂O

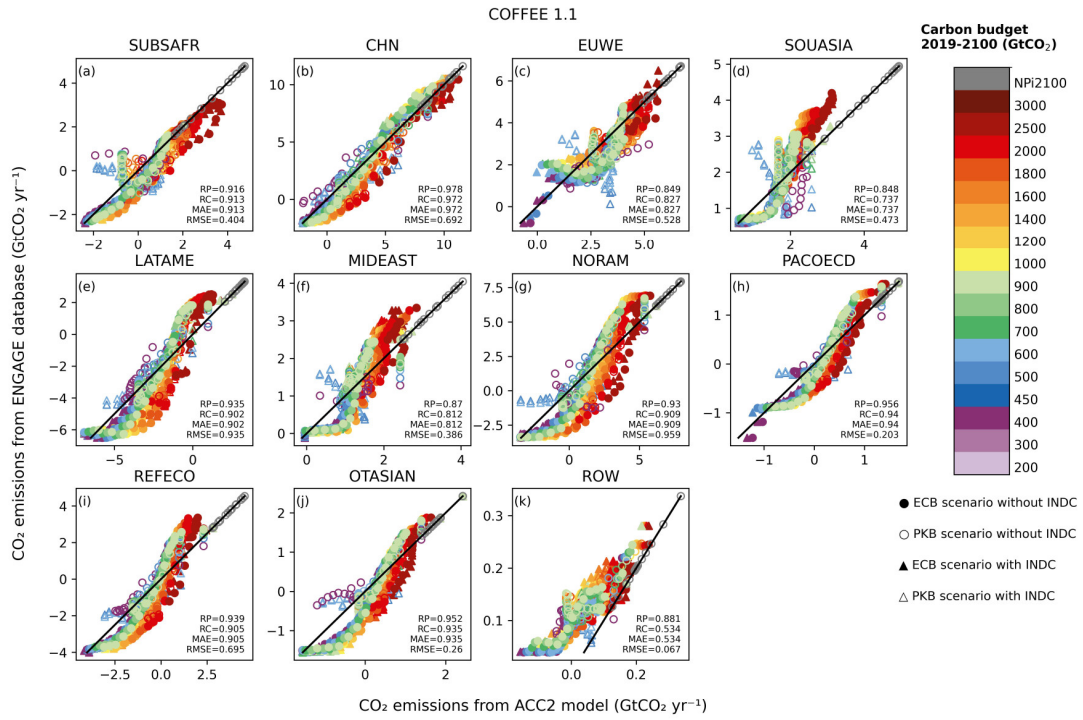


Figure S117. Test 1 - Regional COFFEE - Reproducibility of total anthropogenic CO₂

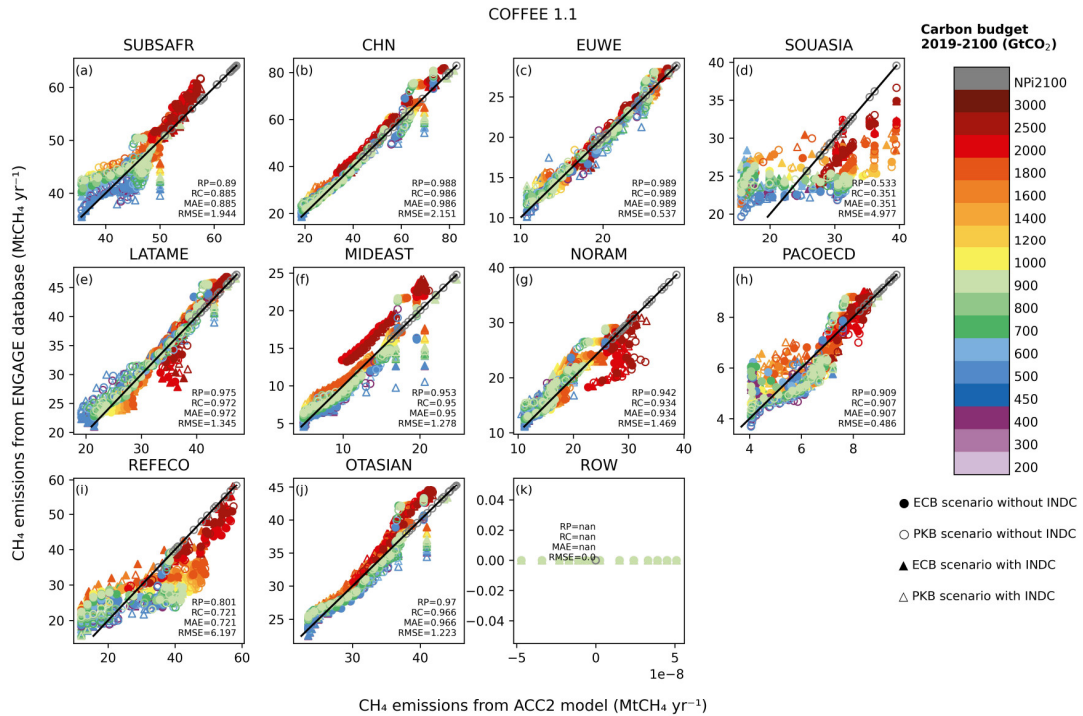


Figure S118. Test 1 - Regional COFFEE - Reproducibility of total anthropogenic CH₄

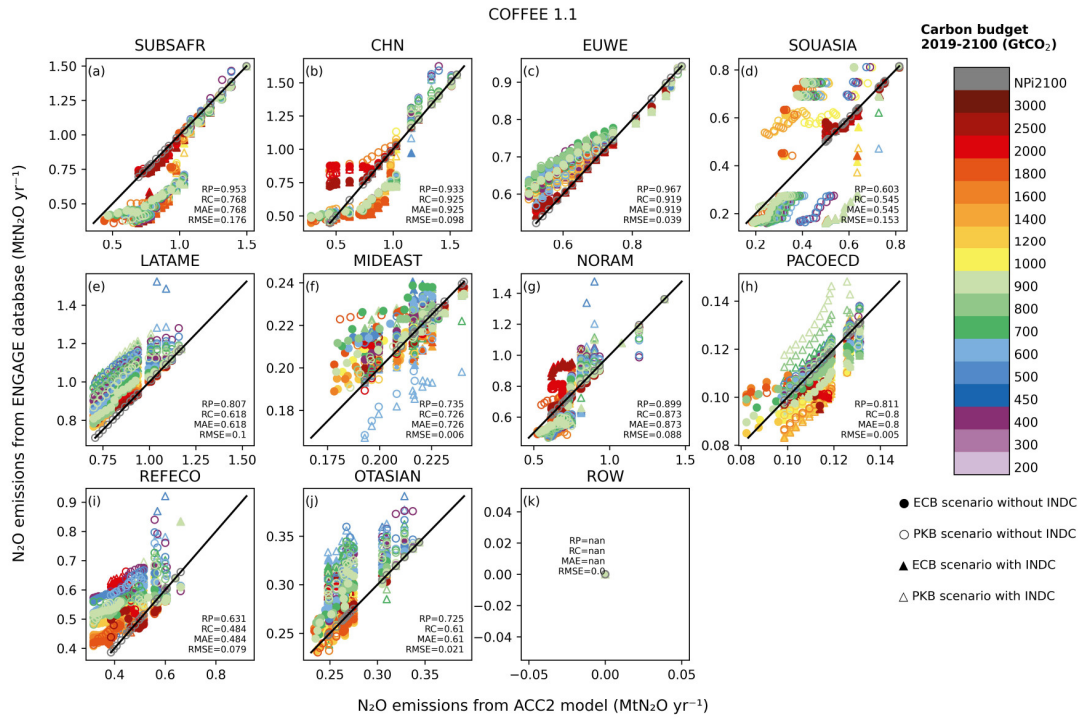


Figure S119. Test 1 - Regional COFFEE - Reproducibility of total anthropogenic N₂O

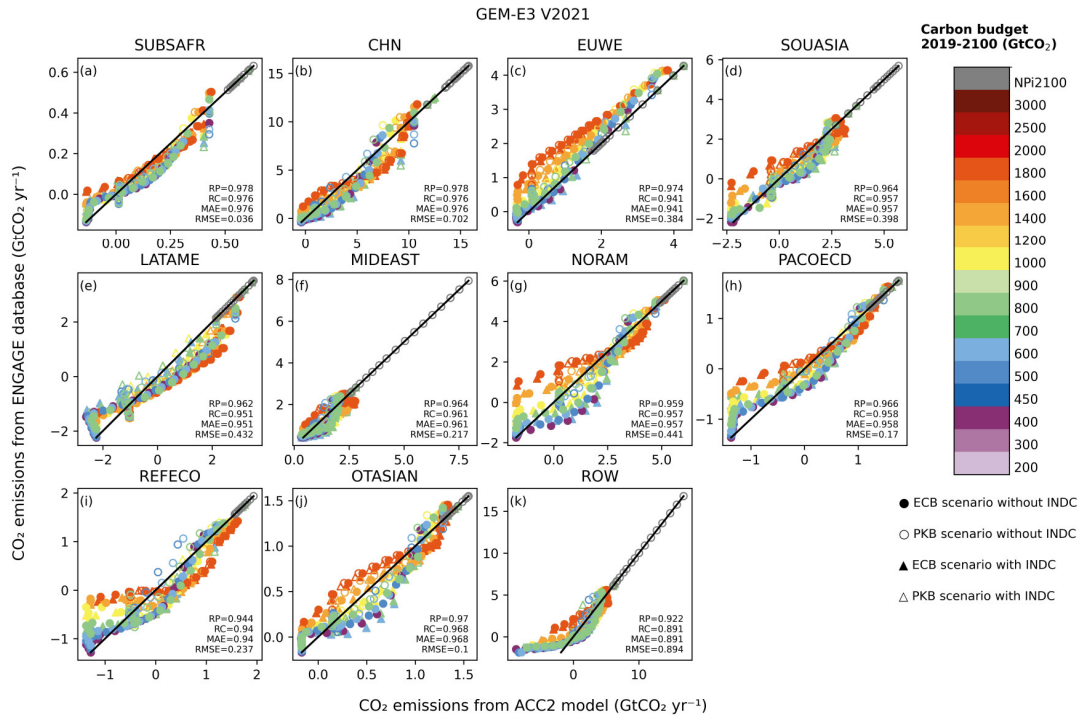


Figure S120. Test 1 - Regional GEM - Reproducibility of total anthropogenic CO₂

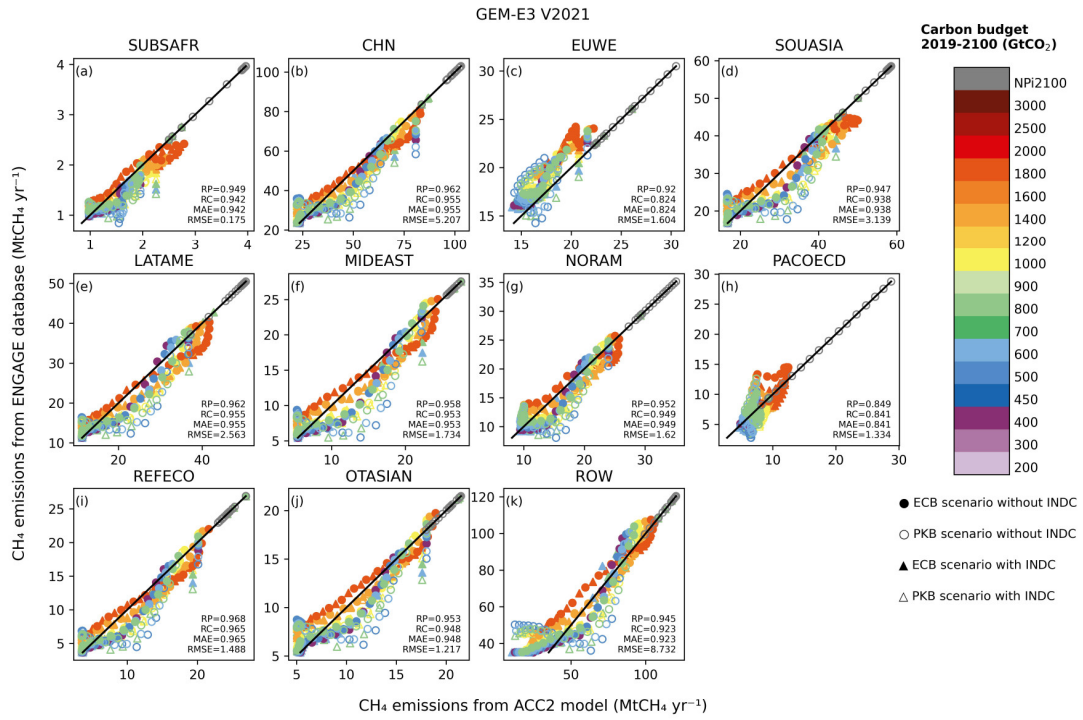


Figure S121. Test 1 - Regional GEM - Reproducibility of total anthropogenic CH₄

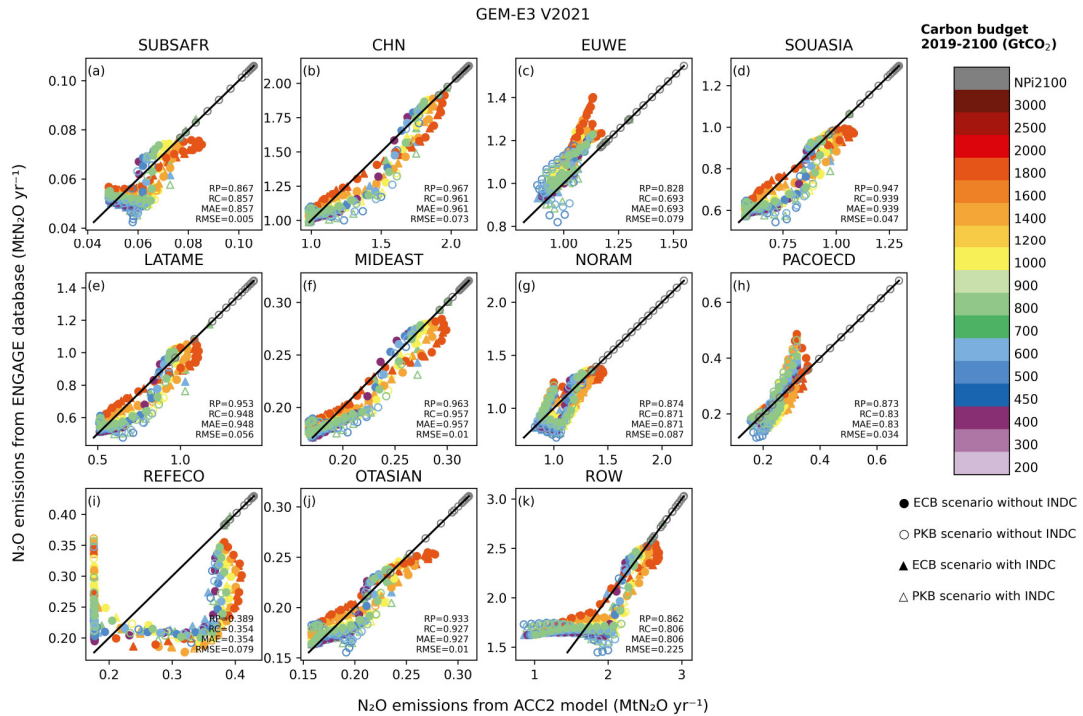


Figure S122. Test 1 - Regional GEM - Reproducibility of total anthropogenic N₂O

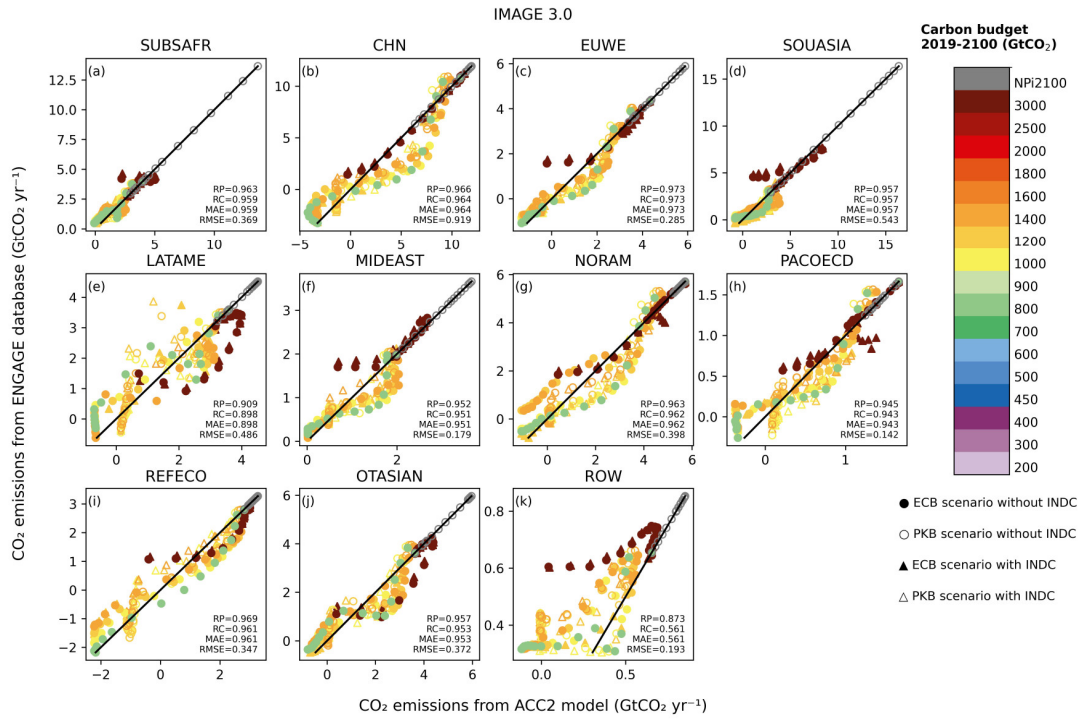


Figure S123. Test 1 - Regional IMAGE - Reproducibility of total anthropogenic CO₂

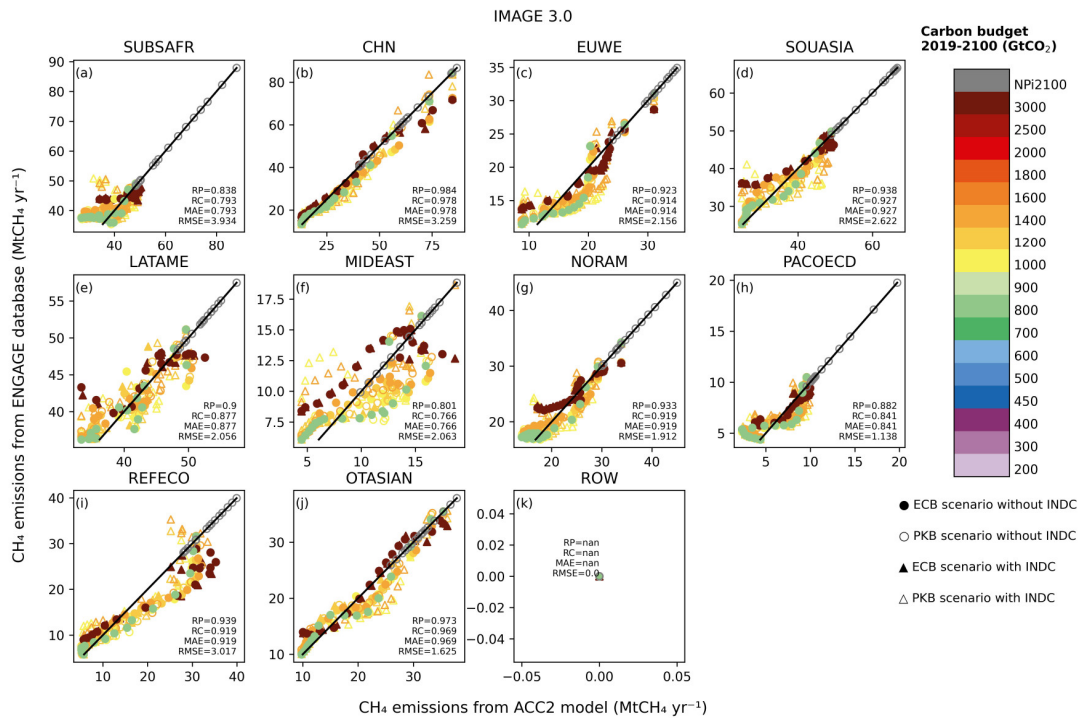


Figure S124. Test 1 - Regional IMAGE - Reproducibility of total anthropogenic CH₄

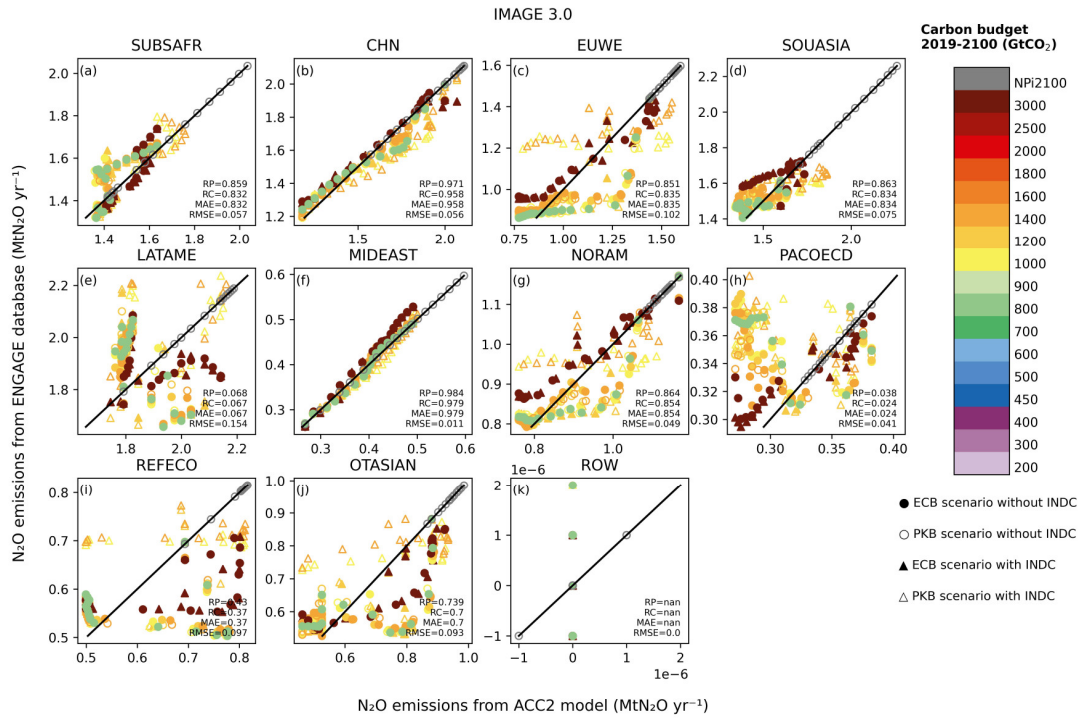


Figure S125. Test 1 - Regional IMAGE - Reproducibility of total anthropogenic N₂O

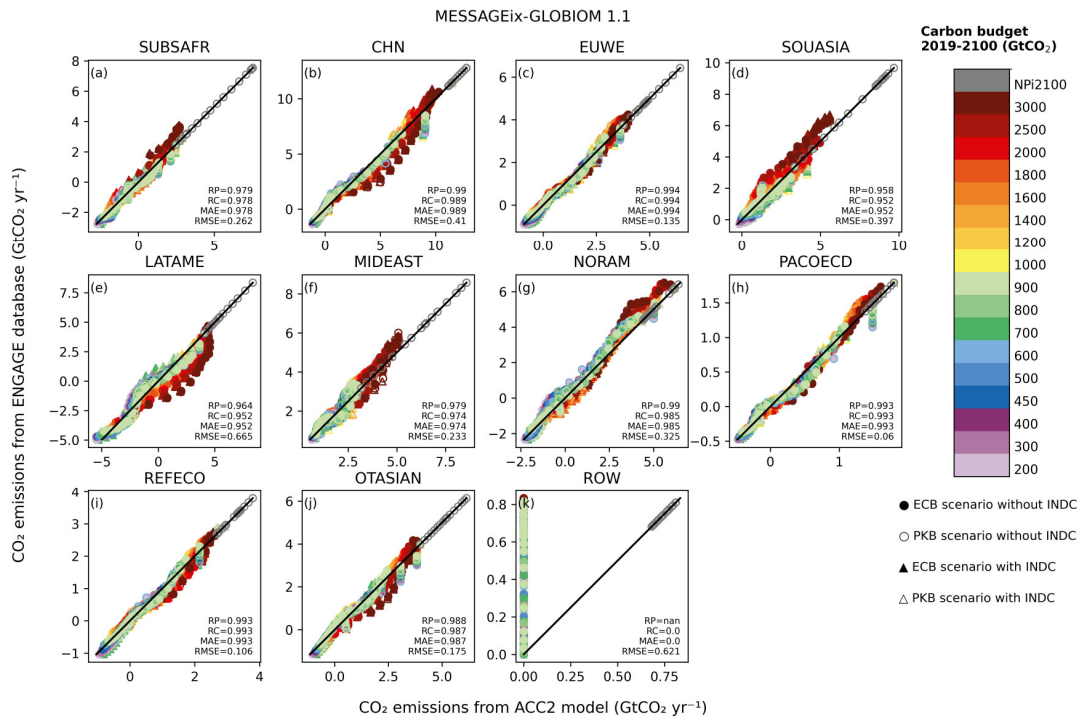


Figure S126. Test 1 - Regional MESSAGE - Reproducibility of total anthropogenic CO₂

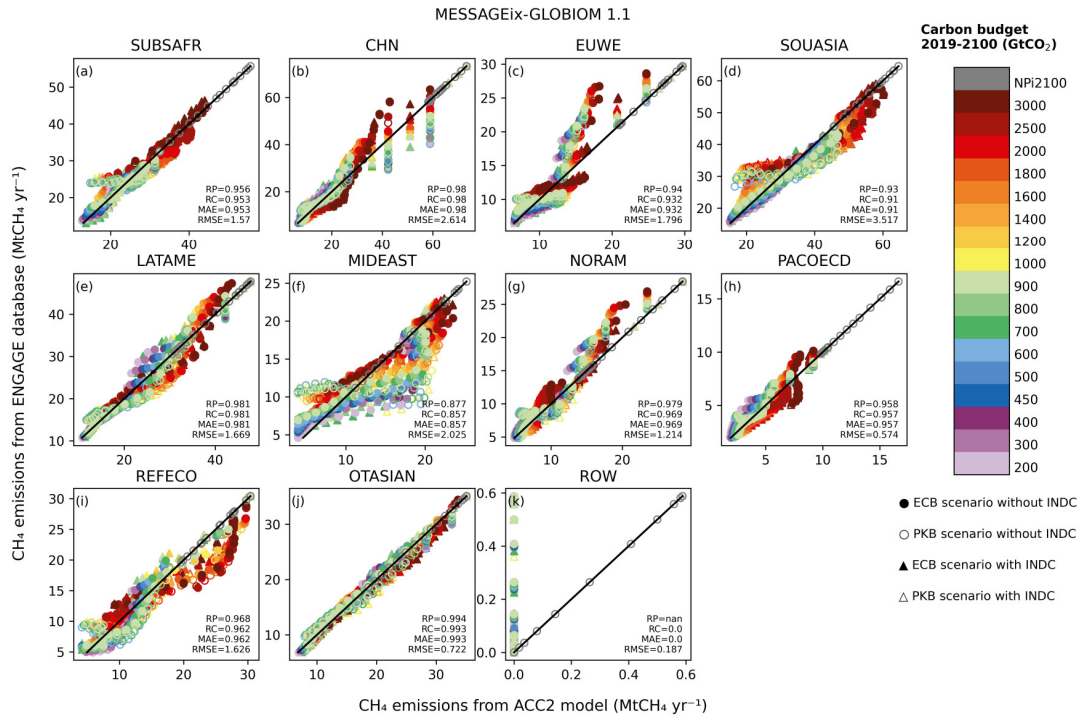


Figure S127. Test 1 - Regional MESSAGE - Reproducibility of total anthropogenic CH₄

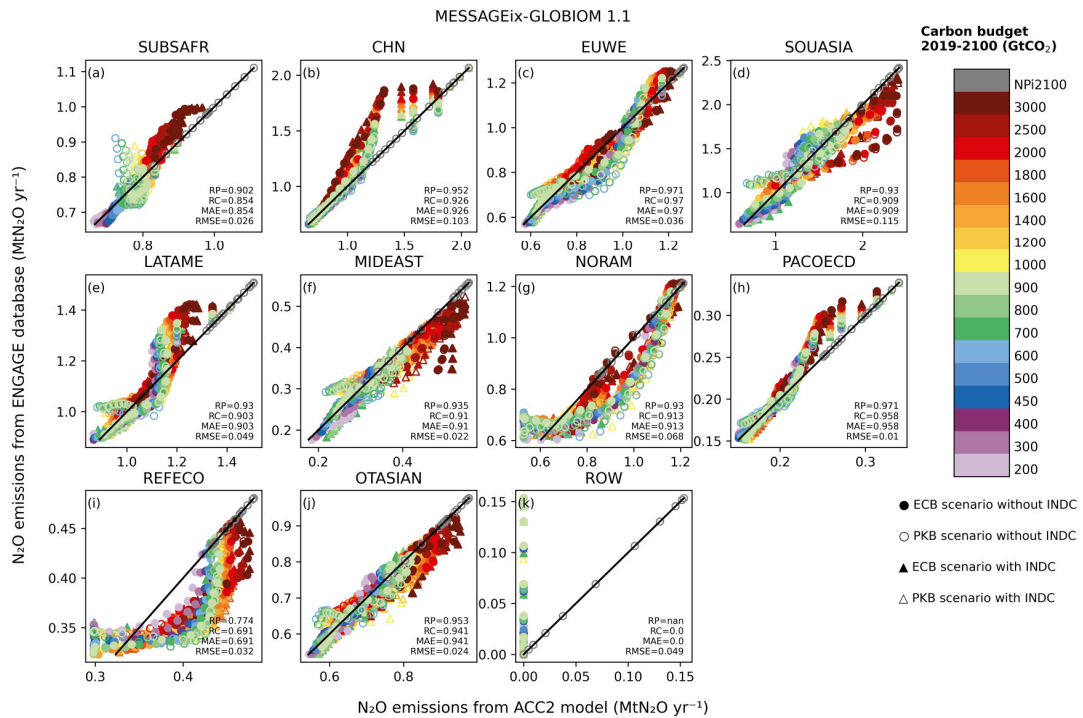


Figure S128. Test 1 - Regional MESSAGE - Reproducibility of total anthropogenic N₂O

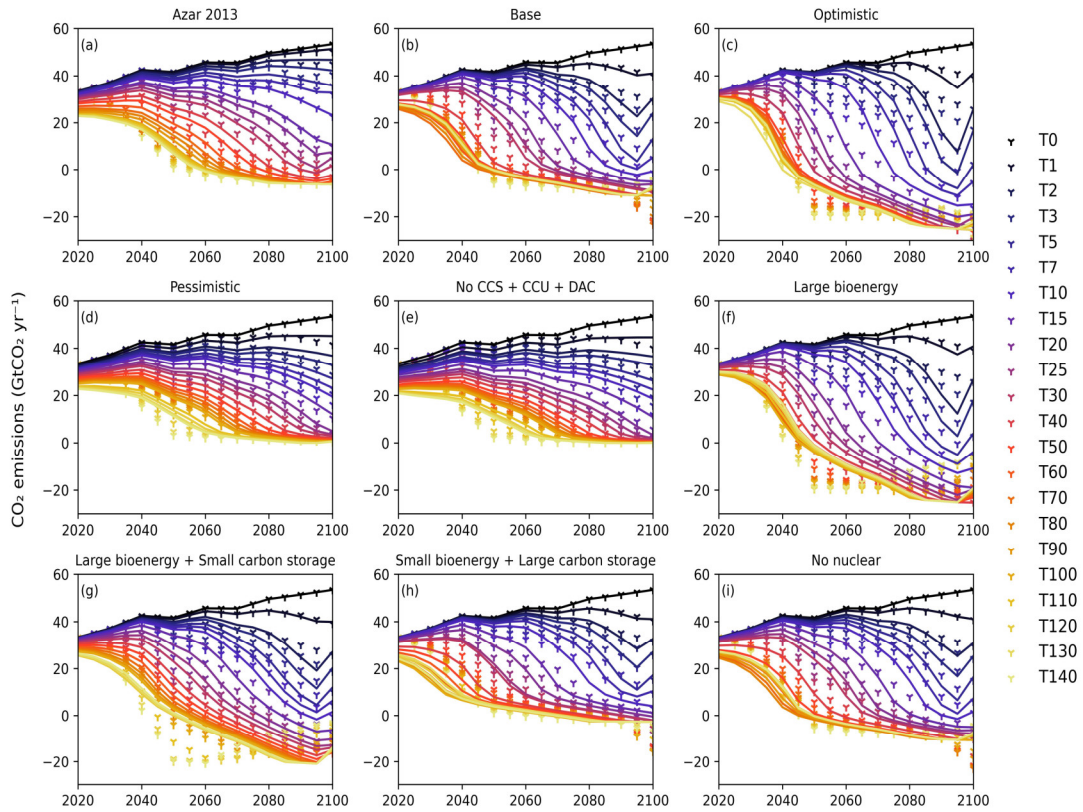


Figure S129. Test 2 – GET nine portfolios energy-related CO₂ validation results

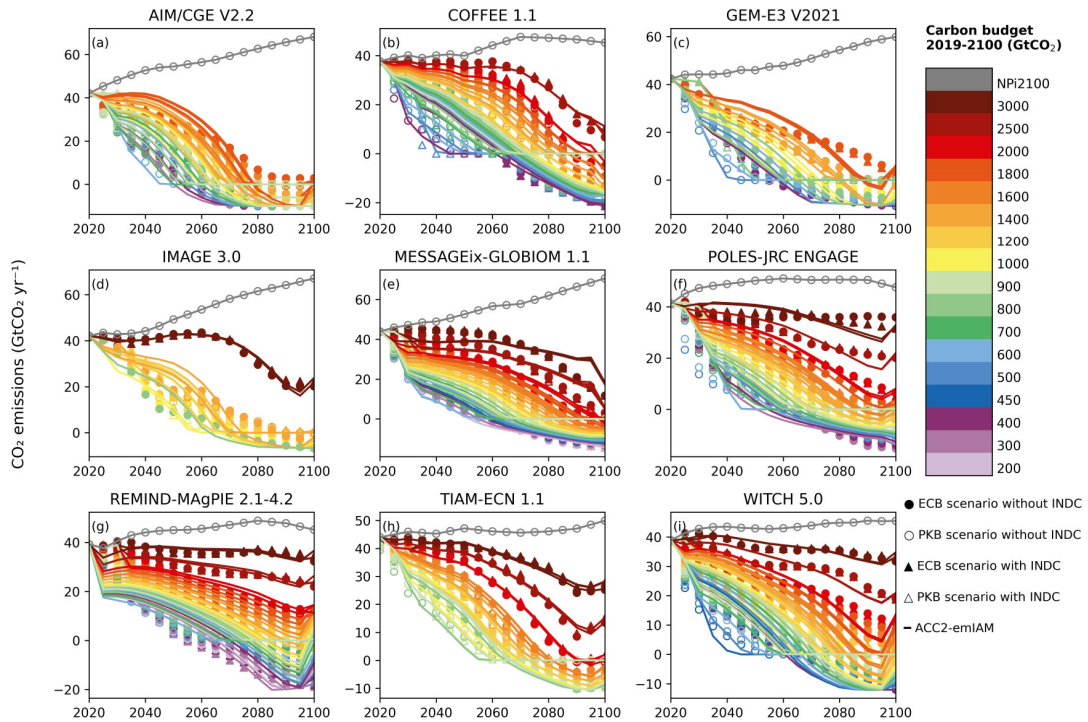


Figure S130. Test 2 – Global nine IAMs total anthropogenic CO₂ validation results

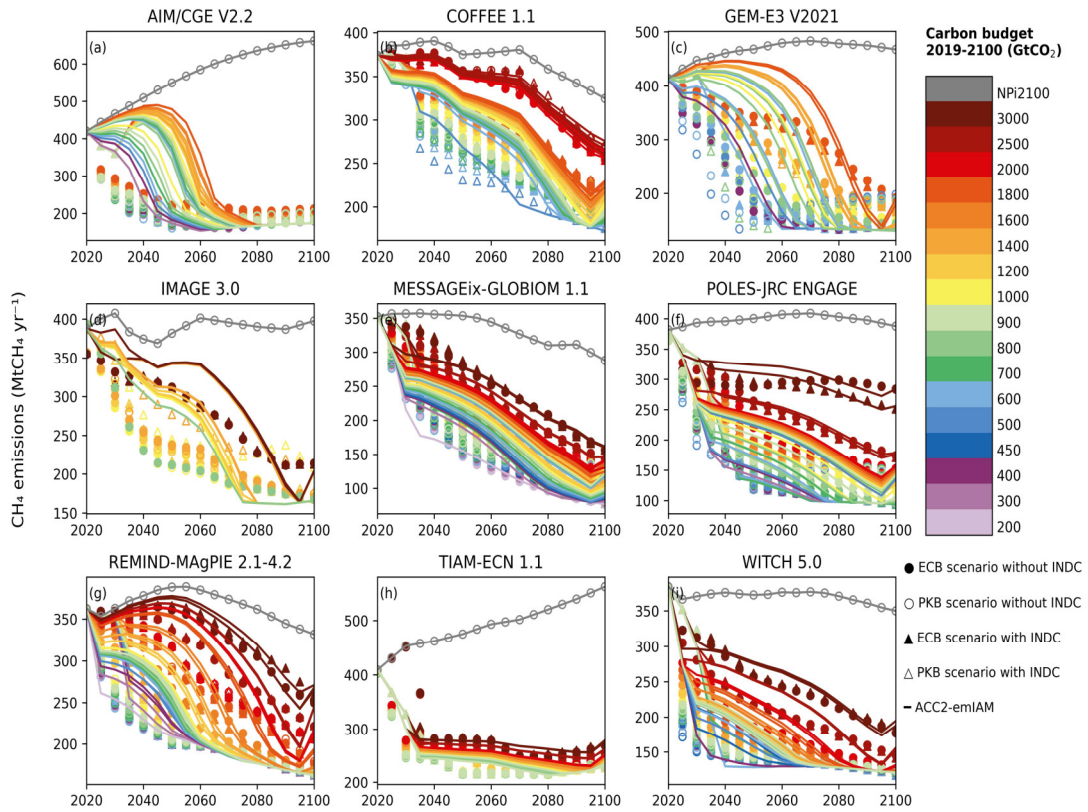


Figure S131. Test 2 – Global nine IAMs total anthropogenic CH₄ validation results

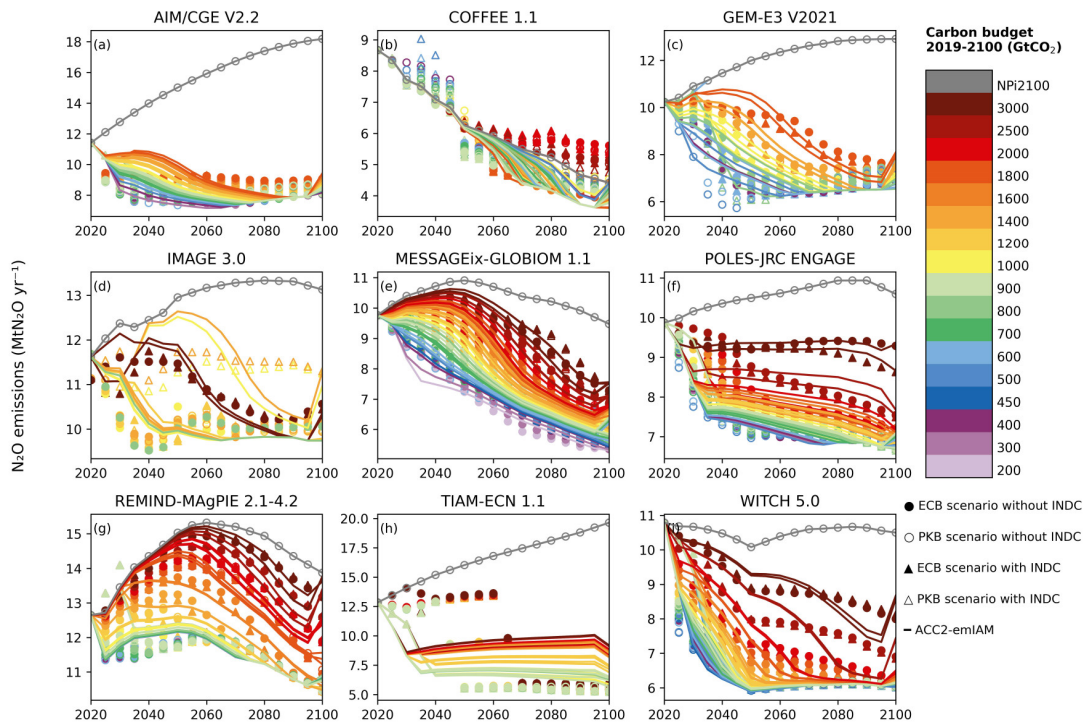


Figure S132. Test 2 – Global nine IAMs total anthropogenic N₂O validation results

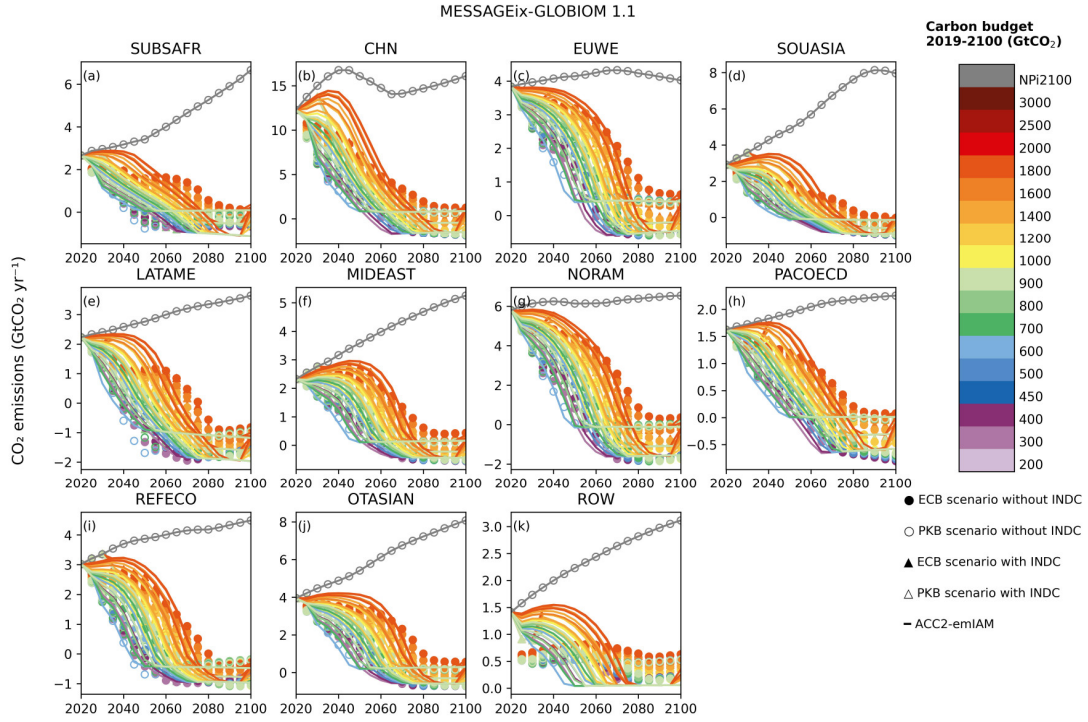


Figure S133. Test 2 - Regional AIM total anthropogenic CO₂ validation results

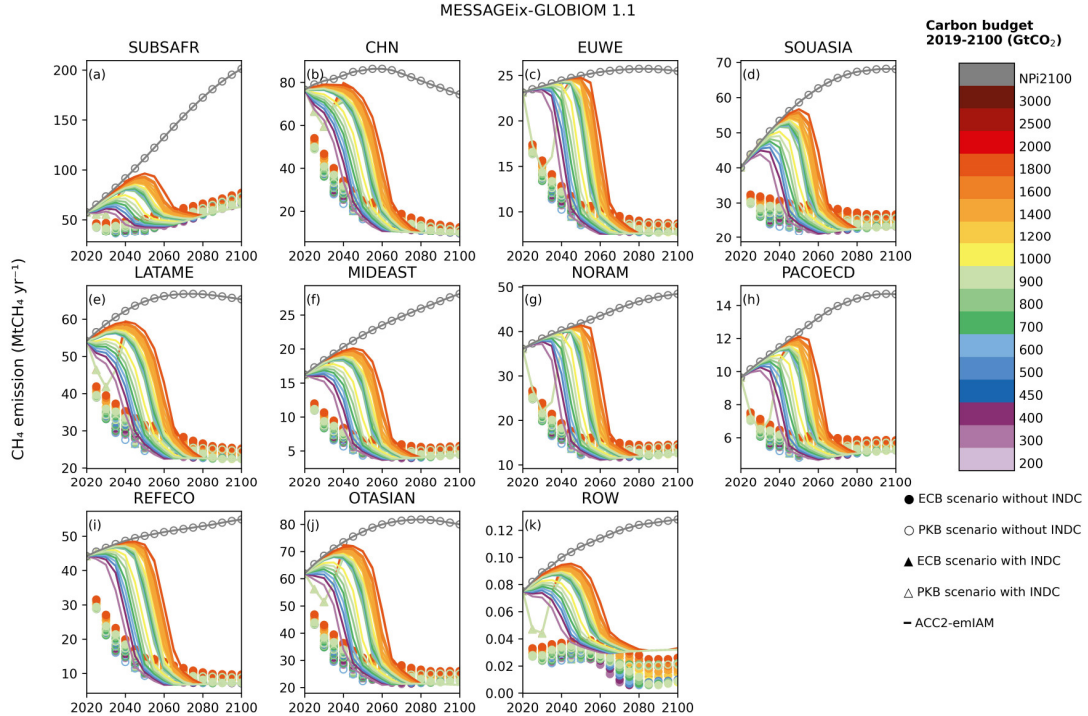


Figure S134. Test 2 - Regional AIM total anthropogenic CH₄ validation results

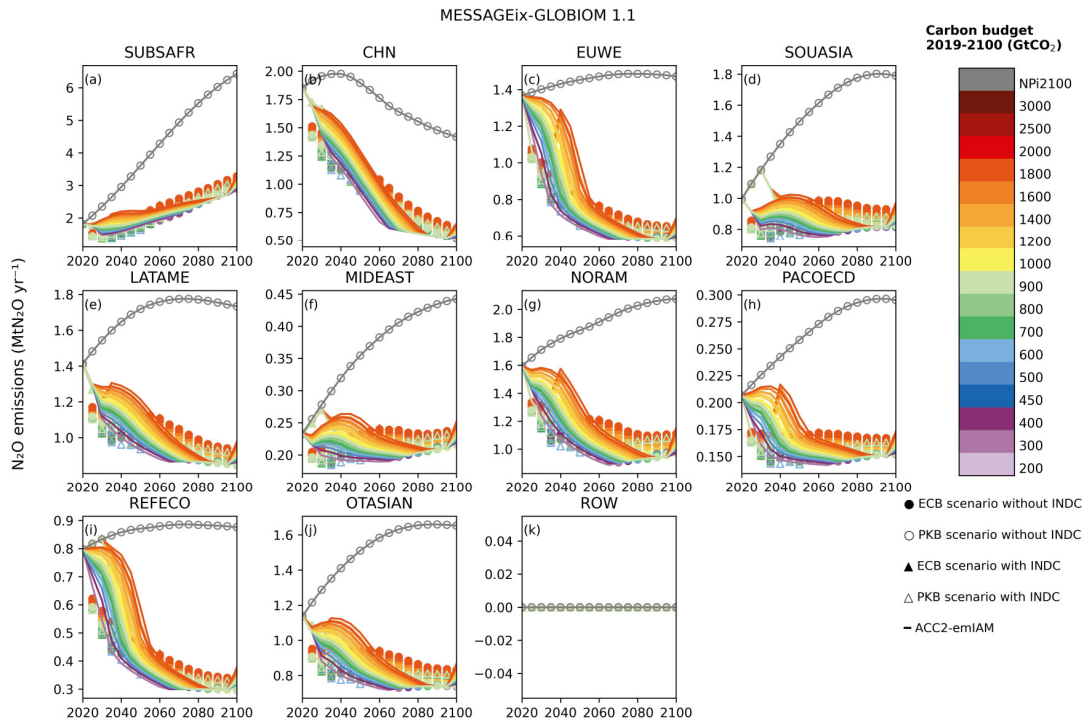


Figure S135. Test 2 - Regional AIM total anthropogenic N₂O validation results

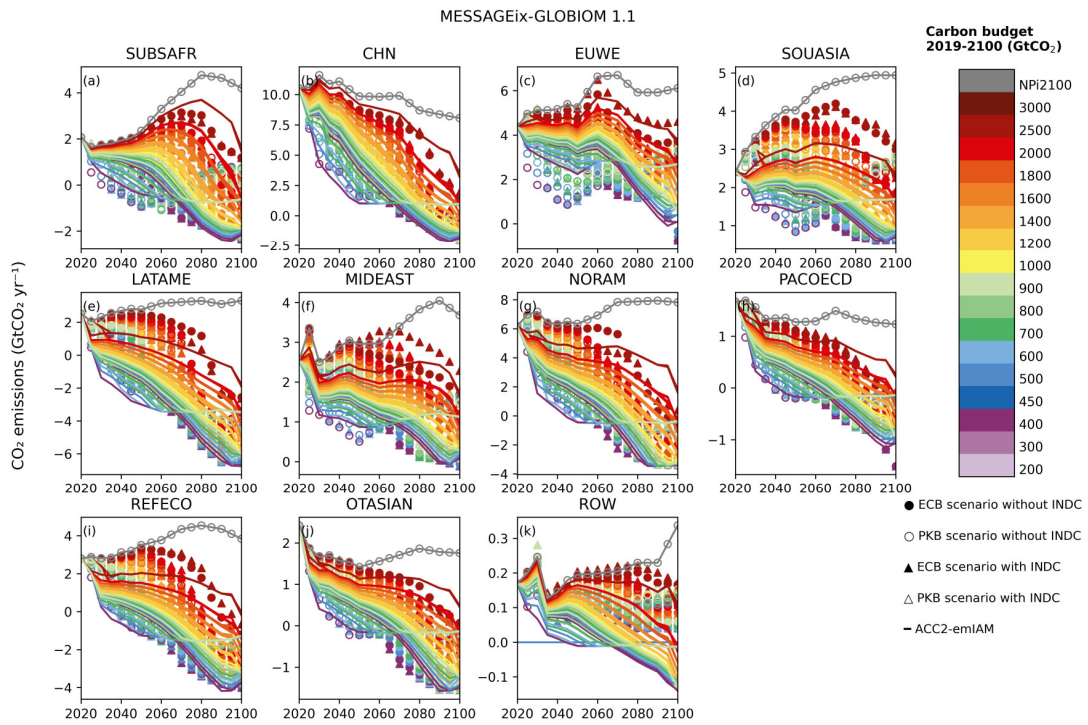


Figure S136. Test 2 - Regional COFFEE total anthropogenic CO₂ validation results

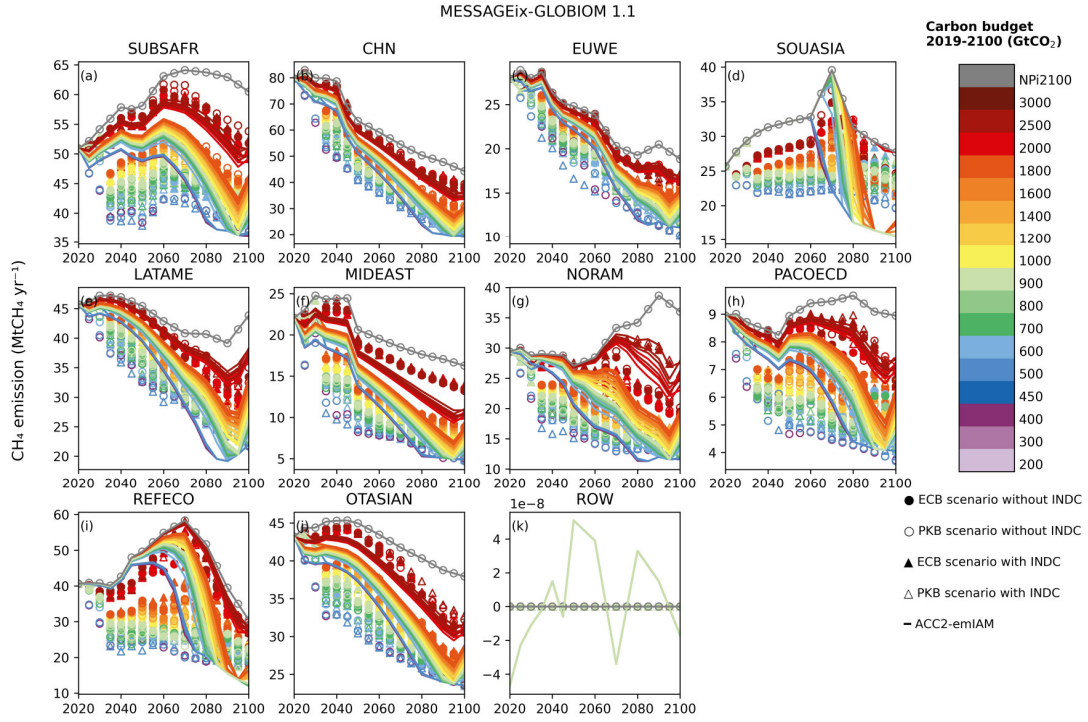


Figure S137. Test 2 - Regional COFFEE total anthropogenic CH₄ validation results

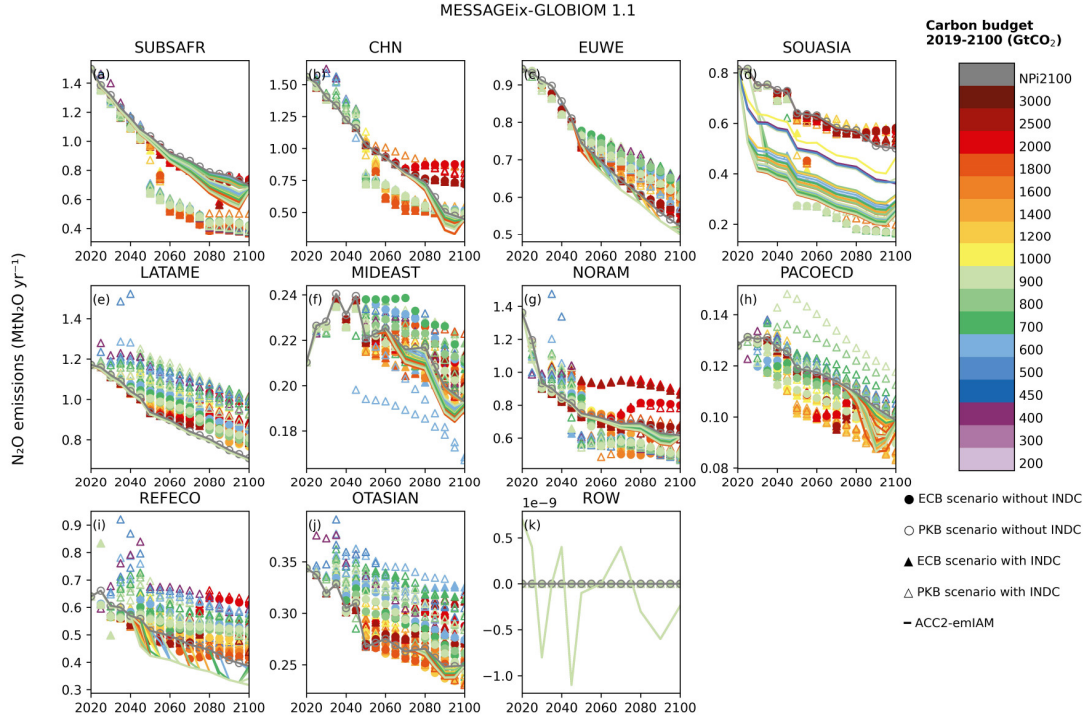


Figure S138. Test 2 - Regional COFFEE total anthropogenic N₂O validation results

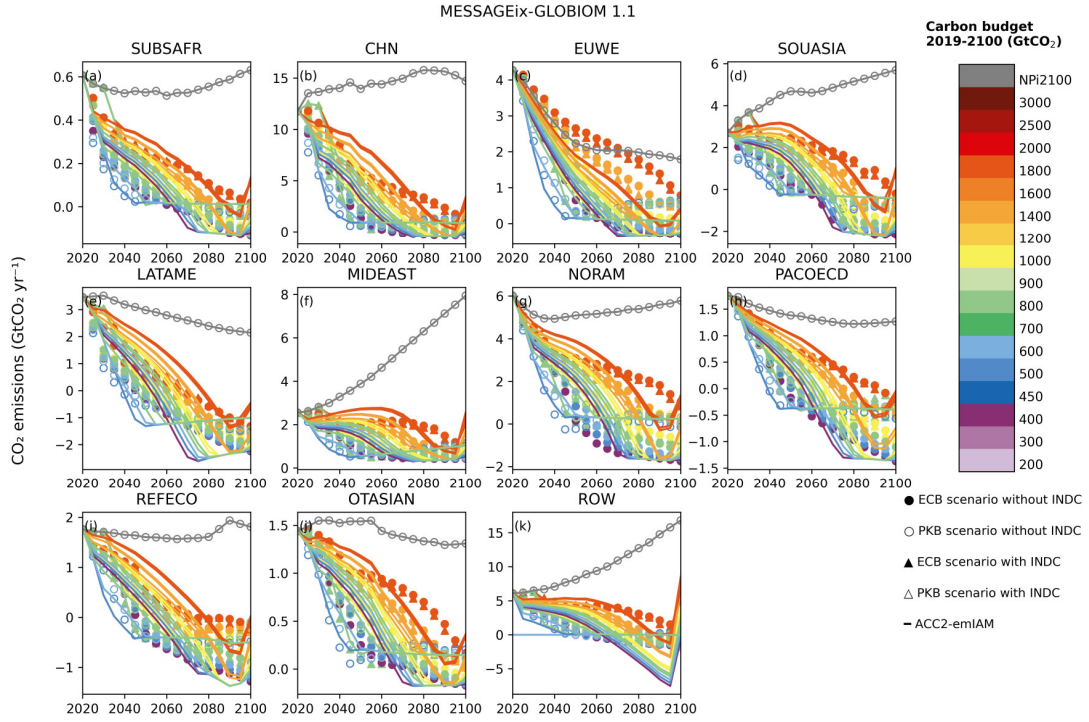


Figure S139. Test 2 - Regional GEM total anthropogenic CO₂ validation results

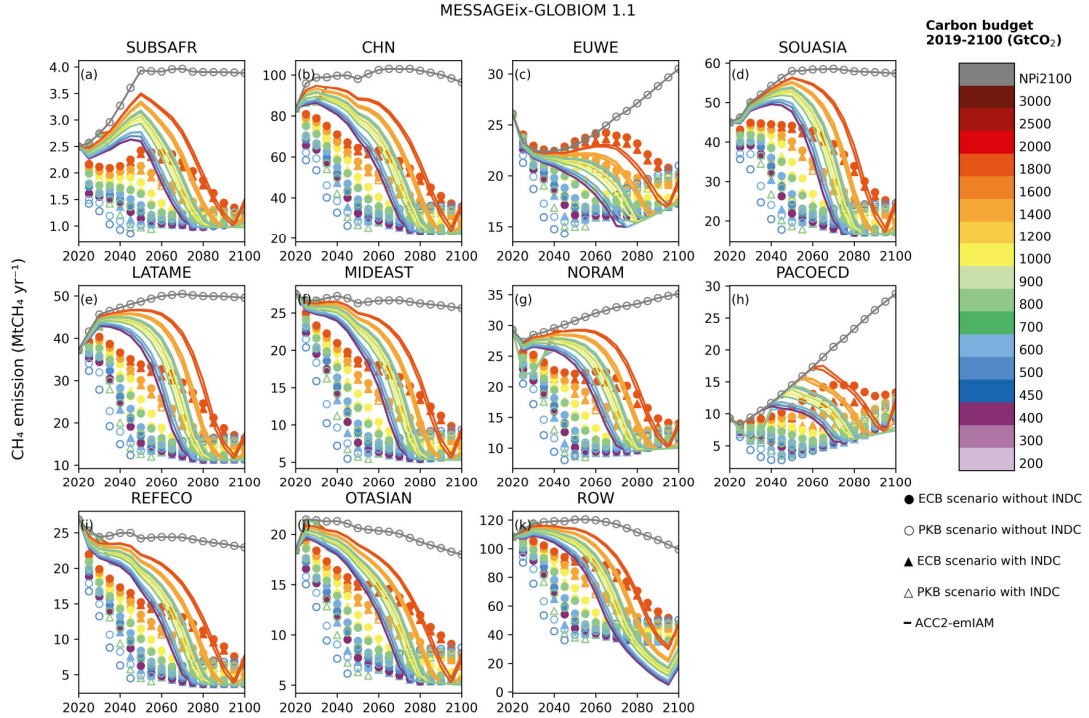


Figure S140. Test 2 - Regional GEM total anthropogenic CH₄ validation results

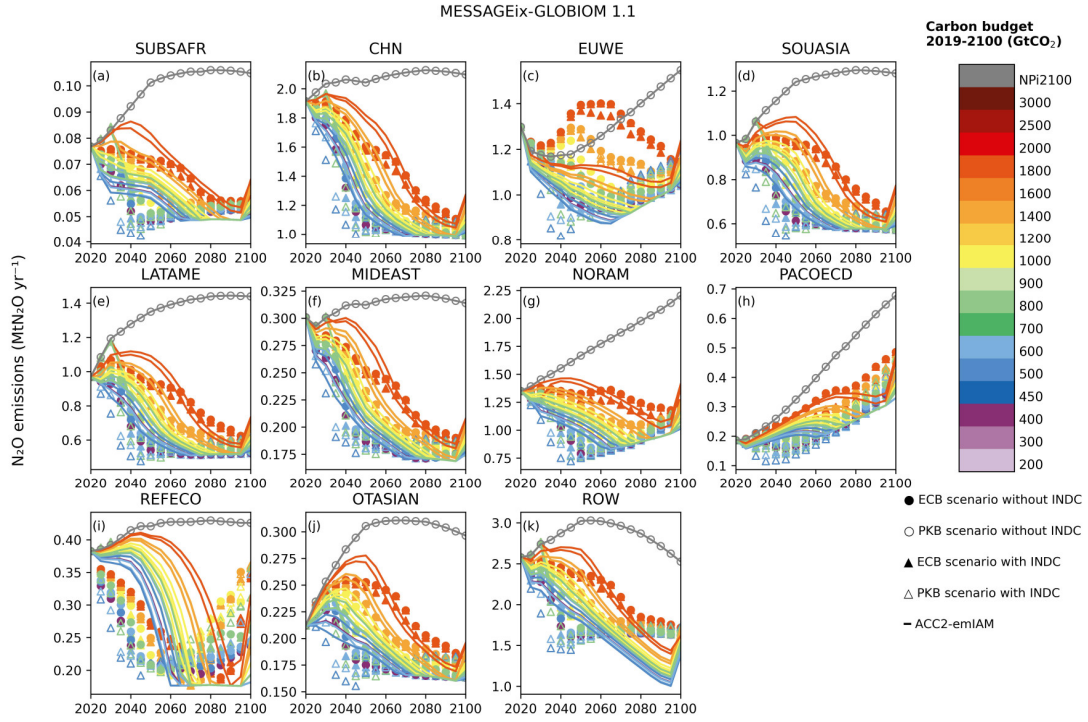


Figure S141. Test 2 - Regional GEM total anthropogenic N₂O validation results

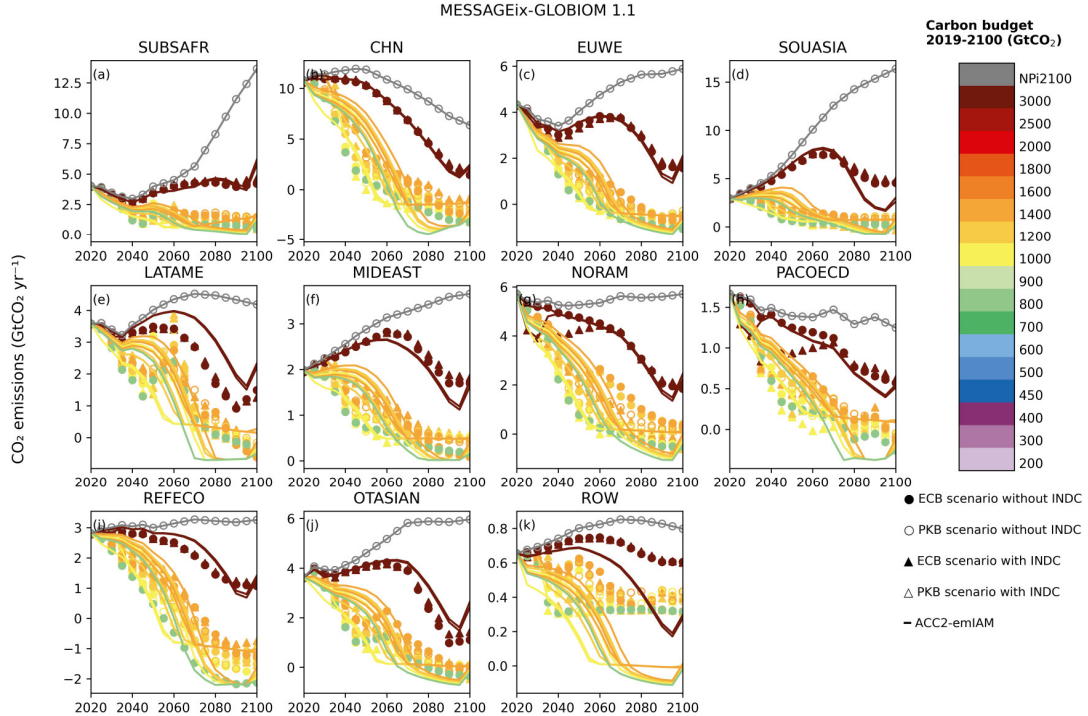


Figure S142. Test 2 - Regional IMAGE total anthropogenic CO₂ validation results

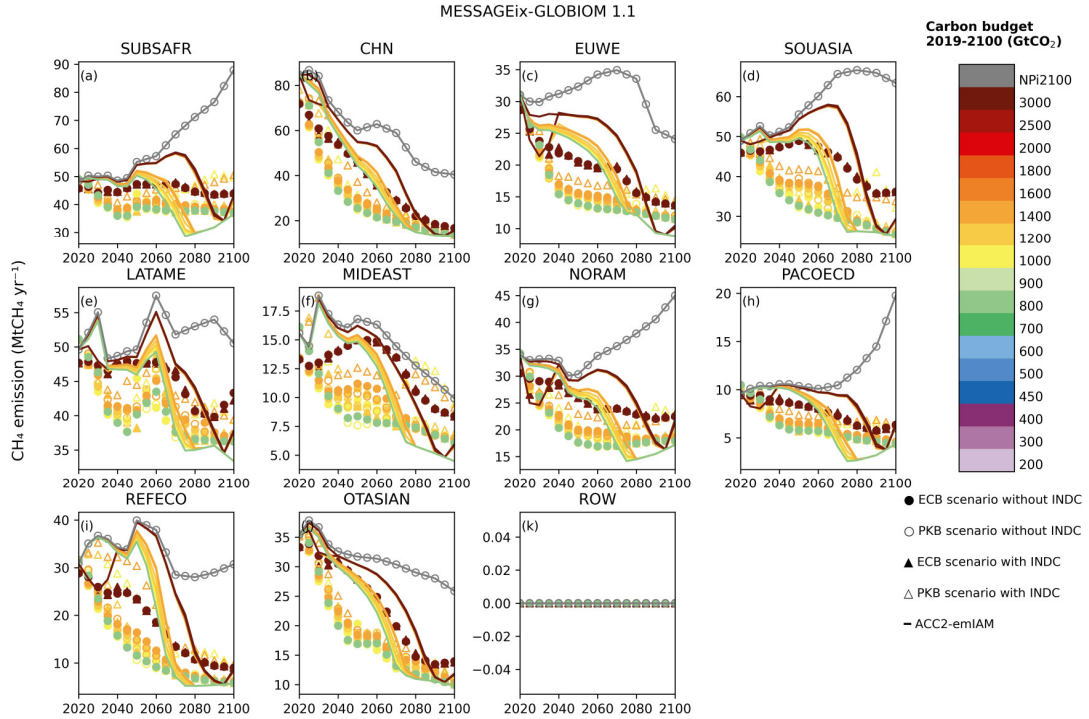


Figure S143. Test 2 - Regional IMAGE total anthropogenic CH₄ validation results

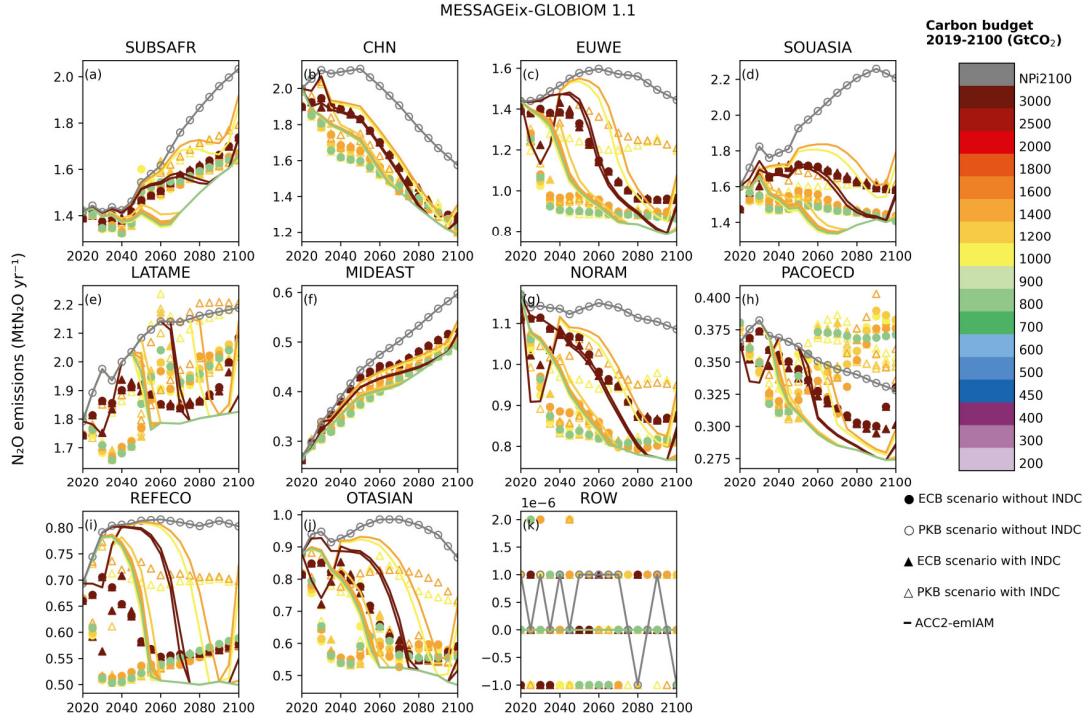


Figure S144. Test 2 - Regional IMAGE total anthropogenic N₂O validation results

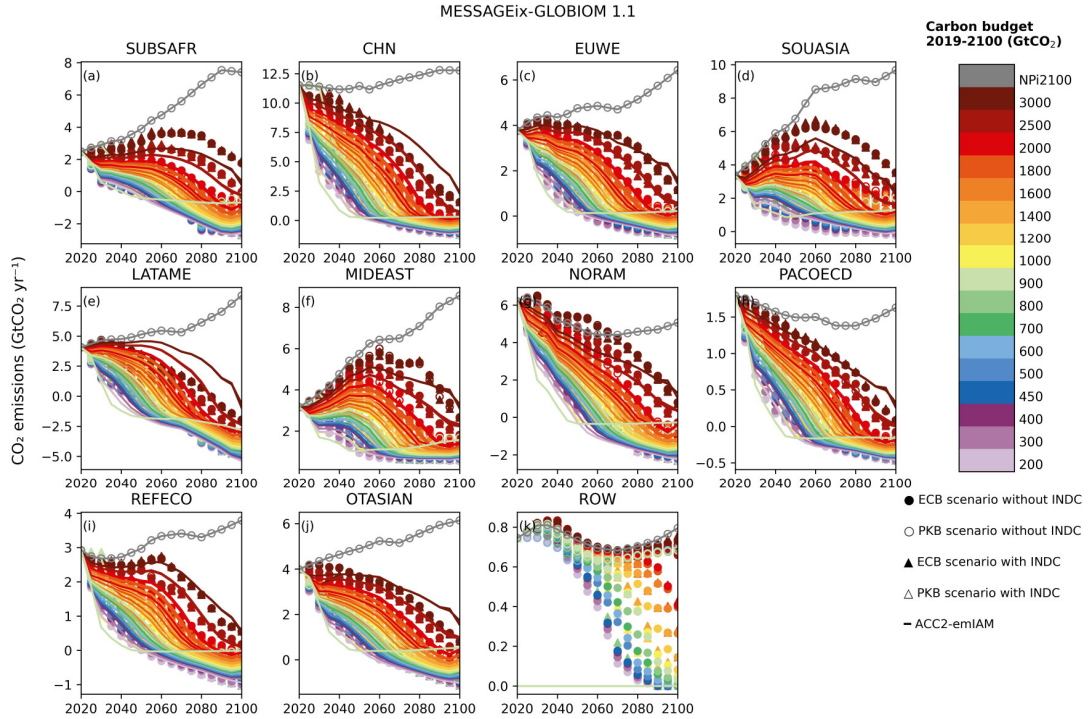


Figure S145. Test 2 - Regional MESSAGE total anthropogenic CO₂ validation results

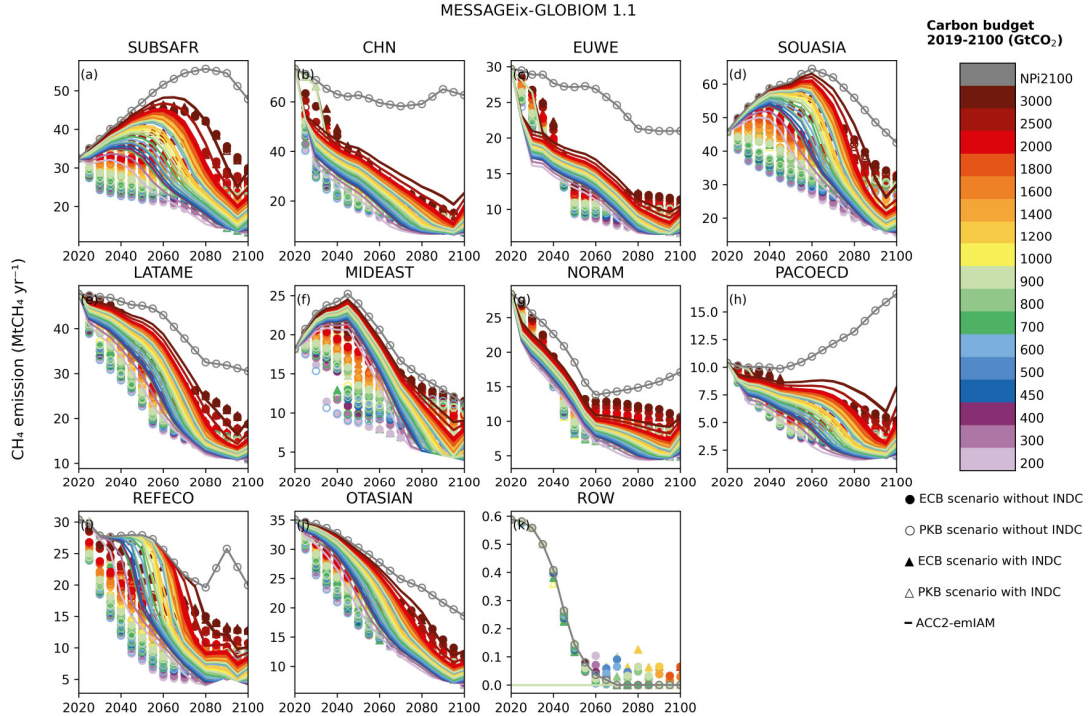


Figure S146. Test 2 - Regional MESSAGE total anthropogenic CH₄ validation results

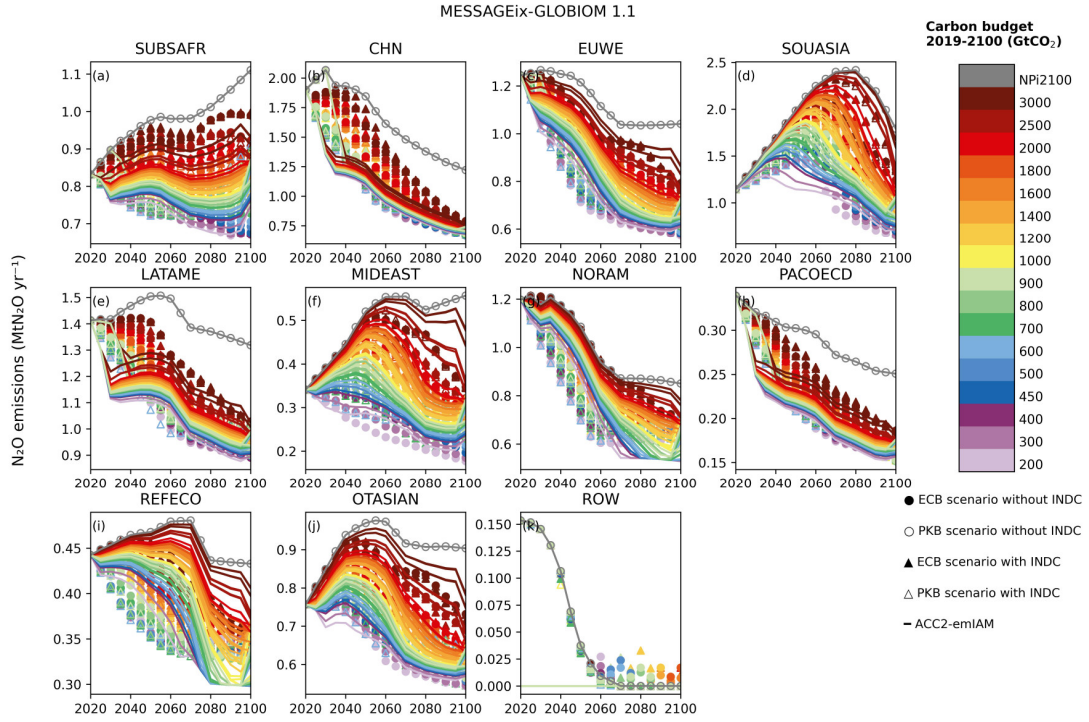


Figure S147. Test 2 - Regional MESSAGE total anthropogenic N₂O validation results

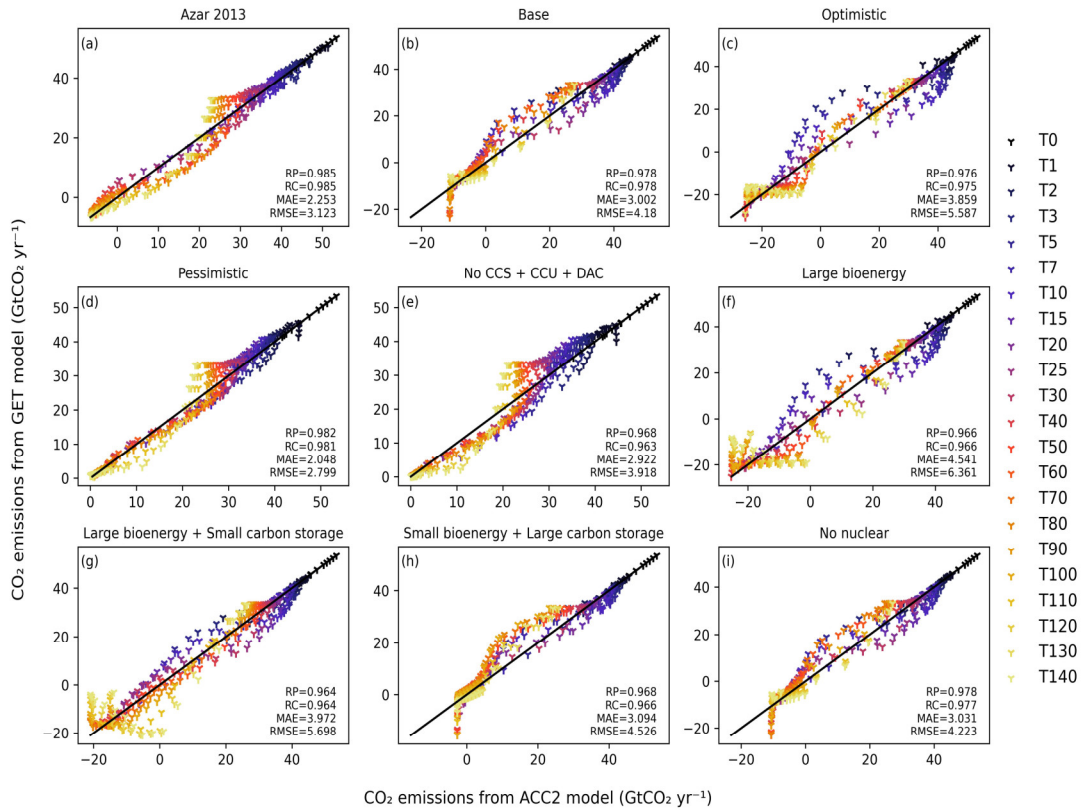


Figure S148. Test 2 - GET - Reproducibility of energy-related CO₂

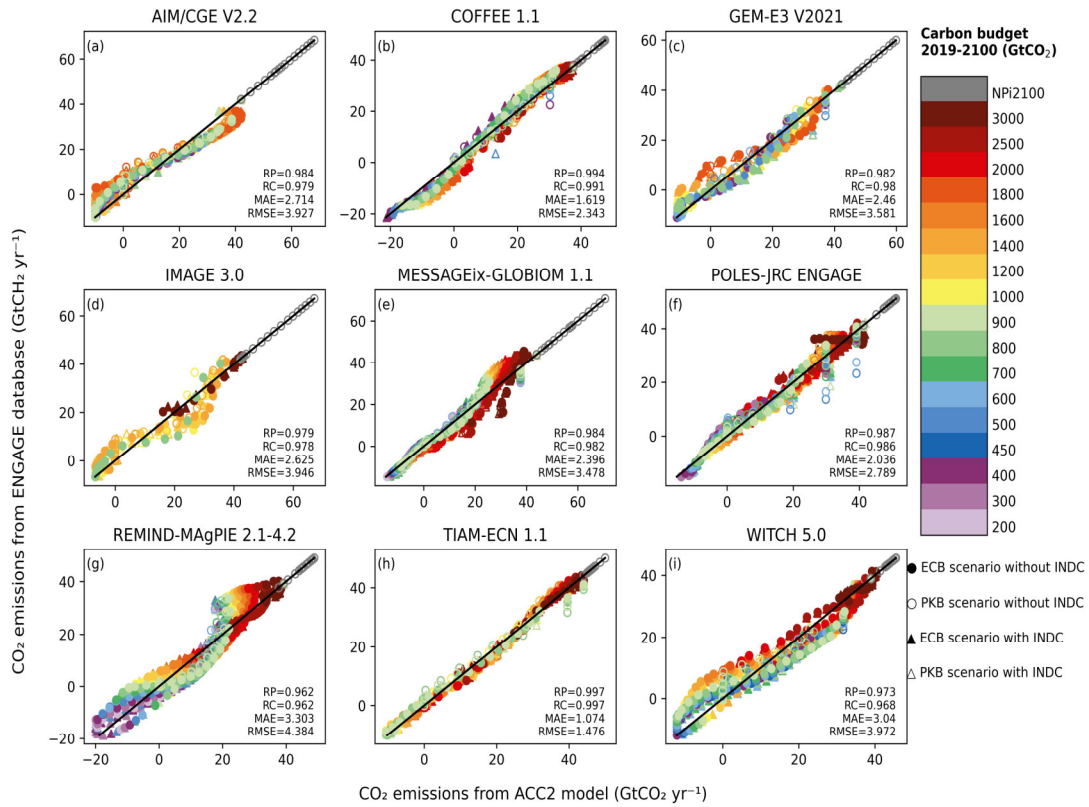


Figure S149. Test 2 - Global nine IAMs - Reproducibility of total anthropogenic CO₂

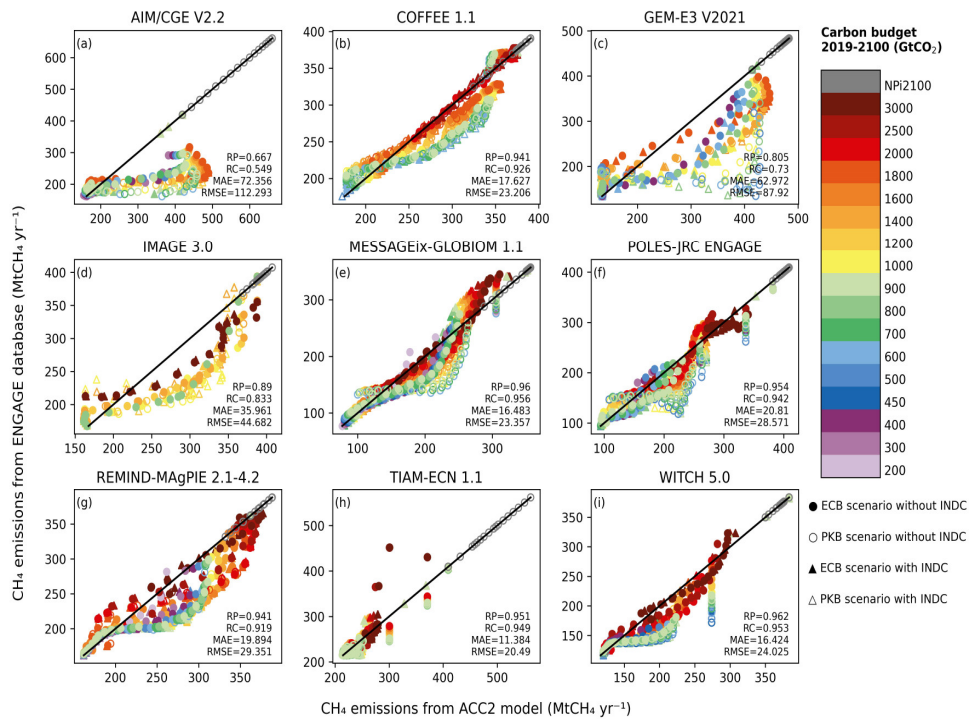


Figure S150. Test 2 - Global nine IAMs - Reproducibility of total anthropogenic CH₄

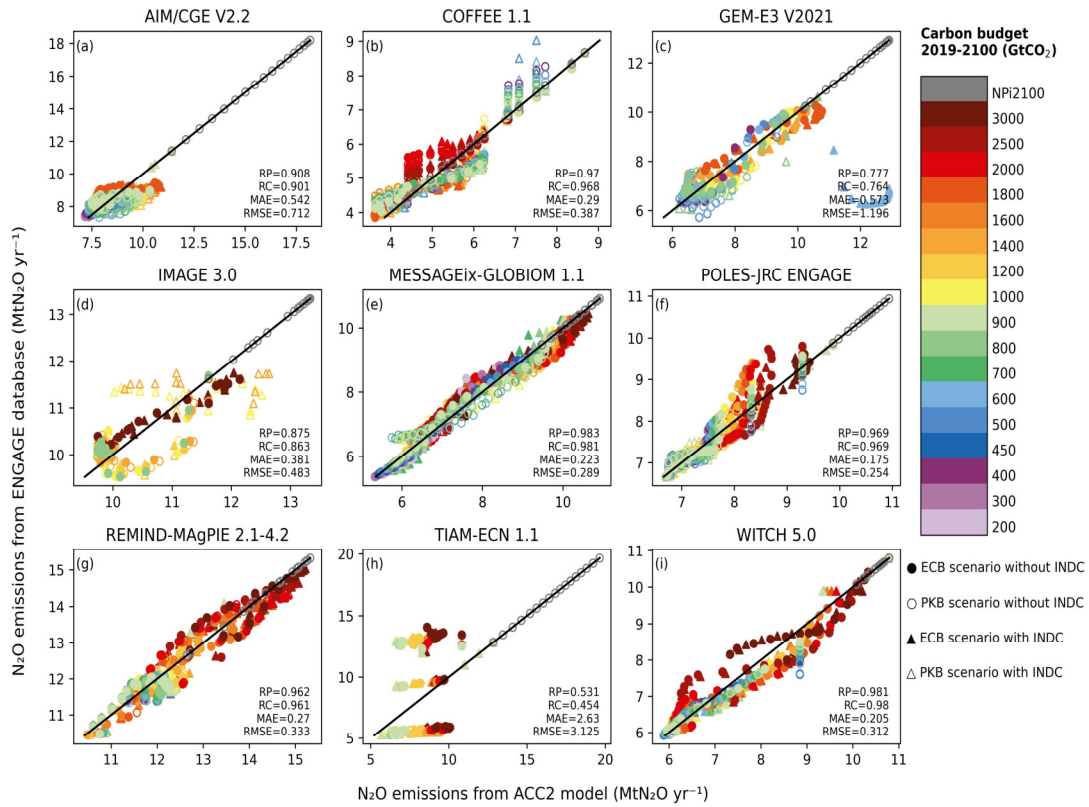


Figure S151. Test 2 - Global nine IAMs - Reproducibility of total anthropogenic N_2O

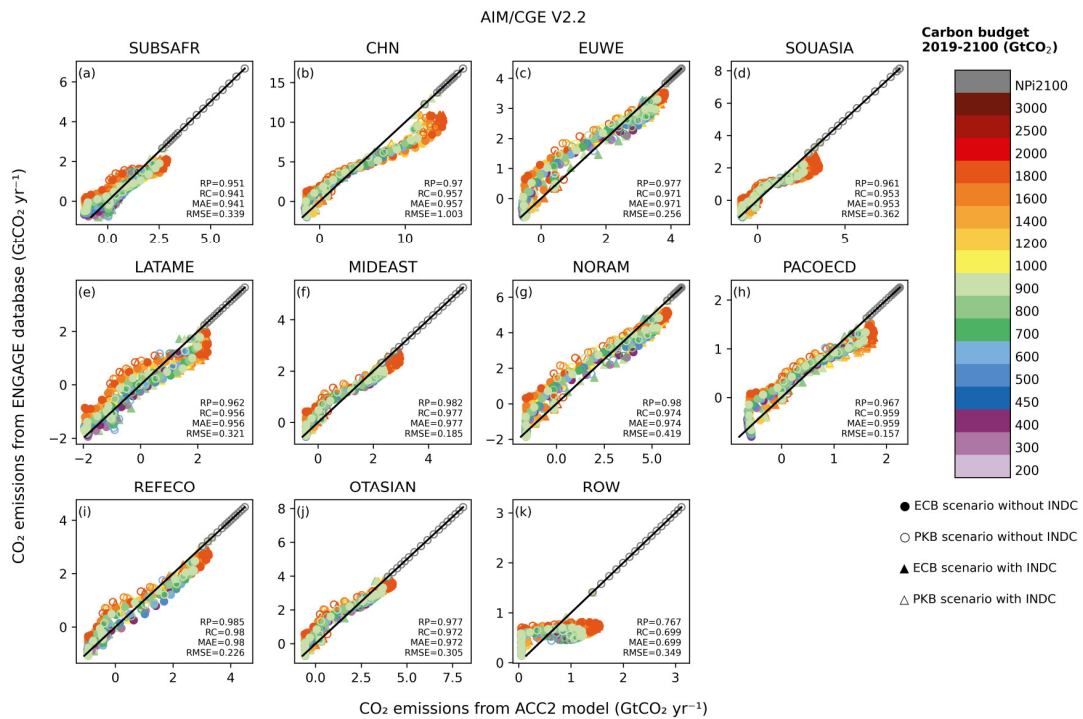


Figure S152. Test 2 - Regional AIM - Reproducibility of total anthropogenic CO_2

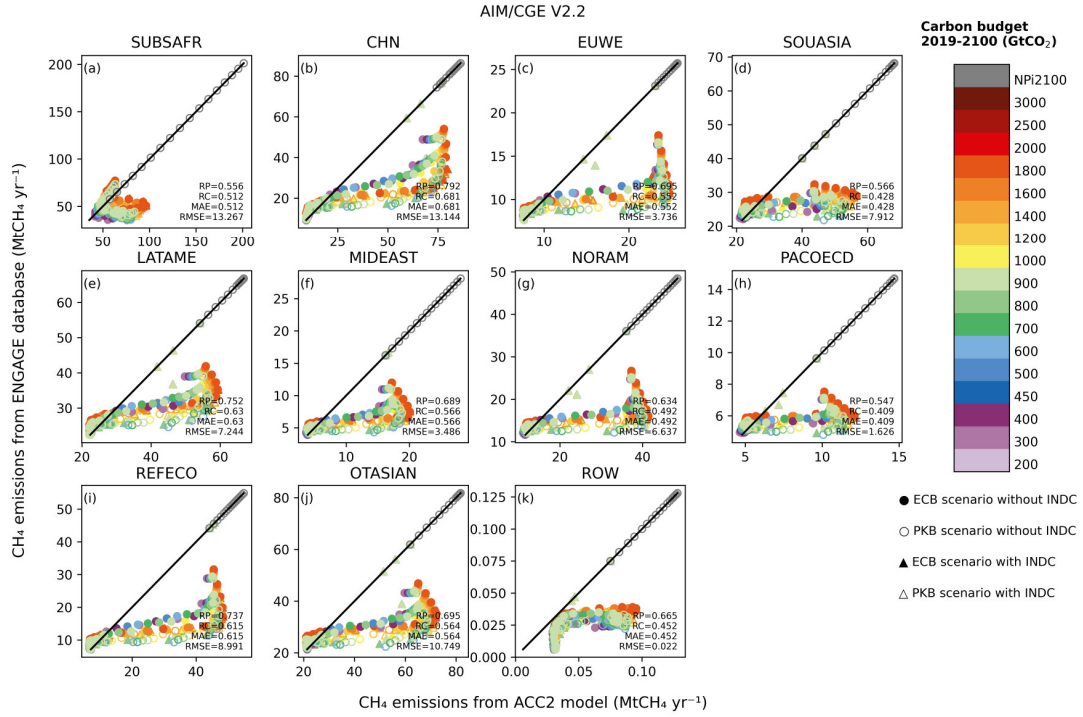


Figure S153. Test 2 - Regional AIM - Reproducibility of total anthropogenic CH₄

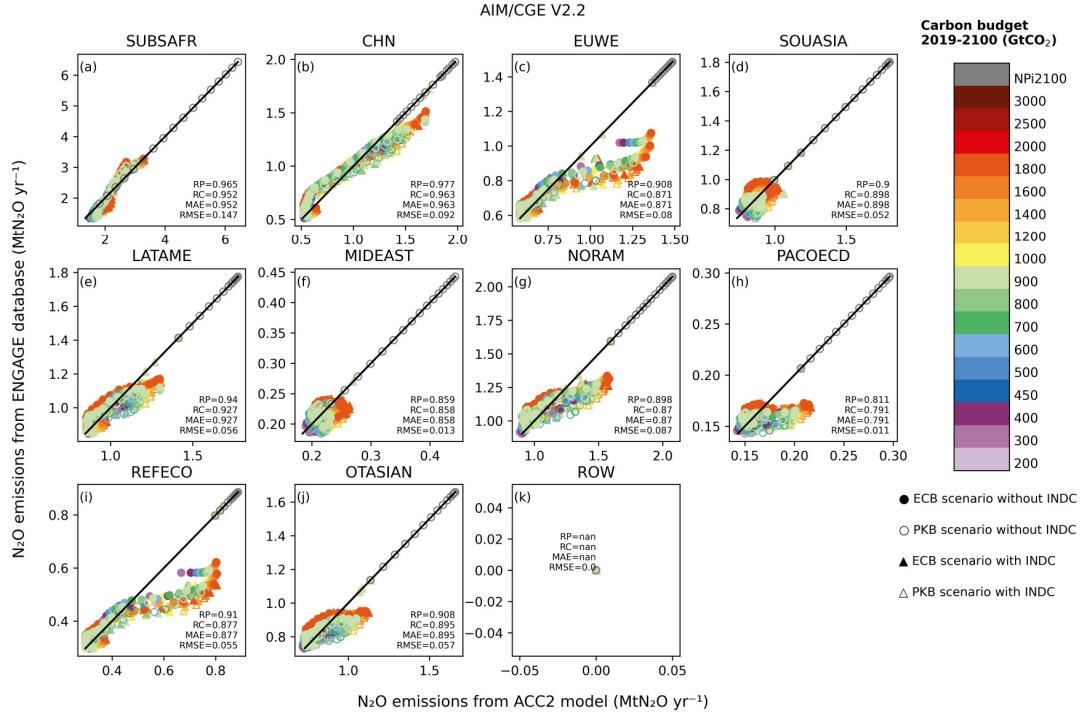


Figure S154. Test 2 - Regional AIM - Reproducibility of total anthropogenic N₂O

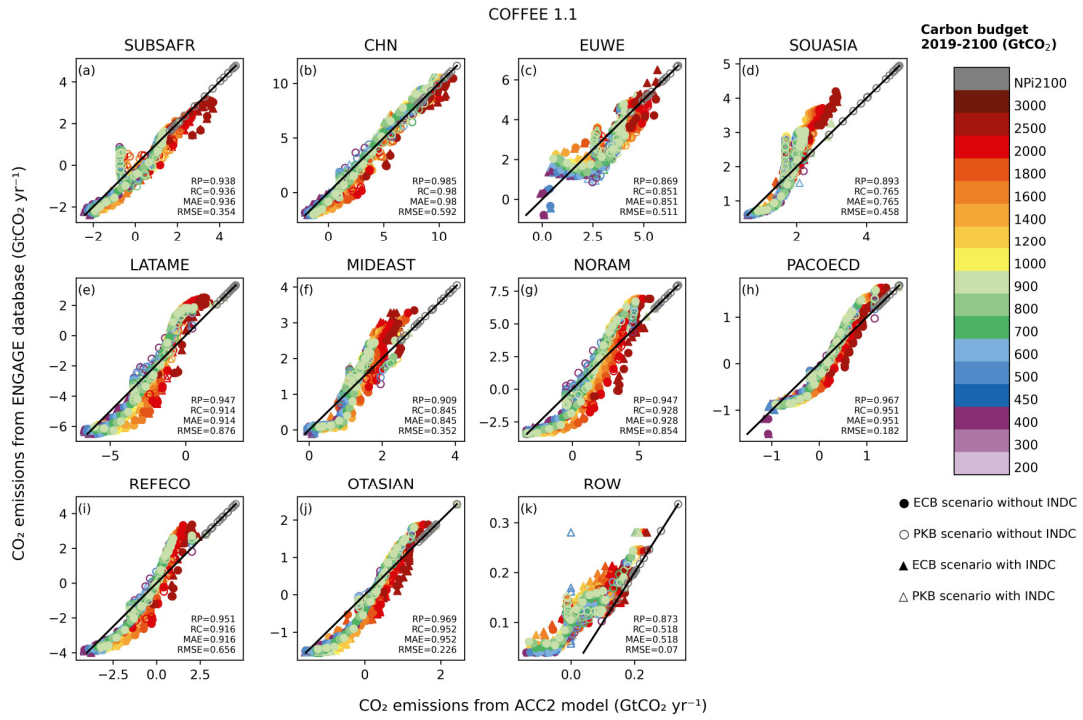


Figure S155. Test 2 - Regional COFFEE - Reproducibility of total anthropogenic CO₂

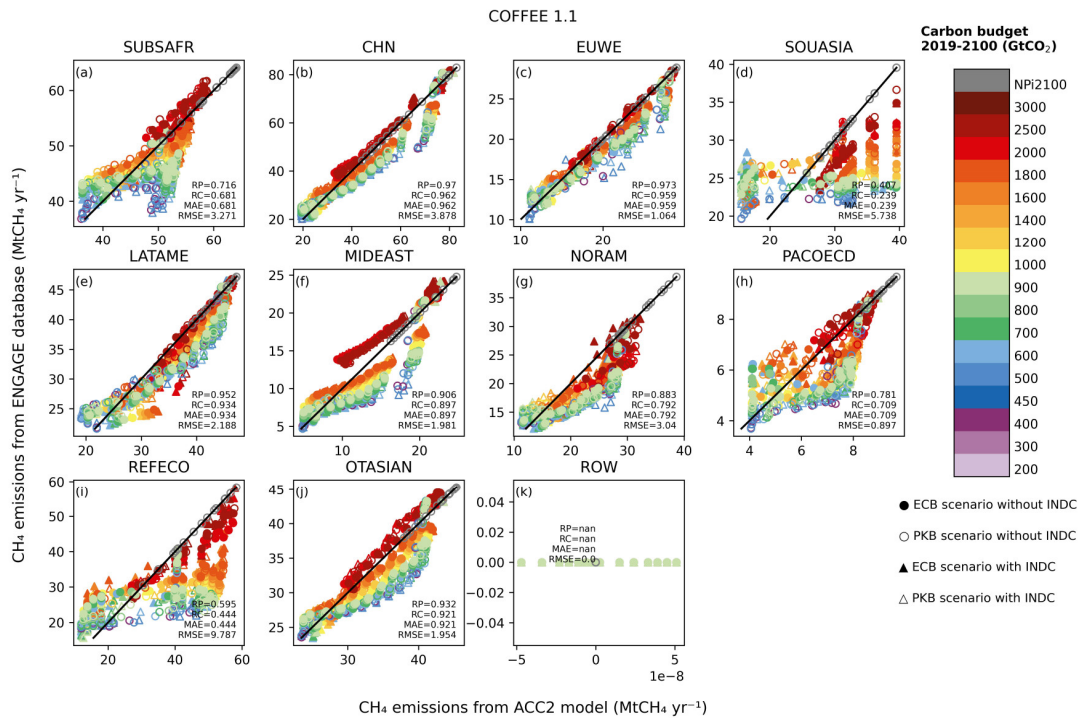


Figure S156. Test 2 - Regional COFFEE - Reproducibility of total anthropogenic CH₄

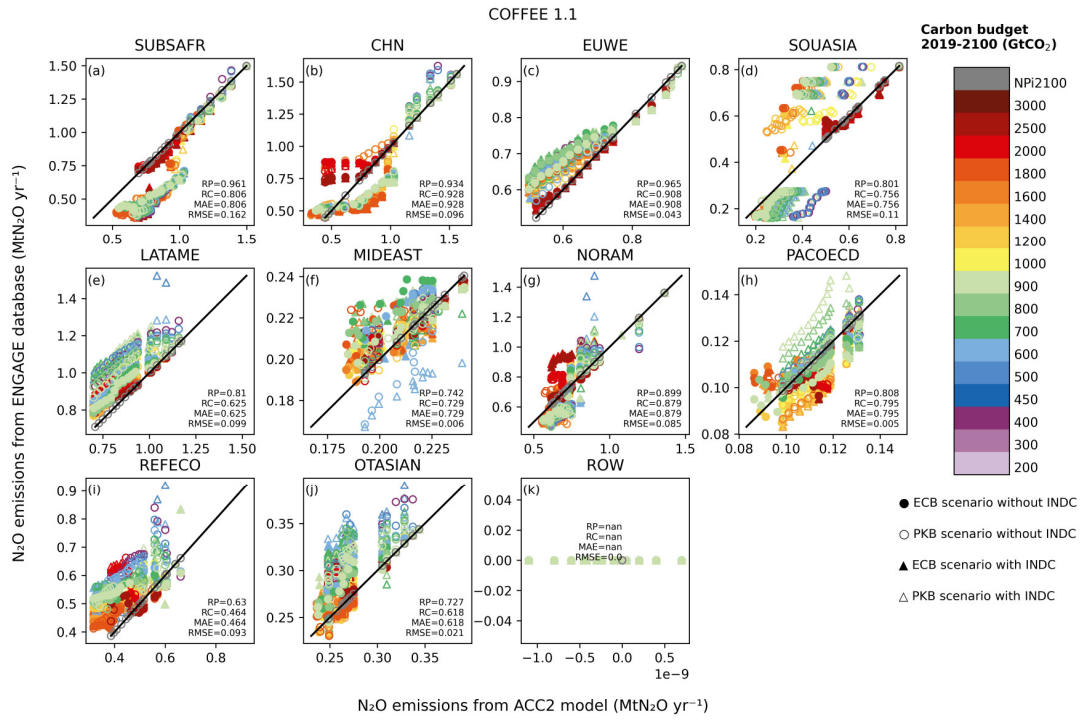


Figure S157. Test 2 - Regional COFFEE - Reproducibility of total anthropogenic N₂O

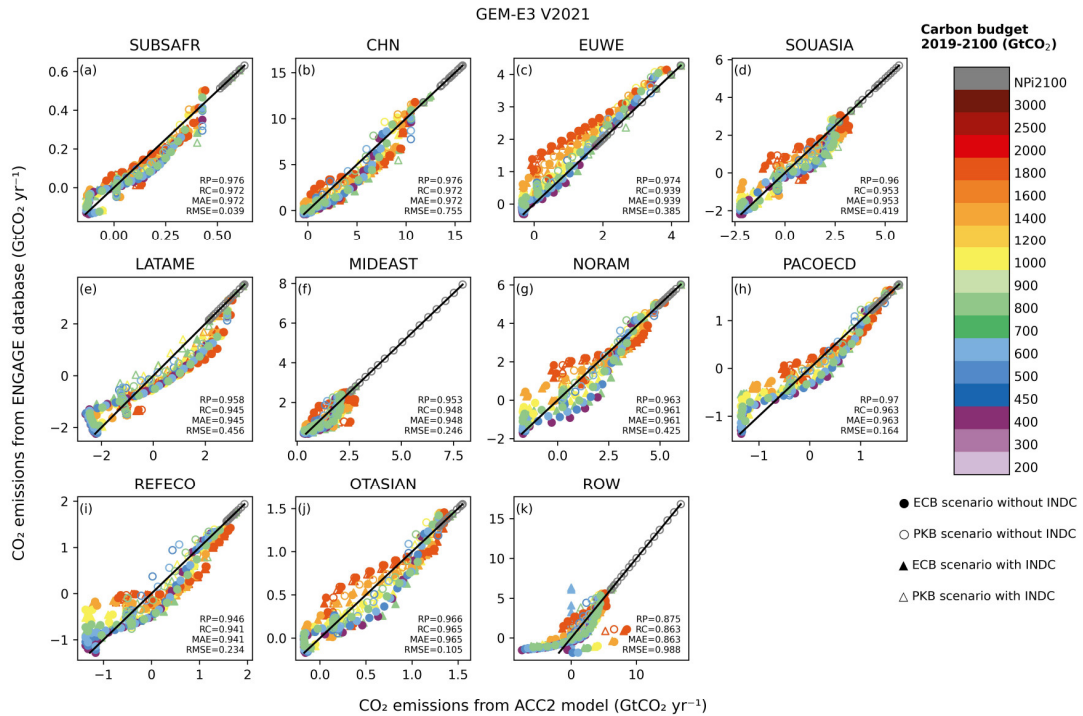


Figure S158. Test 2 - Regional GEM - Reproducibility of total anthropogenic CO₂

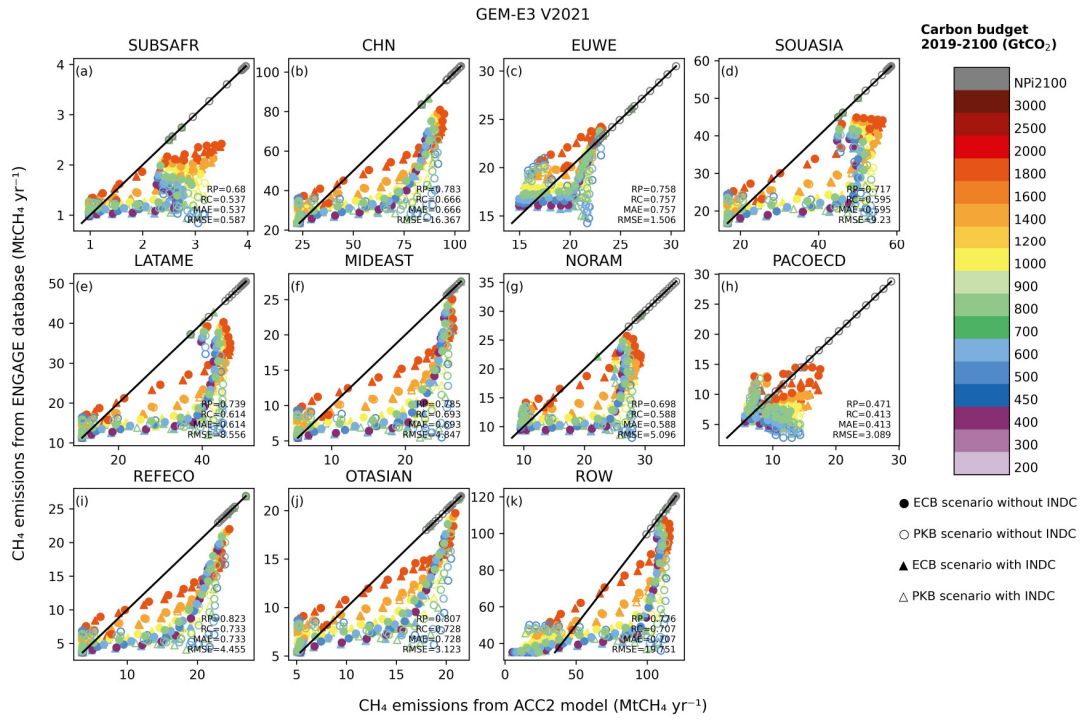


Figure S159. Test 2 - Regional GEM - Reproducibility of total anthropogenic CH₄

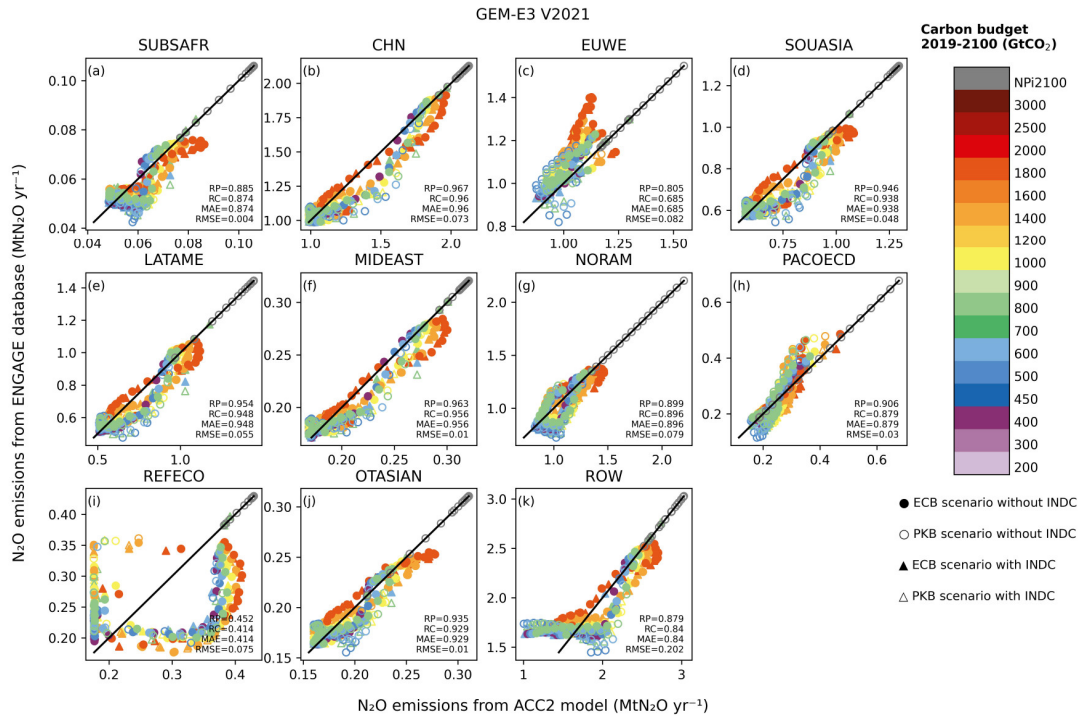


Figure S160. Test 2 - Regional GEM - Reproducibility of total anthropogenic N₂O

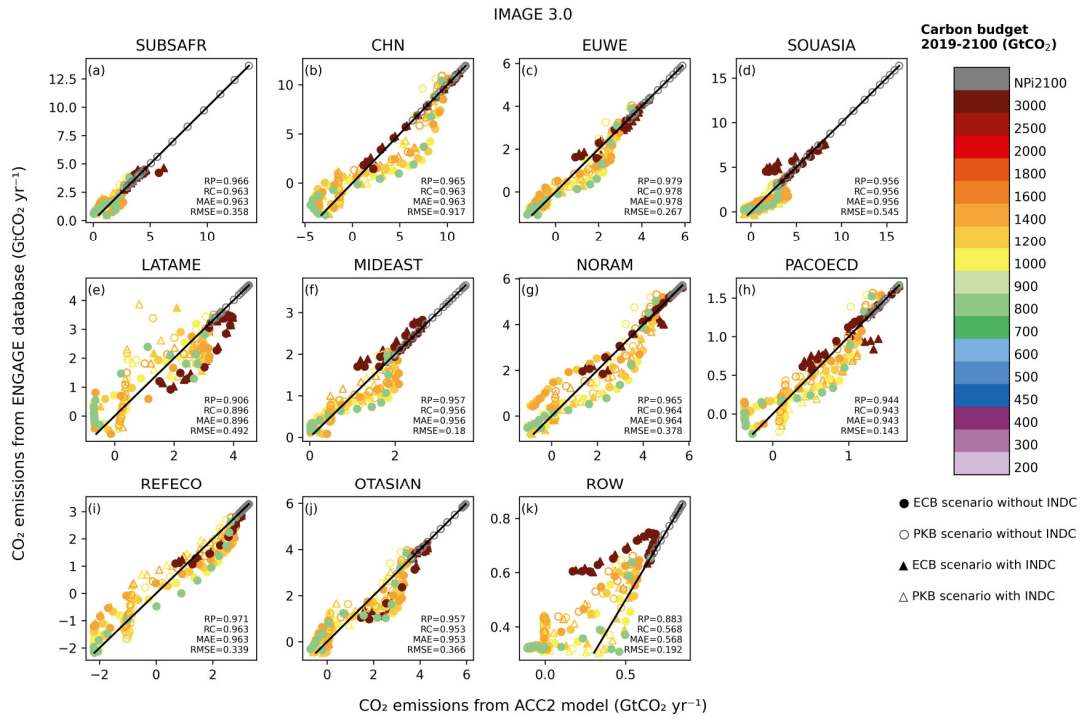


Figure S161. Test 2 - Regional IMAGE - Reproducibility of total anthropogenic CO₂

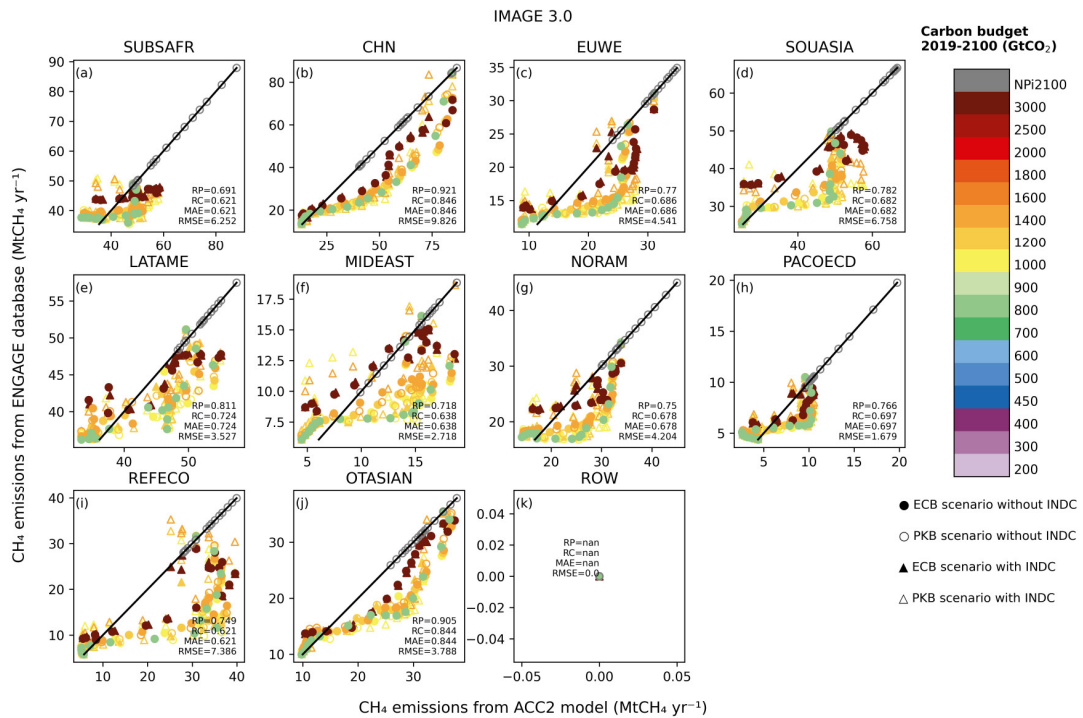


Figure S162. Test 2 - Regional IMAGE - Reproducibility of total anthropogenic CH₄

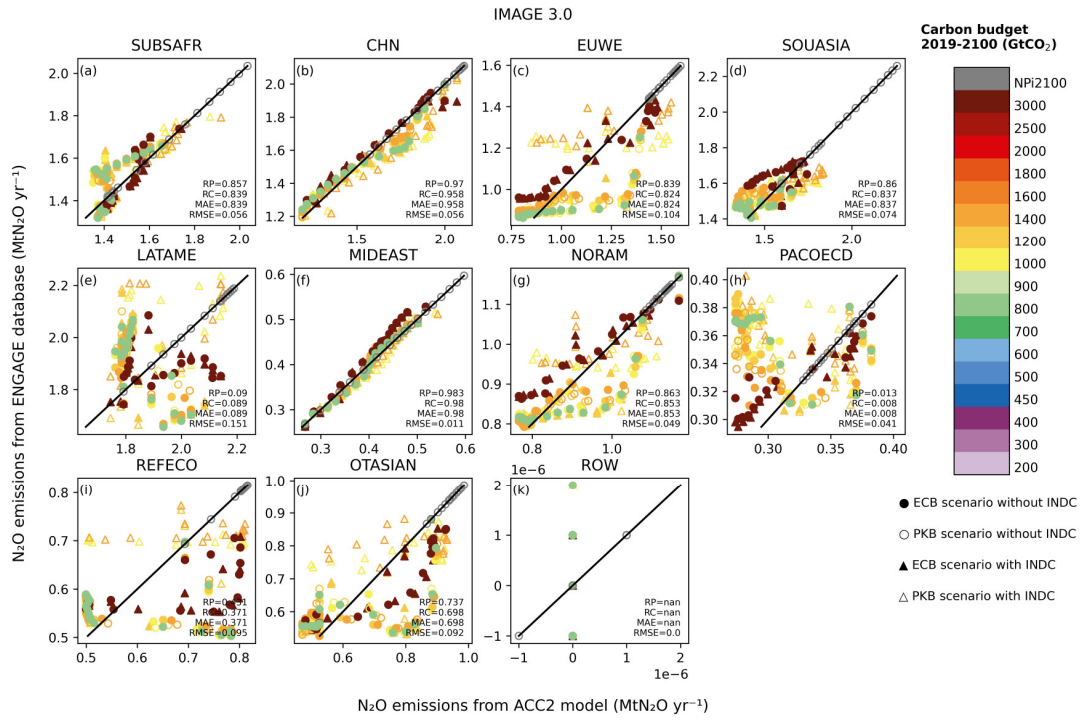


Figure S163. Test 2 - Regional IMAGE - Reproducibility of total anthropogenic N₂O

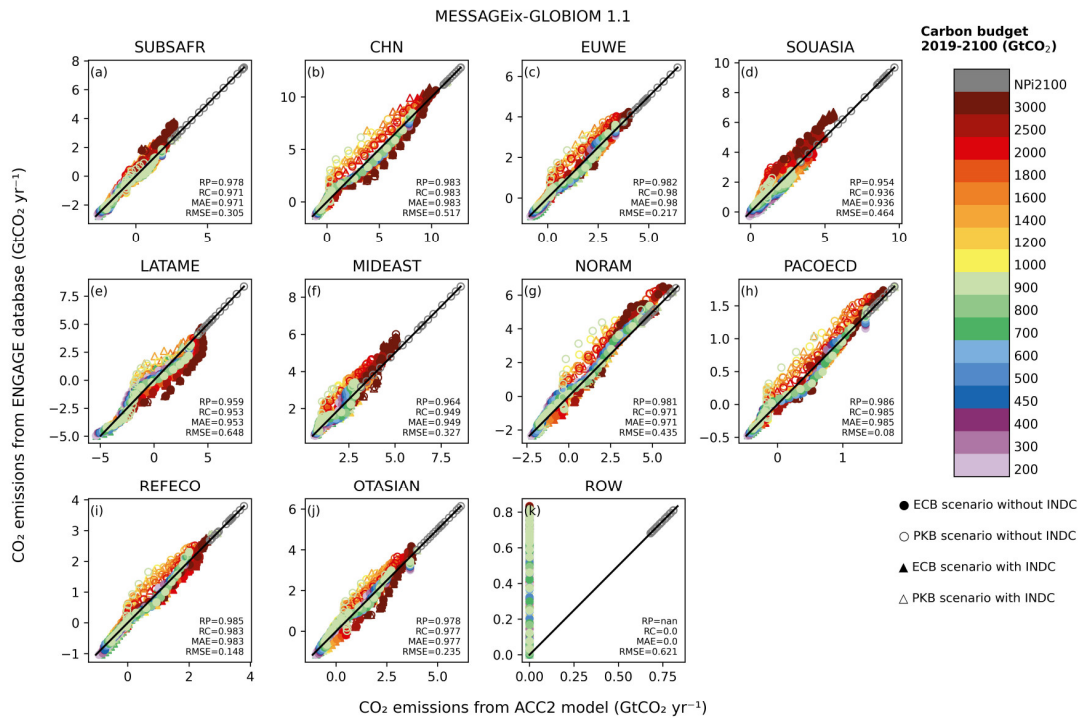


Figure S164. Test 2 - Regional MESSAGE - Reproducibility of total anthropogenic CO₂

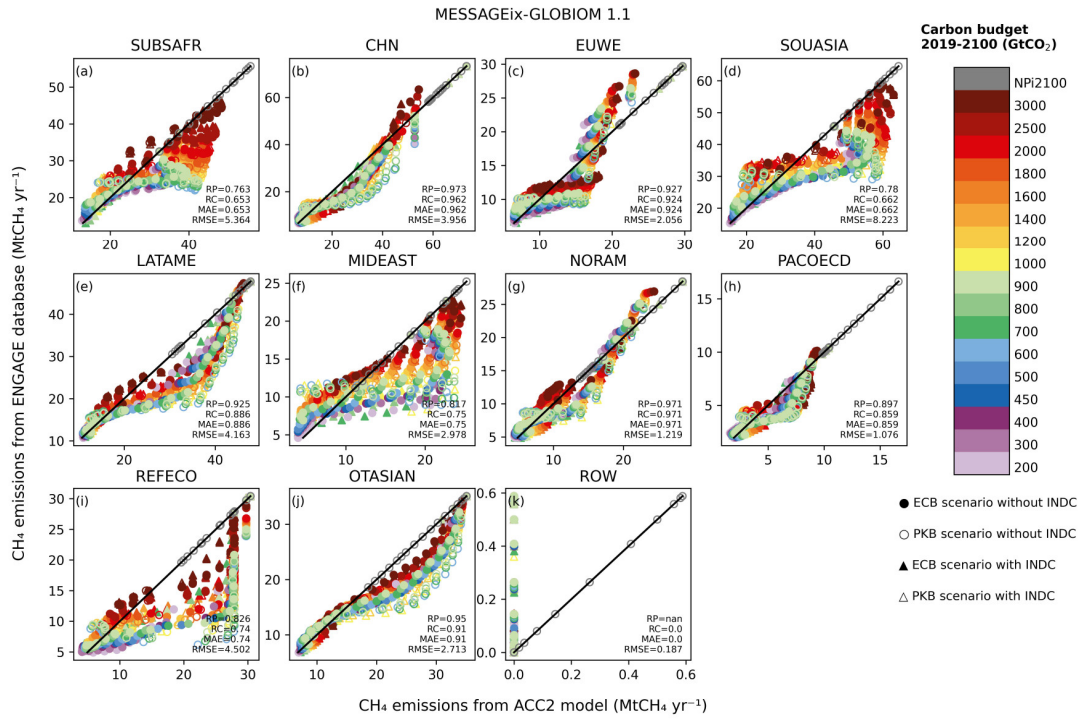


Figure S165. Test 2 - Regional MESSAGE - Reproducibility of total anthropogenic CH₄

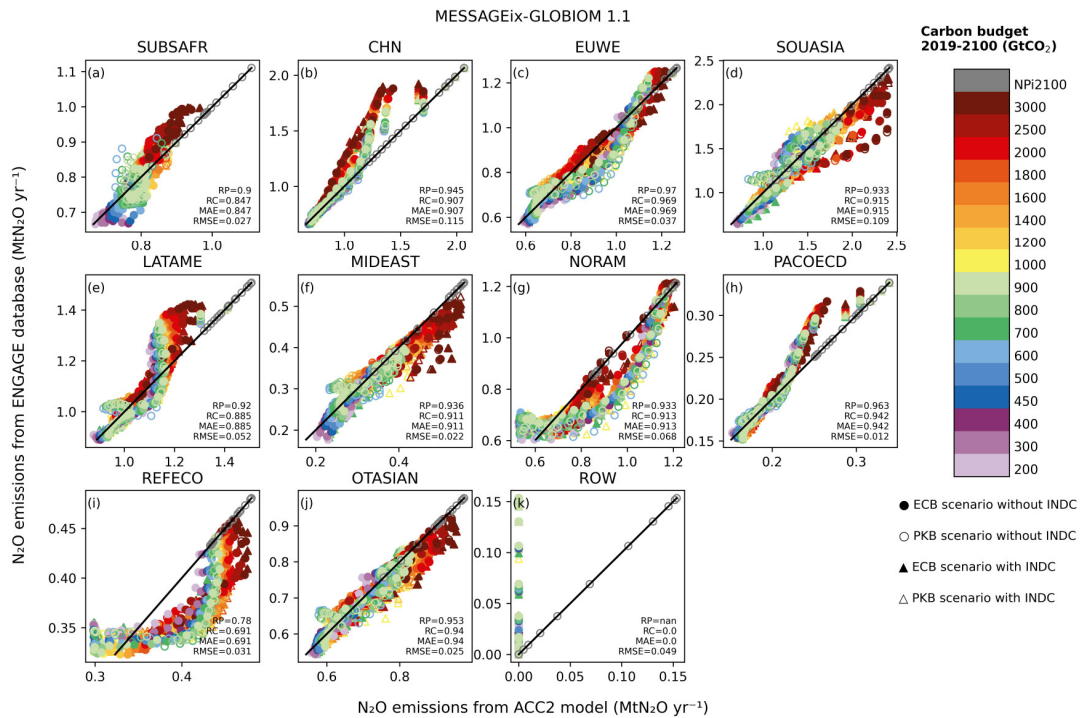


Figure S166. Test 2 - Regional MESSAGE - Reproducibility of total anthropogenic N₂O

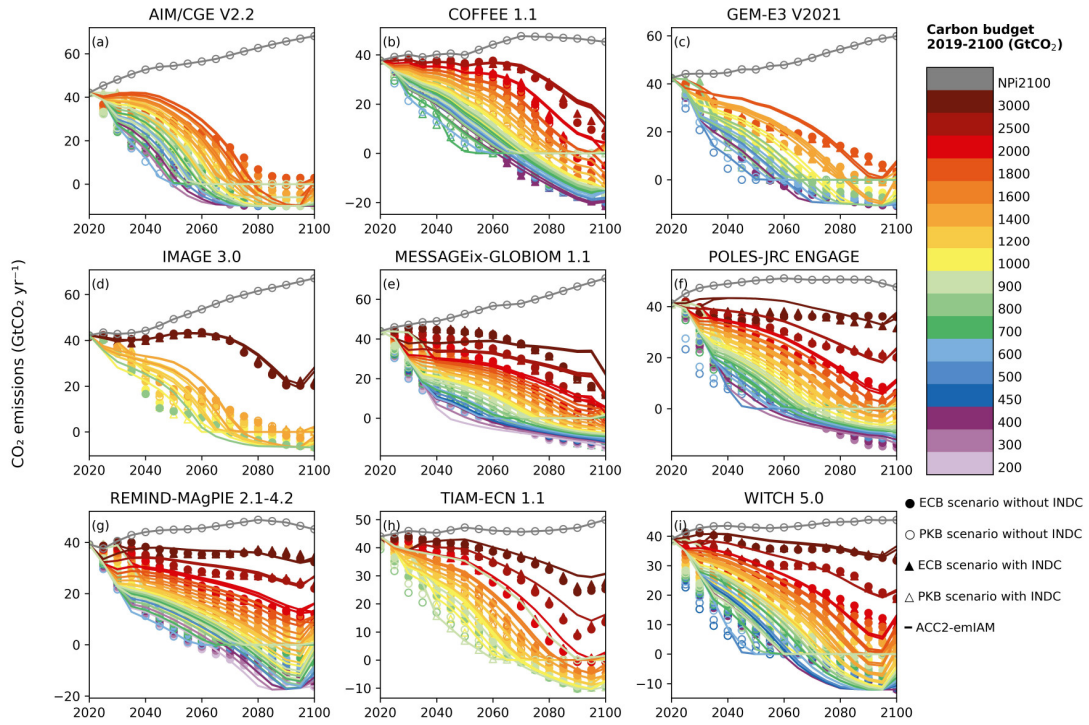


Figure S167. Test 3 – Global nine IAMs total anthropogenic CO₂ validation results

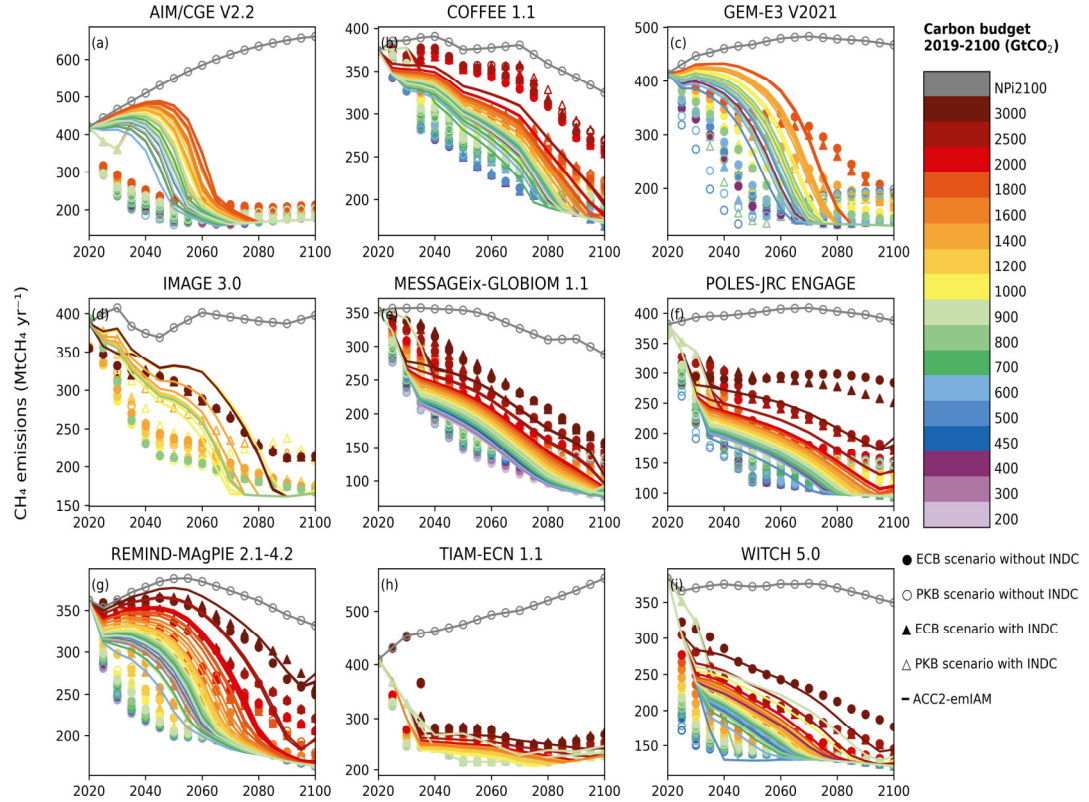


Figure S168. Test 3 – Global nine IAMs total anthropogenic CH₄ validation result

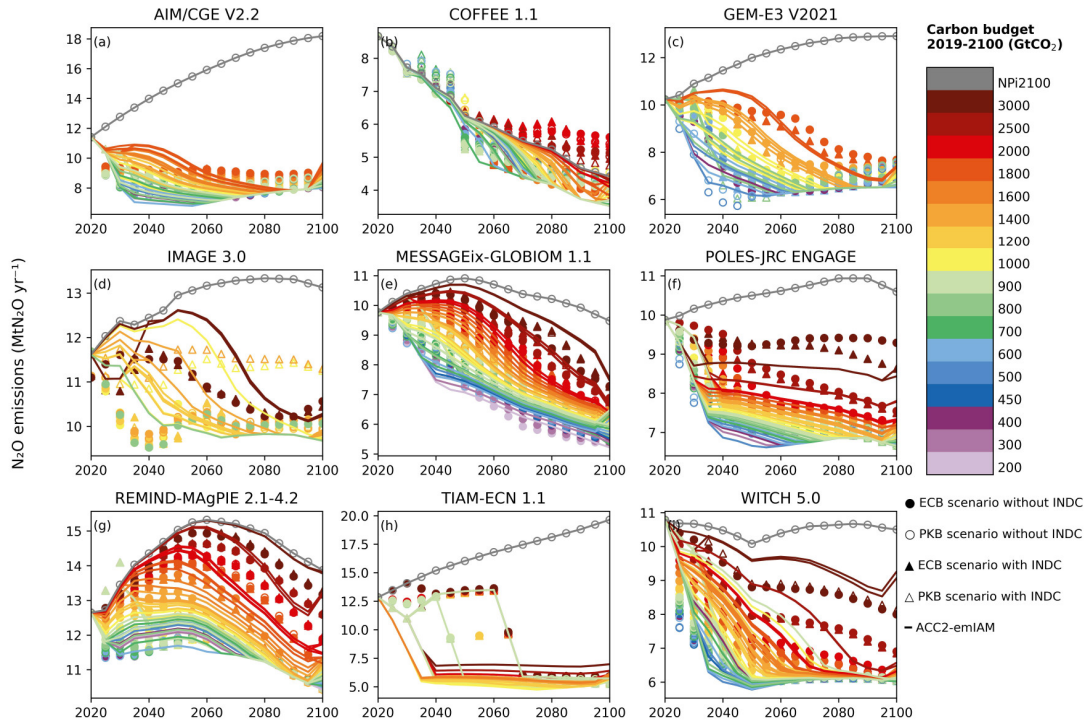


Figure S169. Test 3 – Global nine IAMs total anthropogenic N₂O validation results

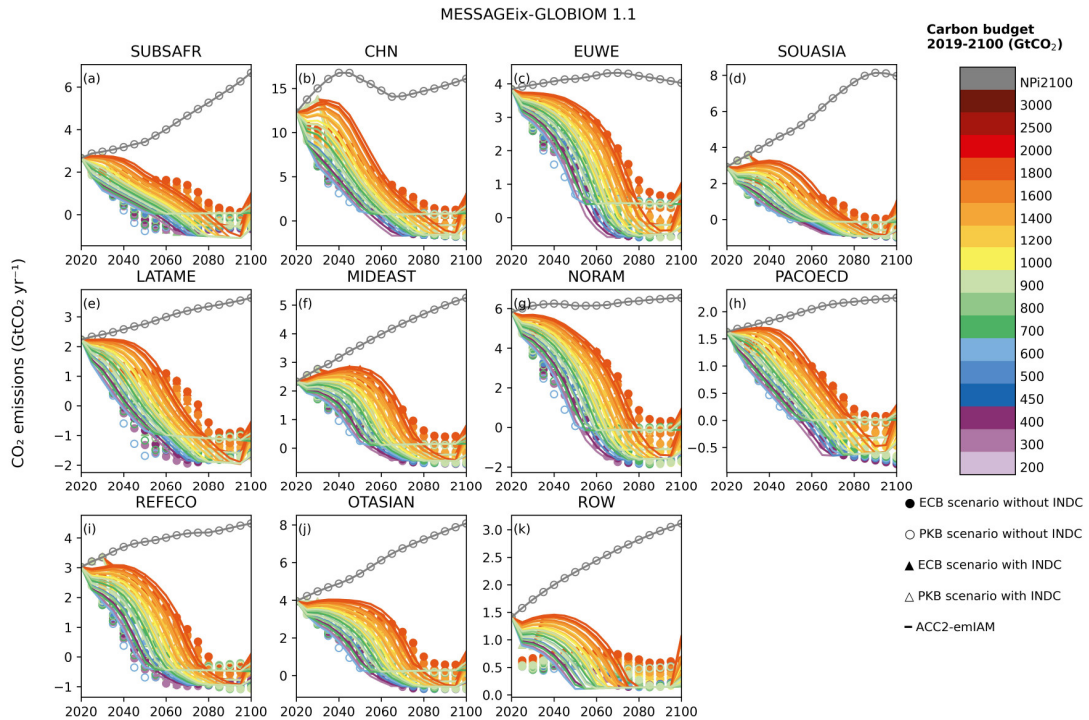


Figure S170. Test 3 - Regional AIM total anthropogenic CO₂ validation results

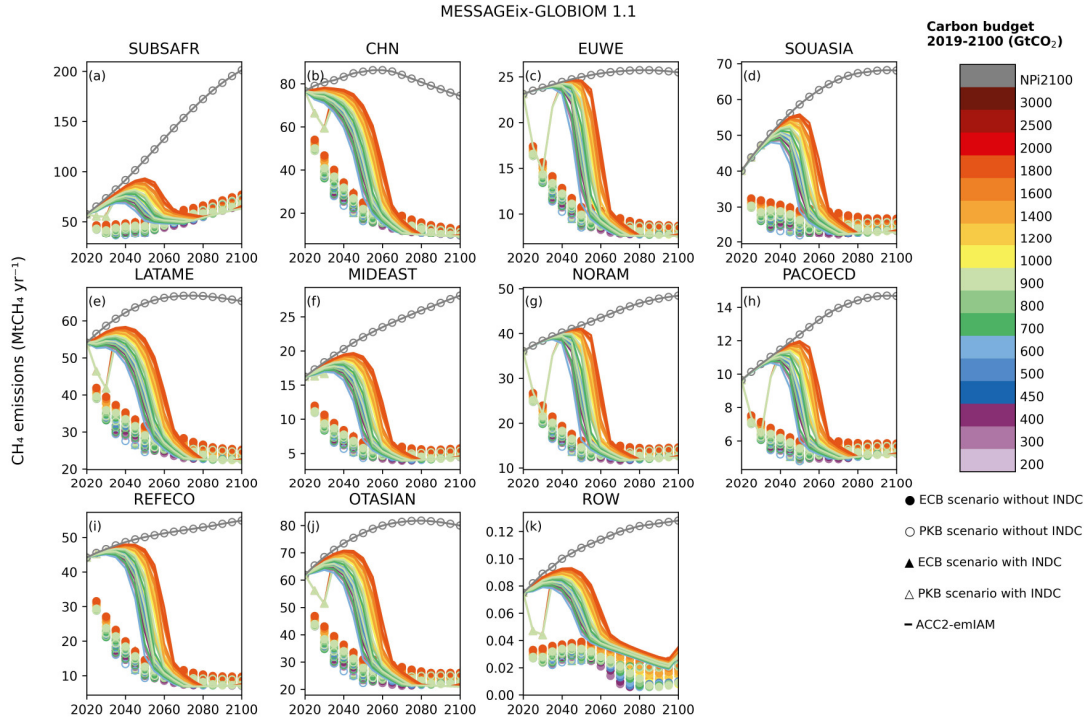


Figure S171. Test 3 - Regional AIM total anthropogenic CH₄ validation results

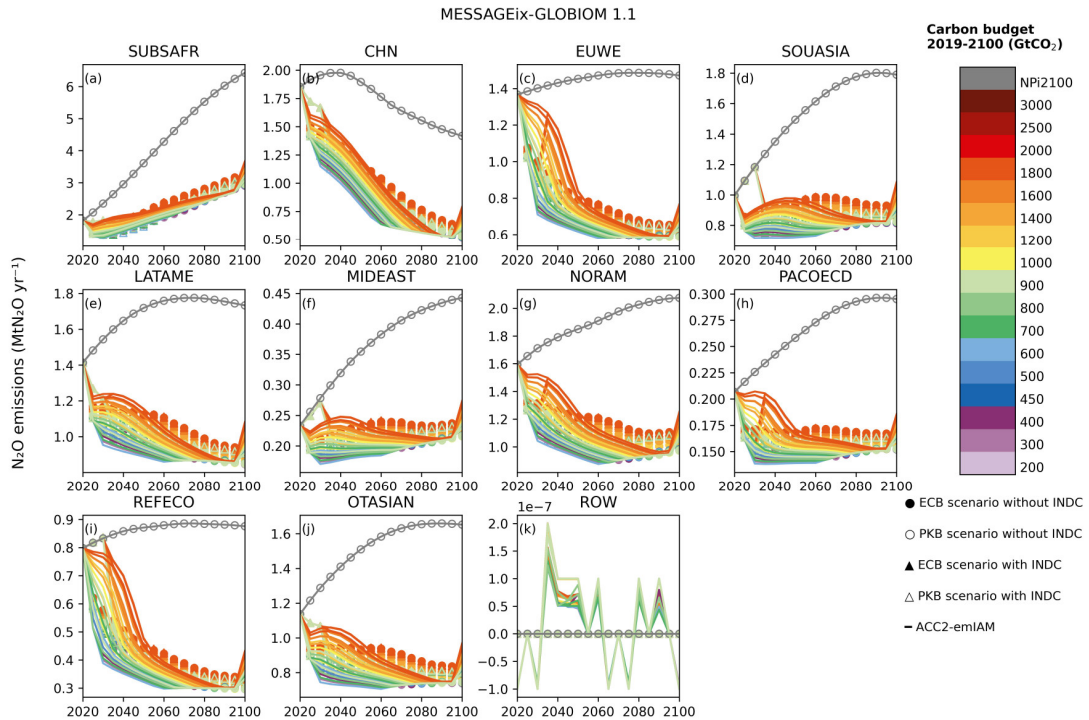


Figure S172. Test 3 - Regional AIM total anthropogenic N₂O validation results

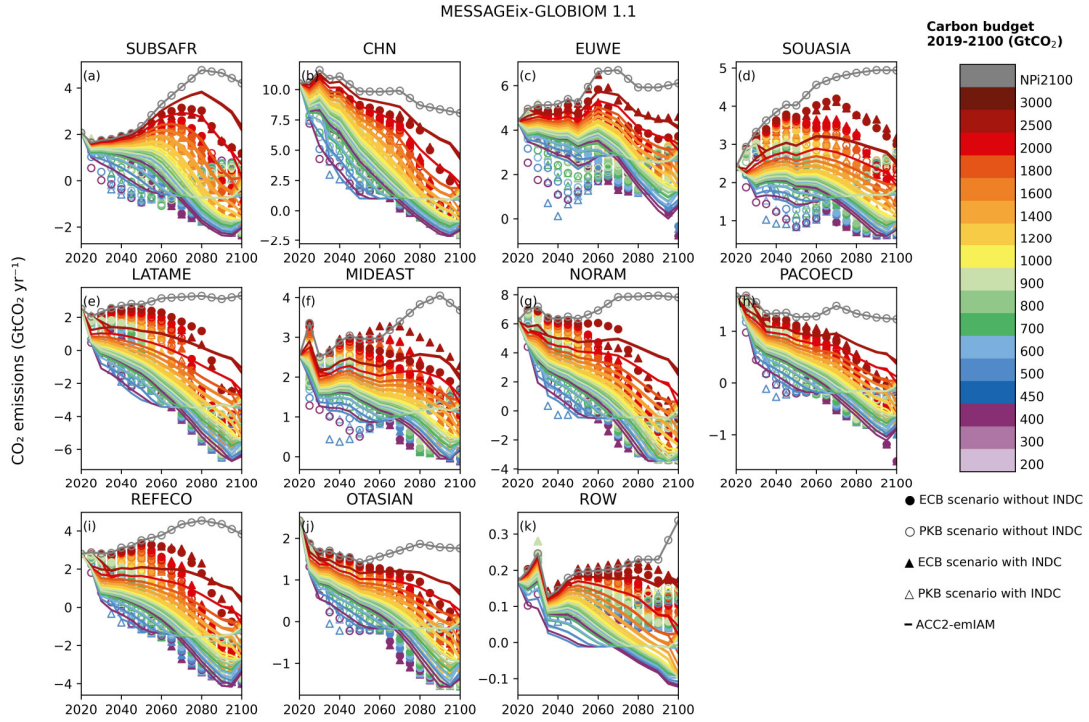


Figure S173. Test 3 - Regional COFFEE total anthropogenic CO₂ validation results

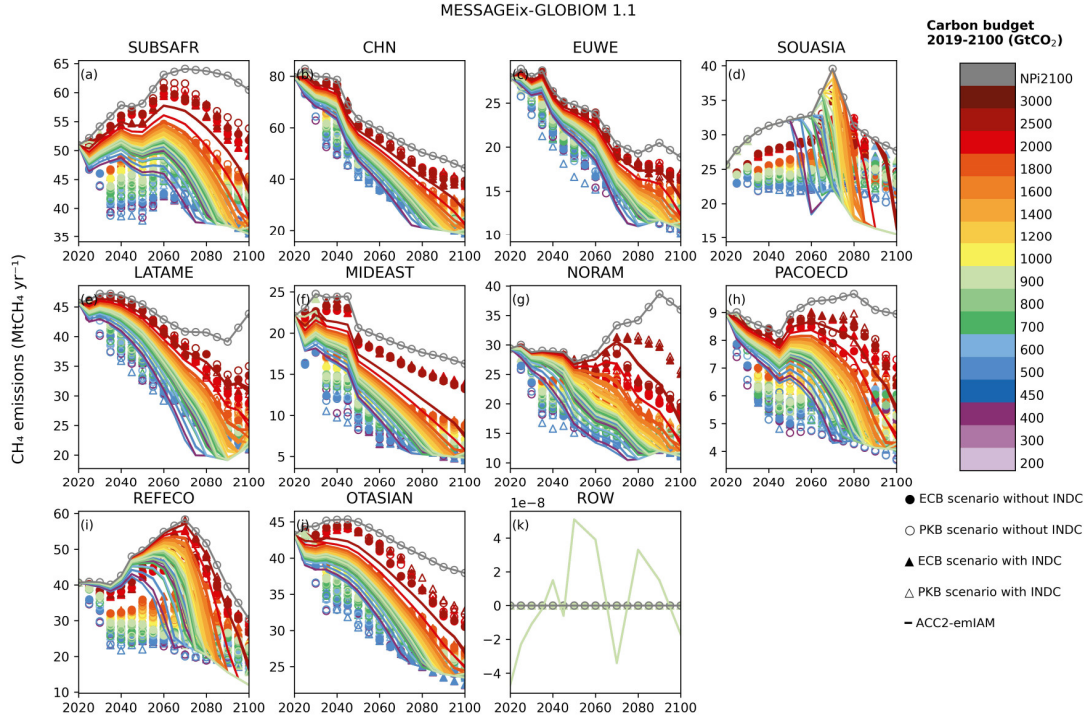


Figure S174. Test 3 - Regional COFFEE total anthropogenic CH₄ validation results

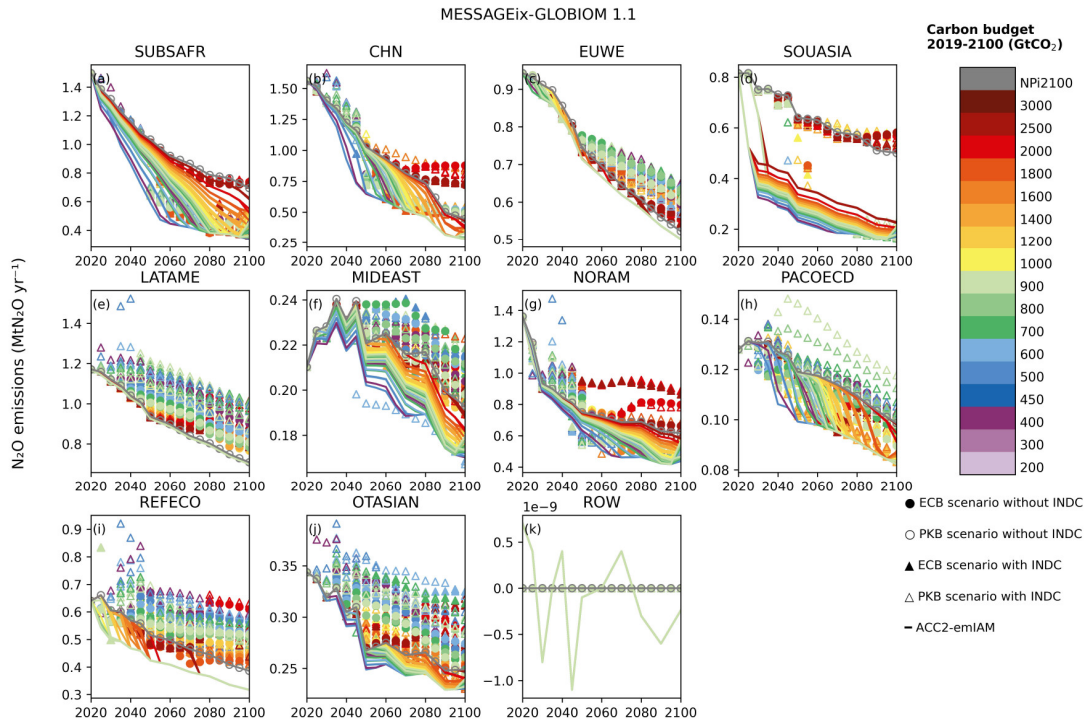


Figure S175. Test 3 - Regional COFFEE total anthropogenic N₂O validation results

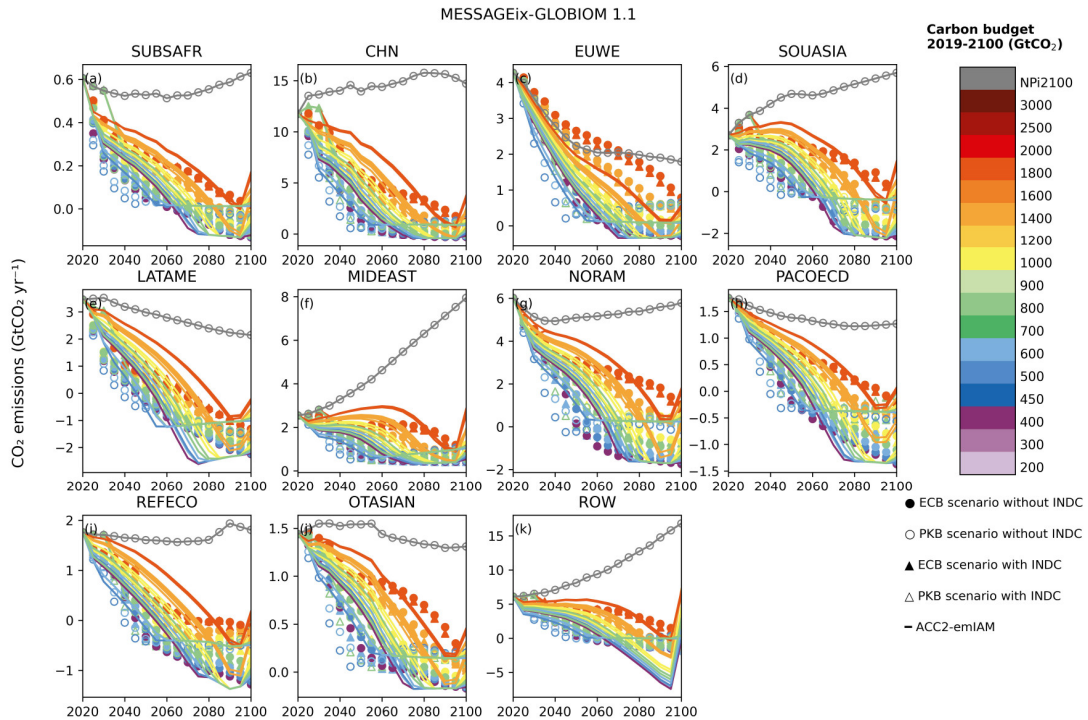


Figure S176. Test 3 - Regional GEM total anthropogenic CO₂ validation results

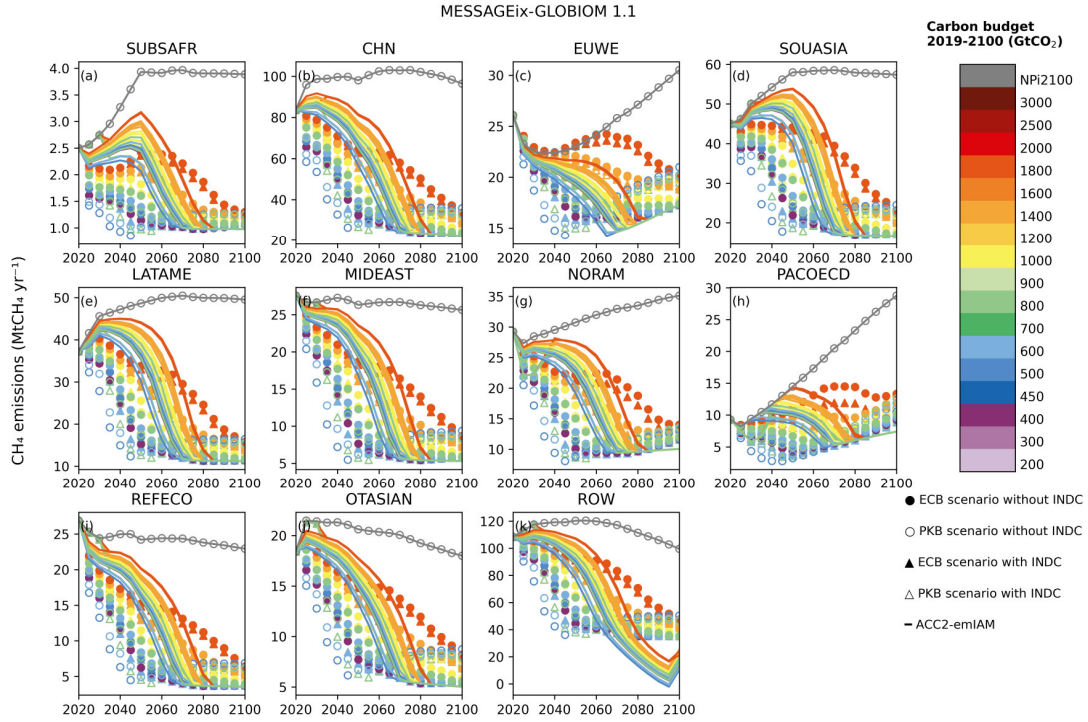


Figure S177. Test 3 - Regional GEM total anthropogenic CH₄ validation results

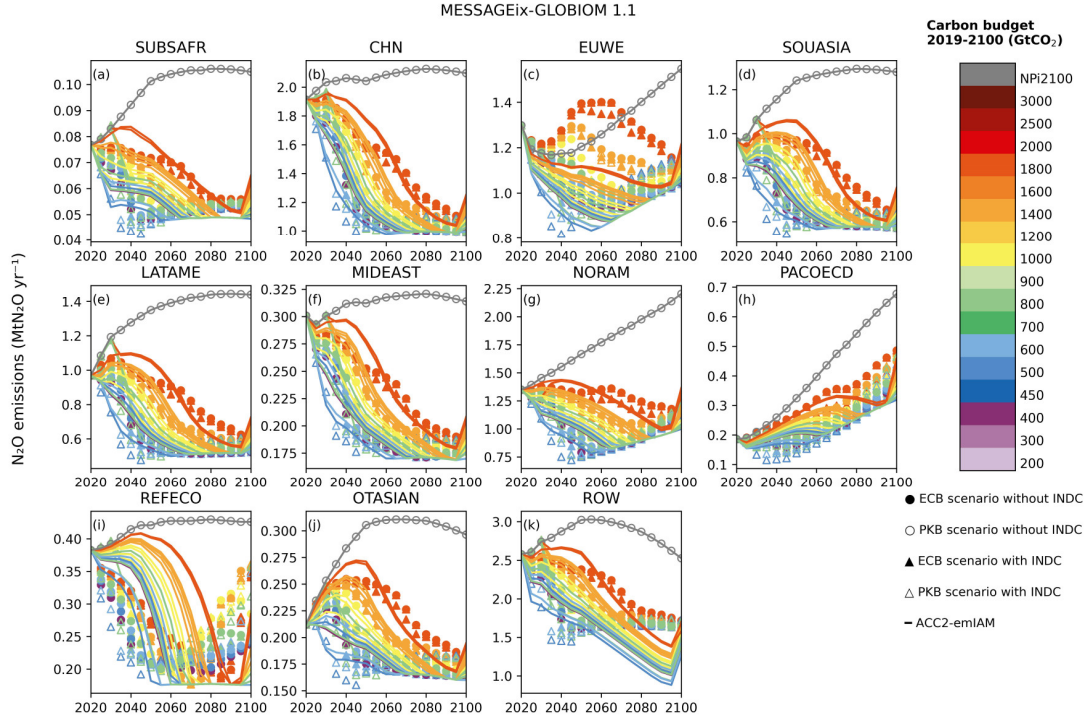


Figure S178. Test 3 - Regional GEM total anthropogenic N₂O validation results

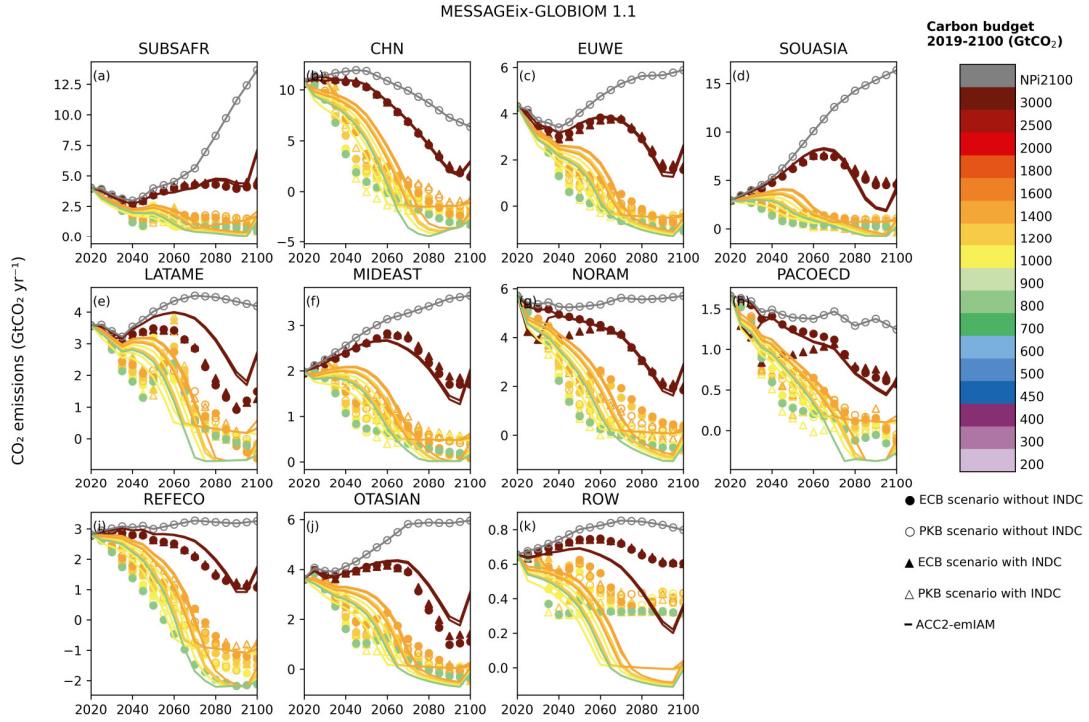


Figure S179. Test 3 - Regional IMAGE total anthropogenic CO₂ validation results

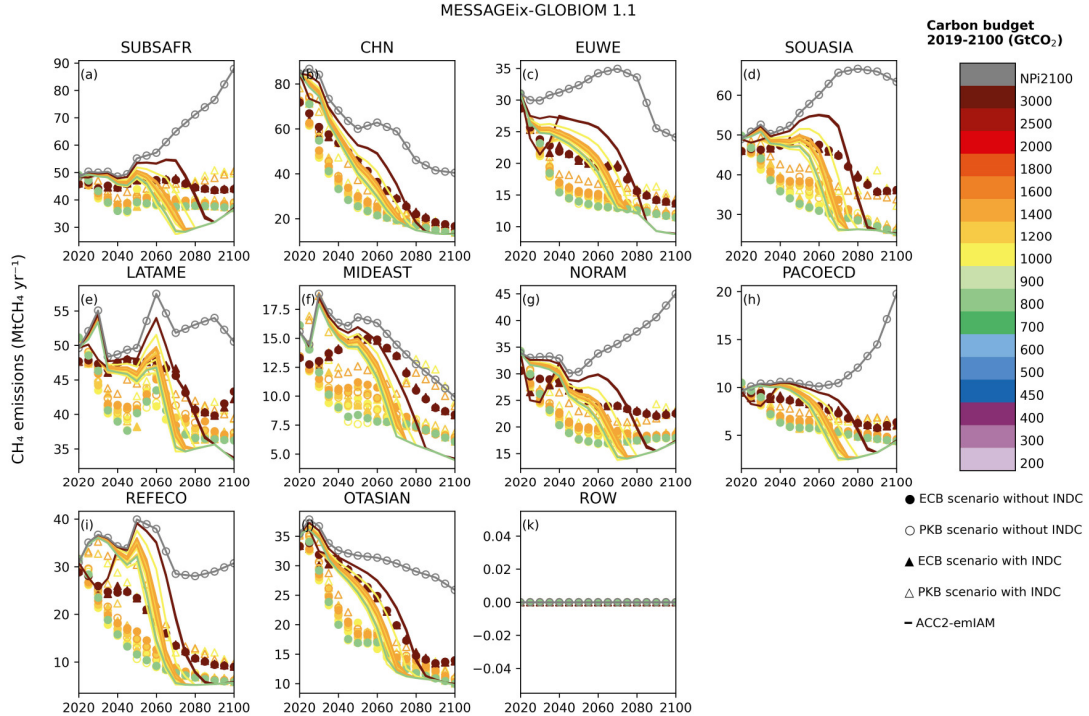


Figure S180. Test 3 - Regional IMAGE total anthropogenic CH₄ validation results

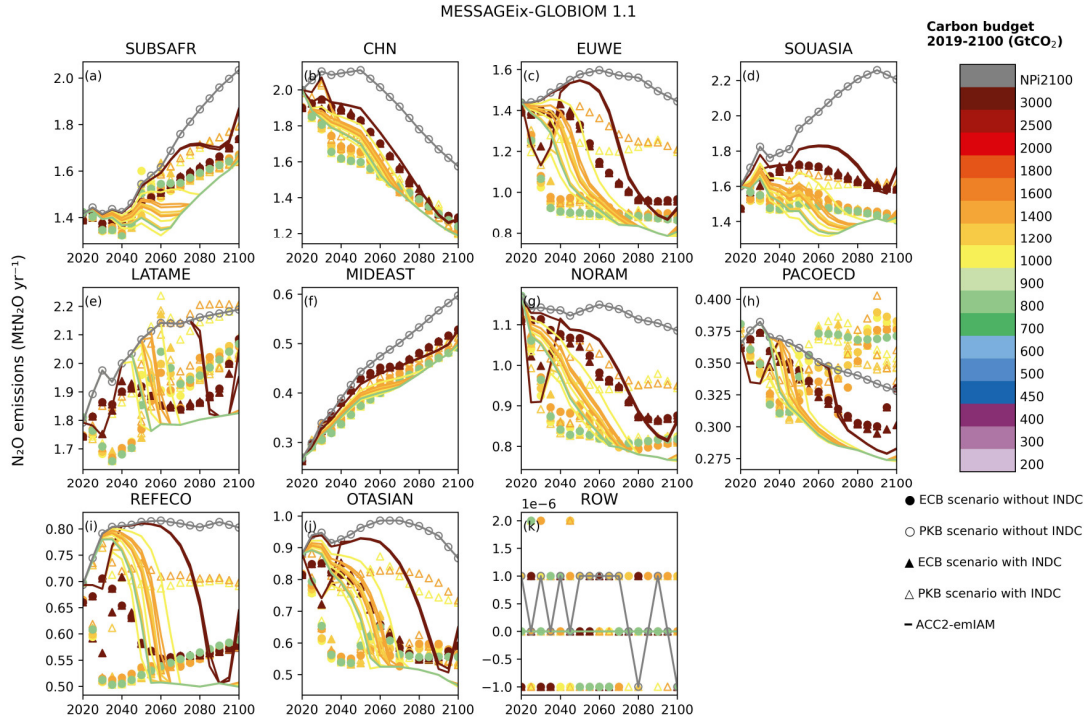


Figure S181. Test 3 - Regional IMAGE total anthropogenic N₂O validation results

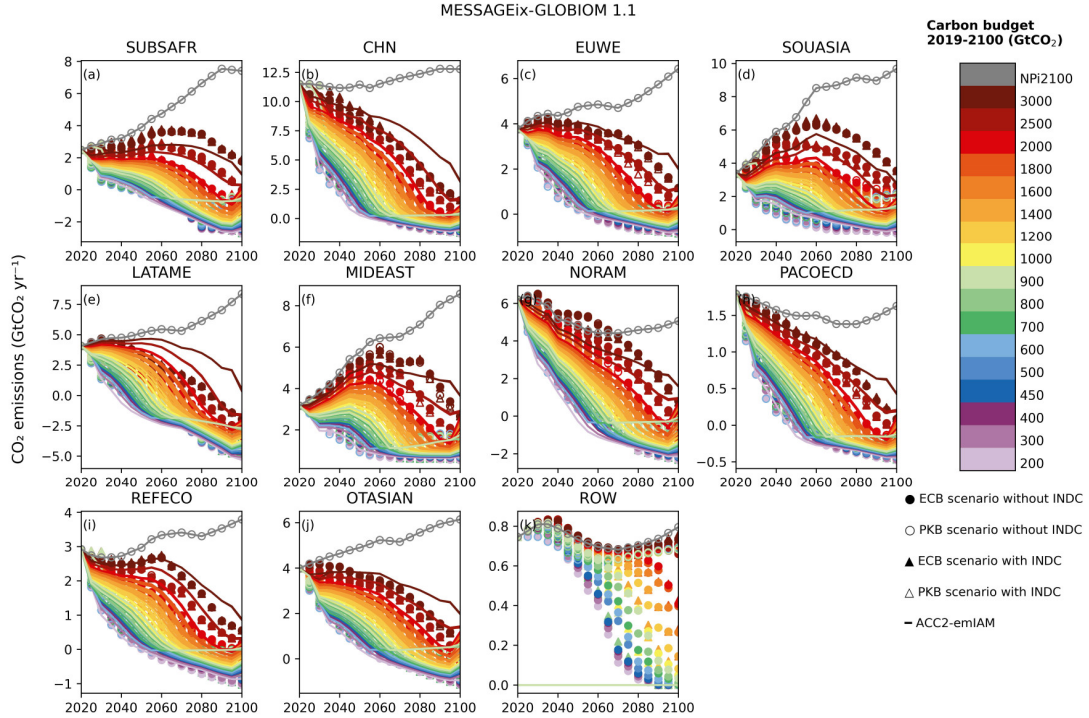


Figure S182. Test 3 - Regional MESSAGE total anthropogenic CO₂ validation results

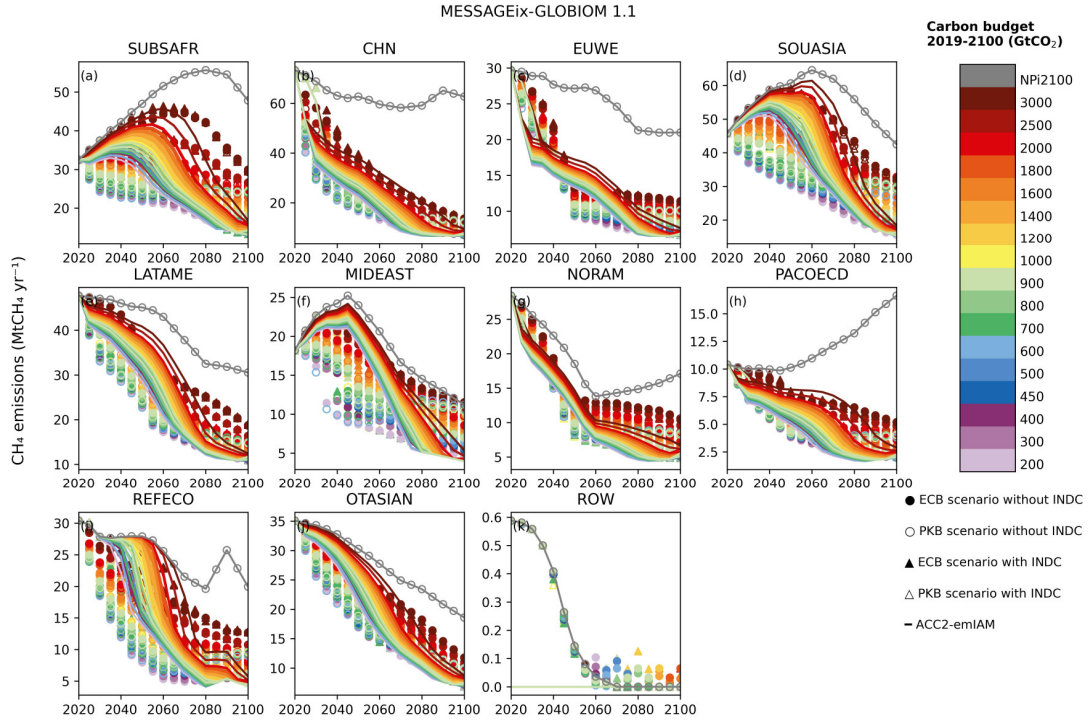


Figure S183. Test 3 - Regional MESSAGE total anthropogenic CH₄ validation results

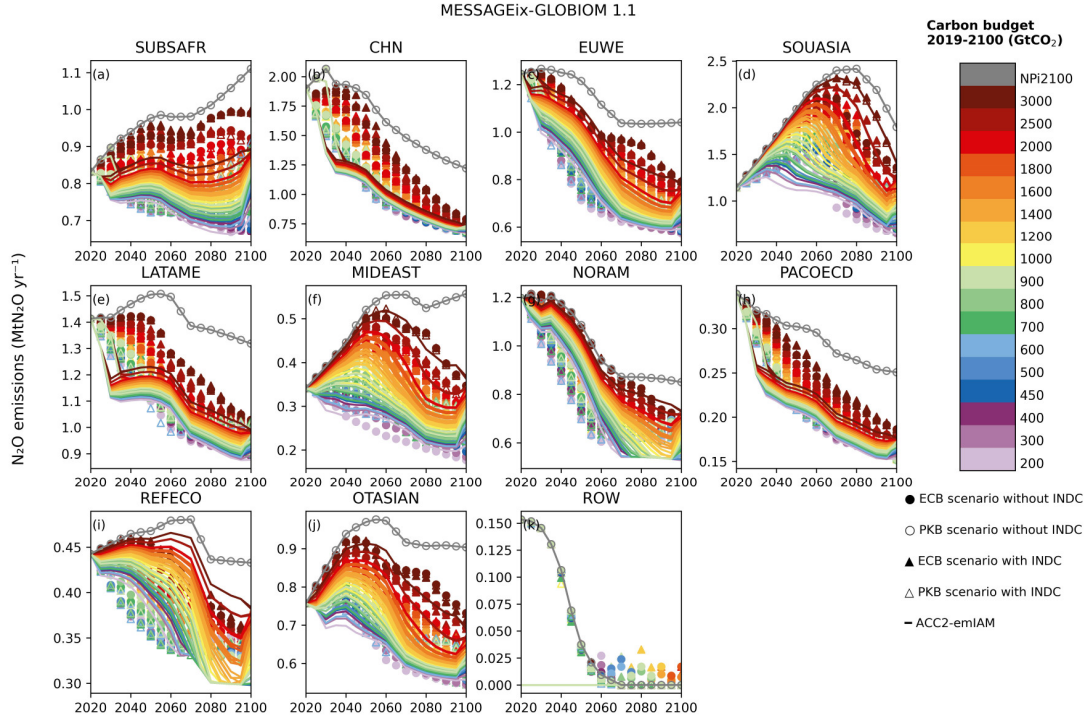


Figure S184. Test 3 - Regional MESSAGE total anthropogenic N₂O validation results

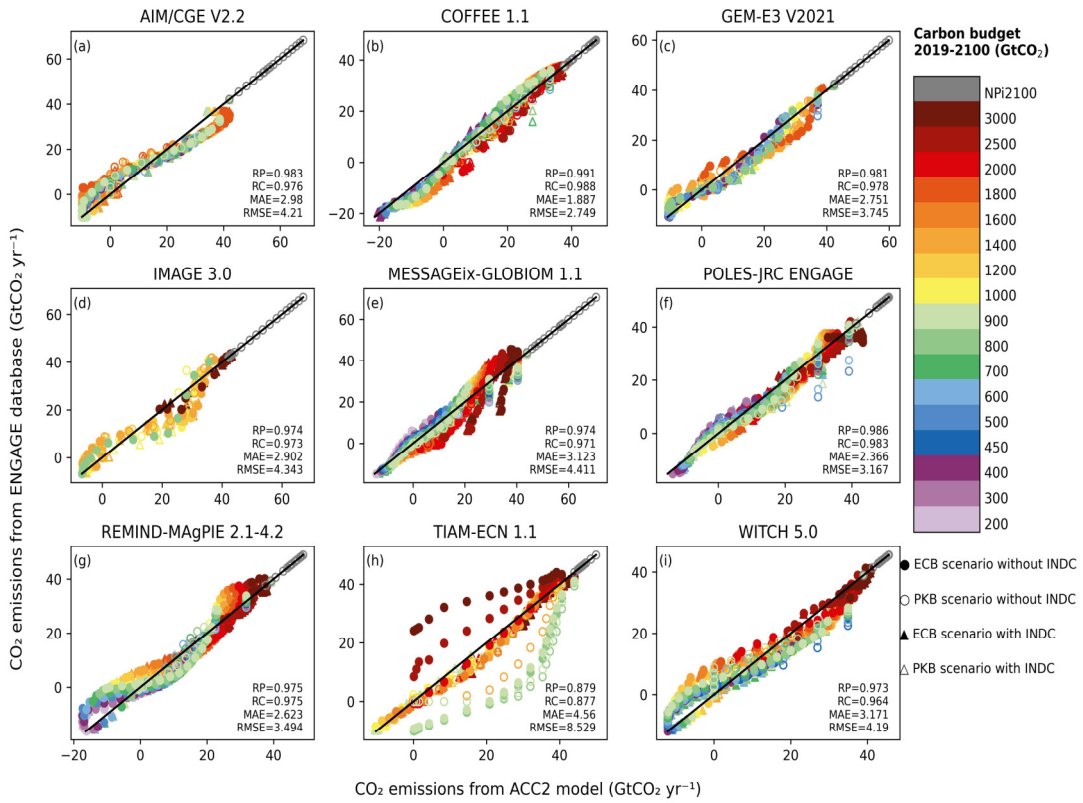


Figure S185. Test 3 - Global nine IAMs - Reproducibility of total anthropogenic CO₂

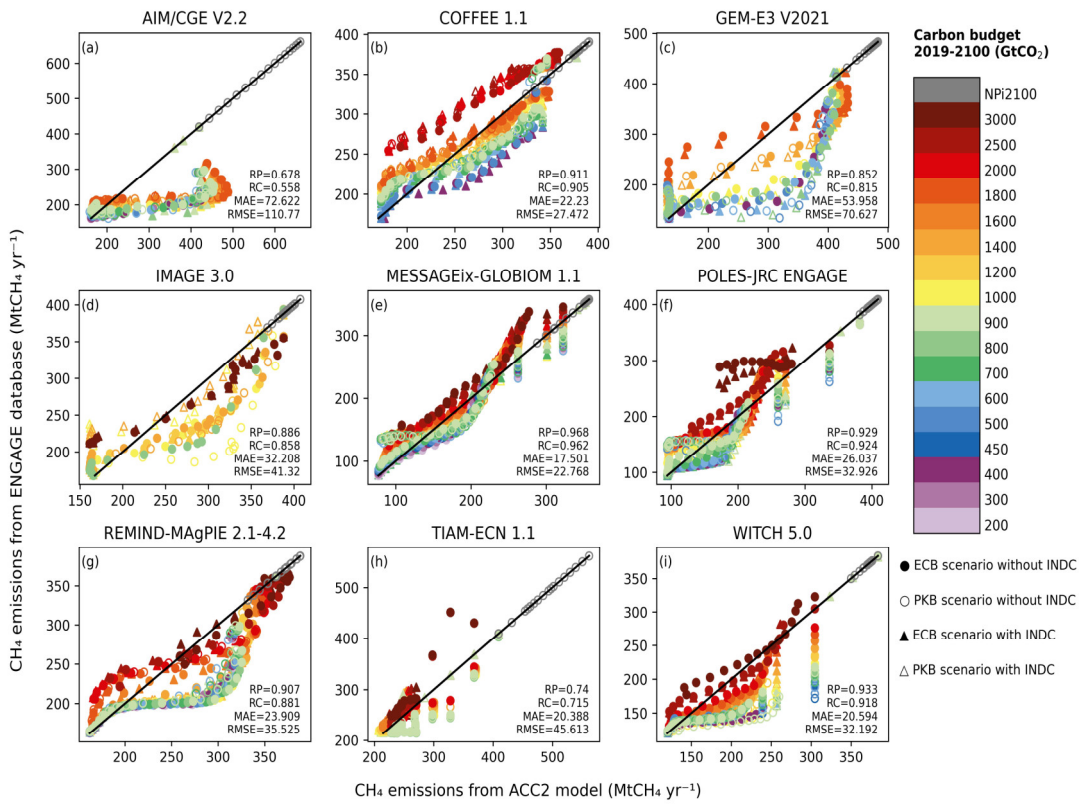


Figure S186. Test 3 - Global nine IAMs - Reproducibility of total anthropogenic CH₄

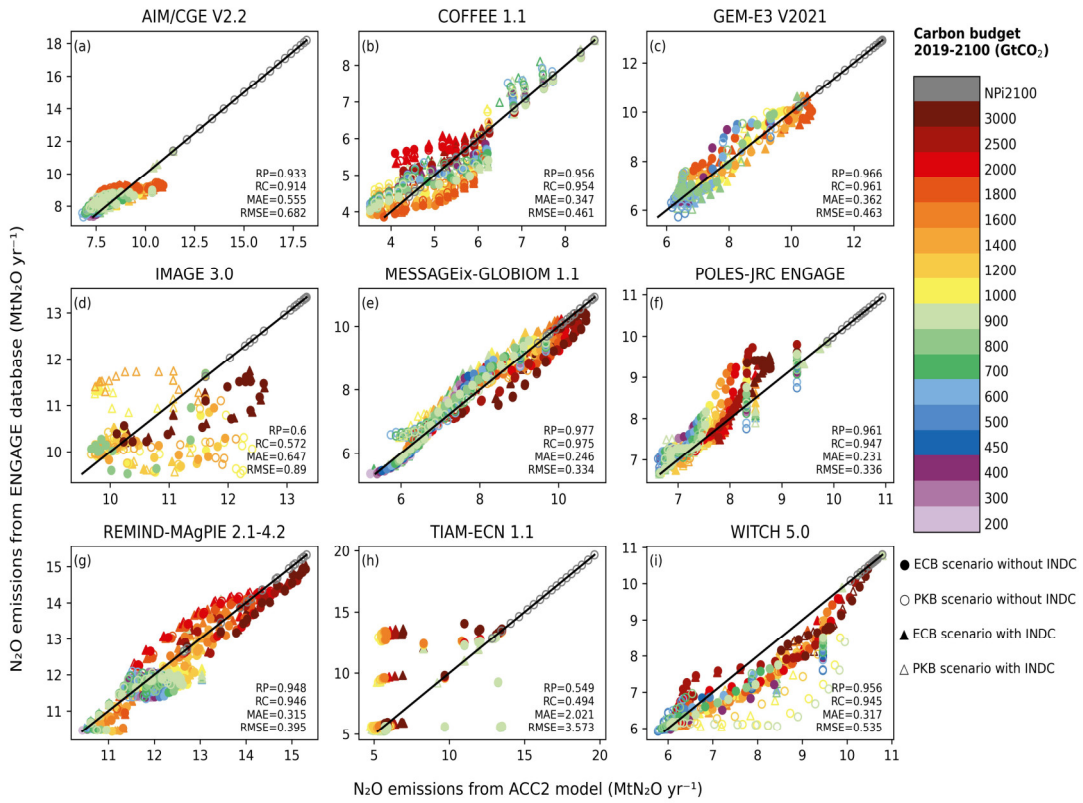


Figure S187. Test 3 - Global nine IAMs - Reproducibility of total anthropogenic N_2O

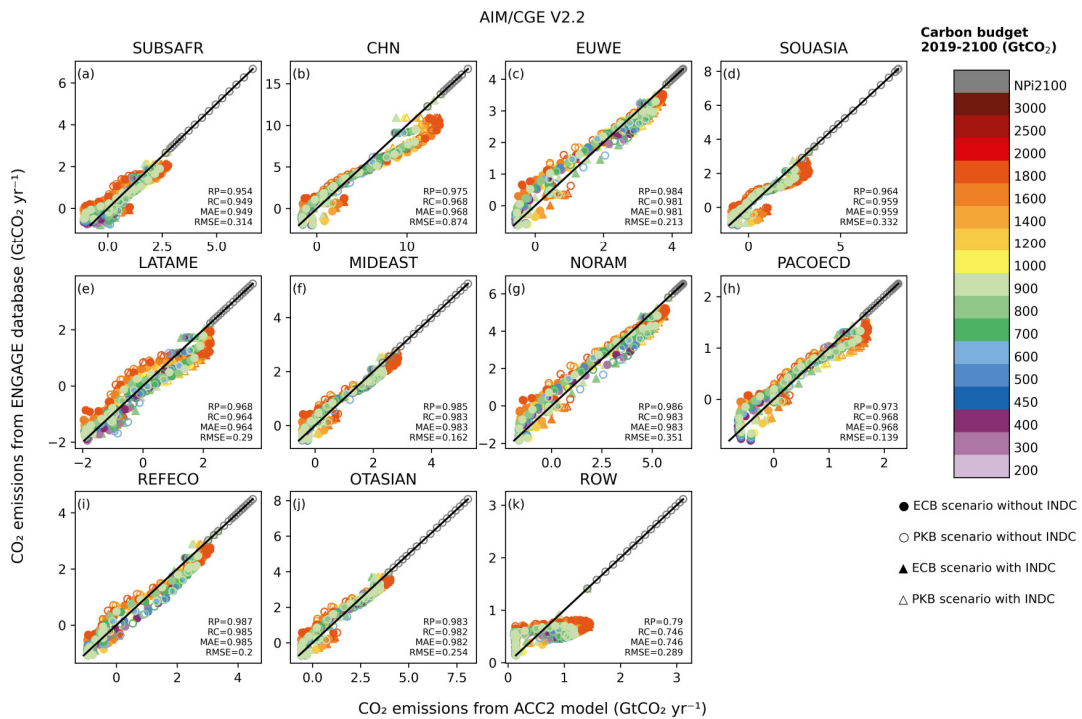


Figure S188. Test 3 - Regional AIM - Reproducibility of total anthropogenic CO_2

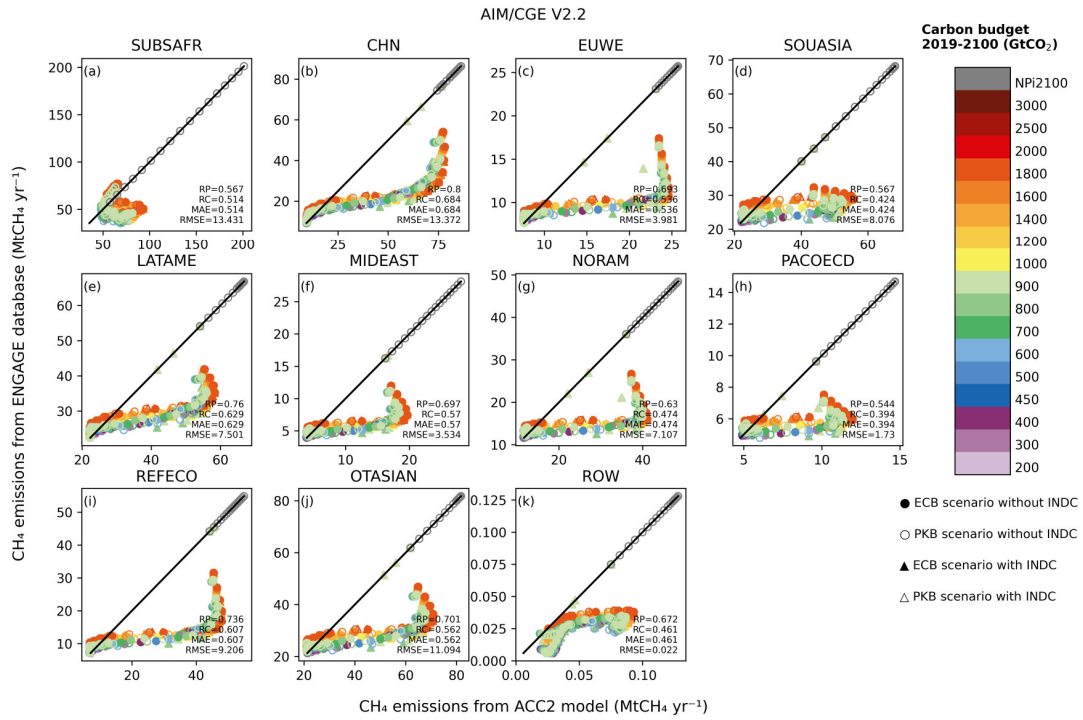


Figure S189. Test 3 - Regional AIM - Reproducibility of total anthropogenic CH₄

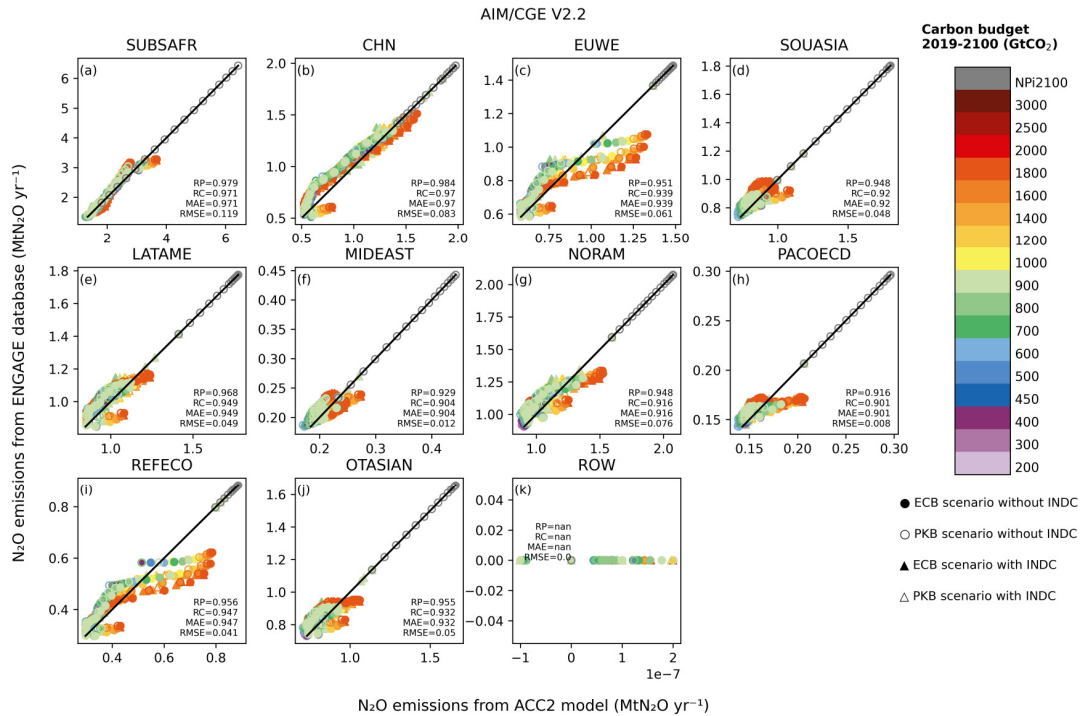


Figure S190. Test 3 - Regional AIM - Reproducibility of total anthropogenic N₂O

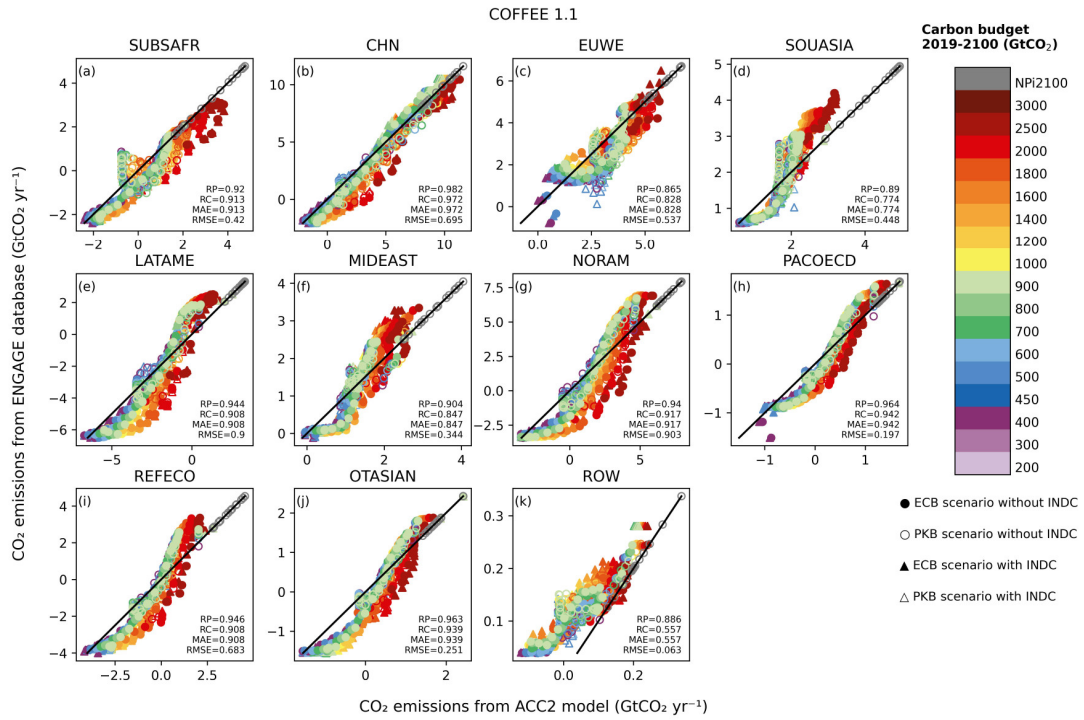


Figure S191. Test 3 - Regional COFFEE - Reproducibility of total anthropogenic CO₂

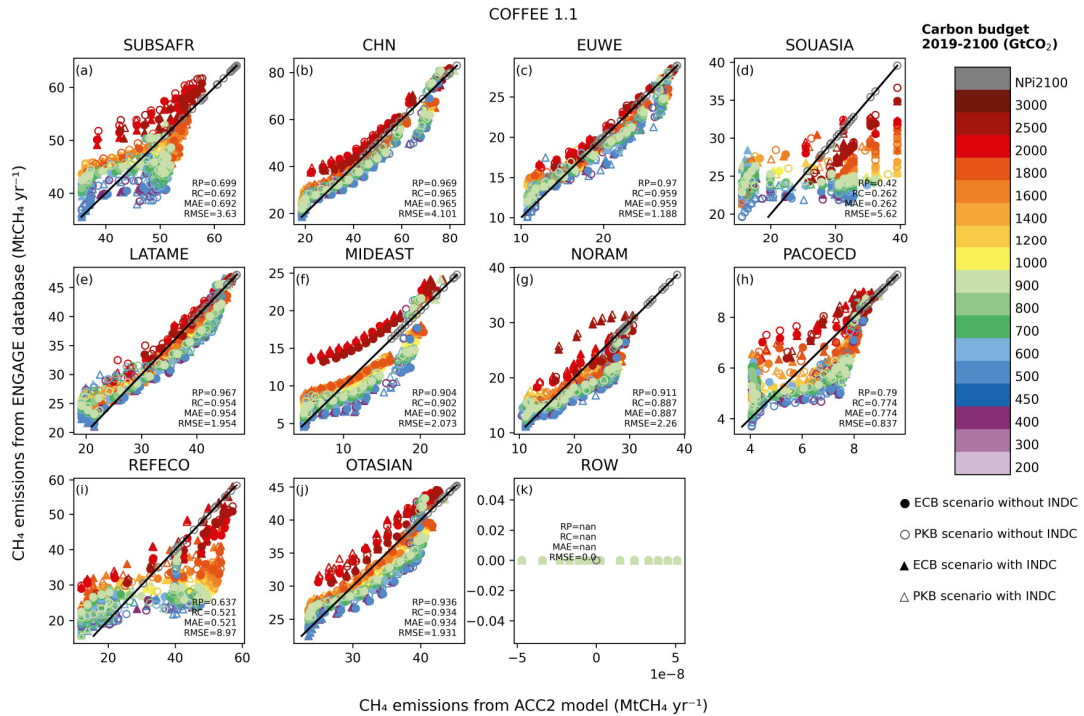


Figure S192. Test 3 - Regional COFFEE - Reproducibility of total anthropogenic CH₄

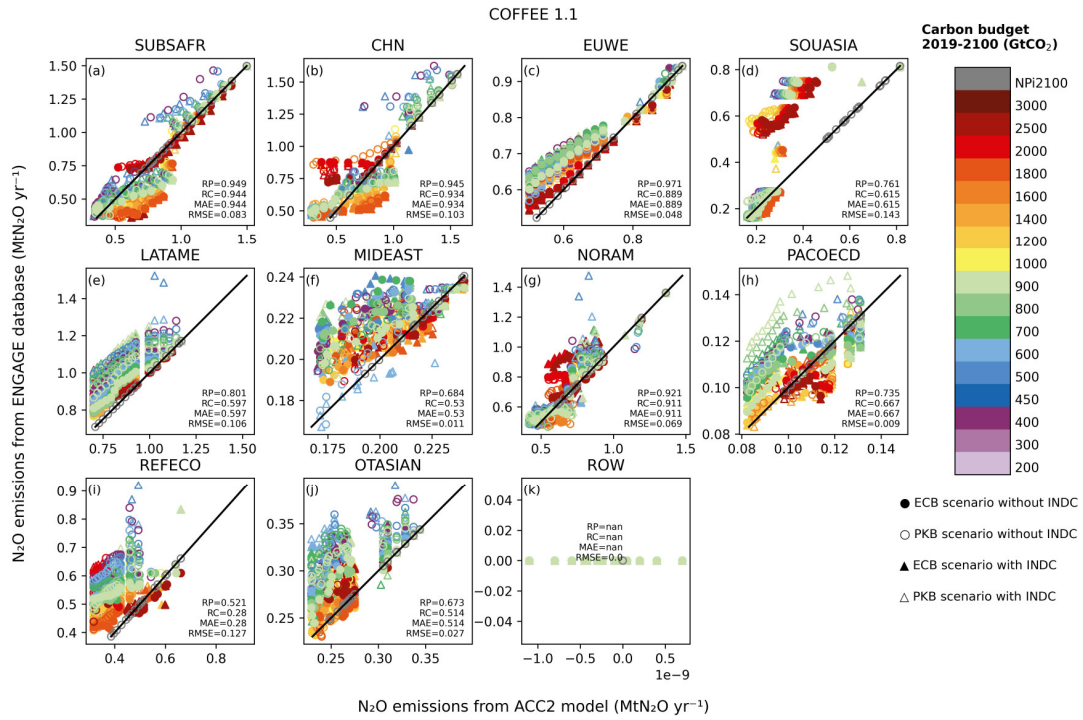


Figure S193. Test 3 - Regional COFFEE - Reproducibility of total anthropogenic N₂O

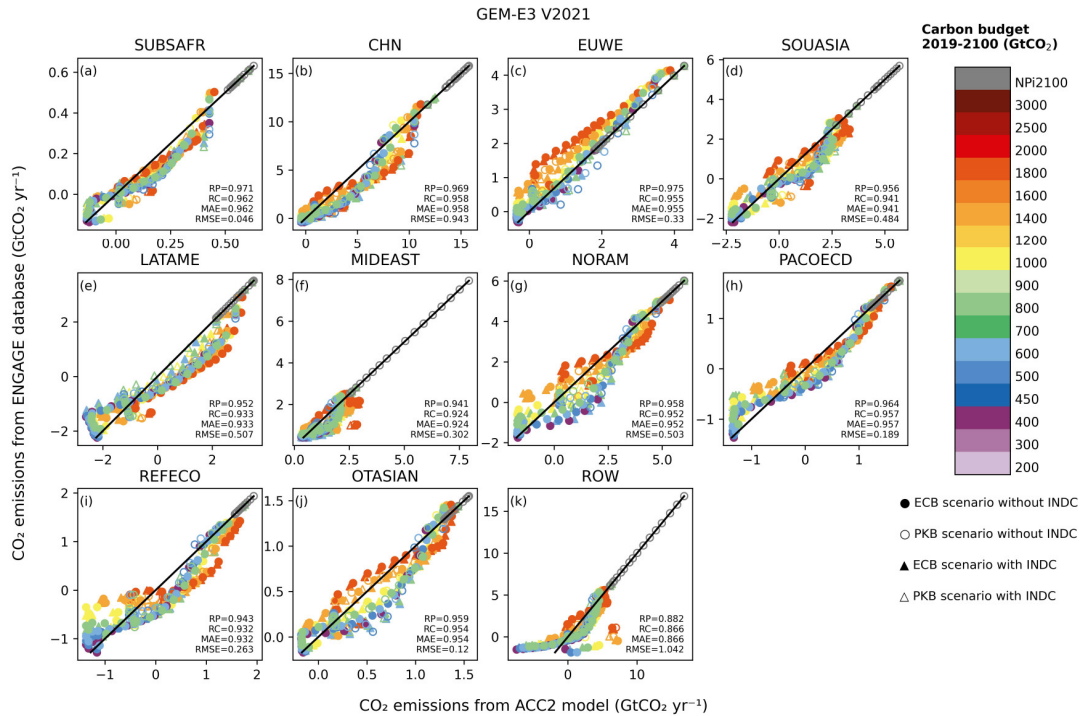


Figure S194. Test 3 - Regional GEM - Reproducibility of total anthropogenic CO₂

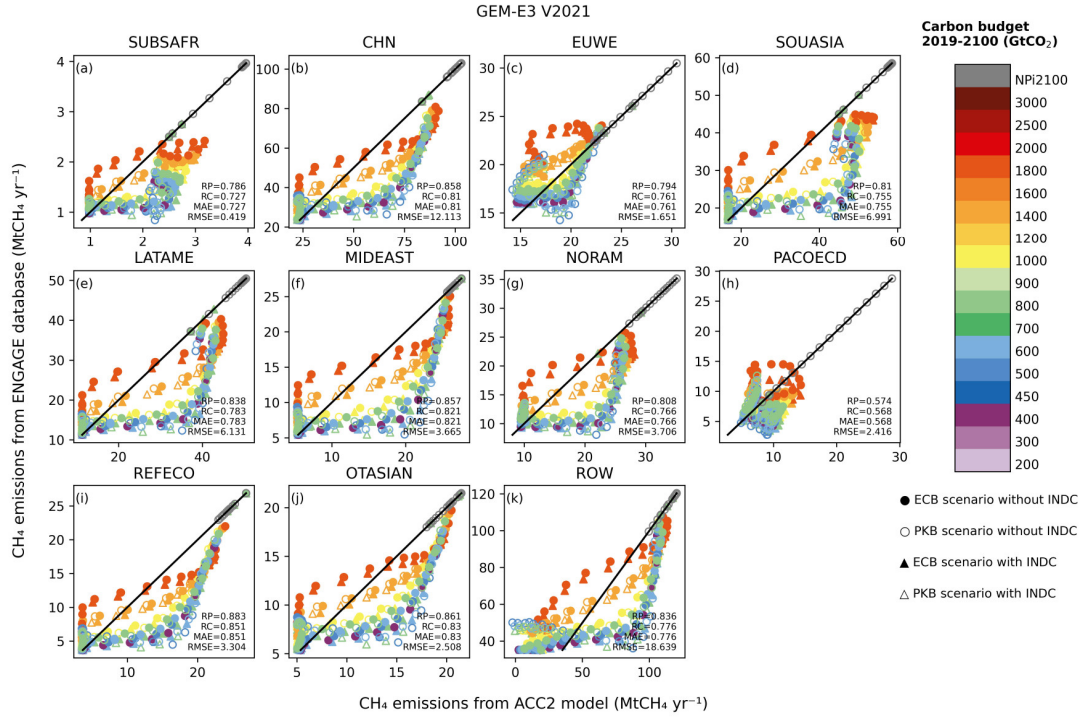


Figure S195. Test 3 - Regional GEM - Reproducibility of total anthropogenic CH₄

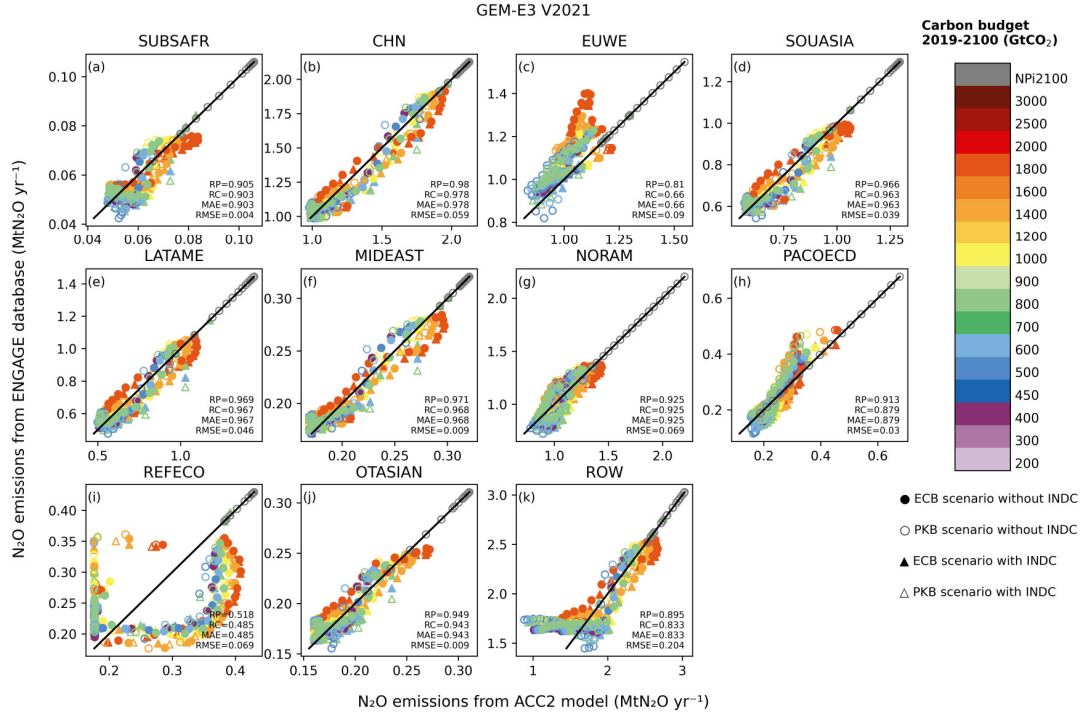


Figure S196. Test 3 - Regional GEM - Reproducibility of total anthropogenic N₂O

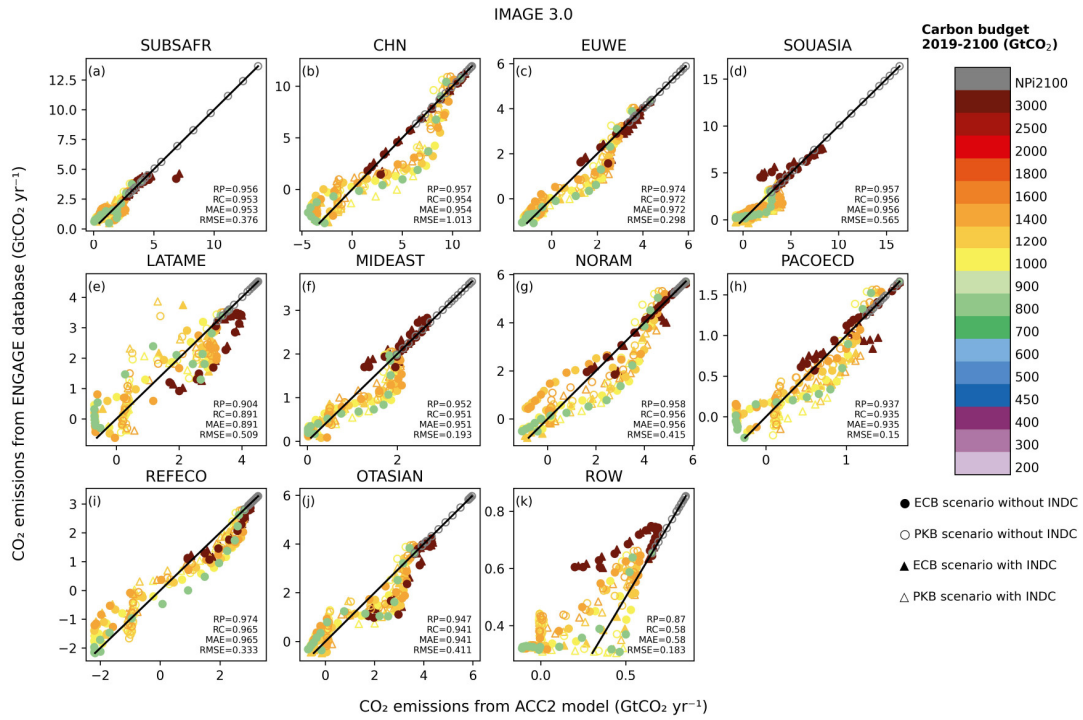


Figure S197. Test 3 - Regional IMAGE - Reproducibility of total anthropogenic CO₂

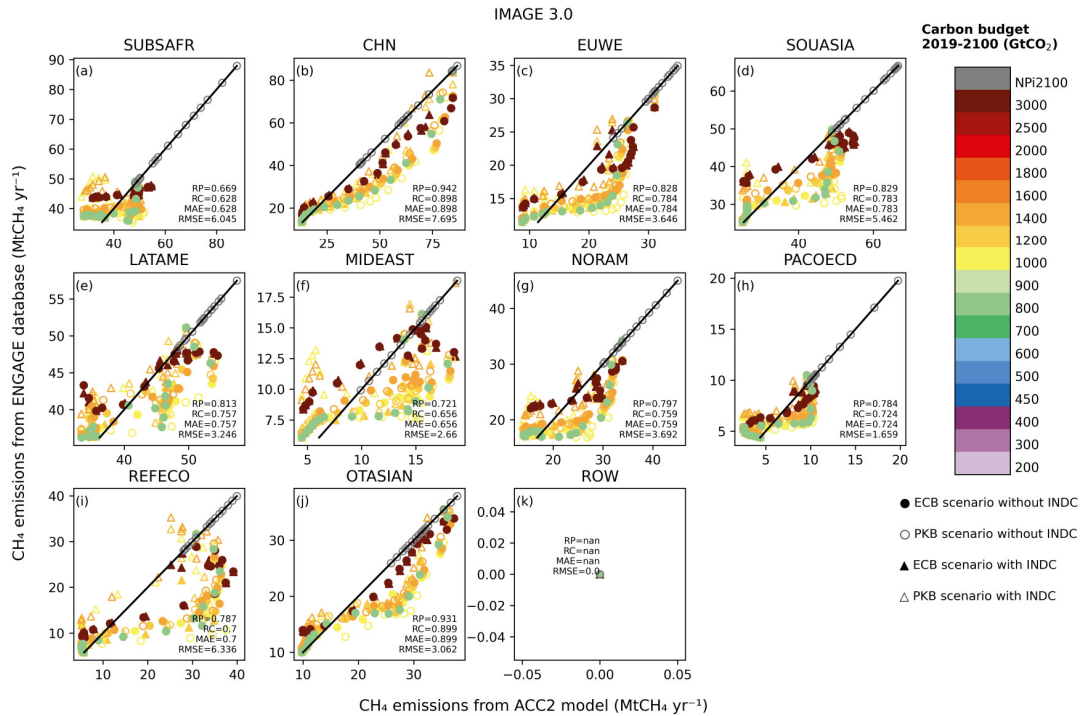


Figure S198. Test 3 - Regional IMAGE - Reproducibility of total anthropogenic CH₄

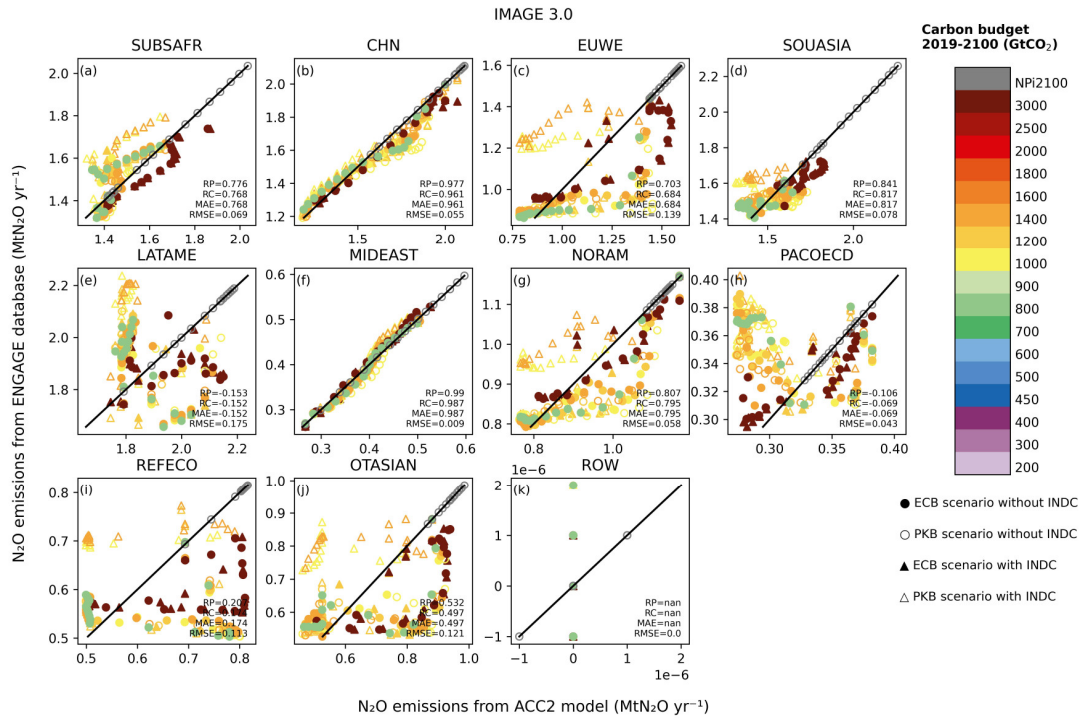


Figure S199. Test 3 - Regional IMAGE - Reproducibility of total anthropogenic N₂O

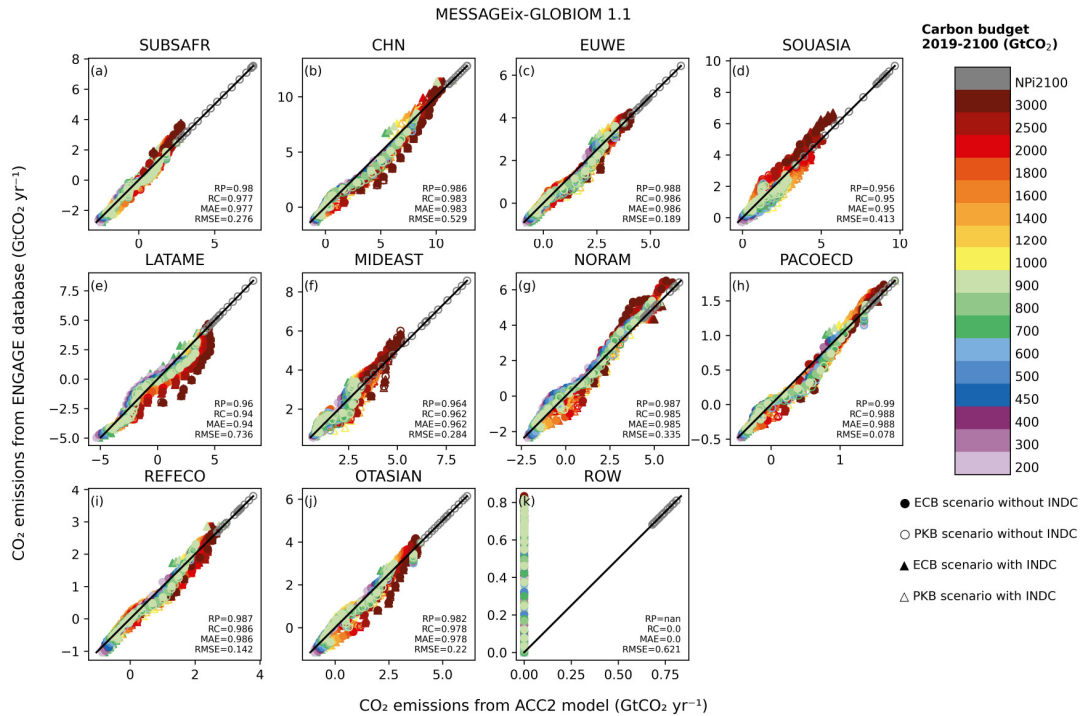


Figure S200. Test 3 - Regional MESSAGE - Reproducibility of total anthropogenic CO₂

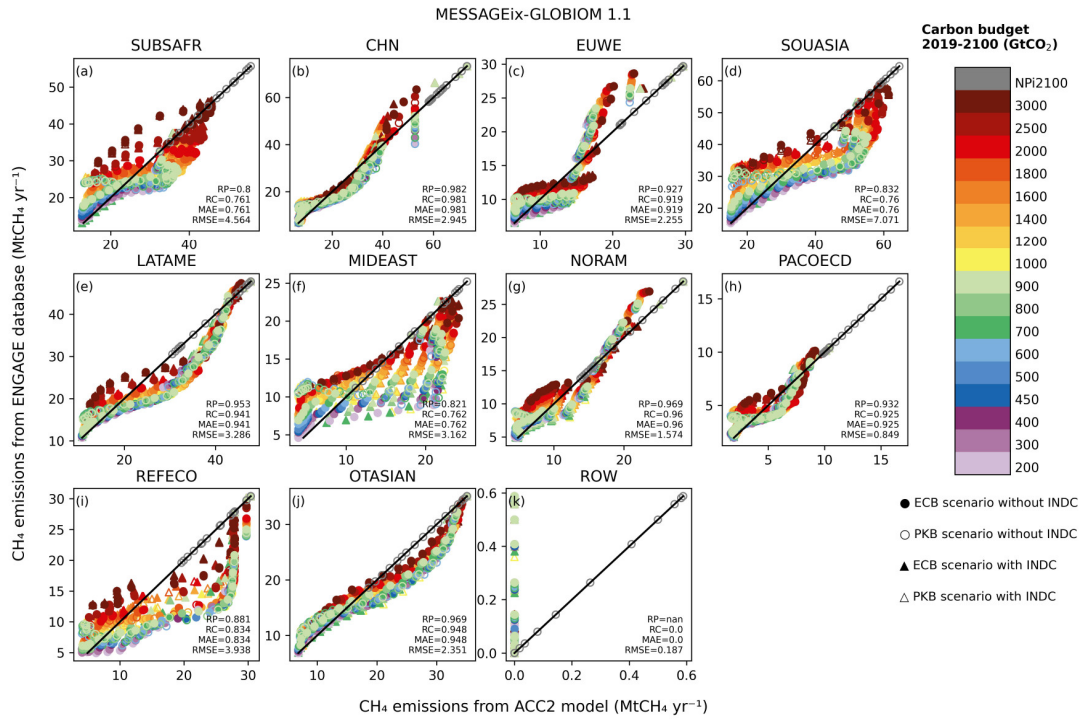


Figure S201. Test 3 - Regional MESSAGE - Reproducibility of total anthropogenic CH₄

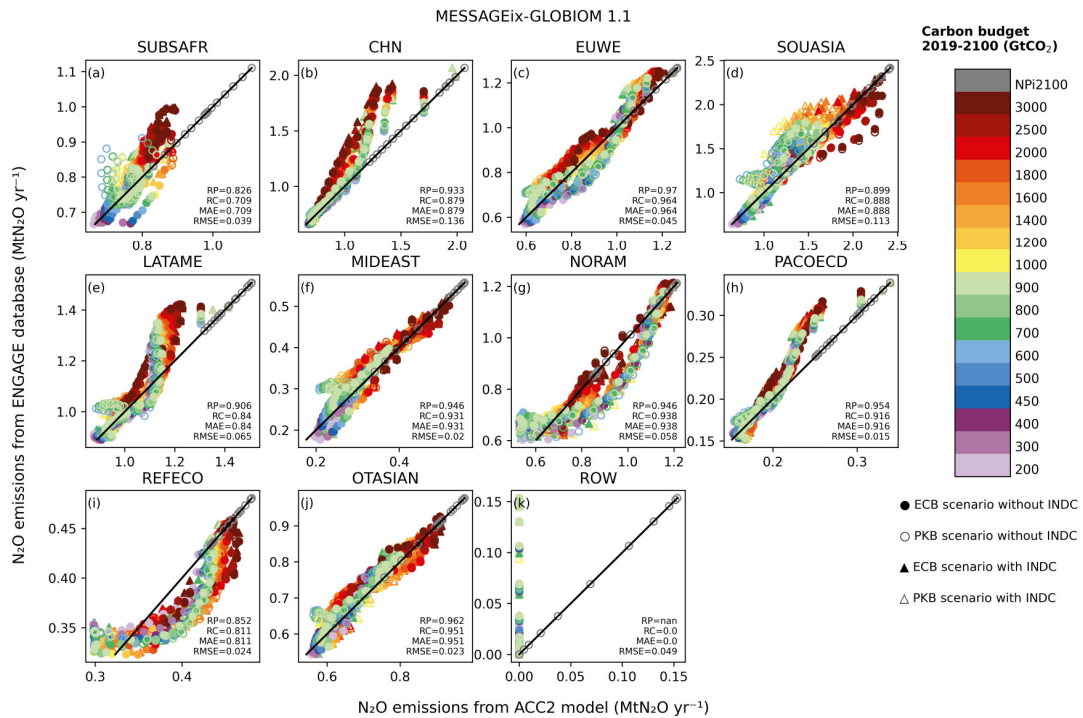


Figure S202. Test 3 - Regional MESSAGE - Reproducibility of total anthropogenic N₂O

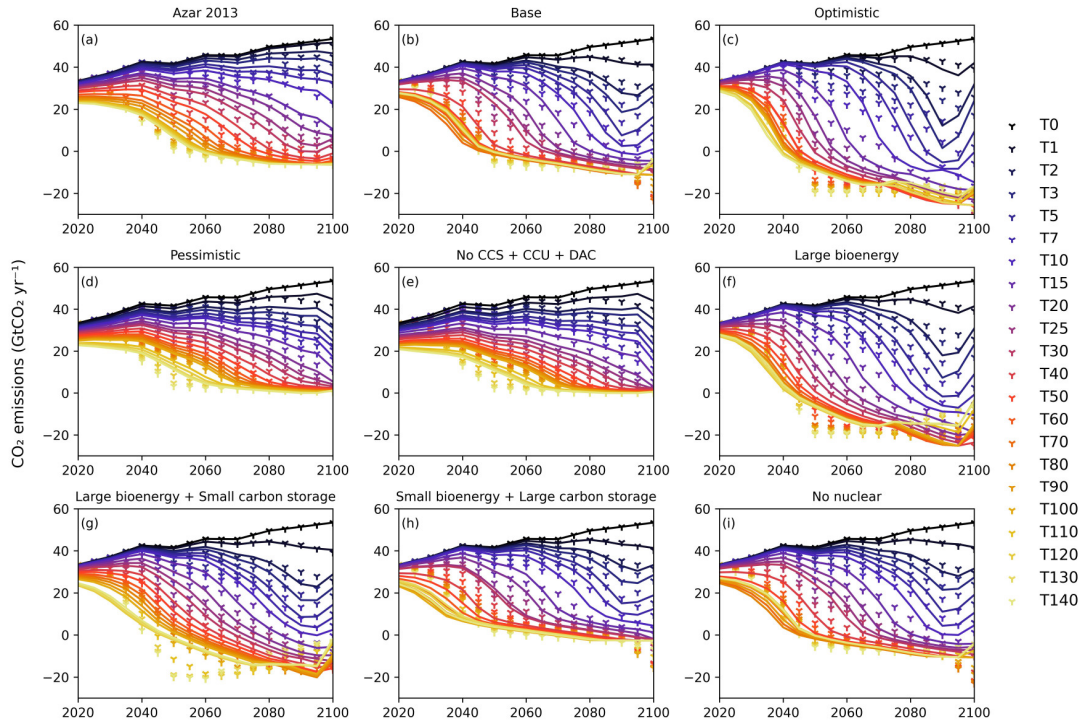


Figure S203. Test 4 – GET nine portfolios energy-related CO₂ validation results

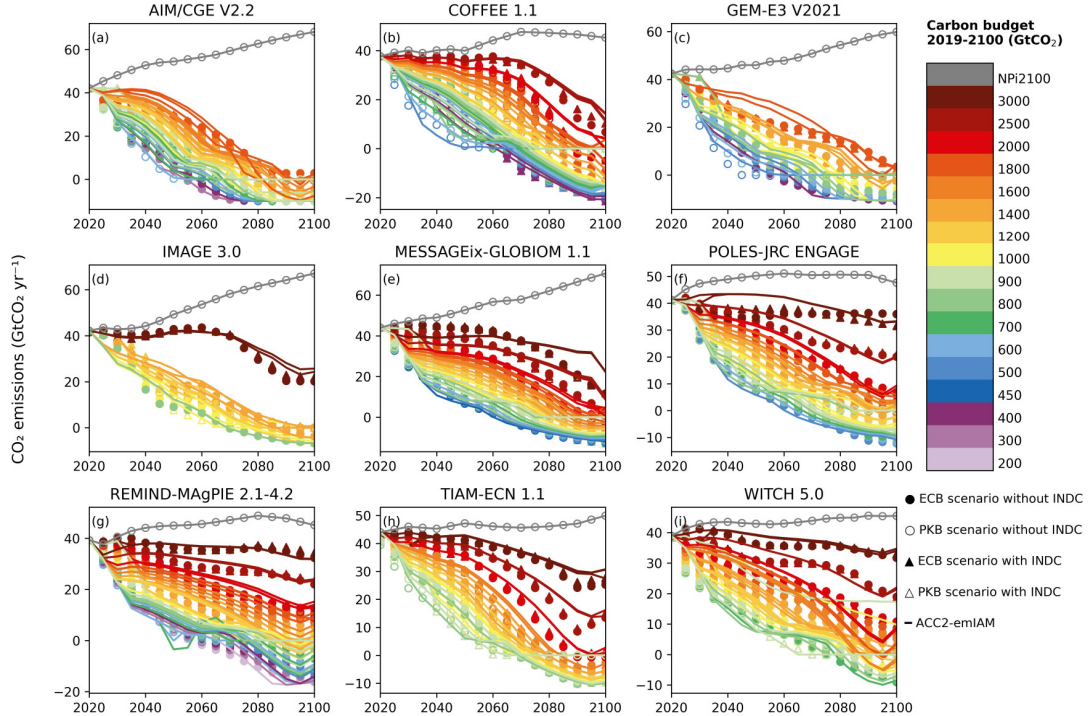


Figure S204. Test 4 – Global nine IAMs total anthropogenic CO₂ validation results

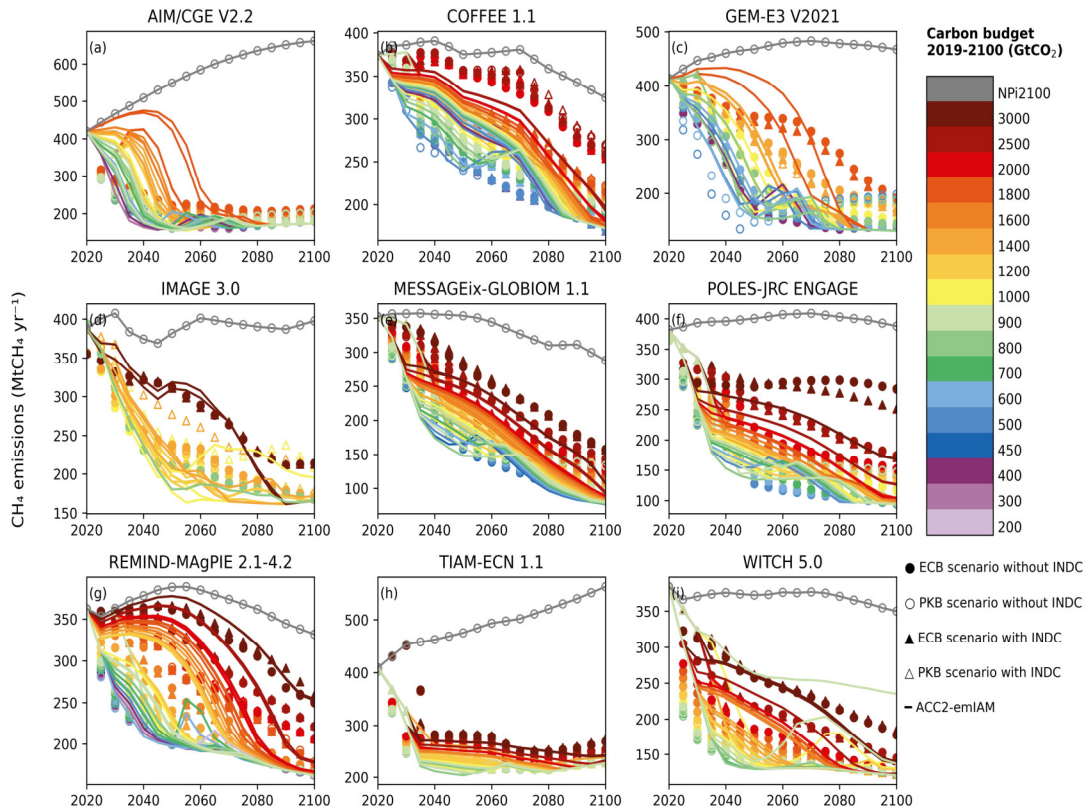


Figure S205. Test 4 – Global nine IAMs total anthropogenic CH₄ validation results

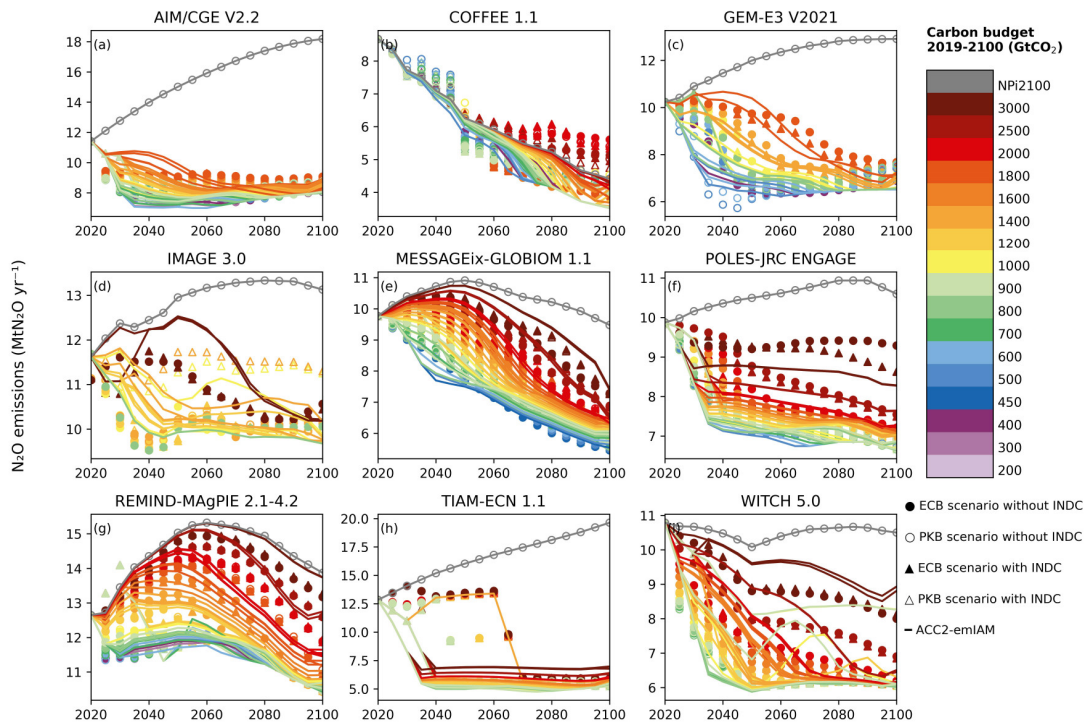


Figure S206. Test 4 – Global nine IAMs total anthropogenic N₂O validation results

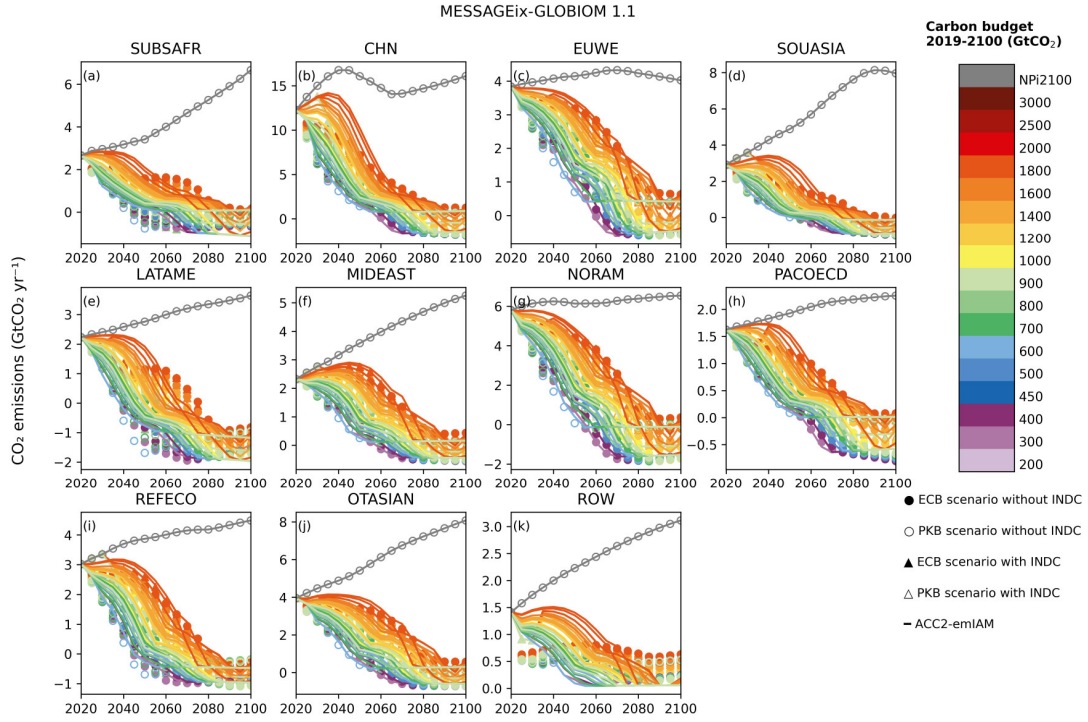


Figure S207. Test 4 - Regional AIM total anthropogenic CO₂ validation results

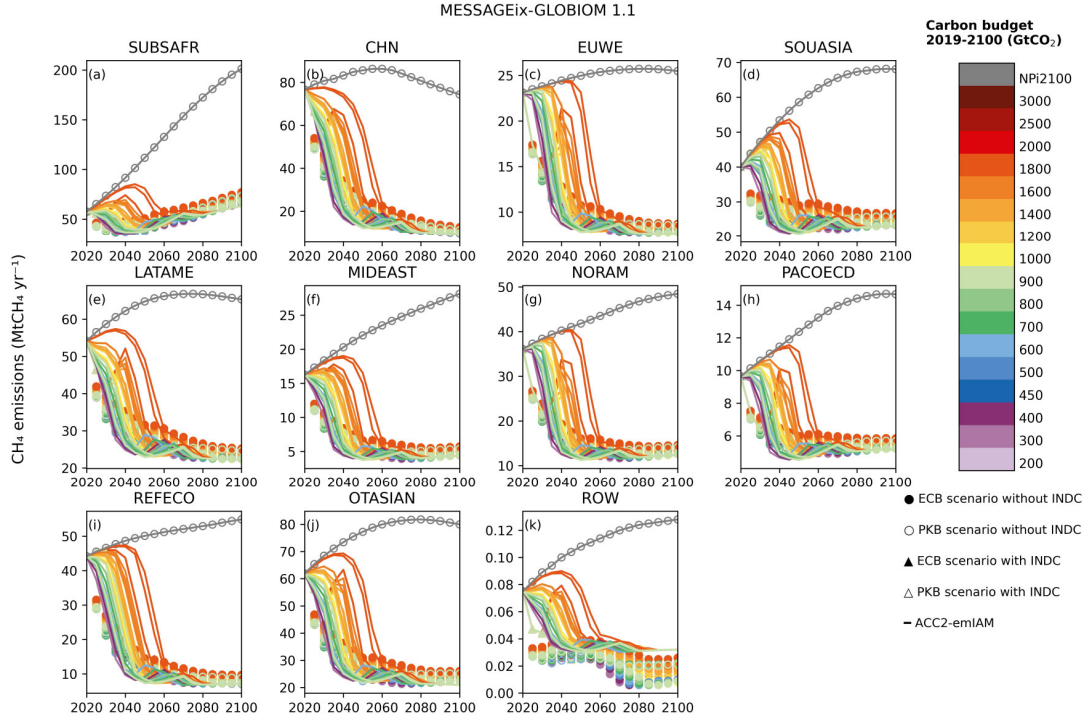


Figure S208. Test 4 - Regional AIM total anthropogenic CH₄ validation results

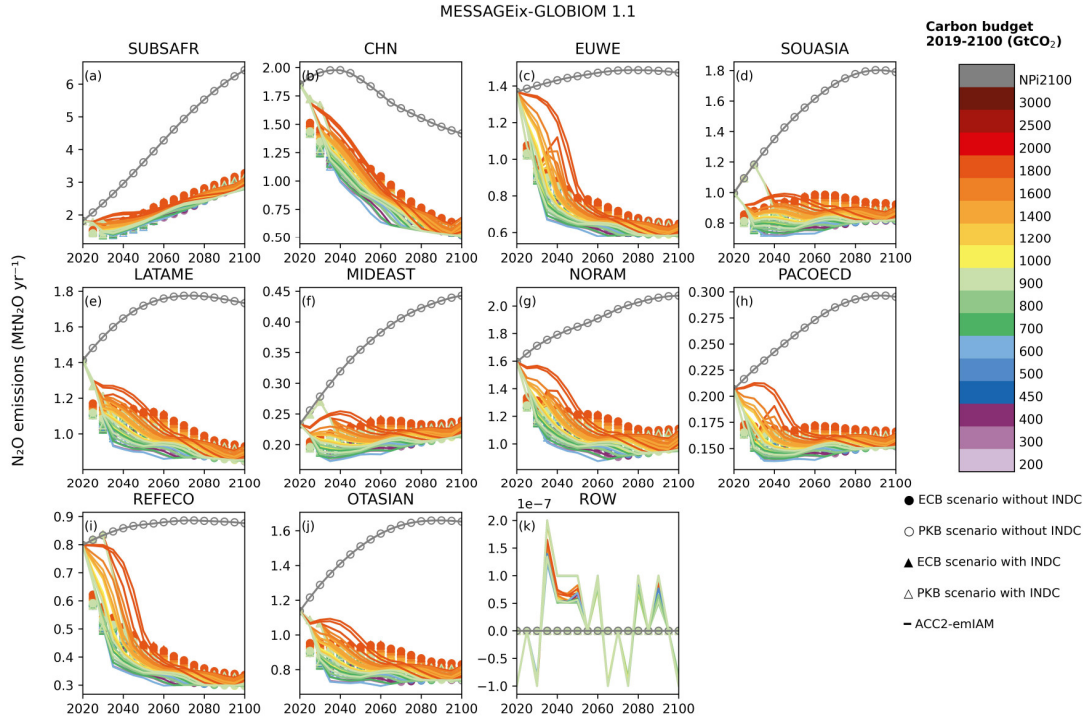


Figure S209. Test 4 - Regional AIM total anthropogenic N₂O validation results

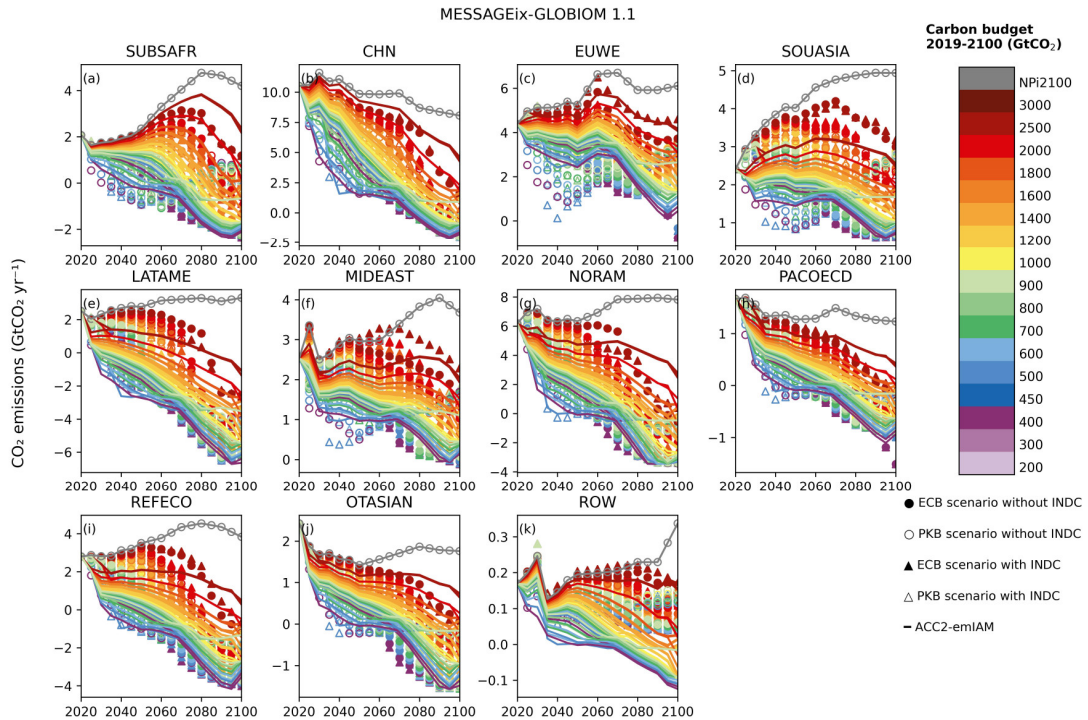


Figure S210. Test 4 - Regional COFFEE total anthropogenic CO₂ validation results

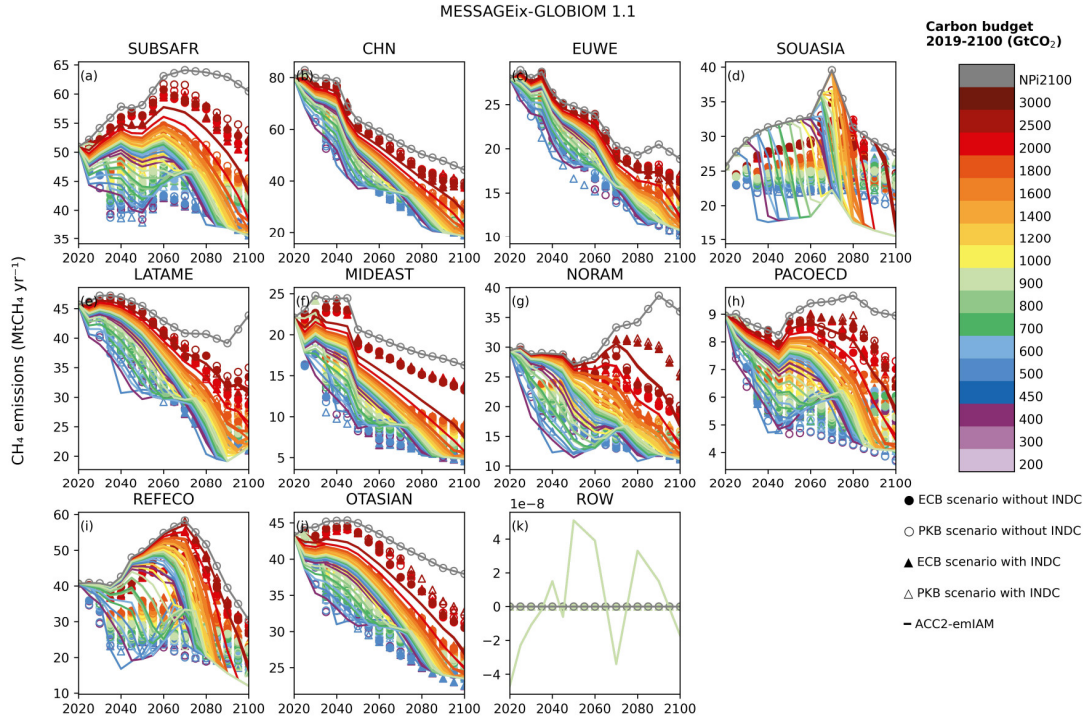


Figure S211. Test 4 - Regional COFFEE total anthropogenic CH₄ validation results

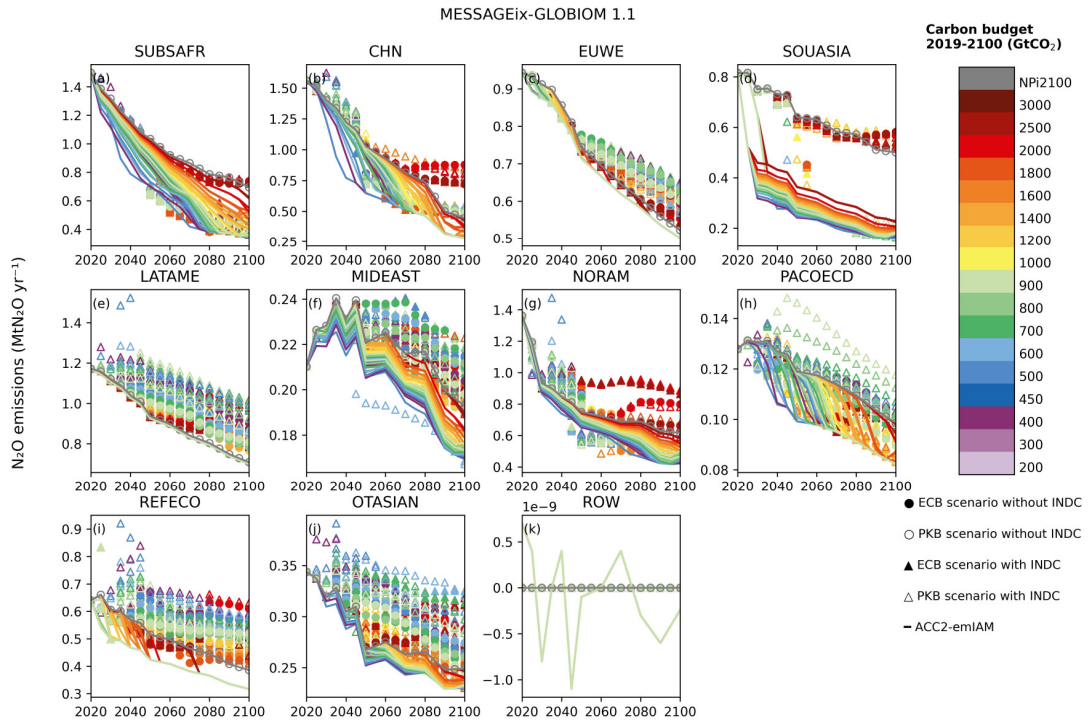


Figure S212. Test 4 - Regional COFFEE total anthropogenic N₂O validation results

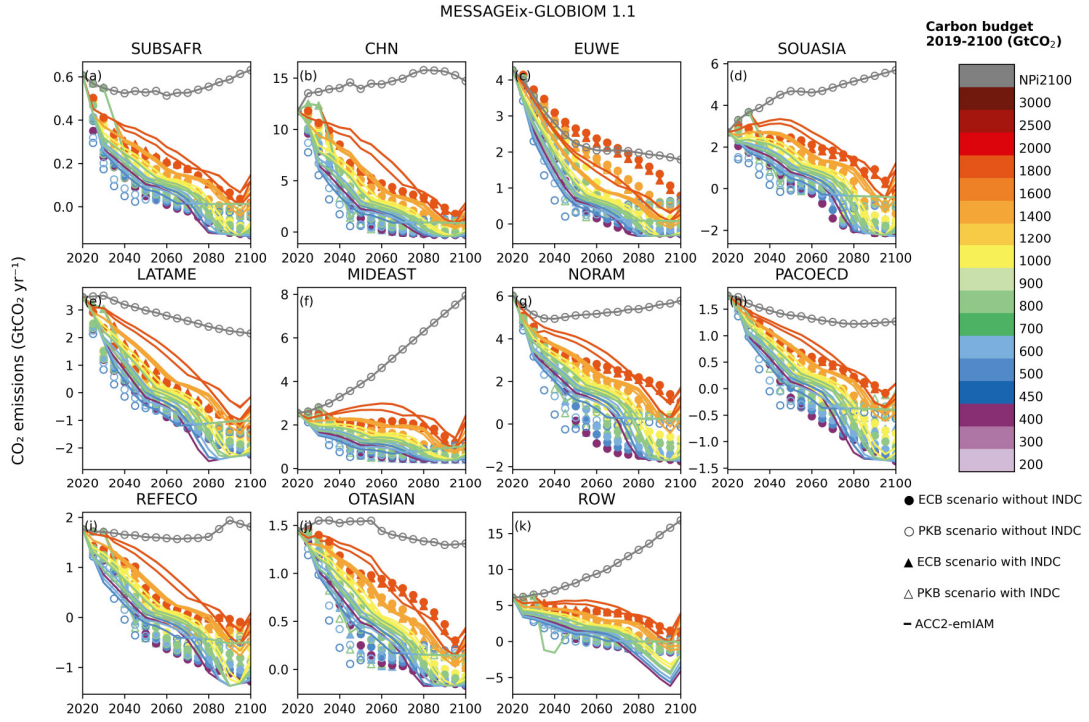


Figure S213. Test 4 - Regional GEM total anthropogenic CO₂ validation results

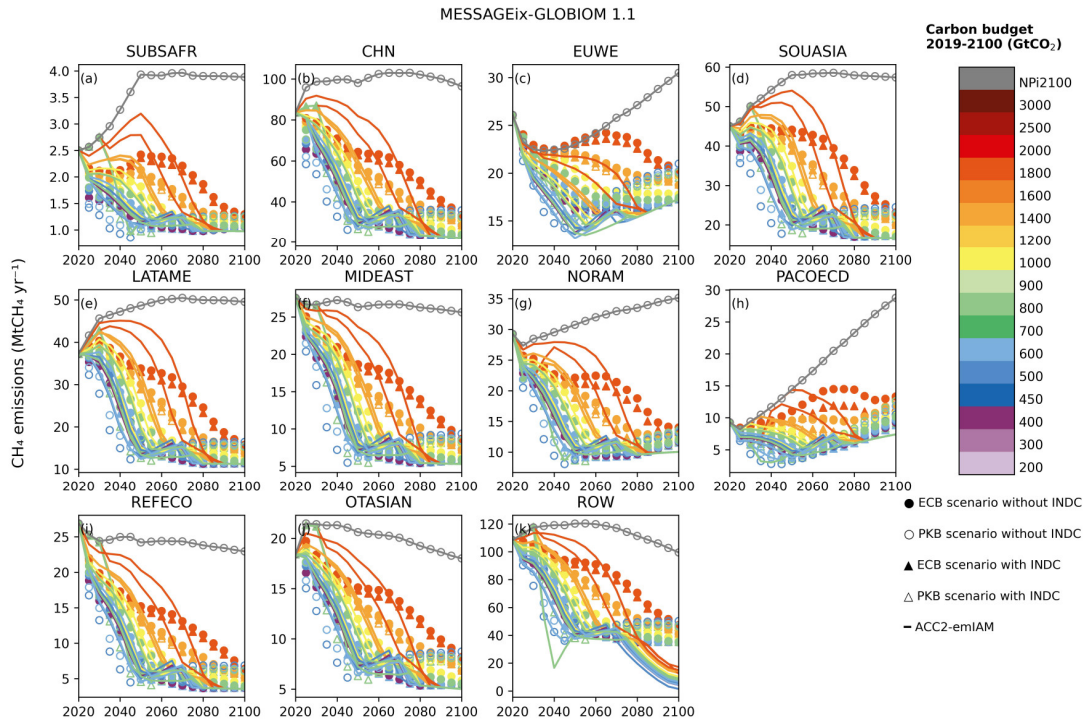


Figure S214. Test 4 - Regional GEM total anthropogenic CH₄ validation results

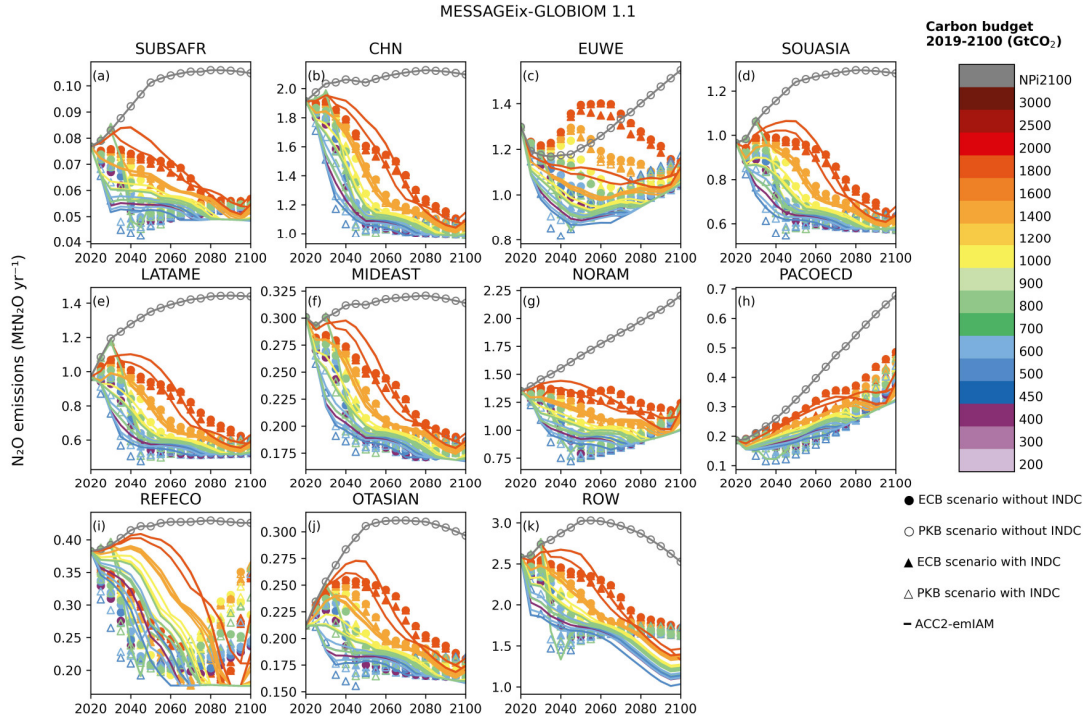


Figure S215. Test 4 - Regional GEM total anthropogenic N₂O validation results

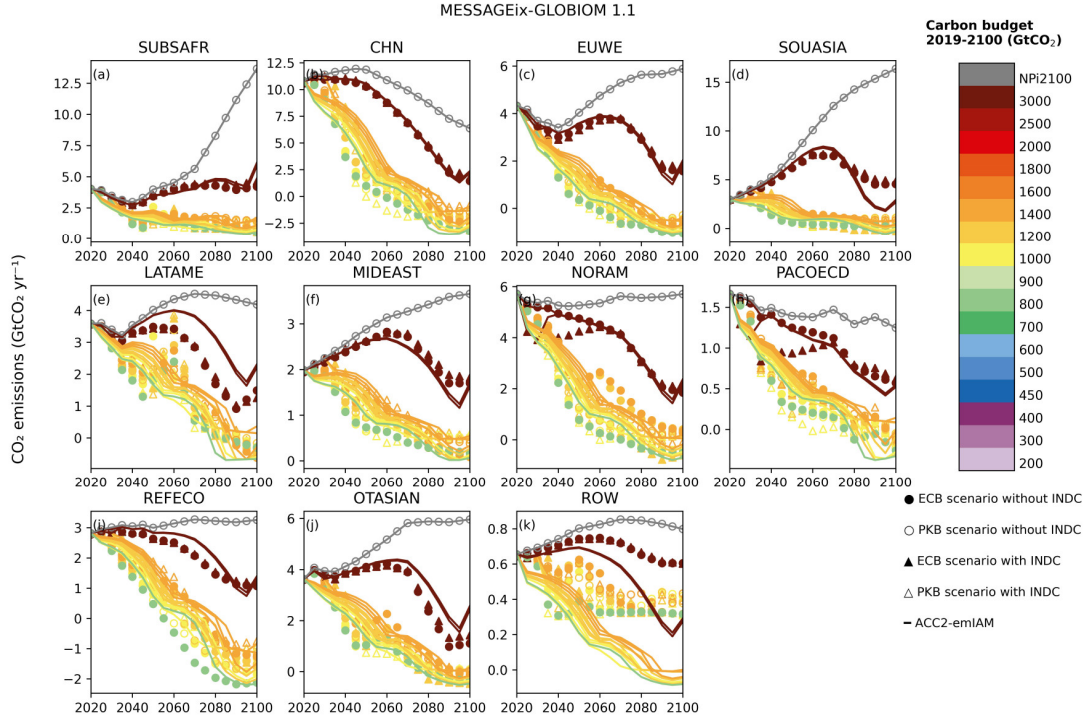


Figure S216. Test 4 - Regional IMAGE total anthropogenic CO₂ validation results

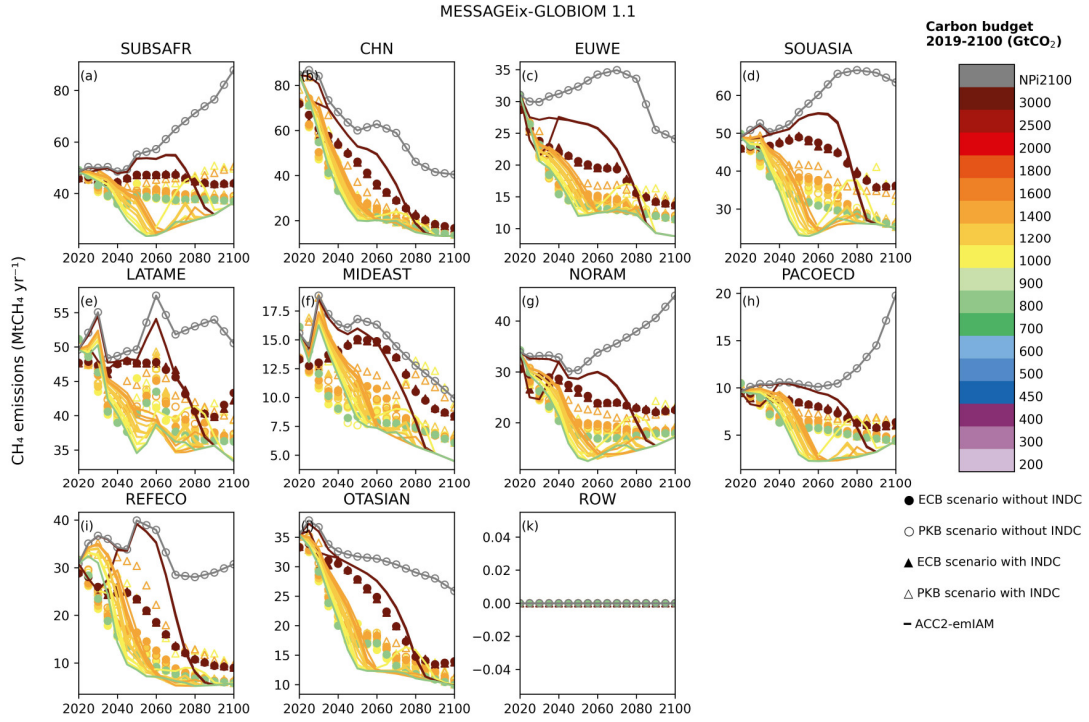


Figure S217. Test 4 - Regional IMAGE total anthropogenic CH₄ validation results

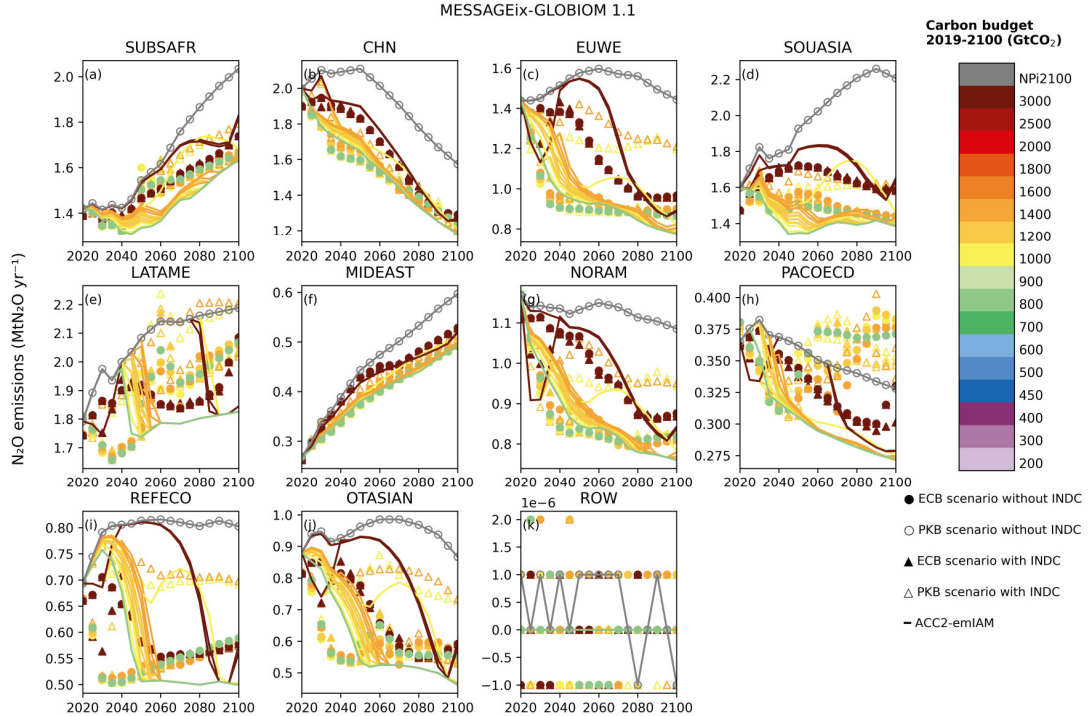


Figure S218. Test 4 - Regional IMAGE total anthropogenic N₂O validation results

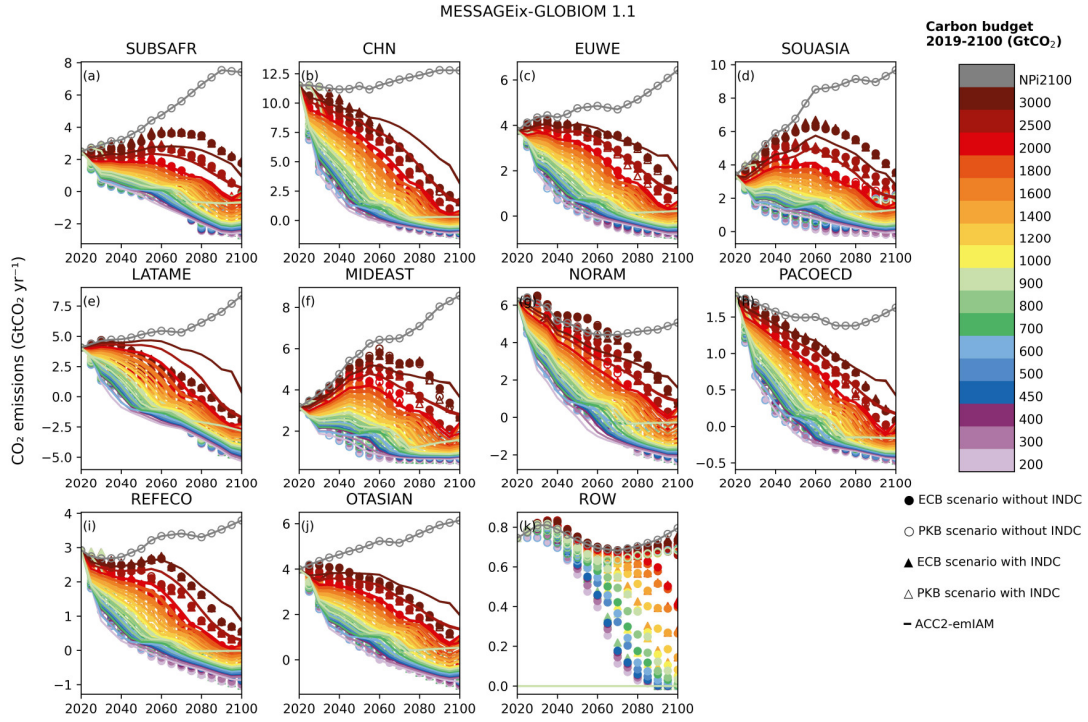


Figure S219. Test 4 - Regional MESSAGE total anthropogenic CO₂ validation results

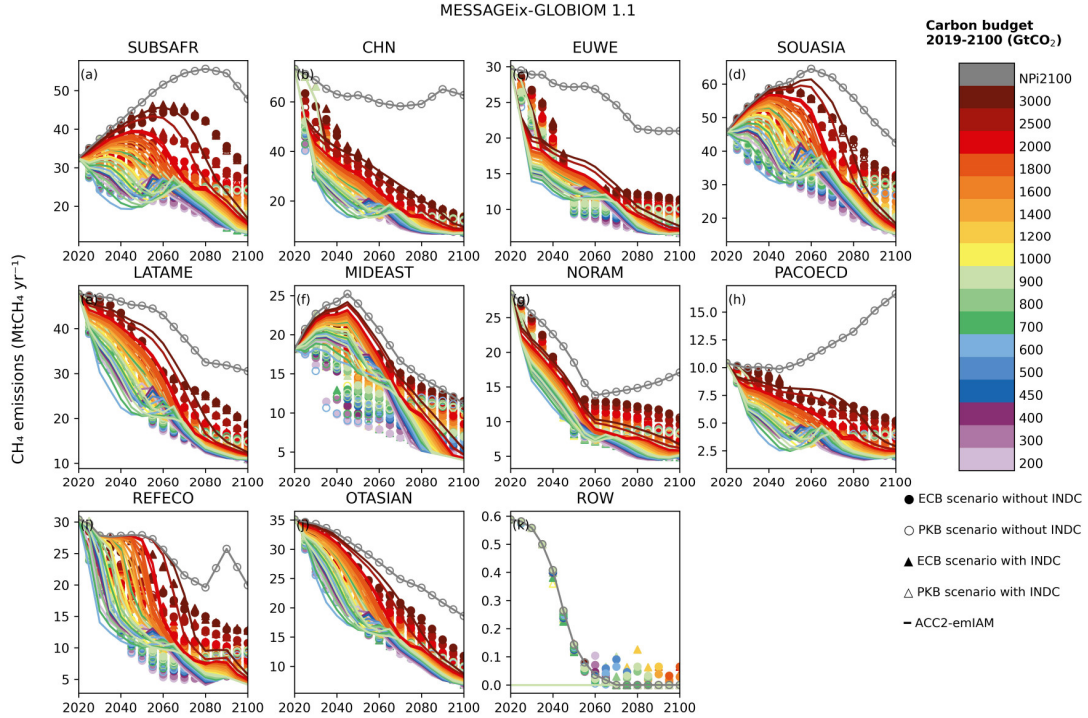


Figure S220. Test 4 - Regional MESSAGE total anthropogenic CH₄ validation results

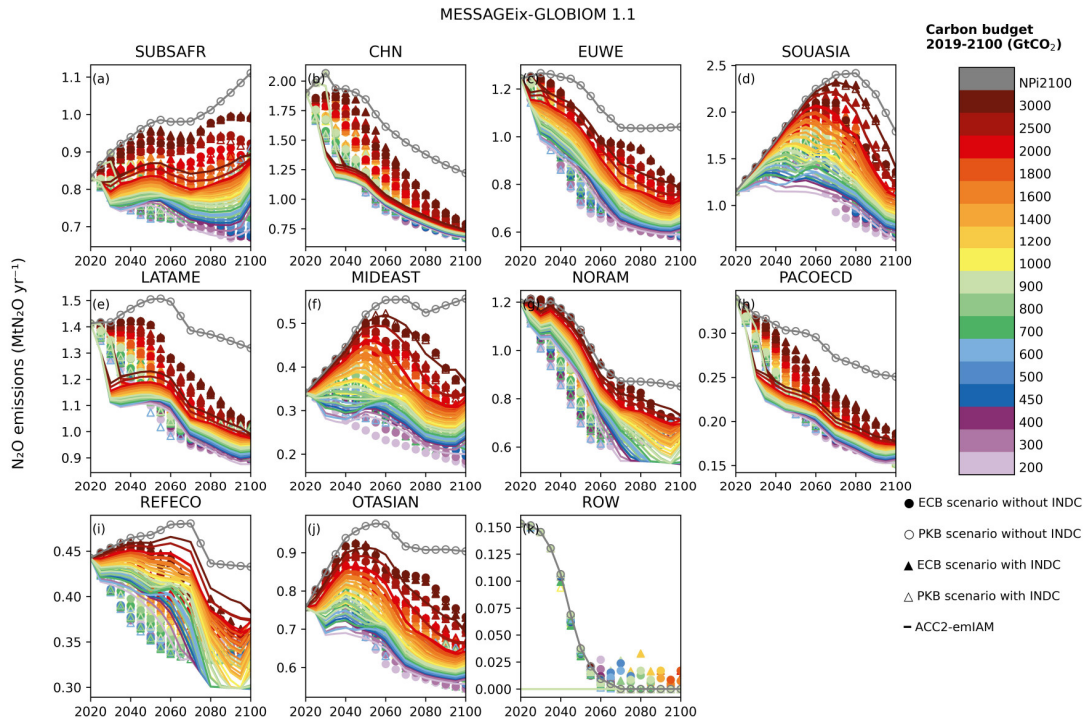


Figure S221. Test 4 - Regional MESSAGE total anthropogenic N₂O validation results

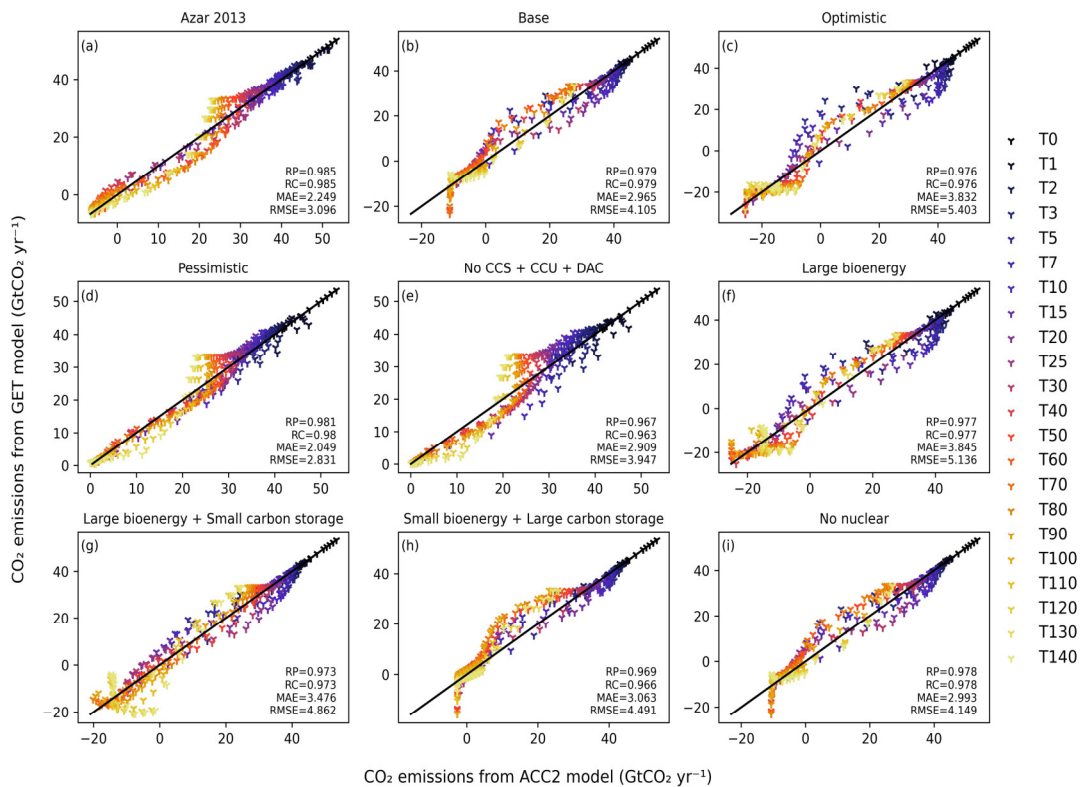


Figure S222. Test 4 - GET - Reproducibility of energy-related CO₂

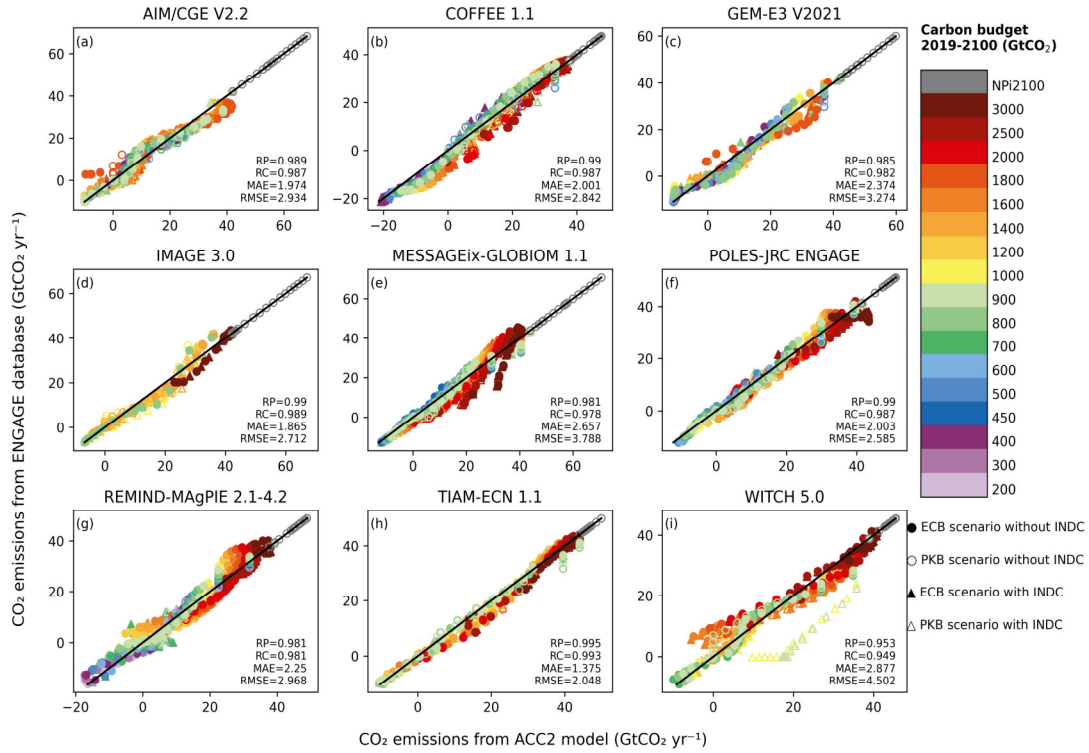


Figure S223. Test 4 - Global nine IAMs - Reproducibility of total anthropogenic CO₂

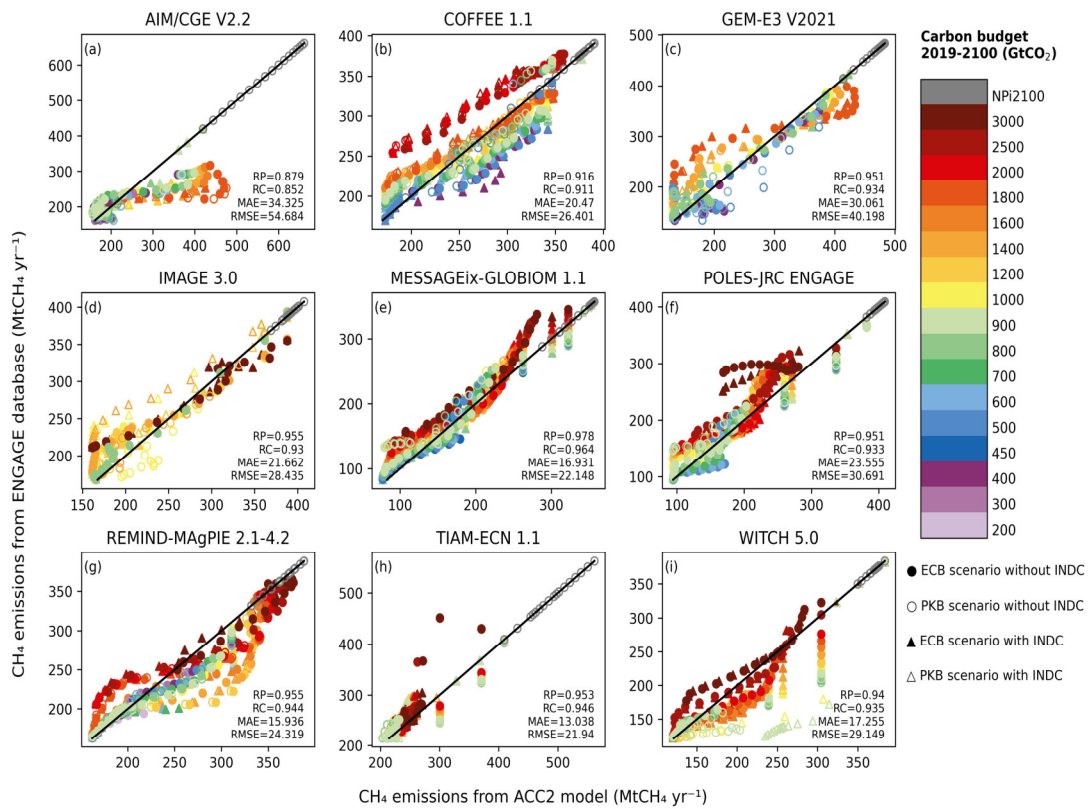


Figure S224. Test 4 - Global nine IAMs - Reproducibility of total anthropogenic CH₄

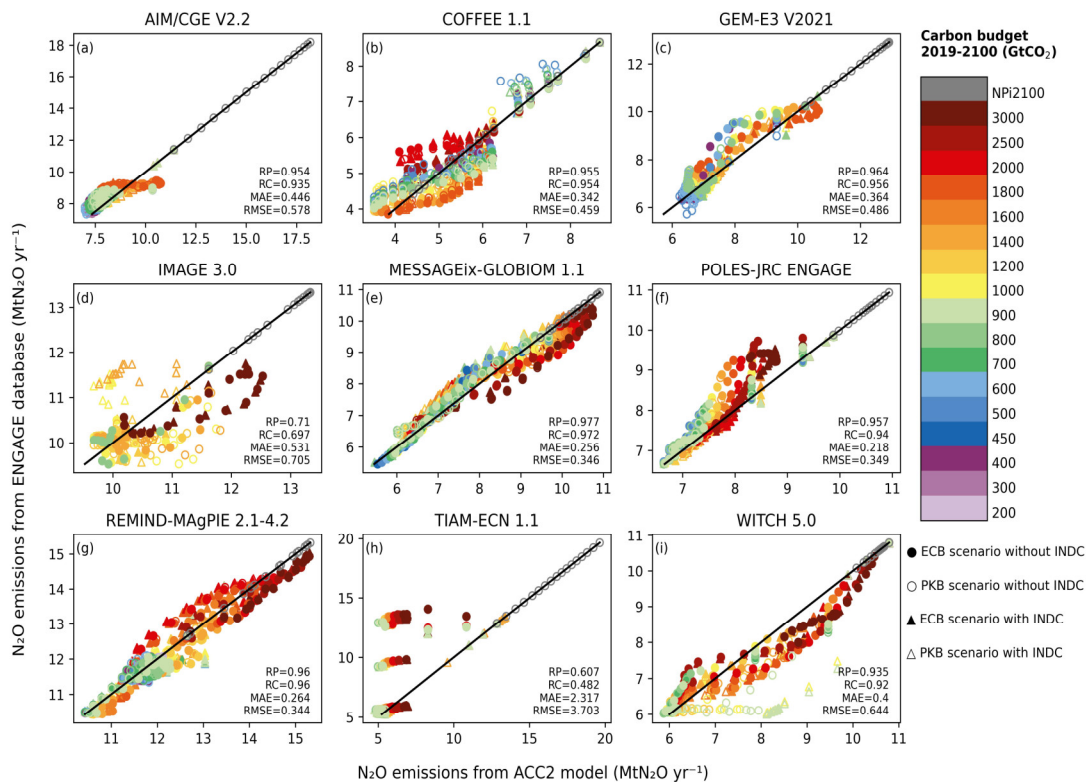


Figure S225. Test 4 - Global nine IAMs - Reproducibility of total anthropogenic N_2O

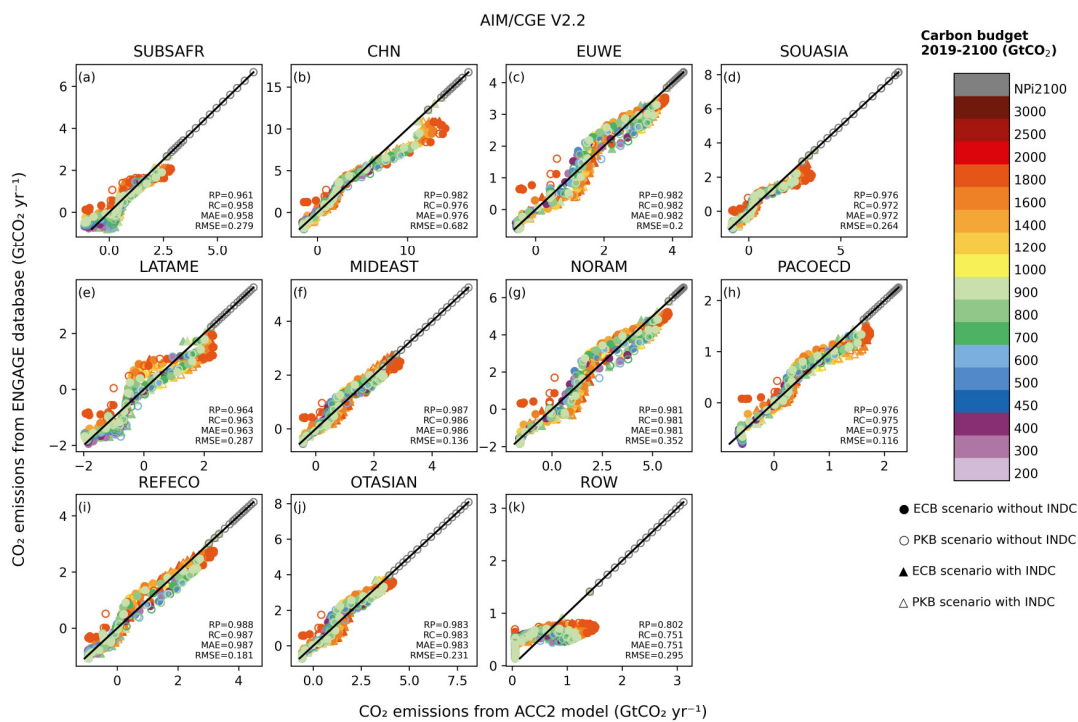


Figure S226. Test 4 - Regional AIM - Reproducibility of total anthropogenic CO_2

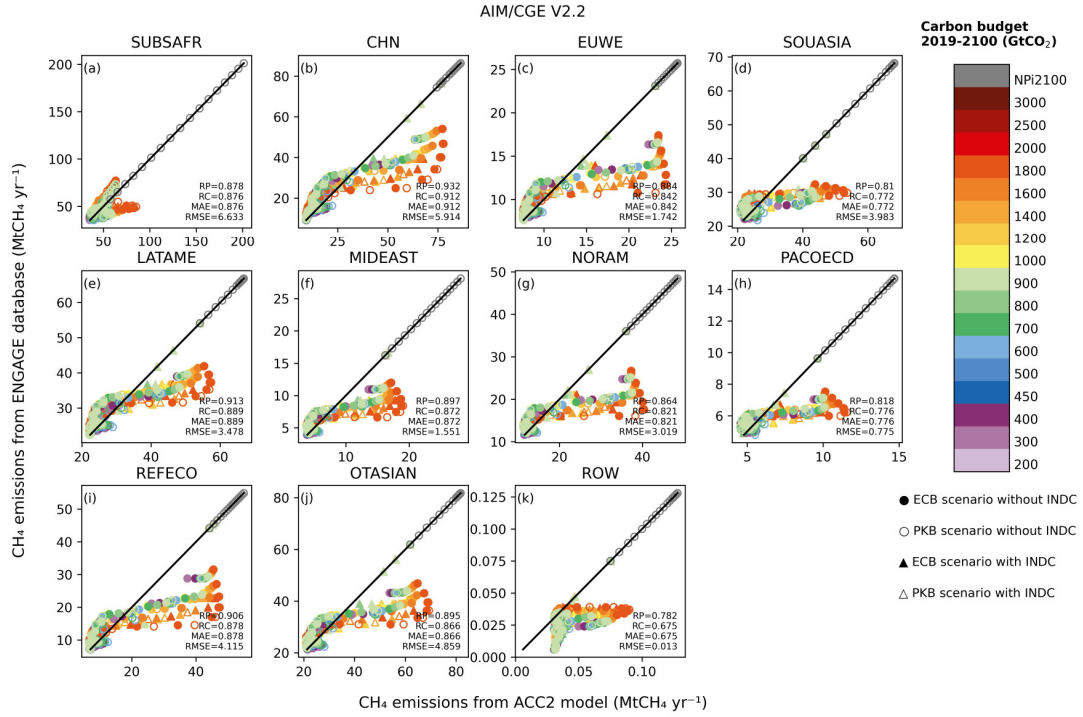


Figure S227. Test 4 - Regional AIM - Reproducibility of total anthropogenic CH₄

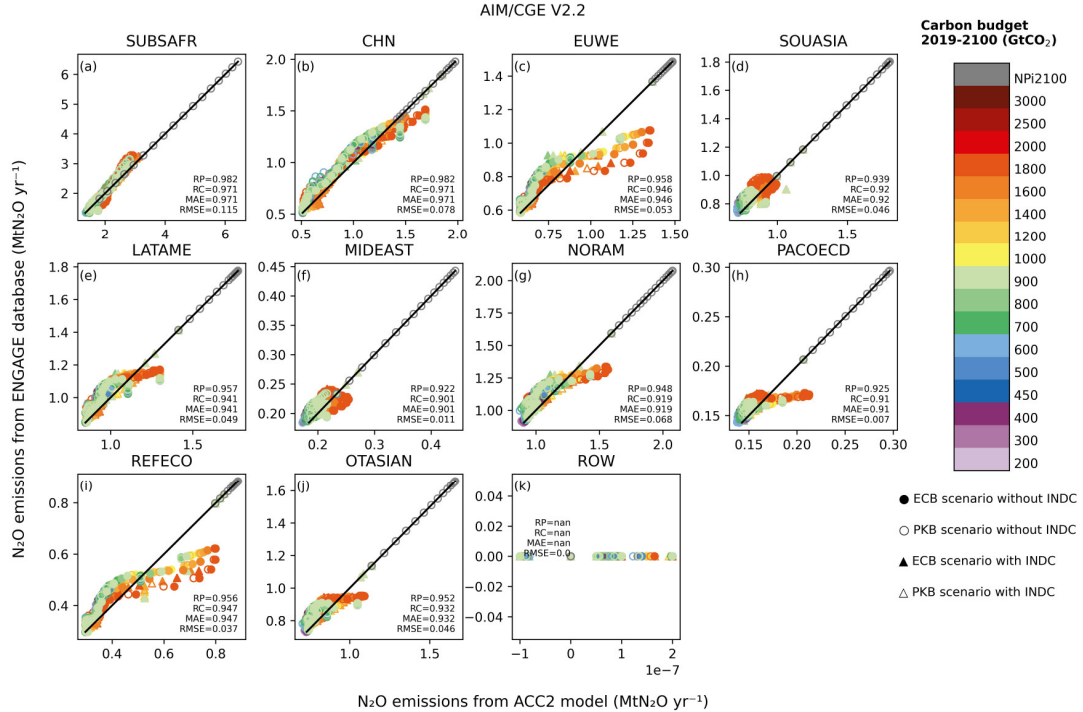


Figure S228. Test 4 - Regional AIM - Reproducibility of total anthropogenic N₂O

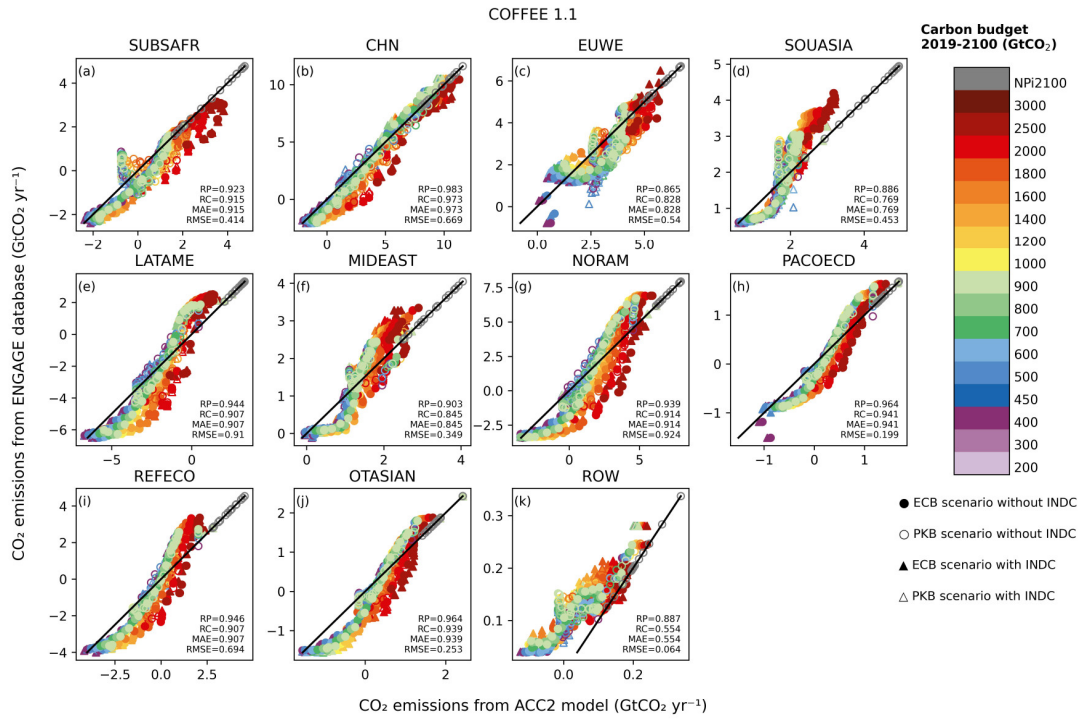


Figure S229. Test 4 - Regional COFFEE - Reproducibility of total anthropogenic CO₂

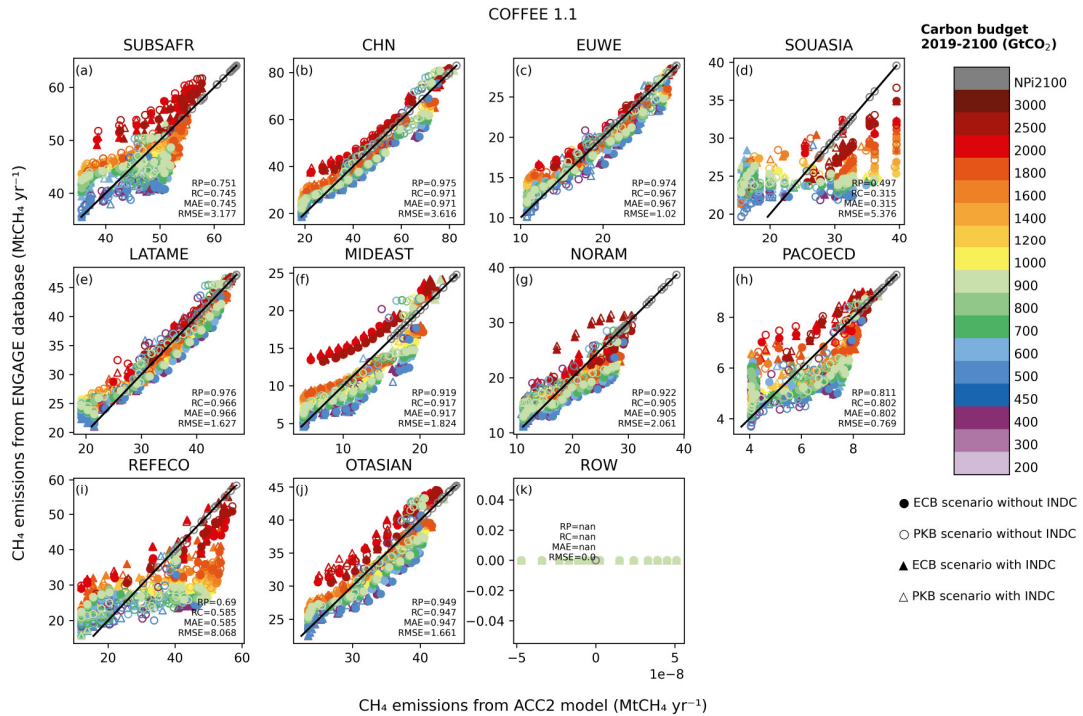


Figure S230. Test 4 - Regional COFFEE - Reproducibility of total anthropogenic CH₄

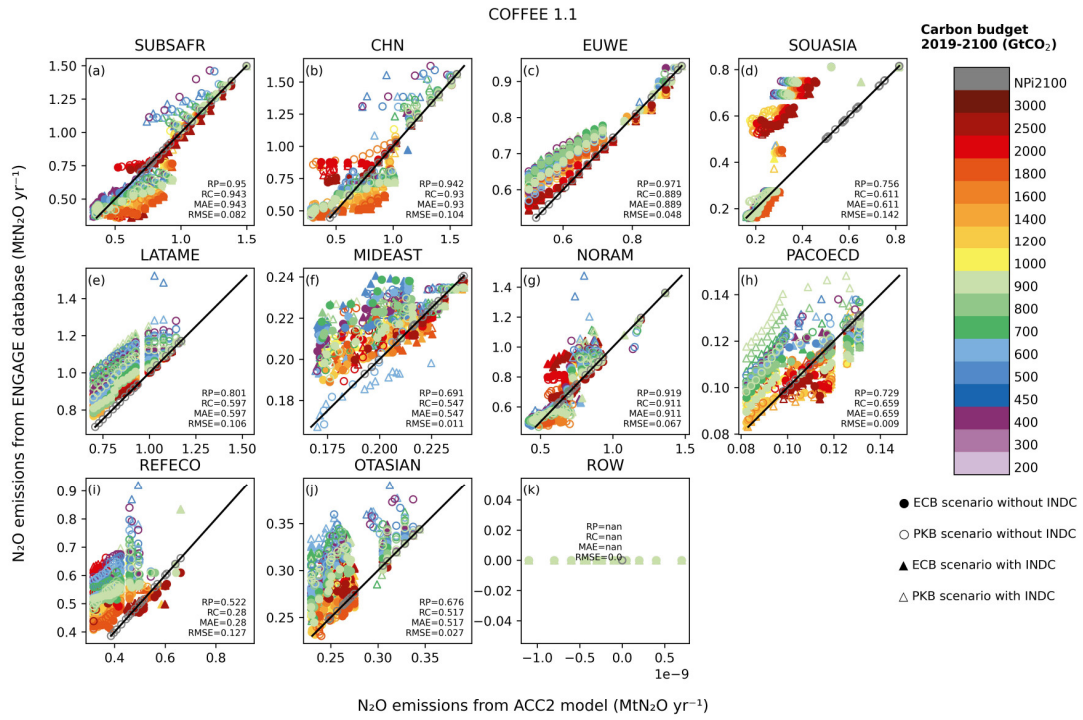


Figure S231. Test 4 - Regional COFFEE - Reproducibility of total anthropogenic N₂O

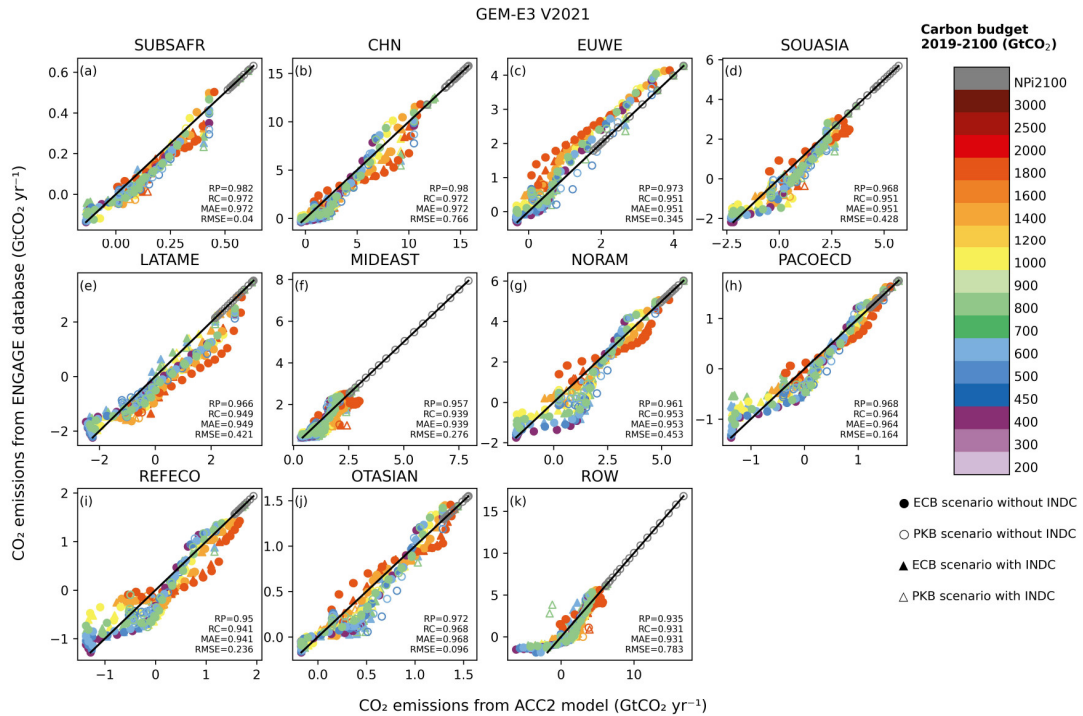


Figure S232. Test 4 - Regional GEM - Reproducibility of total anthropogenic CO₂

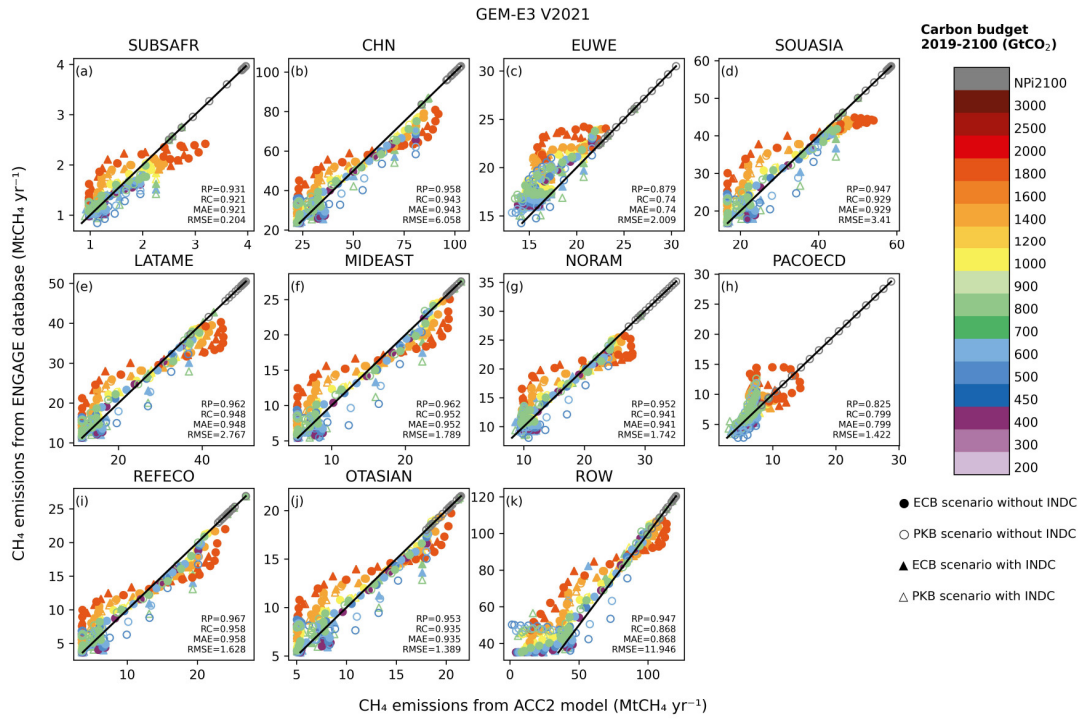


Figure S233. Test 4 - Regional GEM - Reproducibility of total anthropogenic CH₄

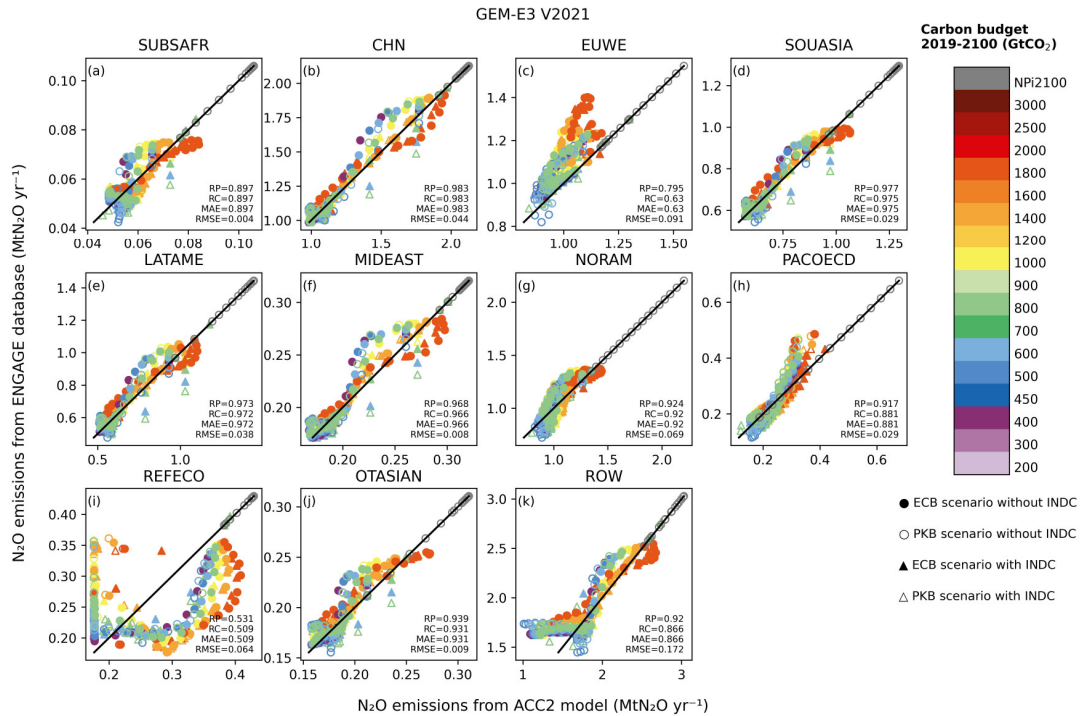


Figure S234. Test 4 - Regional GEM - Reproducibility of total anthropogenic N₂O

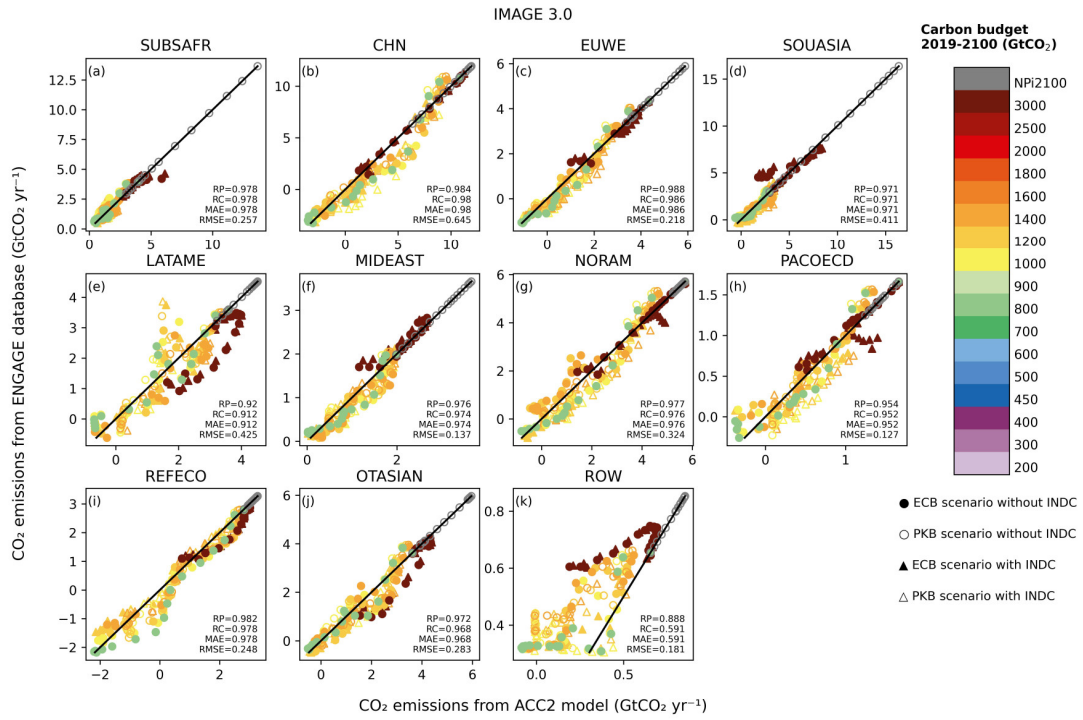


Figure S235. Test 4 - Regional IMAGE - Reproducibility of total anthropogenic CO₂

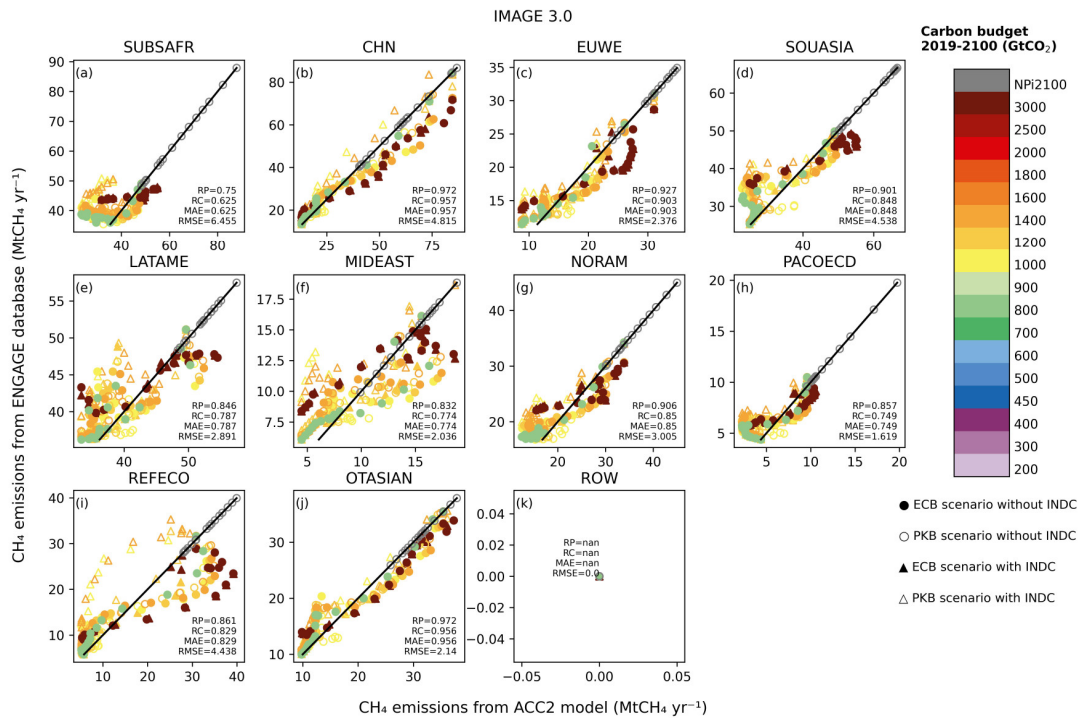


Figure S236. Test 4 - Regional IMAGE - Reproducibility of total anthropogenic CH₄

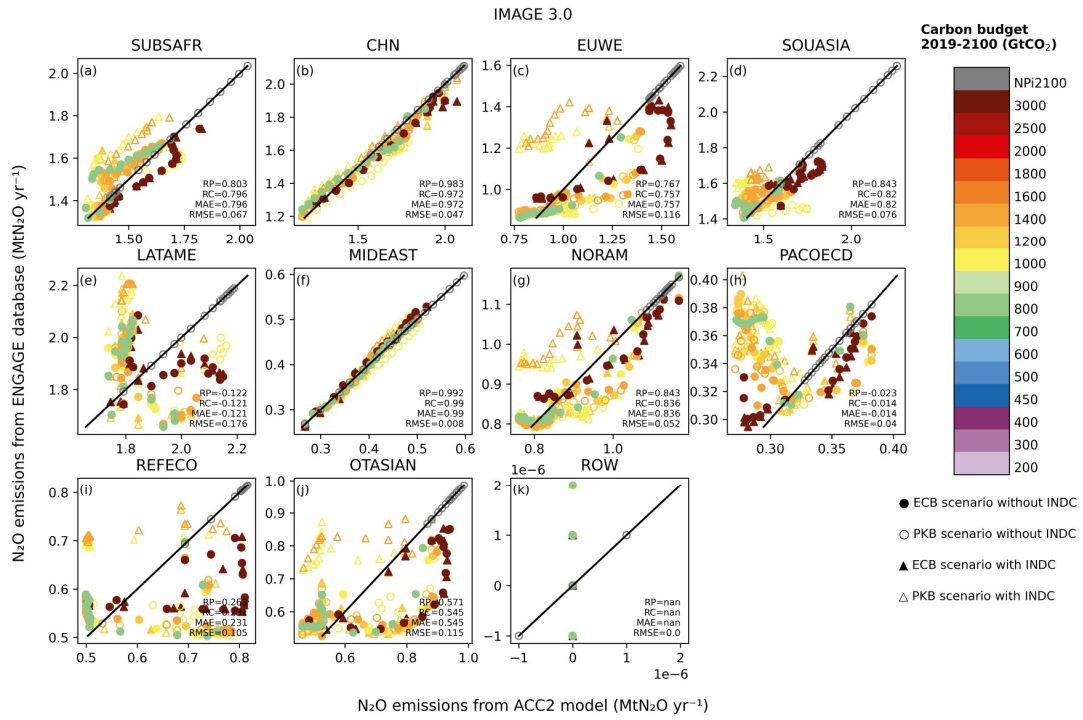


Figure S237. Test 4 - Regional IMAGE - Reproducibility of total anthropogenic N₂O

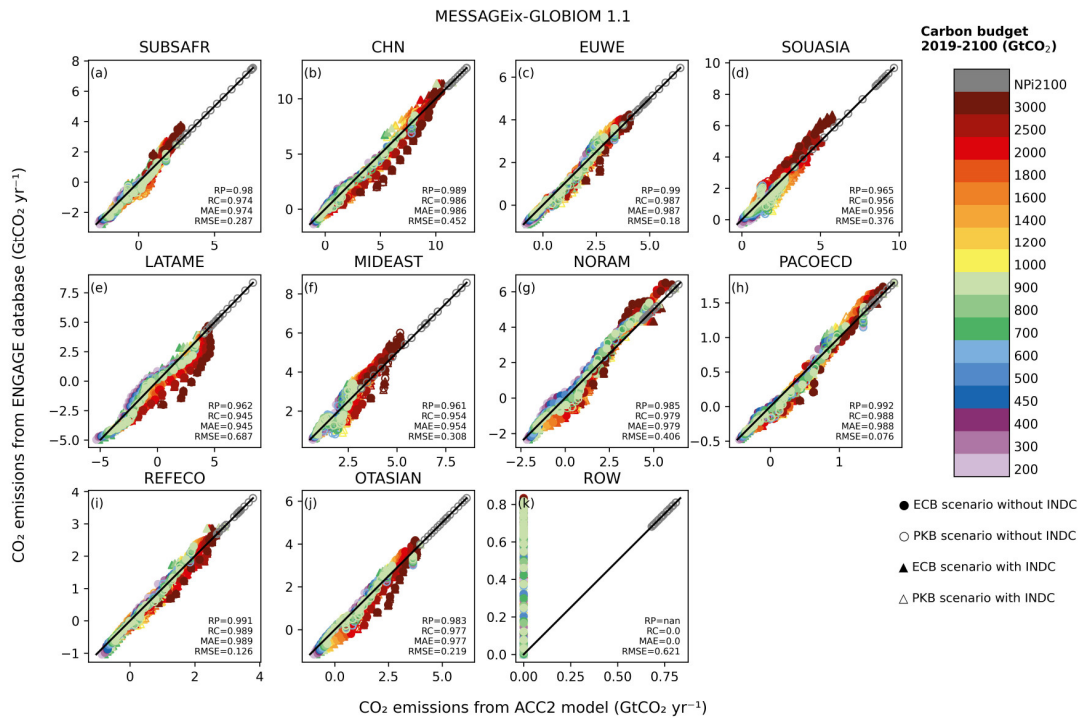


Figure S238. Test 4 - Regional MESSAGE - Reproducibility of total anthropogenic CO₂

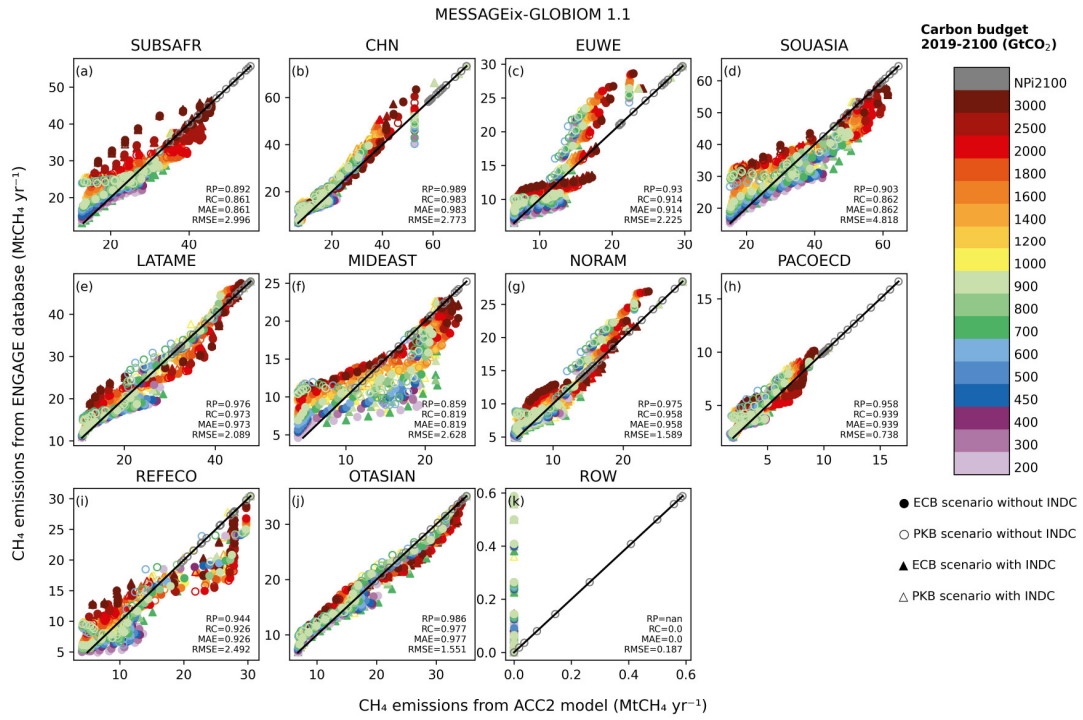


Figure S239. Test 4 - Regional MESSAGE - Reproducibility of total anthropogenic CH₄

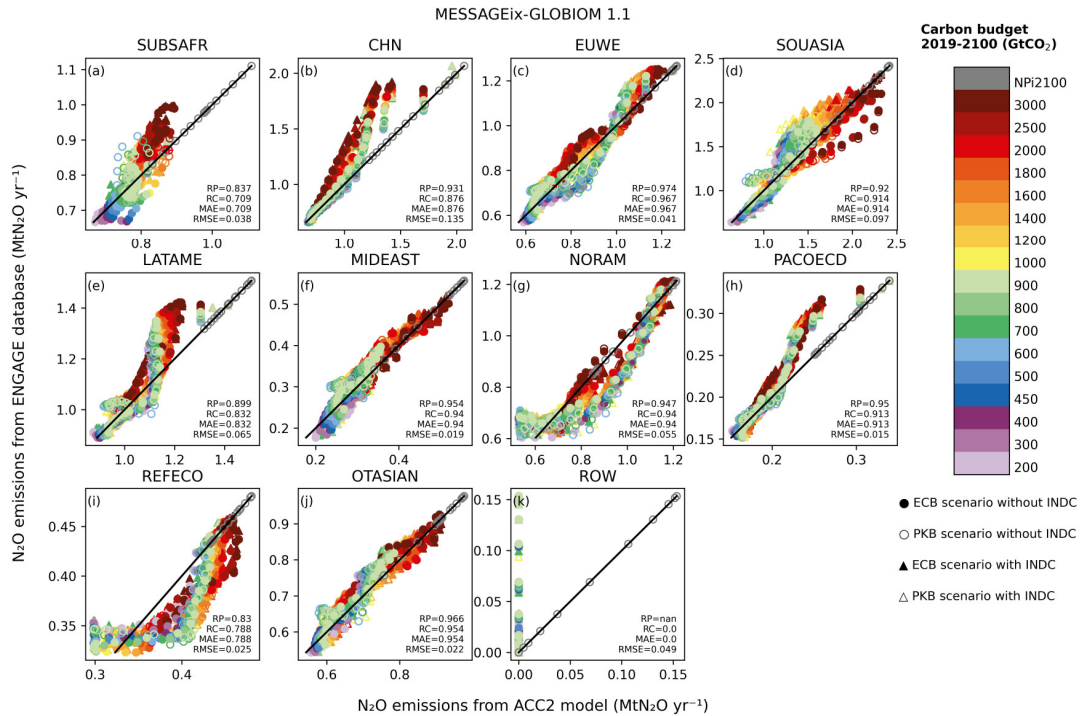


Figure S240. Test 4 - Regional MESSAGE - Reproducibility of total anthropogenic N₂O

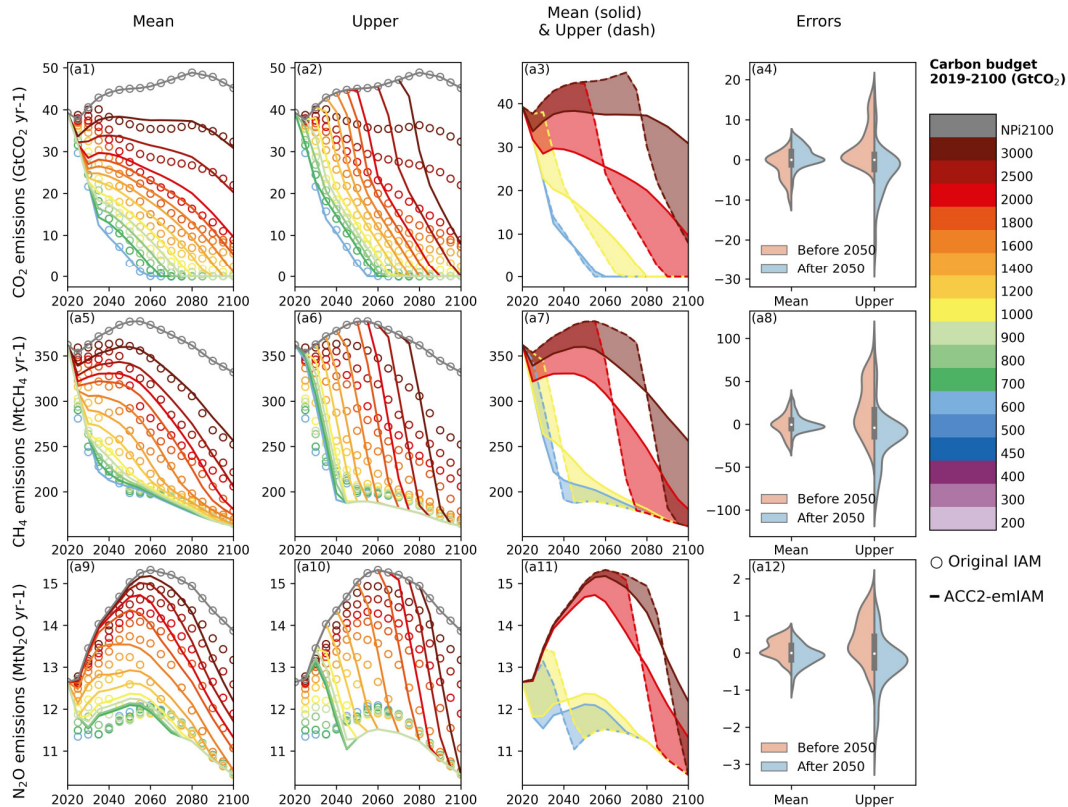


Figure S241. Validation results for ACC2-emIAM with mean and upper MAC curves from REMIND

The points show the original emission pathways from REMIND obtained from the ENGAGE Scenario Explorer; the lines show the emission pathways reproduced from ACC2-emIAM by using the mean (the first column) and upper (the second column) MAC curves. The third column presents the uncertainty (shaded band within two emissions pathways) of ACC2-emIAM by using different MAC curves (only cases with the carbon budgets of 600, 1000, 2000, and 3000 GtCO₂ are shown here). The fourth column shows the errors from the reproduced scenarios (ACC2-emIAM) relative to the original scenarios (REMIND). Positive values indicate ACC2-emIAM gives higher estimates than REMIND and vice versa. The same color is used for each pair of original and reproduced pathways. For the sake of presentation, only the outcomes of the PKB scenarios without INDC are presented. It should be noted that we only report the reproducibility results based on the upper range of the MAC curve (95% confidence interval). We tried with the lower range of the MAC curve (95% confidence interval) as well, but we were not able to obtain reasonable results because of the negative segment of the lower MAC curve. The negative segment requires re-defining the problem as a new type of mathematical problem (a discontinuous nonlinear program (DNLP)), which either made it too complex to solve in our GAMS CONOPT3/4 computational environment or made the optimal solution unreliable (i.e., the solution becomes dependent on initial conditions).