Supplementary for

emIAM v1.0: an emulator for Integrated Assessment Models using marginal abatement cost curves

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Table S1. Equation forms and boundary of parameters for fitting MAC curves

	AIM	GEM	MESSAGE	IMAGE	COFFEE	TIAM	REMIND	WITCH	POLES	GET
Equation 1	***f(x)=a*x^b+c*x^d***									
a	[0,+inf)	[0,+inf)	[0,+inf)	[0,+inf)	[0,+inf)	[0,+inf)	[0,+inf)	[0,+inf)	[0,+inf)	[0,+inf)
b	[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]
c	[0,+inf)	[0,+inf)	[0,+inf)	[0,+inf)	[0,+inf)	[0,+inf)	[0,+inf)	[0,+inf)	[0,+inf)	[0,+inf)
d	[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*x+b*(exp(c*x)-1)***									
a	-	-	-	-	-	-	-	-	-	-
b	-	-	-	-	-	-	-	-	-	-
c	(-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*x+b*x^2+c*x^3+d*x^4***									
a	-	-	-	-	-	-	-	-	-	-
b	[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]
c	-	-	-	-	-	-	-	-	-	-
d	[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 4	***f(x)=a*(b^(c*x)-1)***									
a	[0,+inf)	[0,+inf)	[0,+inf)	[0,+inf)	[0,+inf)	[0,+inf)	[0,+inf)	[0,+inf)	[0,+inf)	[0,+inf)
b	[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)
c	(-inf,100]	(-inf,100]	(-inf,100]	(-inf,100]	(-inf,100]	(-inf,100]	(-inf,100]	(-inf,100]	(-inf,100]	(-inf,100]

Table S2. Carbon price pathways of different initial levels with a 5% of growth rate

Scenarios	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 S3. Parameter values in global MAC curves for energy-related CO_2, CH_4, and N_2O emissions derived from nine ENGAGE IAMs and GET. No data are available for energy-related CH_4, and N_2O emissions from GEM and TIAM.

Model	Variable	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_2O	171.87	1.41	1249.37	12.65	87.2	5.7	1.1
COFFEE	CO_2	40.32	1.15	40.48	5.63	146.4	5.9	0.9
COFFEE	CH_4	455.91	5.77	14.38	0.35	87.9	4.9	3.1
COFFEE	N_2O	85.37	0.39	85.37	0.39	38.4	6.2	2.3
GEM	CO_2	272.42	1.57	119.95	6.82	108.0	5.7	1.1
GEM	CH_4							
GEM	N_2O							
IMAGE	CO_2	309.98	1.23	83.50	24.63	107.6	6.0	1.1
IMAGE	CH_4	879.73	11.96	283.45	1.18	91.8	4.8	1.0
IMAGE	N_2O	22900.43	14.02	126.54	0.27	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	103852.03	49.10	2332.36	7.75	93.7	5.5	1.4
MESSAGE	N_2O	38175.32	5.95	155.77	0.43	62.0	3.8	0.9
POLES	CO_2	1785.75	16.24	2092.84	3.01	110.2	4.4	0.8
POLES	CH_4	4016.39	7.61	4016.39	7.61	97.2	5.8	1.1
POLES	N_2O	630.22	1.71	14691.35	7.56	87.4	5.3	0.8
REMIND	CO_2	316.94	1.82	591.39	21.77	103.5	6.1	0.7
REMIND	CH_4	143.80	1.02	2139.05	14.81	97.4	5.3	1.3
REMIND	N_2O	5558.24	2.93	44.00	0.17	47.8	2.9	0.9
TIAM	CO_2	183.59	11.93	394.27	1.39	116.2	4.6	0.8
TIAM	CH_4							
TIAM	N_2O							
WITCH	CO_2	421.02	1.40	971.12	7.56	100.0	3.8	1.1
WITCH	CH_4	1528.23	36.27	153.56	3.52	98.2	5.8	3.4
WITCH	N_2O	97.19	0.73	437940.23	8.98	50.8	3.3	1.3

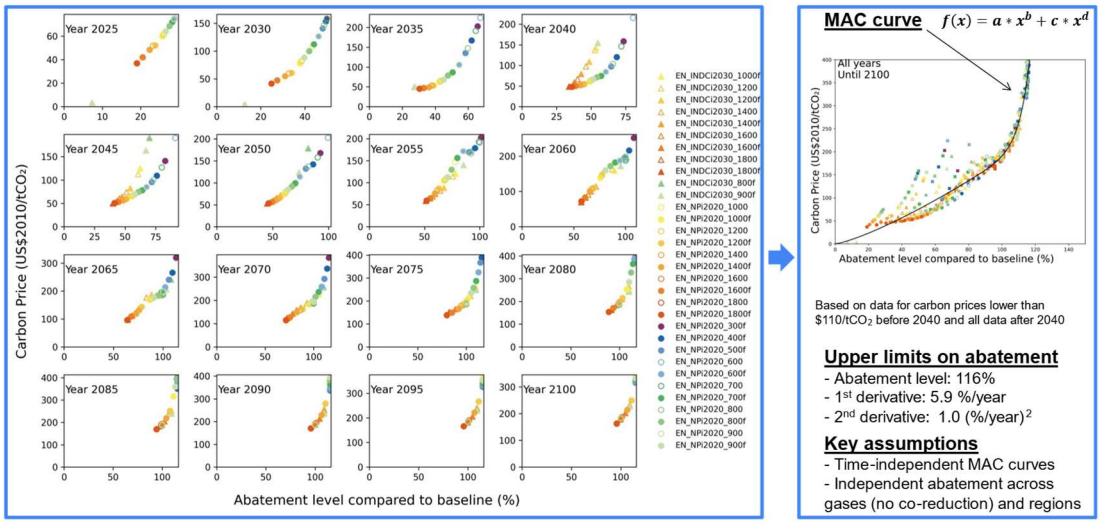

Figure S1. Overview of the methods to derive AIM MAC curves and limits on abatement. The description of the figure can be found in Figure 1 of the main text.

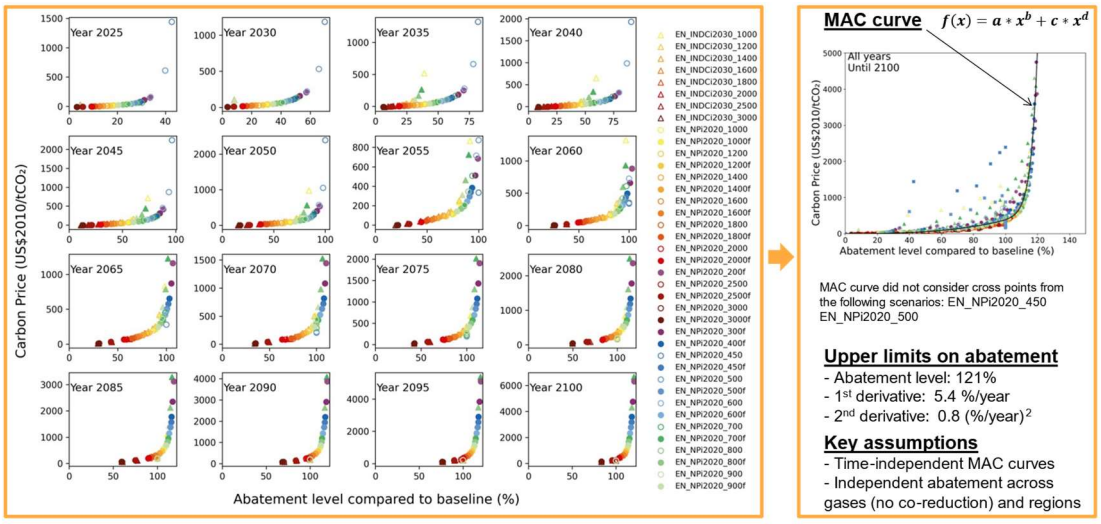

Figure S2. Overview of the methods to derive MESSAGE MAC curves and limits on abatement.

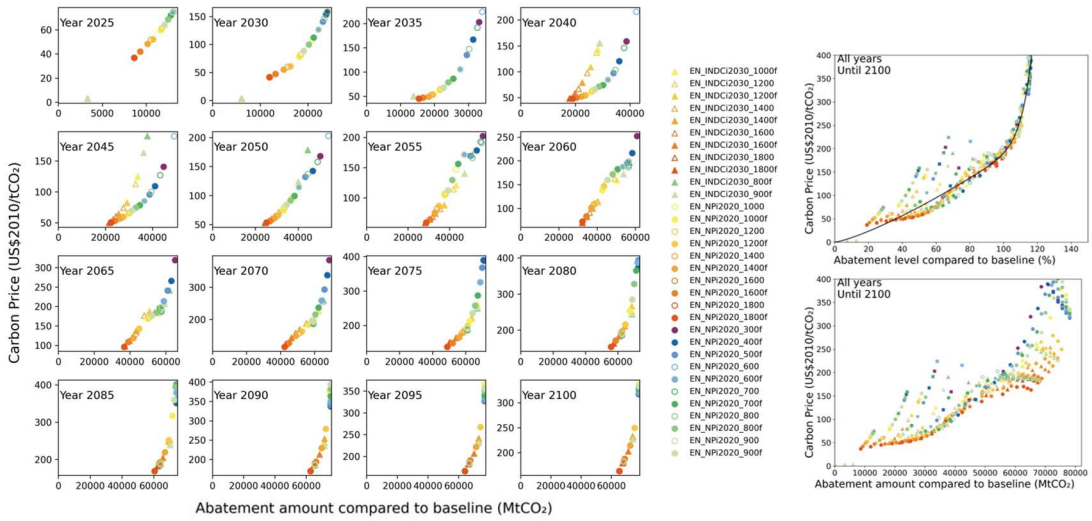

Figure S3. Overview of the methods to derive AIM MAC curves and limits on abatement. The results is in the absolute term.

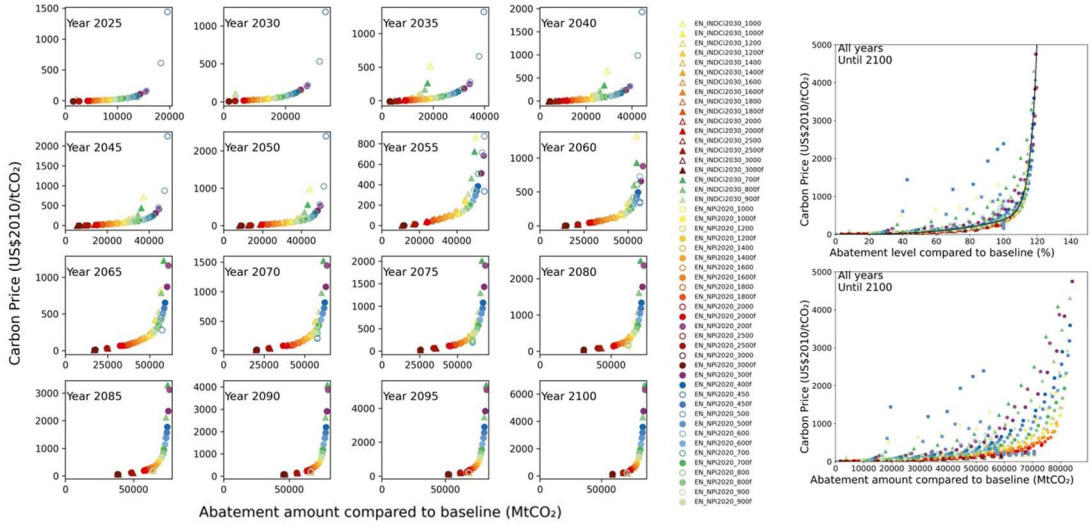

Figure S4. Overview of the methods to derive MESSAGE MAC curves and limits on abatement. The results is in the absolute term.

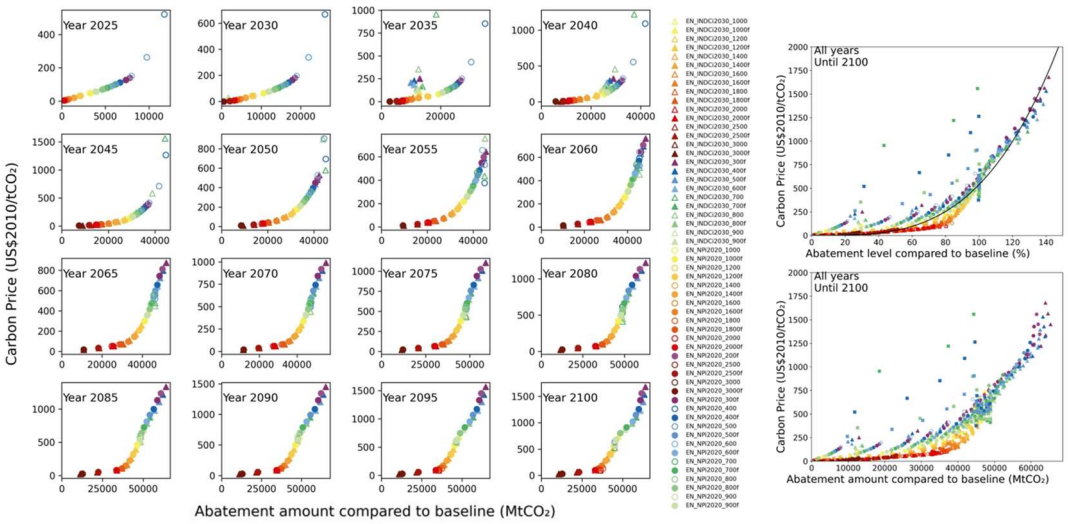

Figure S5. Overview of the methods to derive AIM MAC curves and limits on abatement. The results is in the absolute term.

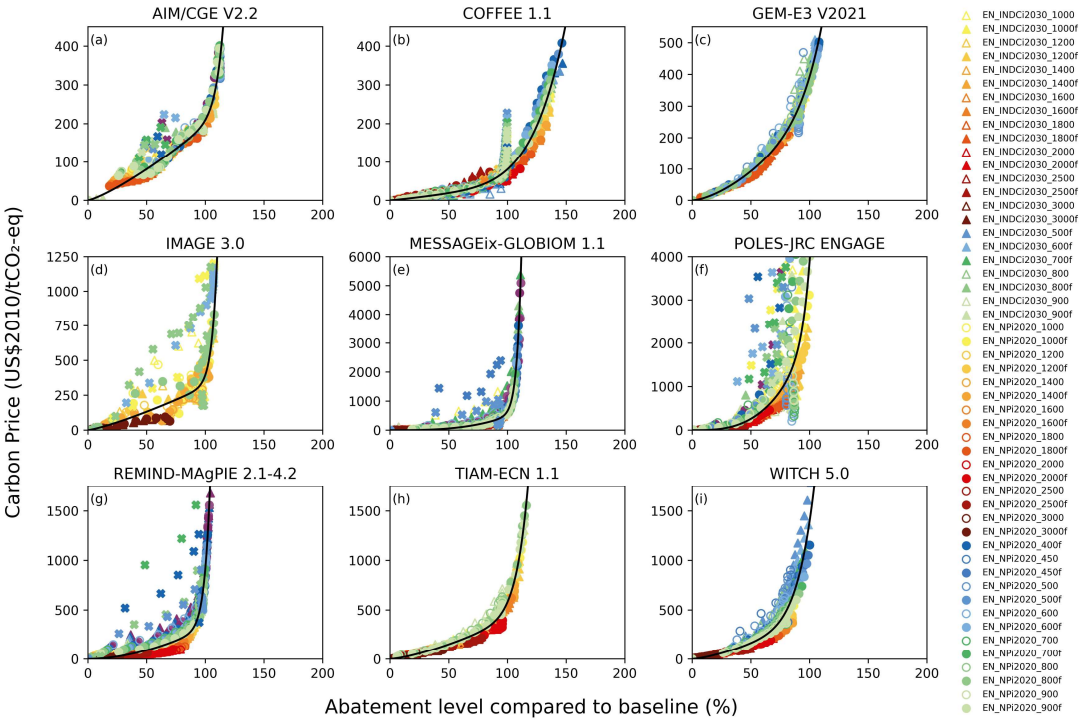

Figure S6. Global energy-related CO_2 MAC curve from nine ENGAGE IAMs. Each panel shows the results from each IAM from the ENGAGE Scenario Explorer. Points are the data obtained from the ENGAGE Scenario Explorer shown in colors and markers as designated in the legend. Black lines are the MAC curves. Open circles are the data that were not considered in the derivation of MAC curves.

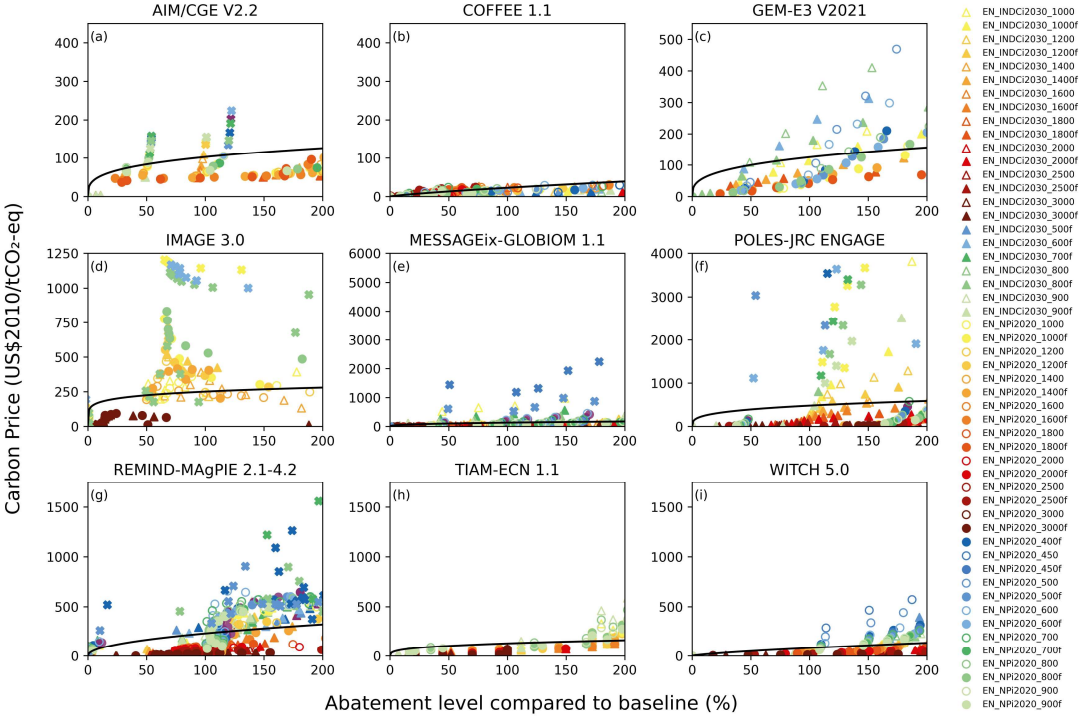

Figure S7. Global non-energy-related CO_2 MAC curve from nine ENGAGE IAMs

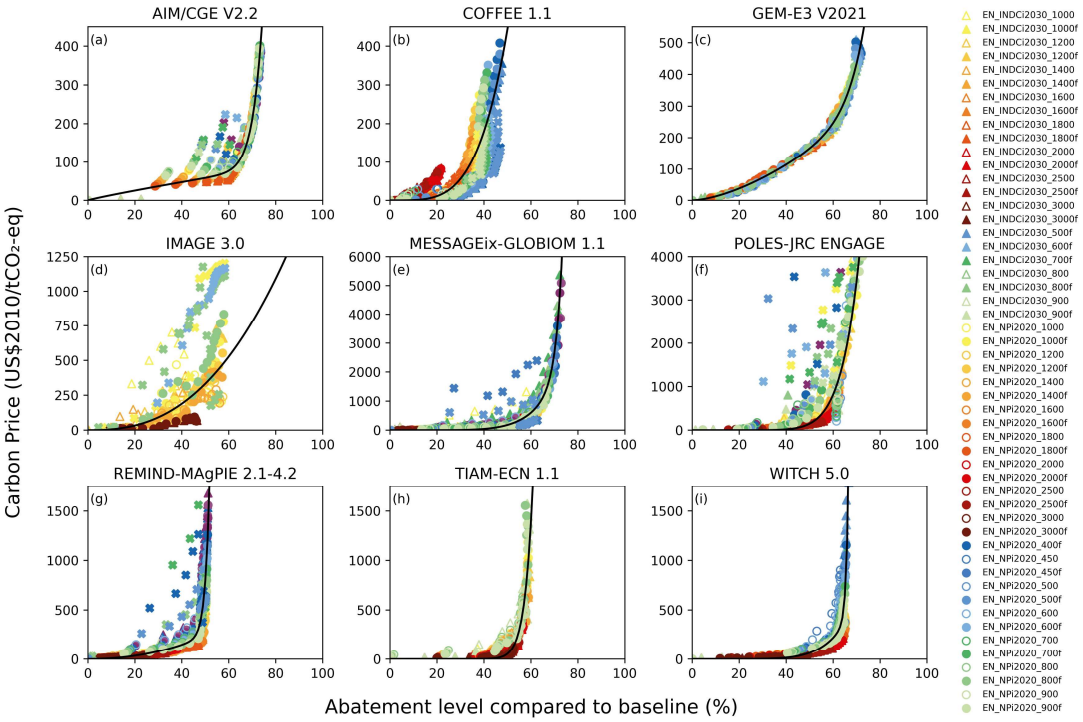

Figure S8. Global total anthropogenic CH_4 MAC curve from nine ENGAGE IAMs

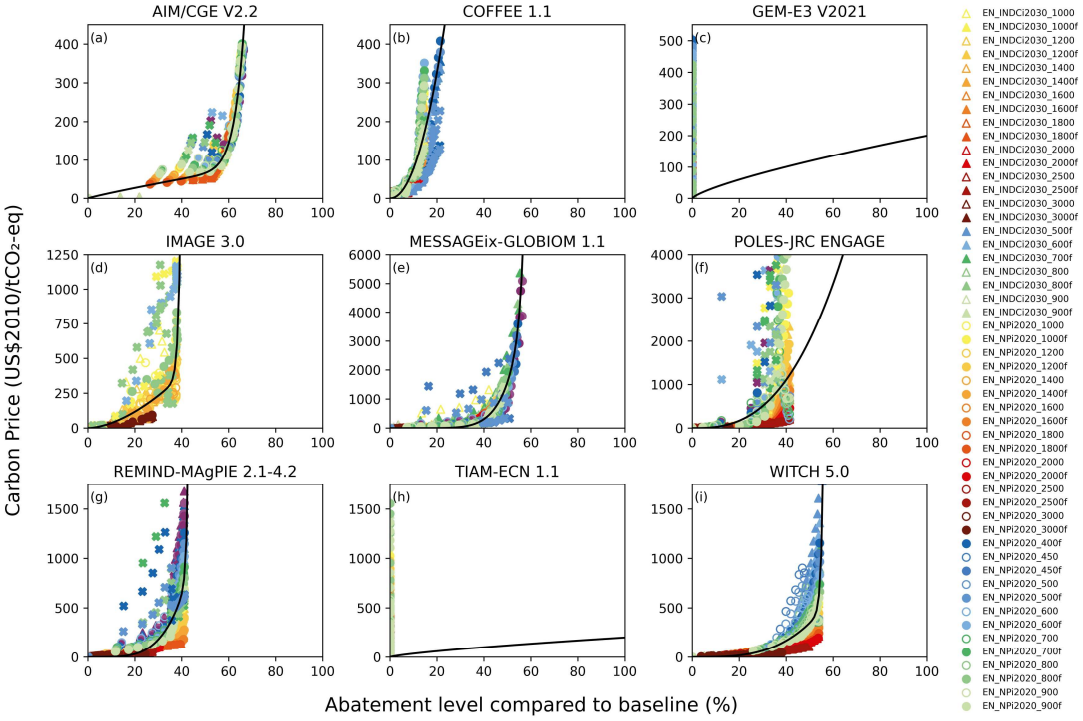

Figure S9. Global energy-related CH_4 MAC curve from nine ENGAGE IAMs

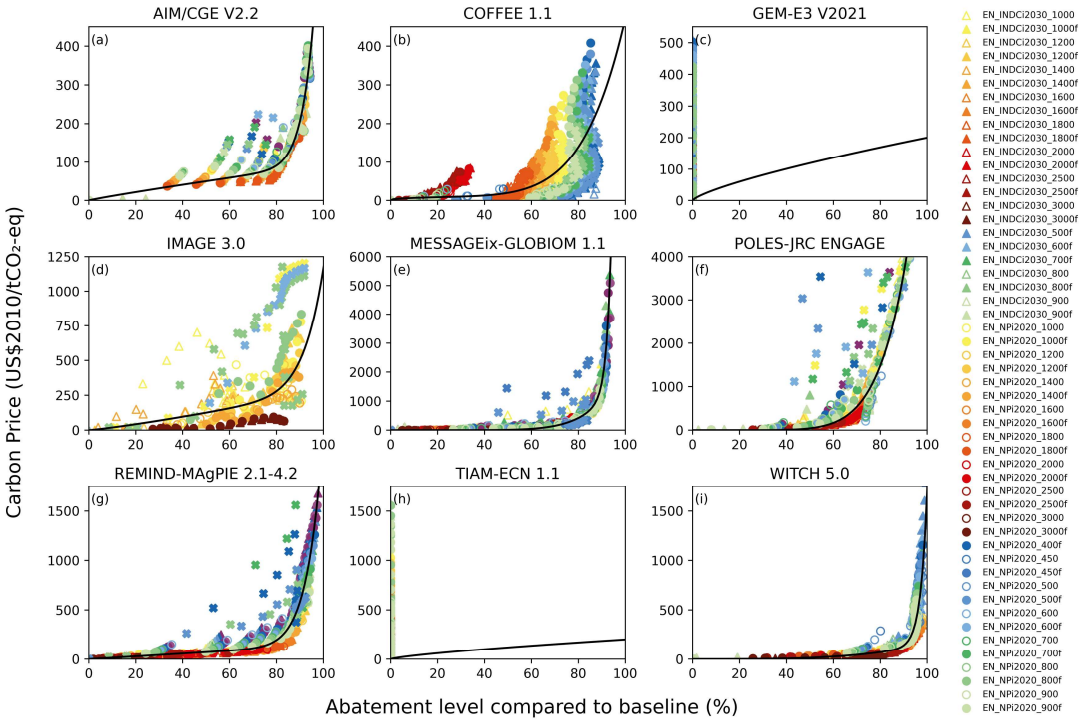

Figure S10. Global non-energy-related CH_4 MAC curve from nine ENGAGE IAMs

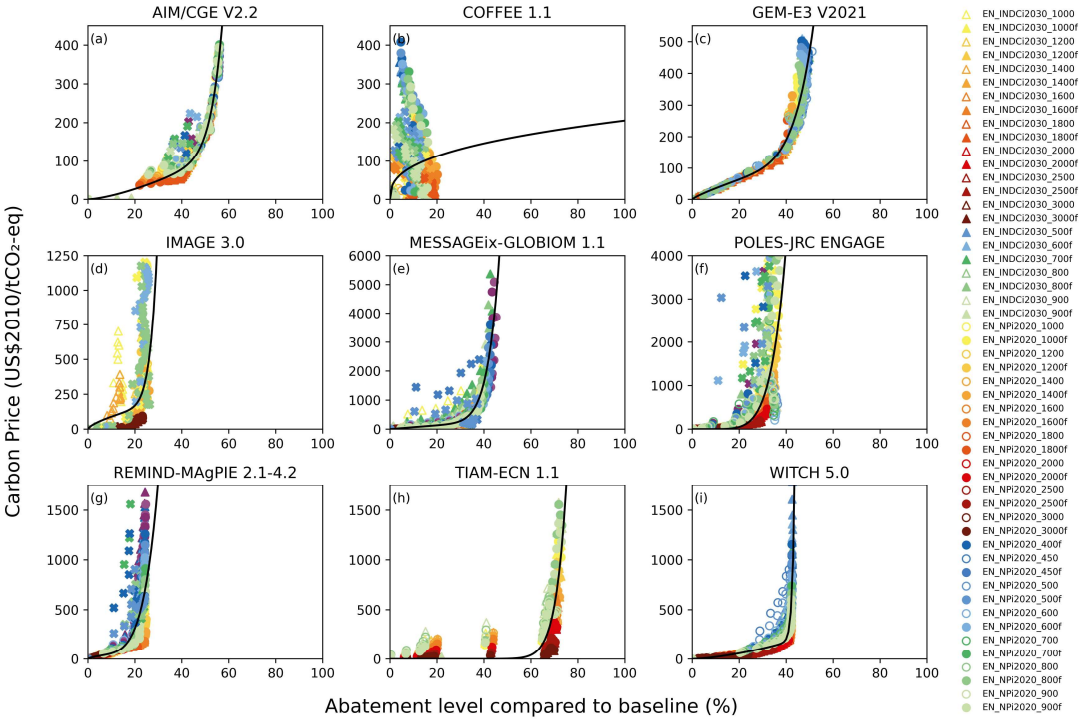

Figure S11. Global total anthropogenic N_2O MAC curve from nine ENGAGE IAMs

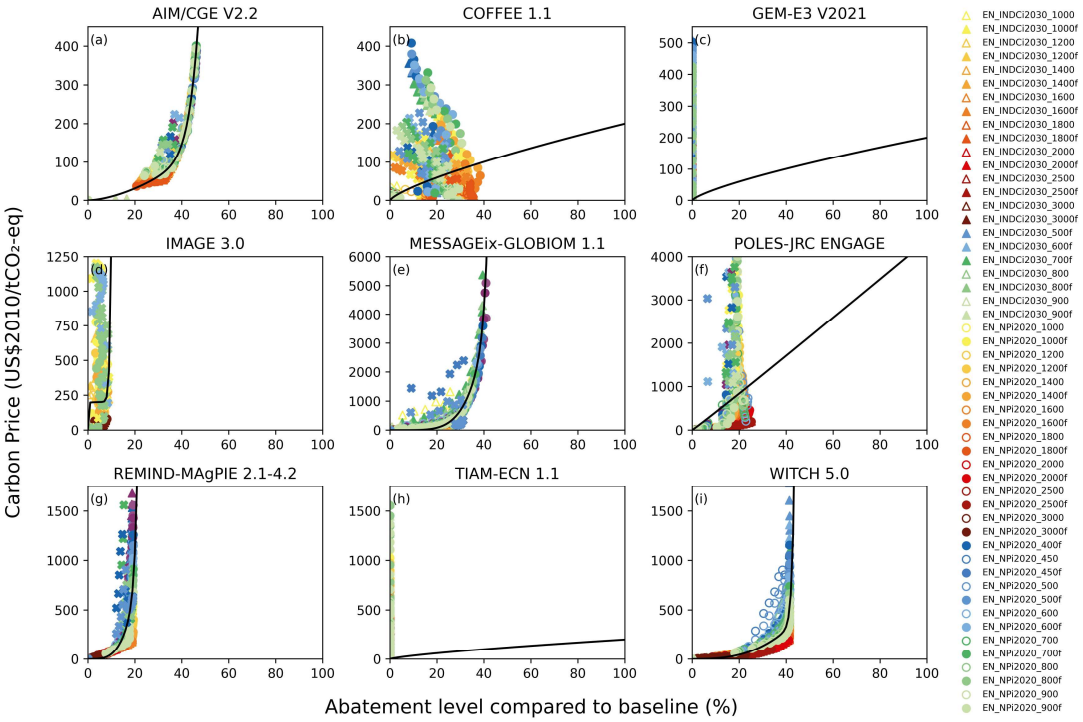

Figure S12. Global energy-related N_2O MAC curve from nine ENGAGE IAMs

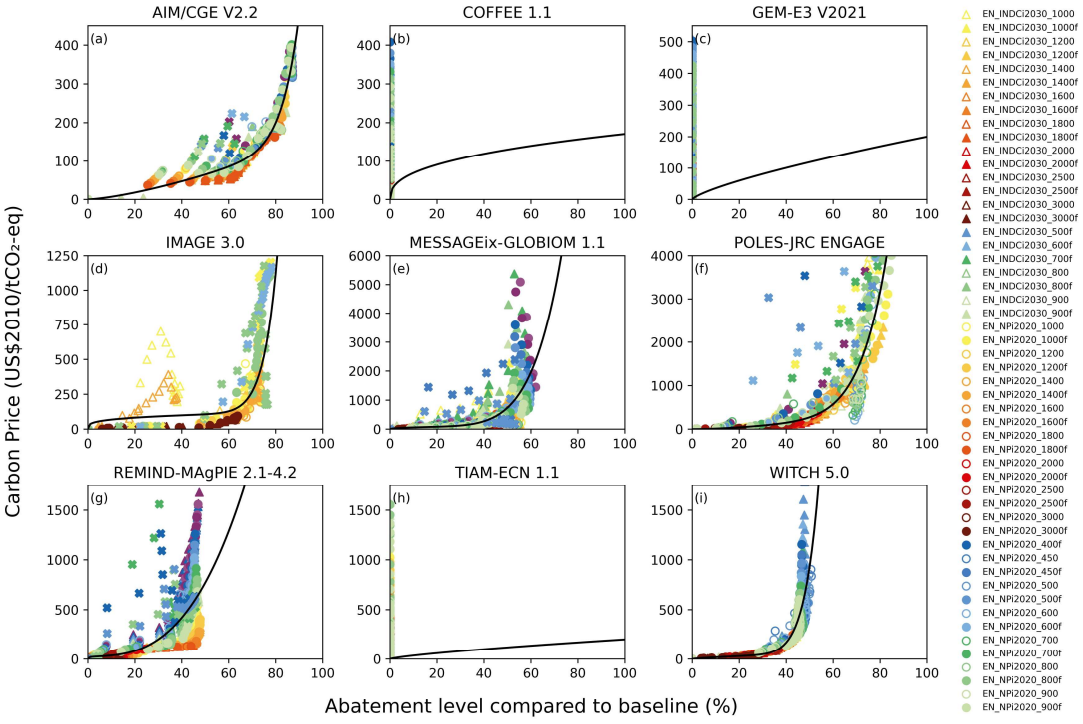

Figure S13. Global non-energy-related N_2O MAC curve from nine ENGAGE IAMs

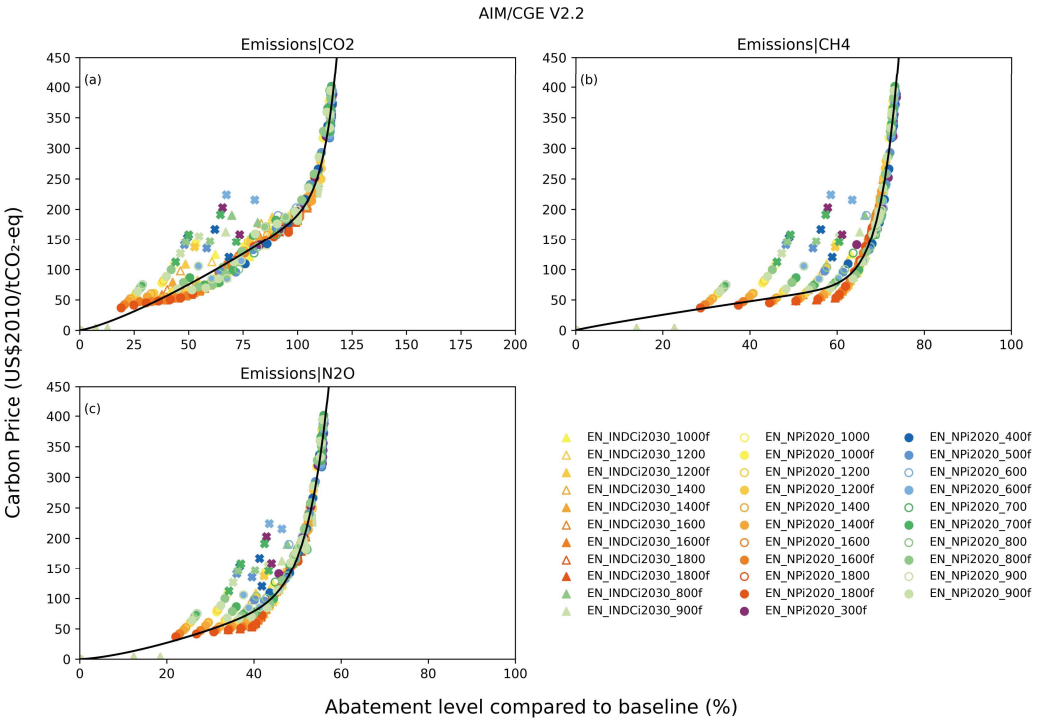

Figure S14. Global AIM MAC curve

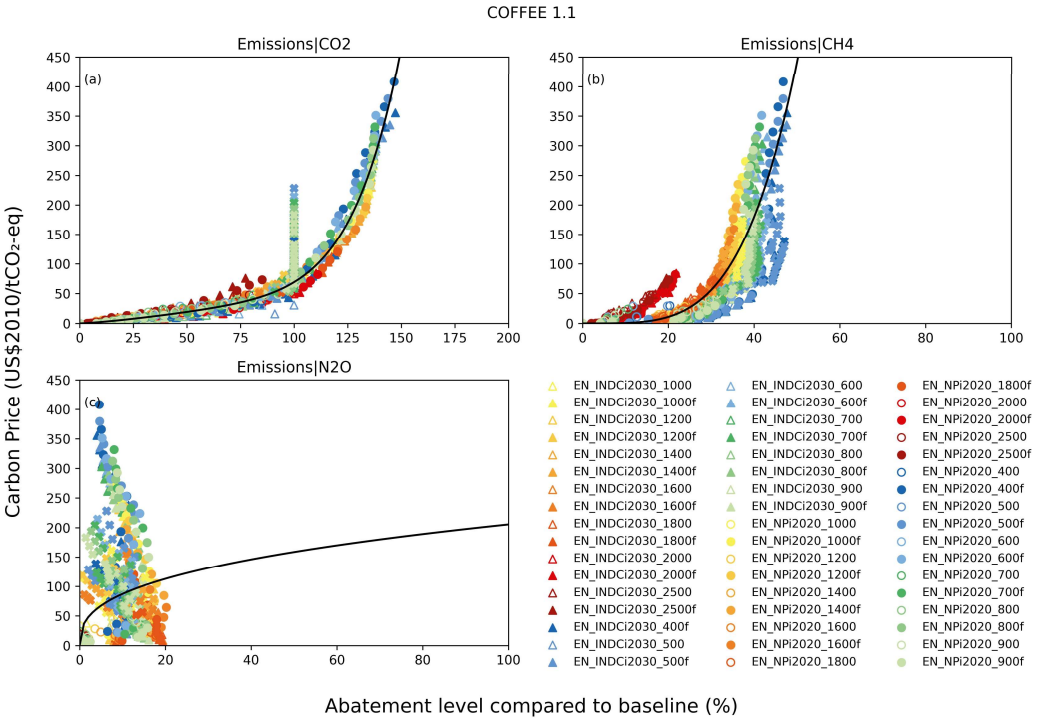

Figure S15. Global COFFEE MAC curve

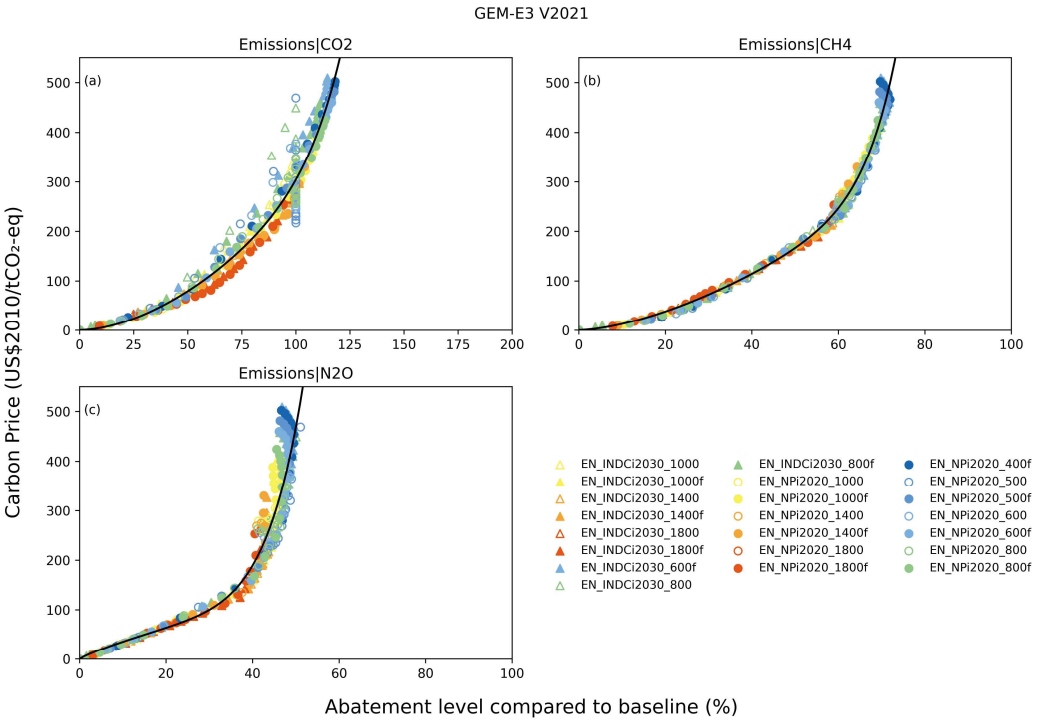

Figure S16. Global GEM MAC curve

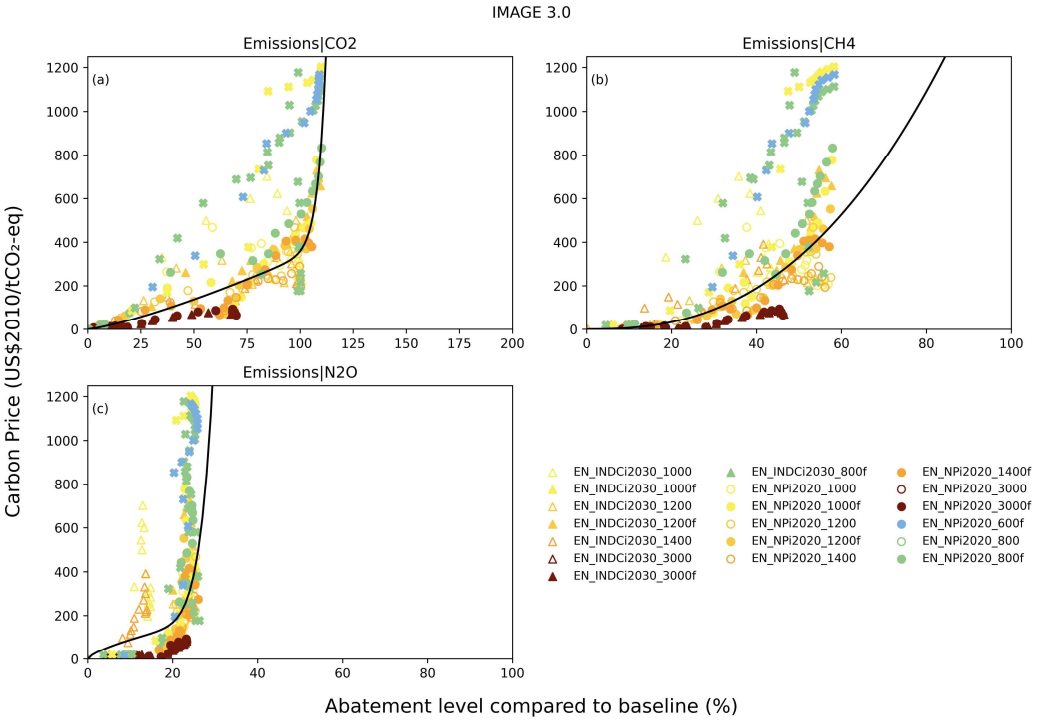

Figure S17. Global IMAGE MAC curve

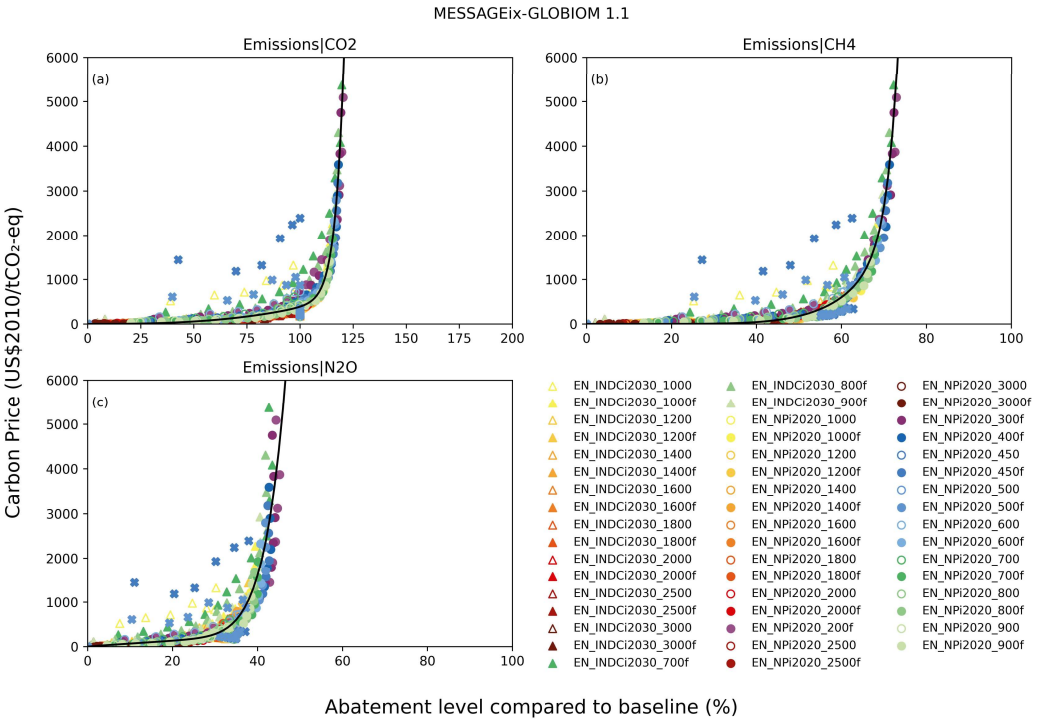

Figure S18. Global MESSAGE MAC curve

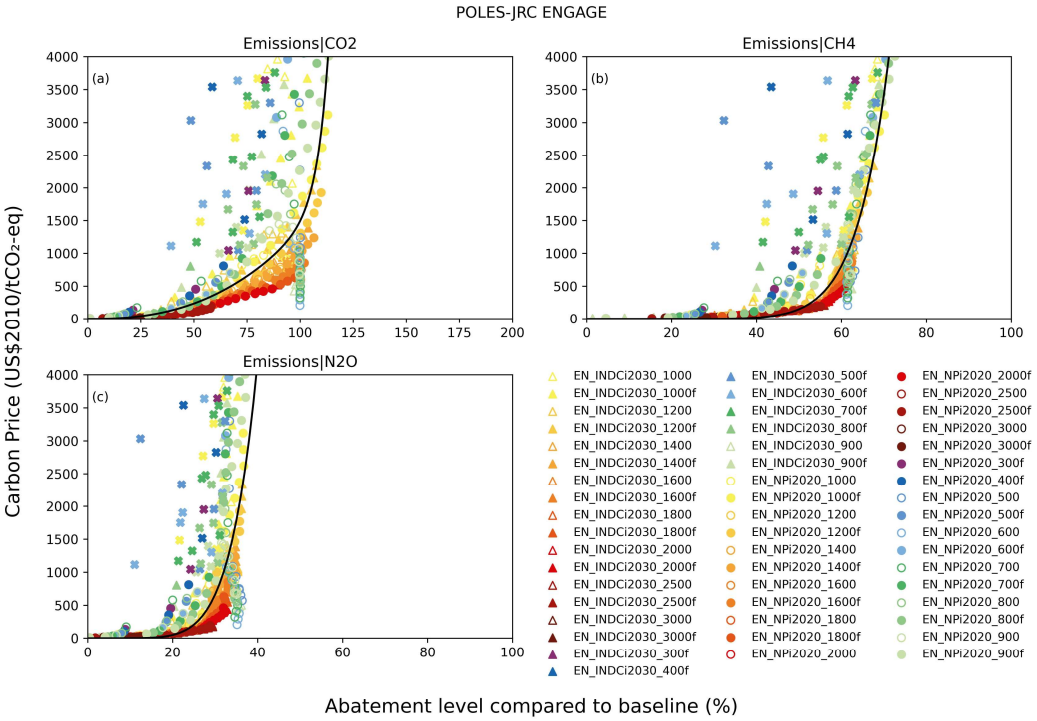

Figure S19. Global POLES MAC curve

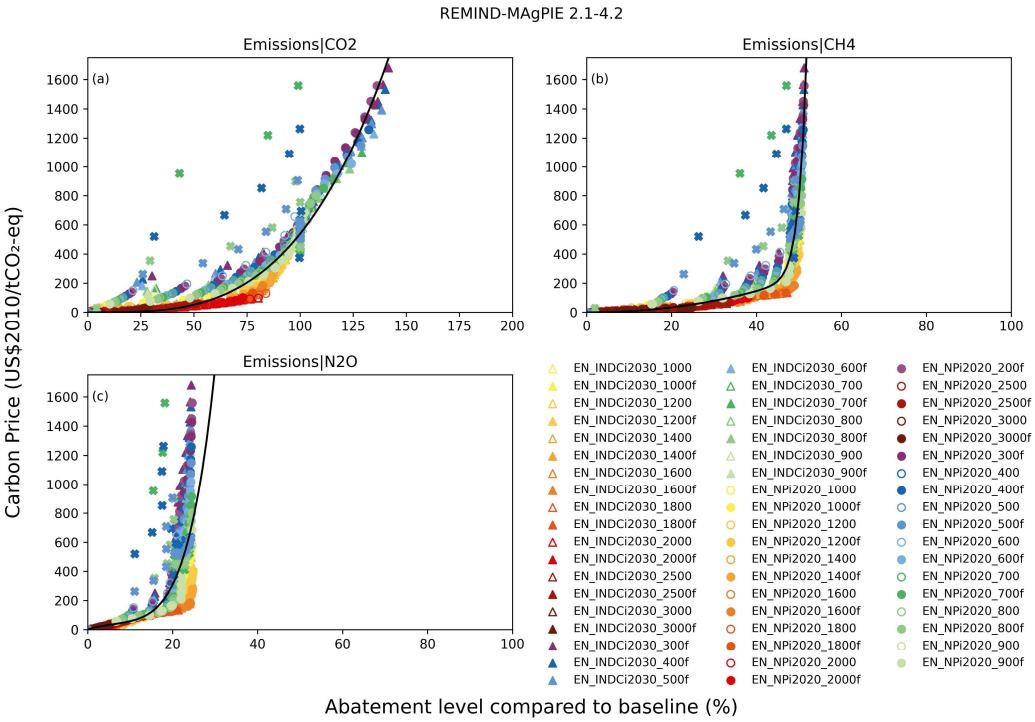

Figure S20. Global REMIND MAC curve

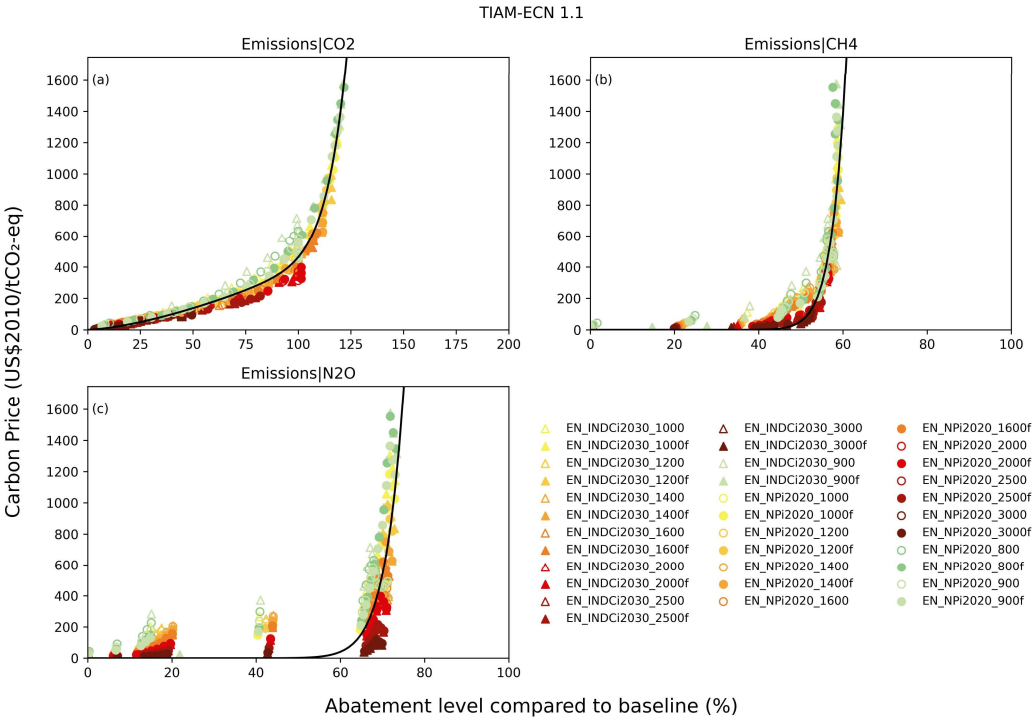

Figure S21. Global TIAM MAC curve

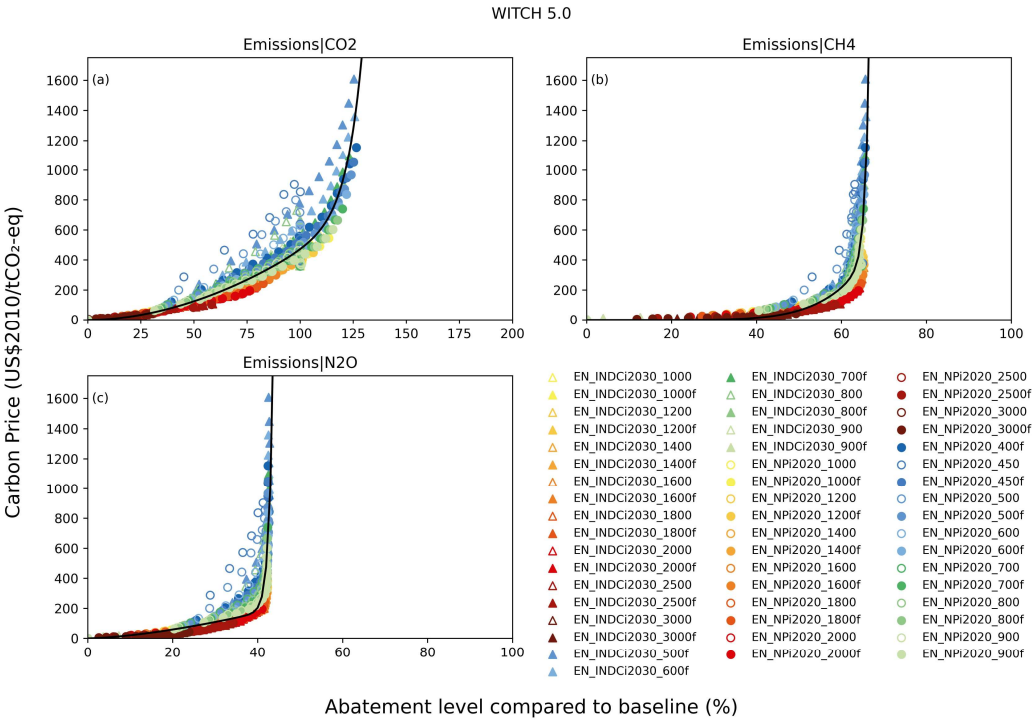

Figure S22. Global WITCH MAC curve

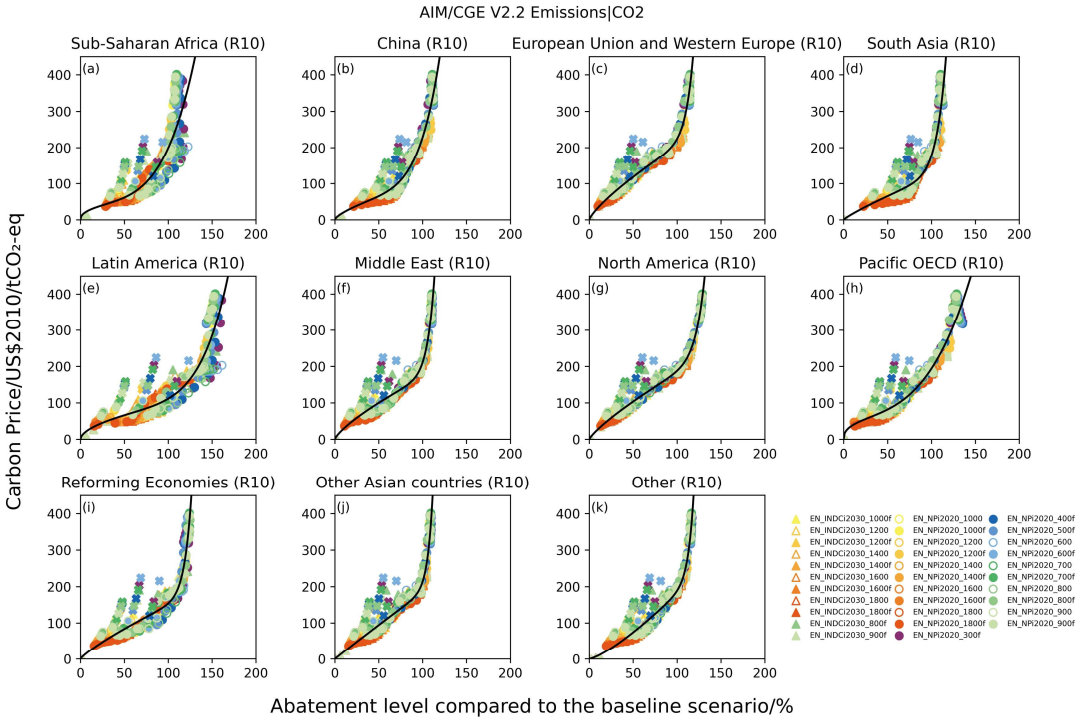

Figure S23. Regional AIM total anthropogenic CO_2 MAC curve

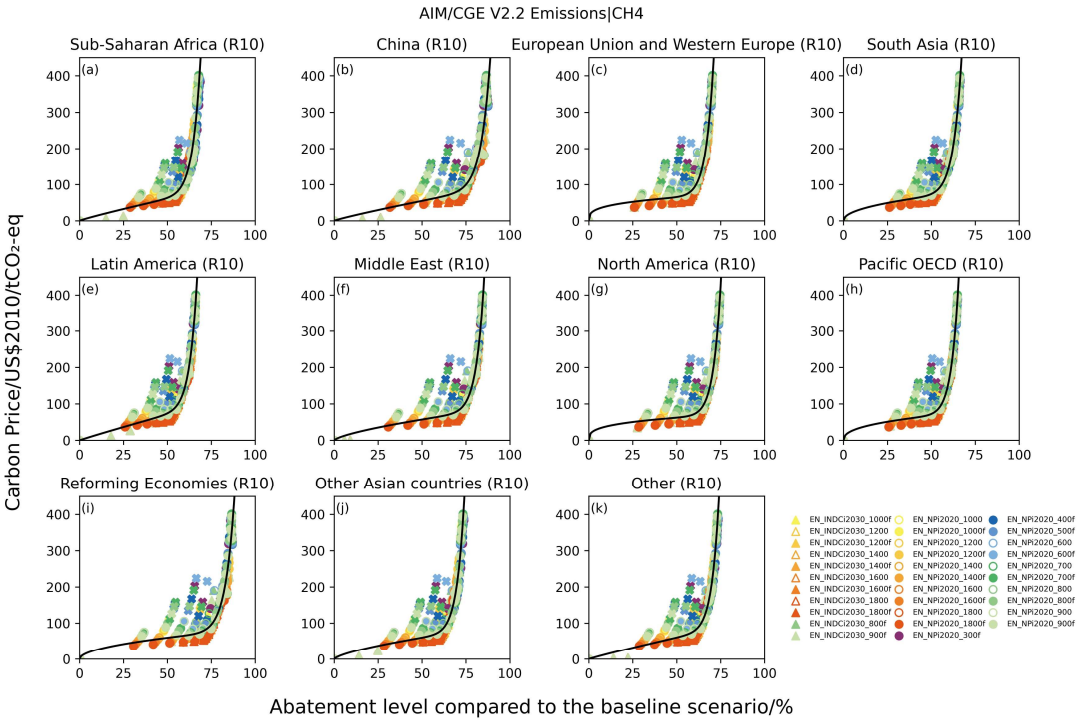

Figure S24. Regional AIM total anthropogenic CH_4 MAC curve

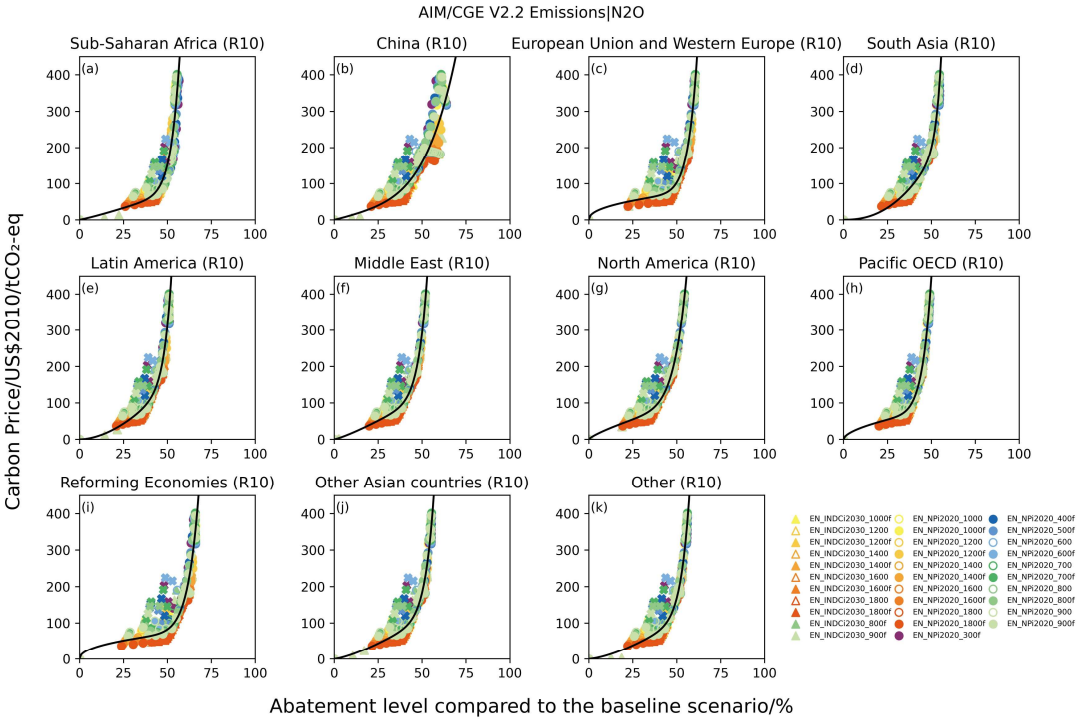

Figure S25. Regional AIM total anthropogenic N_2O MAC curve

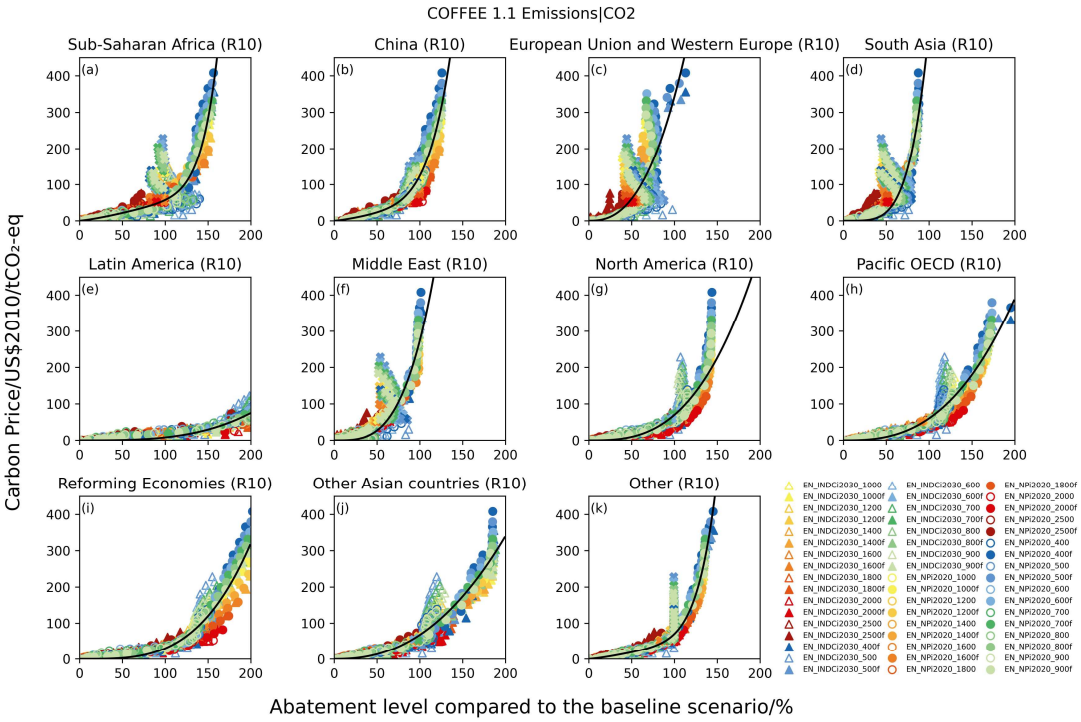

Figure S26. Regional COFFEE total anthropogenic CO_2 MAC curve

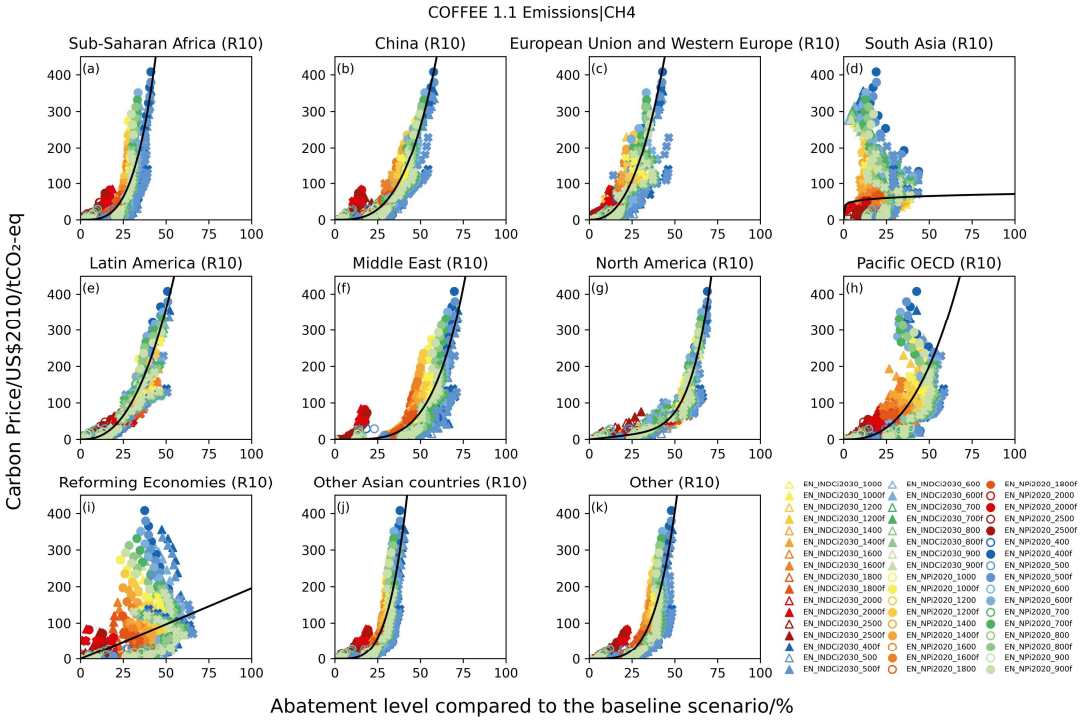

Figure S27. Regional COFFEE total anthropogenic CH_4 MAC curve

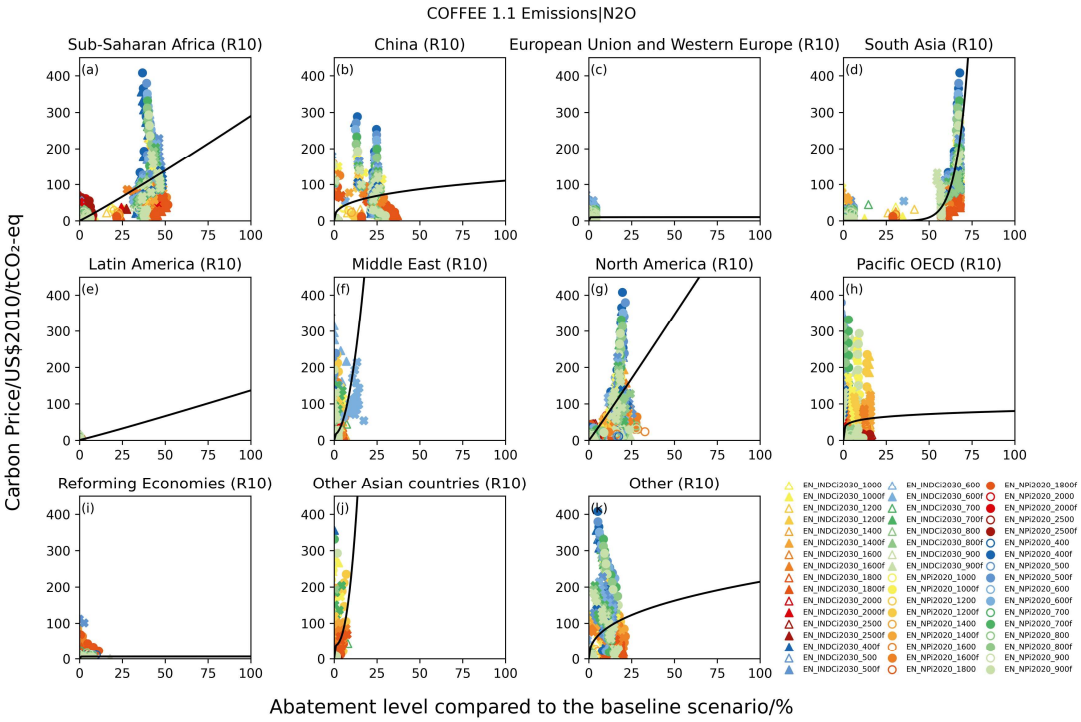

Figure S28. Regional COFFEE total anthropogenic N_2O MAC curve

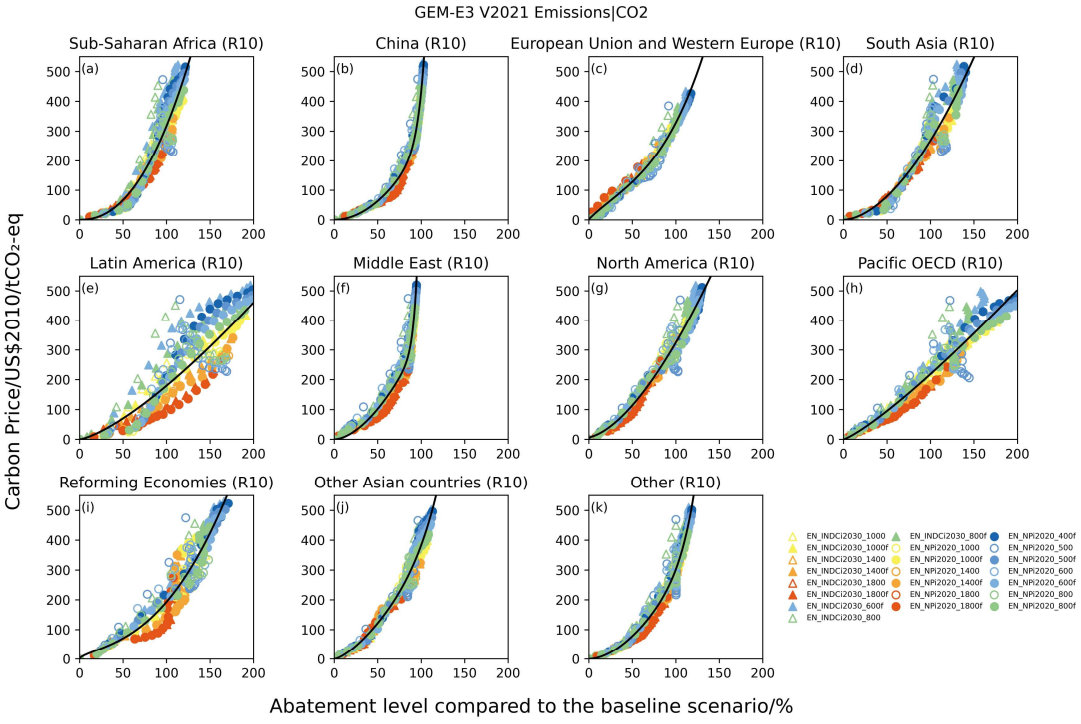

Figure S29. Regional GEM total anthropogenic CO_2 MAC curve

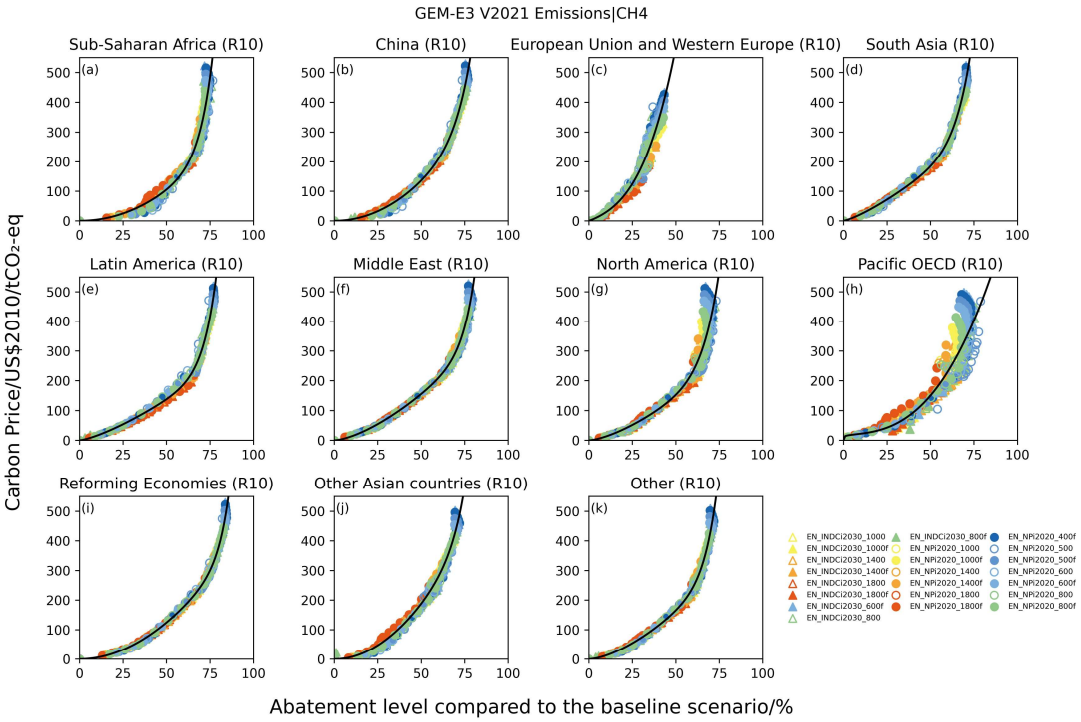

Figure S30. Regional GEM CH_4 MAC curve

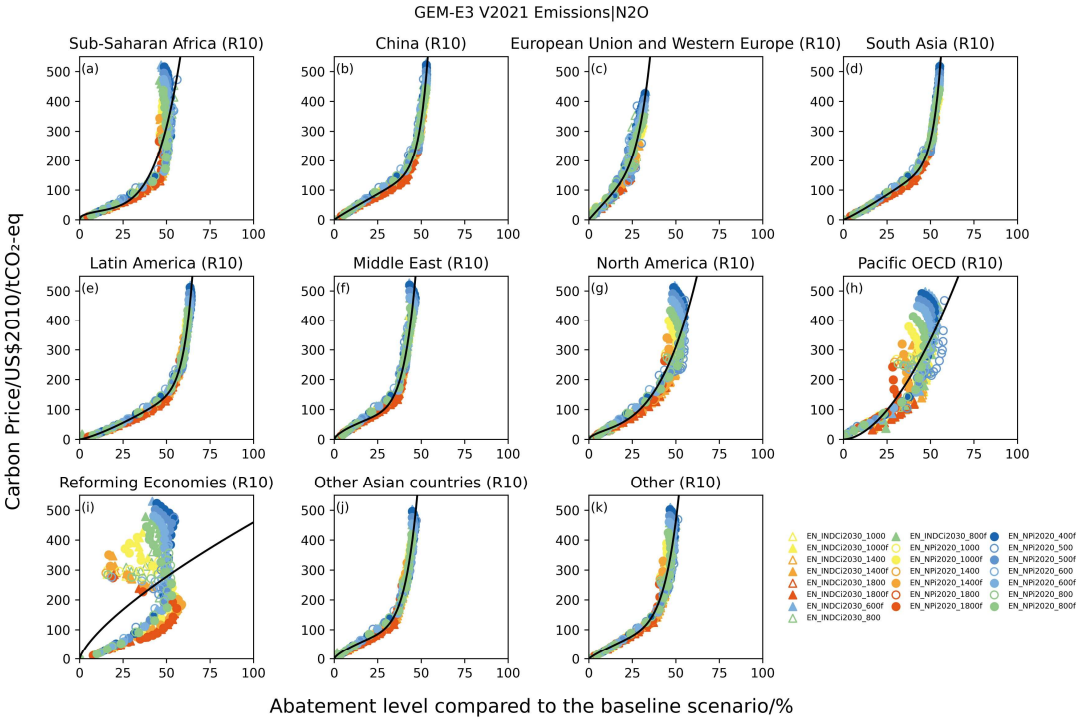

Figure S31. Regional GEM total anthropogenic N_2O MAC curve

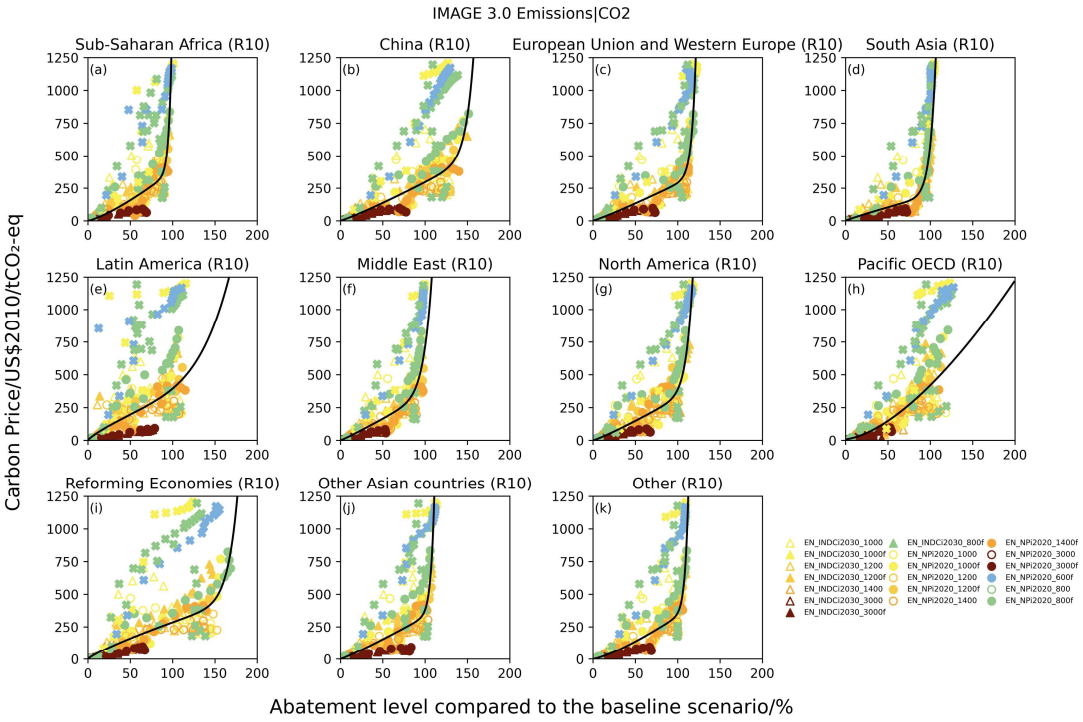

Figure S32. Regional IMAGE total anthropogenic CO_2 MAC curve

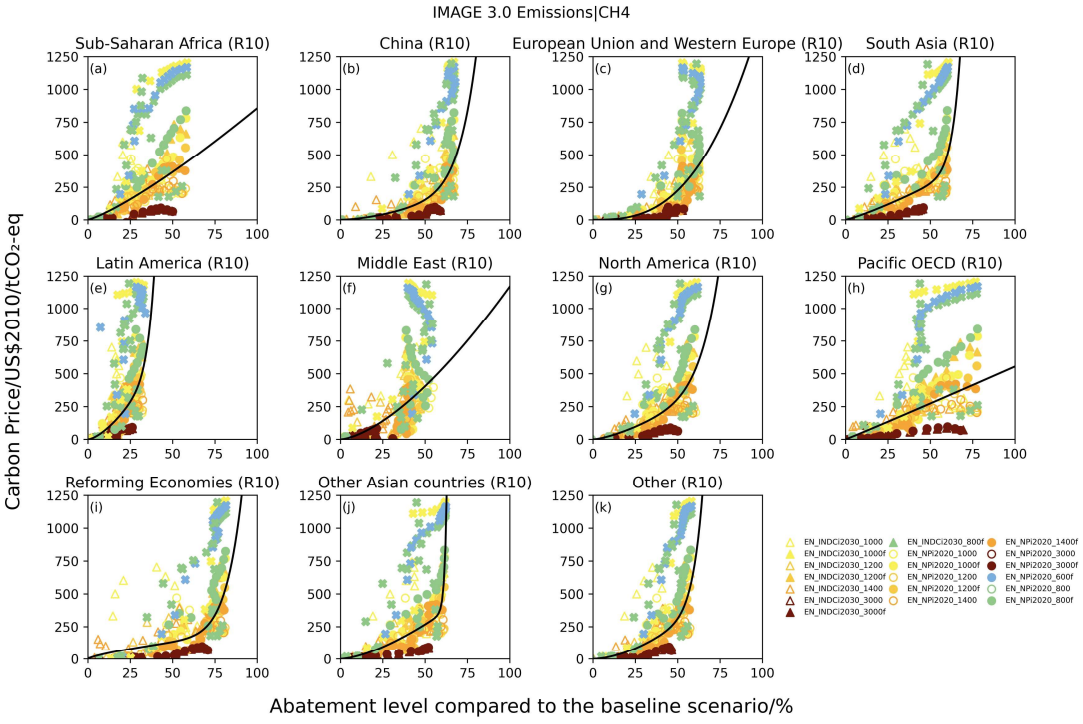

Figure S33. Regional IMAGE total anthropogenic CH_4 MAC curve

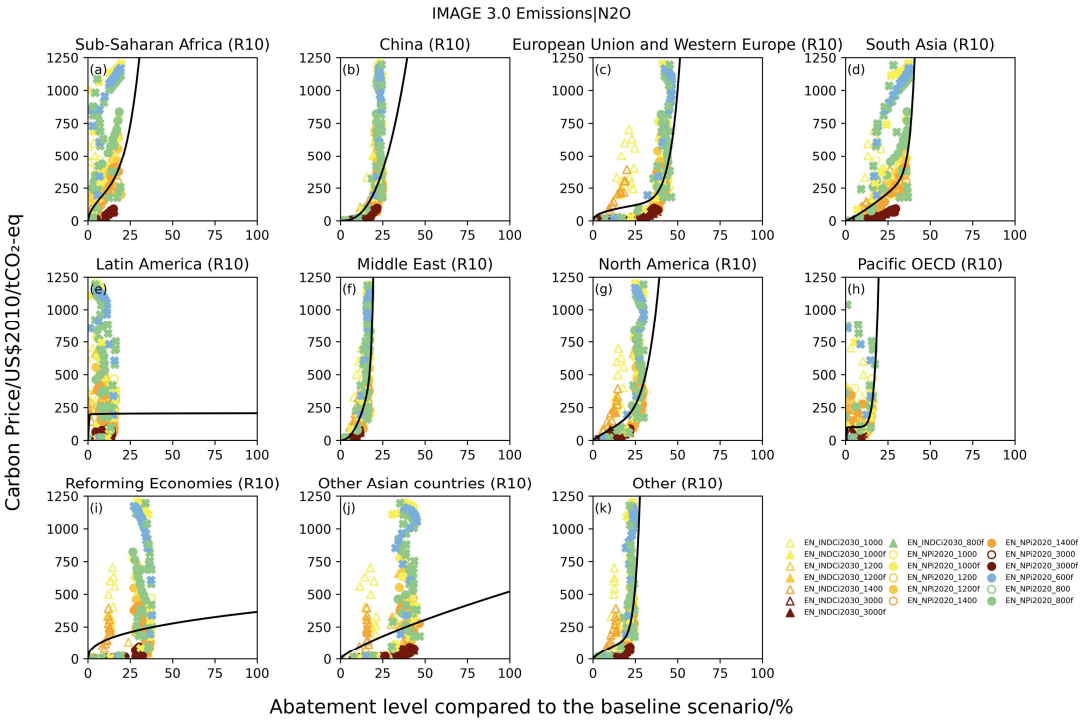

Figure S34. Regional IMAGE total anthropogenic N_2O MAC curve

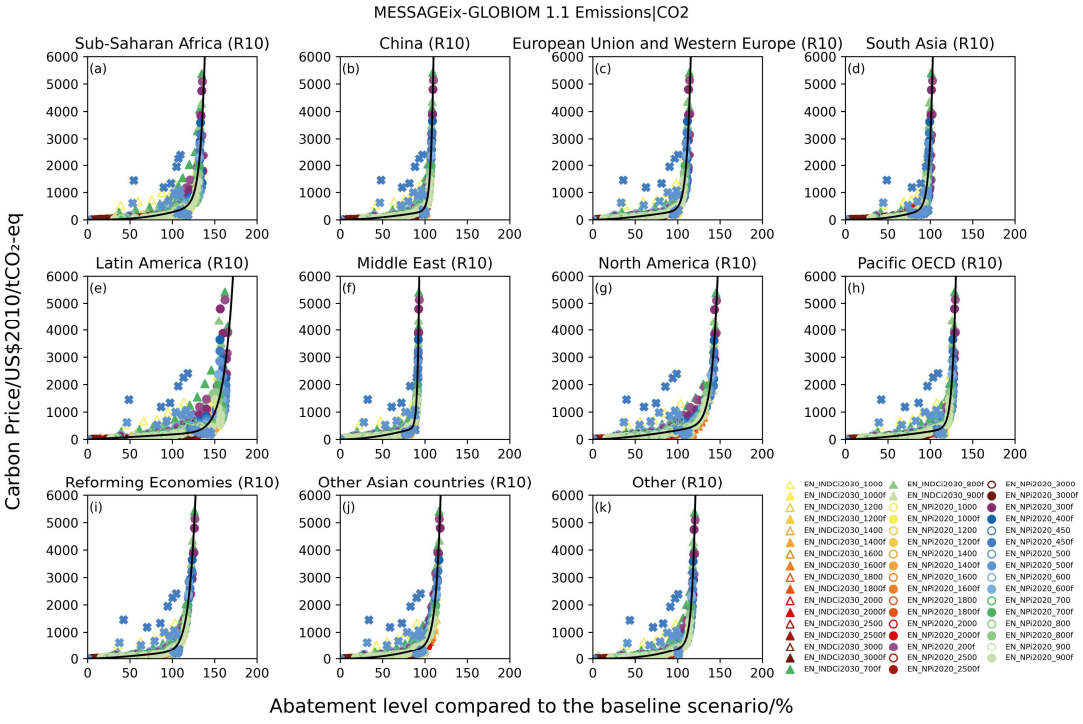

Figure S35. Regional MESSAGE total anthropogenic CO_2 MAC curve

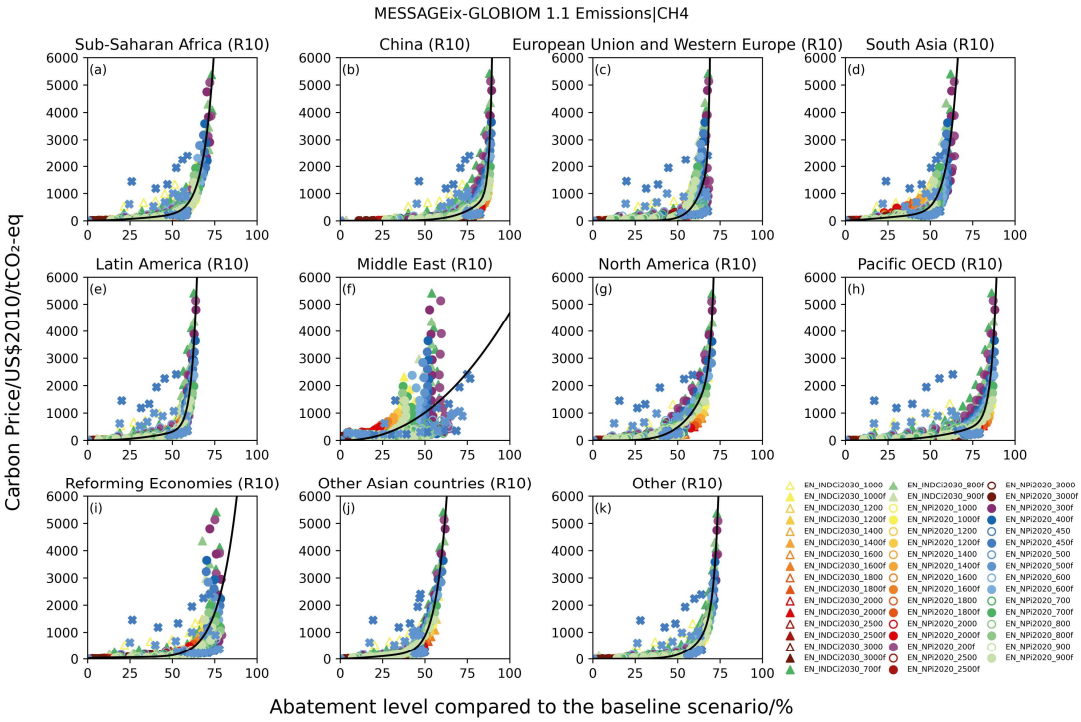

Figure S36. Regional MESSAGE total anthropogenic CH_4 MAC curve

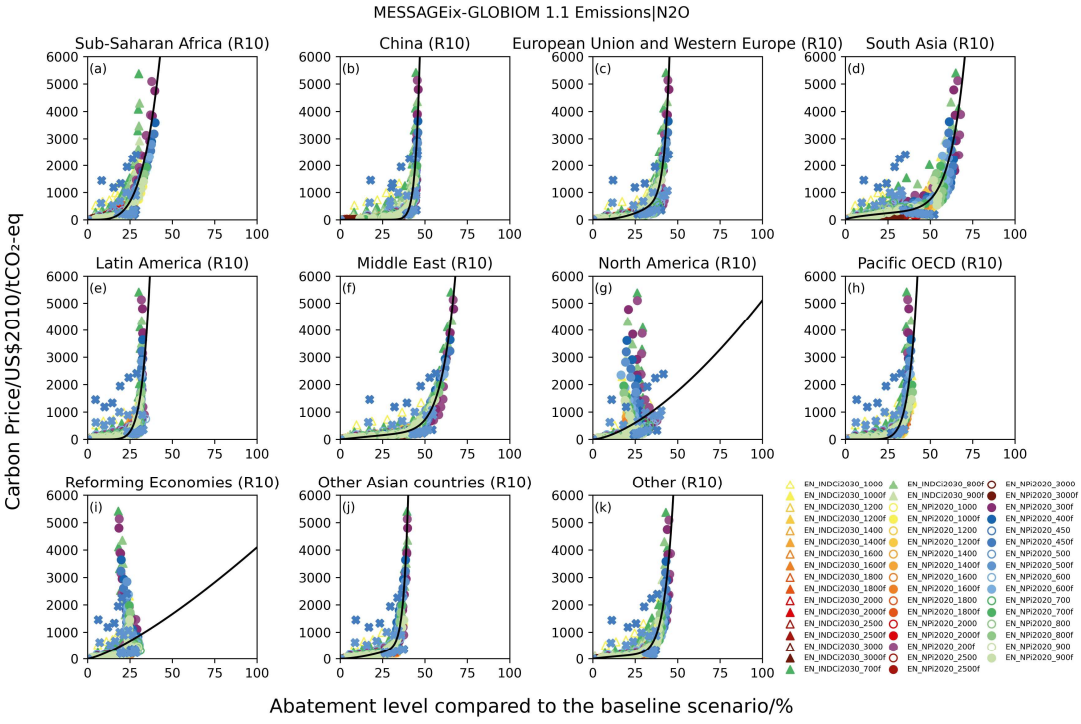

Figure S37. Regional MESSAGE total anthropogenic N_2O MAC curve

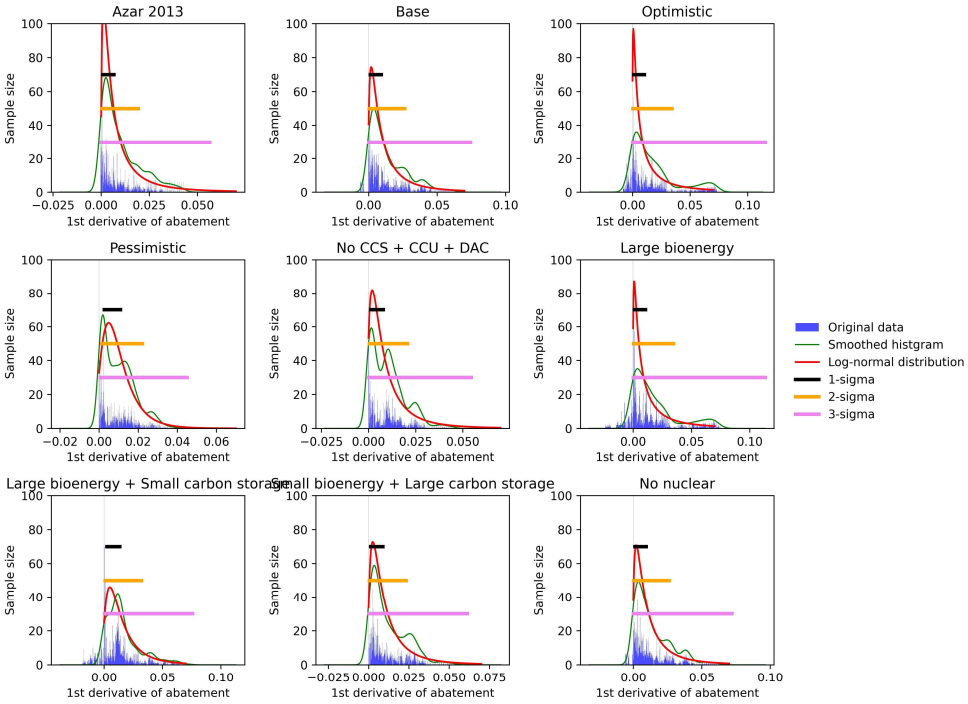

Figure S38. Global GET - Distribution of first derivative of abatement levels

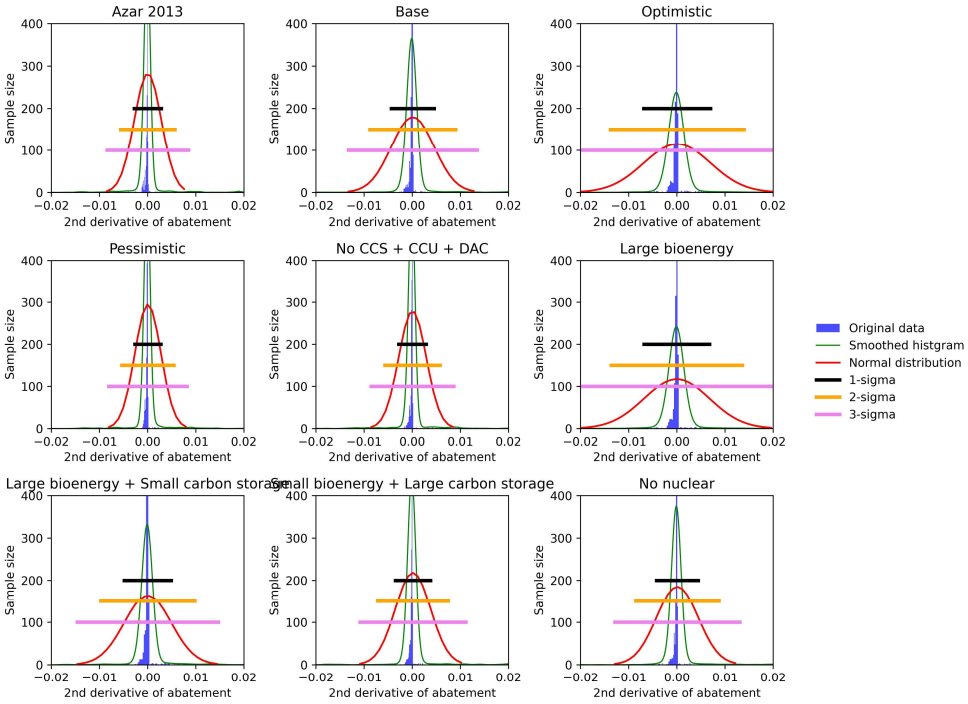

Figure S39. Global GET - Distribution of second derivative of abatement levels

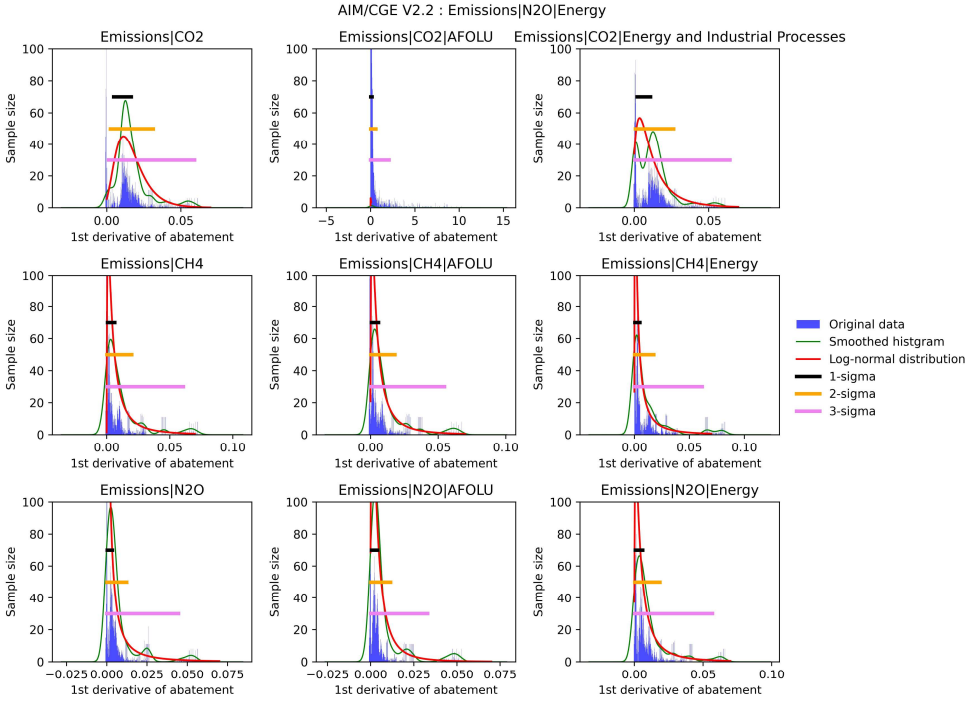

Figure S40. Global AIM - Distribution of first derivative of abatement levels

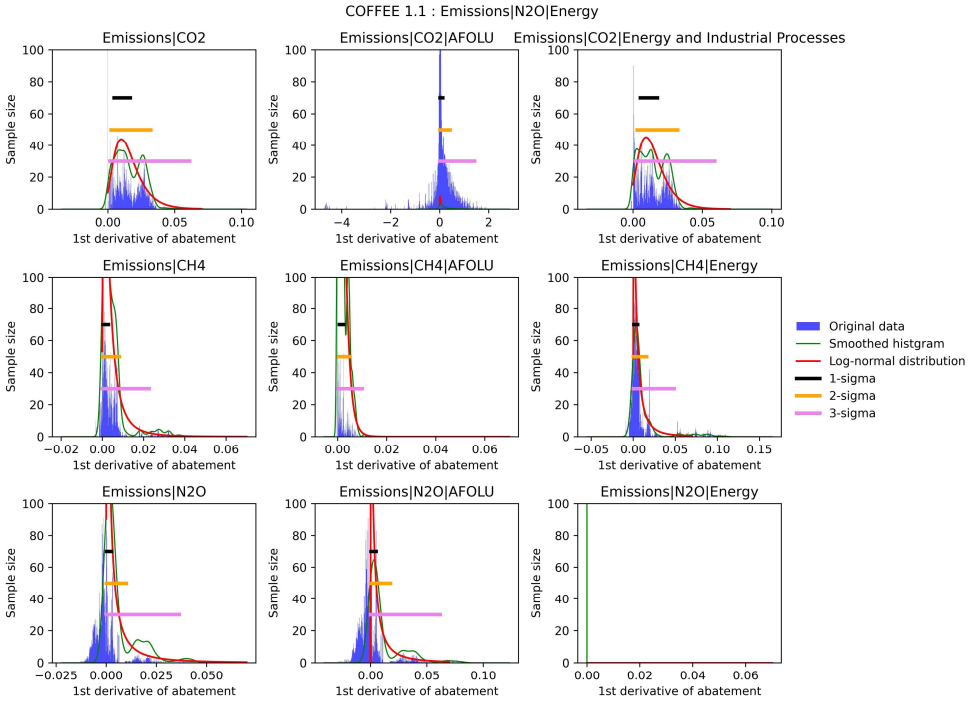

Figure S41. Global COFFEE - Distribution of first derivative of abatement levels

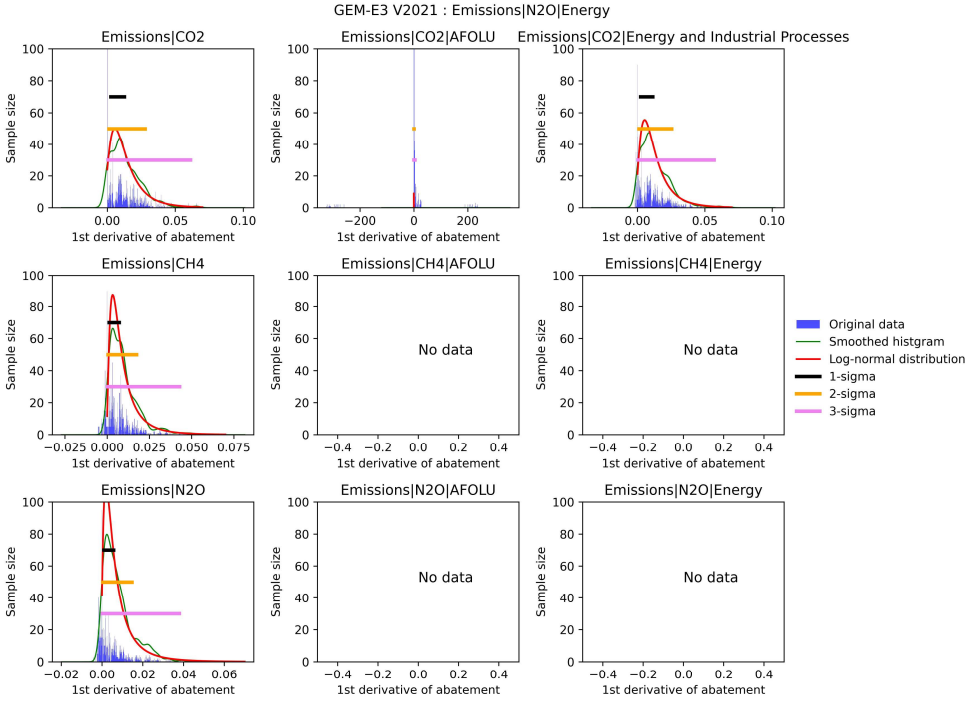

Figure S42. Global GEM - Distribution of first derivative of abatement levels

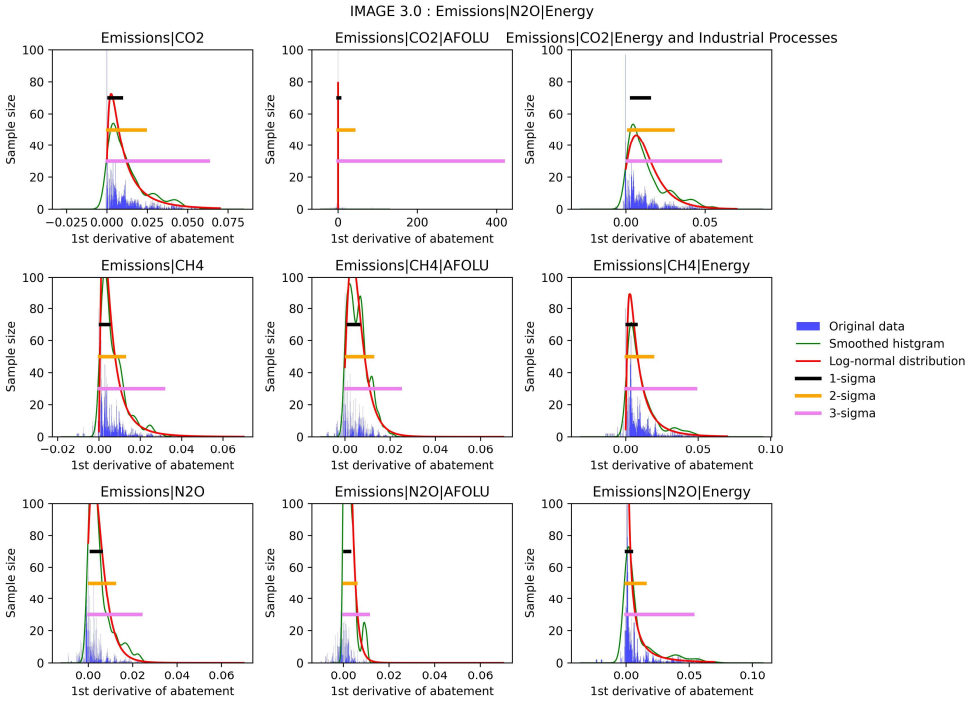

Figure S43. Global IMAGE - Distribution of first derivative of abatement levels

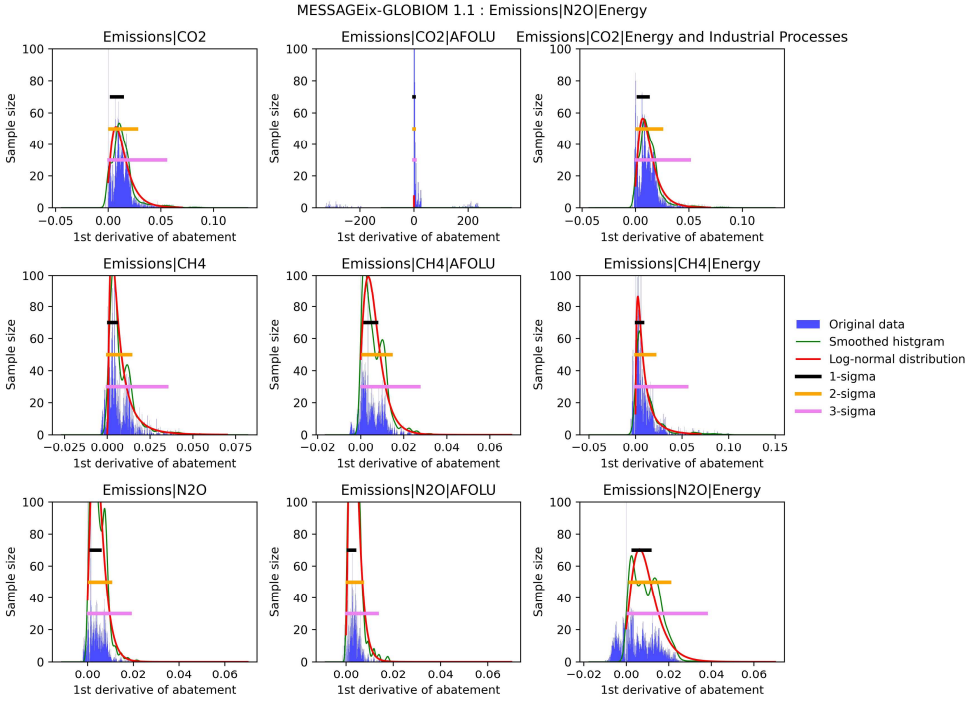

Figure S44. Global MESSAGE - Distribution of first derivative of abatement levels

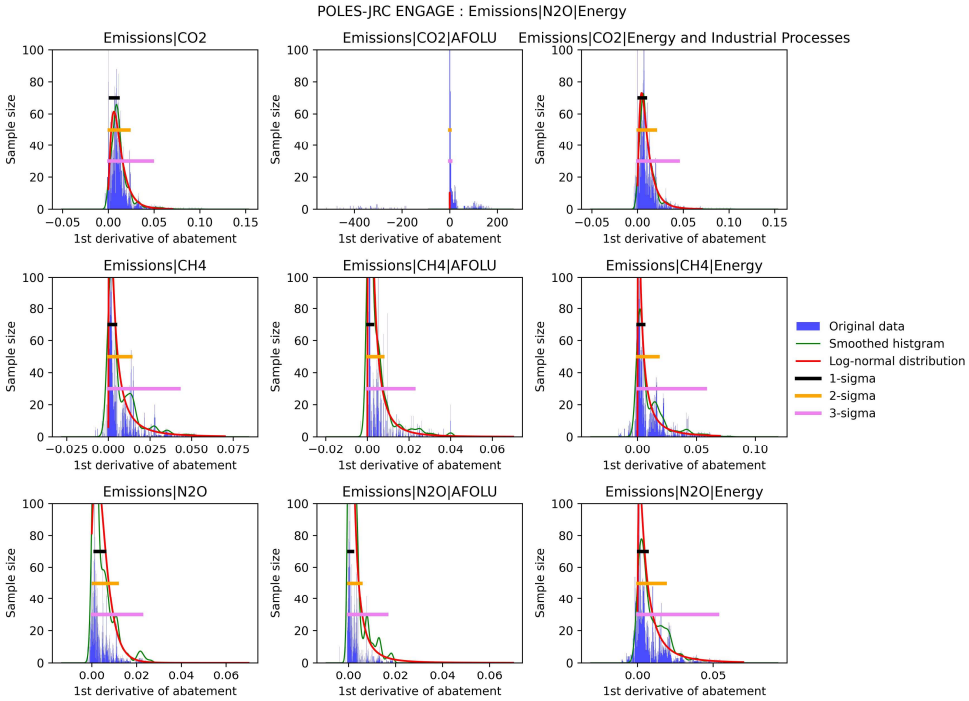

Figure S45. Global POLES - Distribution of first derivative of abatement levels

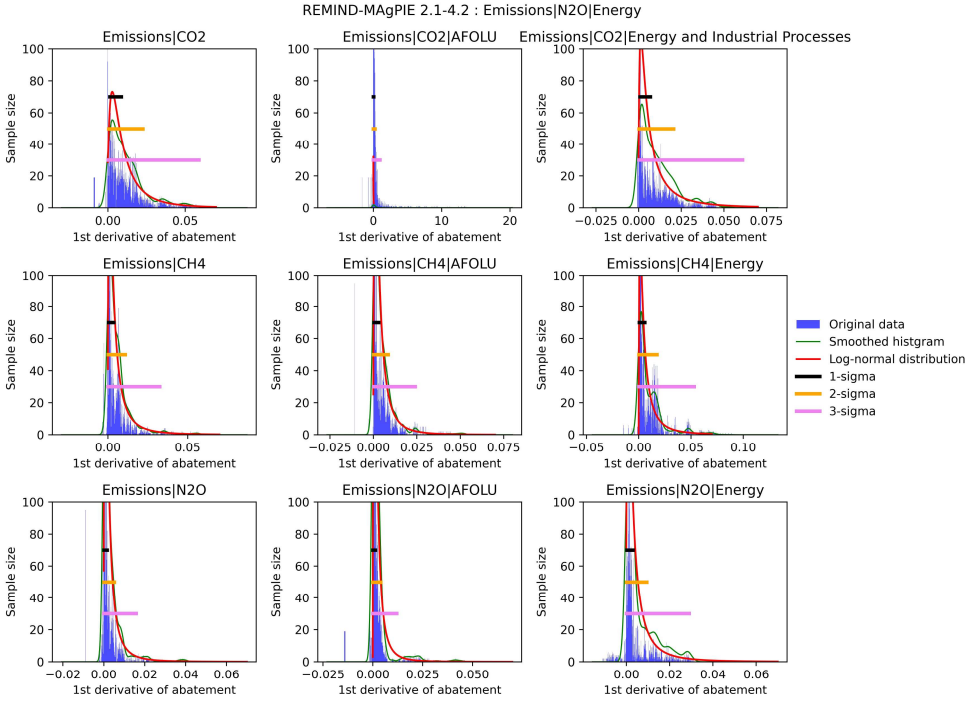

Figure S46. Global REMIND - Distribution of first derivative of abatement levels

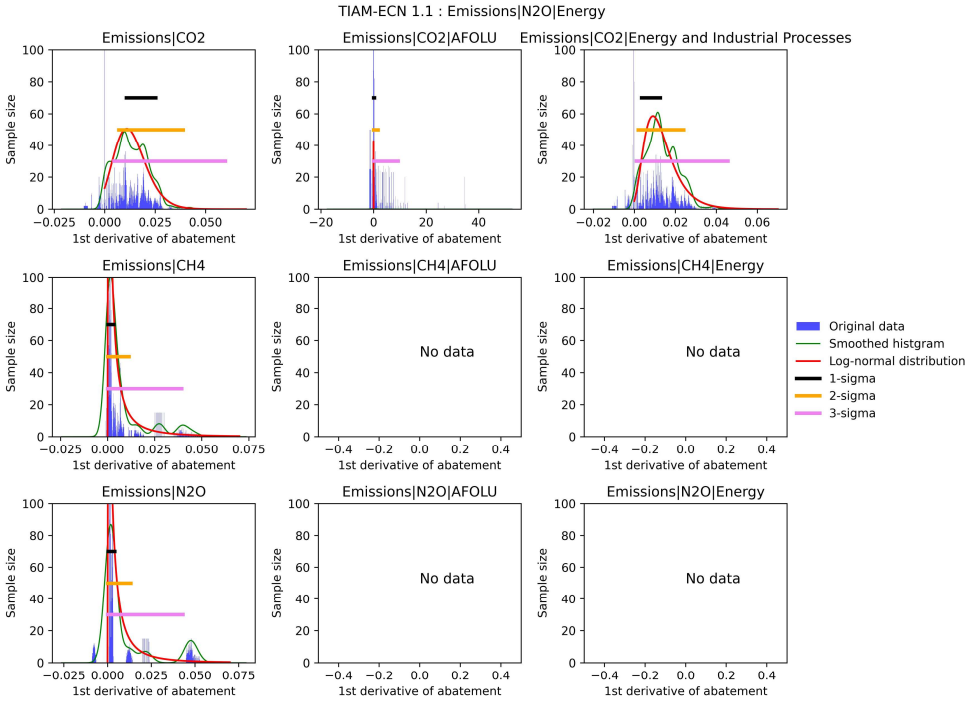

Figure S47. Global TIAM - Distribution of first derivative of abatement levels

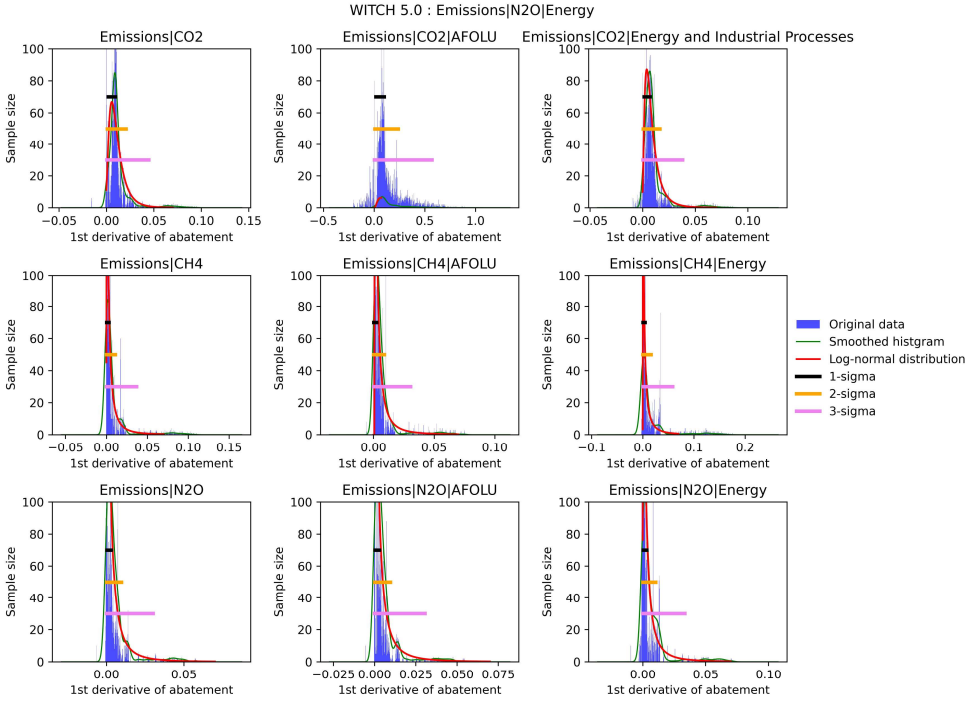

Figure S48. Global WITCH - Distribution of first derivative of abatement levels

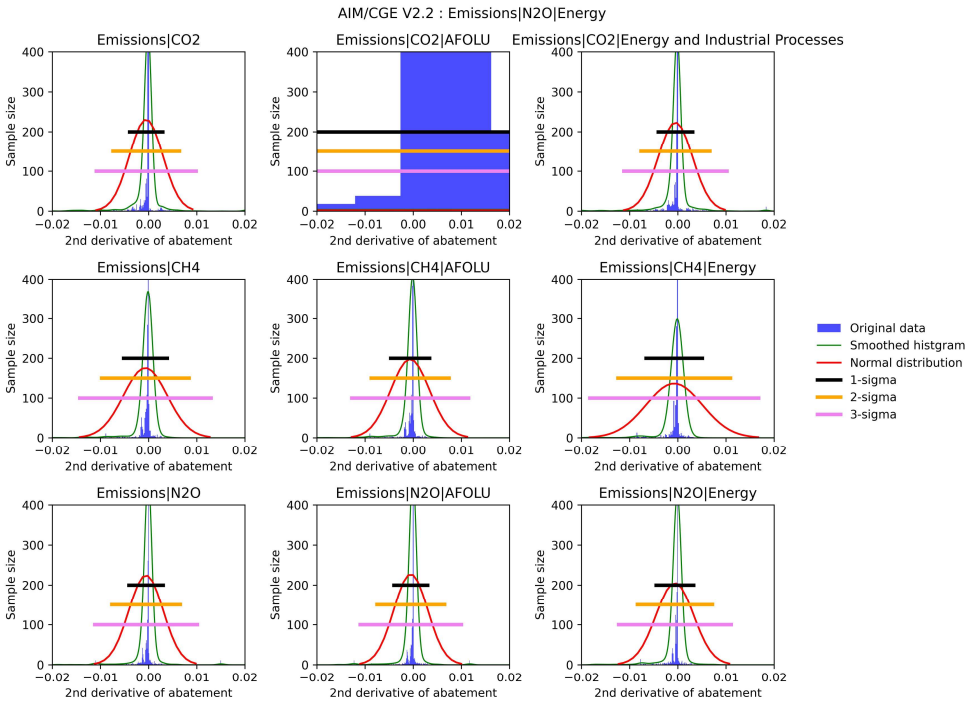

Figure S49. Global AIM - Distribution of second derivative of abatement levels

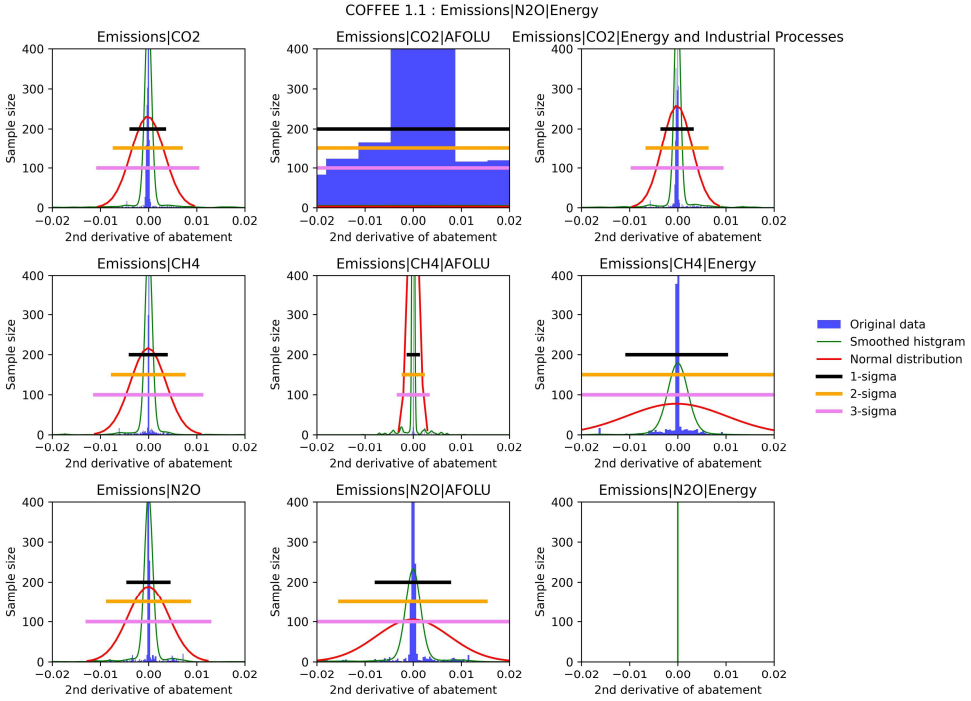

Figure S50. Global COFFEE - Distribution of second derivative of abatement levels

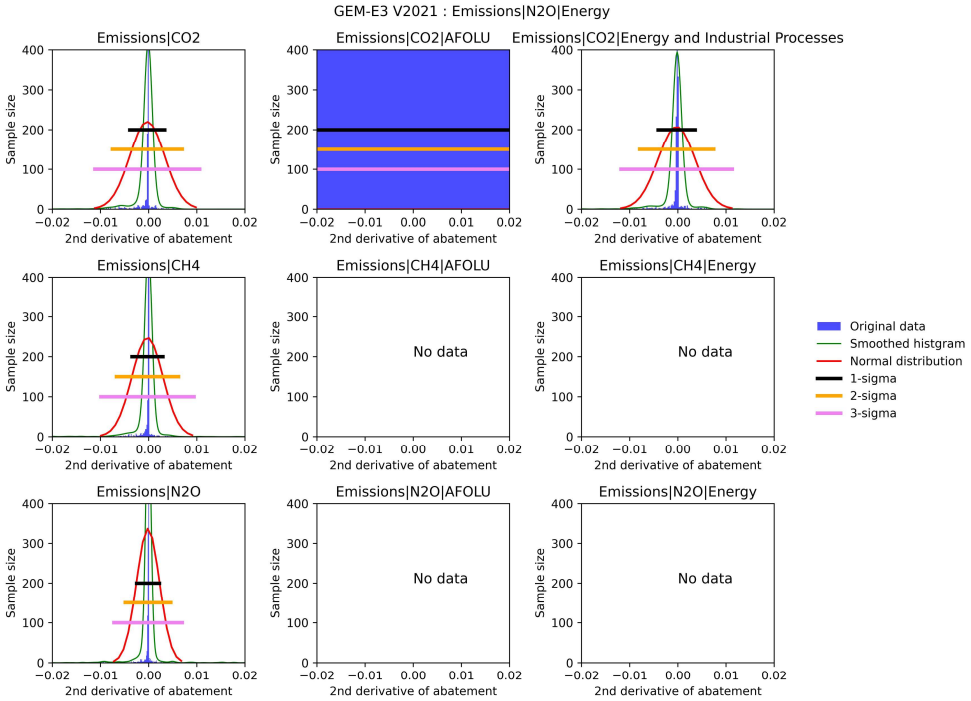

Figure S51. Global GEM - Distribution of second derivative of abatement levels

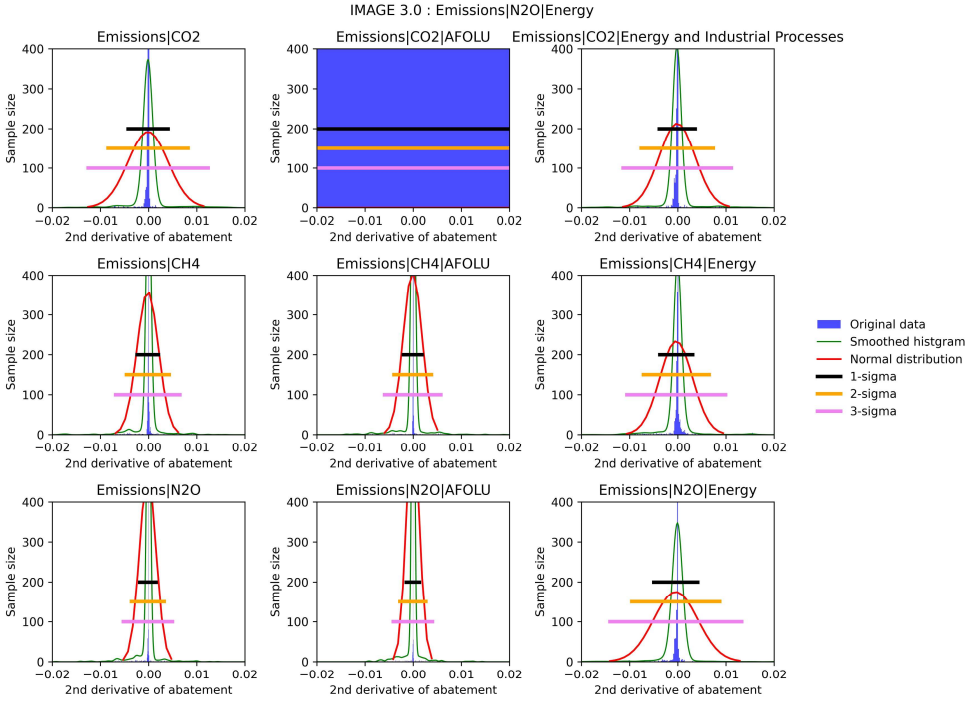

Figure S52. Global IMAGE - Distribution of second derivative of abatement levels

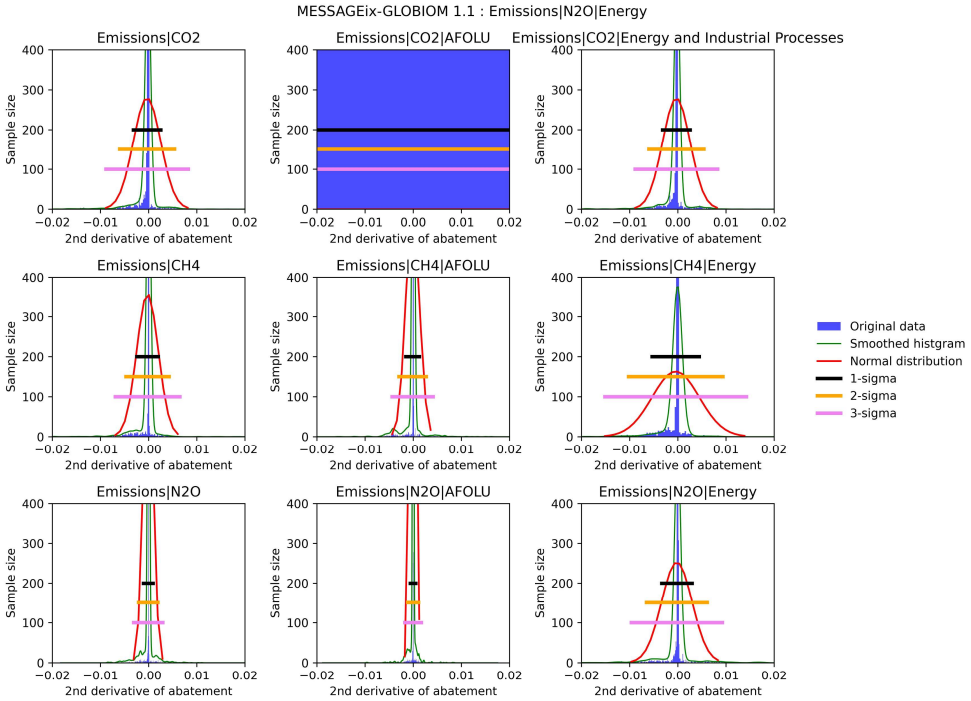

Figure S53. Global MESSAGE - Distribution of second derivative of abatement levels

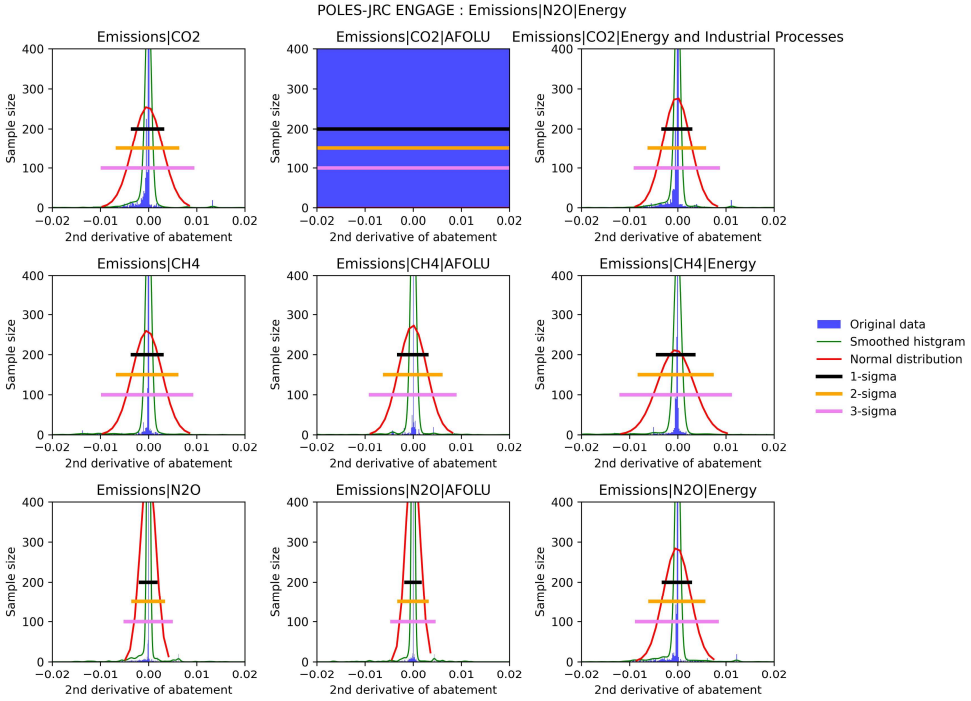

Figure S54. Global POLES - Distribution of second derivative of abatement levels

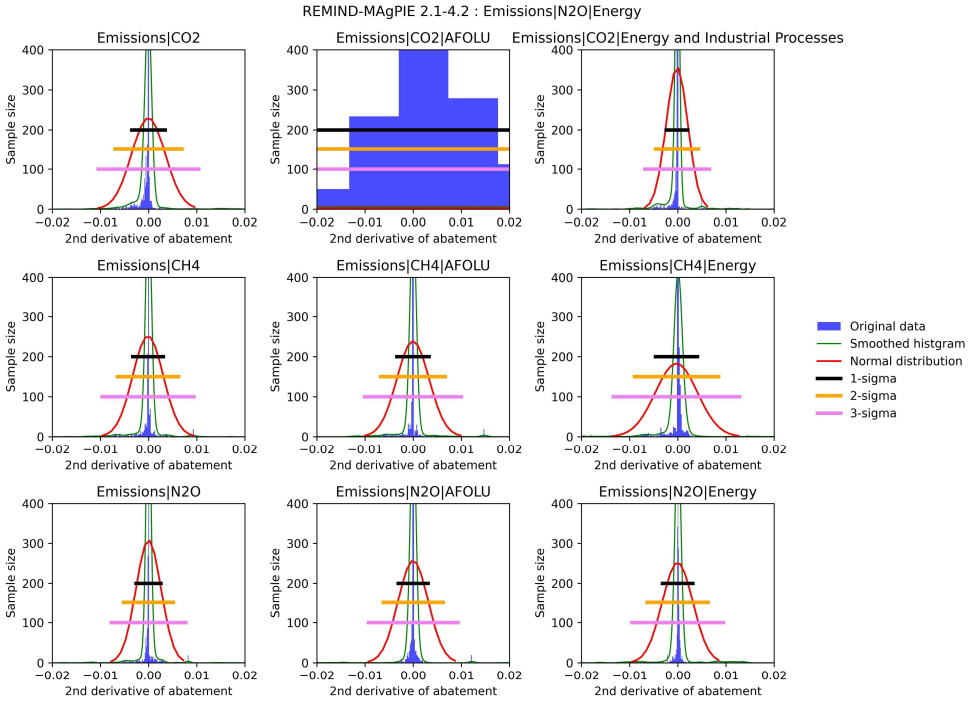

Figure S55. Global REMIND - Distribution of second derivative of abatement levels

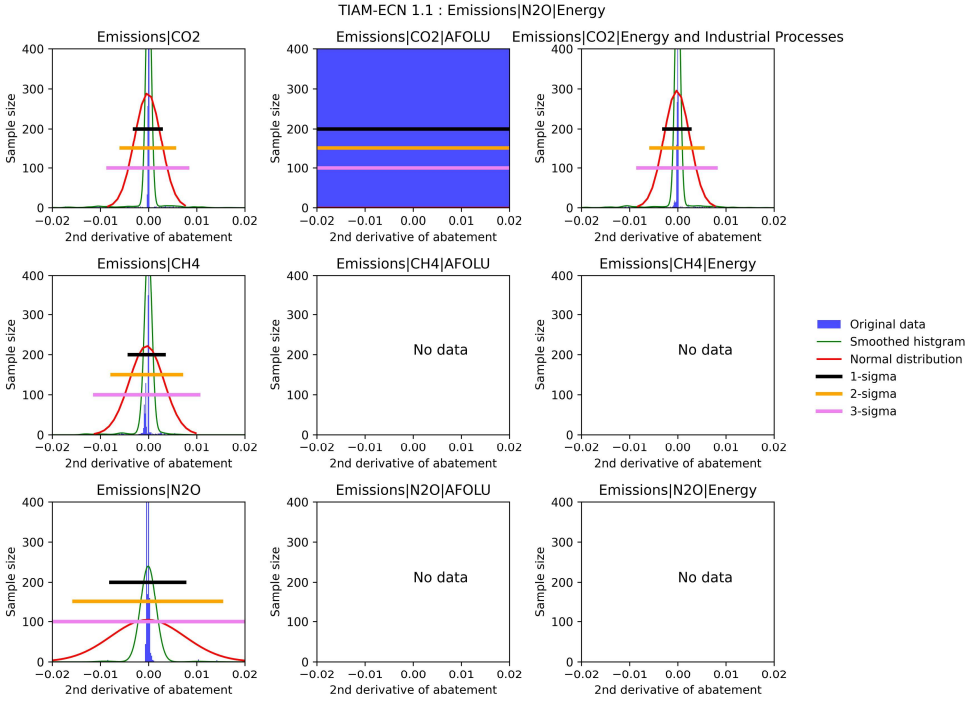

Figure S56. Global TIAM - Distribution of second derivative of abatement levels

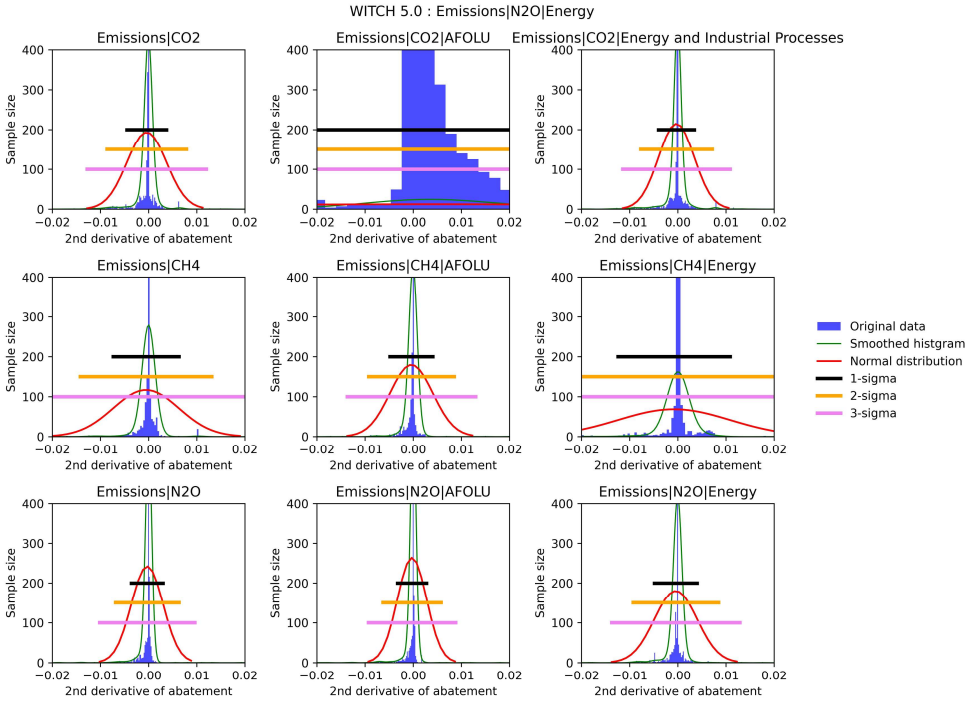

Figure S57. Global WITCH - Distribution of second derivative of abatement levels

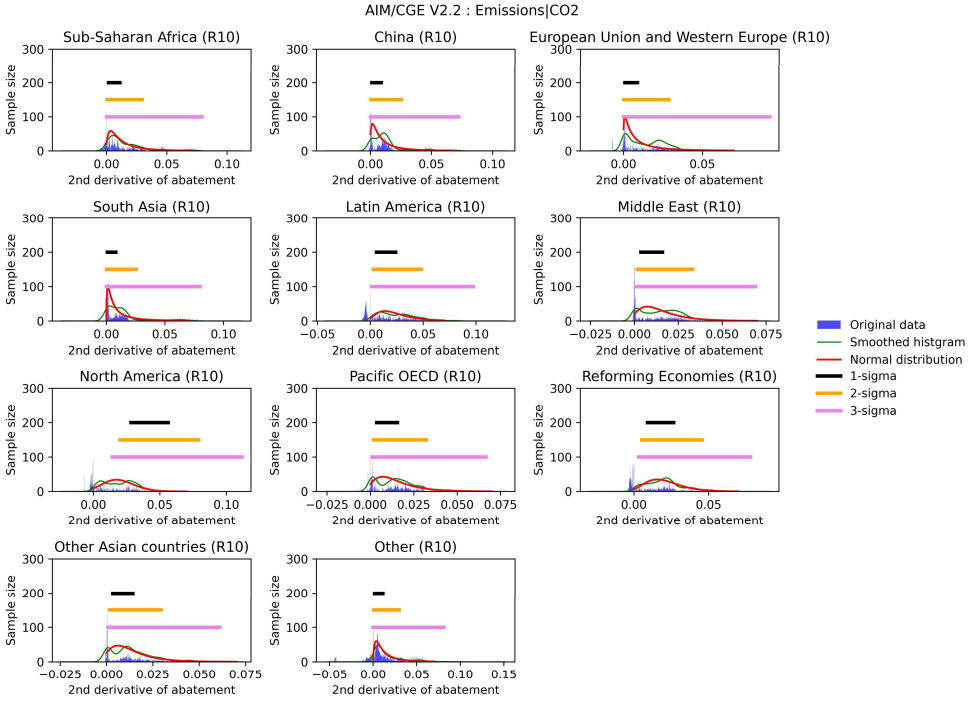

Figure S58. Regional AIM CO_2 - Distribution of first derivative of abatement levels

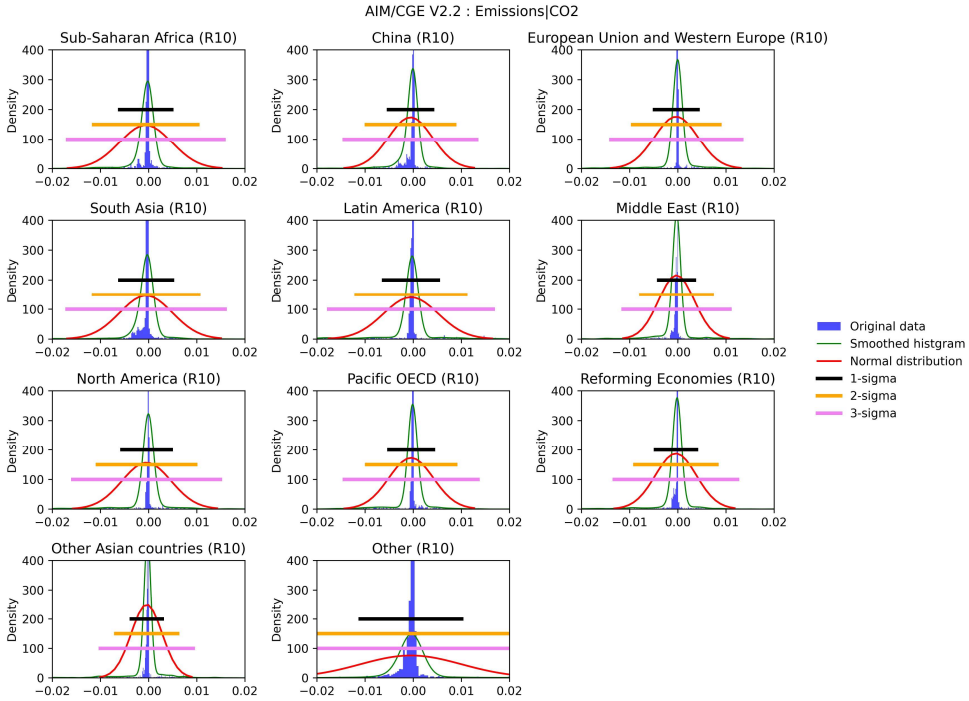

Figure S59. Regional AIM CO_2 - Distribution of first derivative of abatement levels

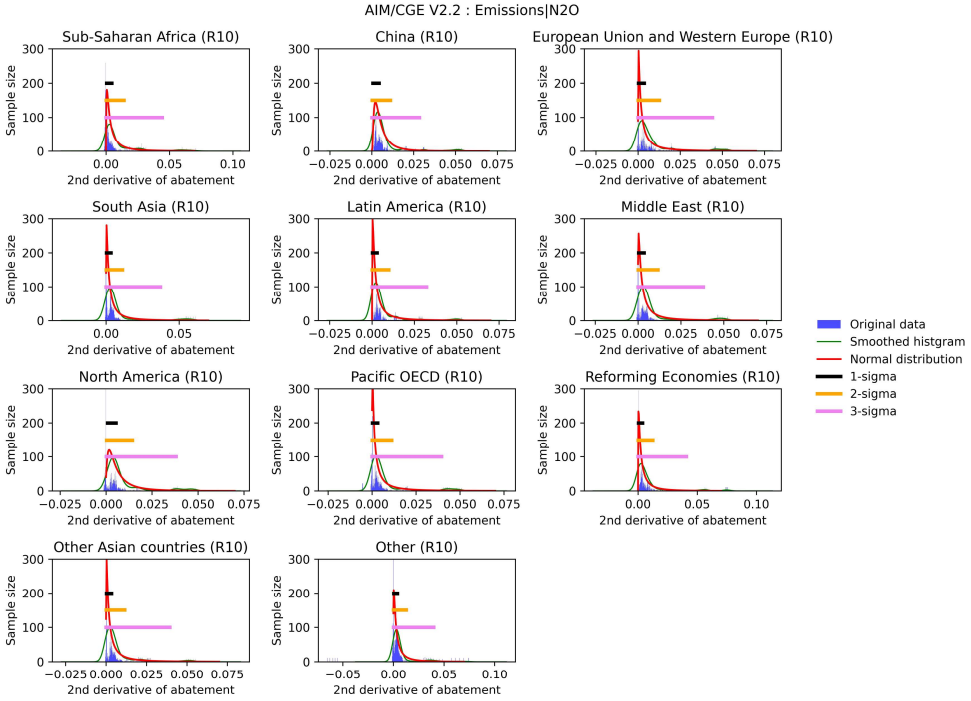

Figure S60. Regional AIM CH_4- Distribution of first derivative of abatement levels

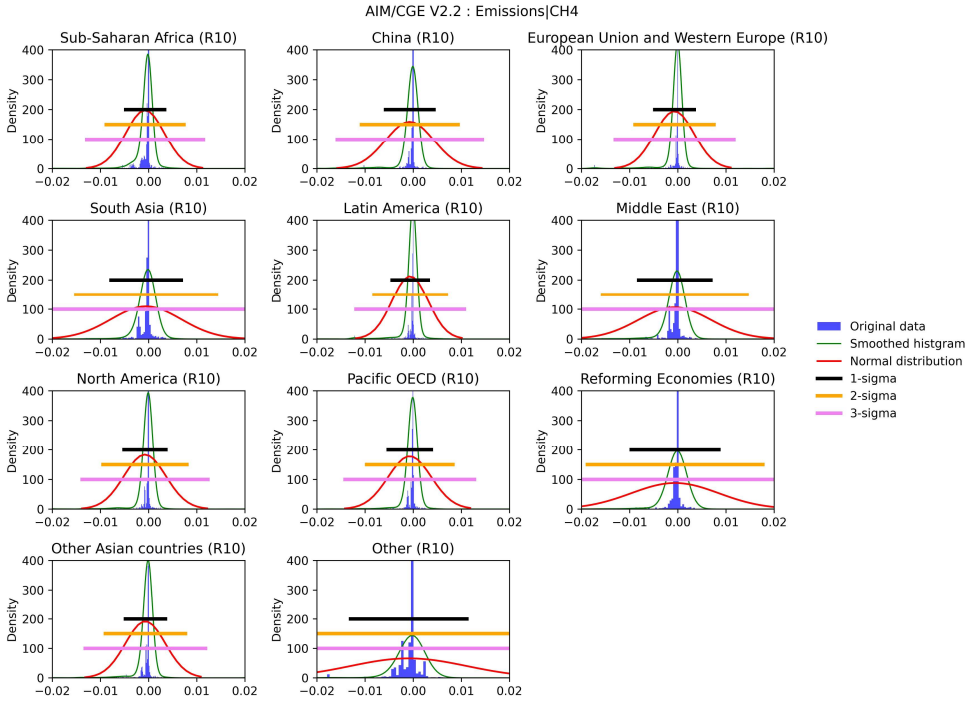

Figure S61. Regional AIM CH_4 - Distribution of second derivative of abatement levels

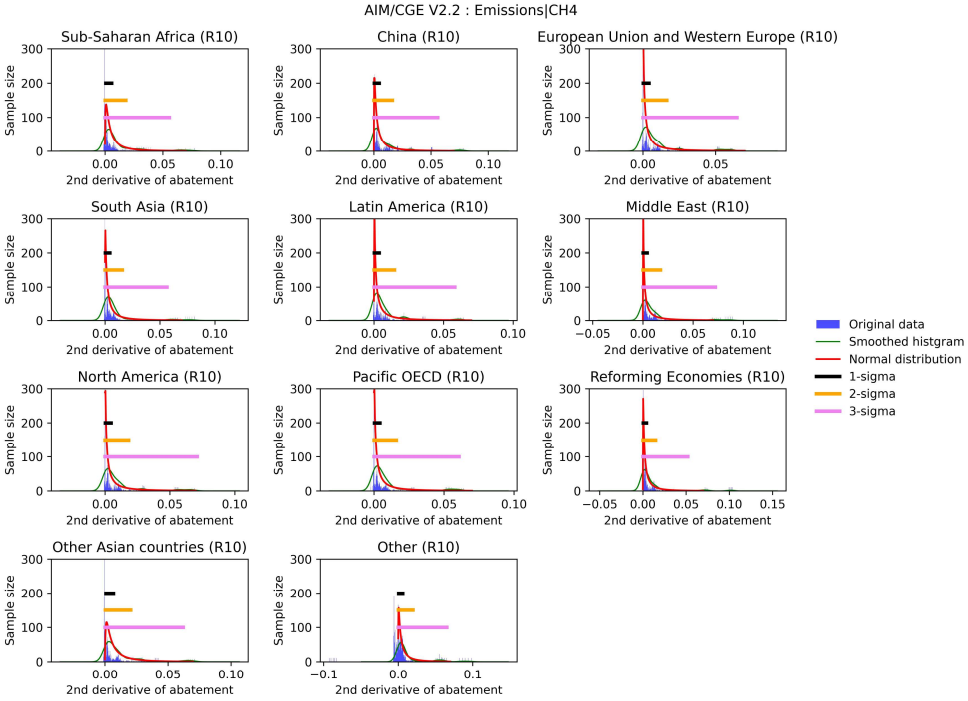

Figure S62. Regional AIM N_2O - Distribution of first derivative of abatement levels

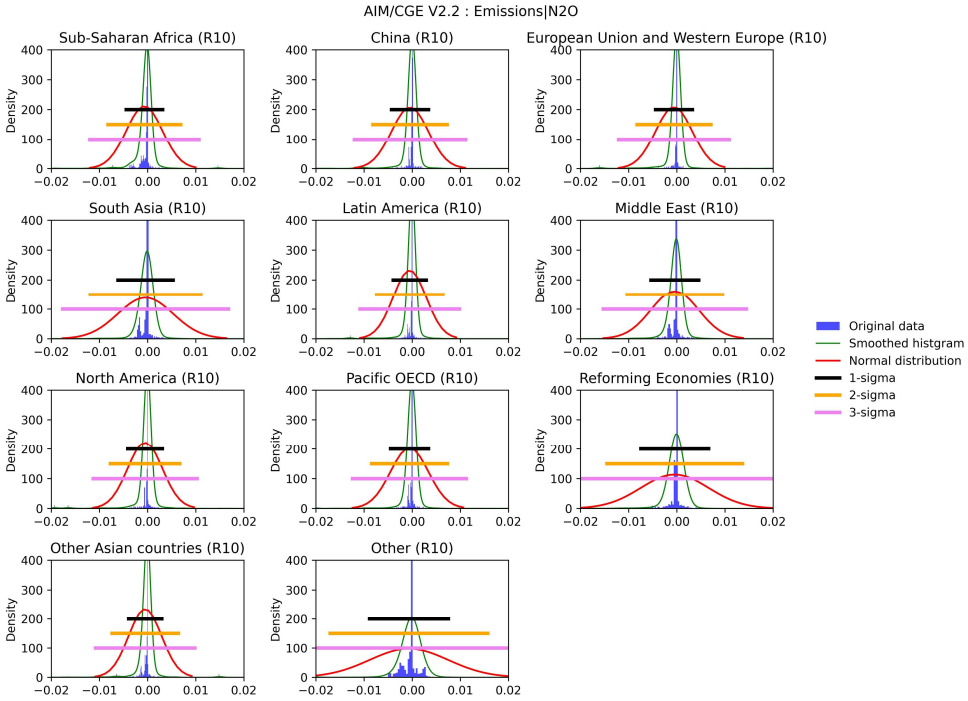

Figure S63. Regional AIM N_2O - Distribution of second derivative of abatement levels

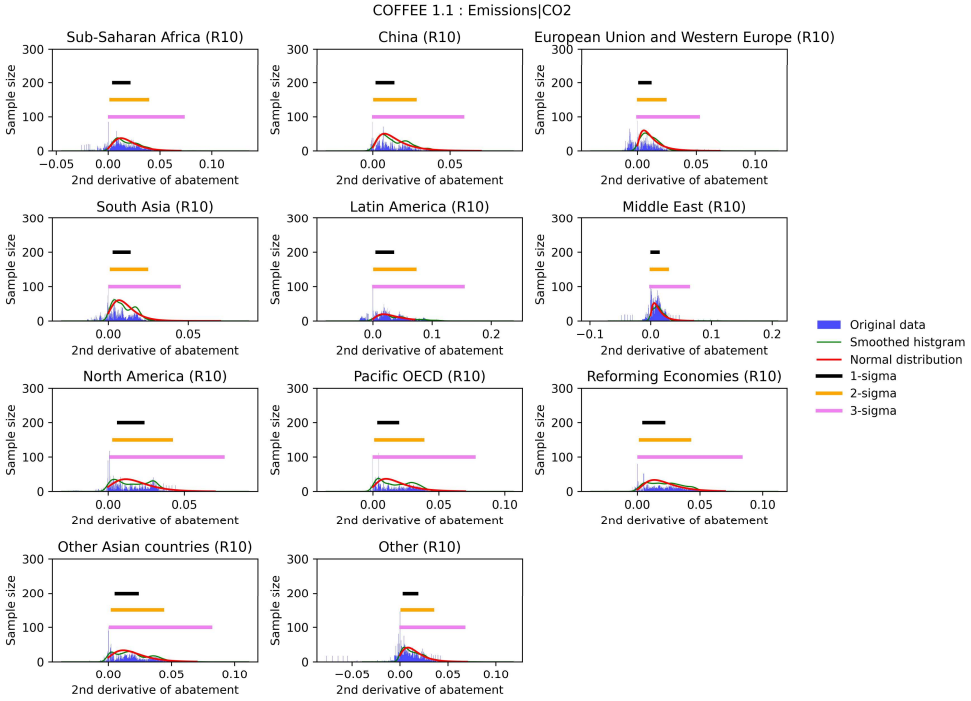

Figure S64. Regional COFFEE CO_2 - Distribution of first derivative of abatement levels

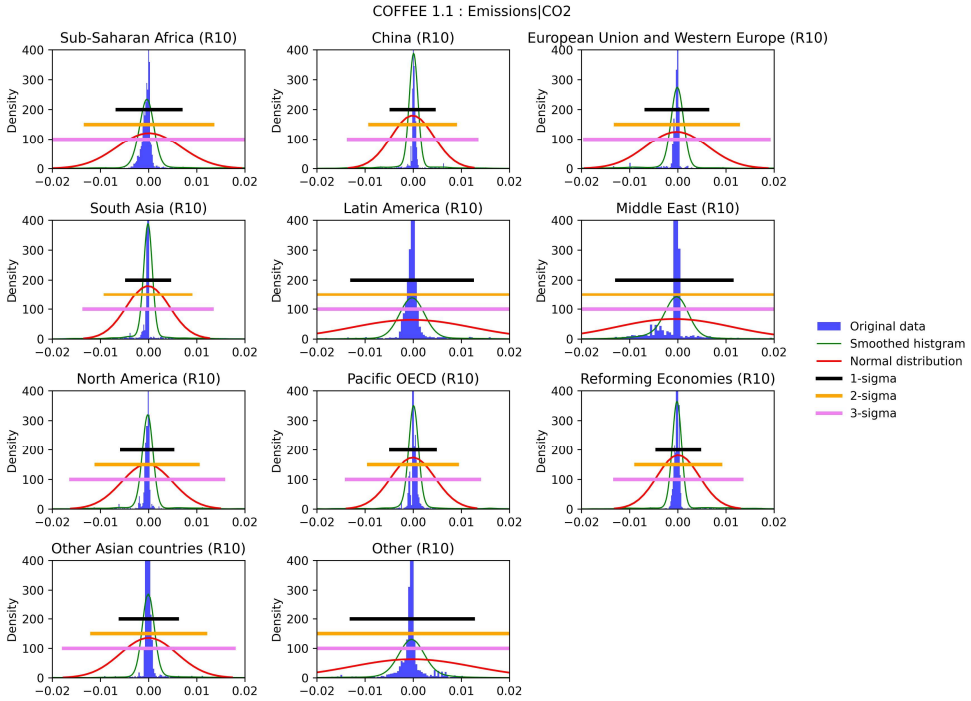

Figure S65. Regional COFFEE CO_2 - Distribution of second derivative of abatement levels

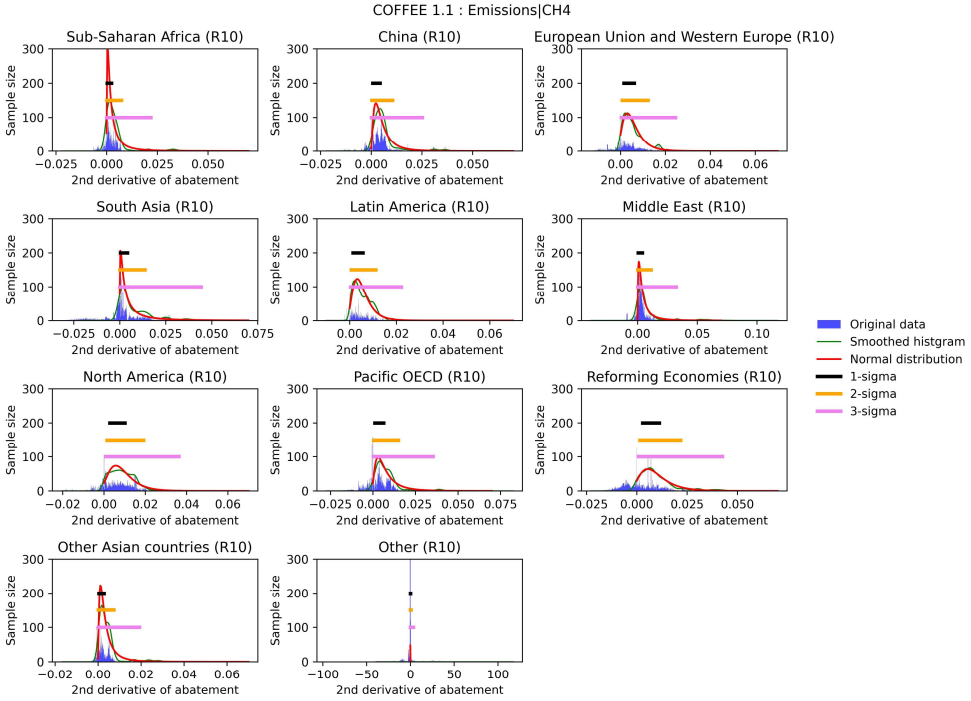

Figure S66. Regional COFFEE CH_4- Distribution of first derivative of abatement levels

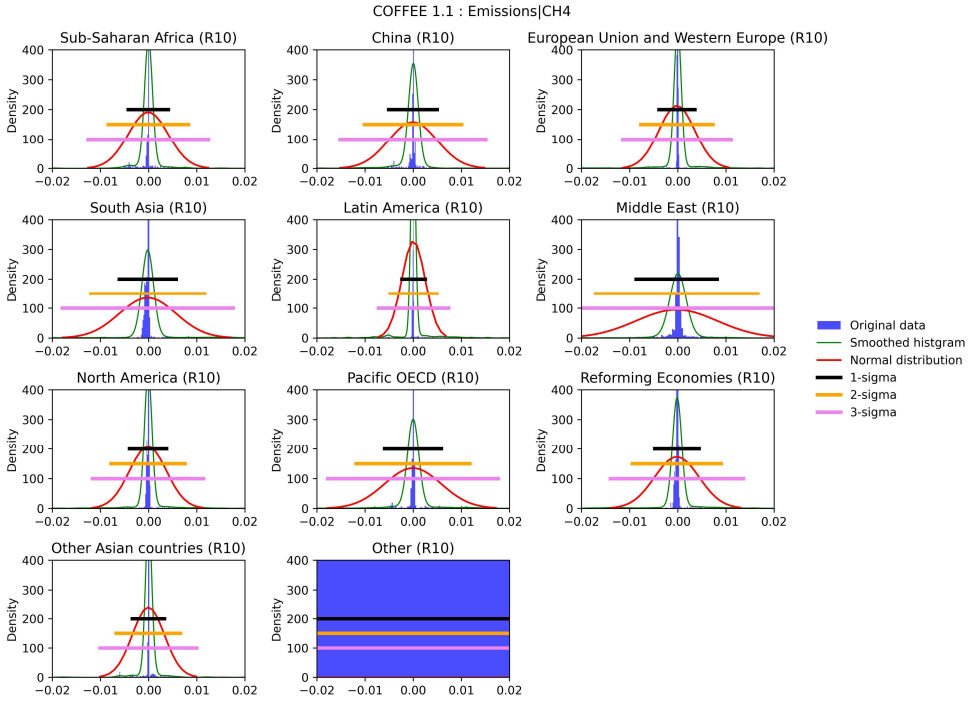

Figure S67. Regional COFFEE CH_4 - Distribution of second derivative of abatement levels

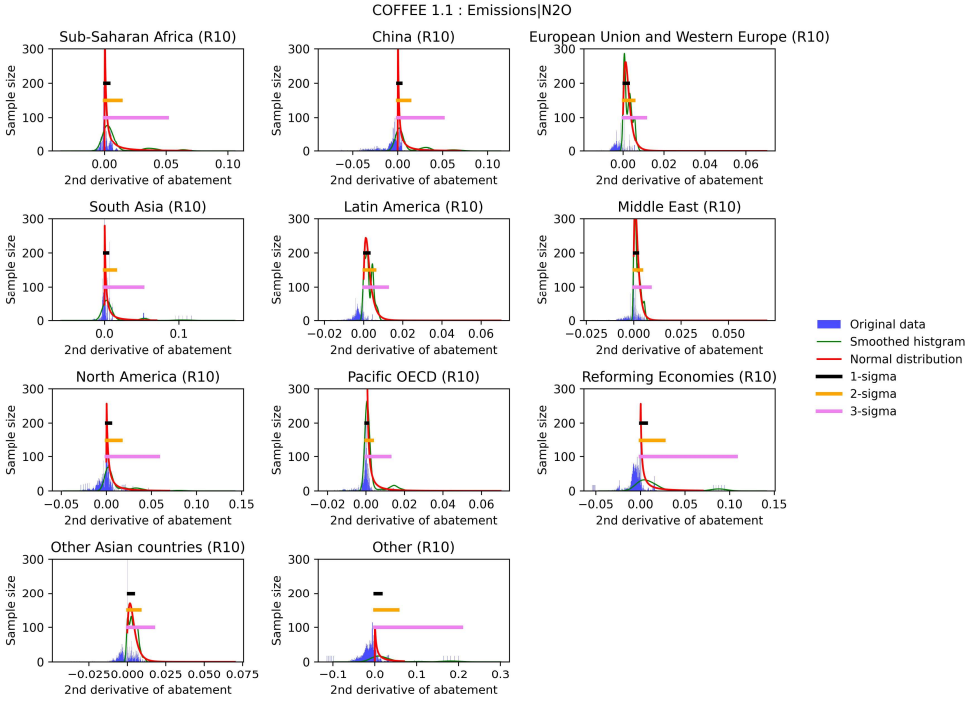

Figure S68. Regional COFFEE N_2O - Distribution of first derivative of abatement levels

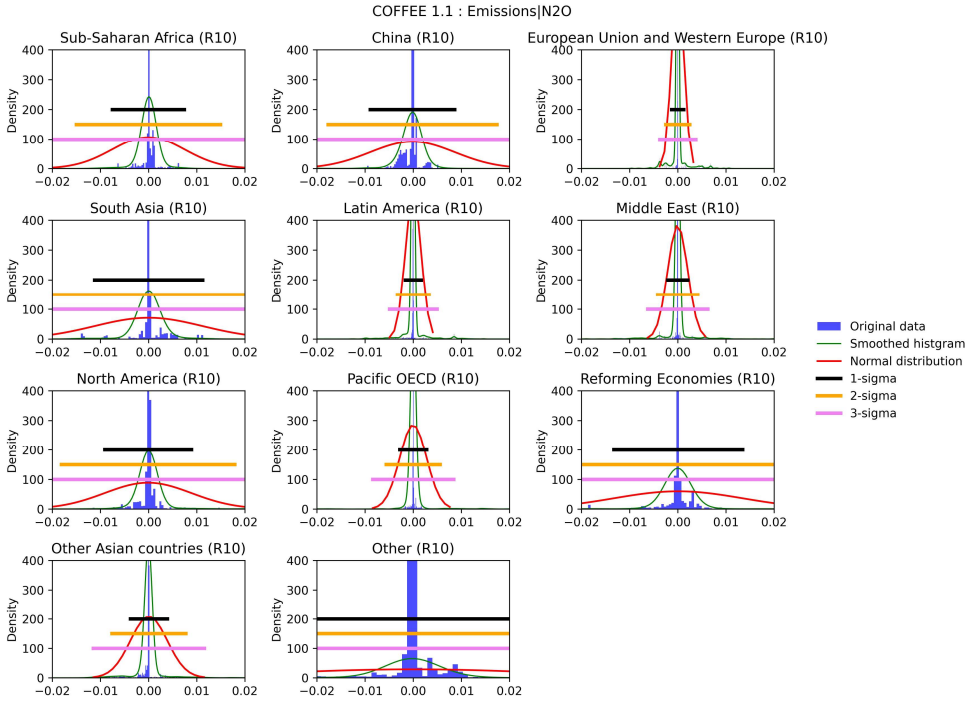

Figure S69. Regional COFFEE N_2O - Distribution of second derivative of abatement levels

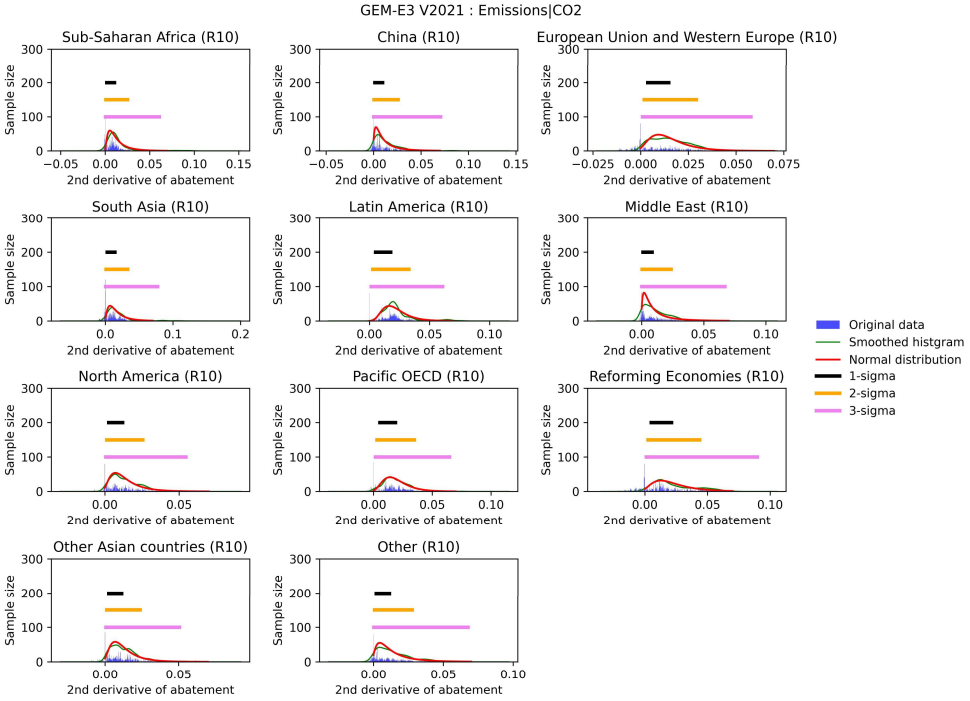

Figure S70. Regional GEM CO_2 - Distribution of first derivative of abatement levels

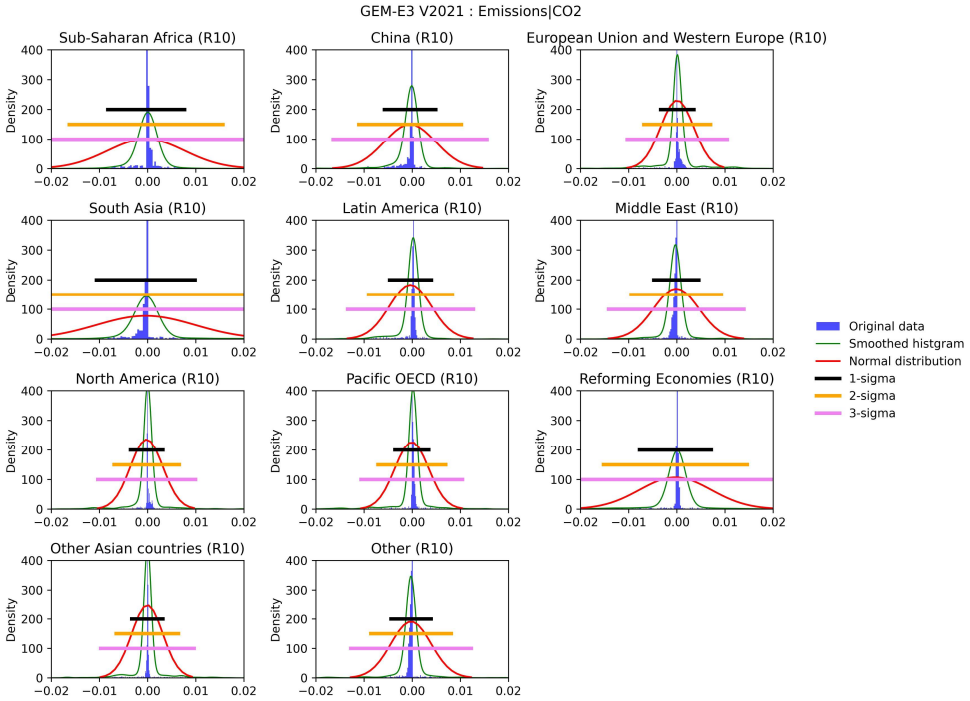

Figure S71. Regional GEM CO_2 - Distribution of second derivative of abatement levels

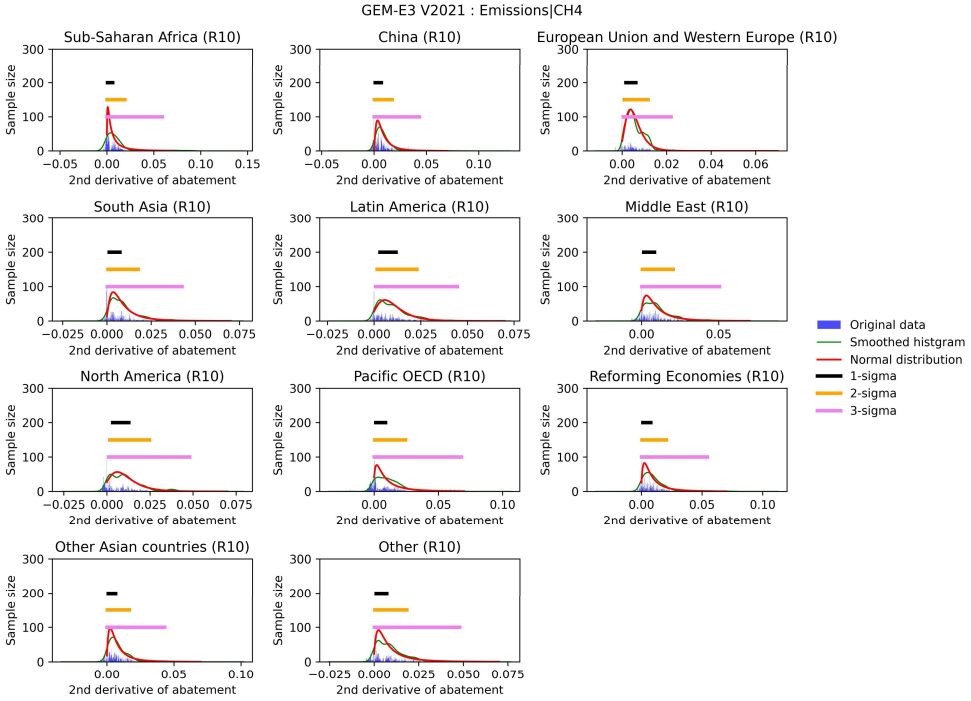

Figure S72. Regional GEM CH_4- Distribution of first derivative of abatement levels

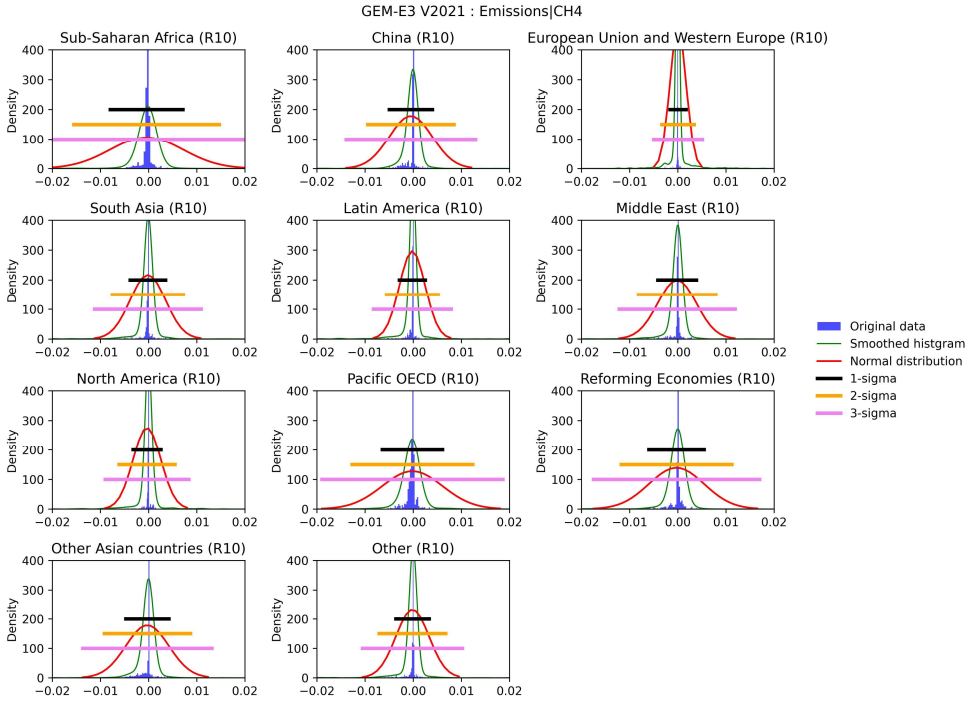

Figure S73. Regional GEM CH_4 - Distribution of second derivative of abatement levels

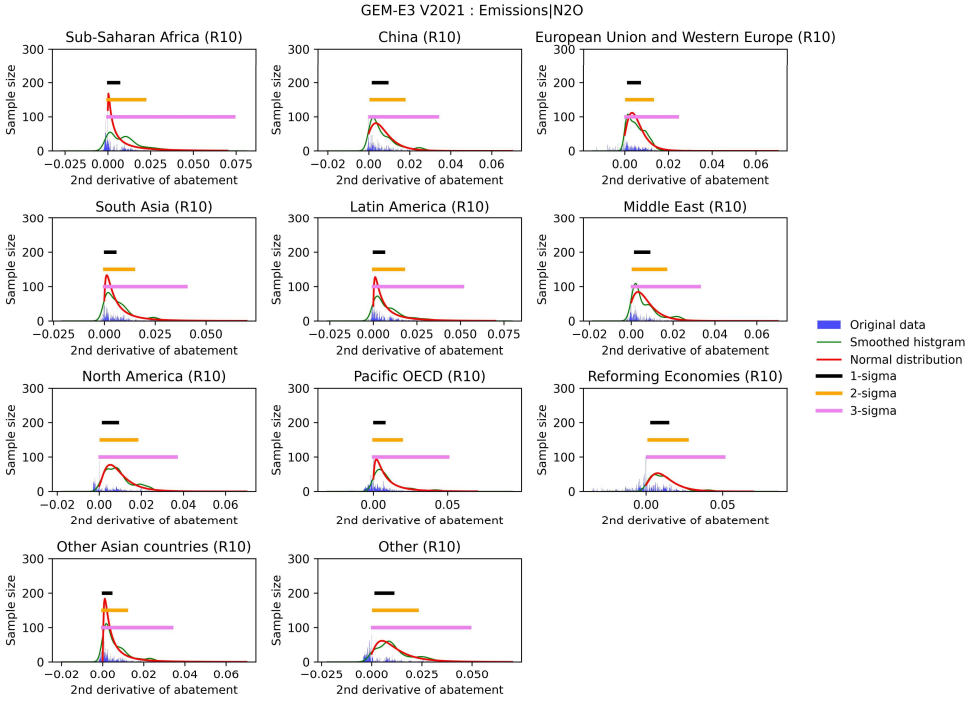

Figure S74. Regional GEM N_2O - Distribution of first derivative of abatement levels

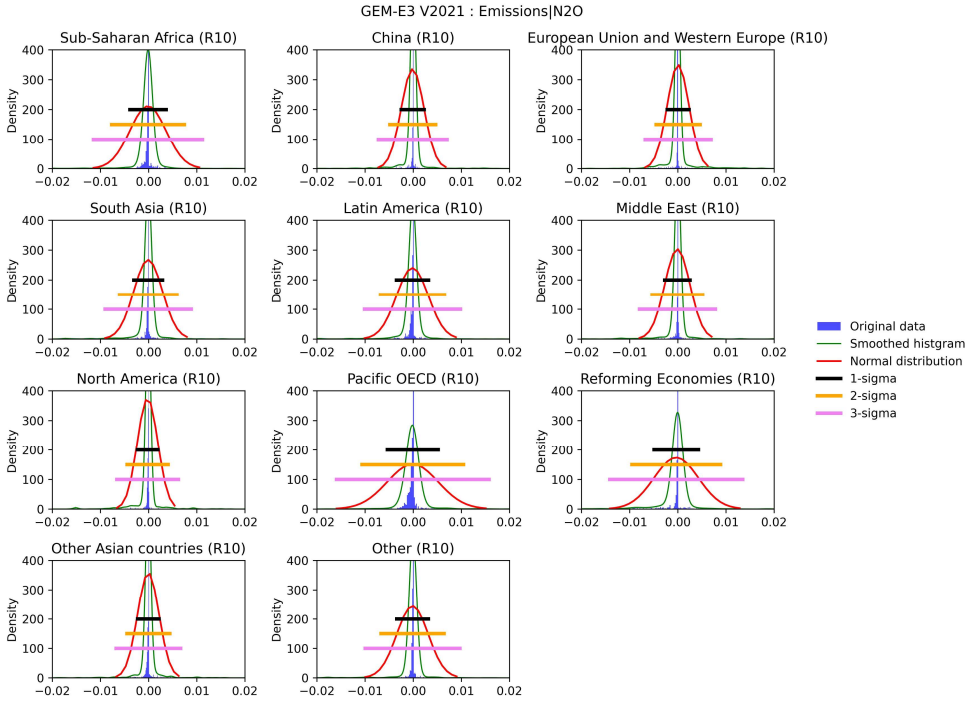

Figure S75. Regional GEM N_2O - Distribution of second derivative of abatement levels

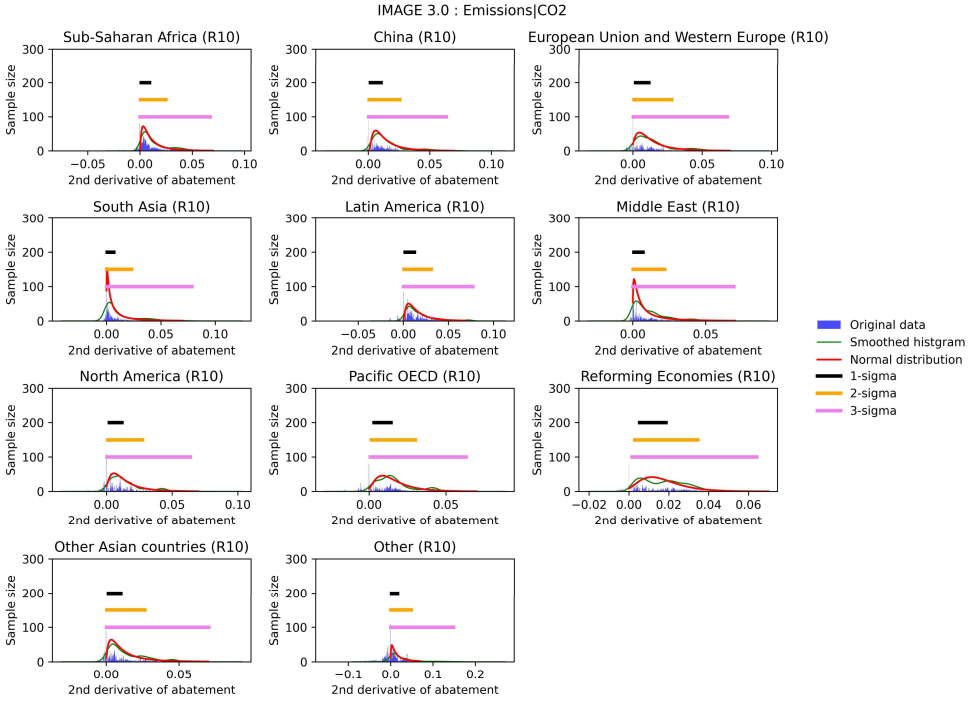

Figure S76. Regional IMAGE CO_2 - Distribution of first derivative of abatement levels

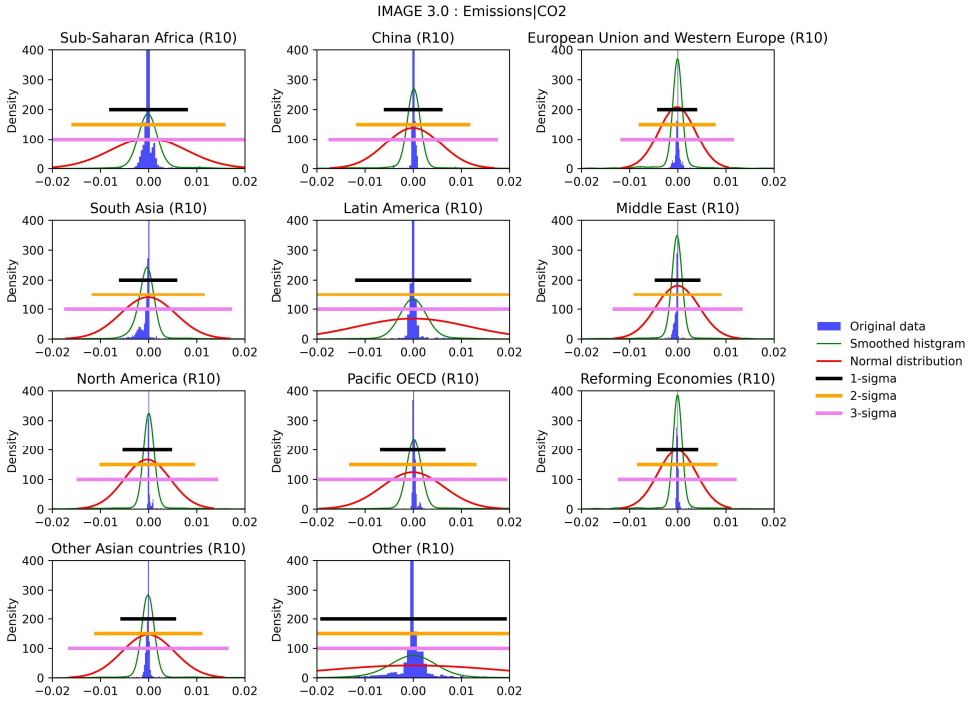

Figure S77. Regional IMAGE CO_2 - Distribution of second derivative of abatement levels

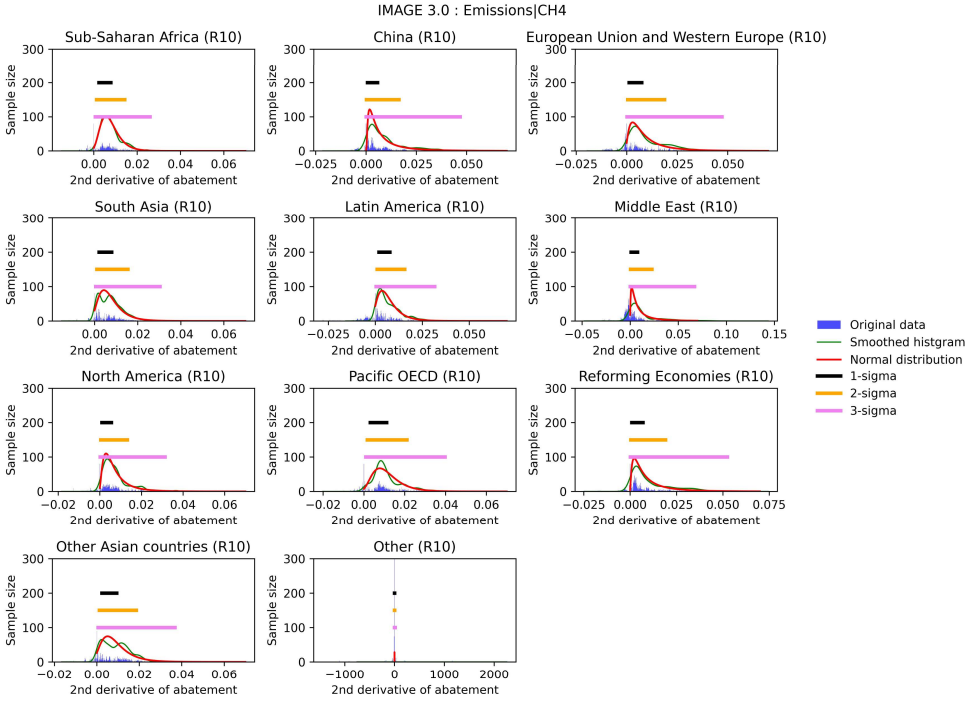

Figure S78. Regional IMAGE CH_4- Distribution of first derivative of abatement levels

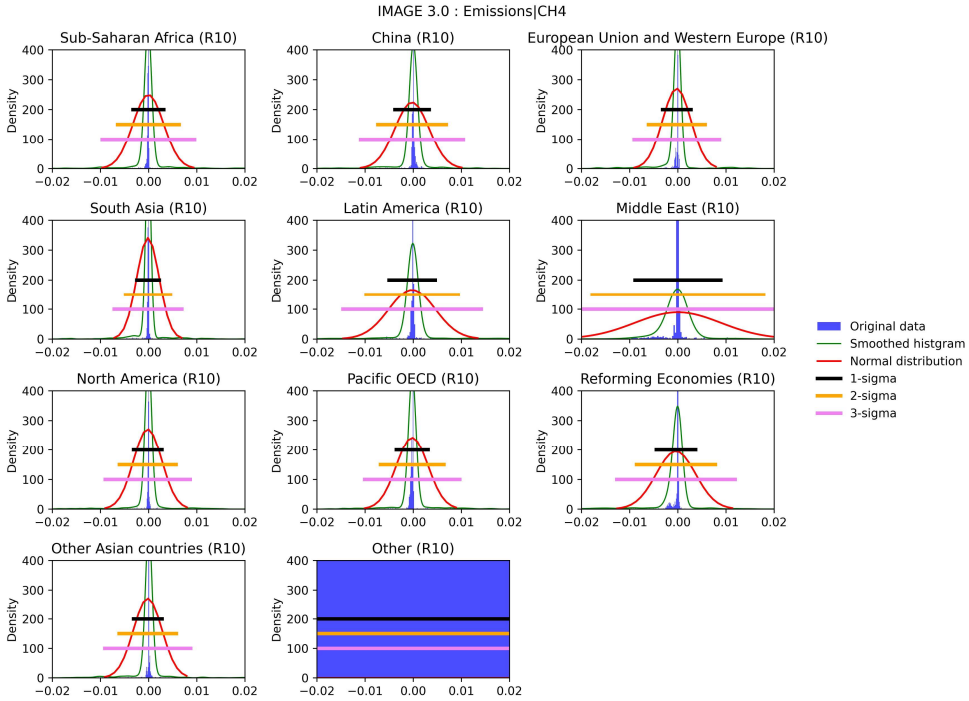

Figure S79. Regional IMAGE CH_4 - Distribution of second derivative of abatement levels

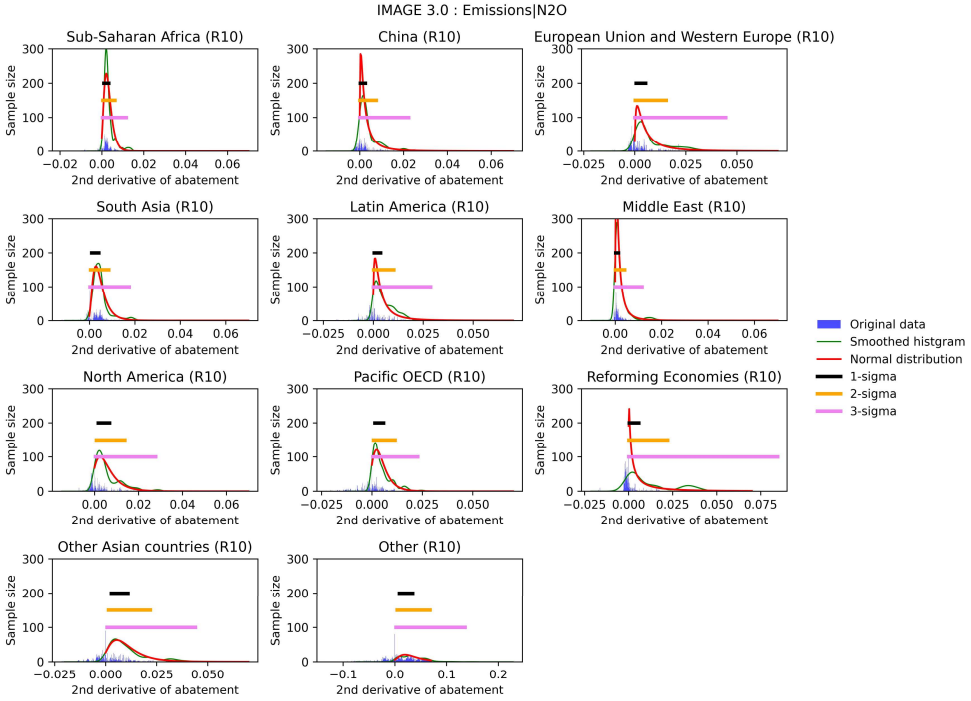

Figure S80. Regional IMAGE N_2O - Distribution of first derivative of abatement levels

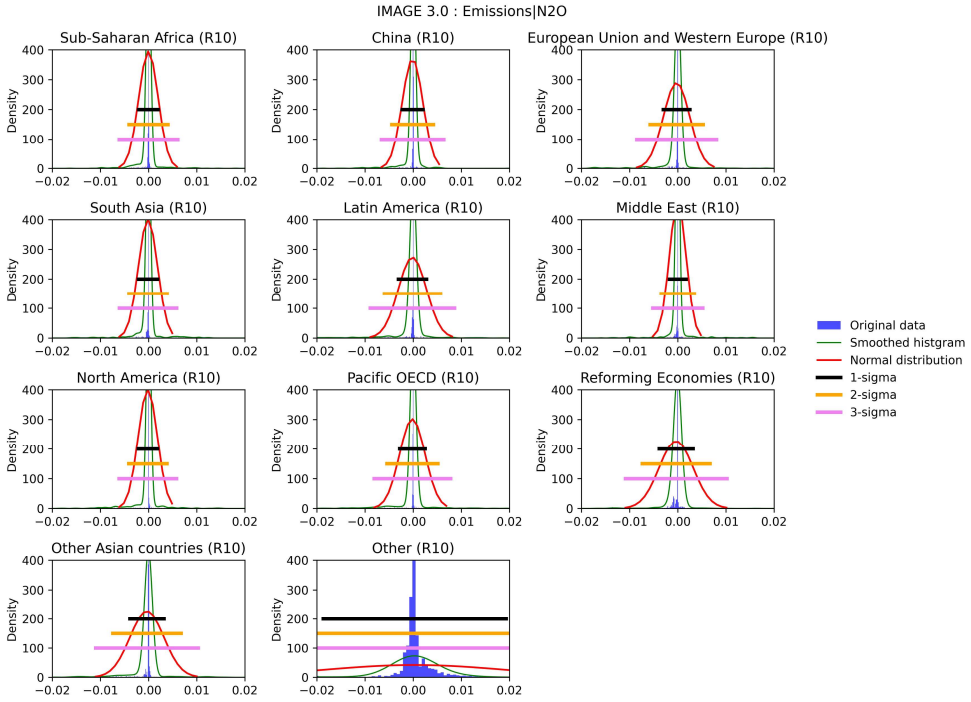

Figure S81. Regional IMAGE N_2O - Distribution of second derivative of abatement levels

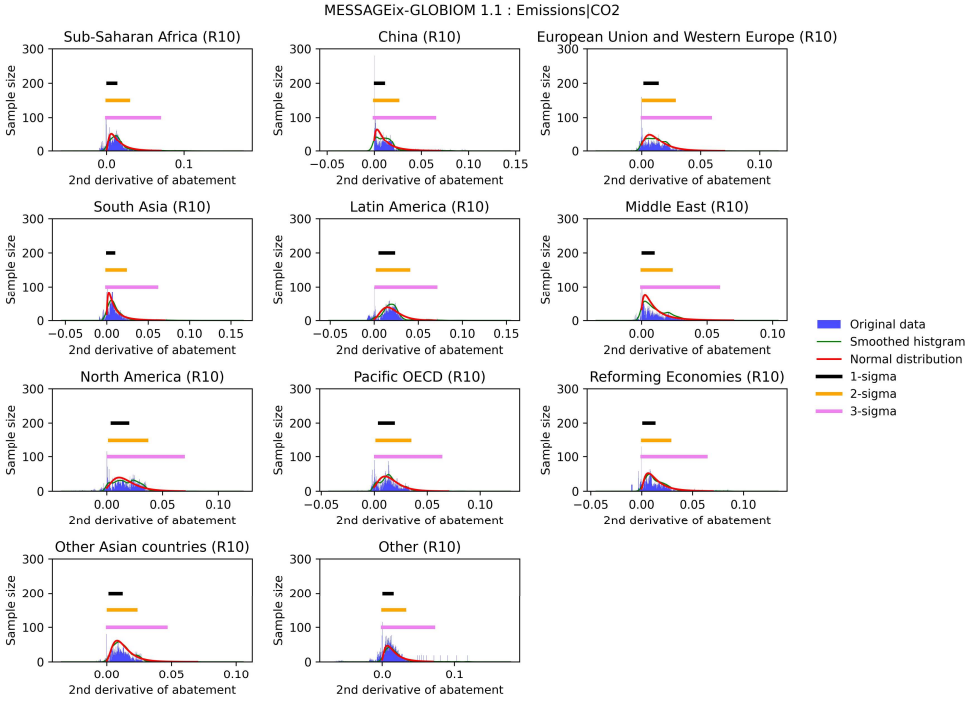

Figure S82. Regional MESSAGE CO_2 - Distribution of first derivative of abatement levels

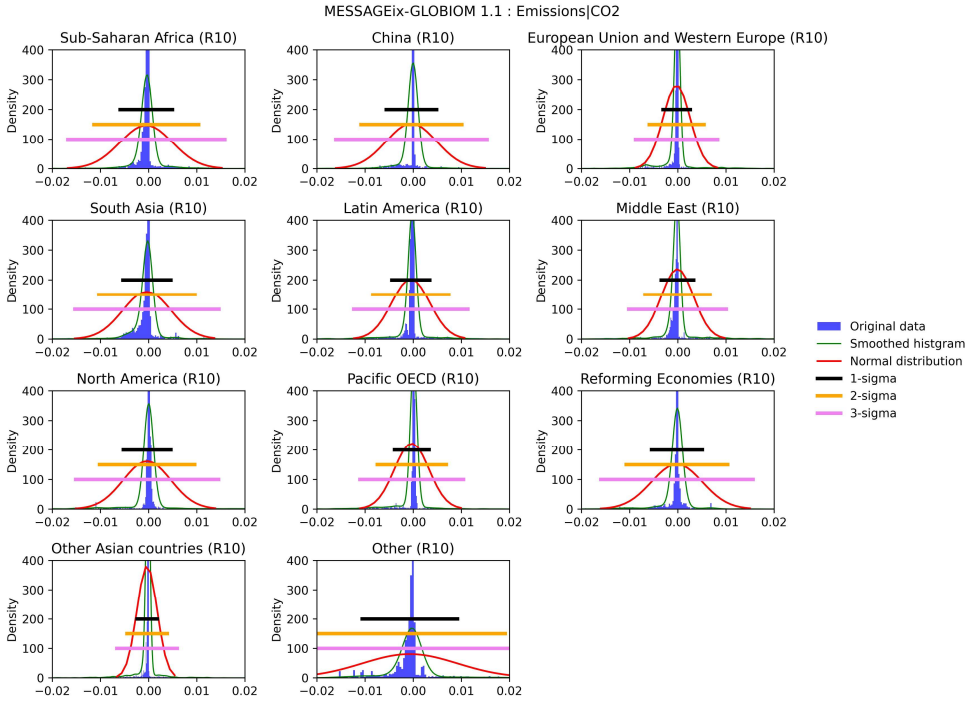

Figure S83. Regional MESSAGE CO_2 - Distribution of second derivative of abatement levels

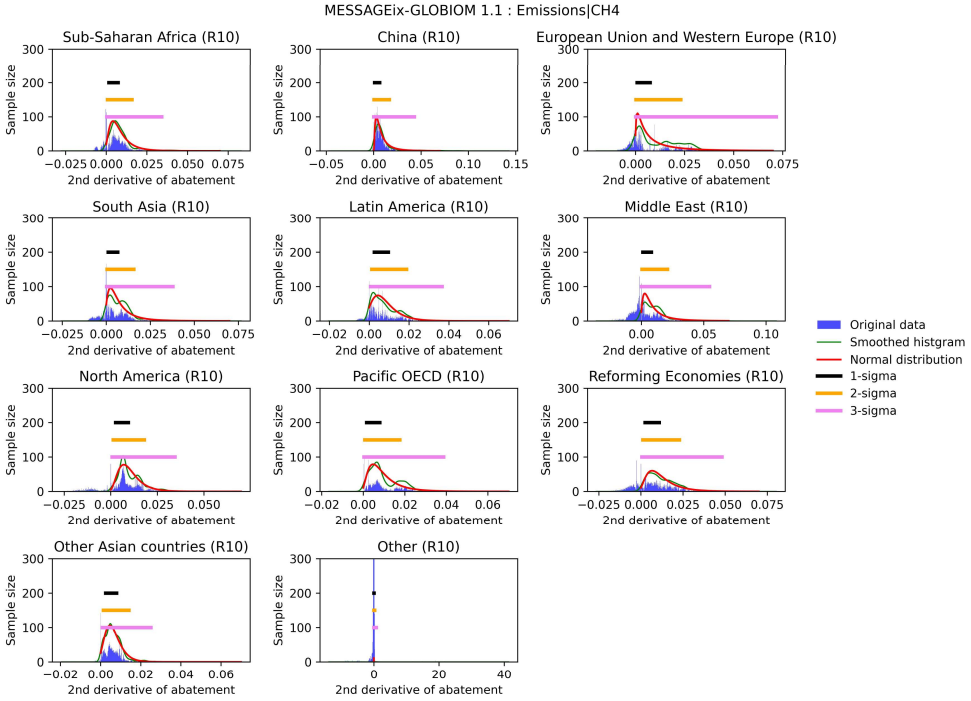

Figure S84. Regional MESSAGE CH_4 - Distribution of first derivative of abatement levels

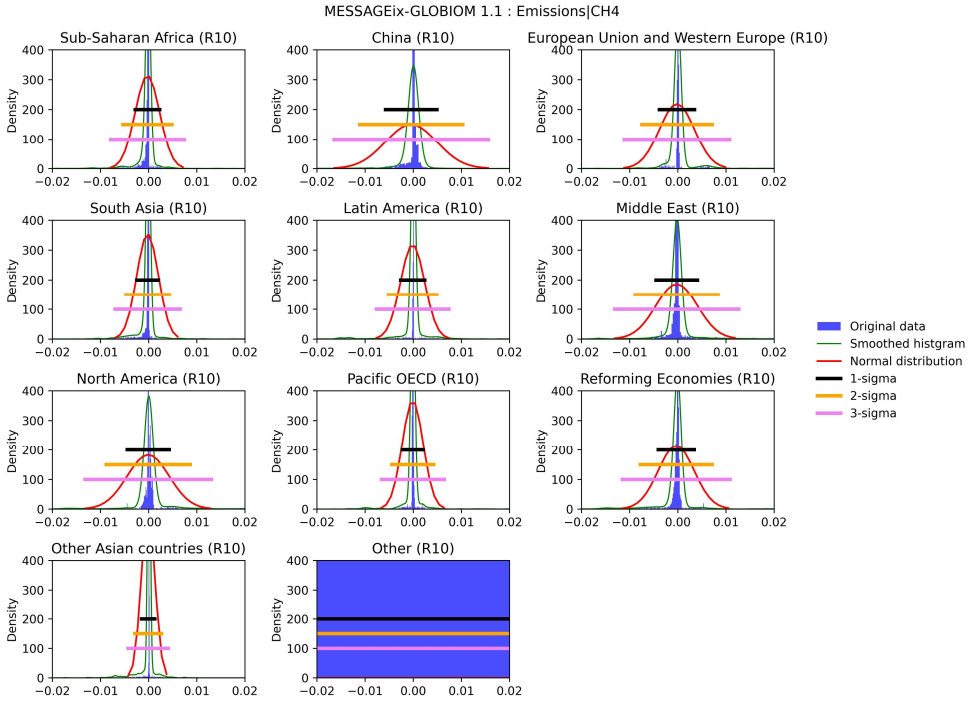

Figure S85. Regional MESSAGE CH_4 - Distribution of second derivative of abatement levels

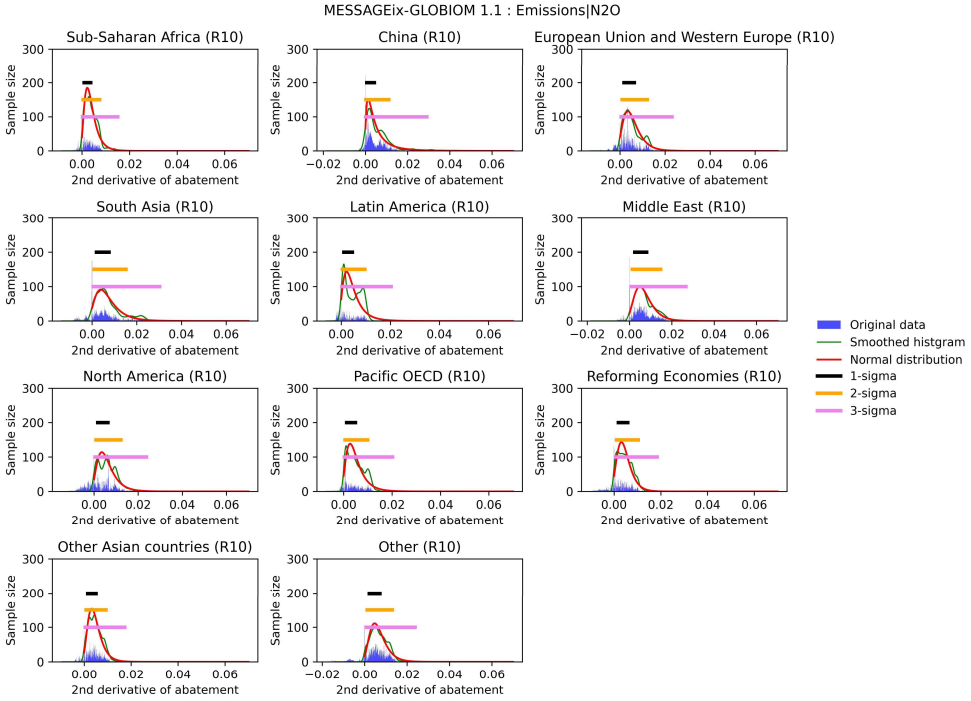

Figure S86. Regional MESSAGE N_2O - Distribution of first derivative of abatement levels

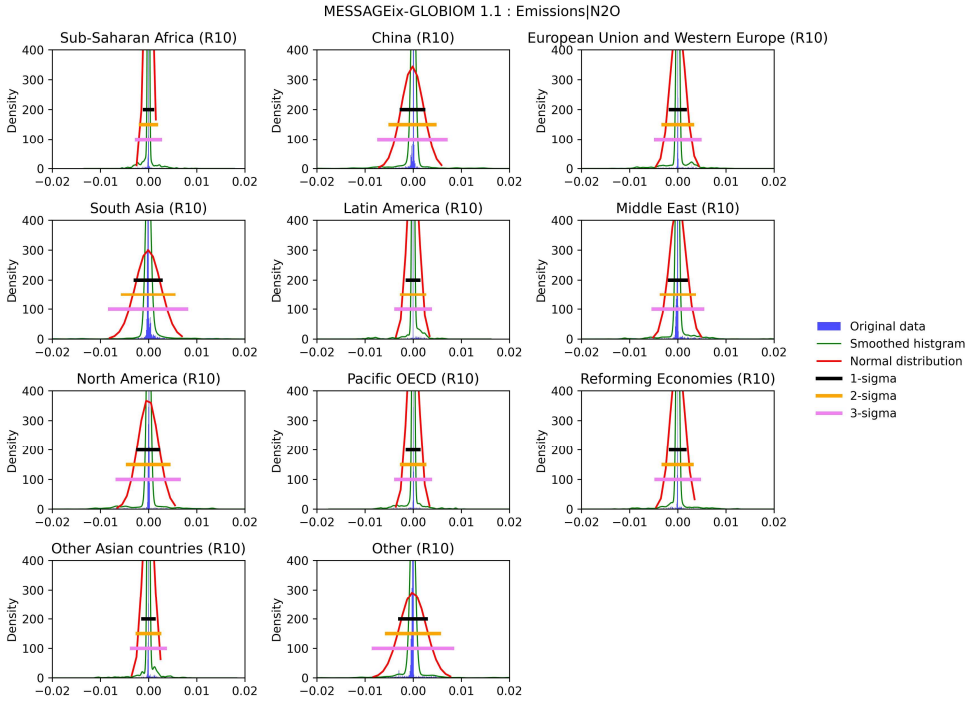

Figure S87. Regional MESSAGE N_2O - Distribution of second derivative of abatement levels

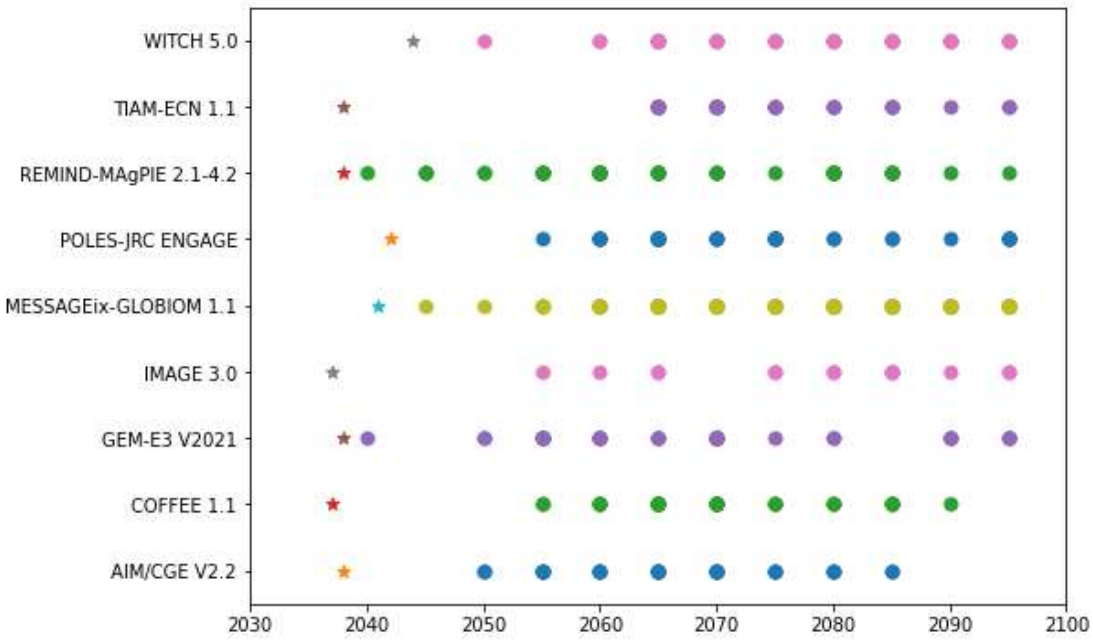

Figure S88. The earliest year to reach net zero for ENGAGE IAMs and MAC curves we derived. The circle points are the results from ENGAGE IAMs, and the star points are the results from MAC curves. We calculated the earliest time for different MACs to reach net zero using the largest 1st and 2nd derivatives.

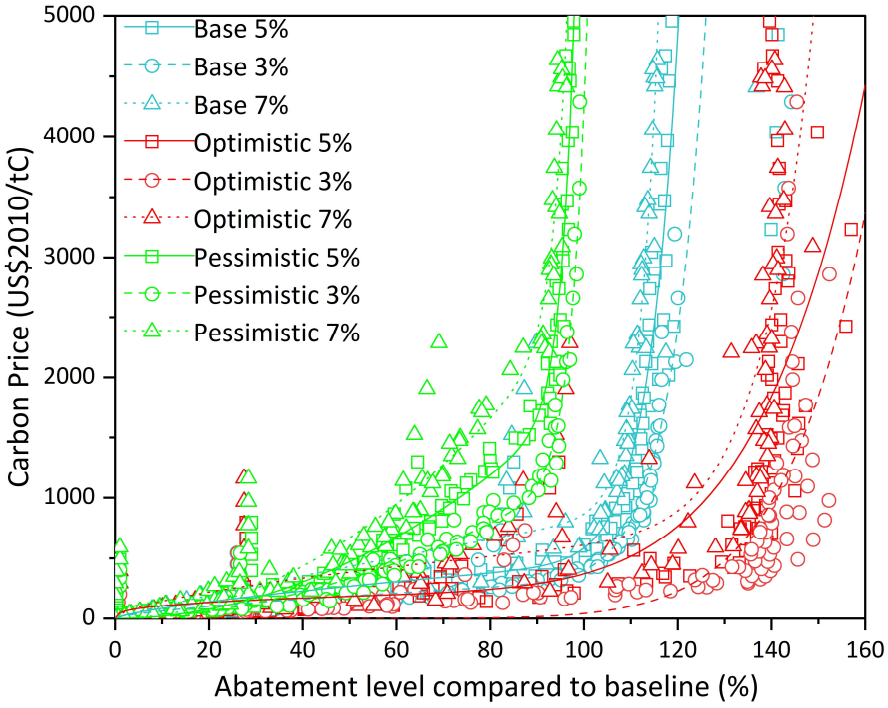

Figure S89. The relationship between abatement level and carbon price with different discount rates for policy portfolios in GET model. For individual policy portfolios, only the discount rate in the GET model is changed as 3%, 5% (default), and 7%, respectively.

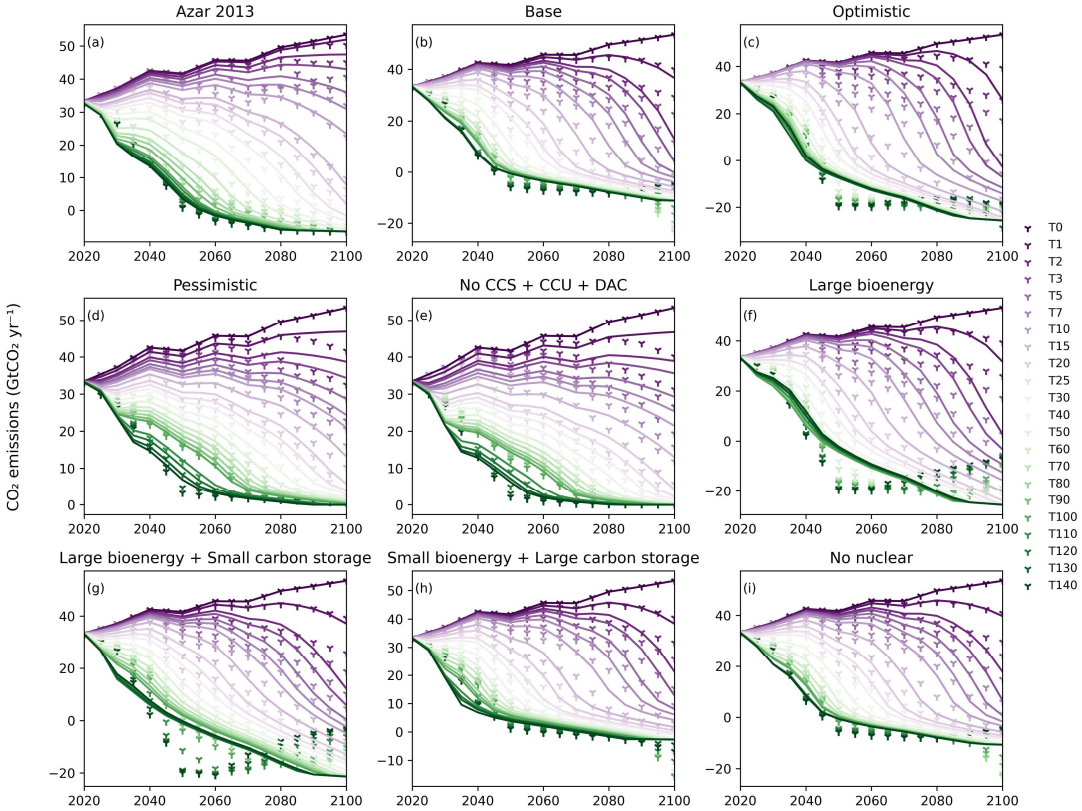

Figure S90. Test 1 – GET 9 portfolios energy-related CO_2 validation result

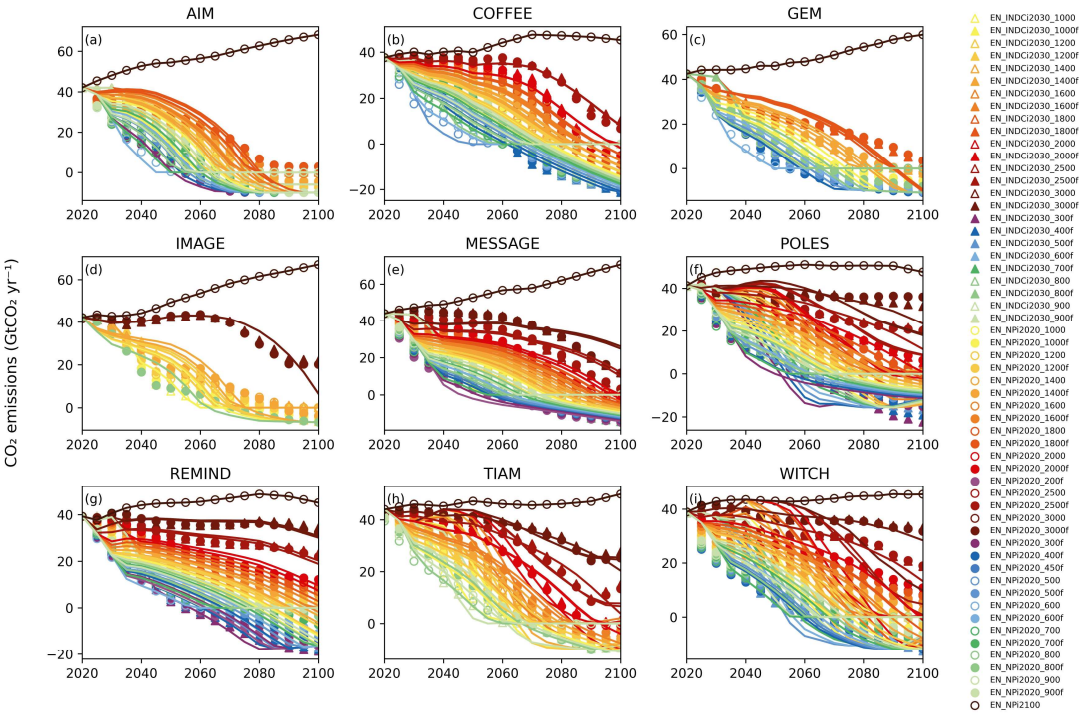

Figure S91. Test 1 – Global 9 models total anthropogenic CO_2 validation result

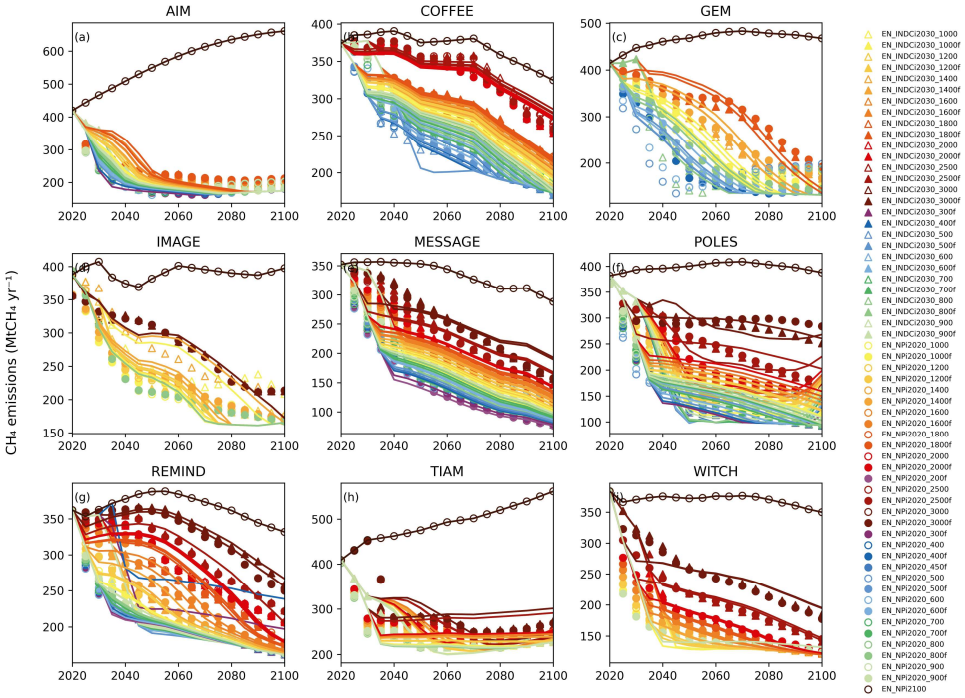

Figure S92. Test 1 – Global 9 models total anthropogenic CH_4 validation result

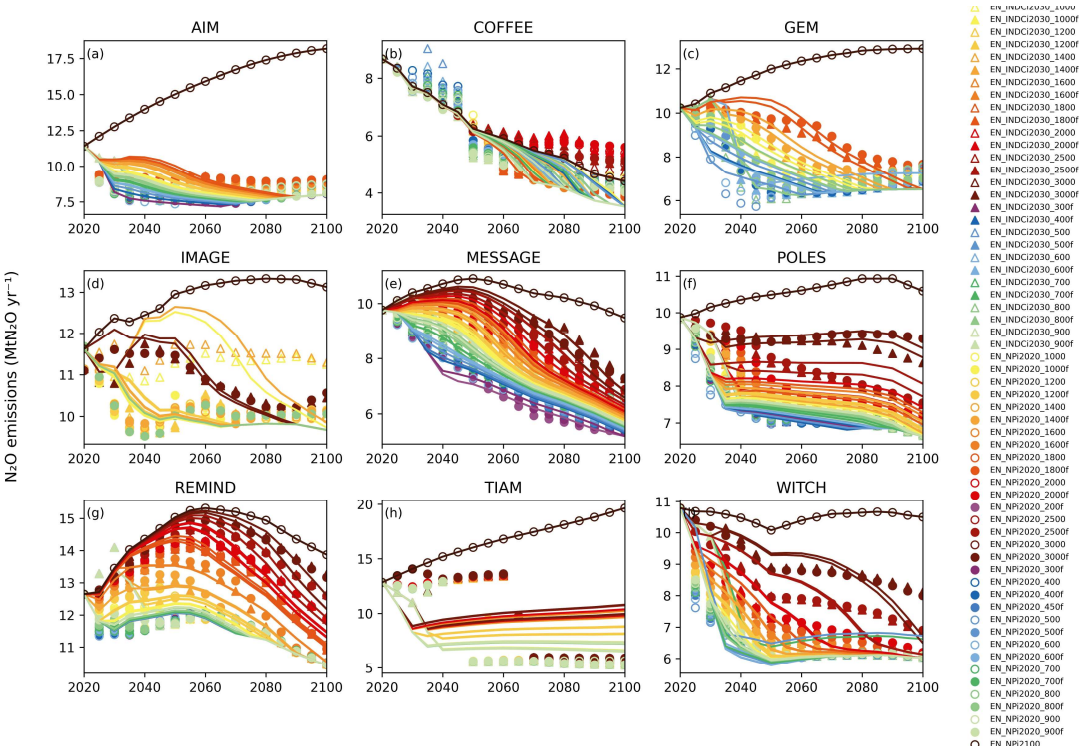

Figure S93. Test 1 – Global 9 models total anthropogenic N_2O validation result

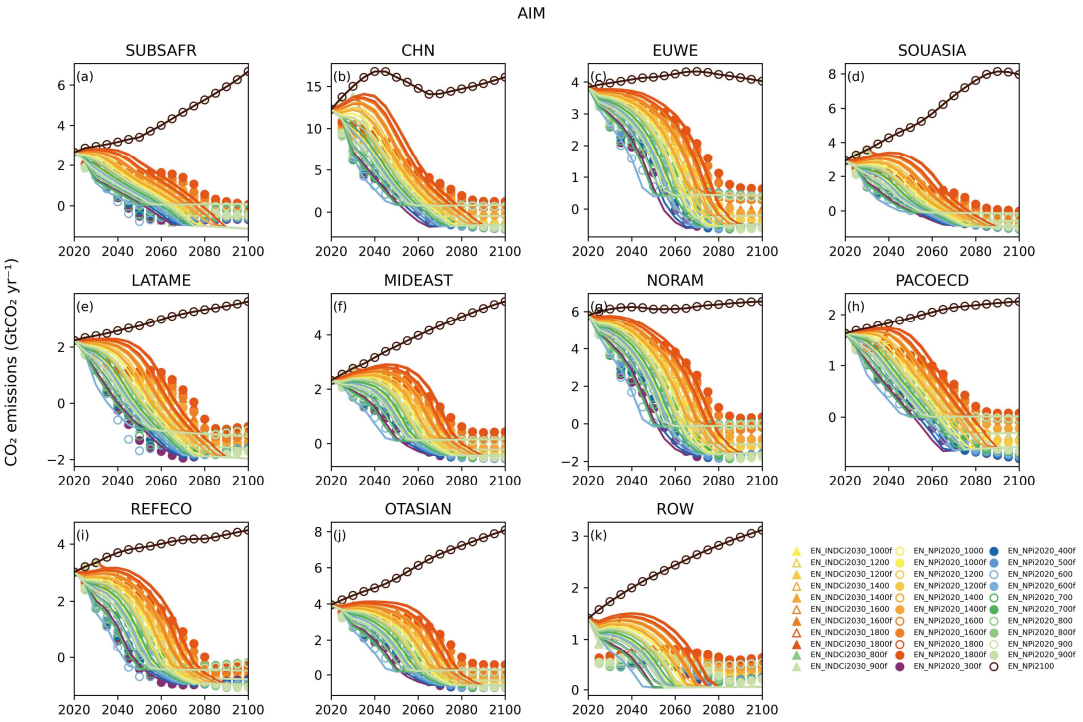

Figure S94. Test 1 - Regional AIM total anthropogenic CO_2 validation result

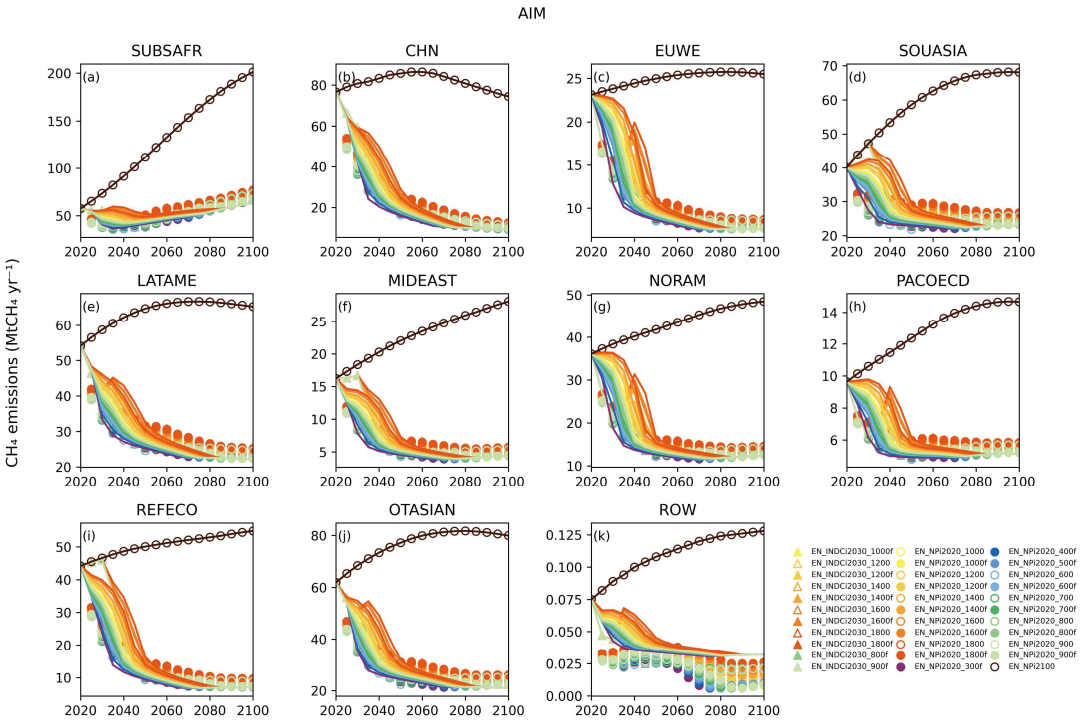

Figure S95. Test 1 - Regional AIM total anthropogenic CH_4 validation result

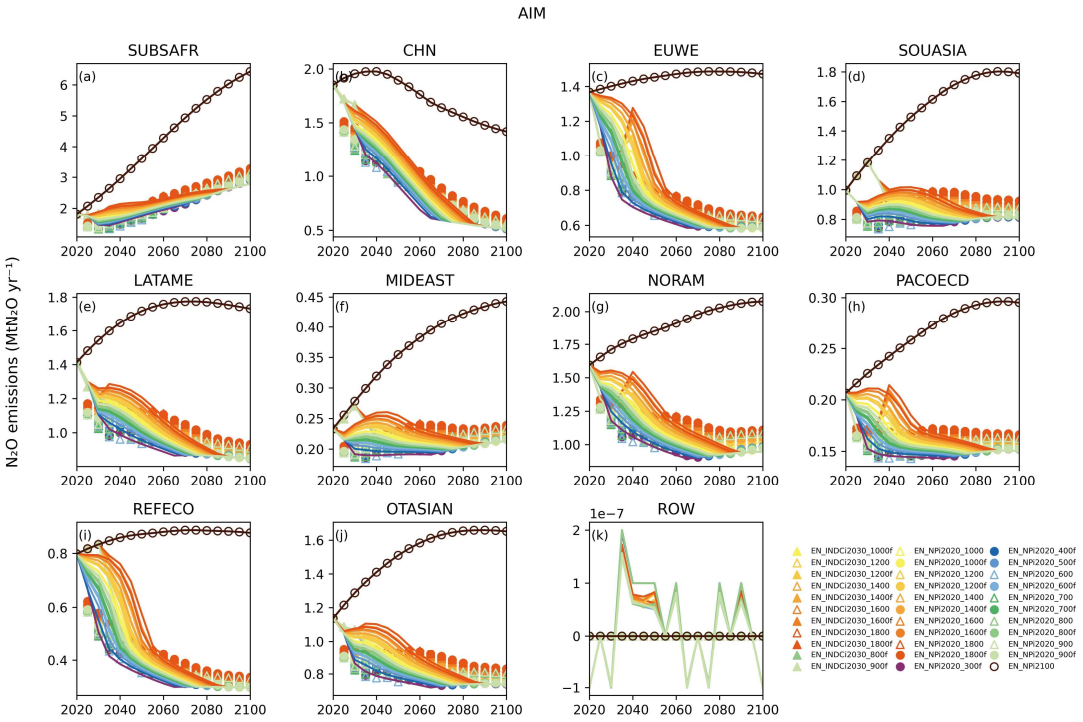

Figure S96. Test 1 - Regional AIM total anthropogenic N_2O validation result

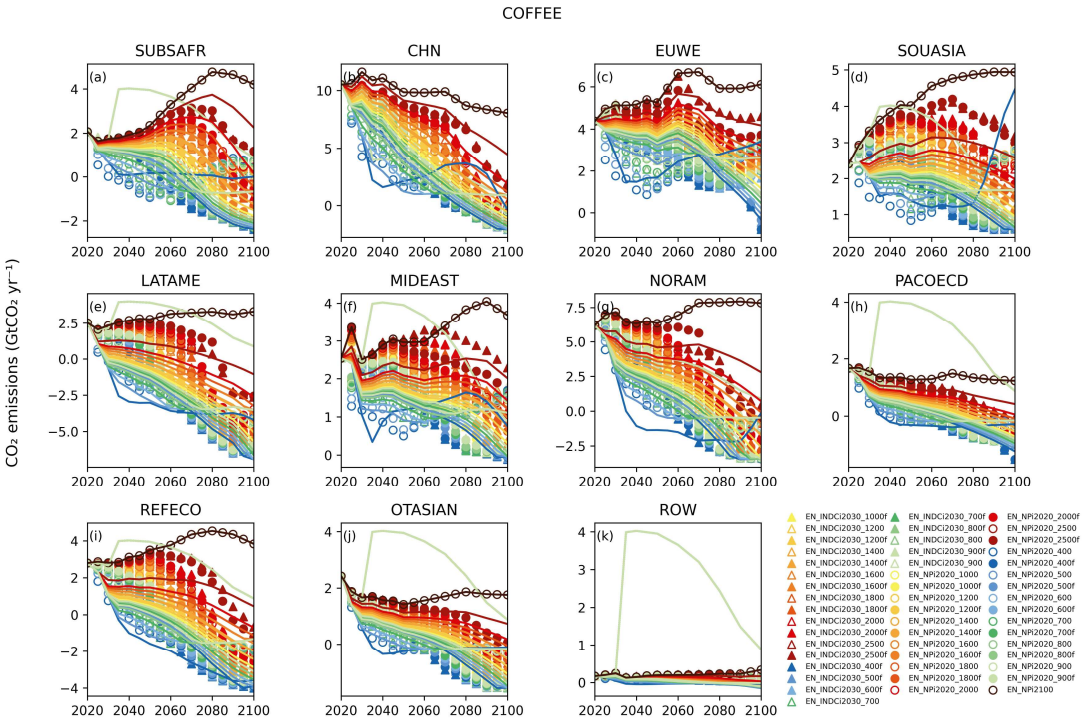

Figure S97. Test 1 - Regional COFFEE total anthropogenic CO_2 validation result

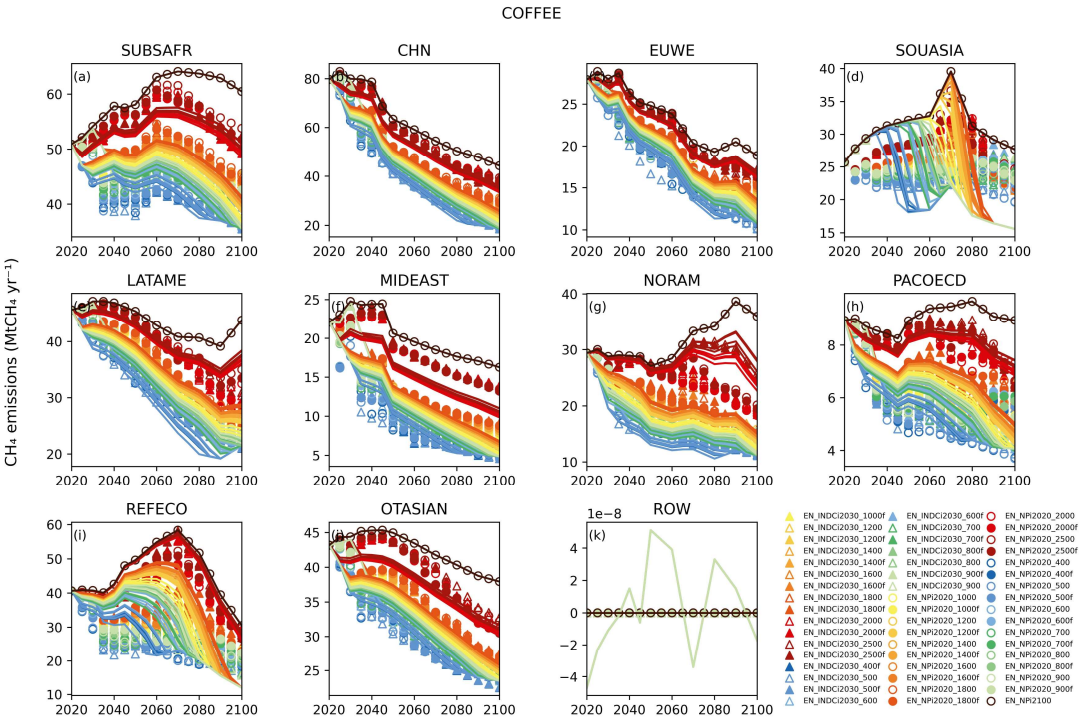

Figure S98. Test 1 - Regional COFFEE total anthropogenic CH_4 validation result

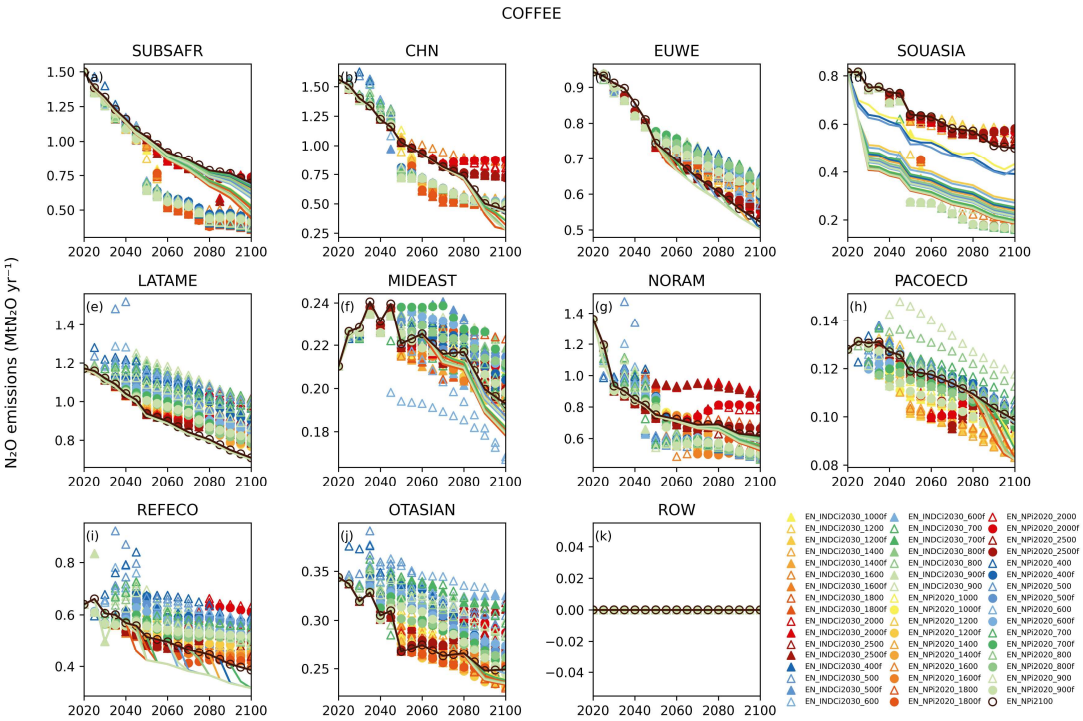

Figure S99. Test 1 - Regional COFFEE total anthropogenic N_2O validation result

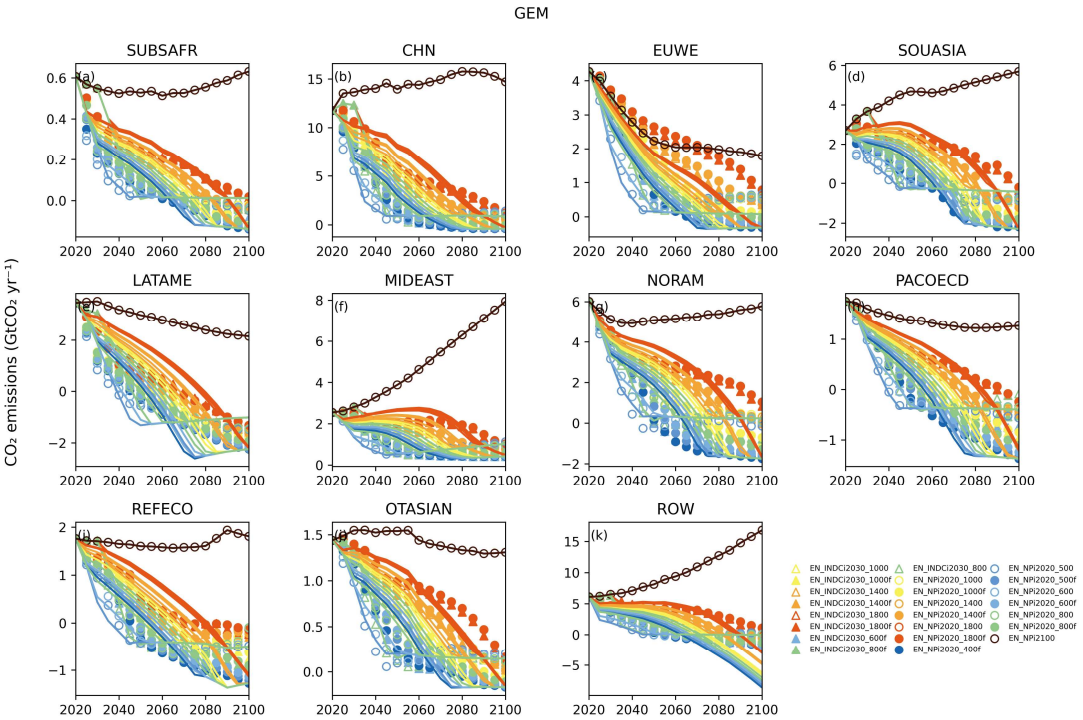

Figure S100. Test 1 - Regional GEM total anthropogenic CO_2 validation result

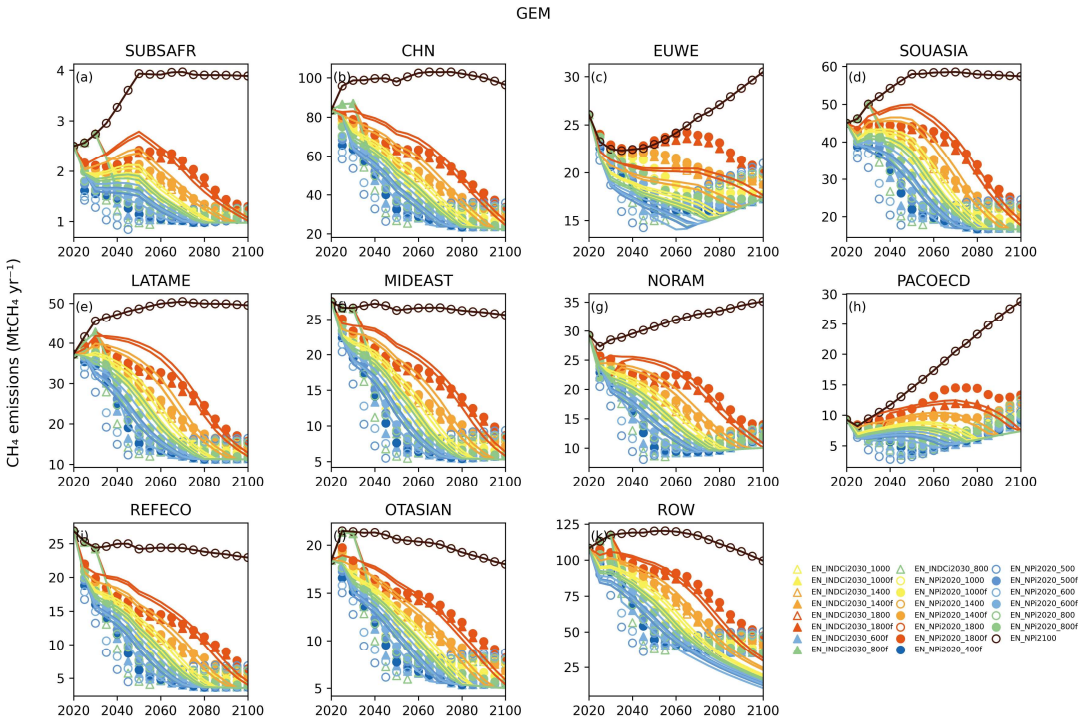

Figure S101. Test 1 - Regional GEM total anthropogenic CH_4 validation result

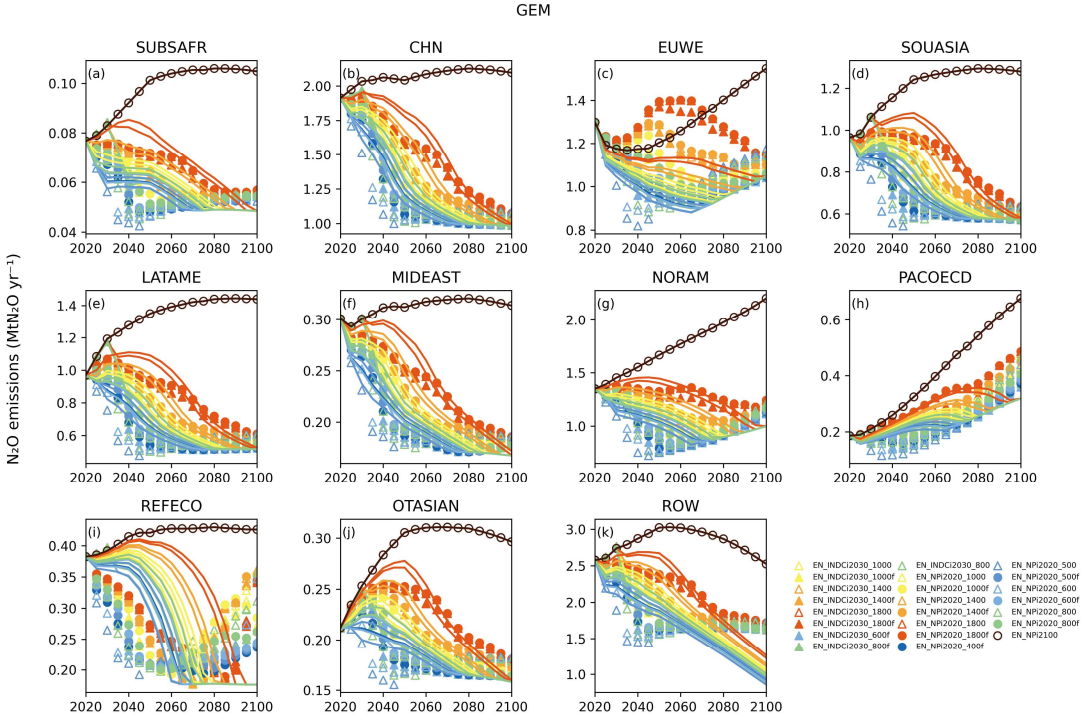

Figure S102. Test 1 - Regional GEM total anthropogenic N_2O validation result

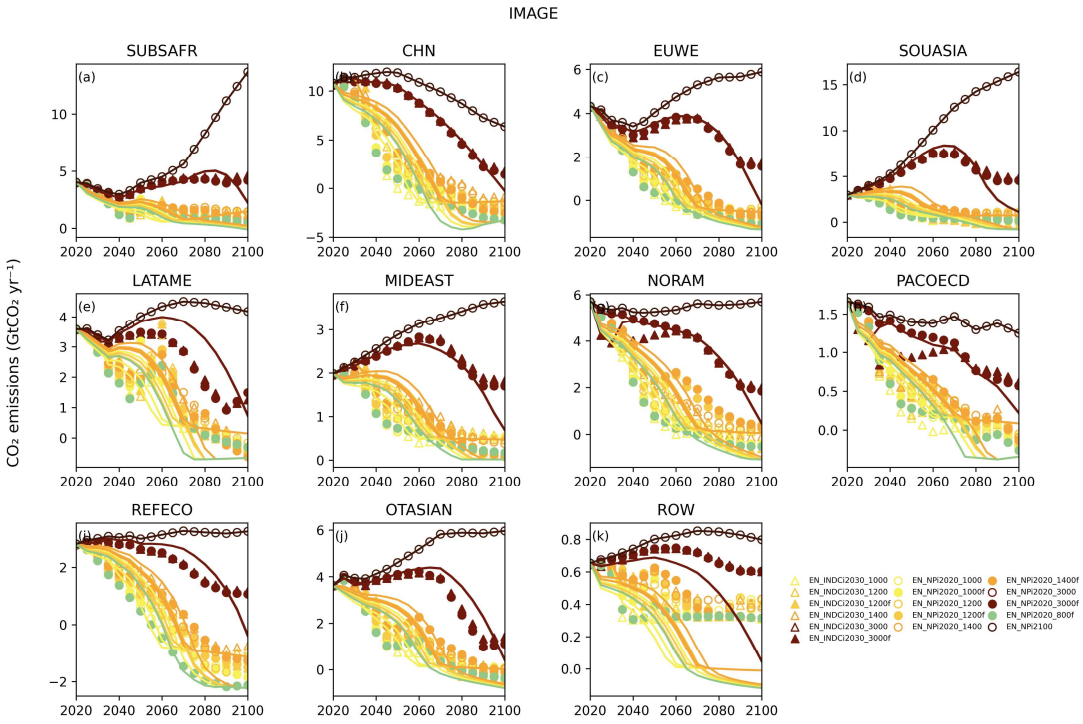

Figure S103. Test 1 - Regional IMAGE total anthropogenic CO_2 validation result

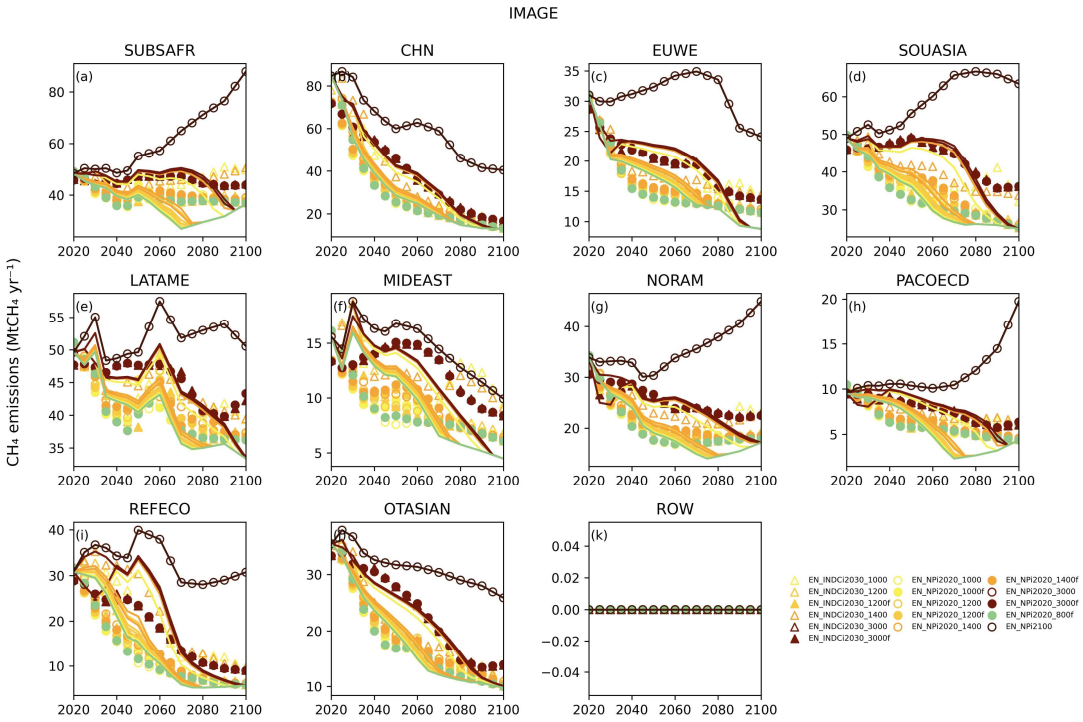

Figure S104. Test 1 - Regional IMAGE total anthropogenic CH_4 validation result

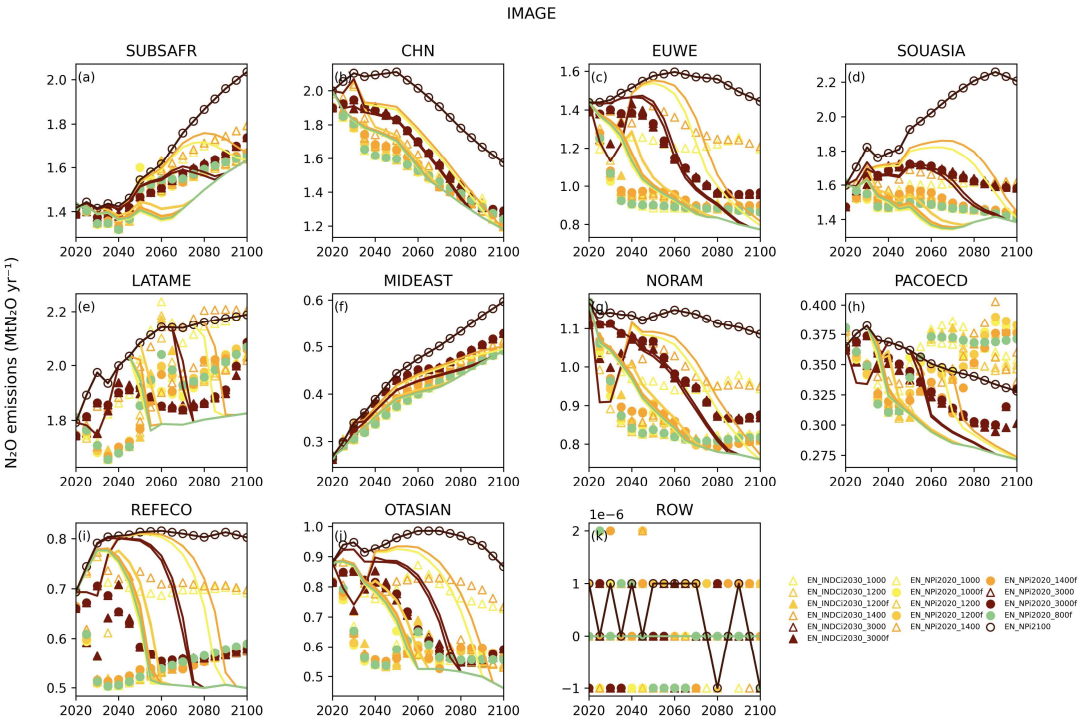

Figure S105. Test 1 - Regional IMAGE total anthropogenic N_2O validation result

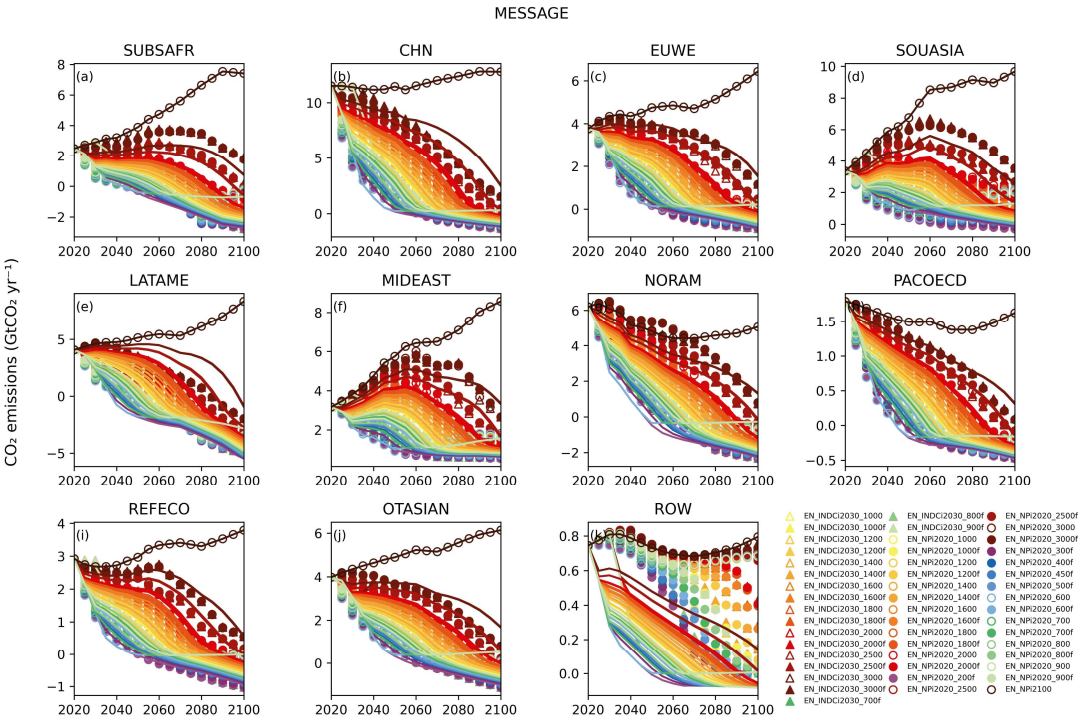

Figure S106. Test 1 - Regional MESSAGE total anthropogenic CO_2 validation result

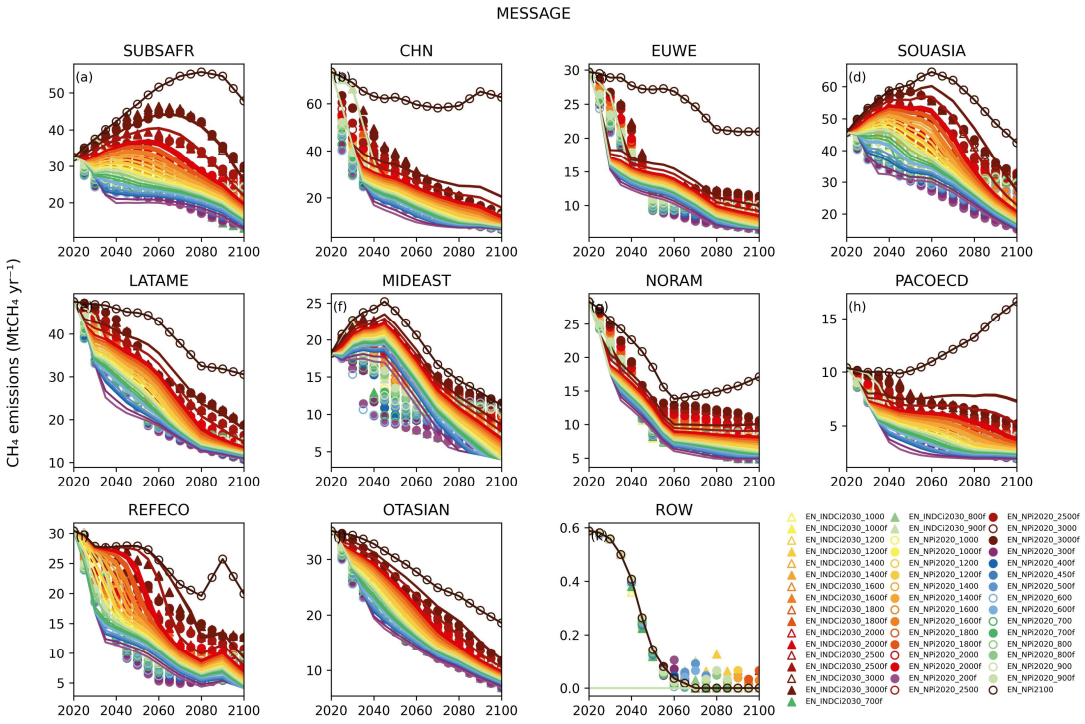

Figure S107. Test 1 - Regional MESSAGE total anthropogenic CH_4 validation result

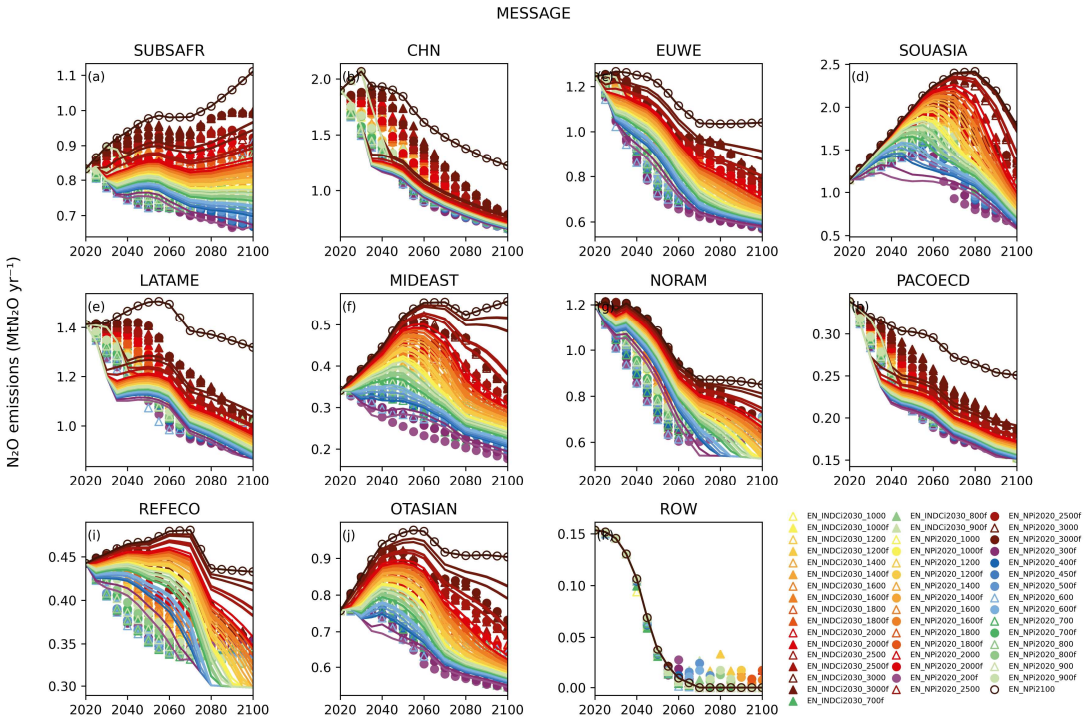

Figure S108. Test 1 - Regional MESSAGE total anthropogenic N_2O validation result

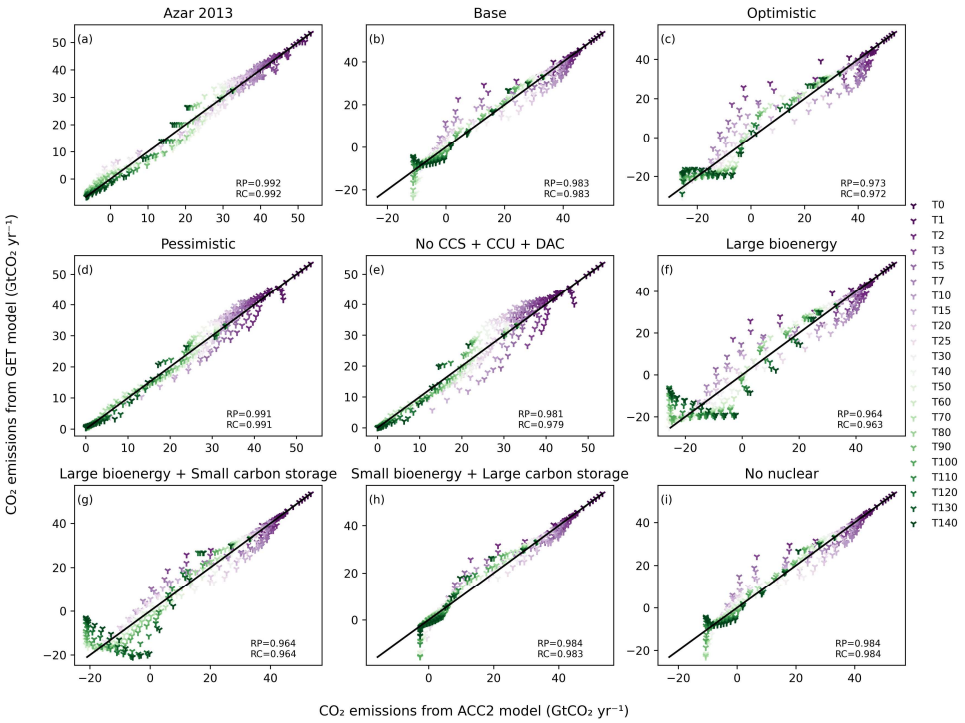

Figure S109. Test 1 - GET Reproducibility of total anthropogenic CO_2

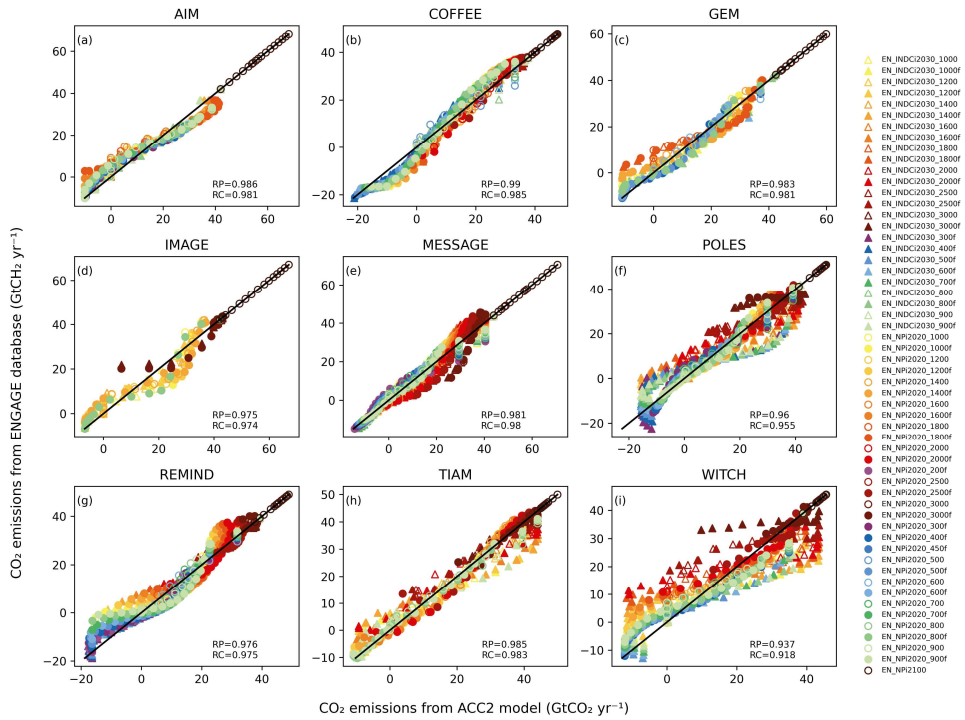

Figure S110. Test 1 - Global 9 models - Reproducibility of total anthropogenic CO_2

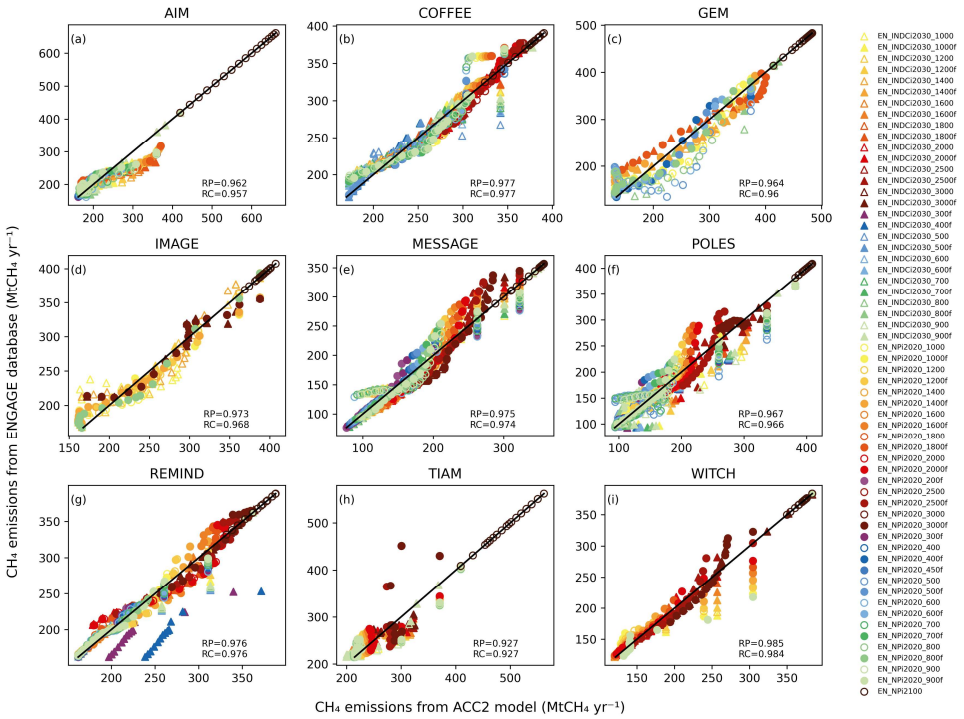

Figure S111. Test 1 - Global 9 models - Reproducibility of total anthropogenic CH_4

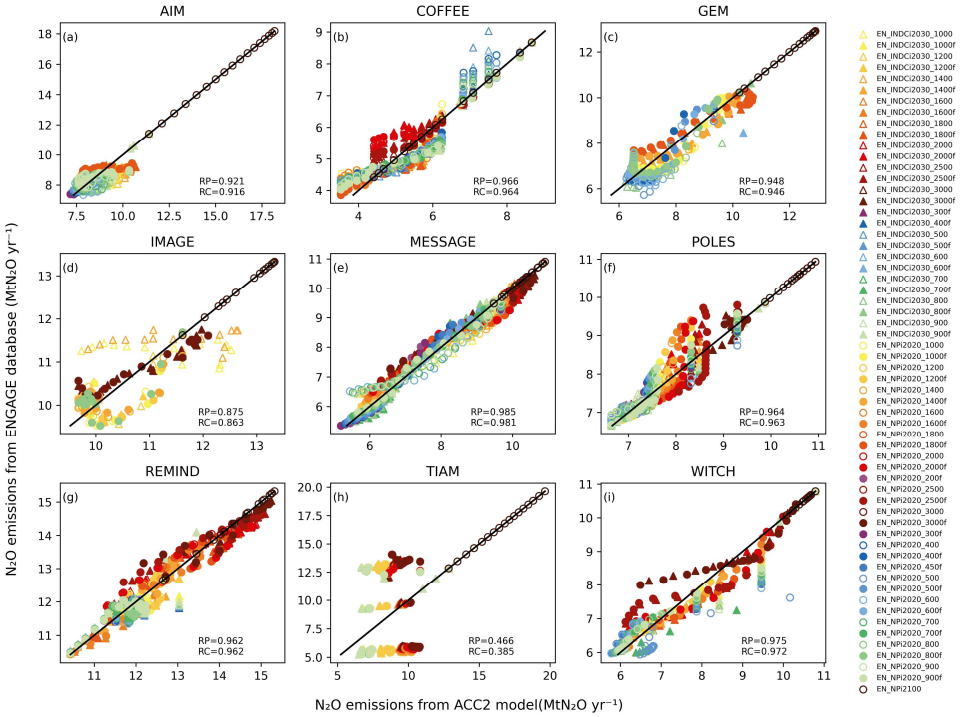

Figure S112. Test 1 - Global 9 models - Reproducibility of total anthropogenic N_2O

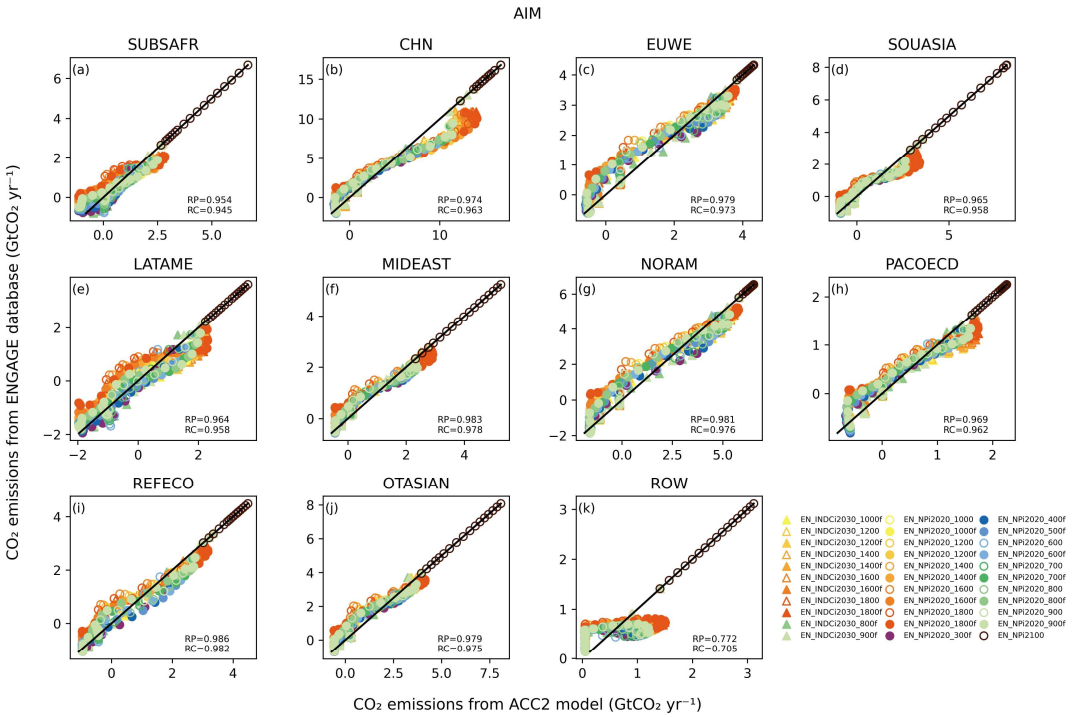

Figure S113. Test 1 - Regional AIM - Reproducibility of total anthropogenic CO_2

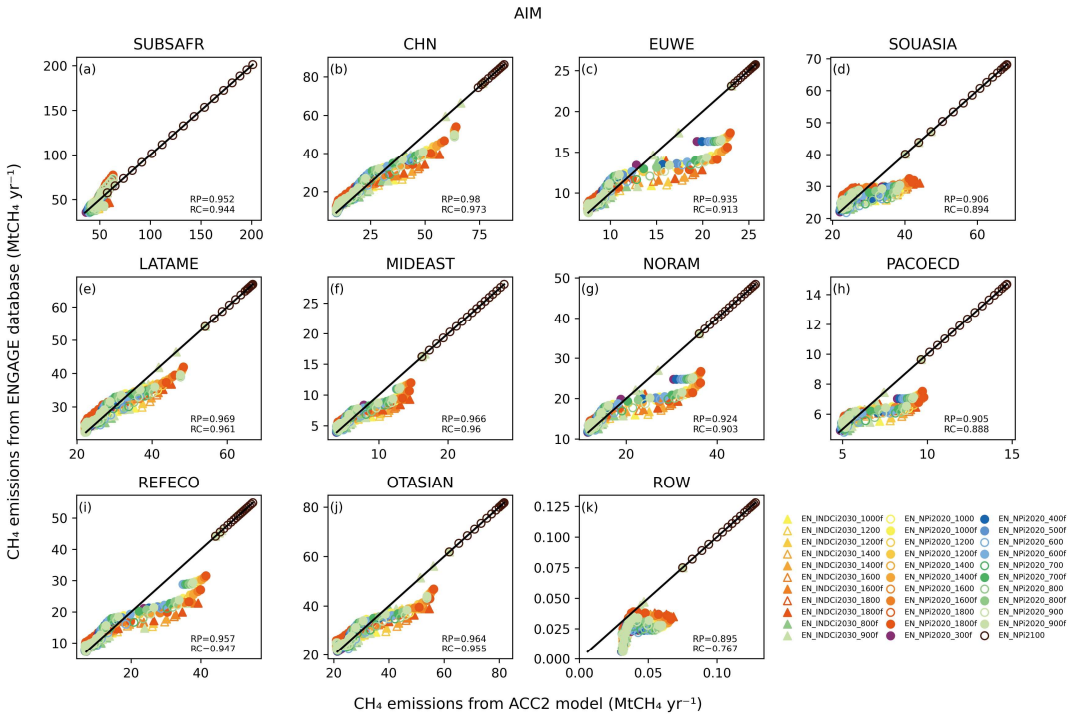

Figure S114. Test 1 - Regional AIM - Reproducibility of total anthropogenic CH_4

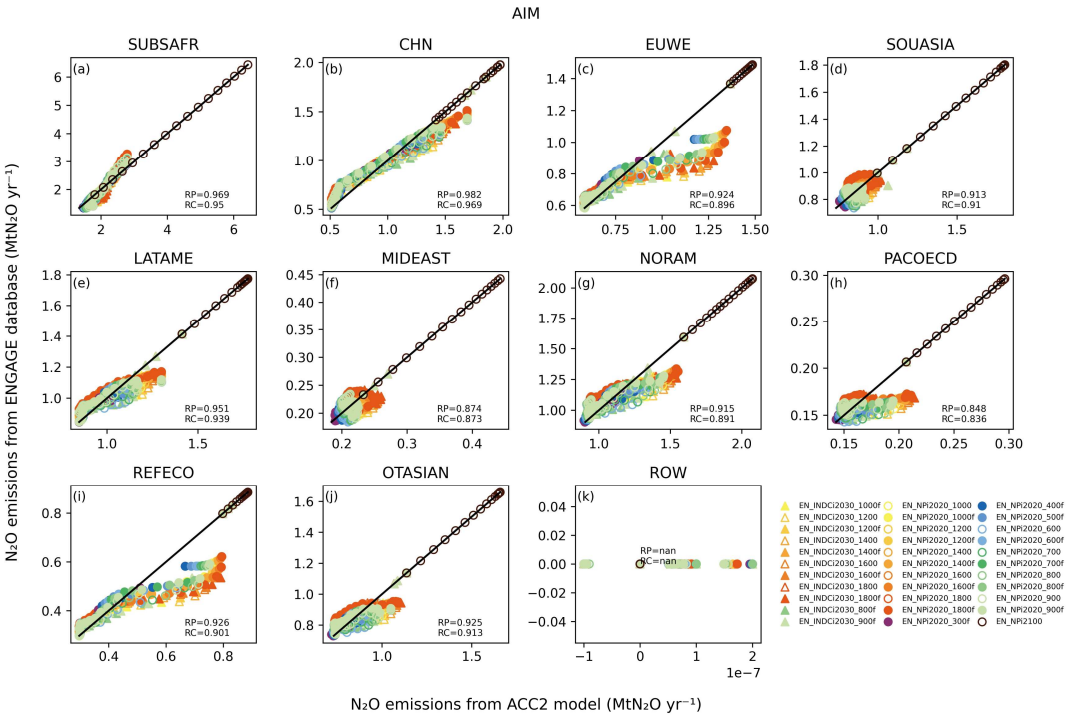

Figure S115. Test 1 - Regional AIM - Reproducibility of total anthropogenic N_2O

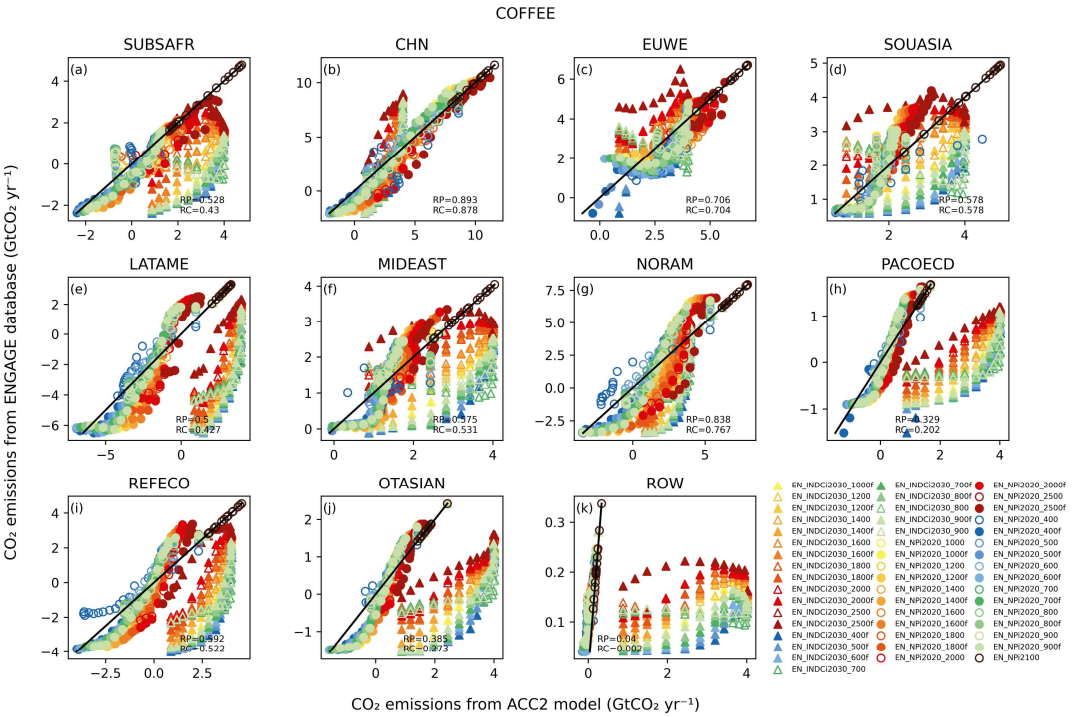

Figure S116. Test 1 - Regional COFFEE - Reproducibility of total anthropogenic CO_2

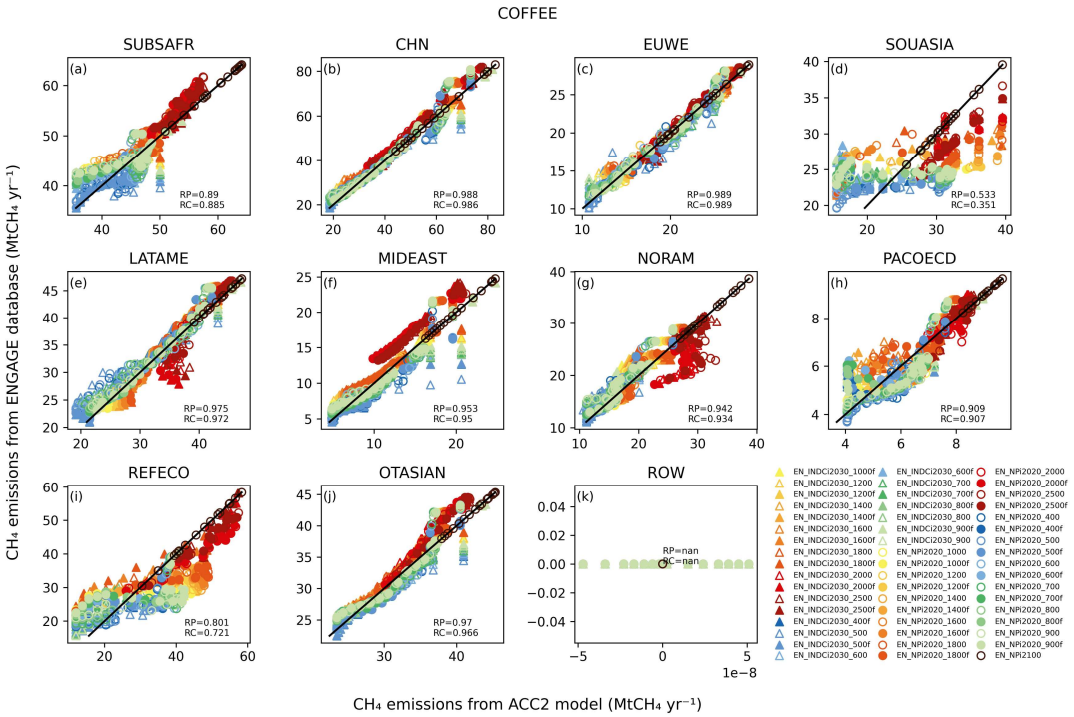

Figure S117. Test 1 - Regional COFFEE - Reproducibility of total anthropogenic CH_4

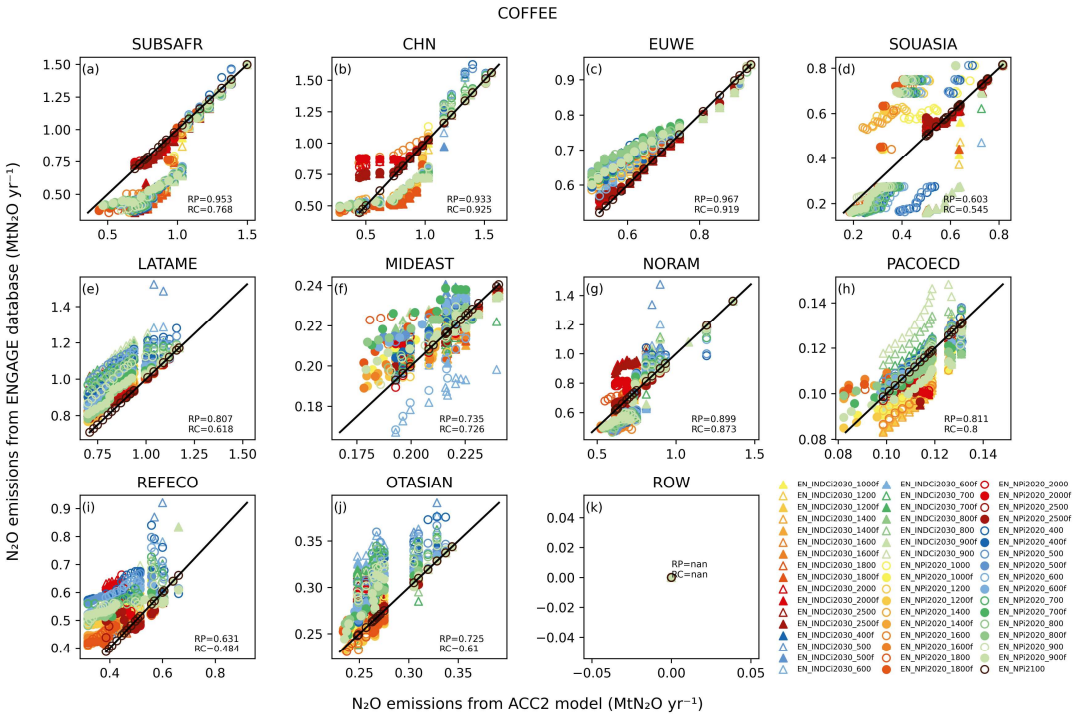

Figure S118. Test 1 - Regional COFFEE - Reproducibility of total anthropogenic N_2O

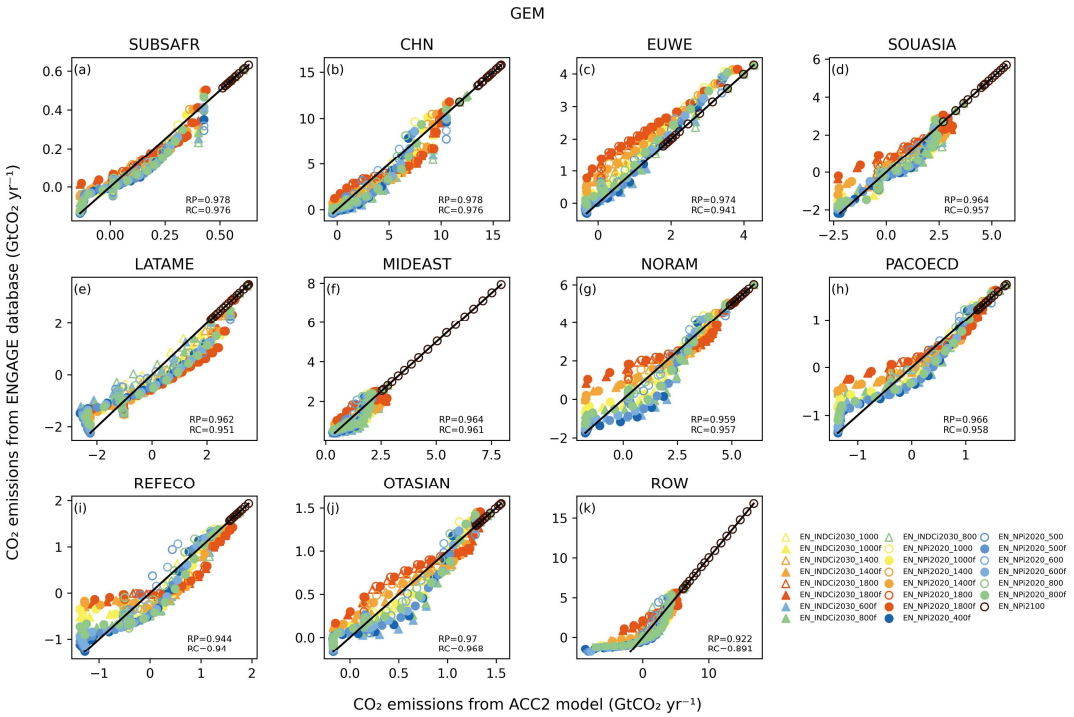

Figure S119. Test 1 - Regional GEM - Reproducibility of total anthropogenic CO_2

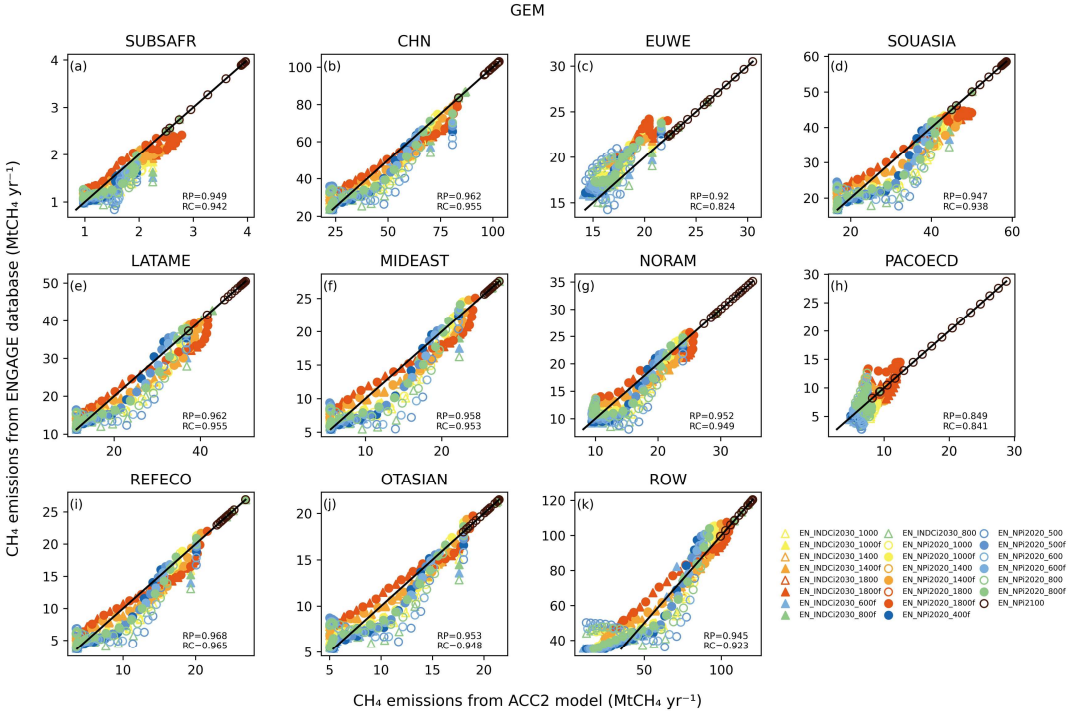

Figure S120. Test 1 - Regional GEM - Reproducibility of total anthropogenic CH_4

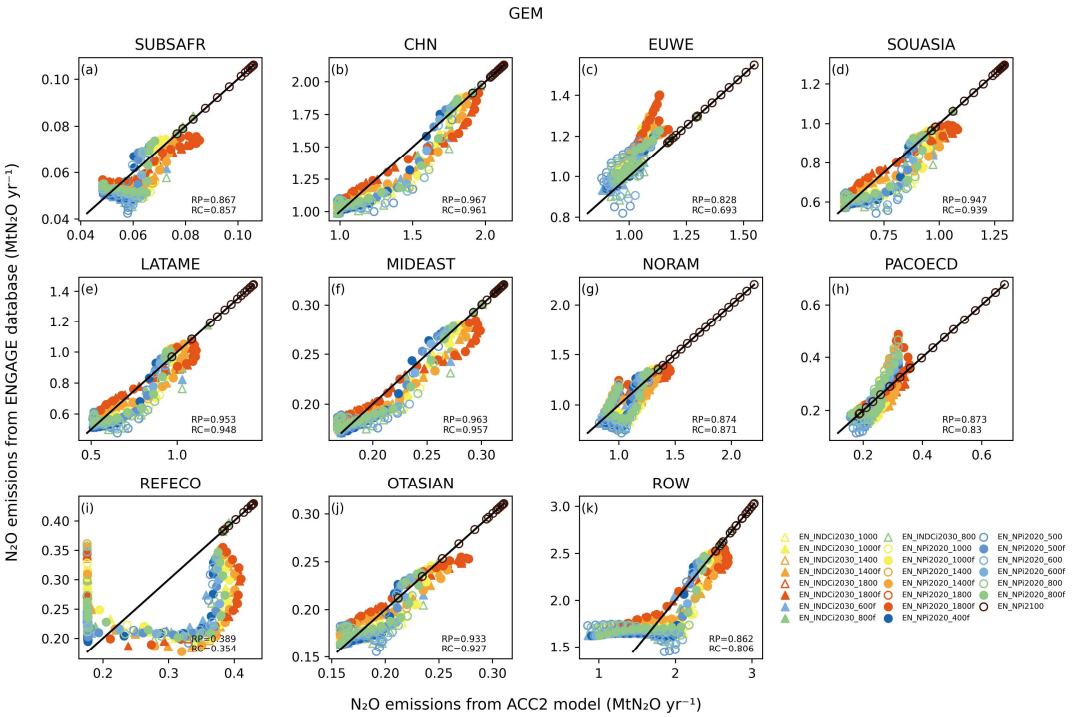

Figure S121. Test 1 - Regional GEM - Reproducibility of total anthropogenic N_2O

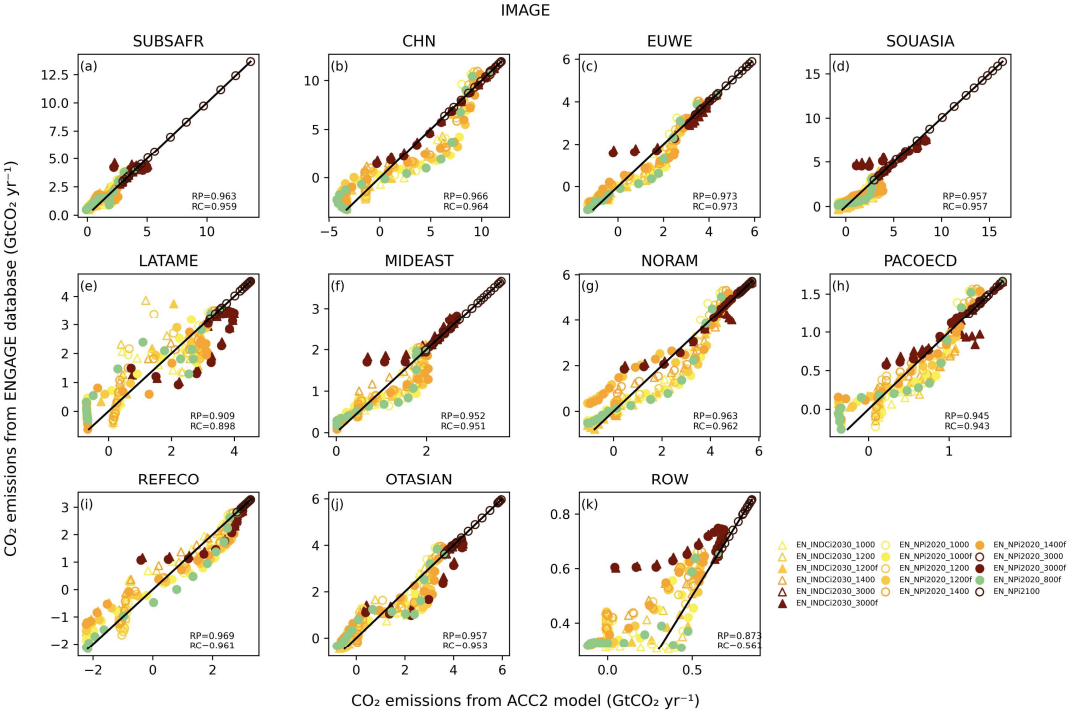

Figure S122. Test 1 - Regional IMAGE - Reproducibility of total anthropogenic CO_2

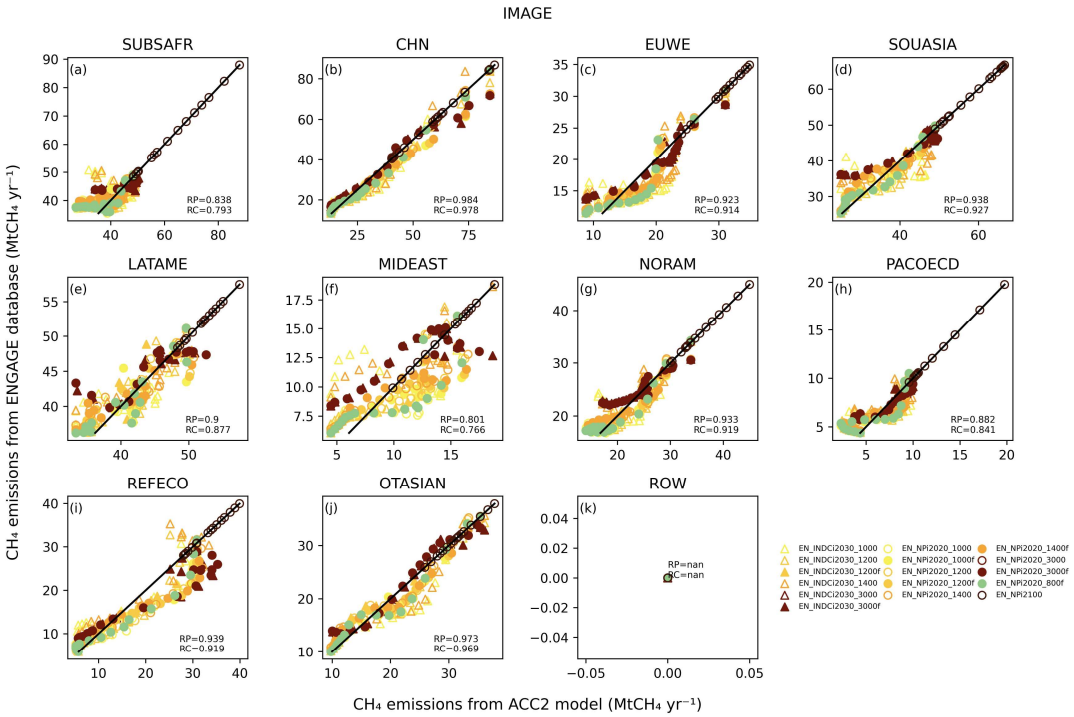

Figure S123. Test 1 - Regional IMAGE - Reproducibility of total anthropogenic CH_4

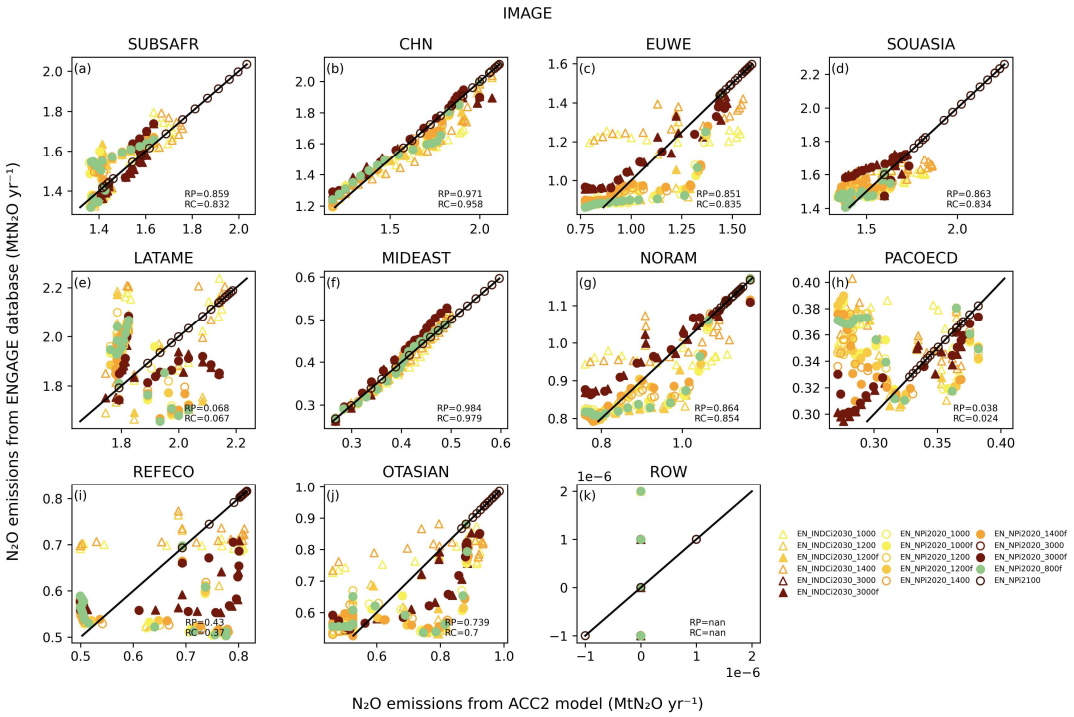

Figure S124. Test 1 - Regional IMAGE - Reproducibility of total anthropogenic N_2O

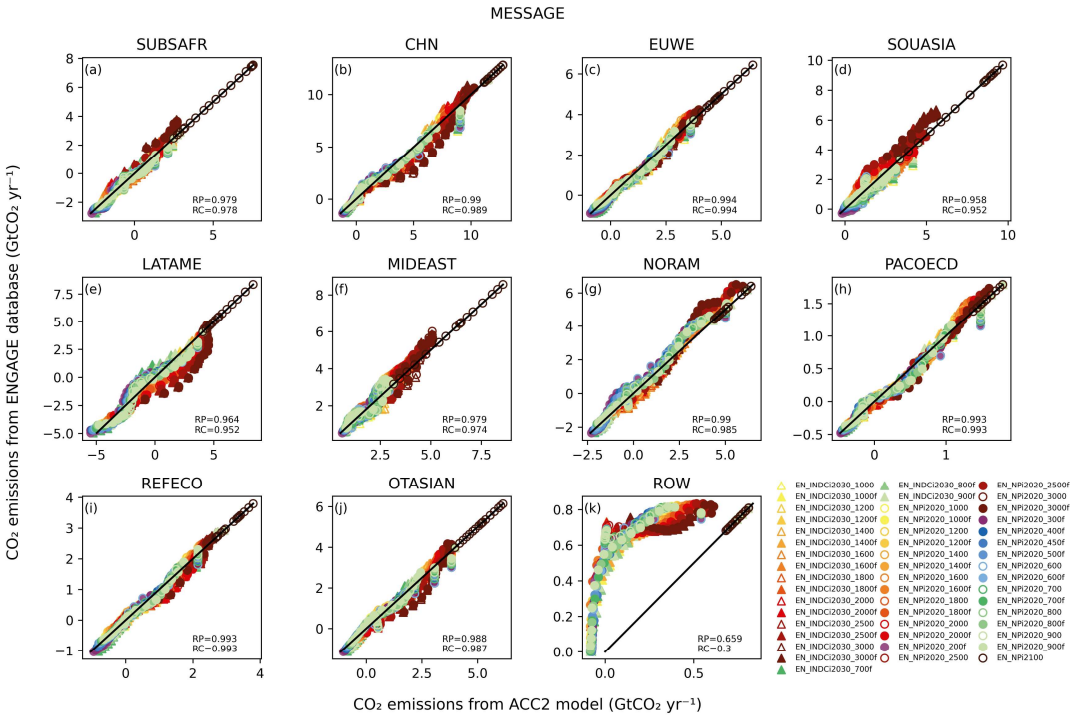

Figure S125. Test 1 - Regional MESSAGE - Reproducibility of total anthropogenic CO_2

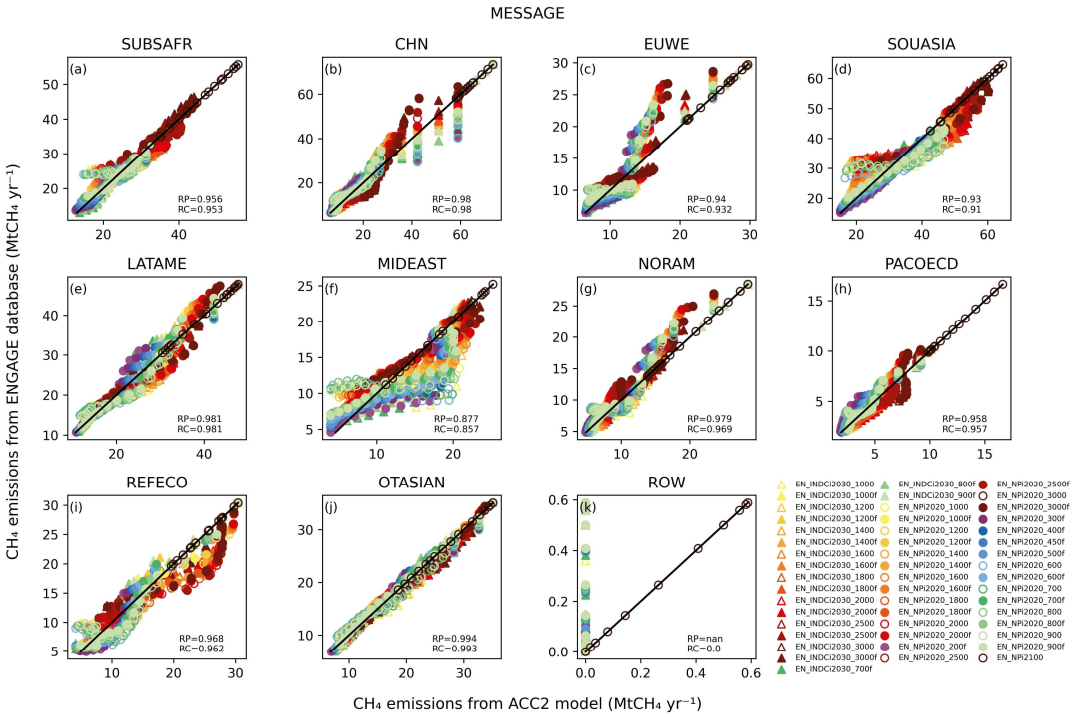

Figure S126. Test 1 - Regional MESSAGE - Reproducibility of total anthropogenic CH_4

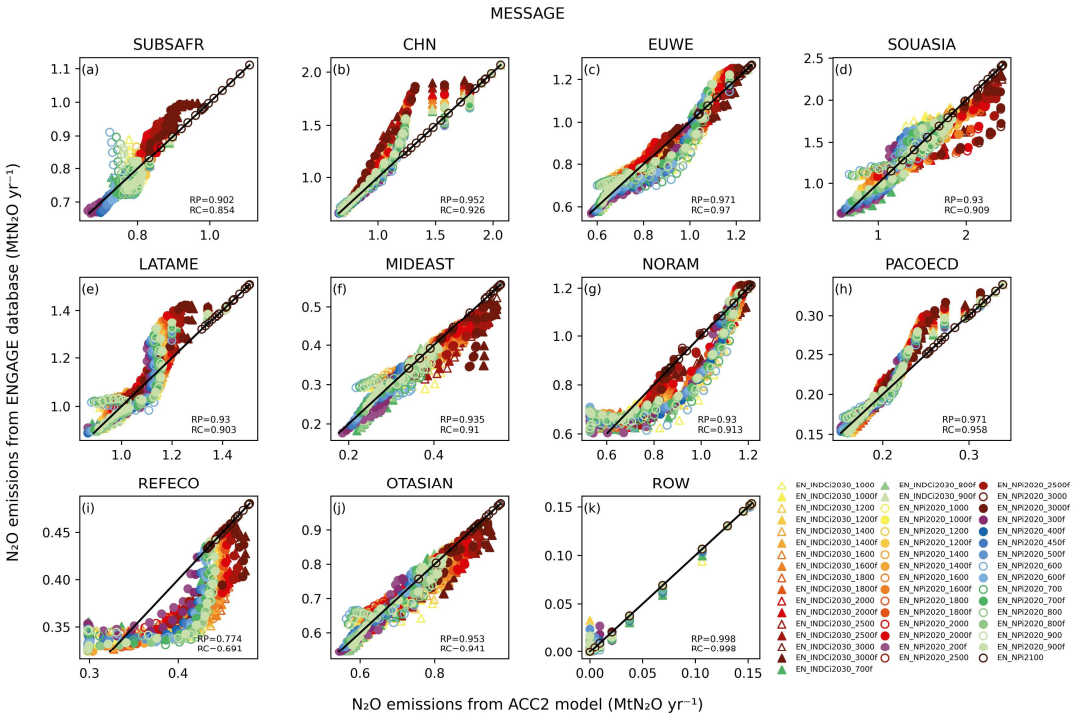

Figure S127. Test 1 - Regional MESSAGE - Reproducibility of total anthropogenic N_2O

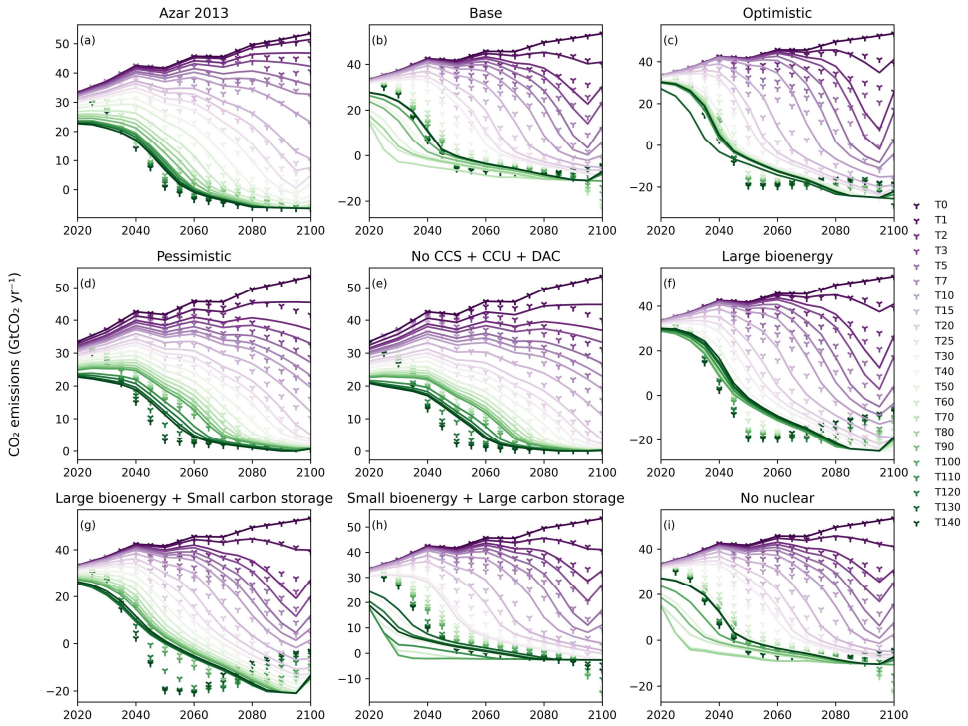

Figure S128. Test 2 – GET 9 portfolios energy-related CO_2 validation result

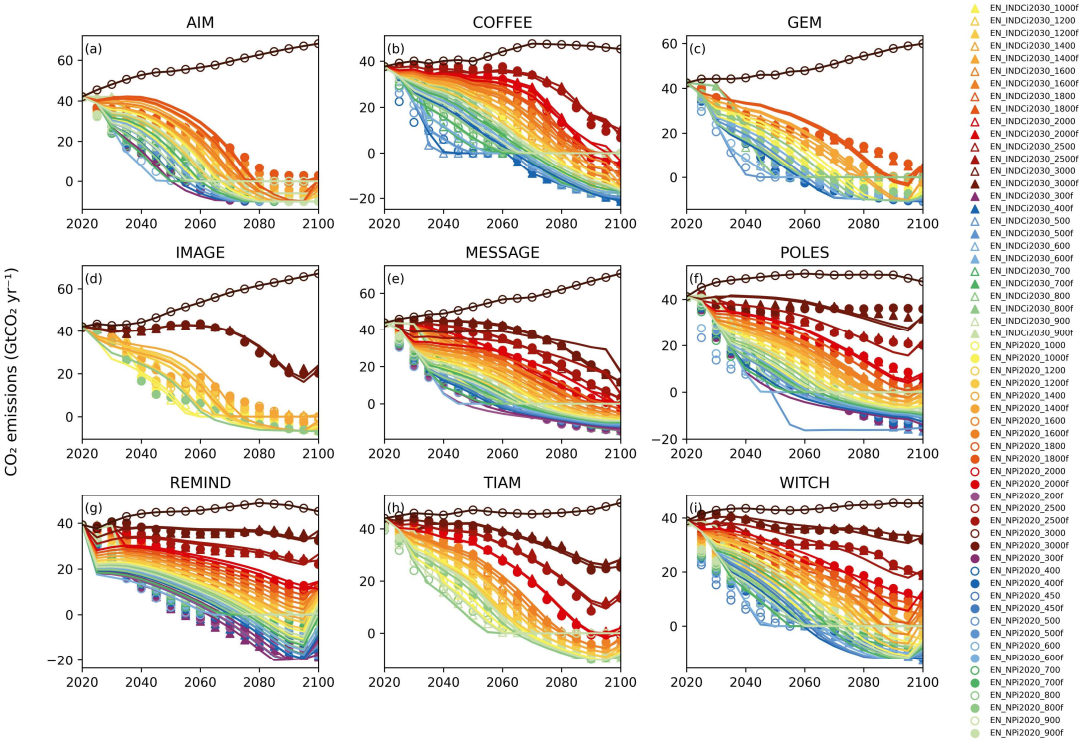

Figure S129. Test 2 – Global 9 models total anthropogenic CO_2 validation result

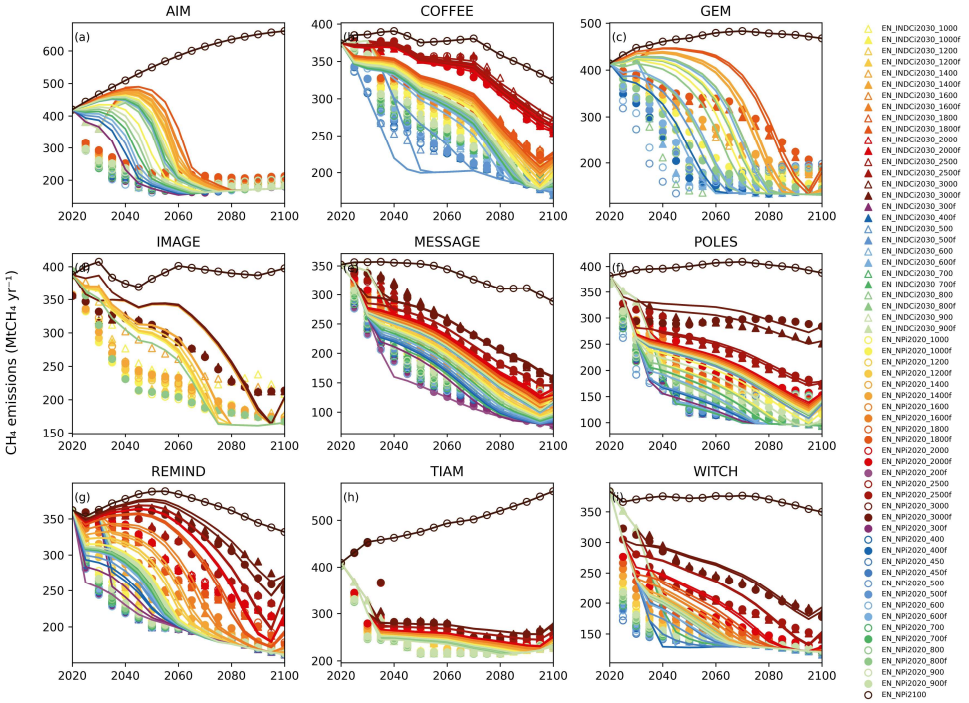

Figure S130. Test 2 – Global 9 models total anthropogenic CH_4 validation result

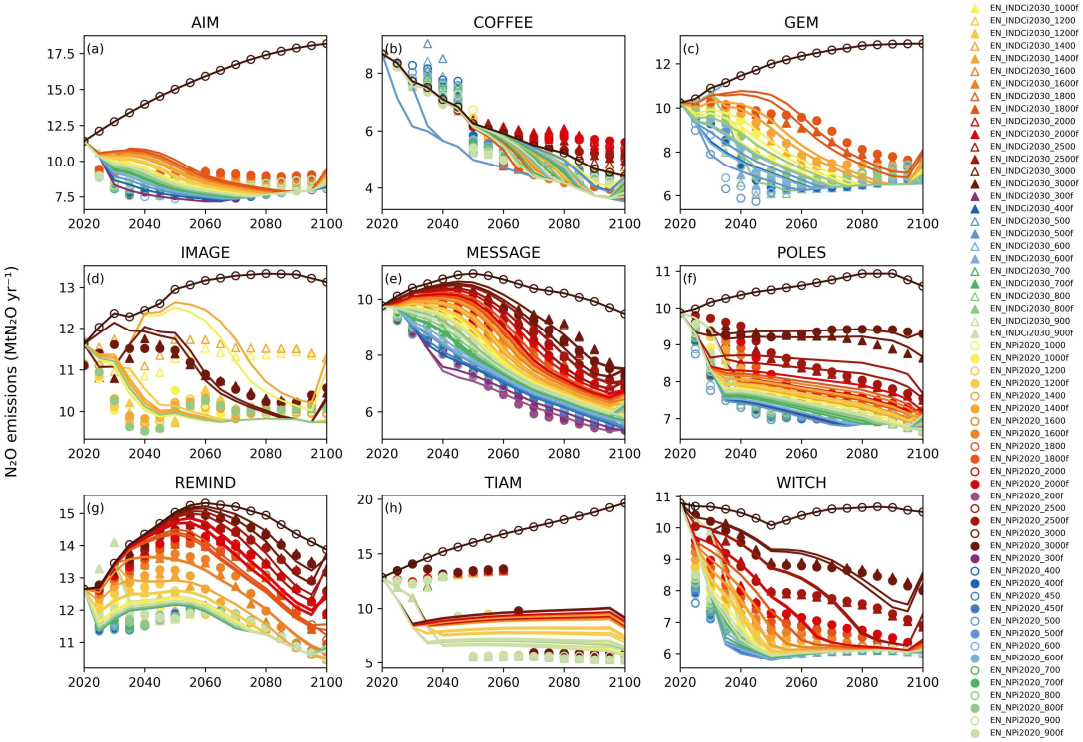

Figure S131. Test 2 – Global 9 models total anthropogenic N_2O validation result

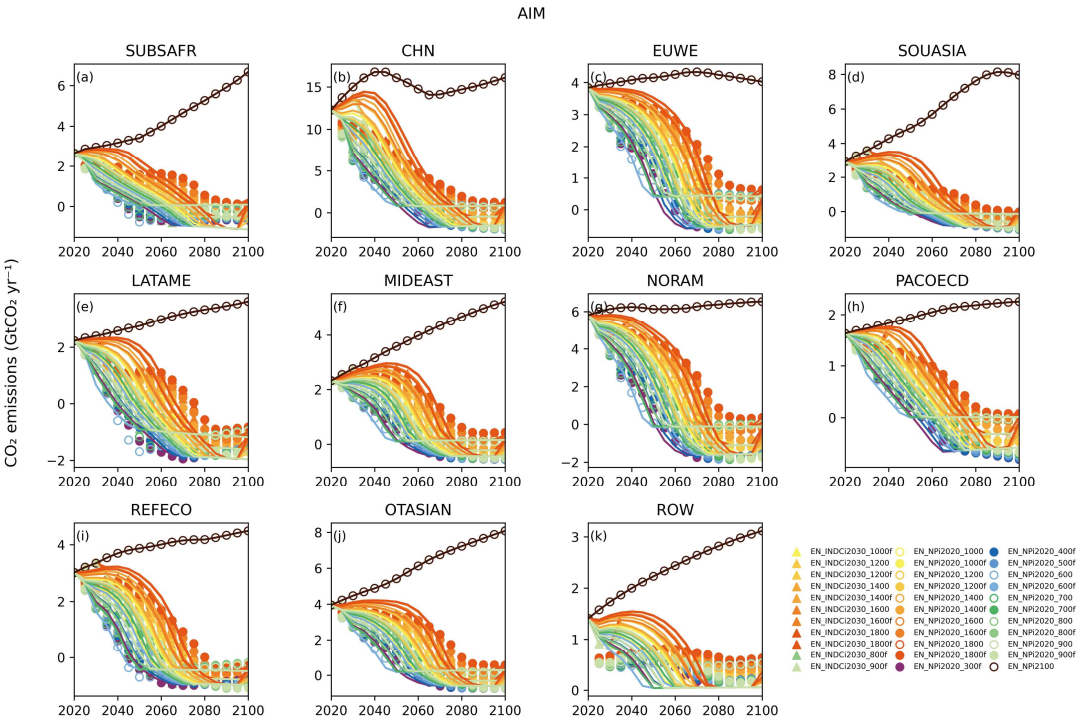

Figure S132. Test 2 - Regional AIM total anthropogenic CO_2 validation result

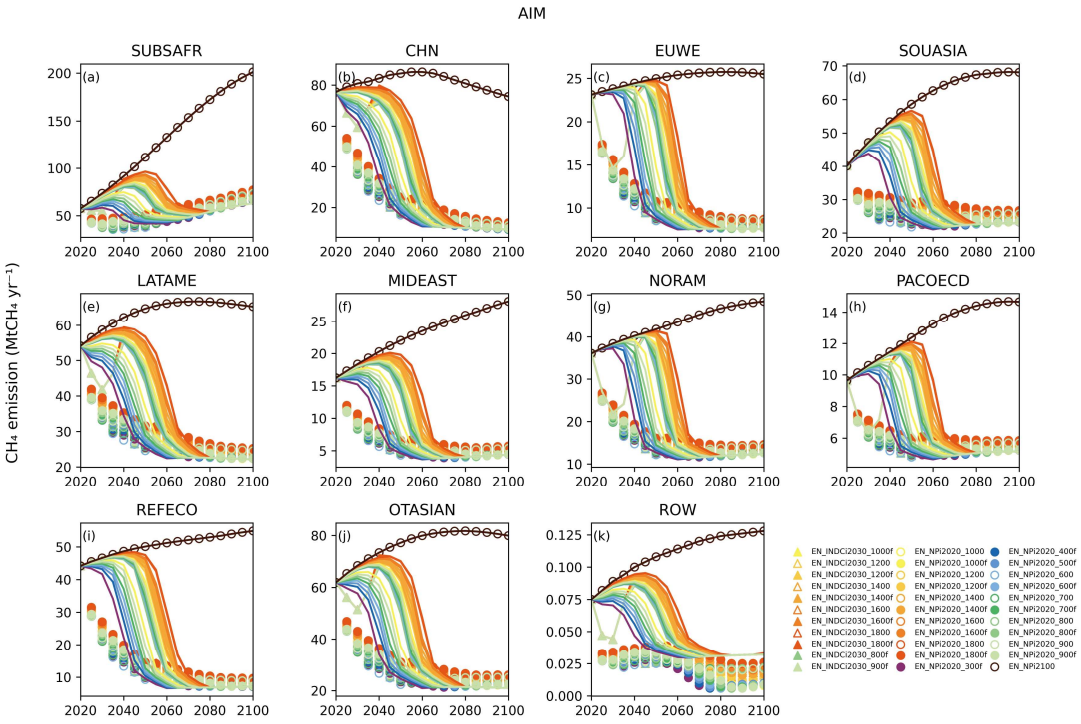

Figure S133. Test 2 - Regional AIM total anthropogenic CH_4 validation result

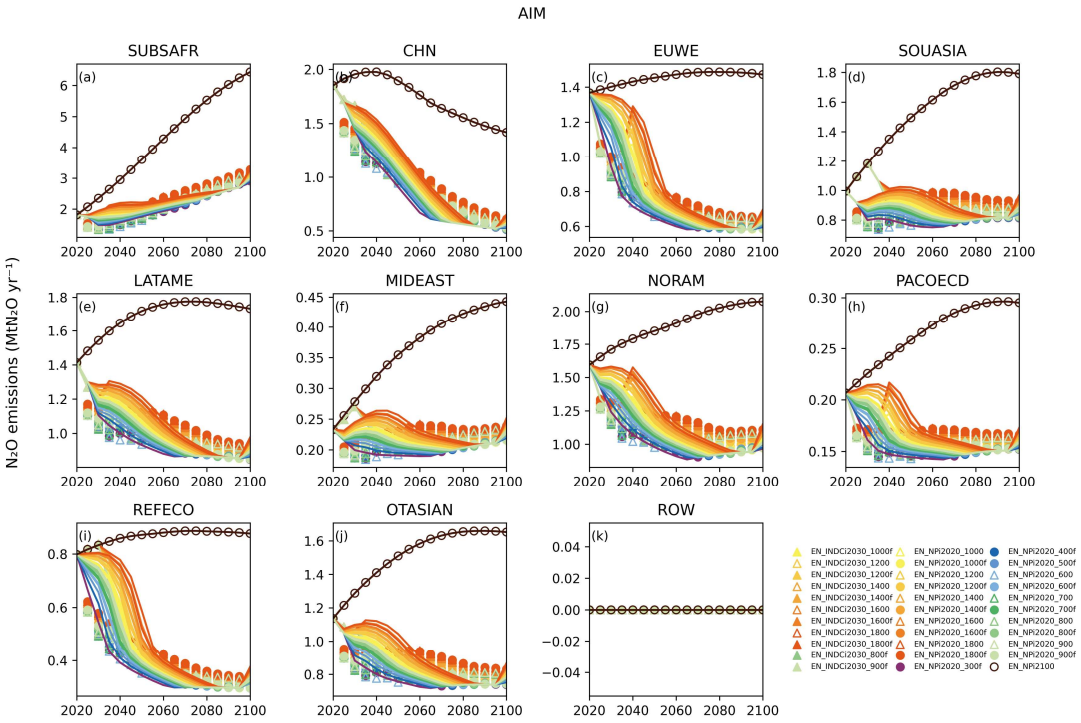

Figure S134. Test 2 - Regional AIM total anthropogenic N_2O validation result

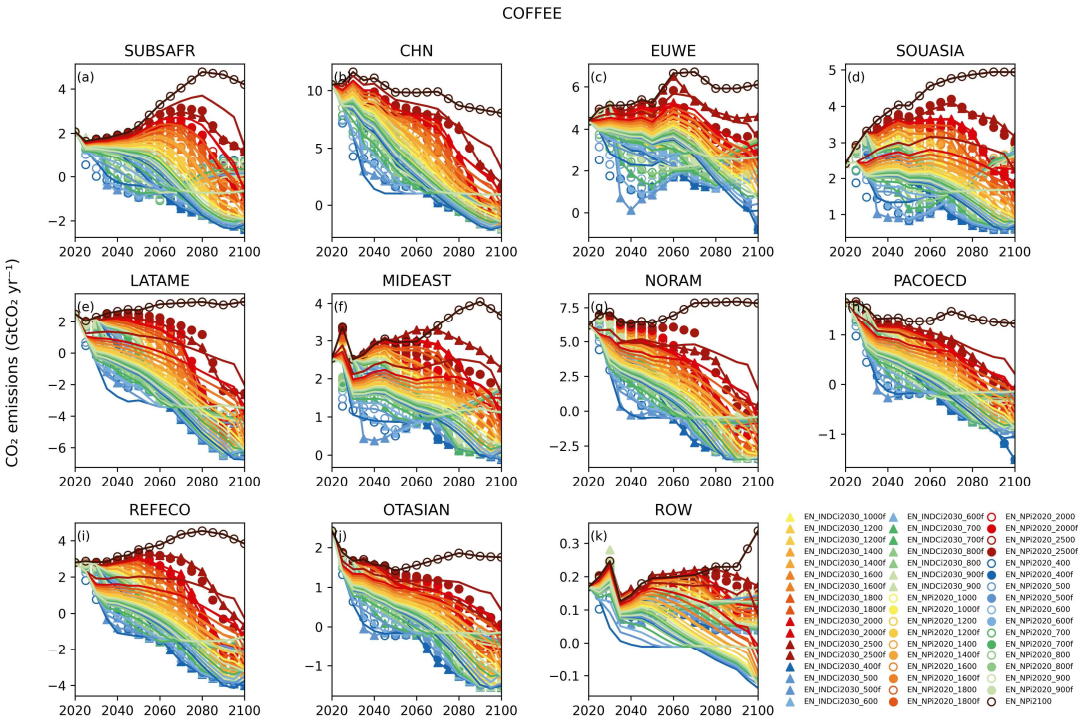

Figure S135. Test 2 - Regional COFFEE total anthropogenic CO_2 validation result

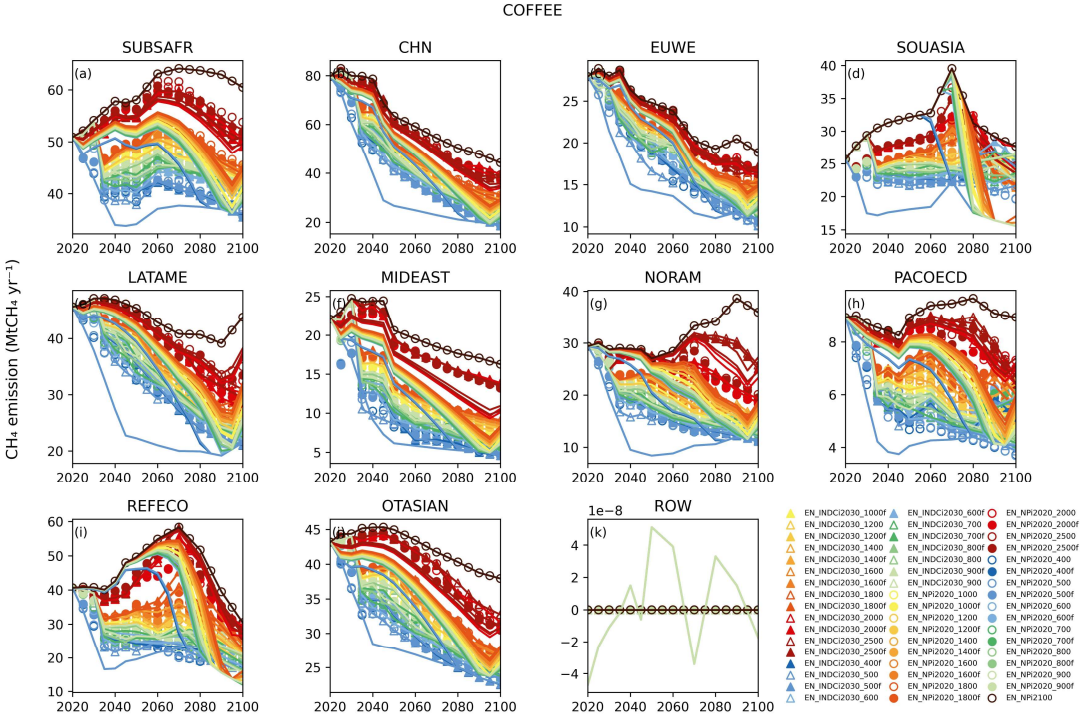

Figure S136. Test 2 - Regional COFFEE total anthropogenic CH_4 validation result

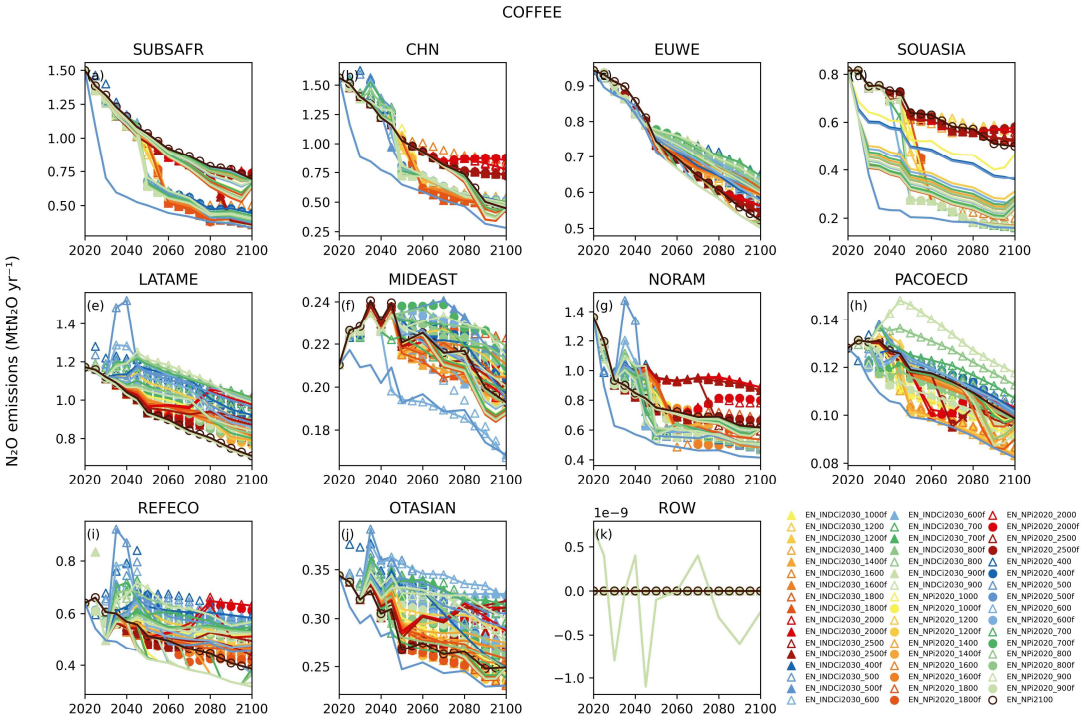

Figure S137. Test 2 - Regional COFFEE total anthropogenic N_2O validation result

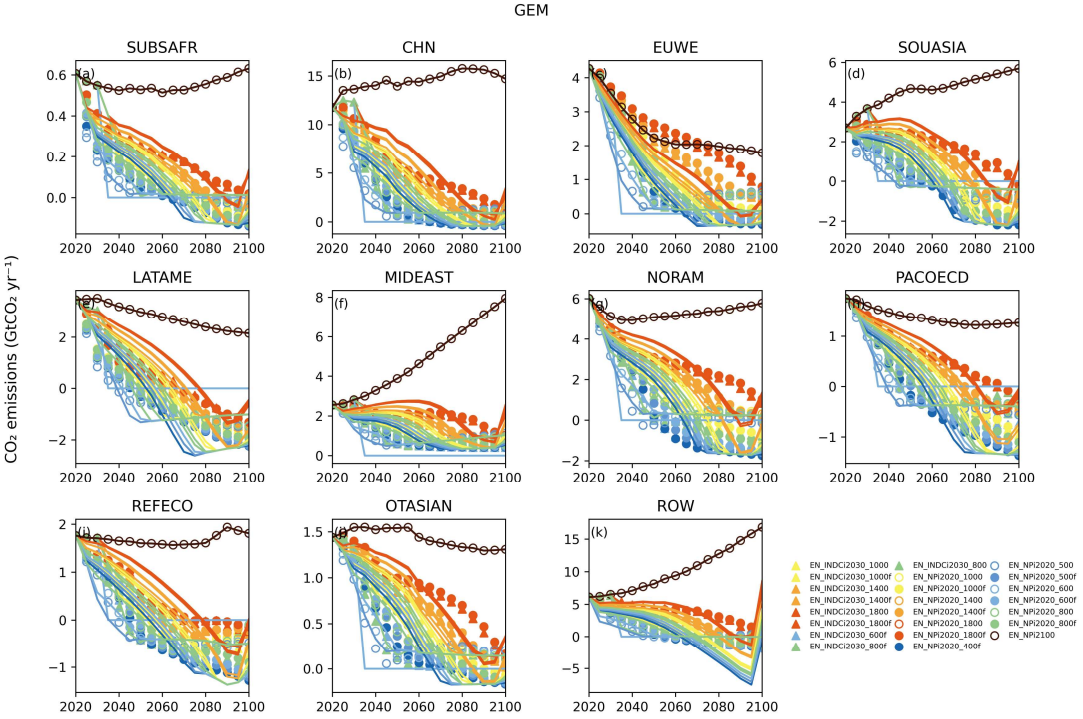

Figure S138. Test 2 - Regional GEM total anthropogenic CO_2 validation result

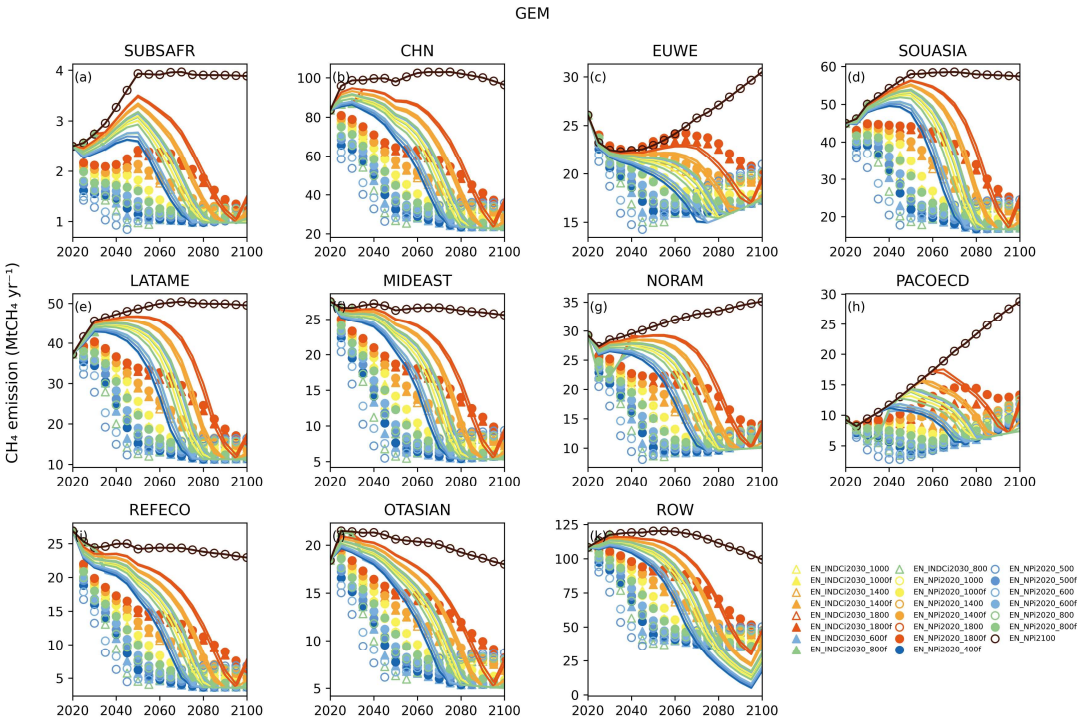

Figure S139. Test 2 - Regional GEM total anthropogenic CH_4 validation result

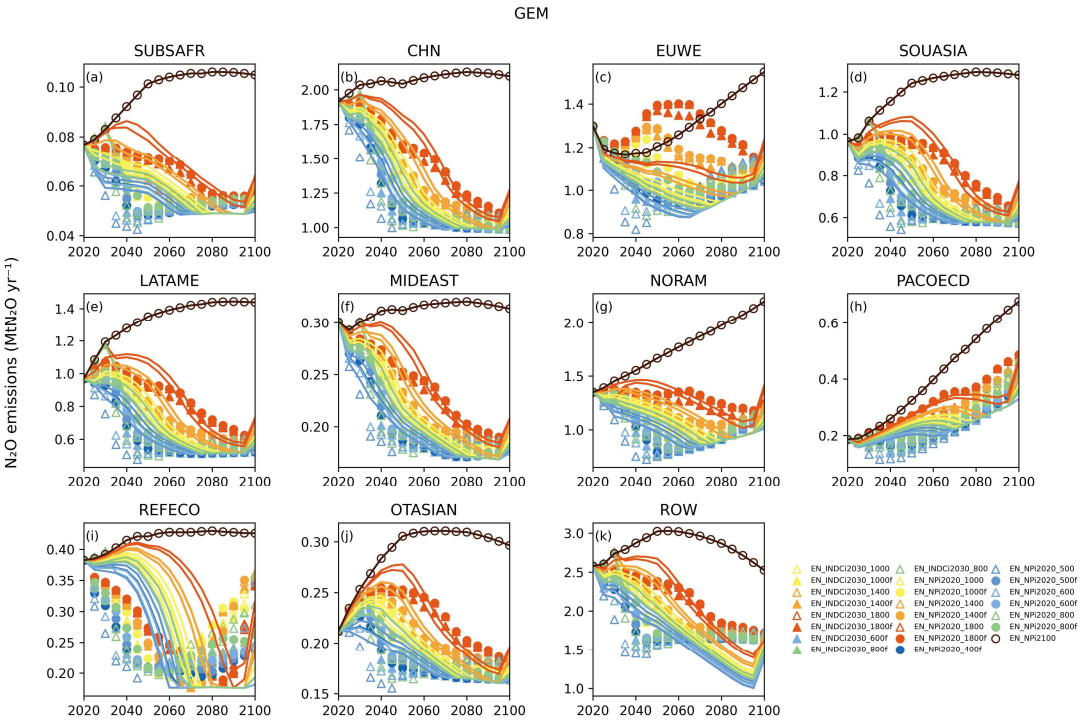

Figure S140. Test 2 - Regional GEM total anthropogenic N_2O validation result

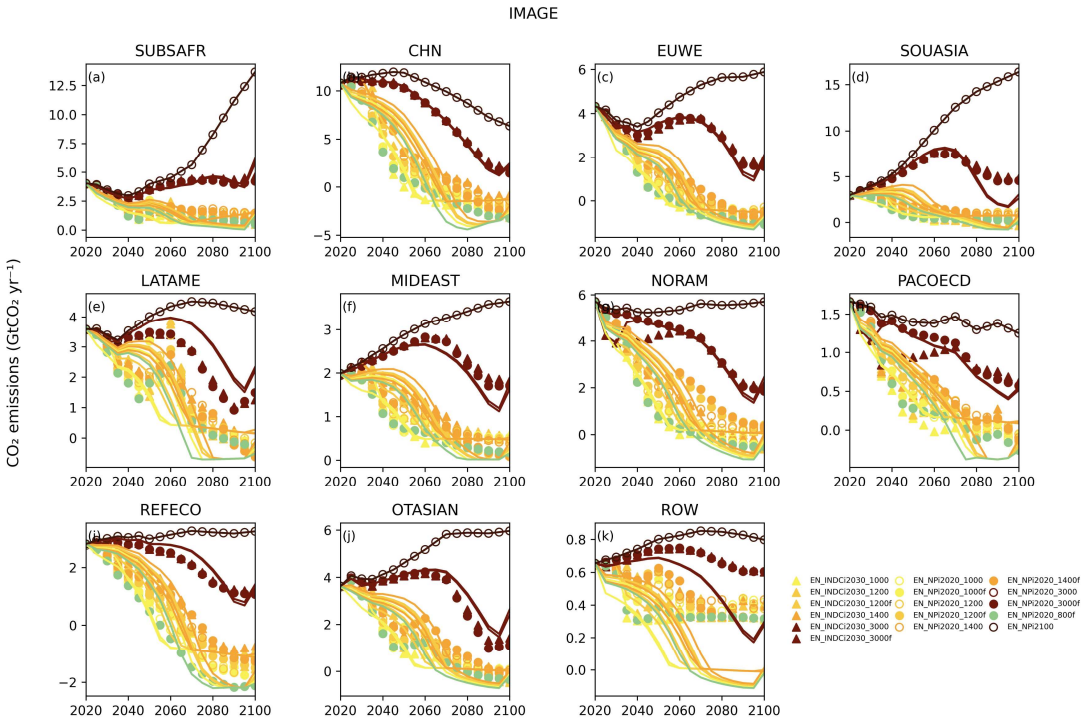

Figure S141. Test 2 - Regional IMAGE total anthropogenic CO_2 validation result

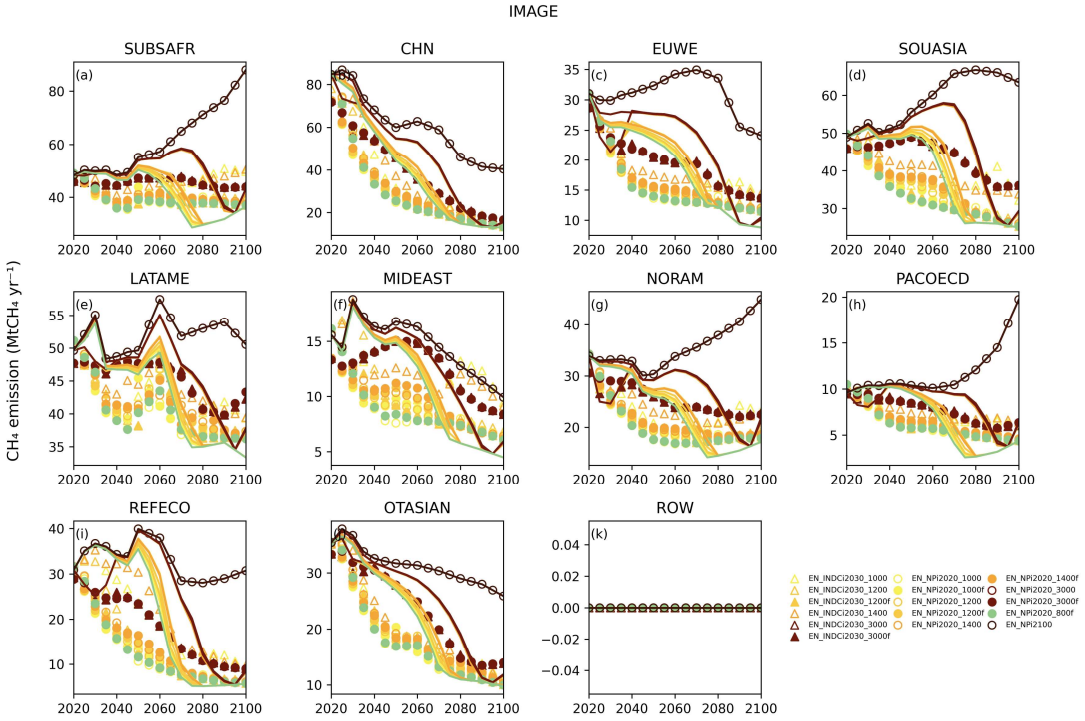

Figure S142. Test 2 - Regional IMAGE total anthropogenic CH_4 validation result

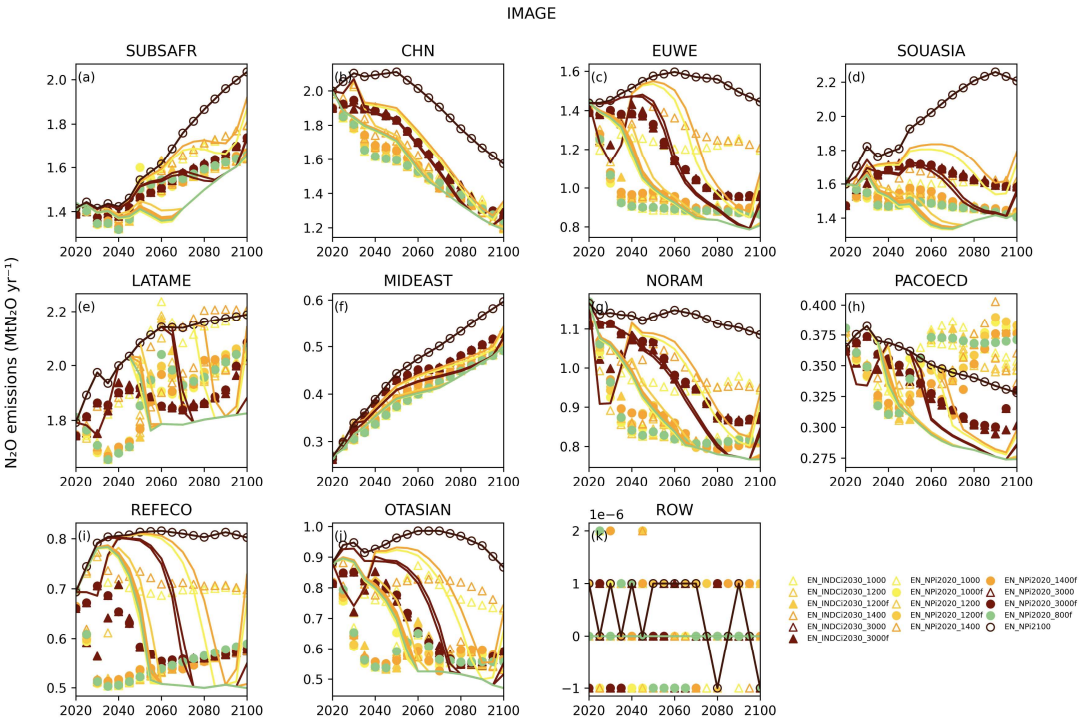

Figure S143. Test 2 - Regional IMAGE total anthropogenic N_2O validation result

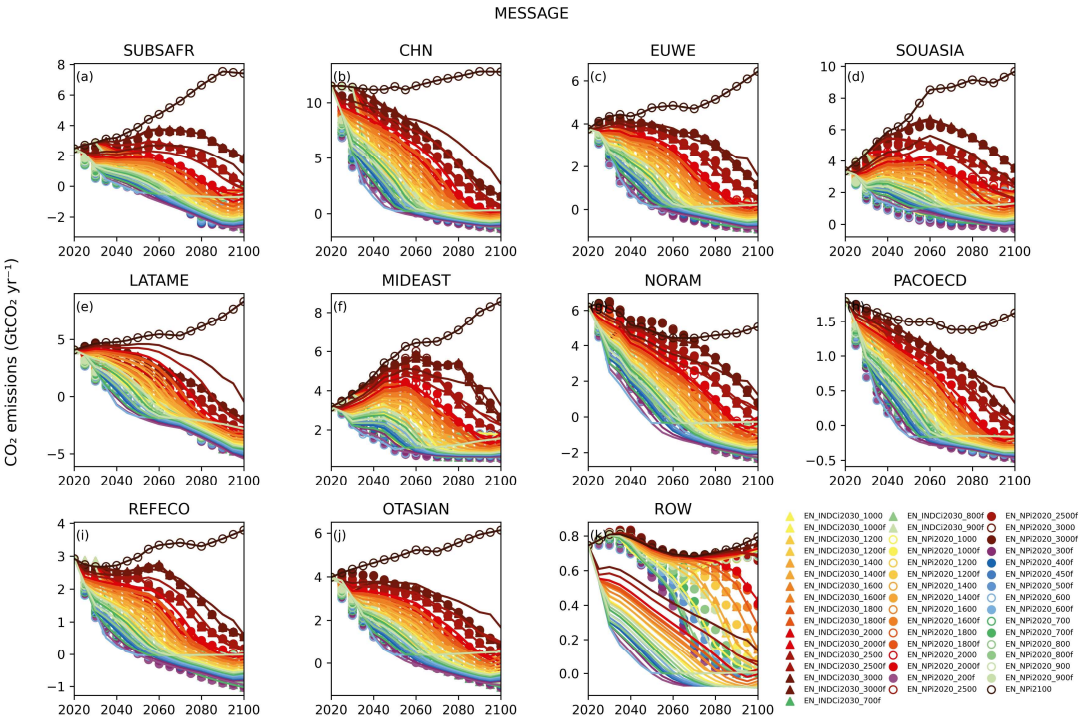

Figure S144. Test 2 - Regional MESSAGE total anthropogenic CO_2 validation result

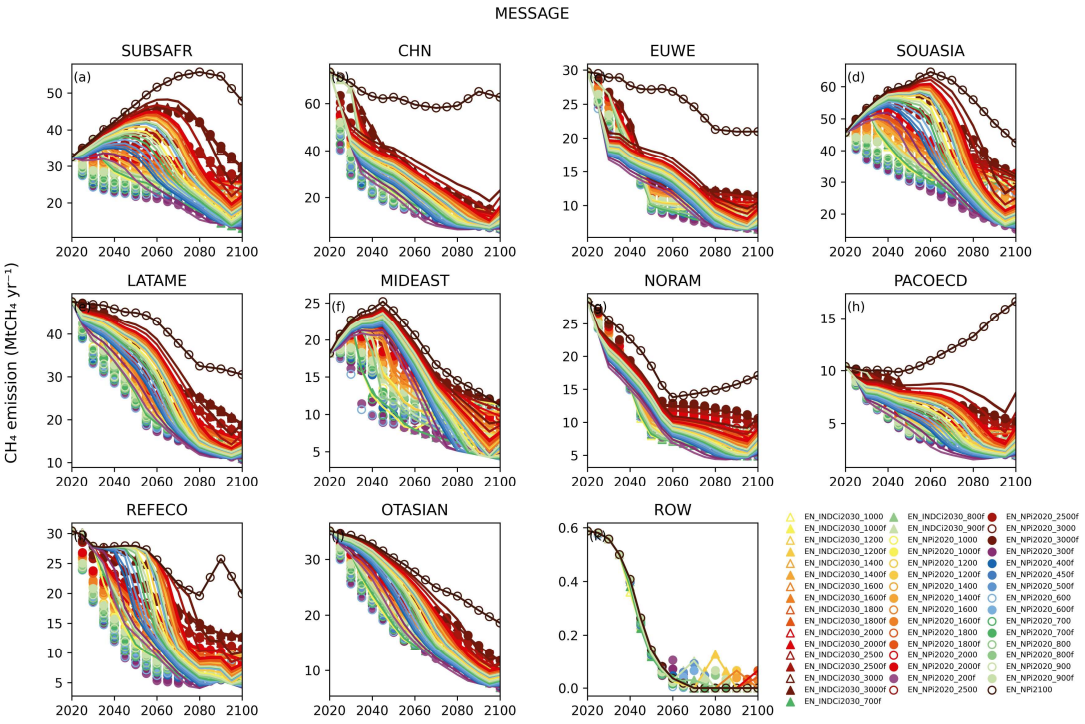

Figure S145. Test 2 - Regional MESSAGE total anthropogenic CH_4 validation result

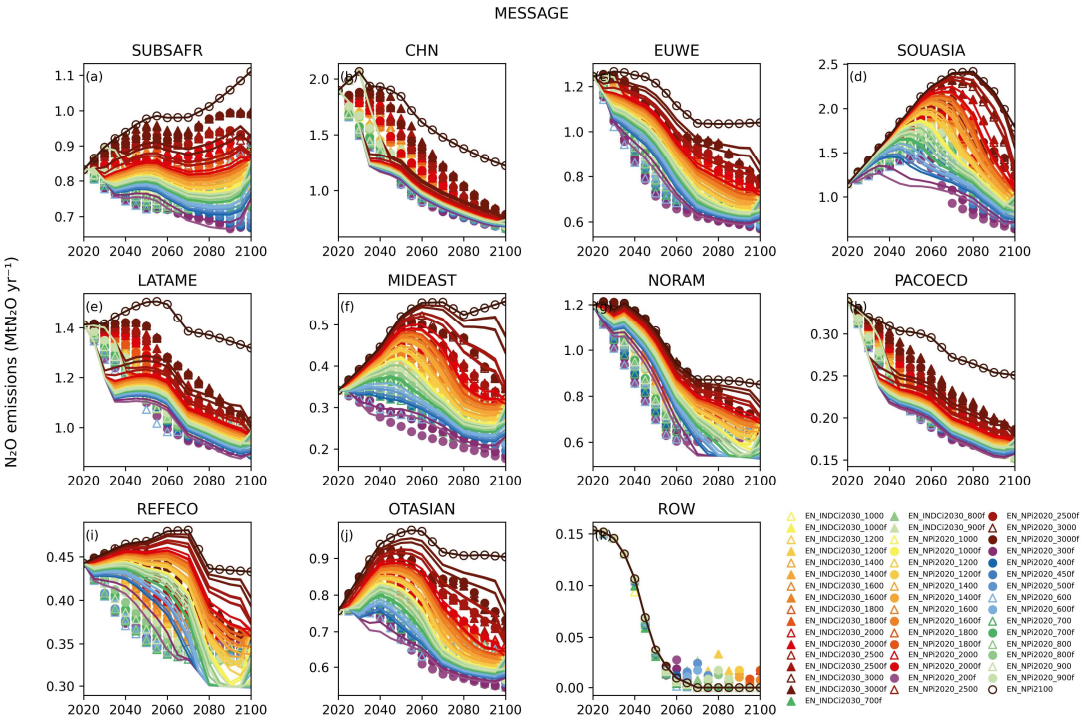

Figure S146. Test 2 - Regional MESSAGE total anthropogenic N_2O validation result

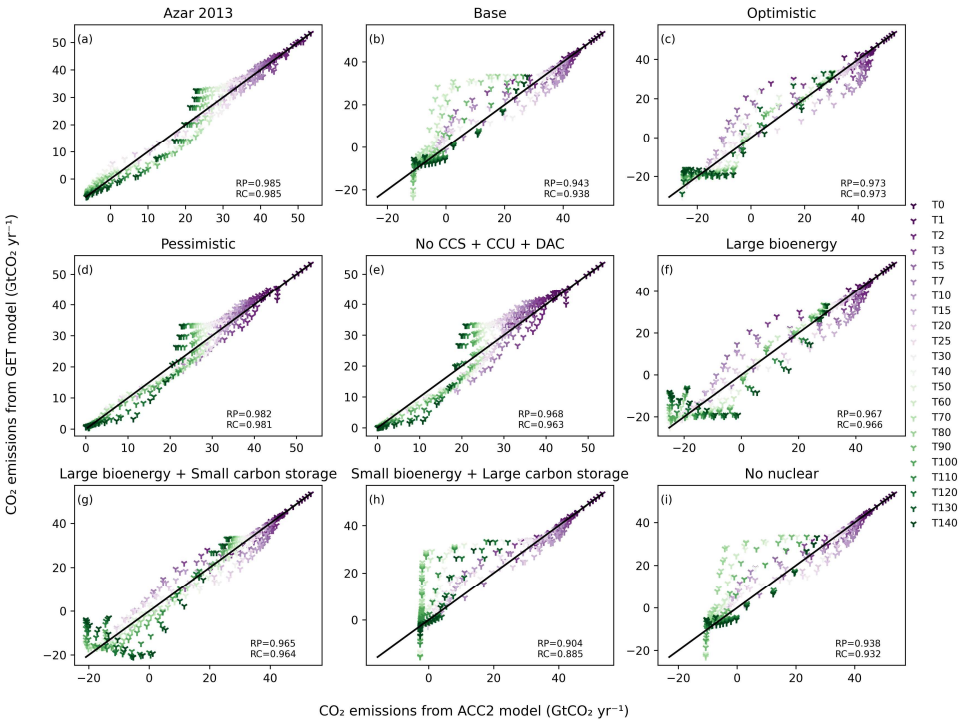

Figure S147. Test 2 - GET Reproducibility of energy-related CO_2

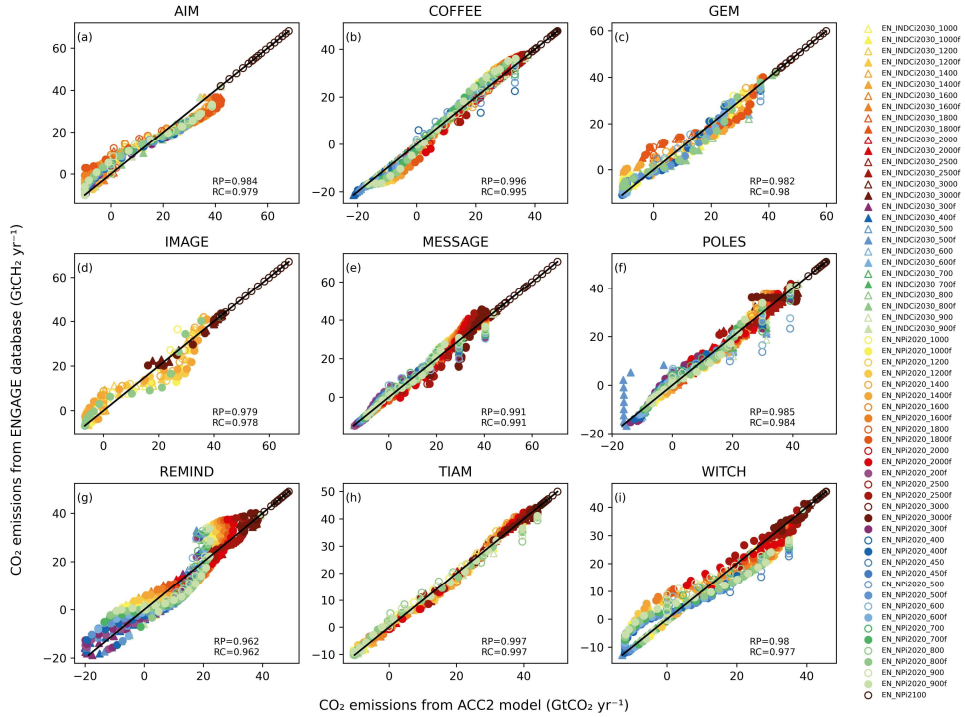

Figure S148. Test 2 - Global 9 models - Reproducibility of total anthropogenic CO_2

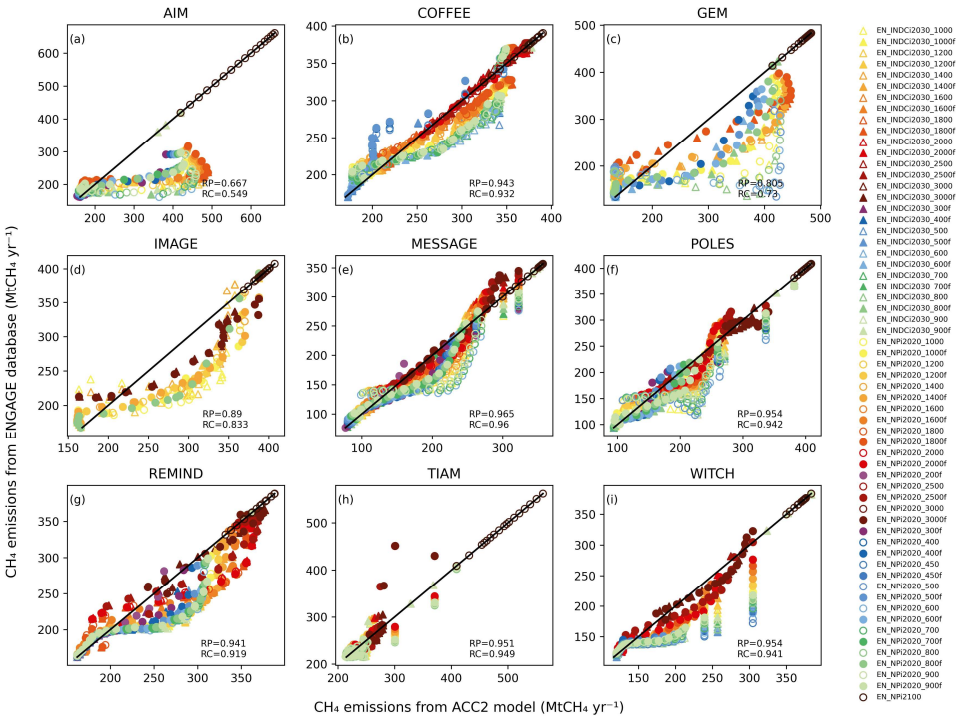

Figure S149. Test 2 - Global 9 models - Reproducibility of total anthropogenic CH_4

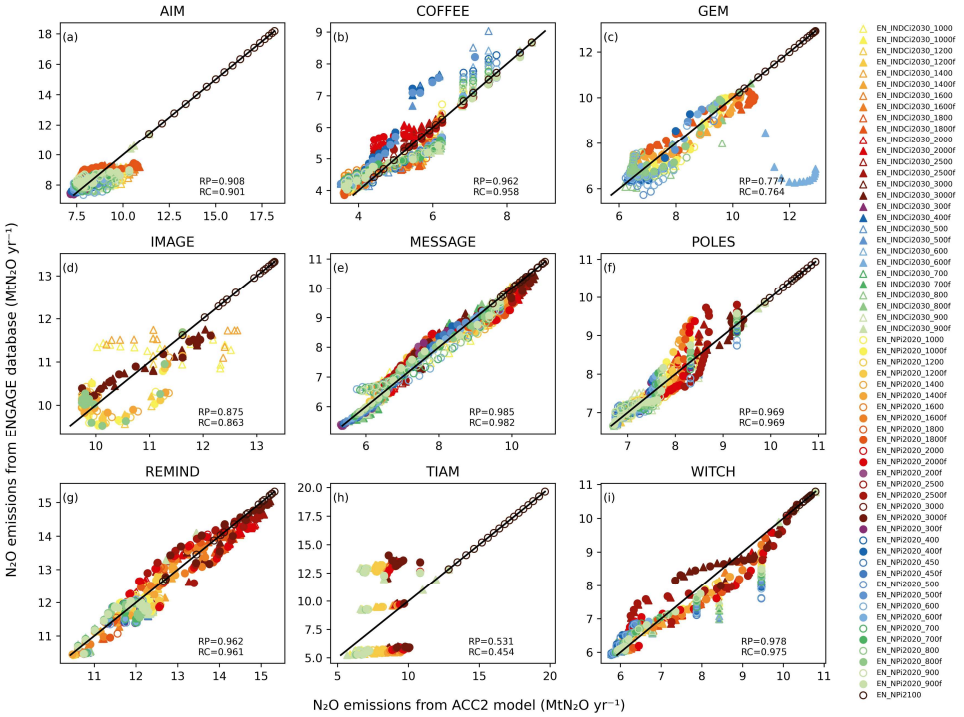

Figure S150. Test 2 - Global 9 models - Reproducibility of total anthropogenic N_2O

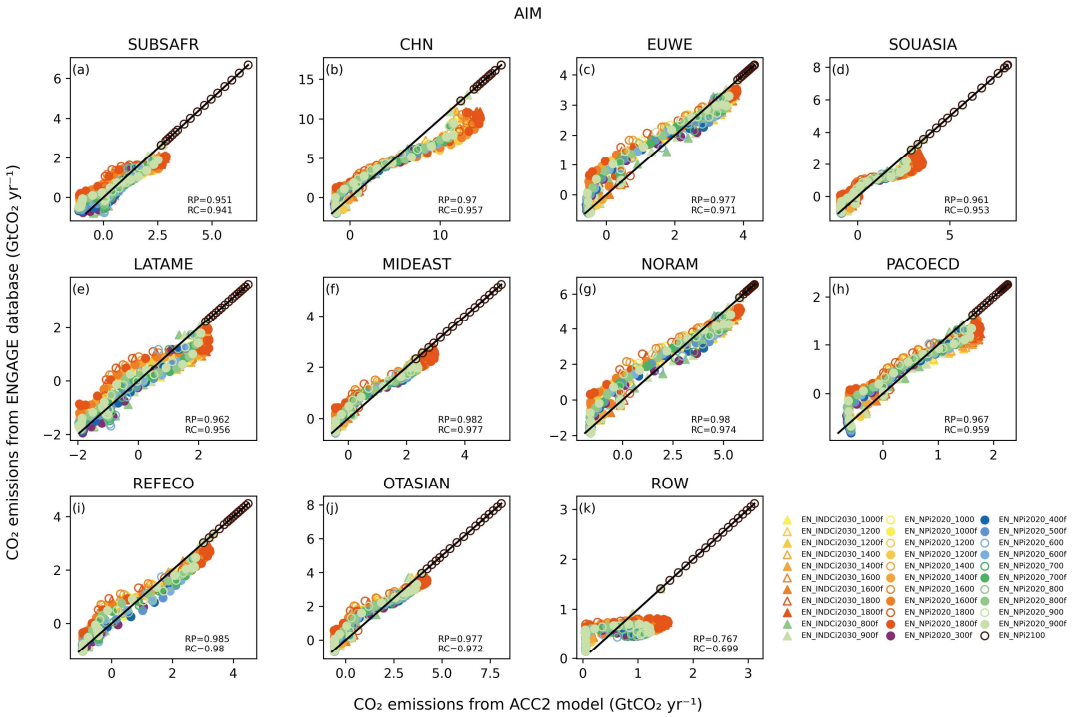

Figure S151. Test 2 - Regional AIM - Reproducibility of total anthropogenic CO_2

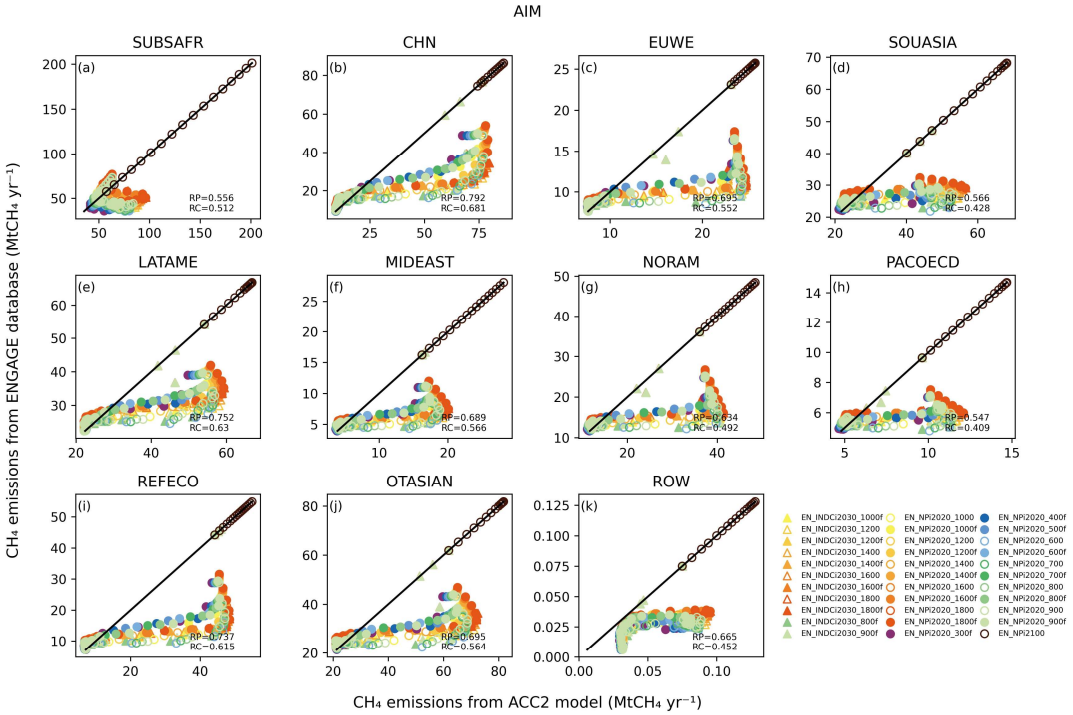

Figure S152. Test 2 - Regional AIM - Reproducibility of total anthropogenic CH_4

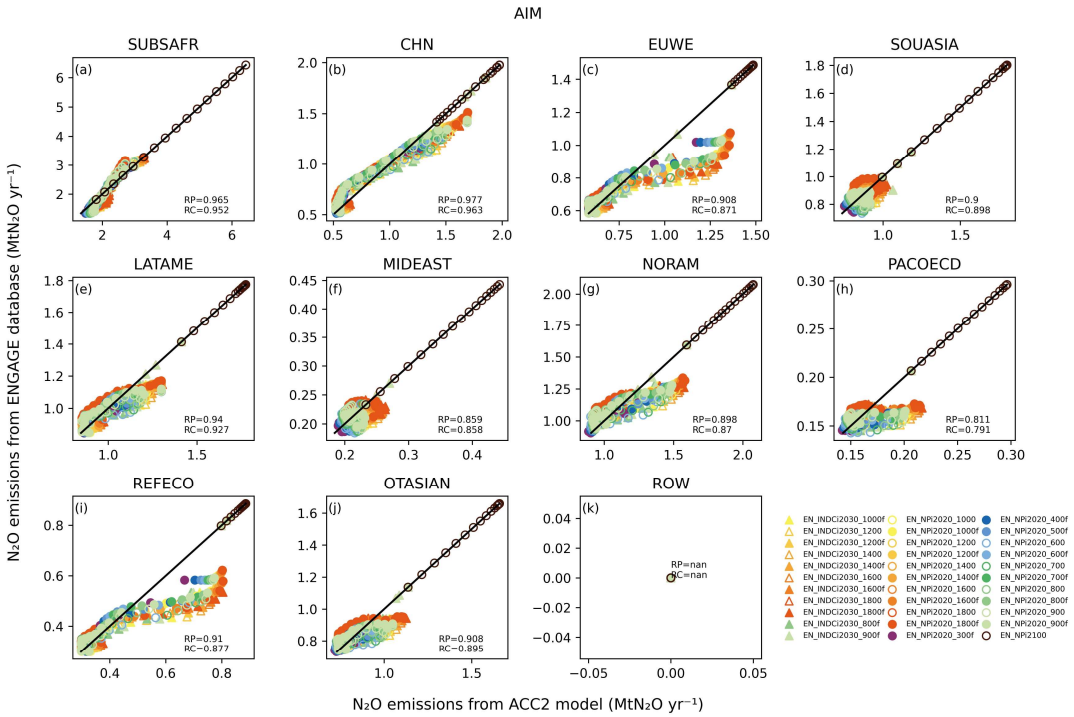

Figure S153. Test 2 - Regional AIM - Reproducibility of total anthropogenic N_2O

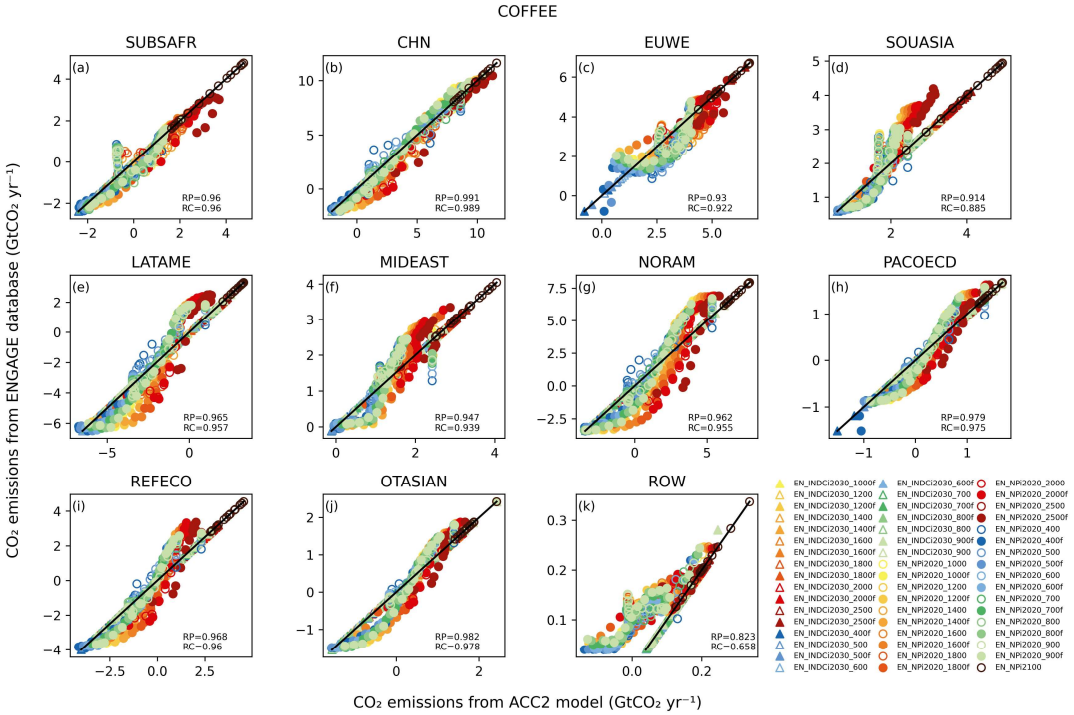

Figure S154. Test 2 - Regional COFFEE - Reproducibility of total anthropogenic CO_2

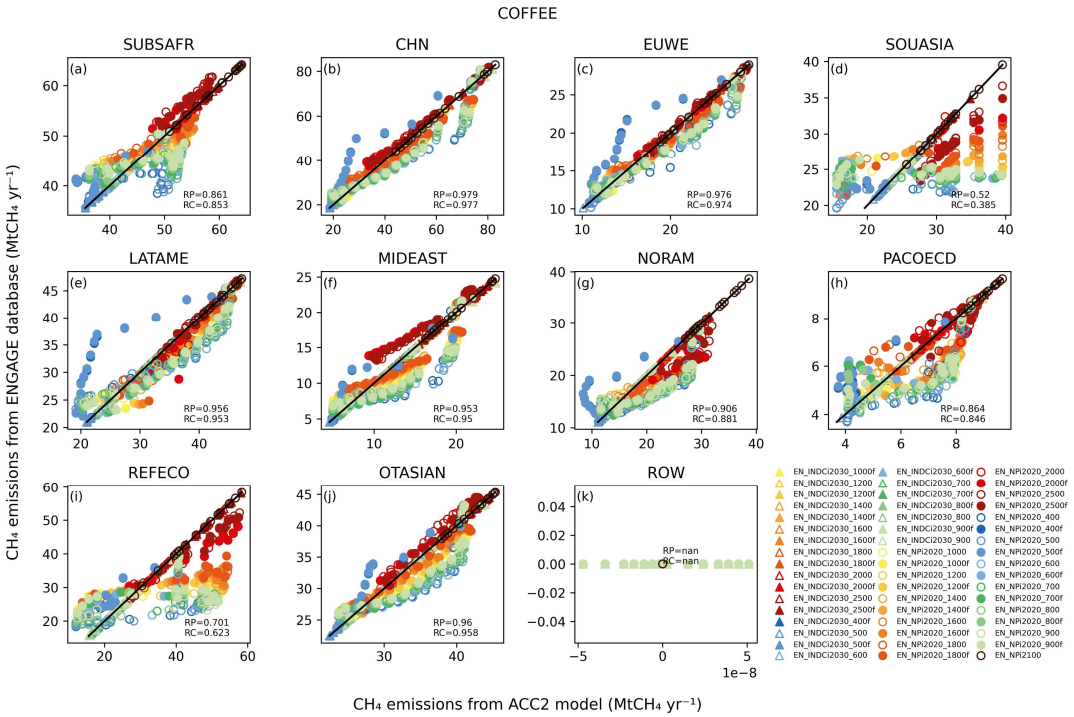

Figure S155. Test 2 - Regional COFFEE - Reproducibility of total anthropogenic CH_4

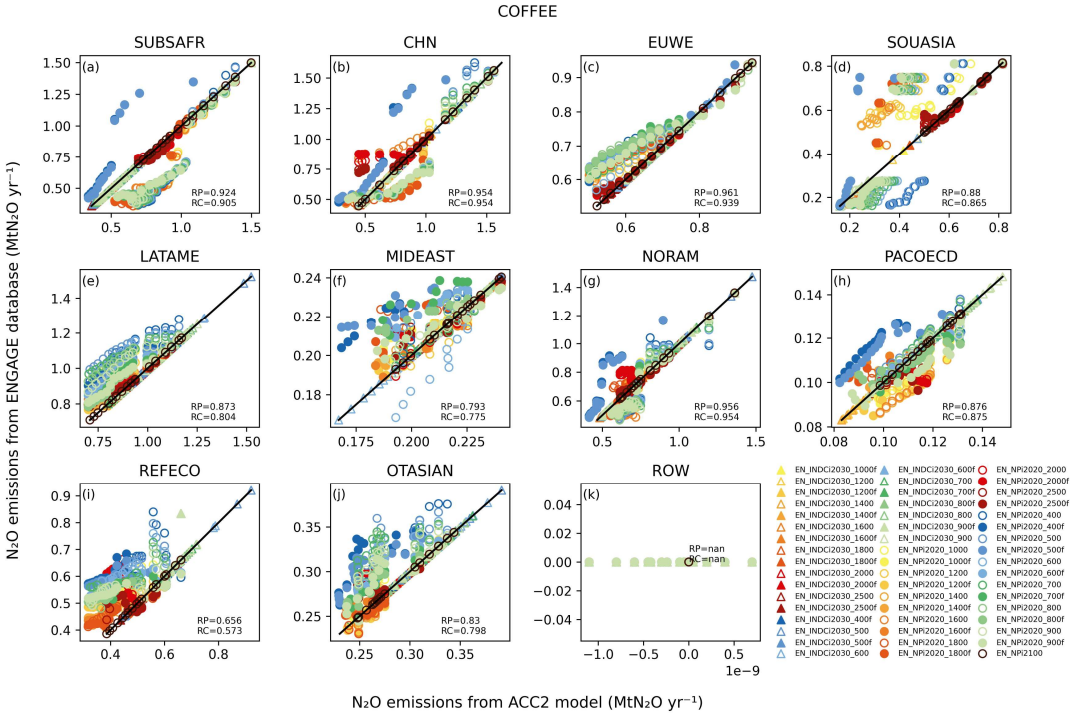

Figure S156. Test 2 - Regional COFFEE - Reproducibility of total anthropogenic N_2O

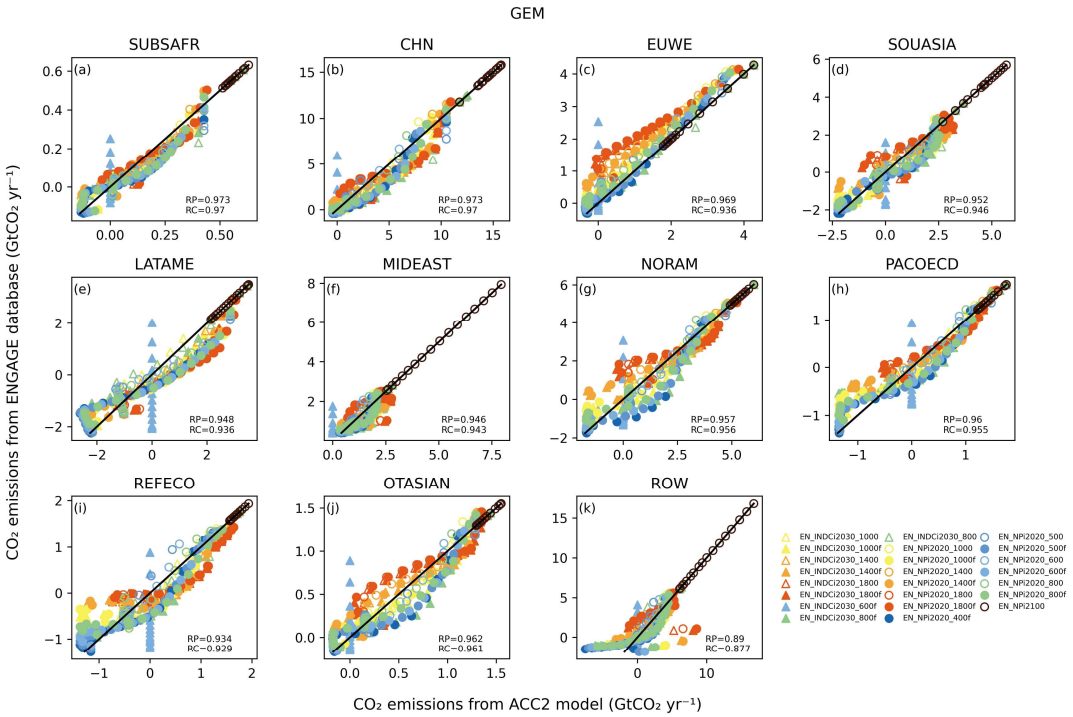

Figure S157. Test 2 - Regional GEM - Reproducibility of total anthropogenic CO_2

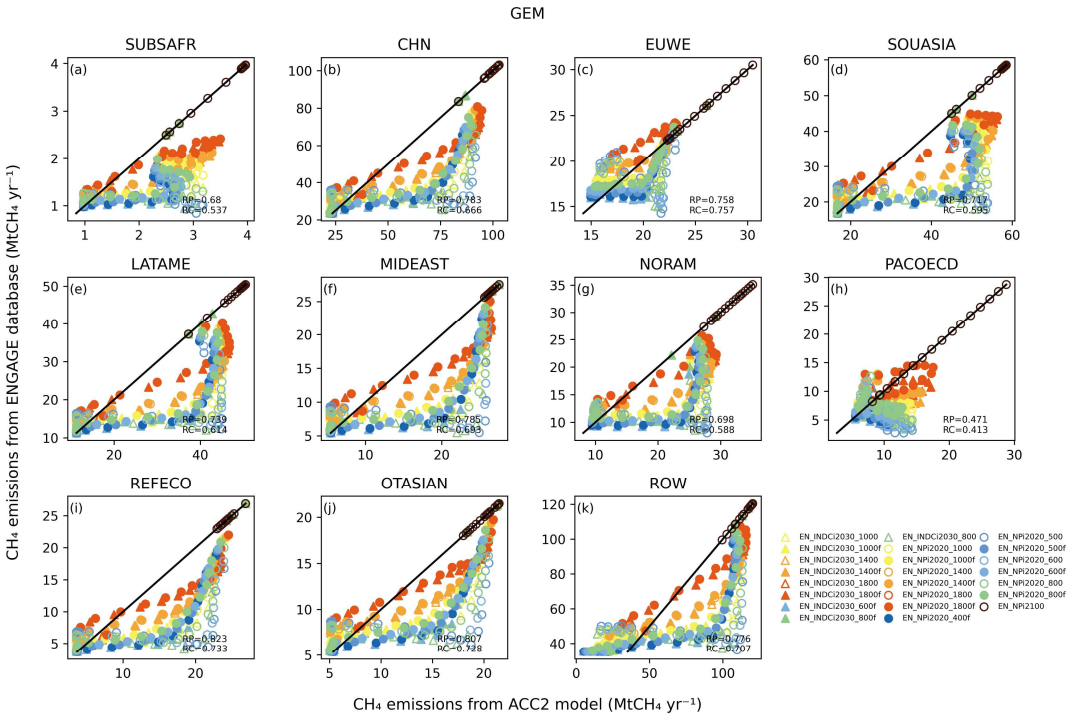

Figure S158. Test 2 - Regional GEM - Reproducibility of total anthropogenic CH_4

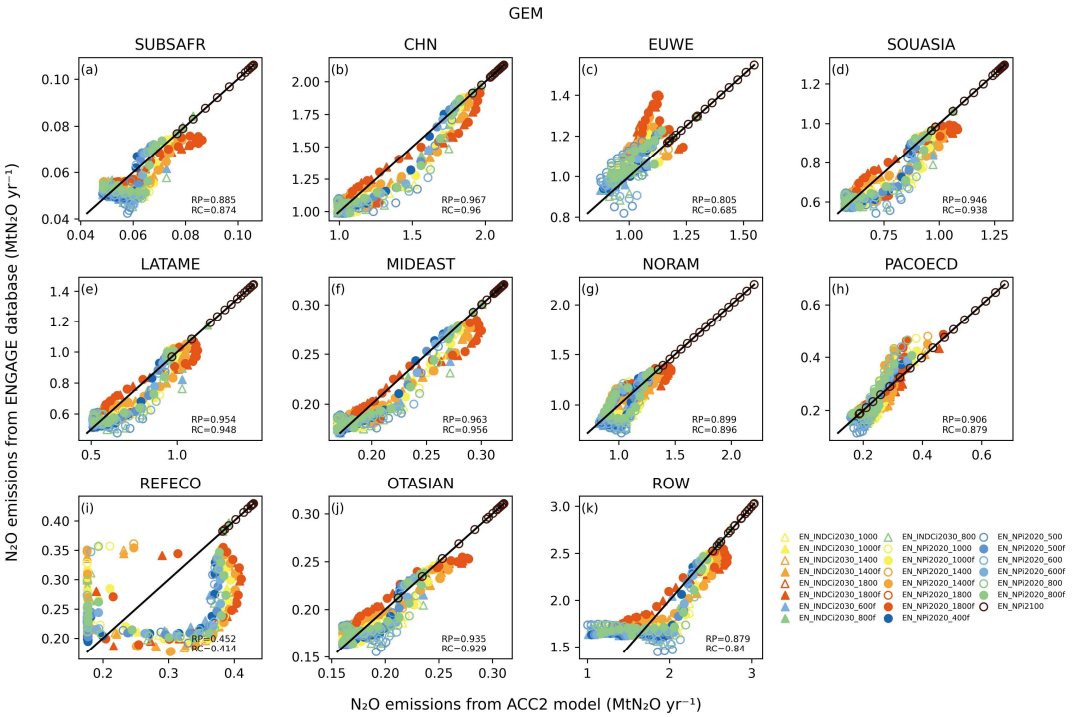

Figure S159. Test 2 - Regional GEM - Reproducibility of total anthropogenic N_2O

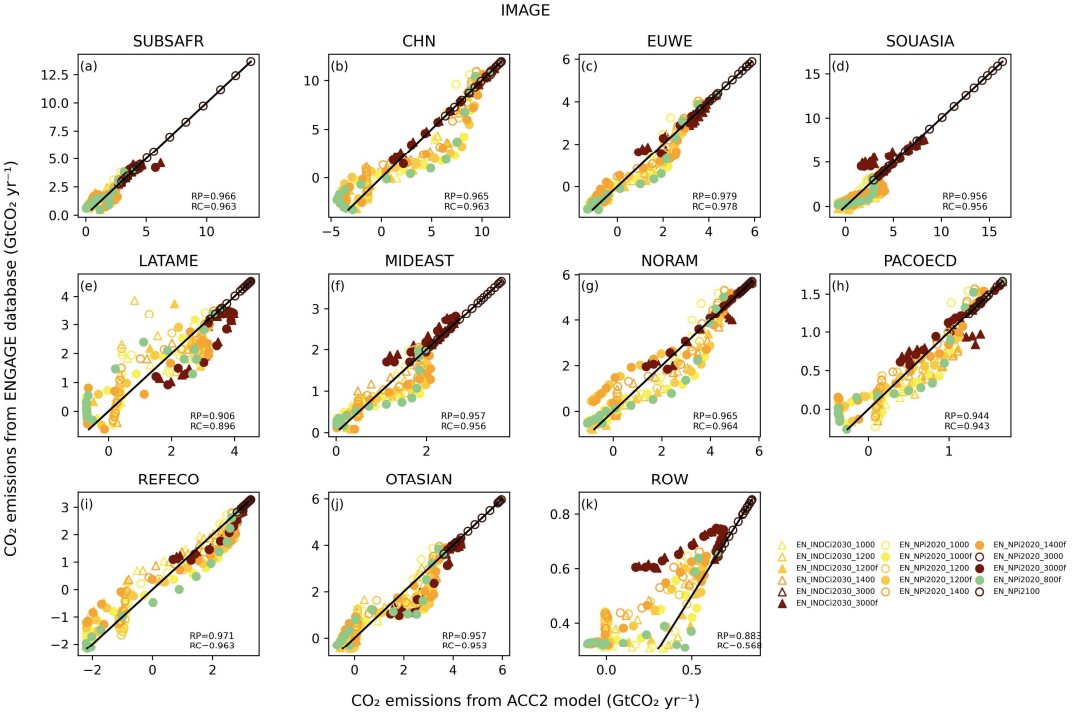

Figure S160. Test 2 - Regional IMAGE - Reproducibility of total anthropogenic CO_2

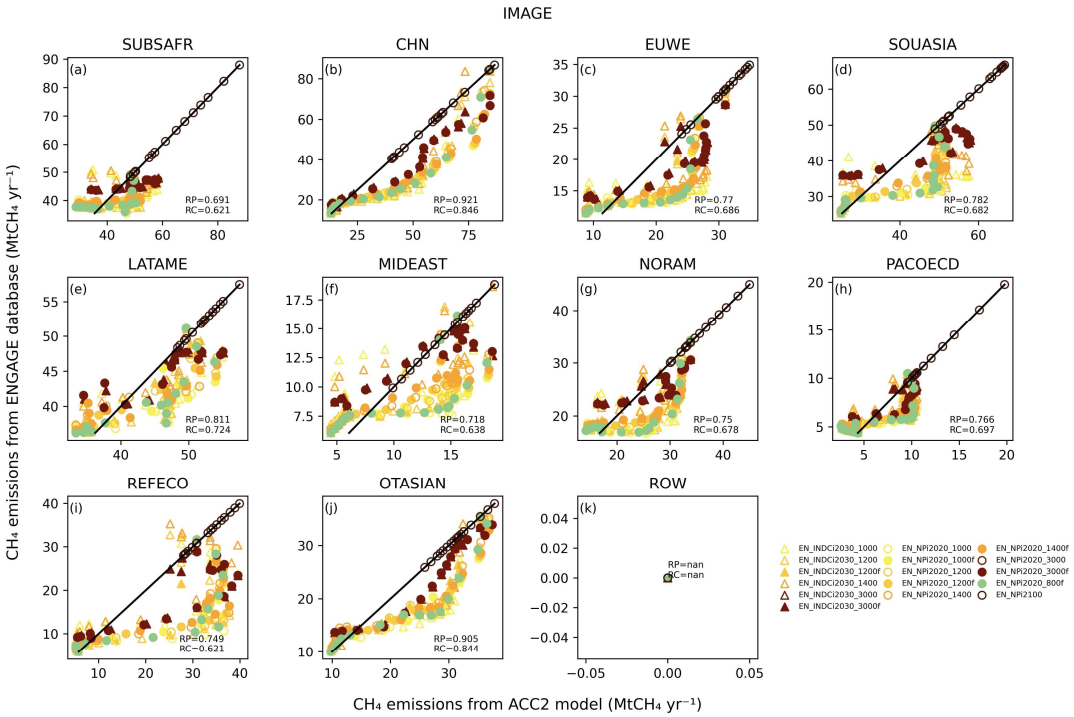

Figure S161. Test 2 - Regional IMAGE - Reproducibility of total anthropogenic CH_4

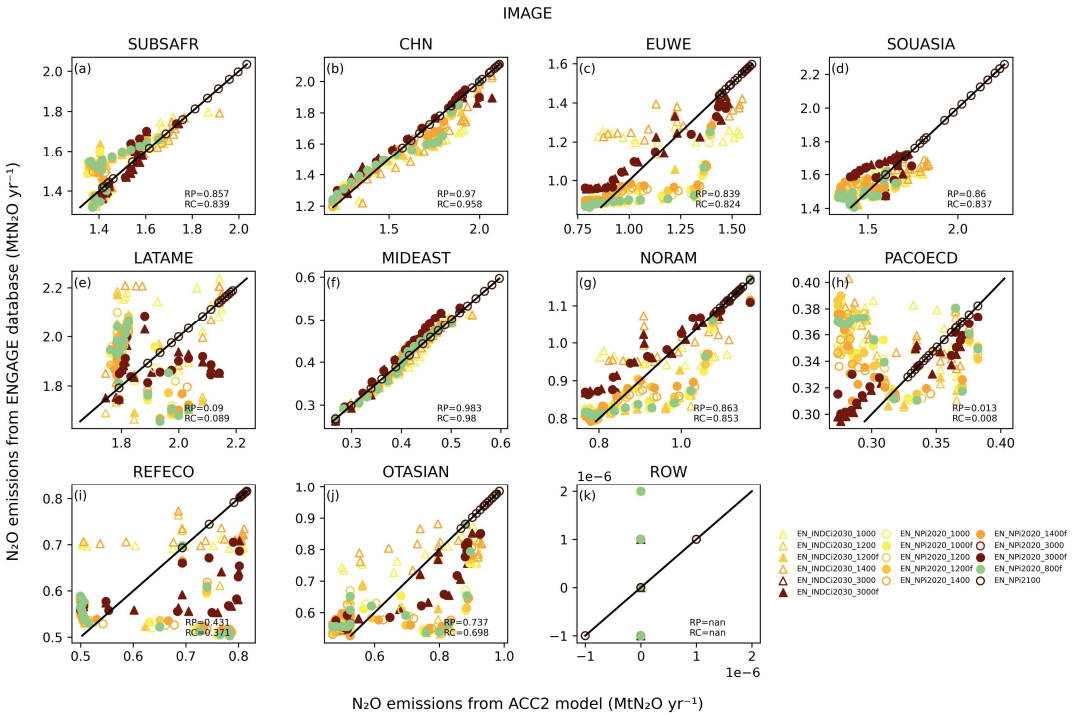

Figure S162. Test 2 - Regional IMAGE - Reproducibility of total anthropogenic N_2O

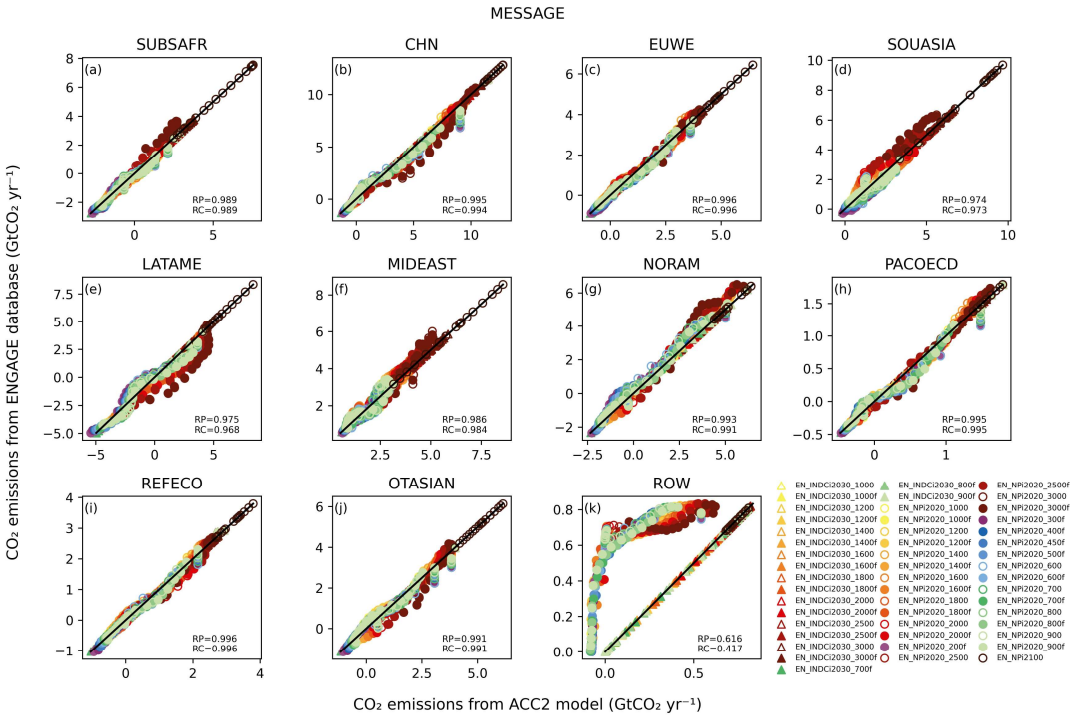

Figure S163. Test 2 - Regional MESSAGE - Reproducibility of CO_2

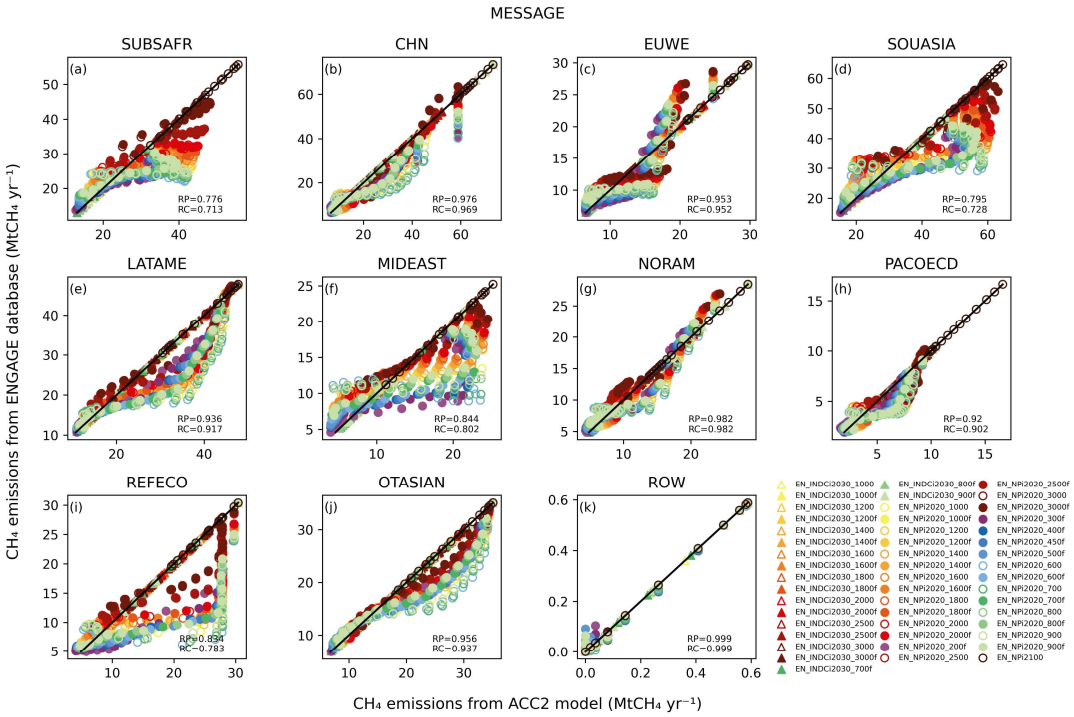

Figure S164. Test 2 - Regional MESSAGE - Reproducibility of total anthropogenic CH_4

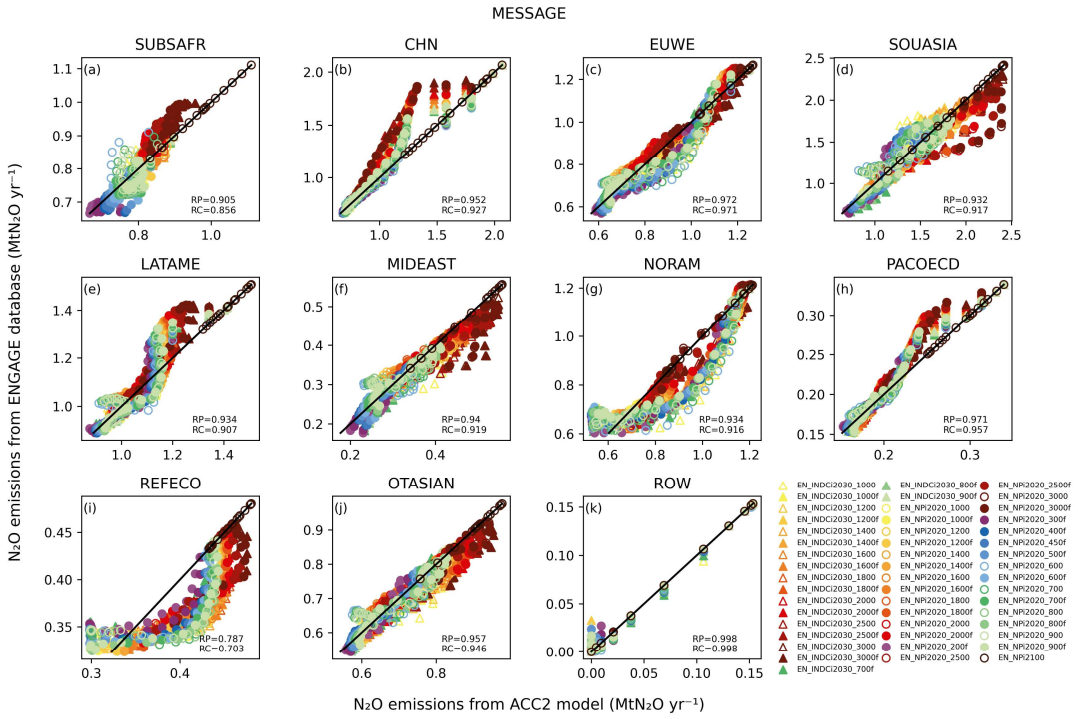

Figure S165. Test 2 - Regional MESSAGE - Reproducibility of total anthropogenic N_2O

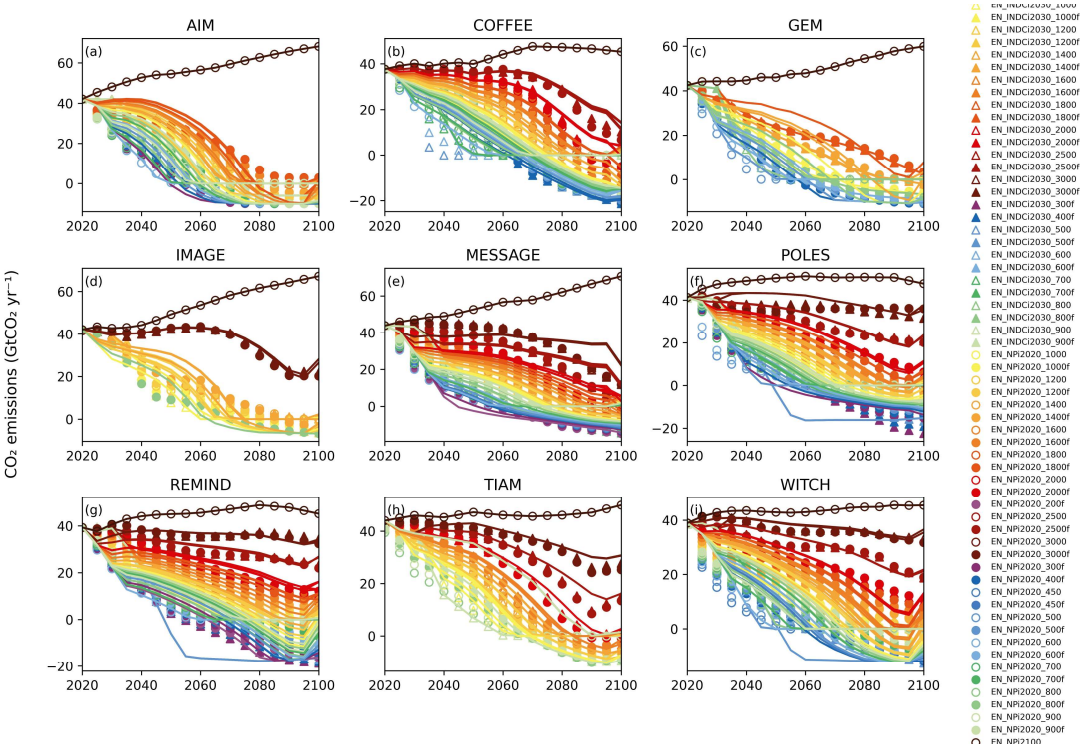

Figure S166. Test 3 – Global 9 models total anthropogenic CO_2 validation result

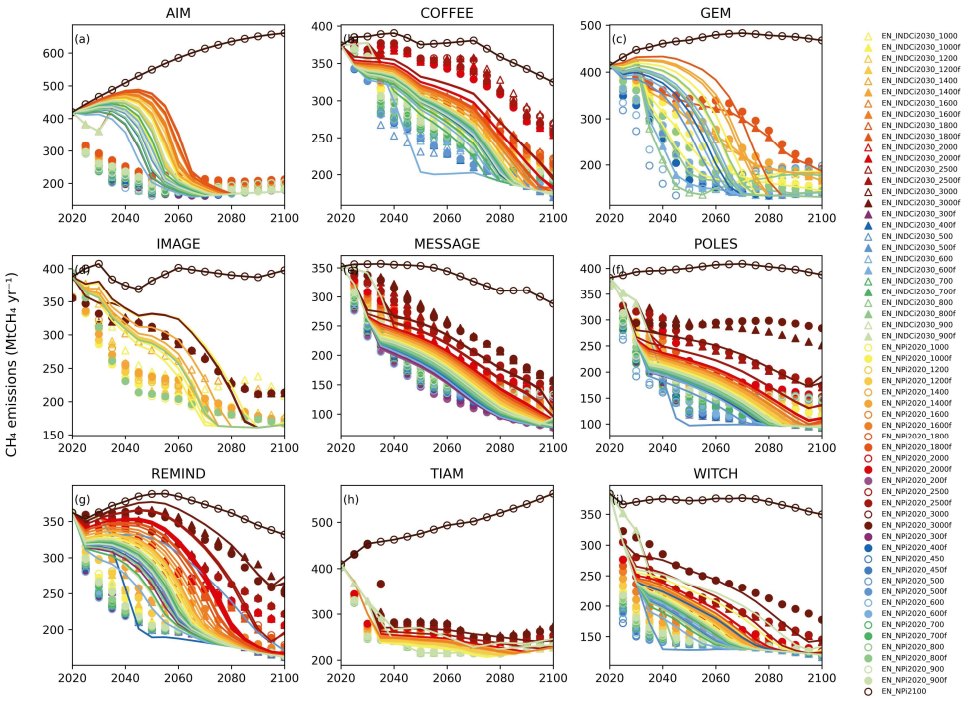

Figure S167. Test 3 – Global 9 models total anthropogenic CH_4 validation result

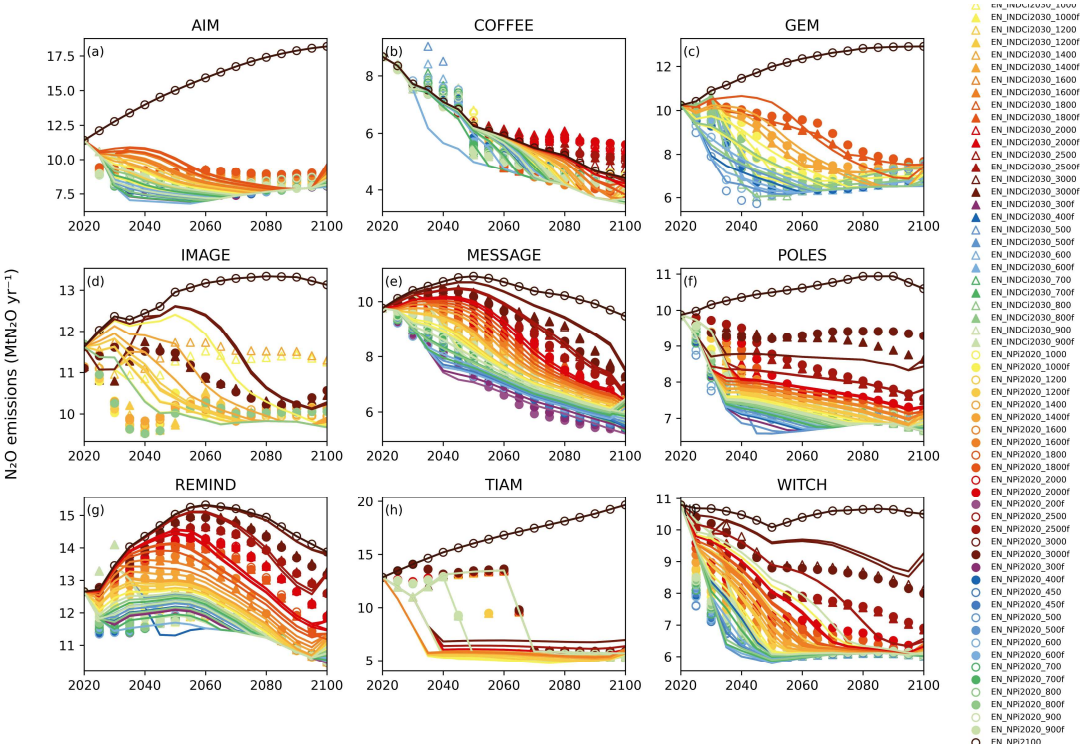

Figure S168. Test 3 – Global 9 models total anthropogenic N_2O validation result

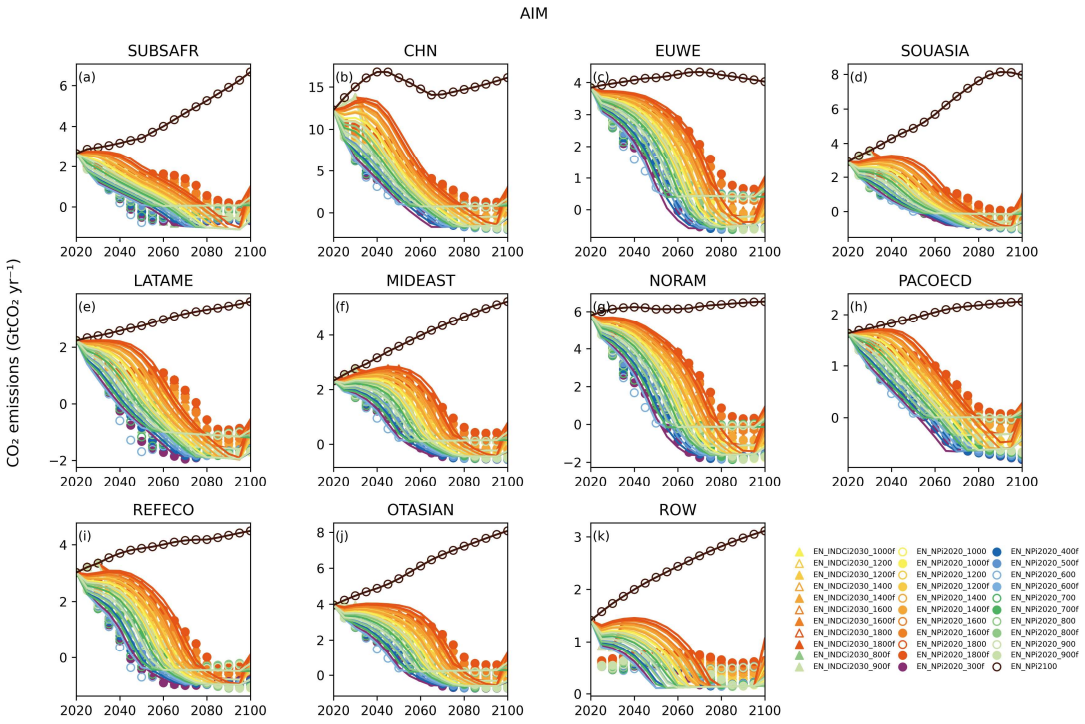

Figure S169. Test 3 - Regional AIM total anthropogenic CO_2 validation result

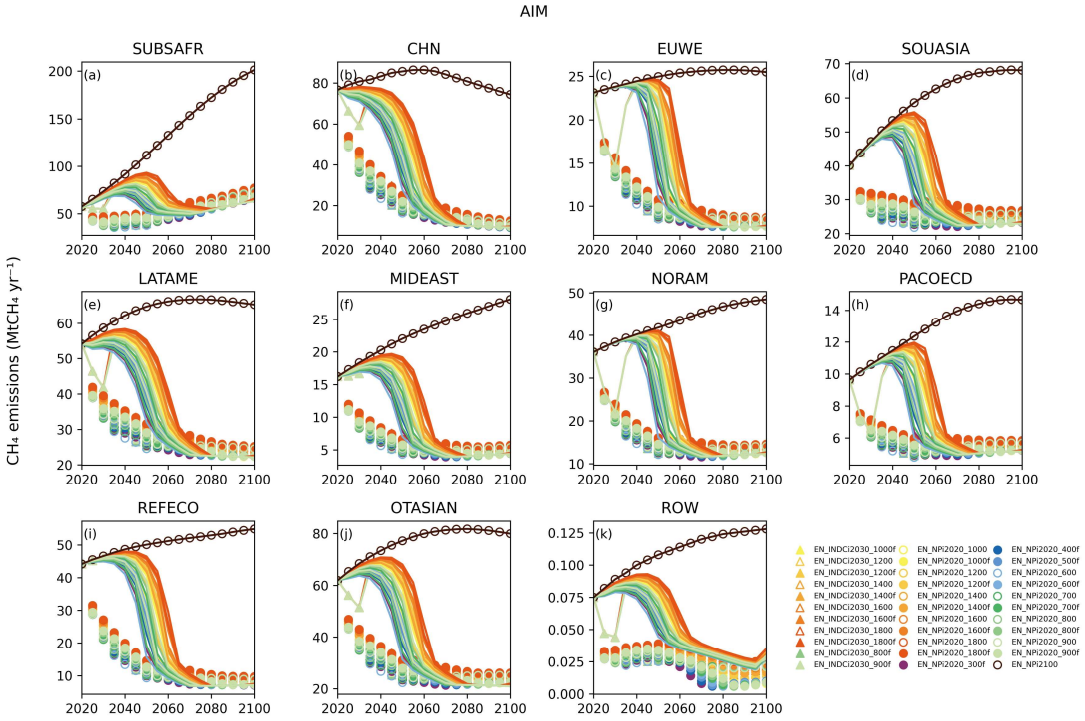

Figure S170. Test 3 - Regional AIM total anthropogenic CH_4 validation result

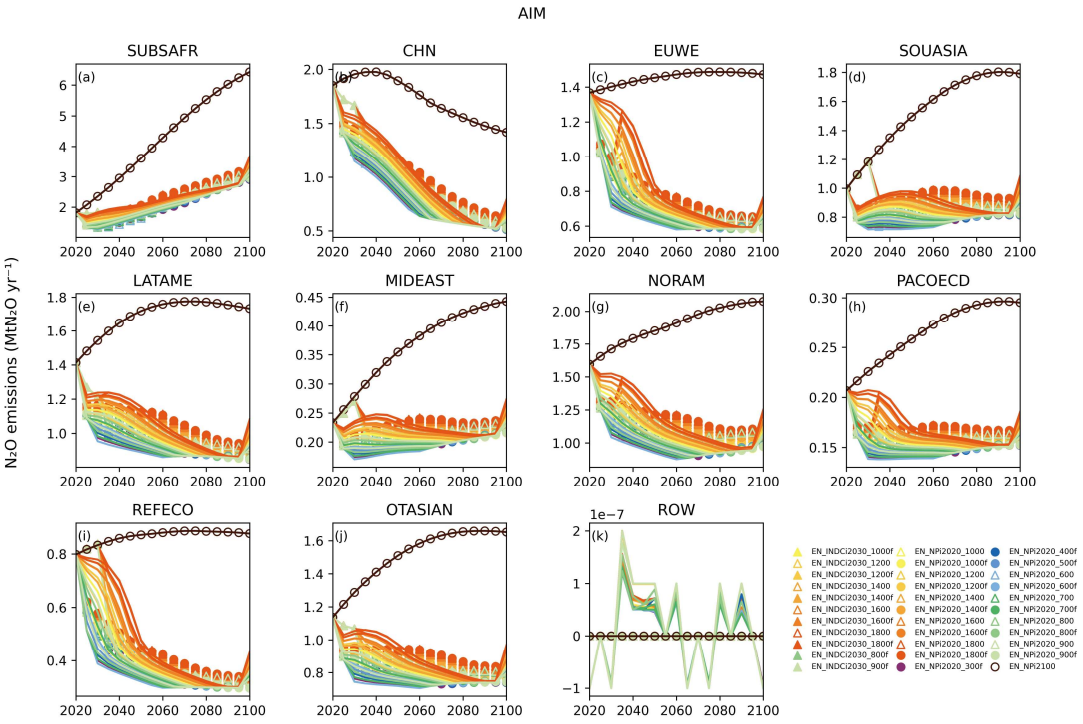

Figure S171. Test 3 - Regional AIM total anthropogenic N_2O validation result

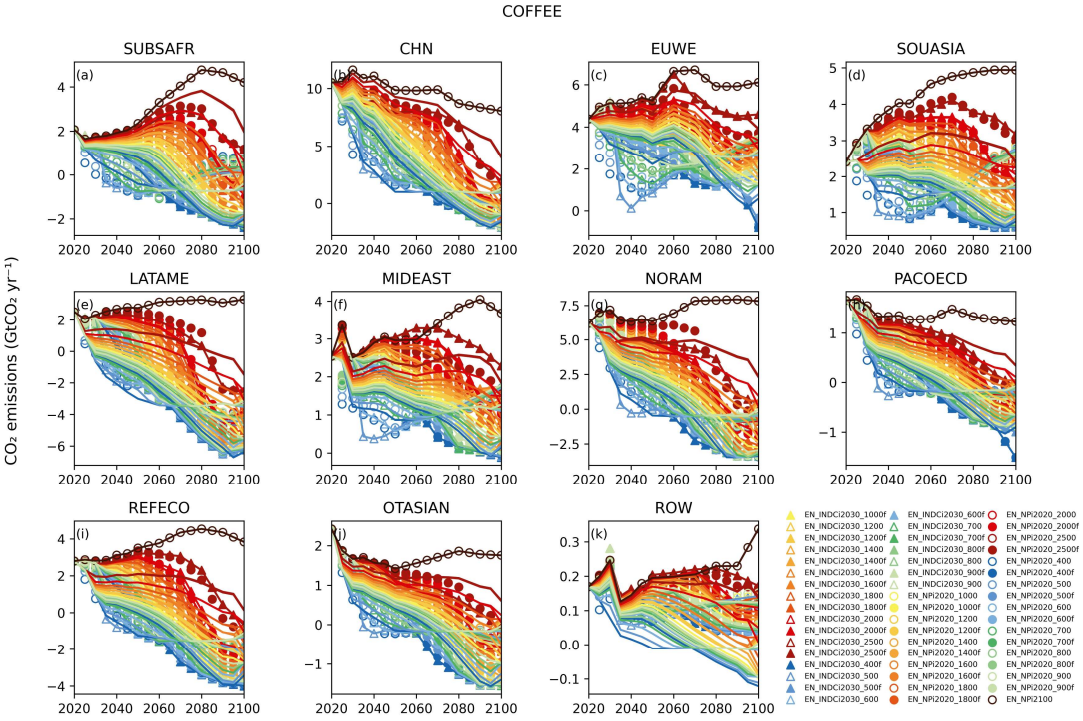

Figure S172. Test 3 - Regional COFFEE total anthropogenic CO_2 validation result

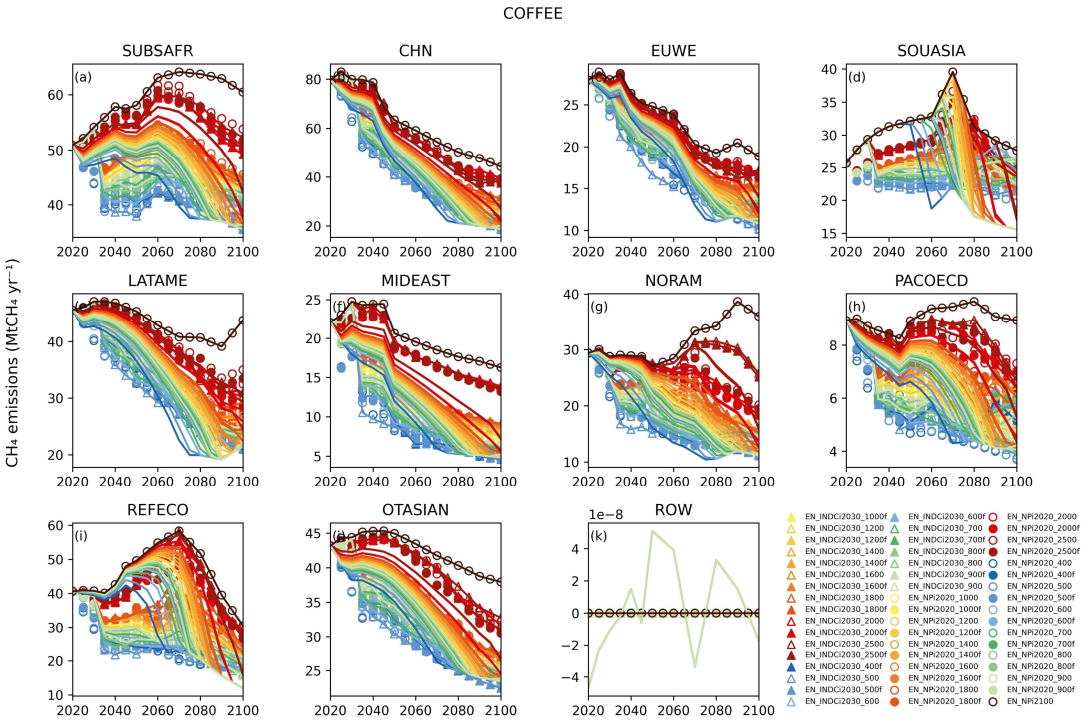

Figure S173. Test 3 - Regional COFFEE total anthropogenic CH_4 validation result

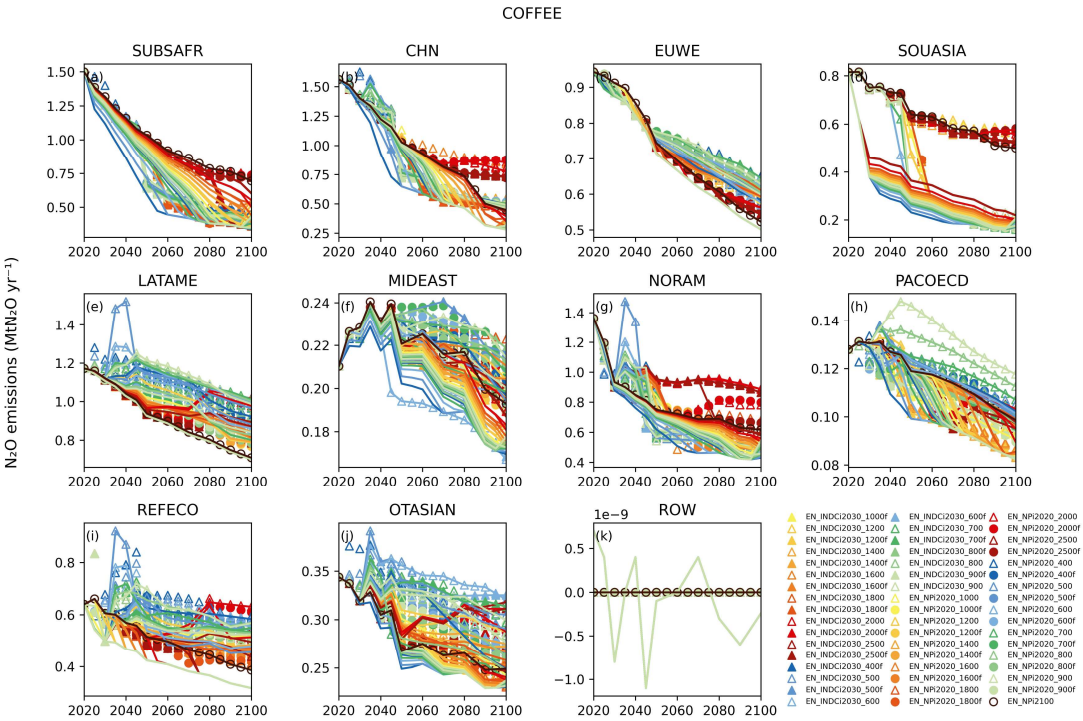

Figure S174. Test 3 - Regional COFFEE total anthropogenic N_2O validation result

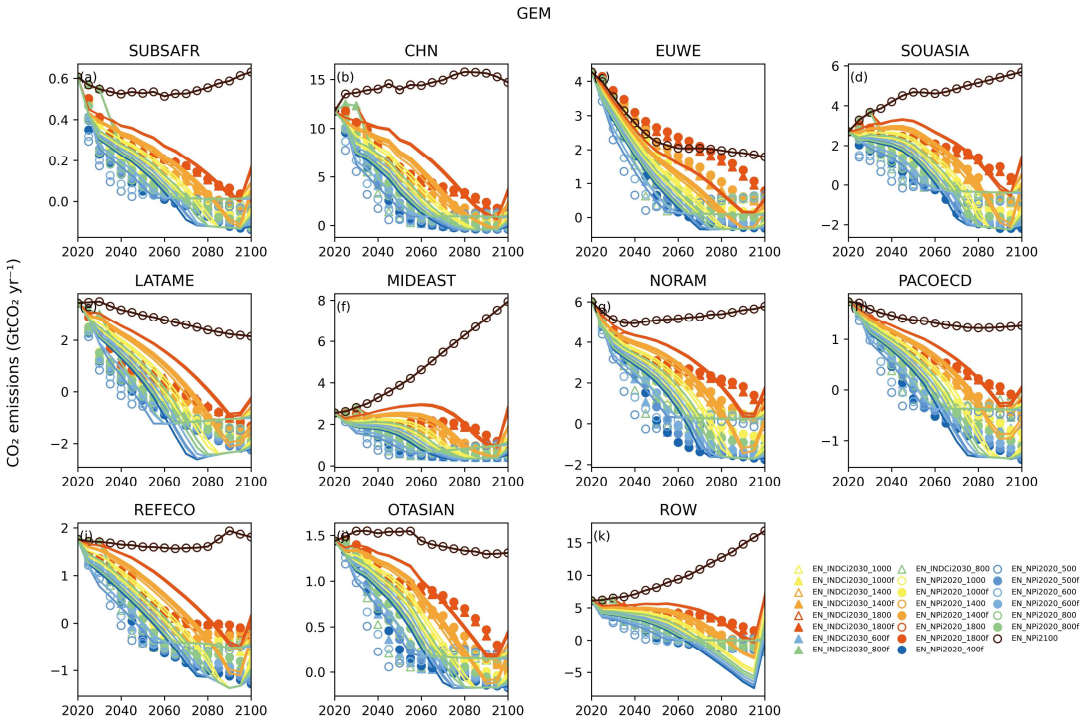

Figure S175. Test 3 - Regional GEM total anthropogenic CO_2 validation result

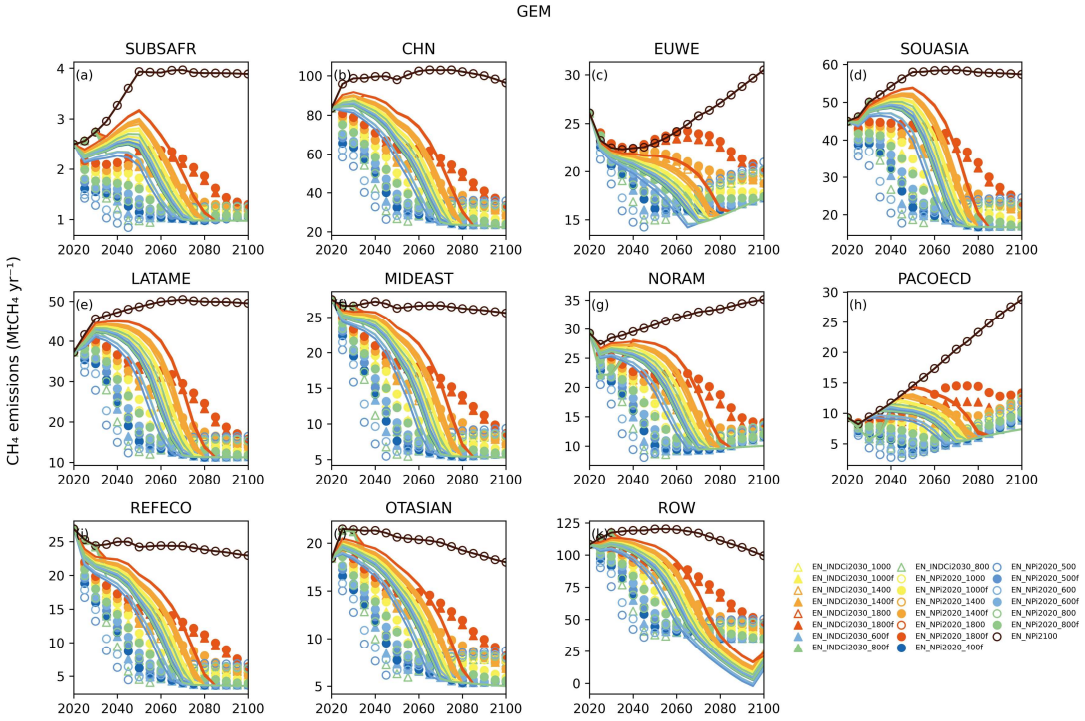

Figure S176. Test 3 - Regional GEM total anthropogenic CH_4 validation result

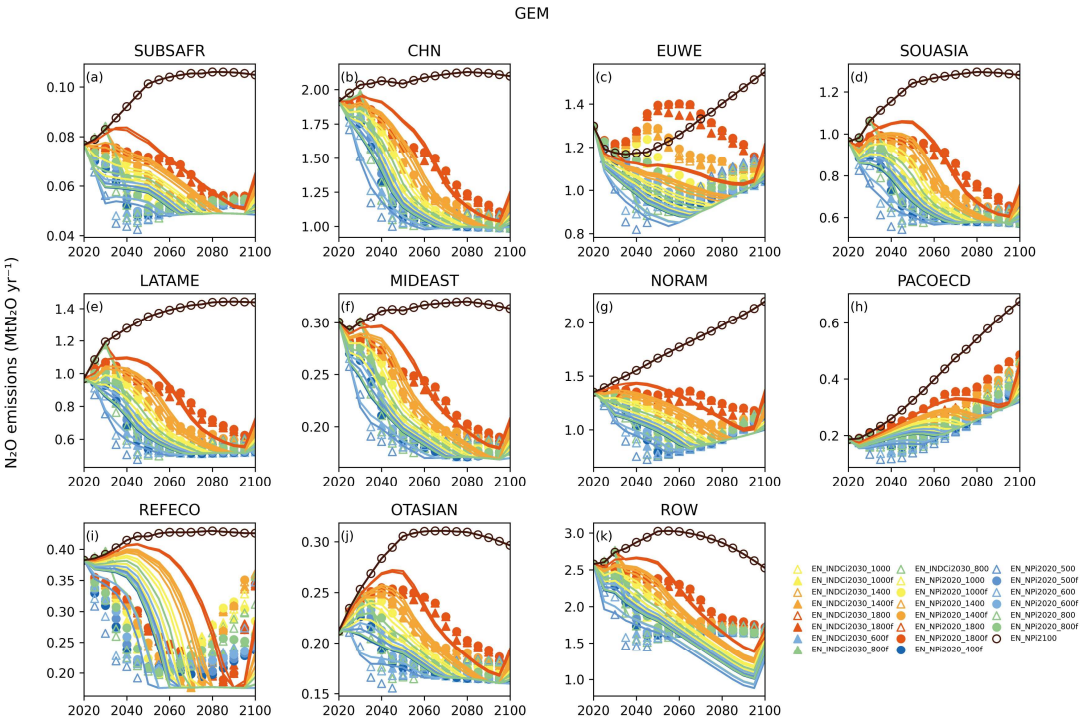

Figure S177. Test 3 - Regional GEM total anthropogenic N_2O validation result

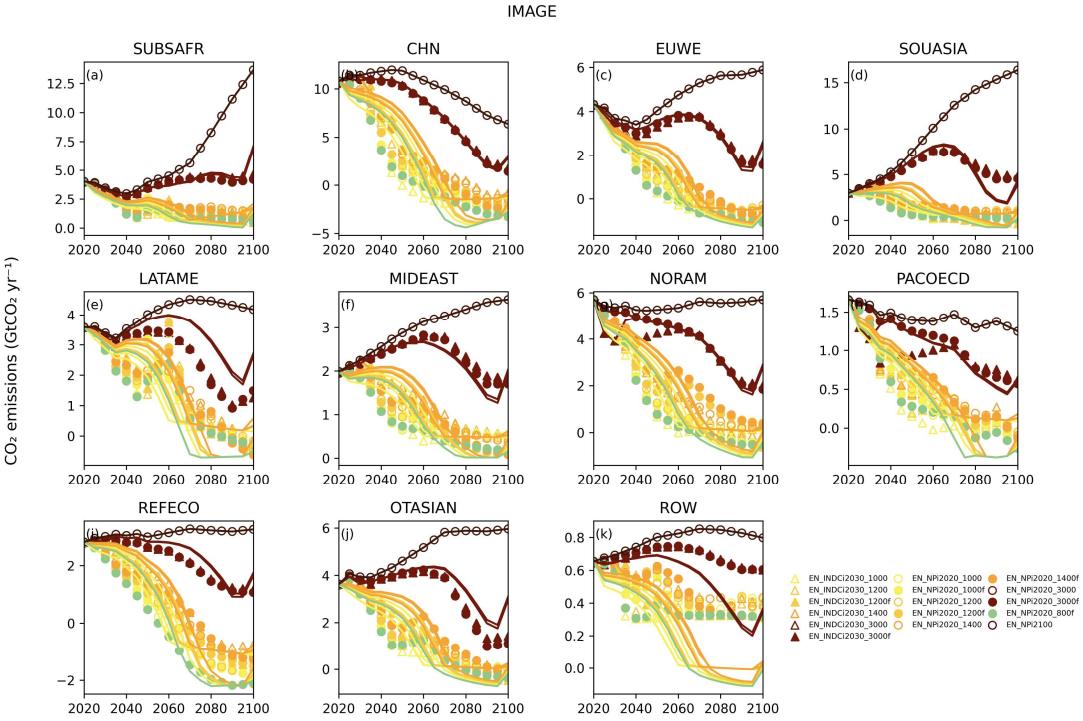

Figure S178. Test 3 - Regional IMAGE total anthropogenic CO_2 validation result

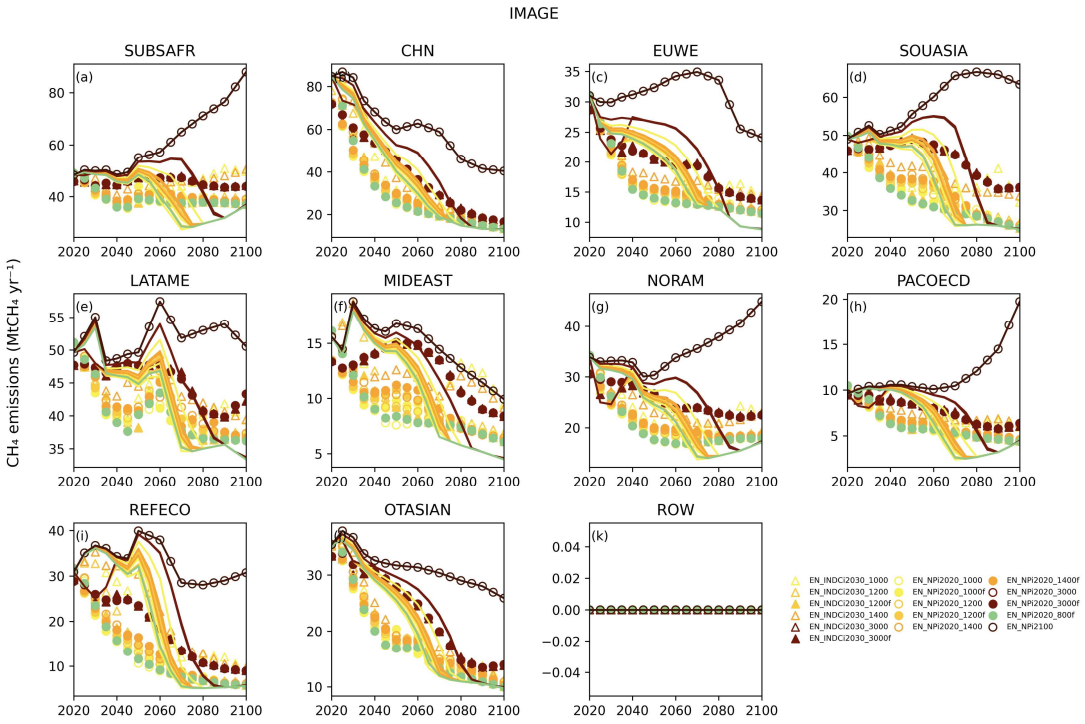

Figure S179. Test 3 - Regional IMAGE total anthropogenic CH_4 validation result

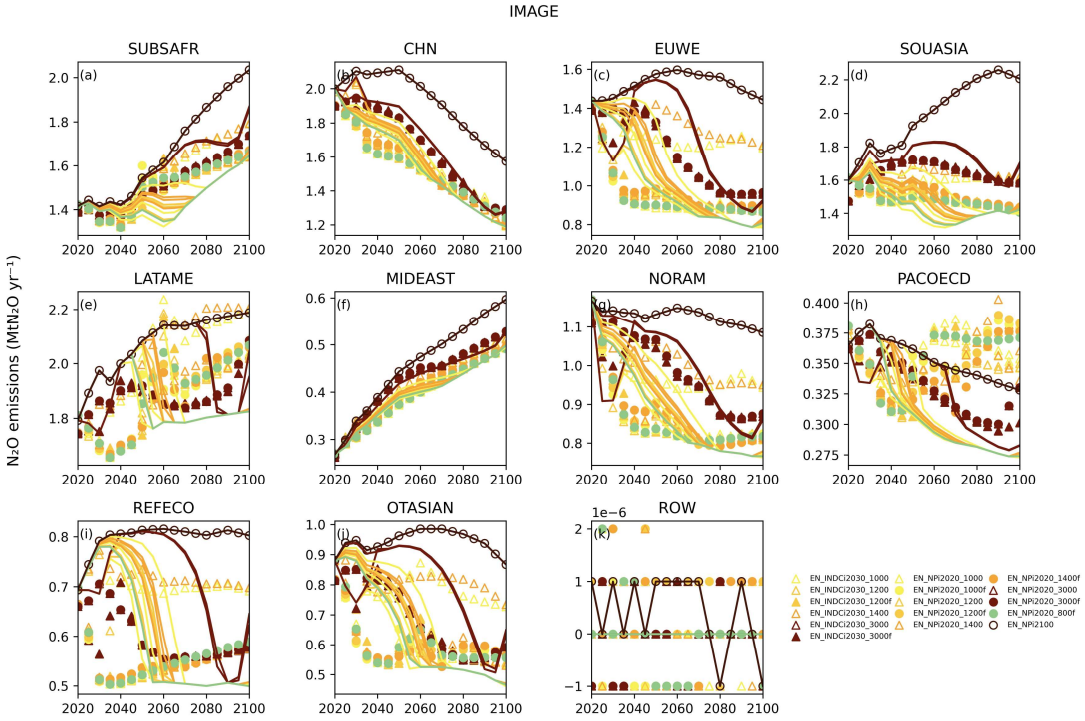

Figure S180. Test 3 - Regional IMAGE total anthropogenic N_2O validation result

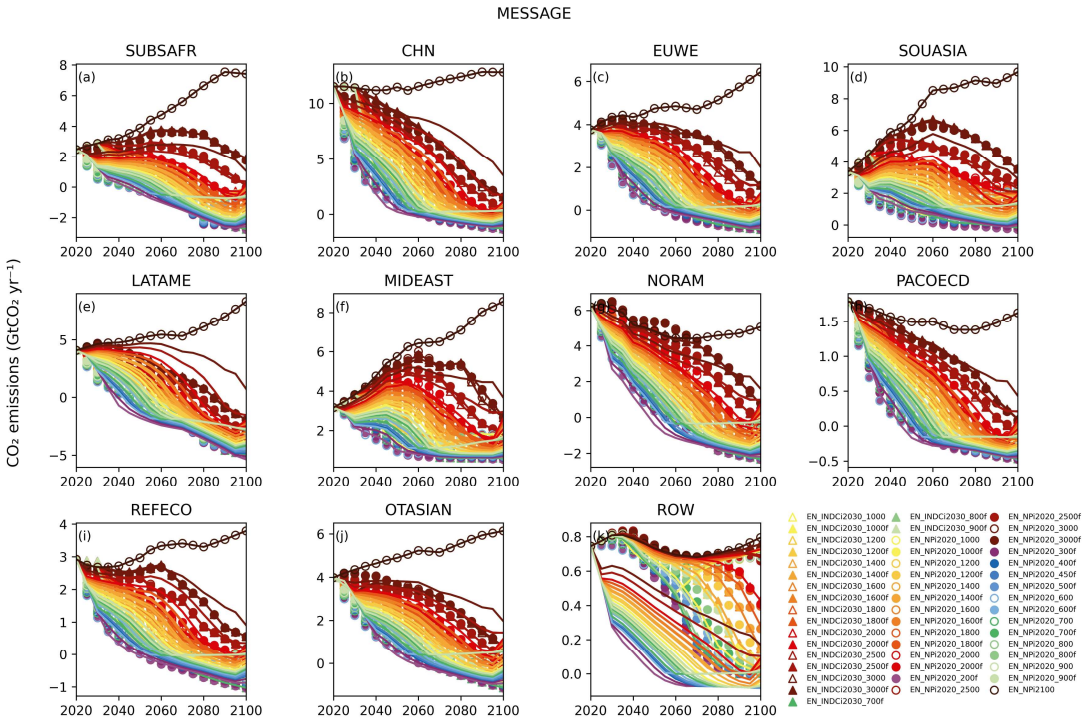

Figure S181. Test 3 - Regional MESSAGE total anthropogenic CO_2 validation result

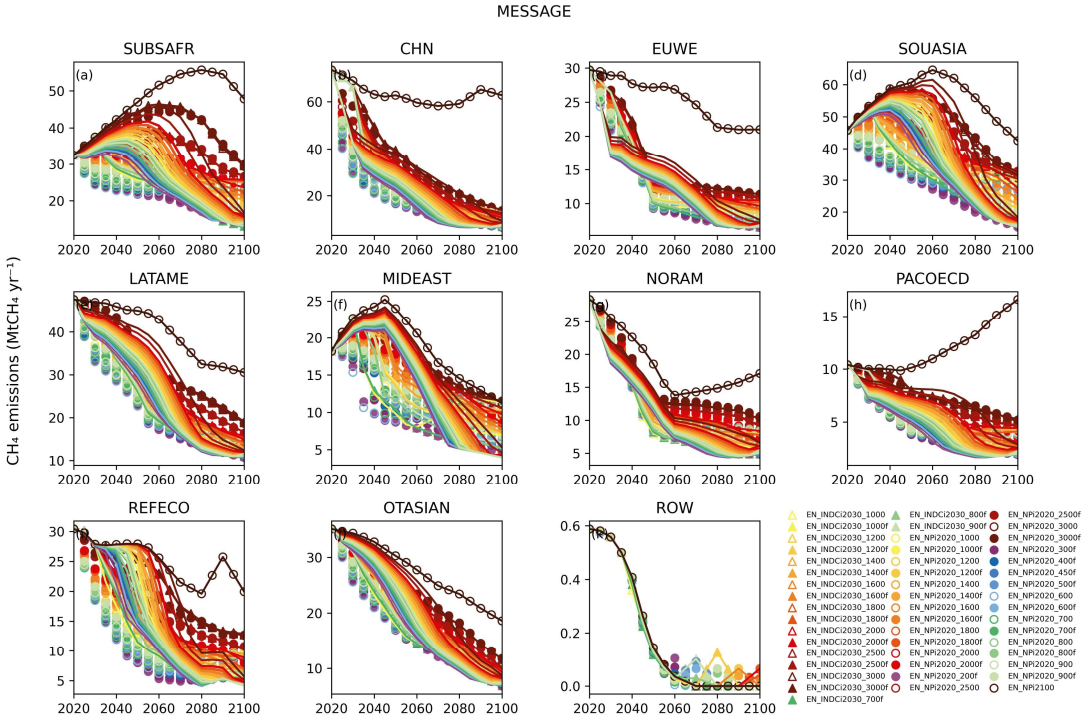

Figure S182. Test 3 - Regional MESSAGE total anthropogenic CH_4 validation result

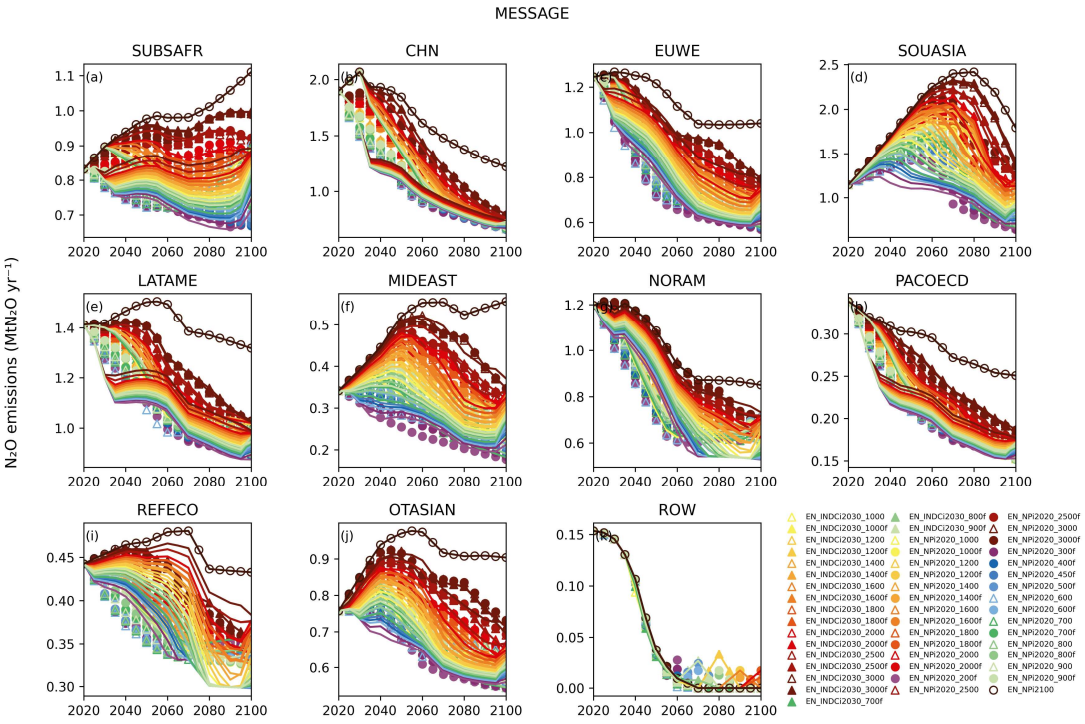

Figure S183. Test 3 - Regional MESSAGE total anthropogenic N_2O validation result

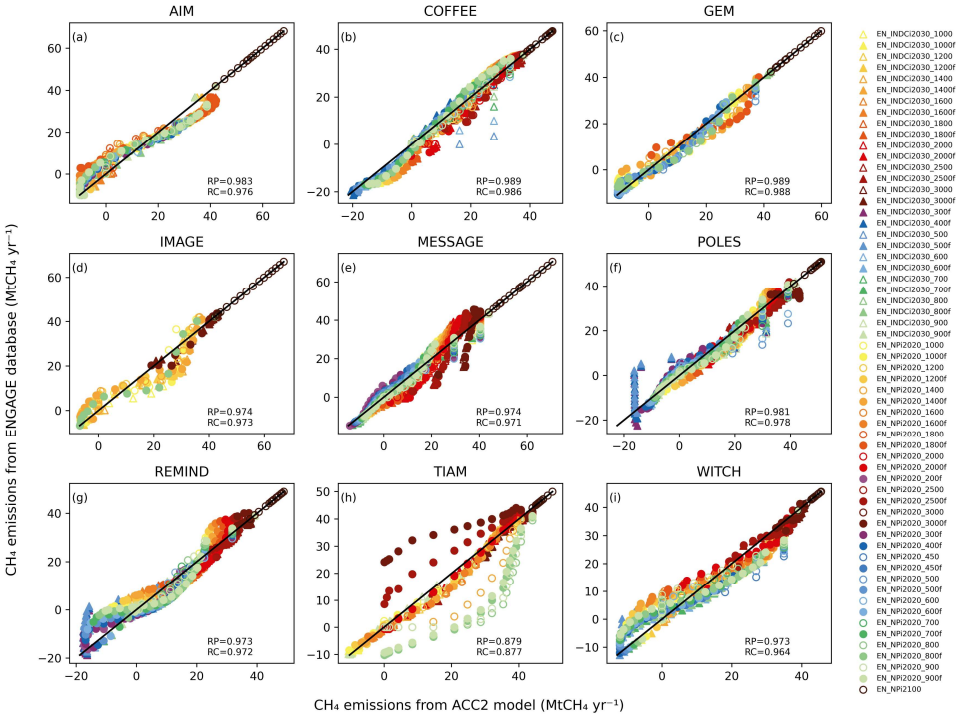

Figure S184. Test 3 - Global 9 models - Reproducibility of total anthropogenic CO_2

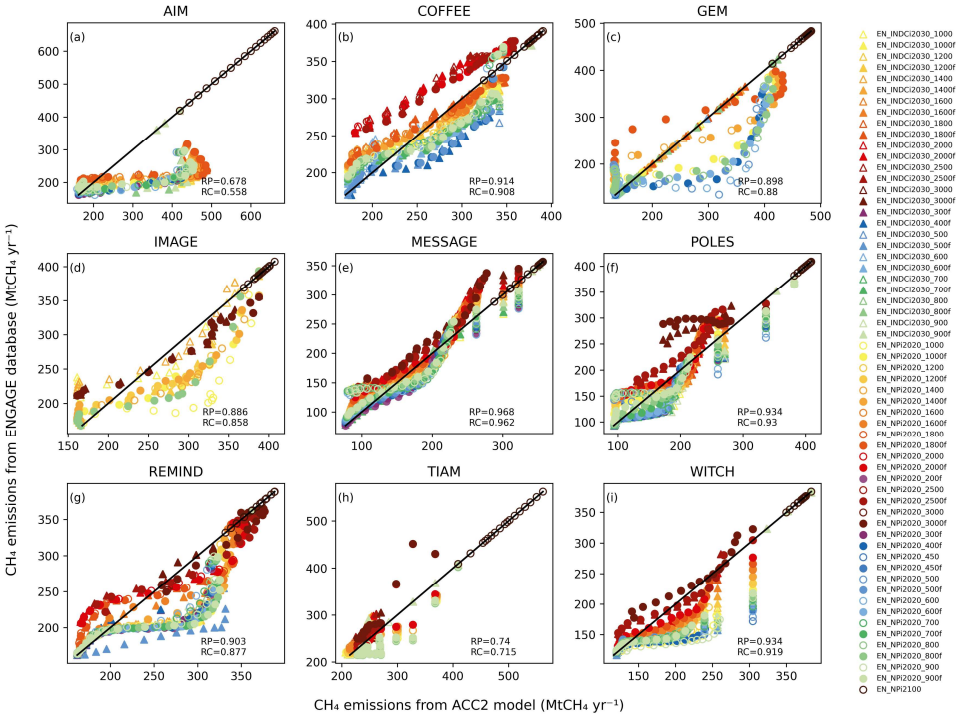

Figure S185. Test 3 - Global 9 models - Reproducibility of total anthropogenic CH_4

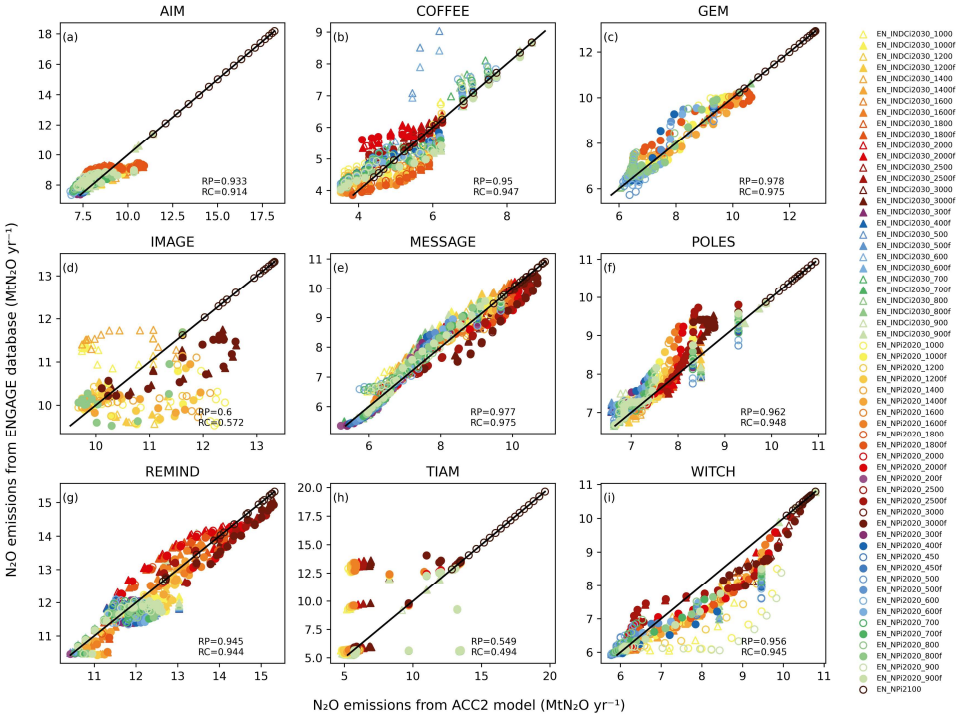

Figure S186. Test 3 - Global 9 models - Reproducibility of total anthropogenic N_2O

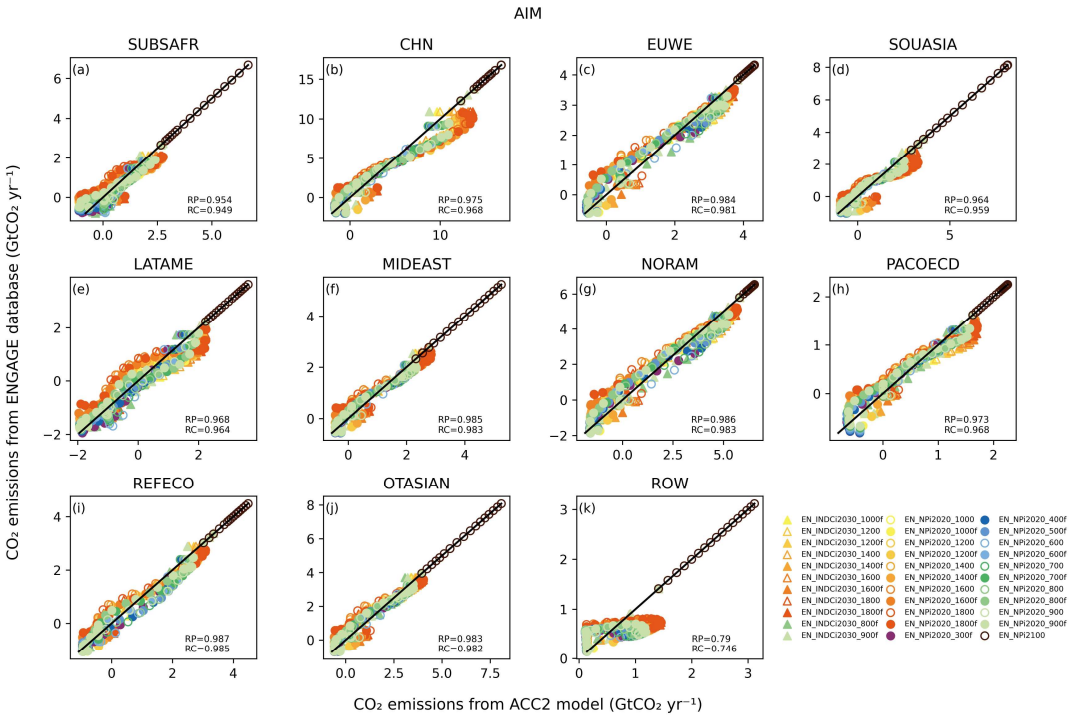

Figure S187. Test 3 - Regional AIM - Reproducibility of total anthropogenic CO_2

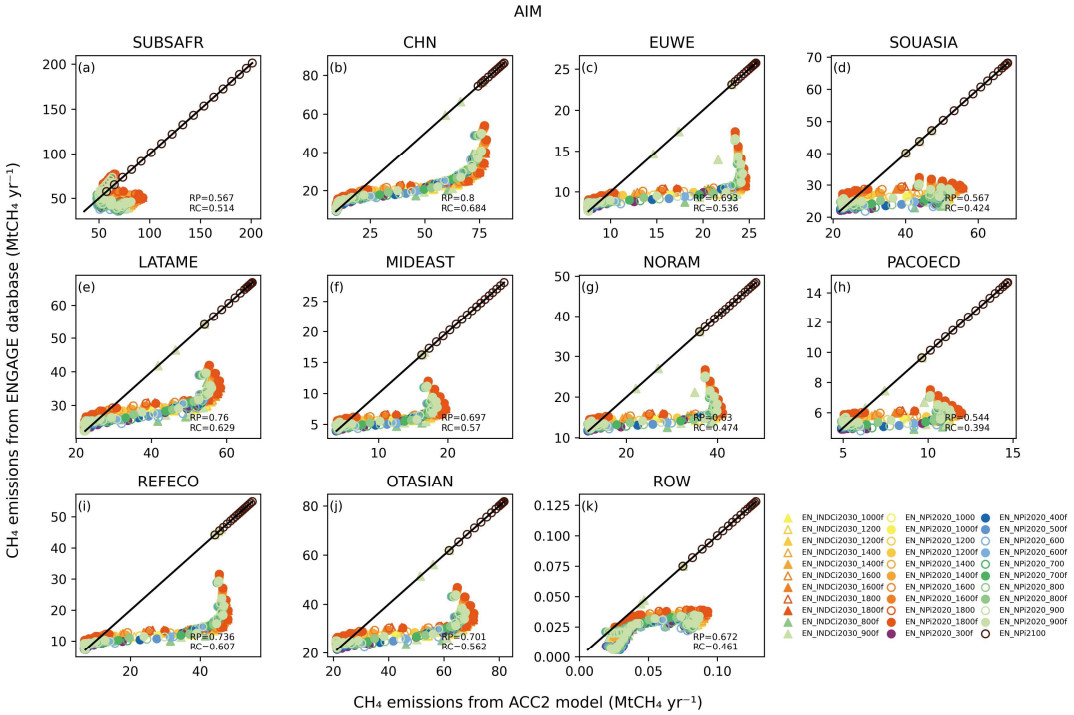

Figure S188. Test 3 - Regional AIM - Reproducibility of total anthropogenic CH_4

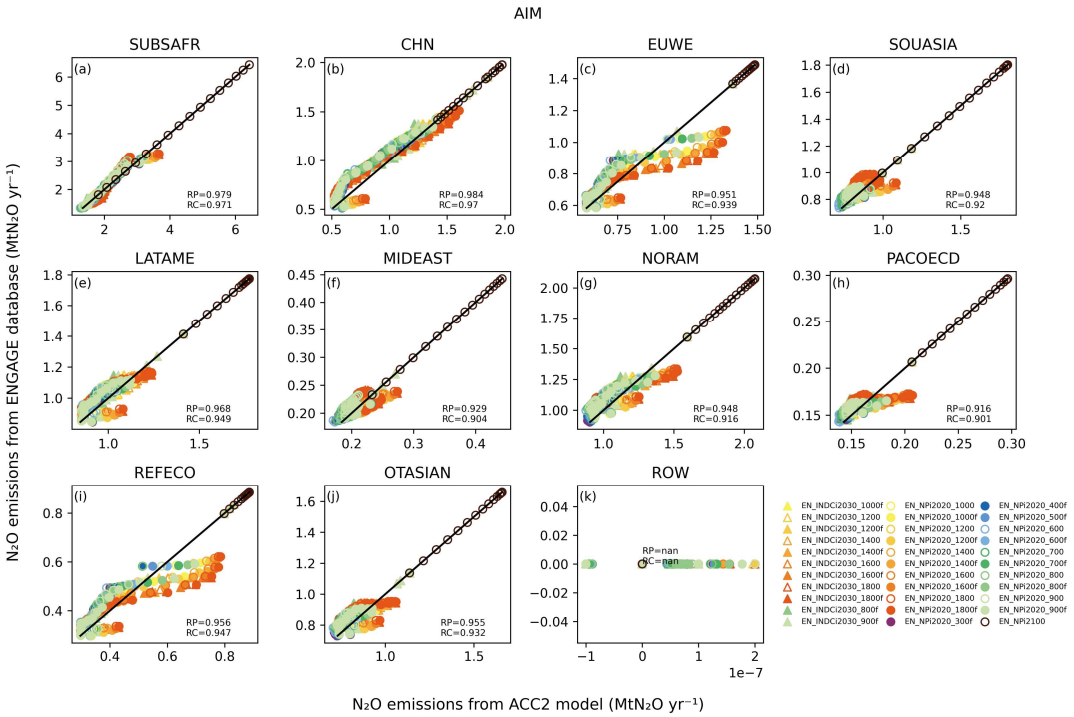

Figure S189. Test 3 - Regional AIM - Reproducibility of total anthropogenic N_2O

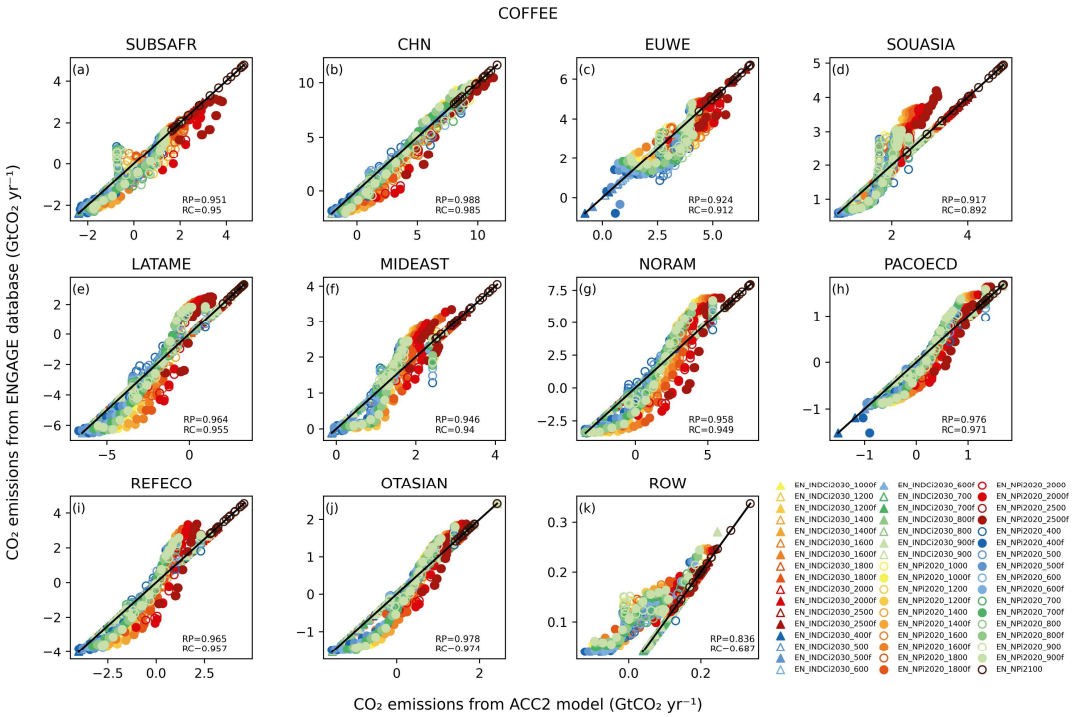

Figure S190. Test 3 - Regional COFFEE - Reproducibility of total anthropogenic CO_2

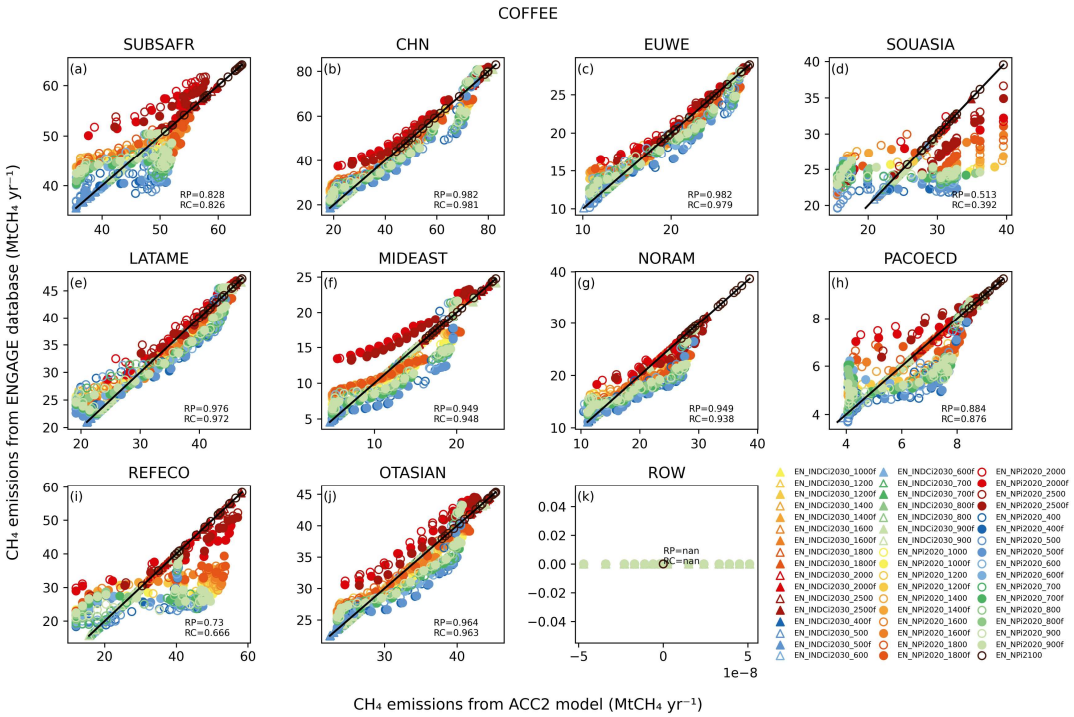

Figure S191. Test 3 - Regional COFFEE - Reproducibility of total anthropogenic CH_4

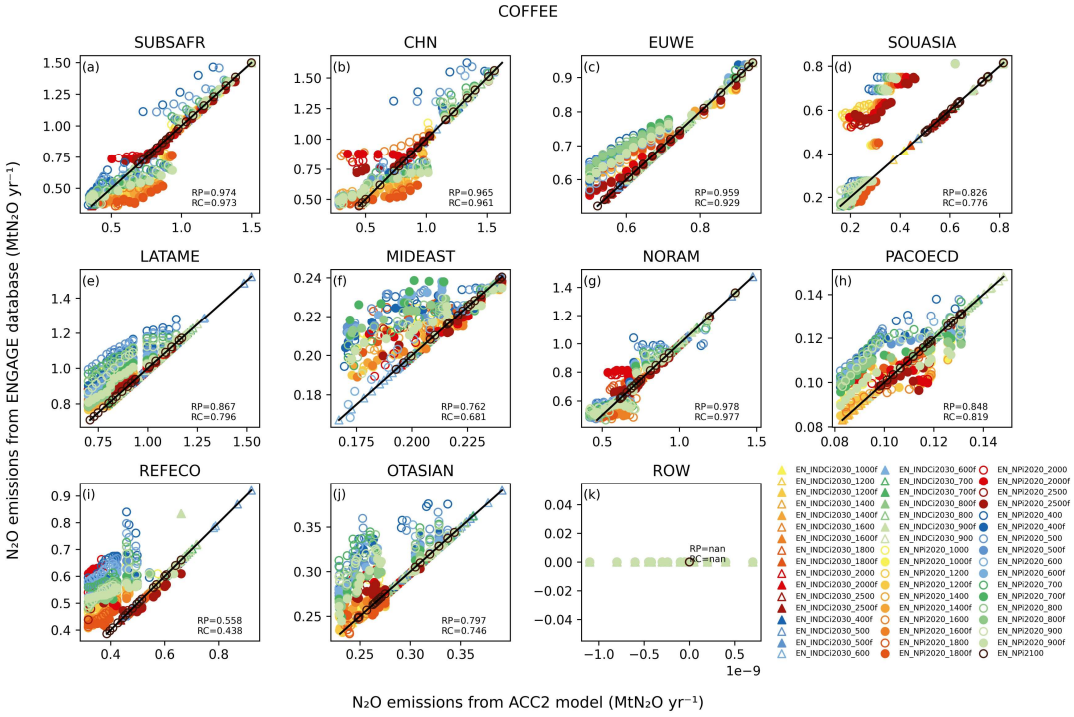

Figure S192. Test 3 - Regional COFFEE - Reproducibility of total anthropogenic N_2O

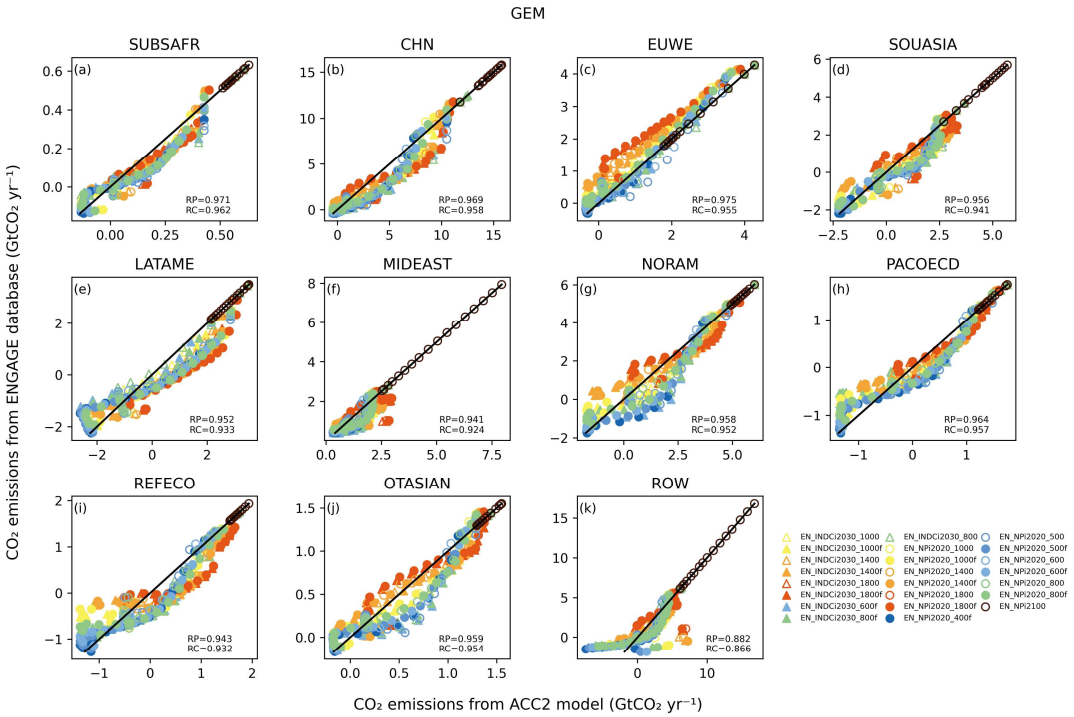

Figure S193. Test 3 - Regional GEM - Reproducibility of total anthropogenic CO_2

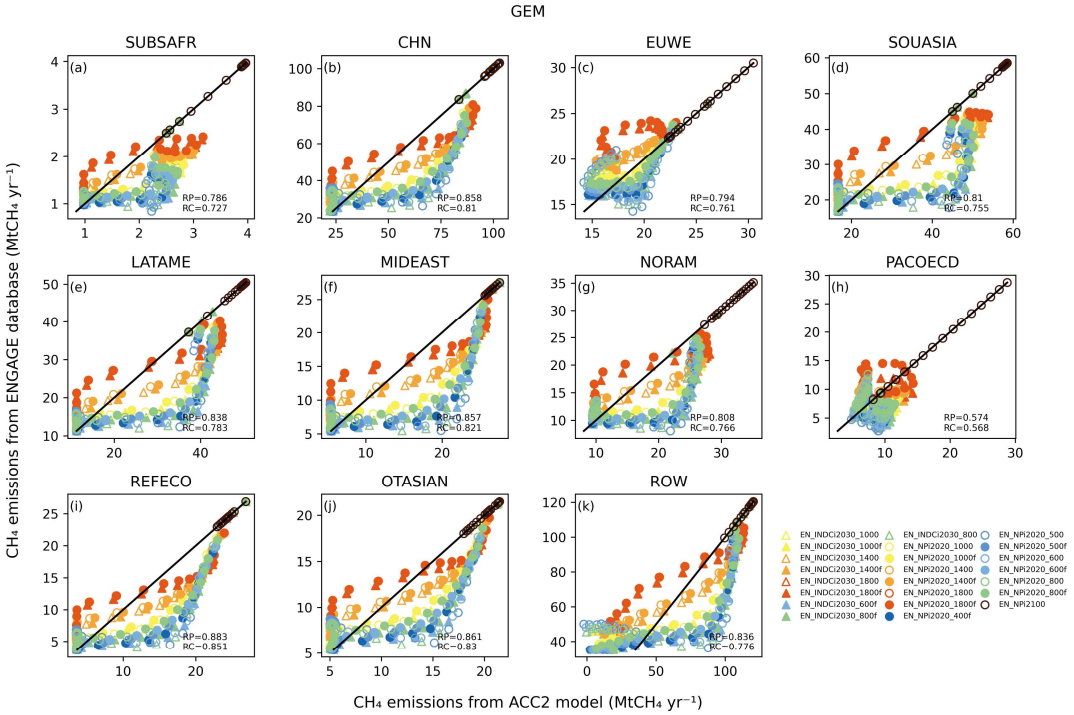

Figure S194. Test 3 - Regional GEM - Reproducibility of total anthropogenic CH_4

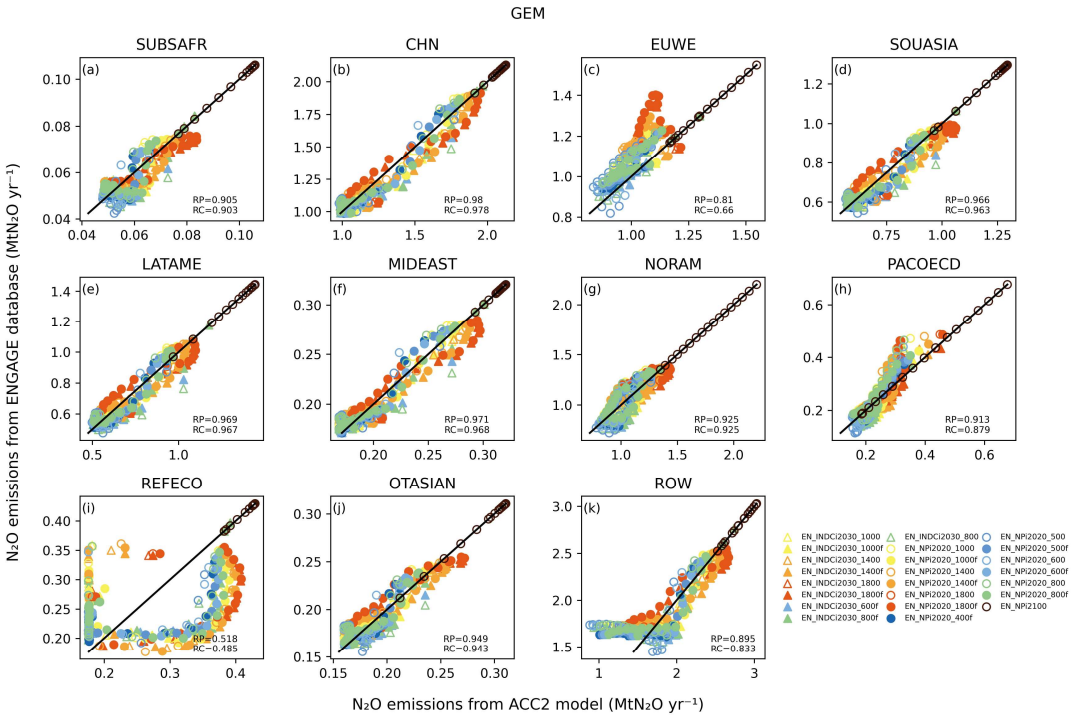

Figure S195. Test 3 - Regional GEM - Reproducibility of total anthropogenic N_2O

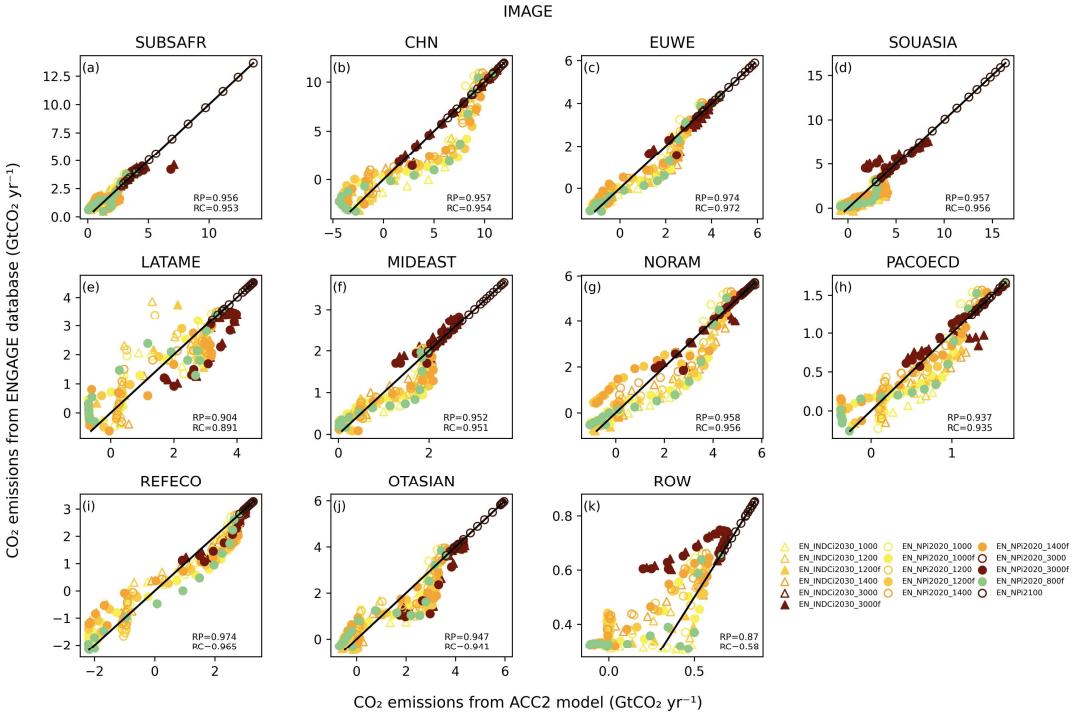

Figure S196. Test 3 - Regional IMAGE - Reproducibility of total anthropogenic CO_2

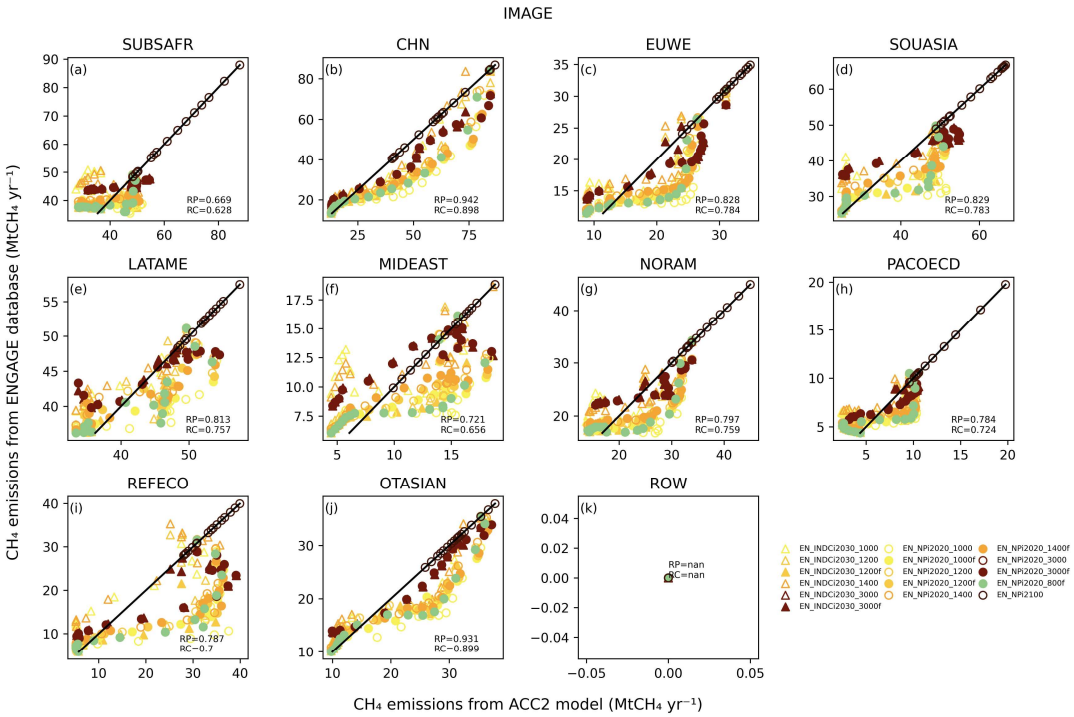

Figure S197. Test 3 - Regional IMAGE - Reproducibility of total anthropogenic CH_4

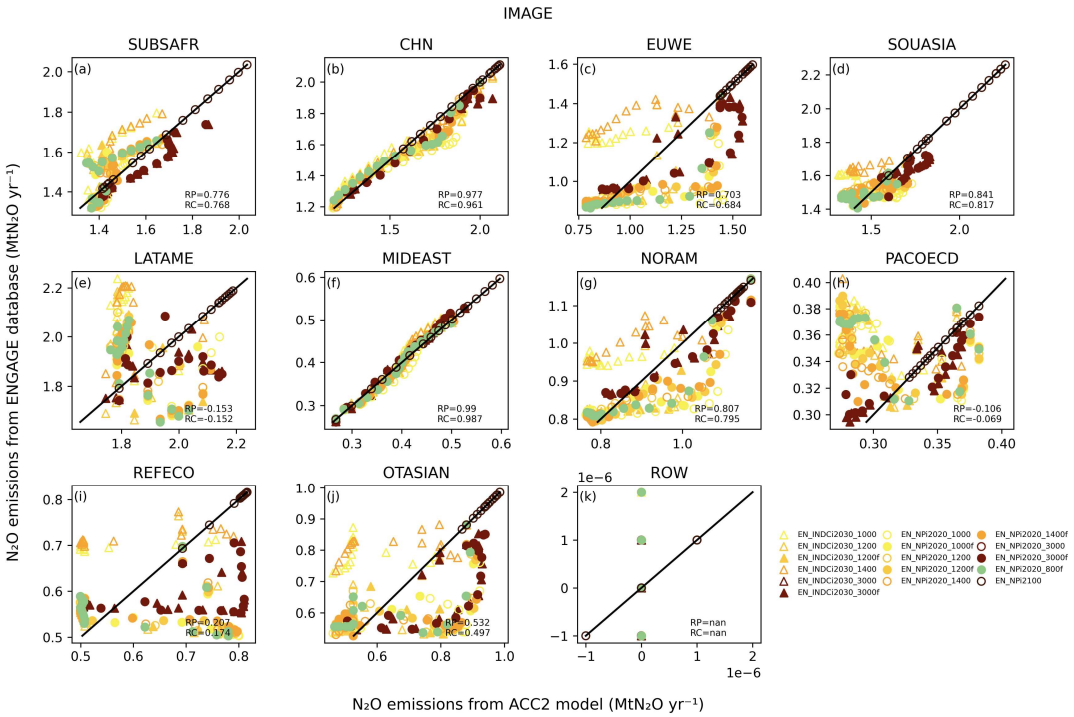

Figure S198. Test 3 - Regional IMAGE - Reproducibility of total anthropogenic N_2O

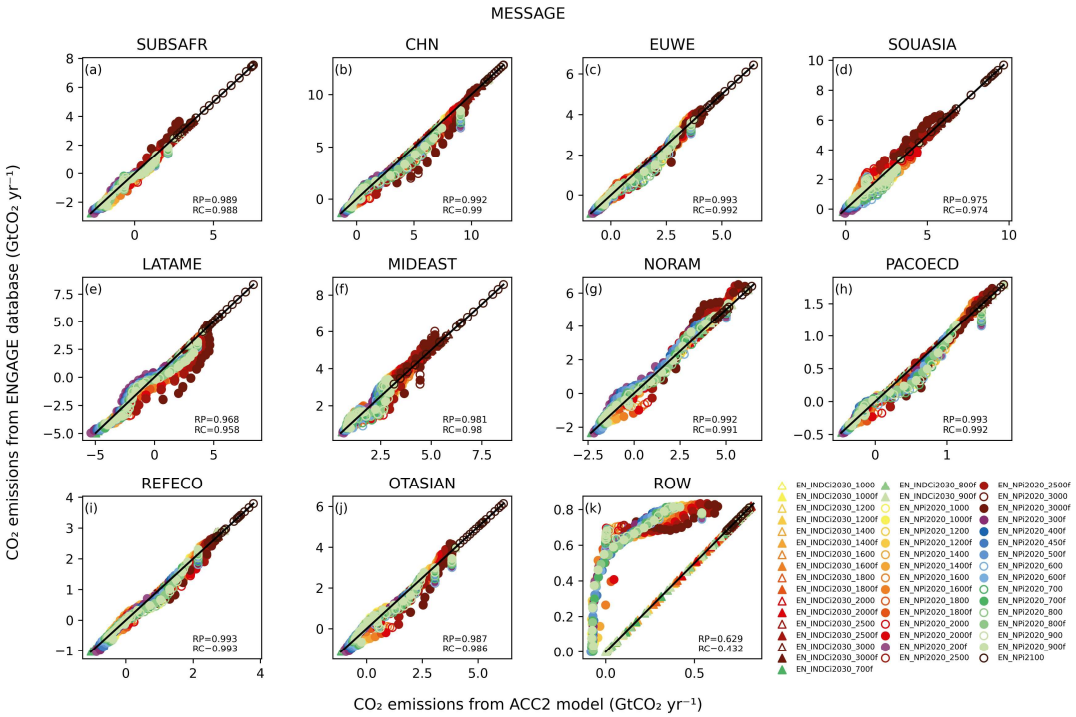

Figure S199. Test 3 - Regional MESSAGE - Reproducibility of total anthropogenic CO_2

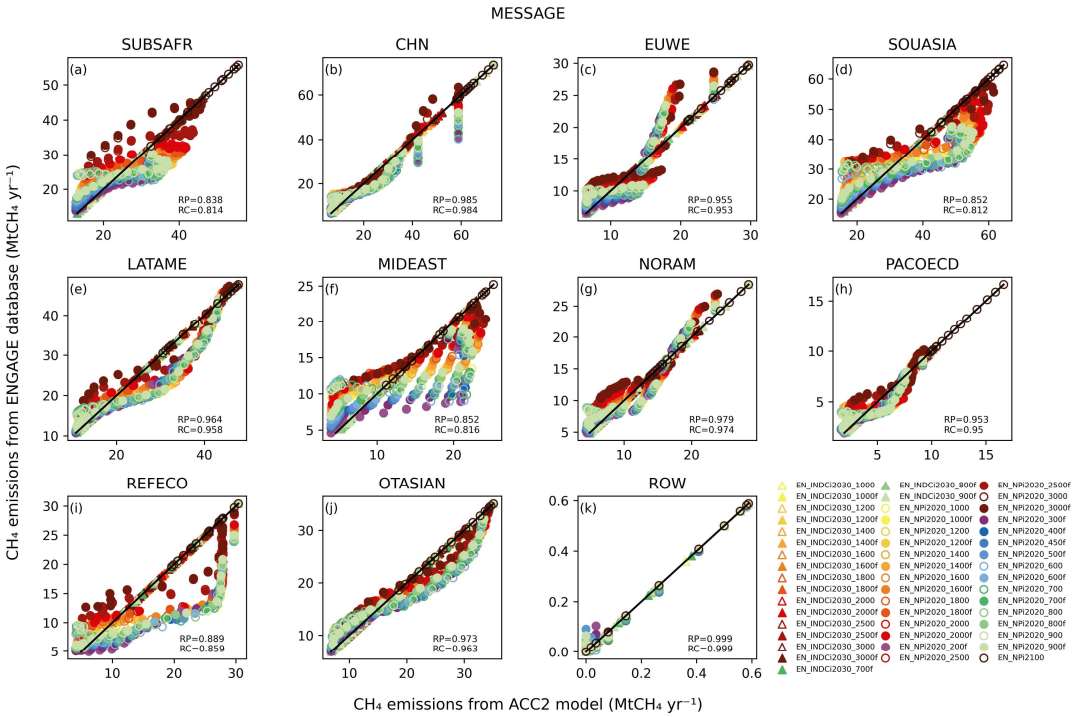

Figure S200. Test 3 - Regional MESSAGE - Reproducibility of total anthropogenic CH_4

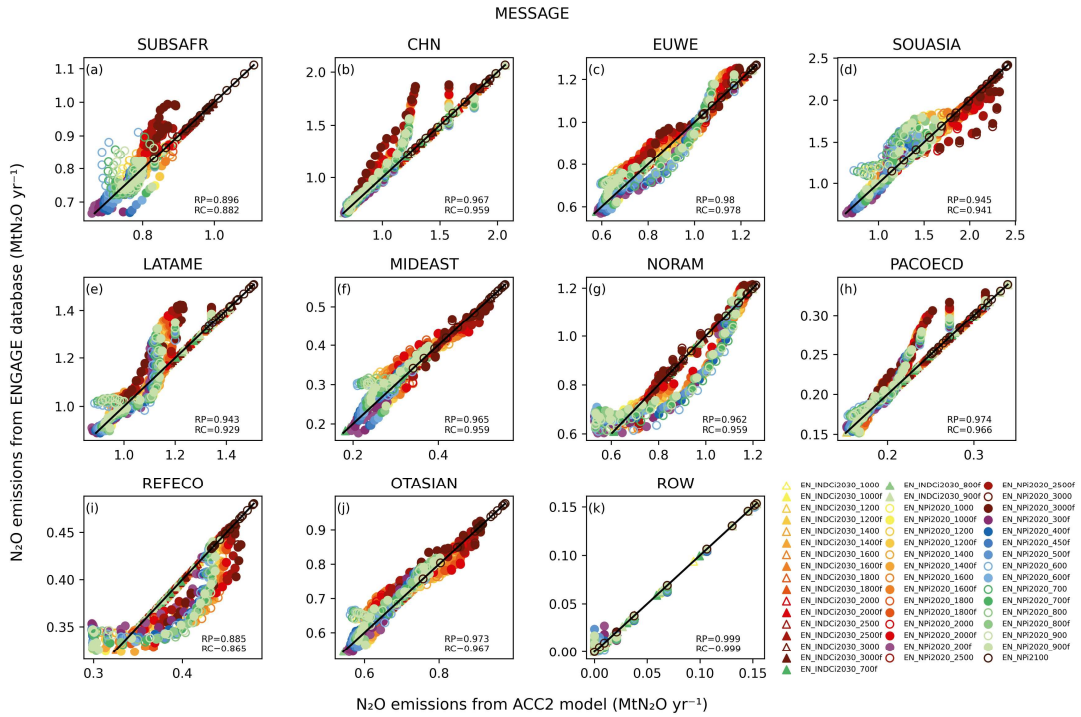

Figure S201. Test 3 - Regional MESSAGE total anthropogenic N_2O validation result

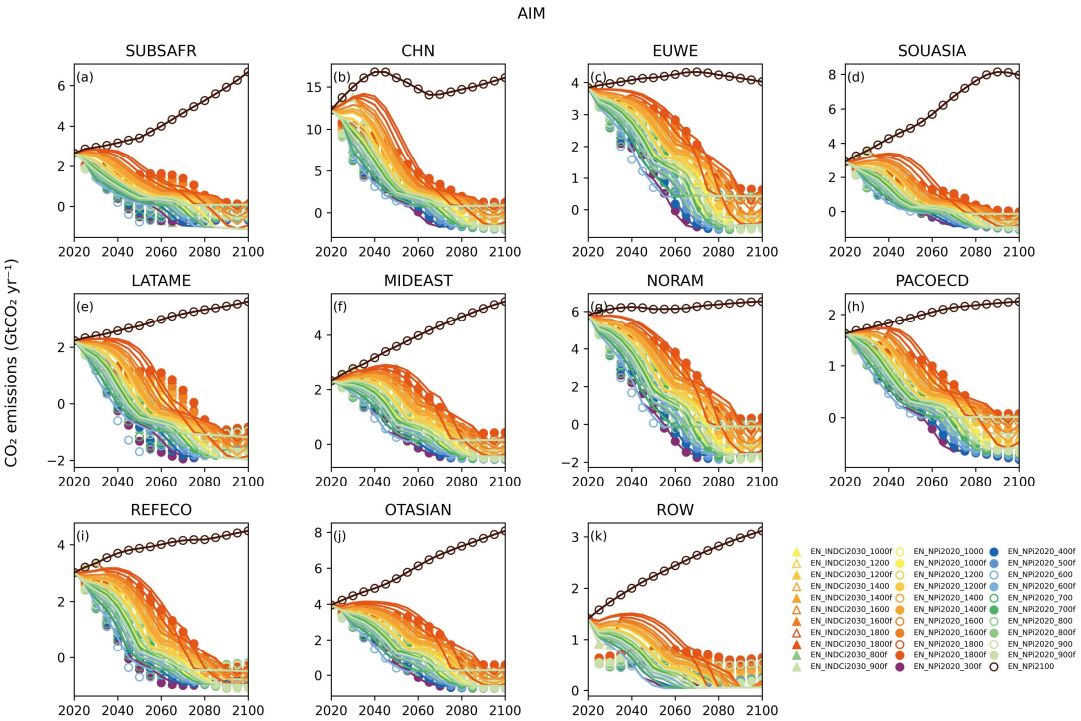

Figure S202. Test 4 - Regional AIM total anthropogenic CO_2 validation result

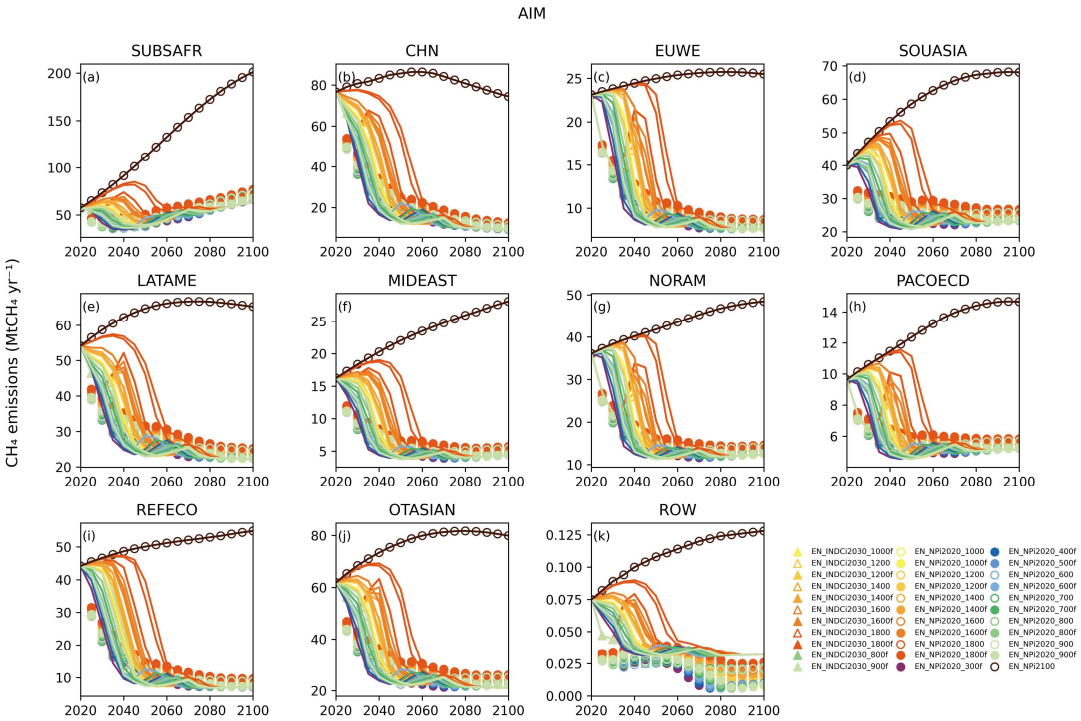

Figure S203. Test 4 - Regional AIM total anthropogenic CH_4 validation result

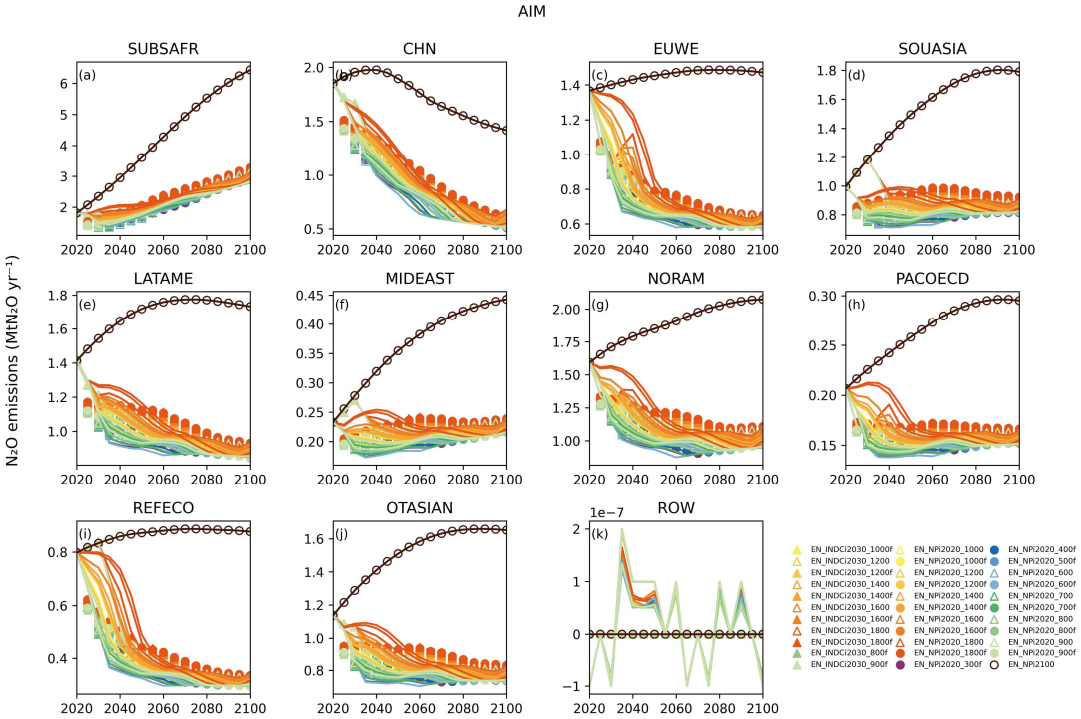

Figure S204. Test 4 - Regional AIM total anthropogenic N_2O validation result

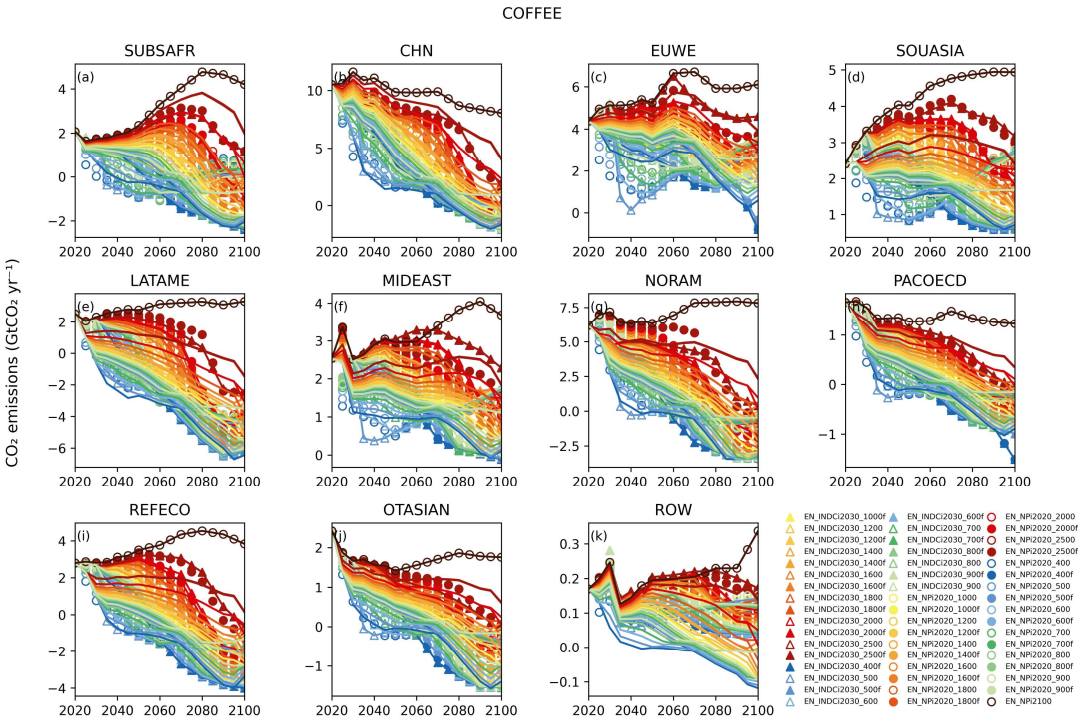

Figure S205. Test 4 - Regional COFFEE total anthropogenic CO_2 validation result

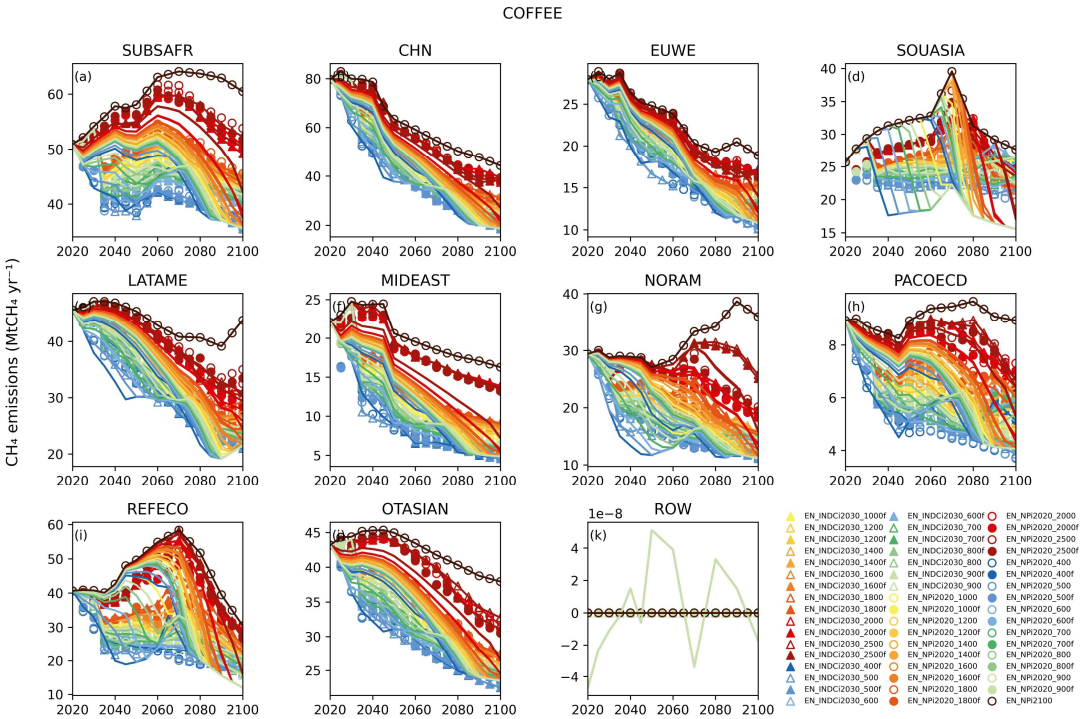

Figure S206. Test 4 - Regional COFFEE total anthropogenic CH_4 validation result

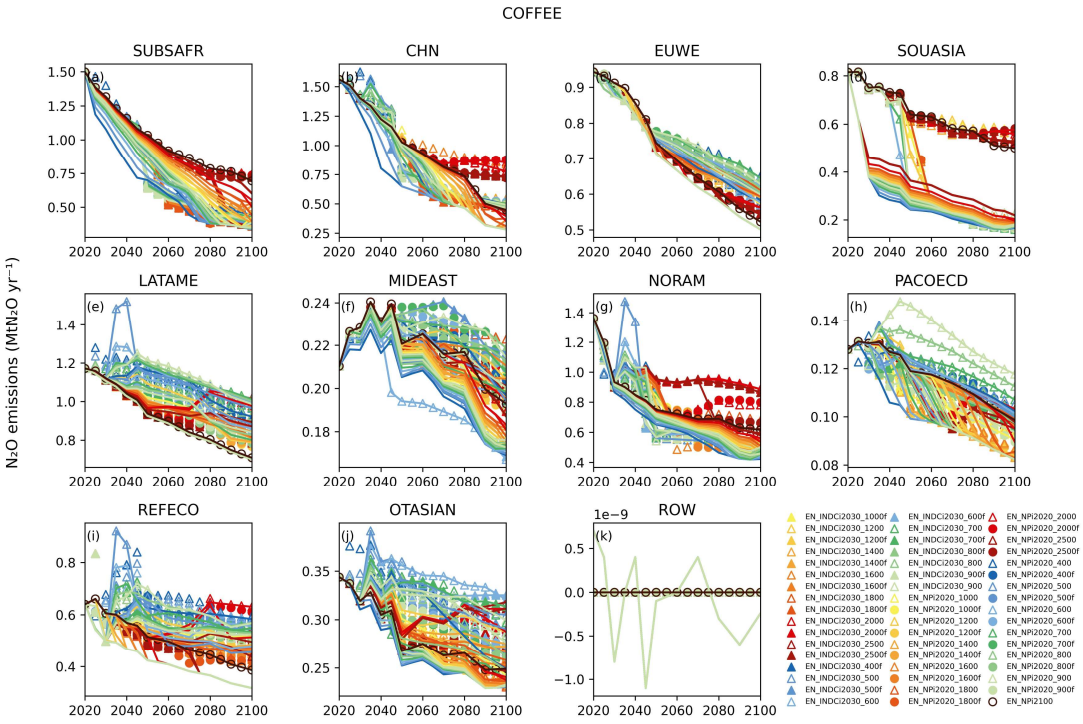

Figure S207. Test 4 - Regional COFFEE total anthropogenic N_2O validation result

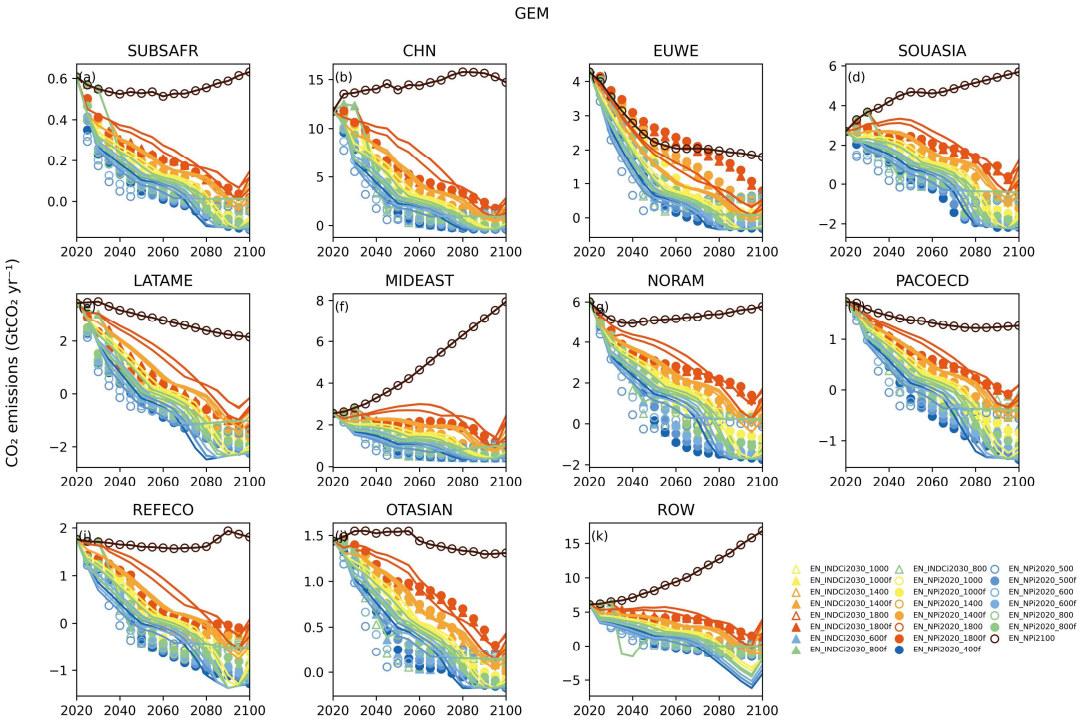

Figure S208. Test 4 - Regional GEM total anthropogenic CO_2 validation result

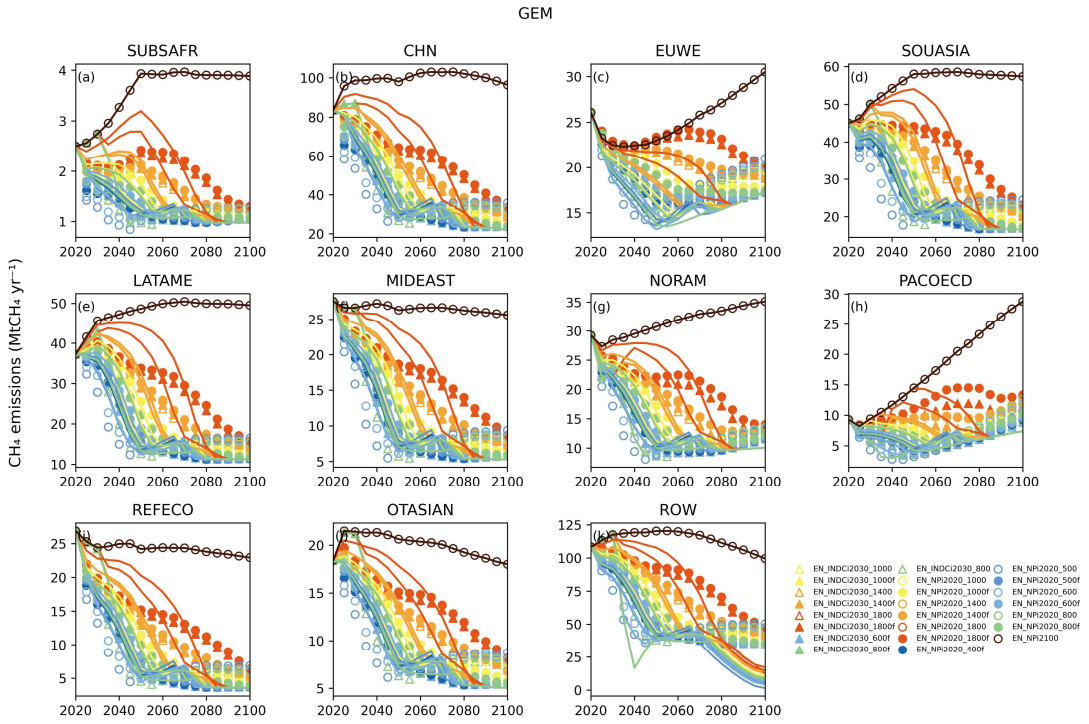

Figure S209. Test 4 - Regional GEM total anthropogenic CH_4 validation result

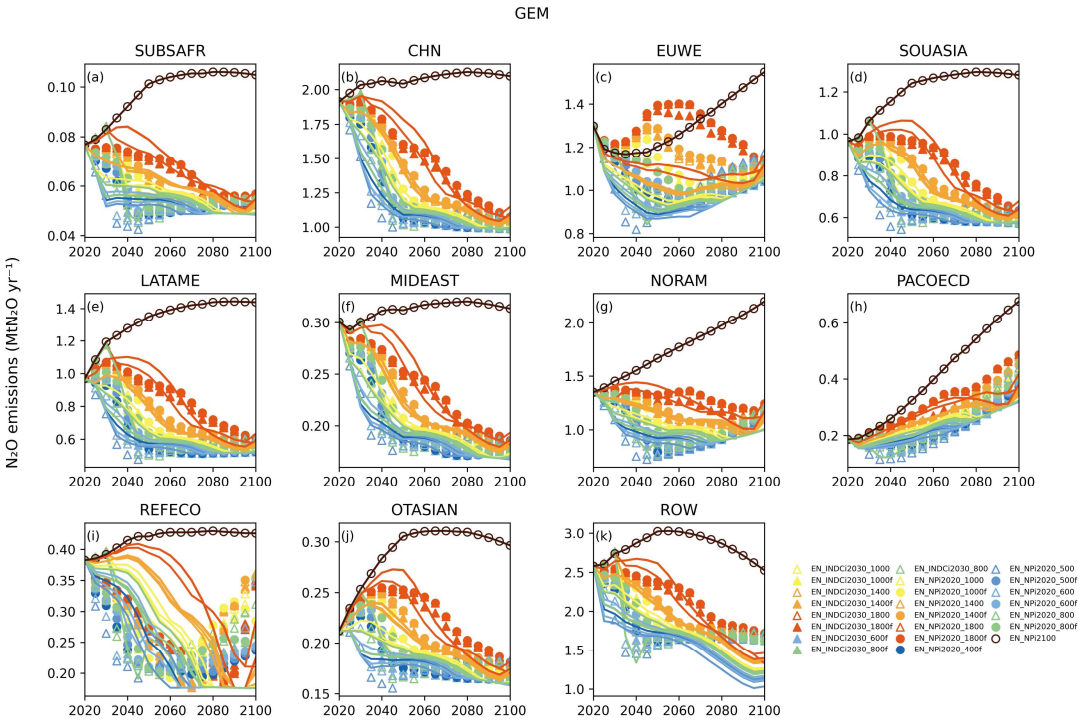

Figure S210. Test 4 - Regional GEM total anthropogenic N_2O validation result

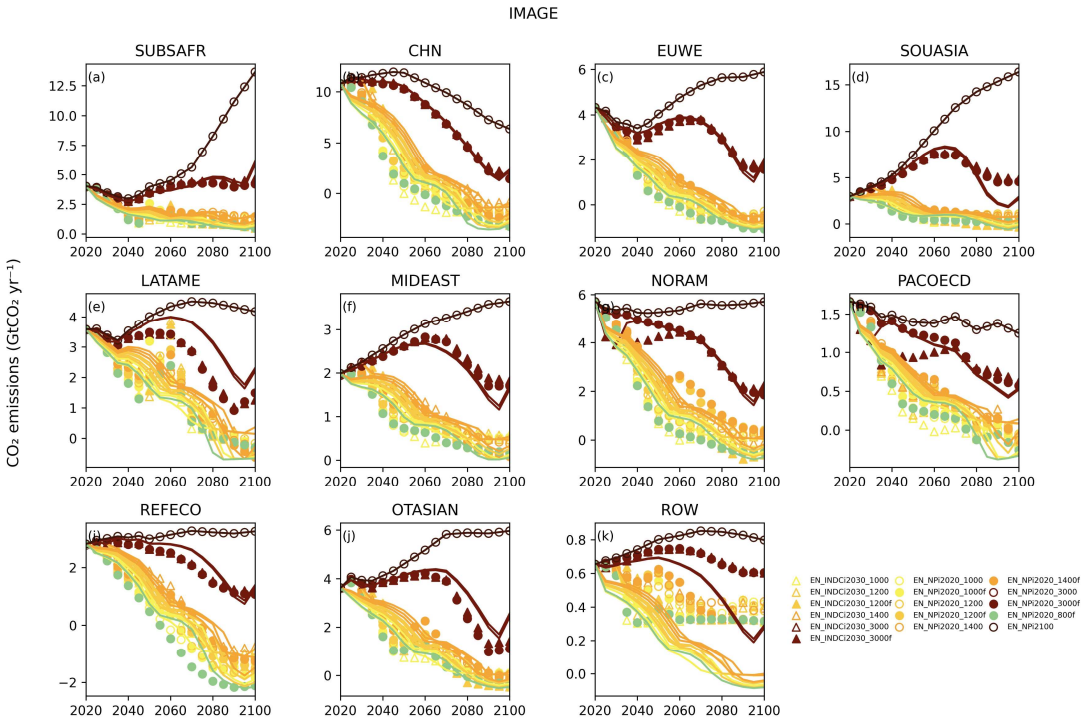

Figure S211. Test 4 - Regional IMAGE total anthropogenic CO_2 validation result

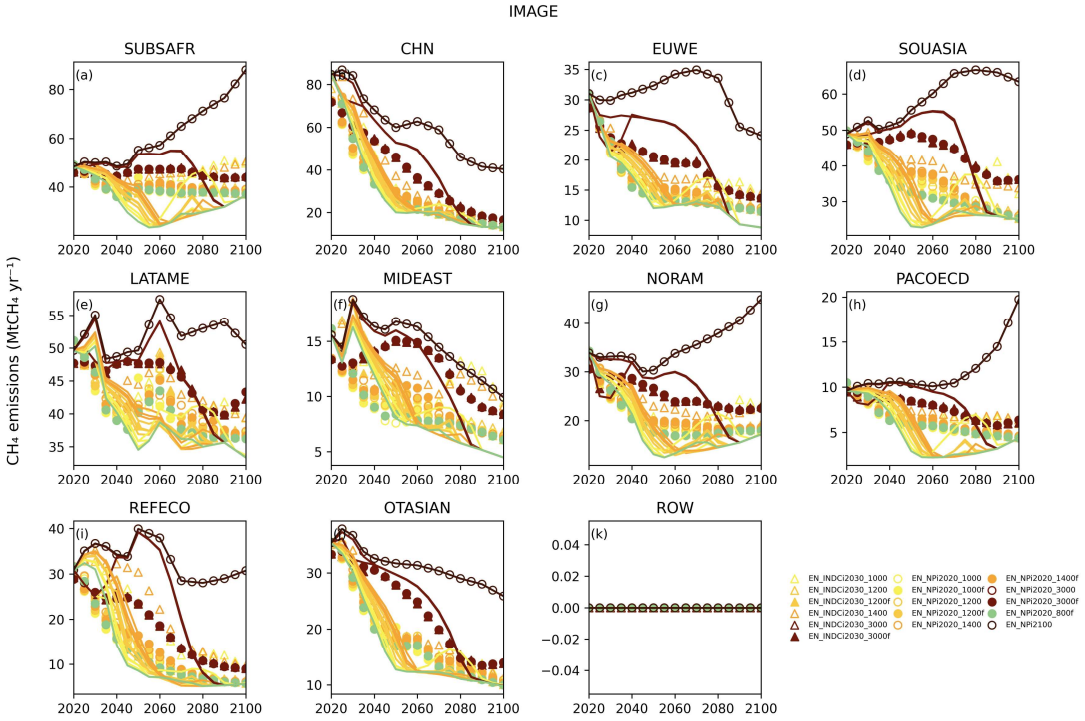

Figure S212. Test 4 - Regional IMAGE total anthropogenic CH_4 validation result

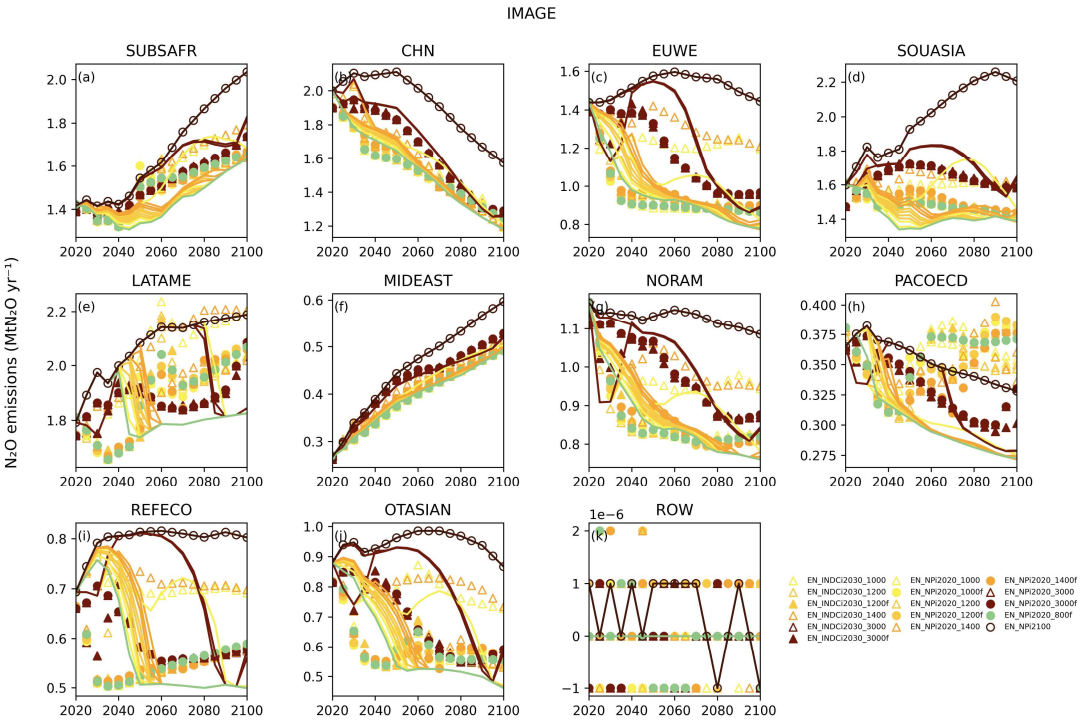

Figure S213. Test 4 - Regional IMAGE total anthropogenic N_2O validation result

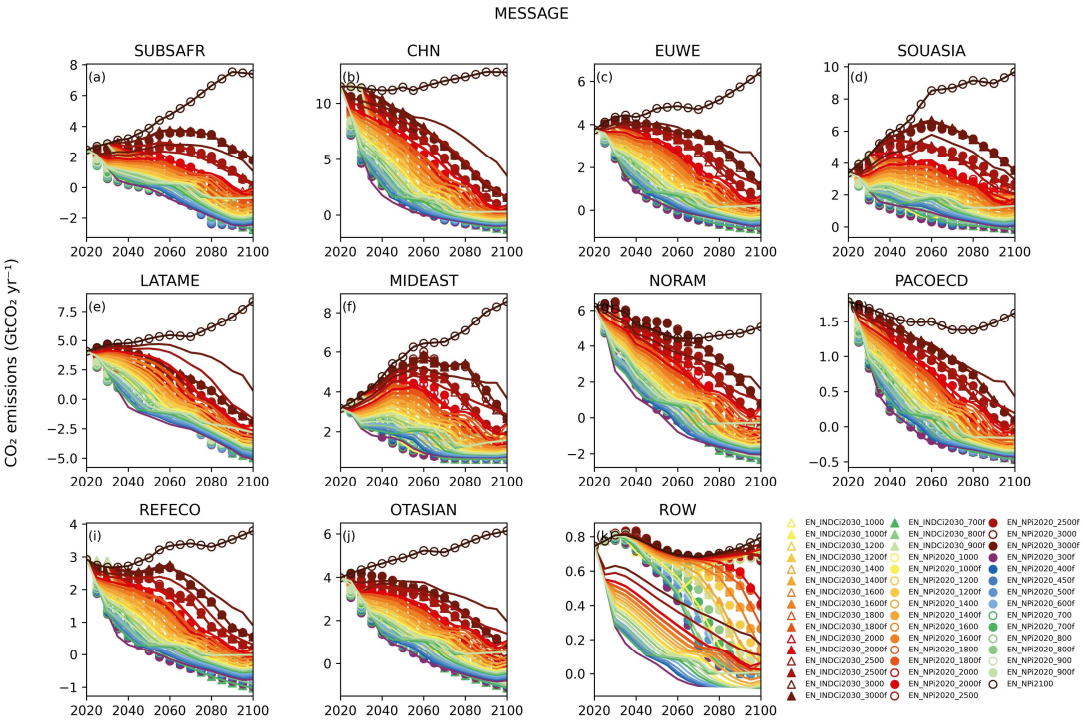

Figure S214. Test 4 - Regional MESSAGE total anthropogenic CO_2 validation result

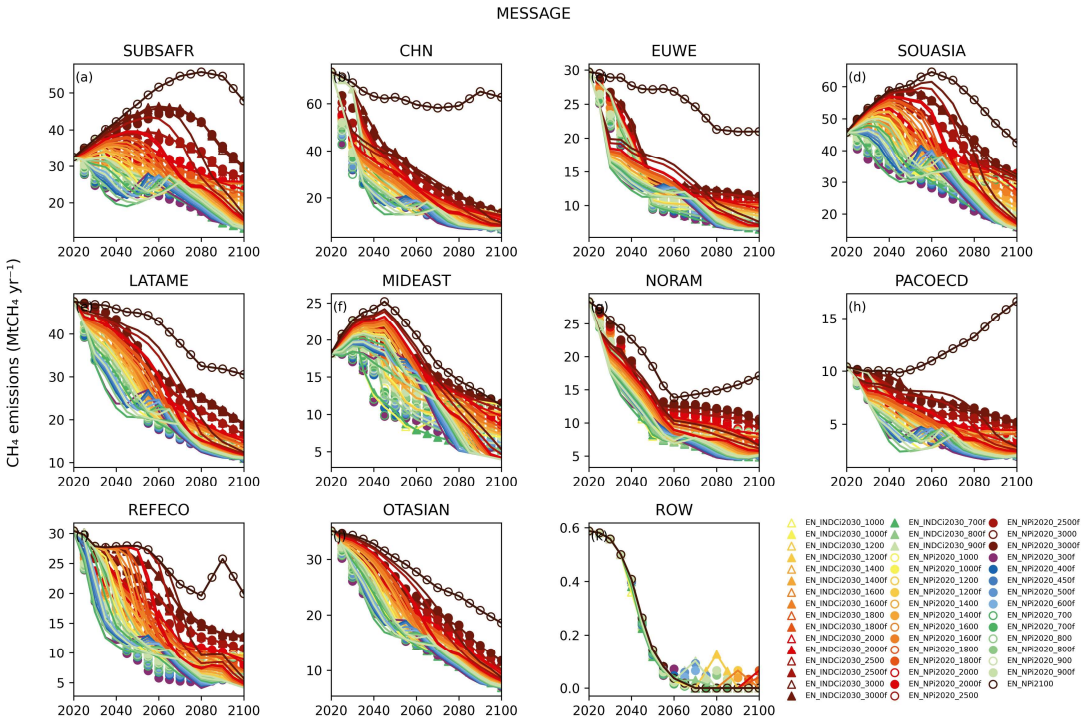

Figure S215. Test 4 - Regional MESSAGE total anthropogenic CH_4 validation result

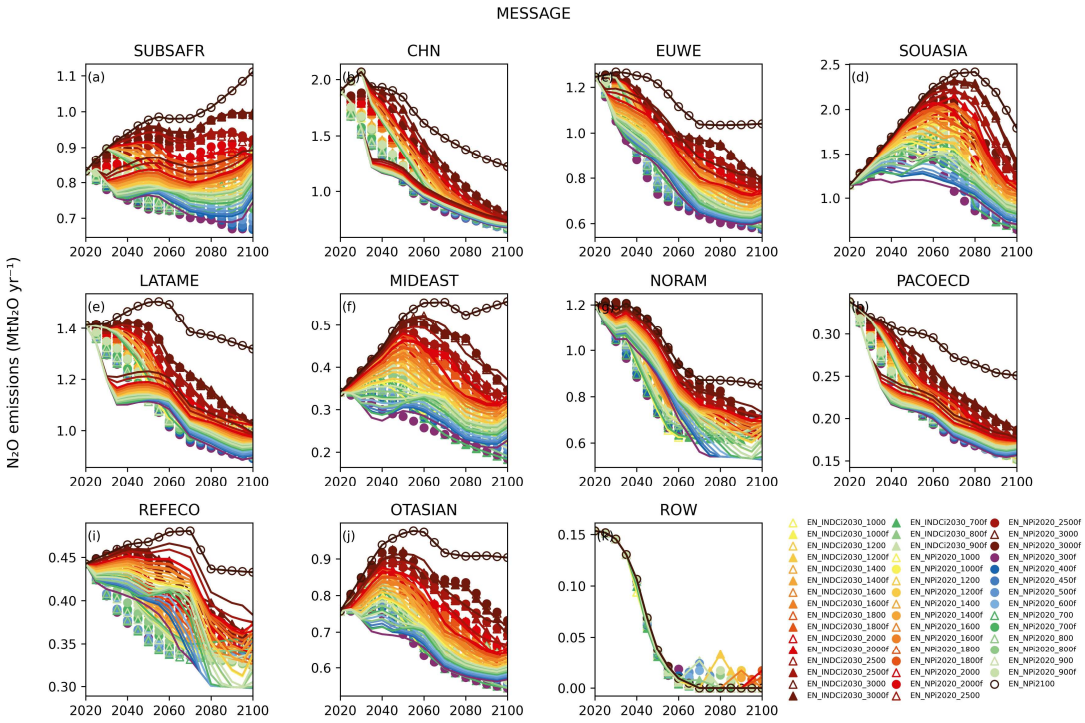

Figure S216. Test 4 - Regional MESSAGE total anthropogenic N_2O validation result

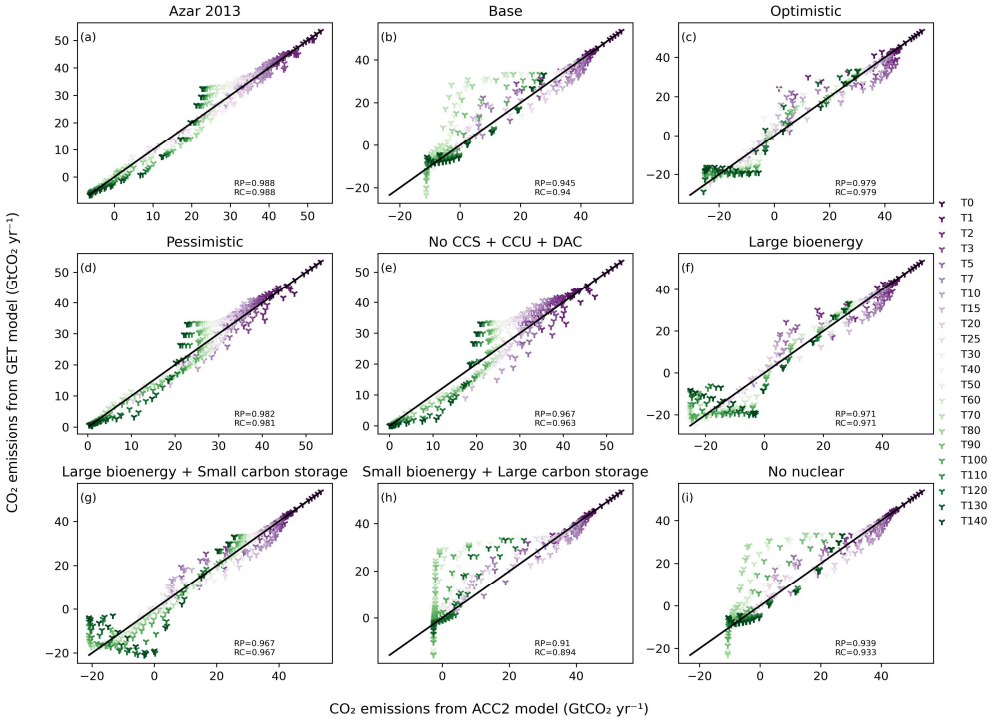

Figure S217. Test 4 - GET Reproducibility of energy-related CO_2

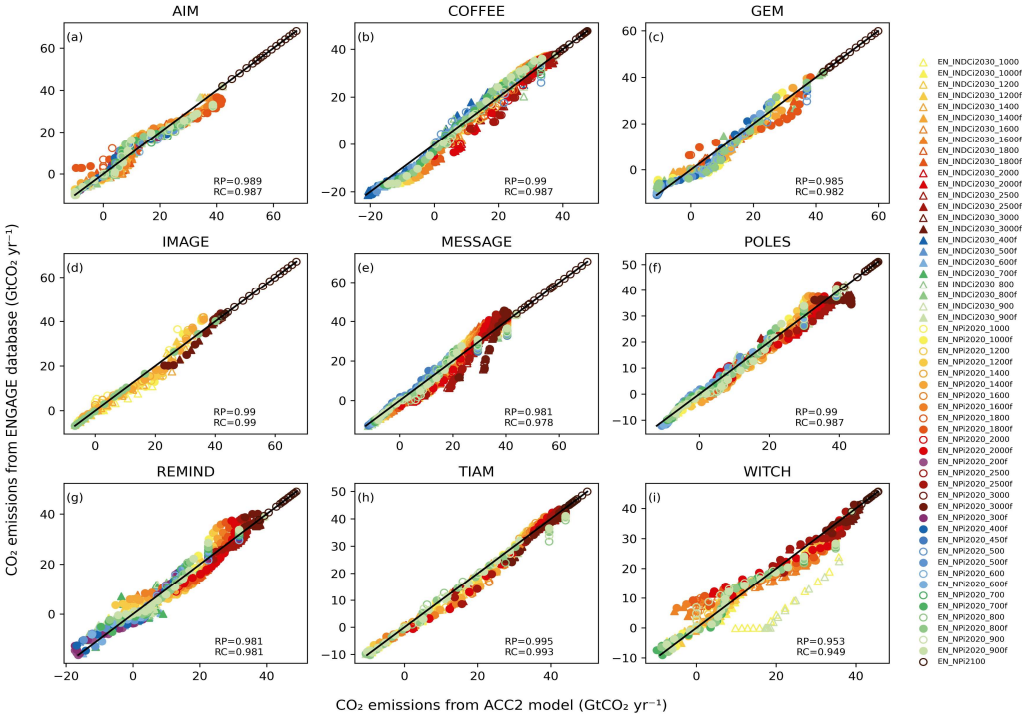

Figure S218. Test 4 - Global 9 models - Reproducibility of total anthropogenic CO_2

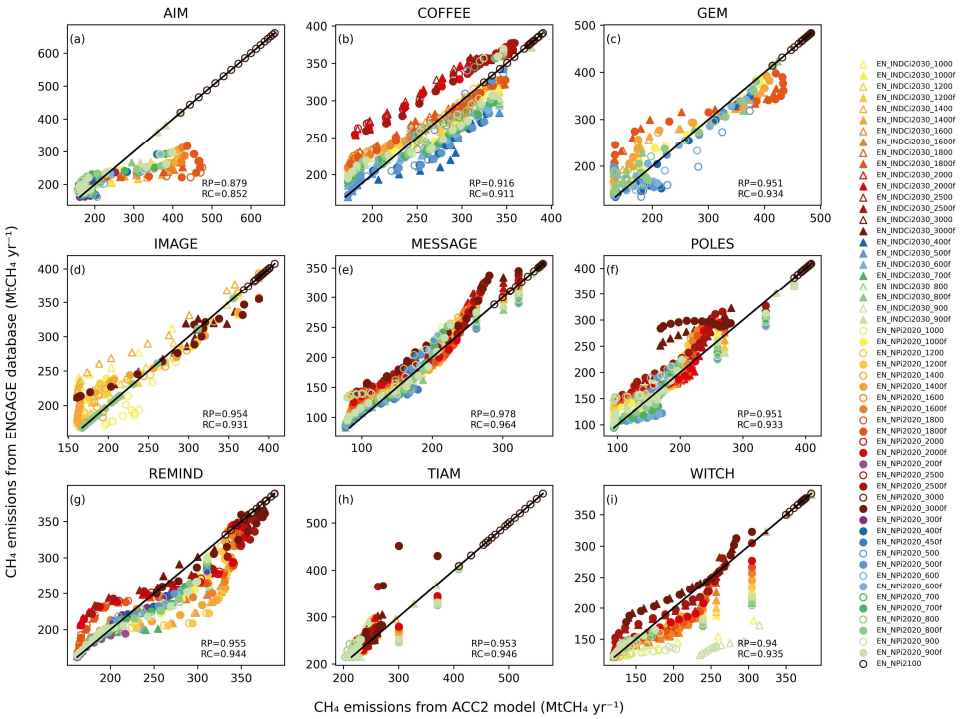

Figure S219. Test 4 - Global 9 models - Reproducibility of total anthropogenic CH_4

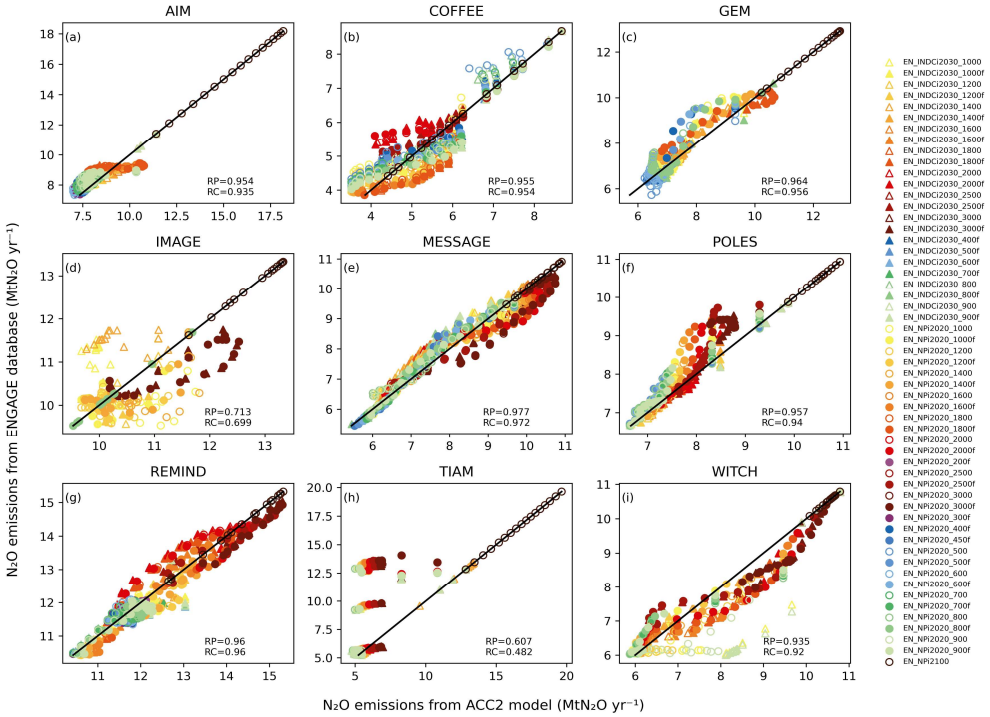

Figure S220. Test 4 - Global 9 models - Reproducibility of total anthropogenic N_2O

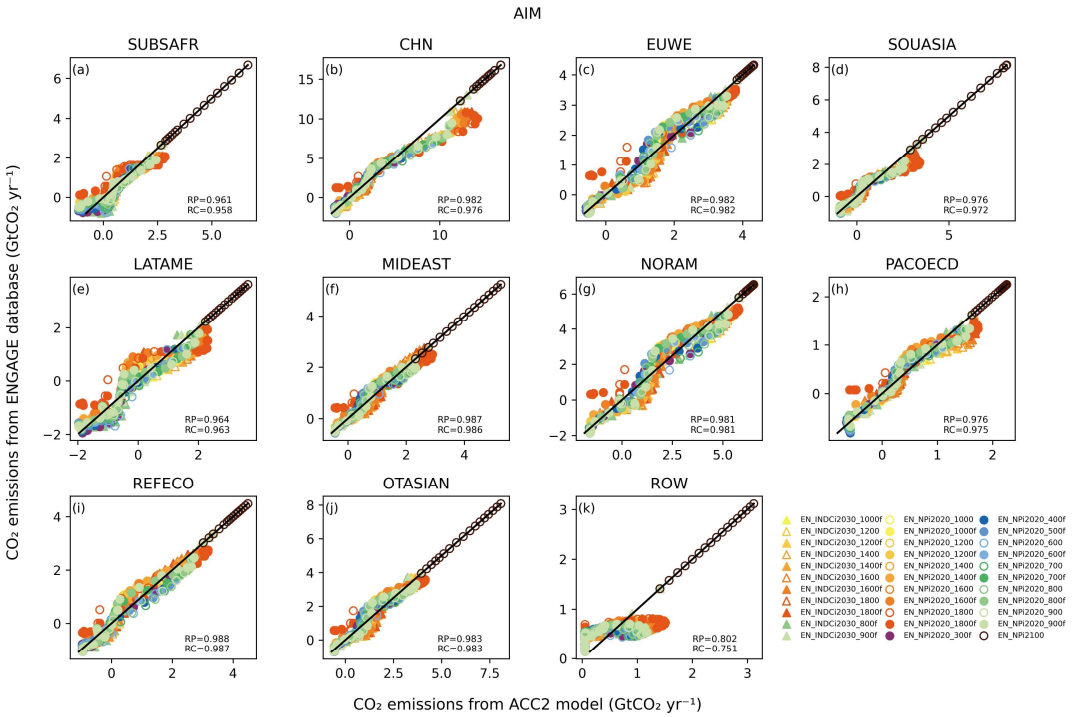

Figure S221. Test 4 - Regional AIM - Reproducibility of total anthropogenic CO_2

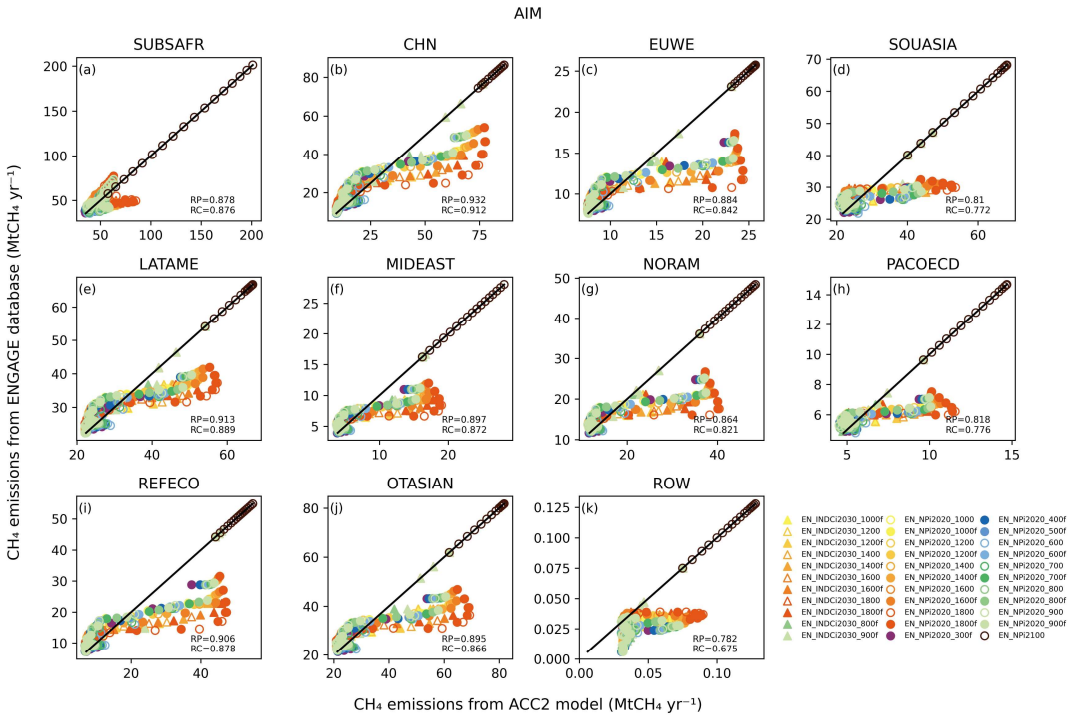

Figure S222. Test 4 - Regional AIM - Reproducibility of total anthropogenic CH_4

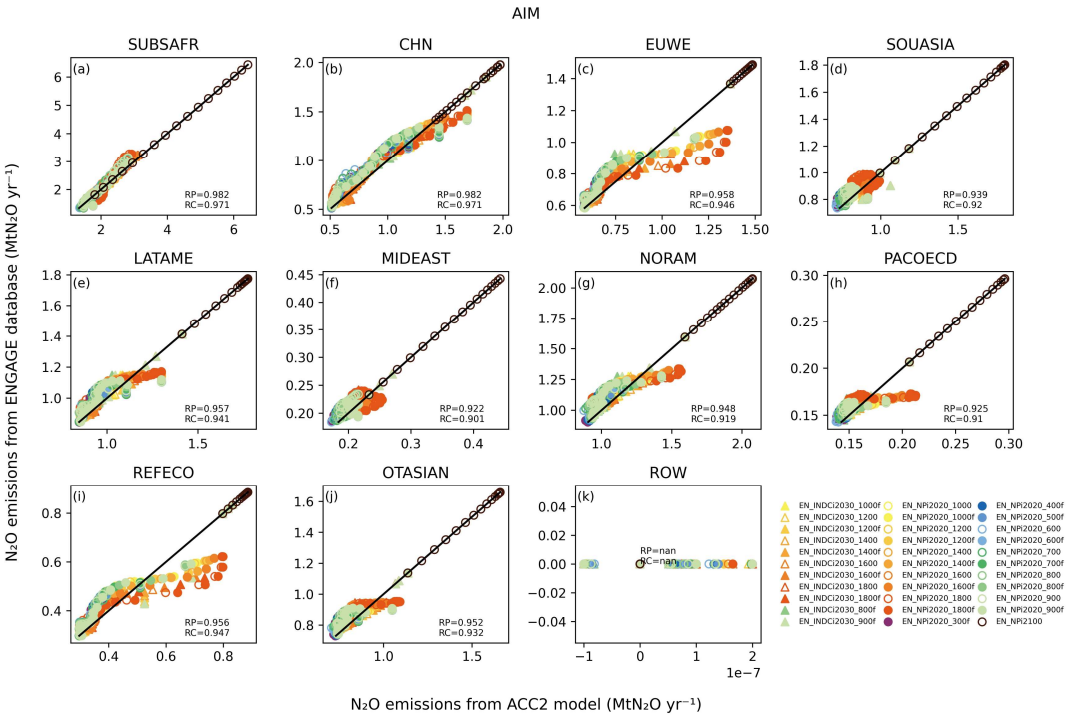

Figure S223. Test 4 - Regional AIM - Reproducibility of total anthropogenic N_2O

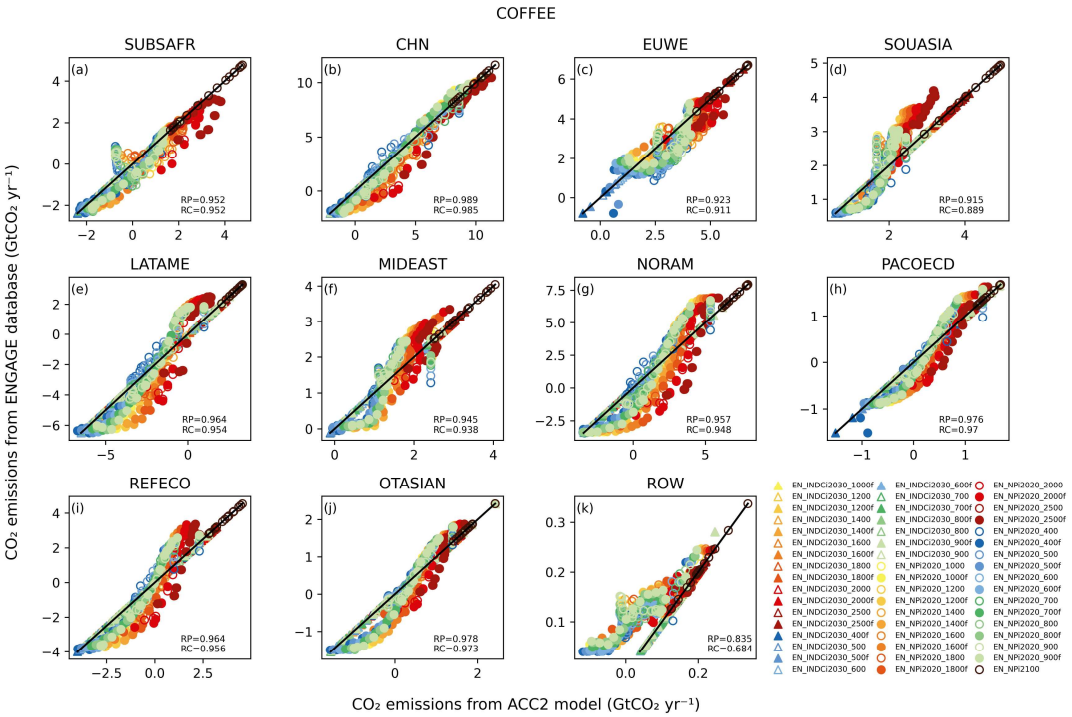

Figure S224. Test 4 - Regional COFFEE - Reproducibility of total anthropogenic CO_2

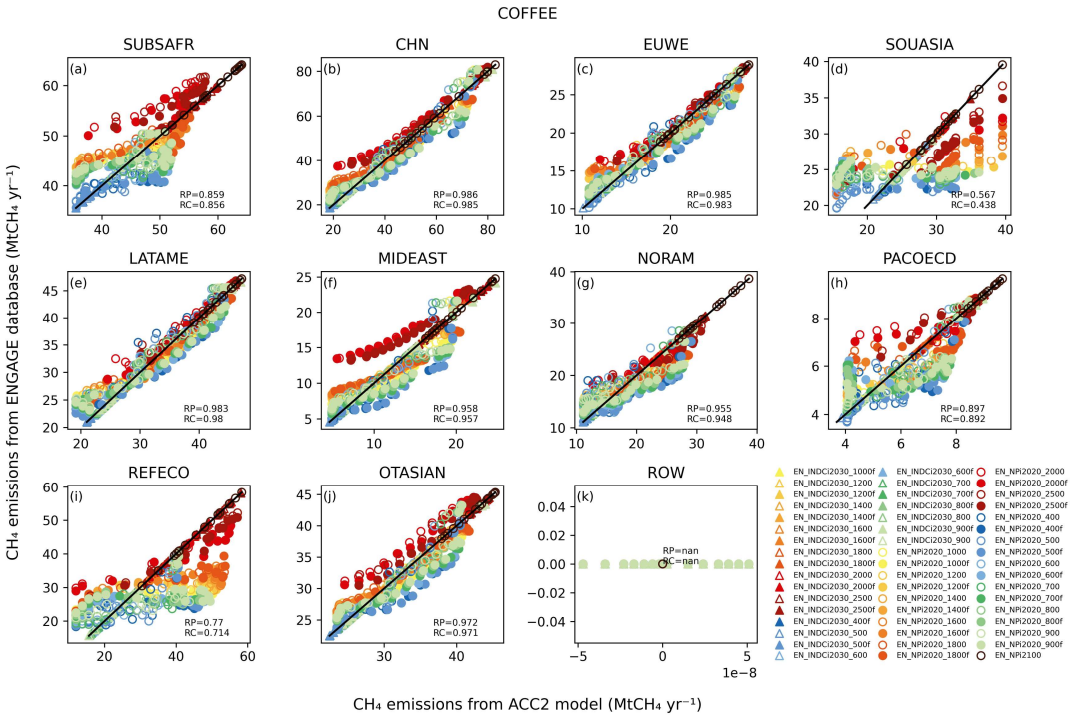

Figure S225. Test 4 - Regional COFFEE - Reproducibility of total anthropogenic CH_4

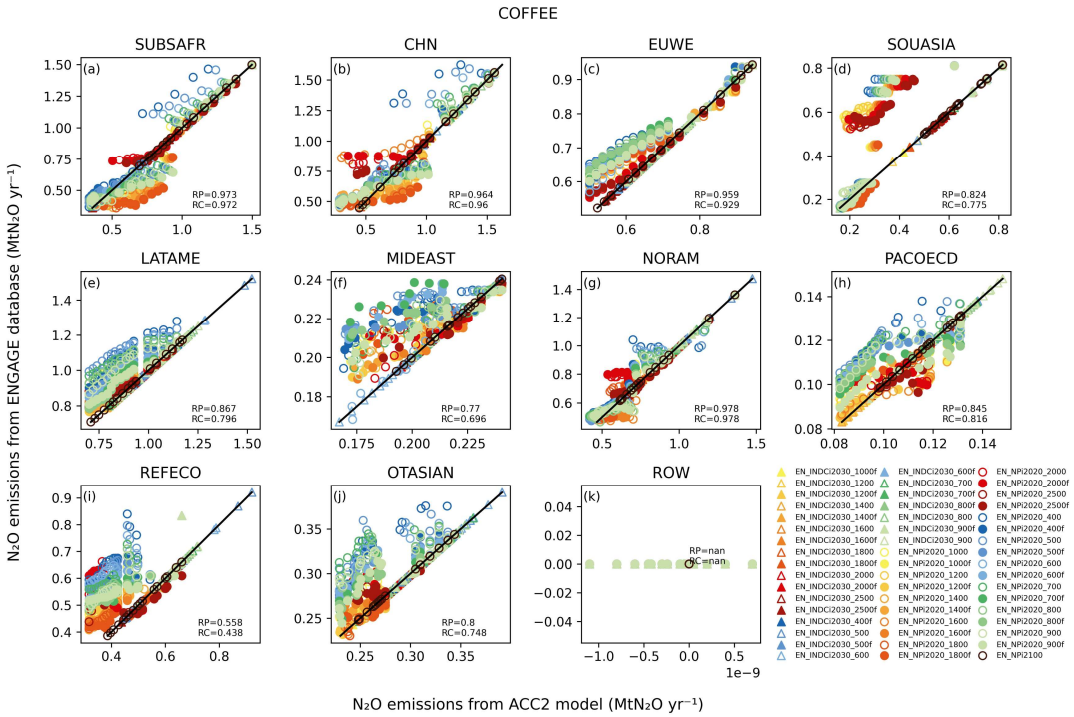

Figure S226. Test 4 - Regional COFFEE - Reproducibility of total anthropogenic N_2O

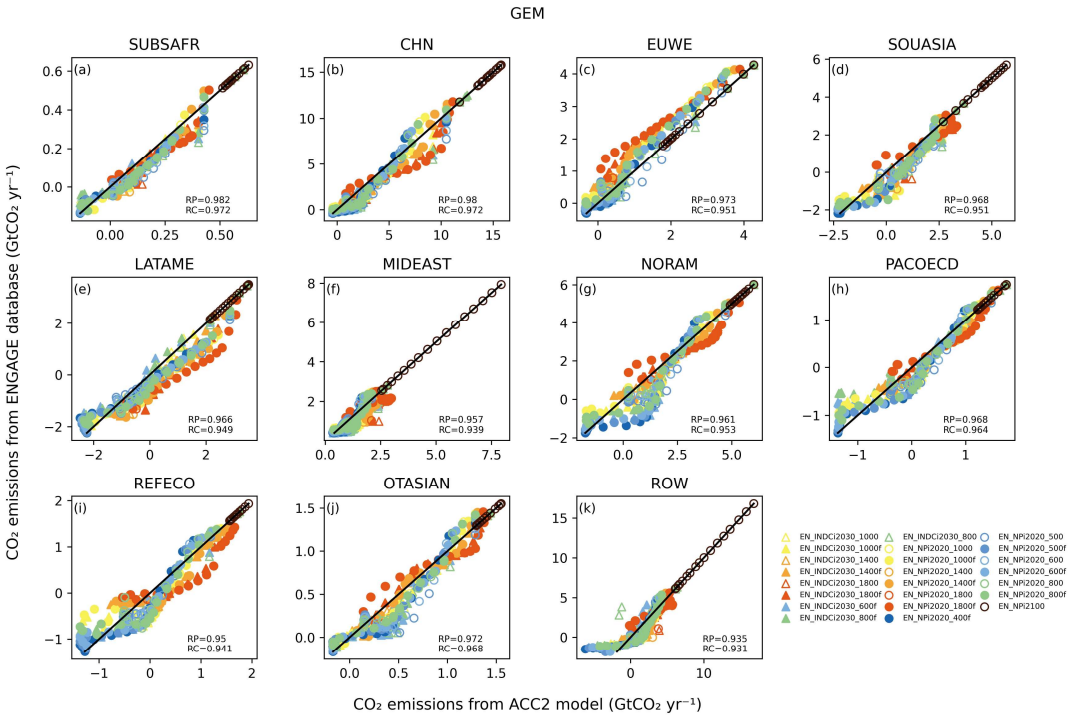

Figure S227. Test 4 - Regional GEM - Reproducibility of total anthropogenic CO_2

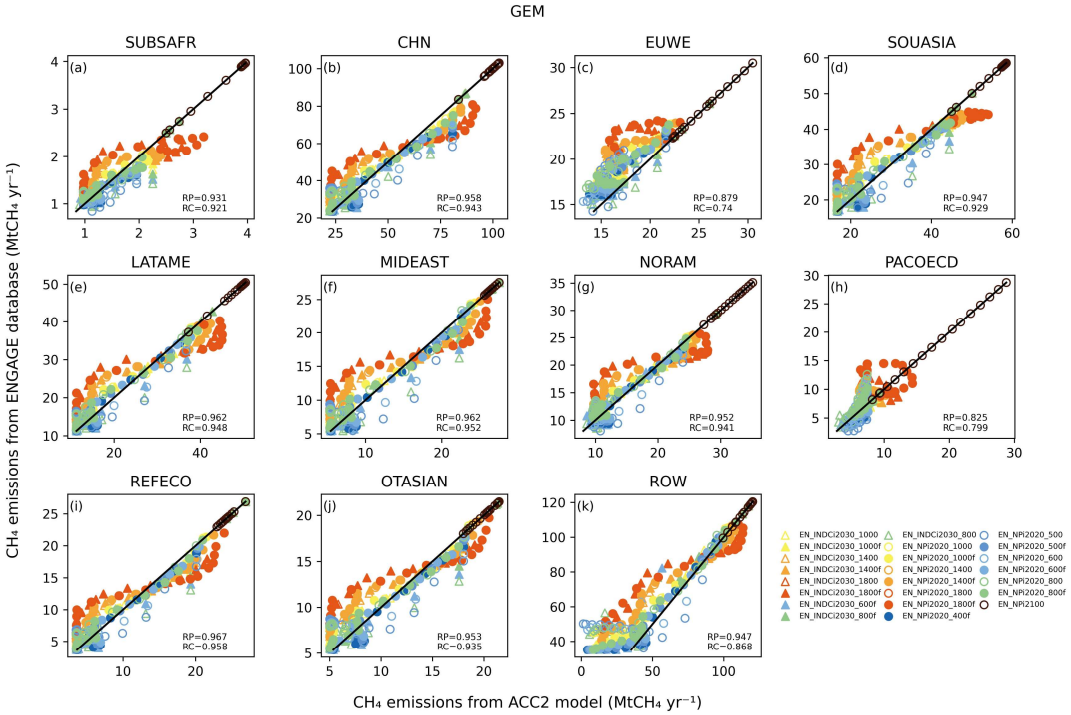

Figure S228. Test 4 - Regional GEM - Reproducibility of total anthropogenic CH_4

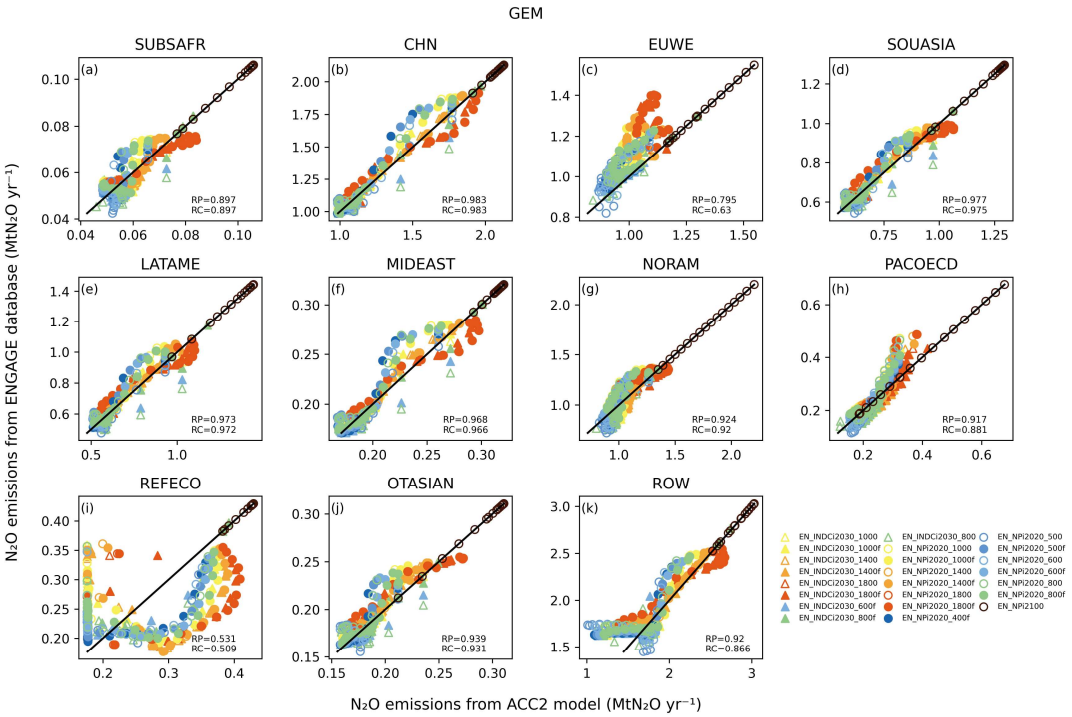

Figure S229. Test 4 - Regional GEM - Reproducibility of total anthropogenic N_2O

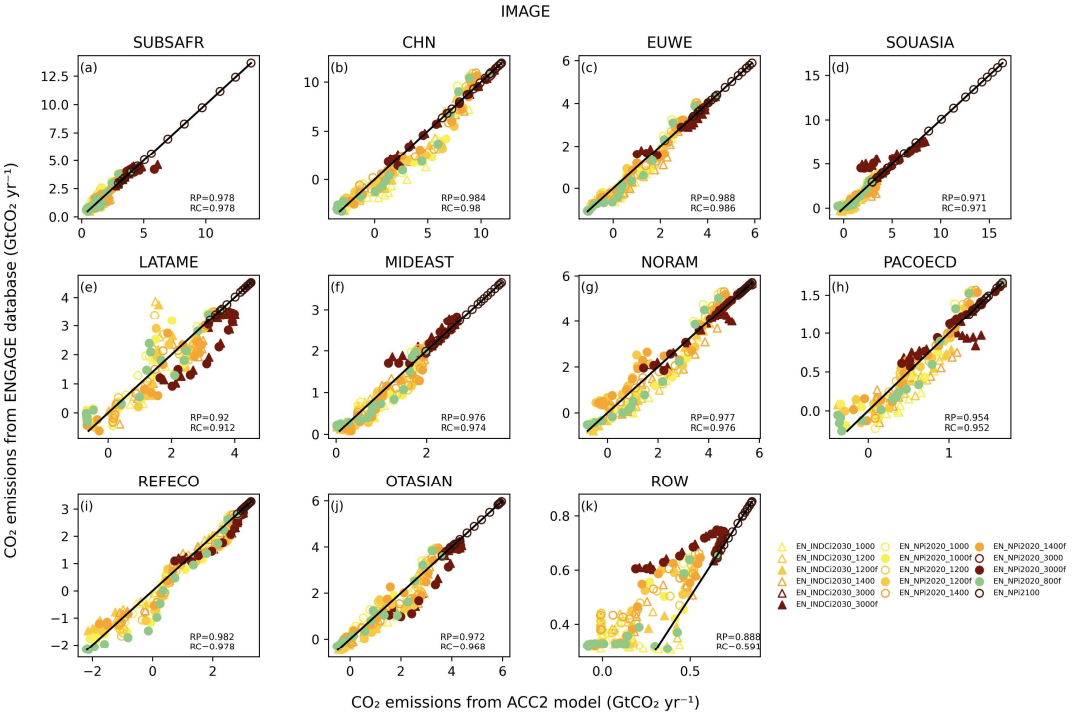

Figure S230. Test 4 - Regional IMAGE - Reproducibility of total anthropogenic CO_2

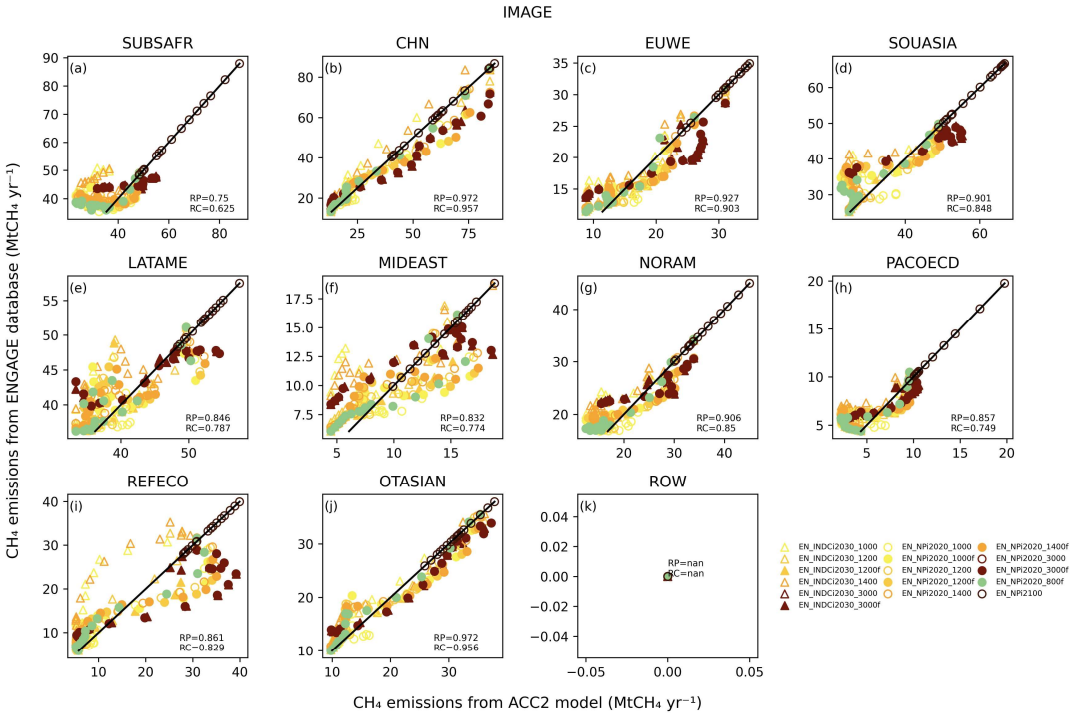

Figure S231. Test 4 - Regional IMAGE - Reproducibility of total anthropogenic CH_4

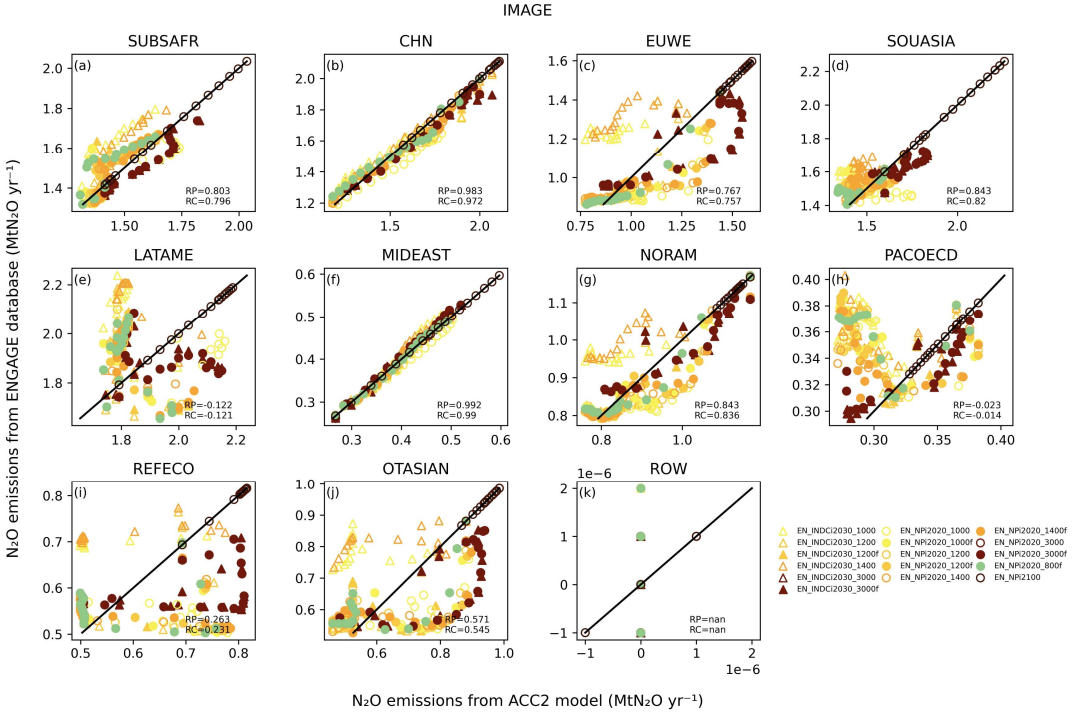

Figure S232. Test 4 - Regional IMAGE - Reproducibility of total anthropogenic N_2O

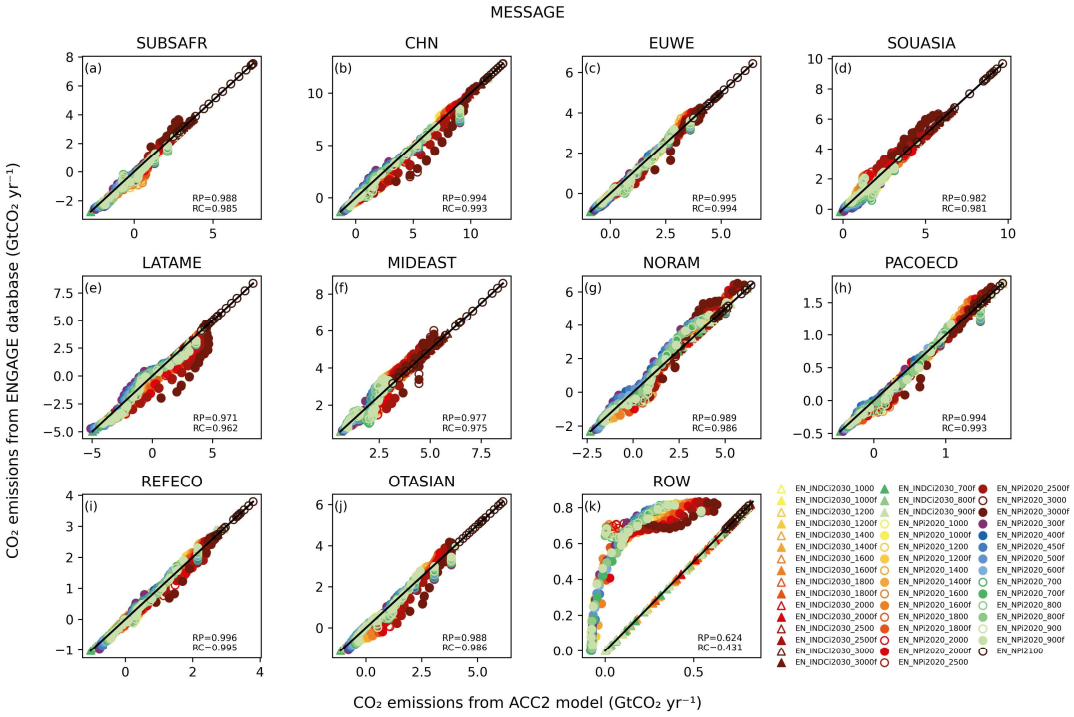

Figure S233. Test 4 - Regional MESSAGE - Reproducibility of total anthropogenic CO_2

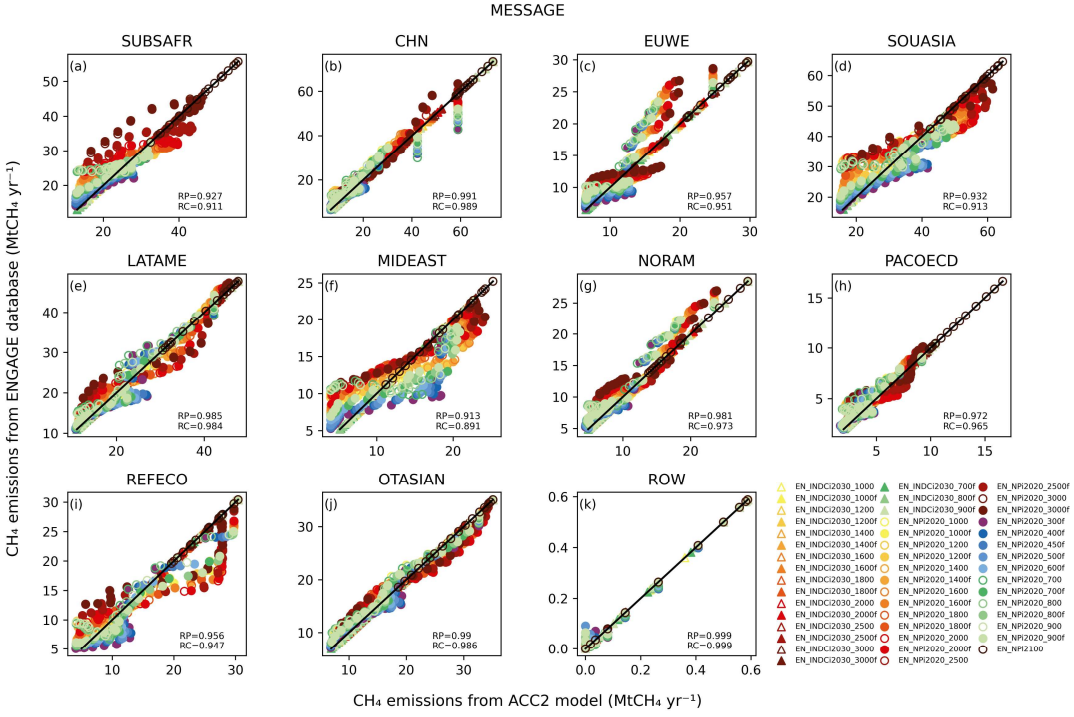

Figure S234. Test 4 - Regional MESSAGE - Reproducibility of total anthropogenic CH_4

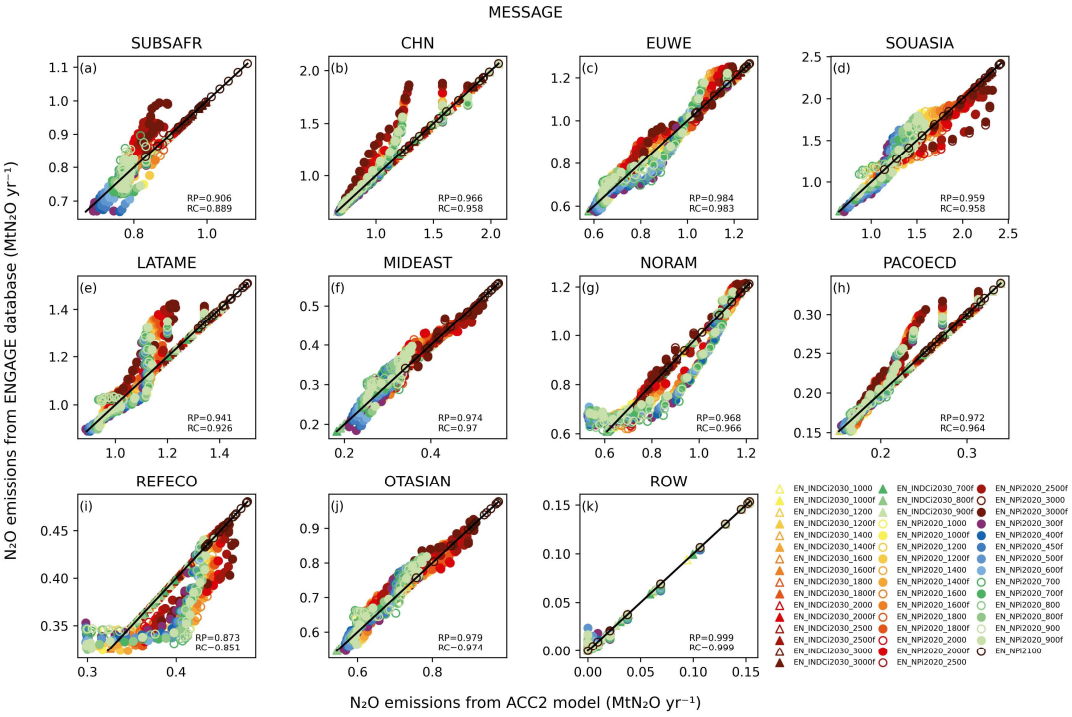

Figure S235. Test 4 - Regional MESSAGE - Reproducibility of total anthropogenic N_2O