

Supplement of:

Investigating the yield of H₂O and H₂ from methane oxidation in the stratosphere

Franziska Frank¹, Patrick Jöckel¹, Sergey Gromov^{2,3}, and Martin Dameris¹

¹Deutsches Zentrum für Luft- und Raumfahrt (DLR), Institut für Physik der Atmosphäre, Oberpfaffenhofen, Germany

²Max-Planck-Institute for Chemistry, Air Chemistry Departement, Mainz, Germany

³Institute of Global Climate and Ecology Roshydromet & RAS (IGCE), Moscow, Russia

Correspondence to: Franziska Frank (franziska.frank@dlr.de)

Contents

	1	2D Profiles of Yield in the Global Simulation	2
	2	2D Profiles of the Ratio of H:H₂:H₂O	3
	3	Results of the Box Model Simulations	4
5	3.1	Exp1	4
	3.2	Ref	6
	3.3	SS01	8
	3.4	SS02	10
	3.5	SS03	12
10	3.6	SS04	14
	3.7	SS05	16

1 2D Profiles of Yield in the Global Simulation

The panels of Fig. S1 show the zonal mean of the effective and direct yield as an annual and seasonal climatology. Overall, the vertical profile in the tropics generally applies to the mid latitudes as well. The area below the tropopause, where the yield peaks in values above 2, is also represented at higher latitudes, where the tropopause is lower than in the tropics. A notable exception is that in the summer hemisphere the yield below the tropopause is smaller and in the upper stratosphere larger than in the tropics. It is, however, not possible to apply the presented method to calculate yield of water vapour (H_2O) from the oxidation of methane (CH_4) (γ_{H_2O}) in the winter polar region, since through the absence of sunlight the concentrations of hydroxyl radical (OH) are very low and therefore the loss of CH_4 so small that numerical errors influence the calculation of γ_{H_2O} too much for a reliable estimate.

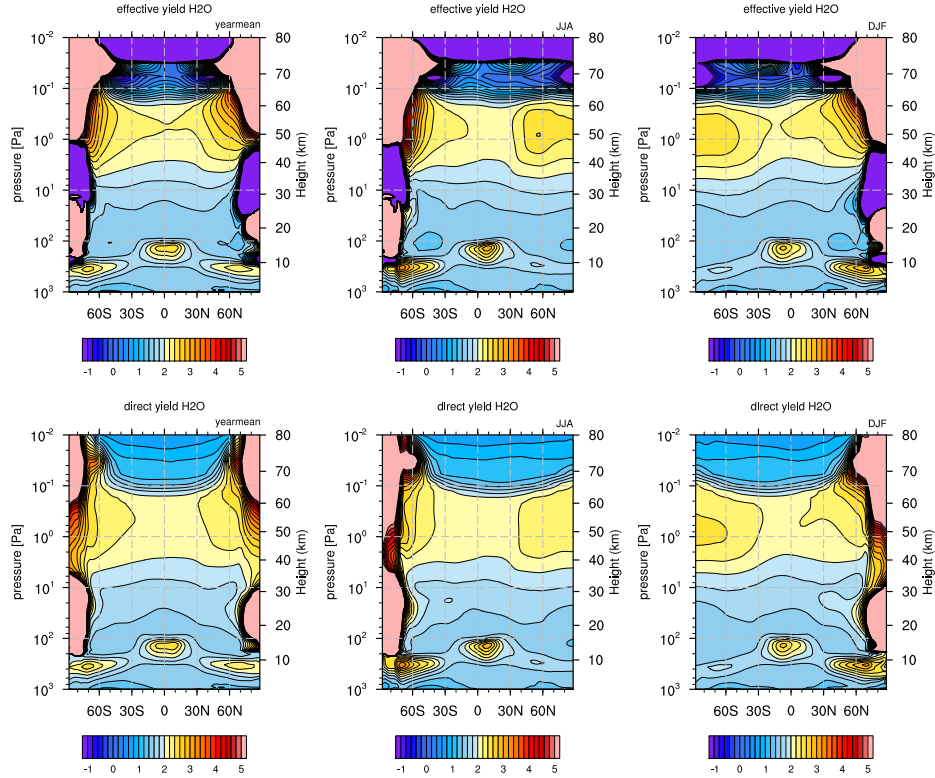


Figure S1. Zonal mean of effective (upper panels) and direct yield (lower panels) from global model as an annual climatology (left column), seasonal climatology of the months June, July and August (middle column) and of the months December, January and February (right column) respectively.

2 2D Profiles of the Ratio of $\text{H}:\text{H}_2:\text{H}_2\text{O}$

Considering the zonal mean of the H portions (see Fig. S2), it becomes again apparent that the tropical profile of the H portion is a good estimate for its annual climatology. The local minimum at the tropopause is, for example, evident throughout the year. In the summer hemispheres the hydrogen content in H_2O increases in the upper stratosphere and mesosphere, while it decreases substantially at the same altitudes in the winter hemisphere. Where the share of H portion of H_2O is low the share of hydrogen gas (H_2) increases. For polar stratospheric clouds variations in the ratio of H_2O to H_2 are decisive. An investigation of this influence is, however, beyond the scope of this study.

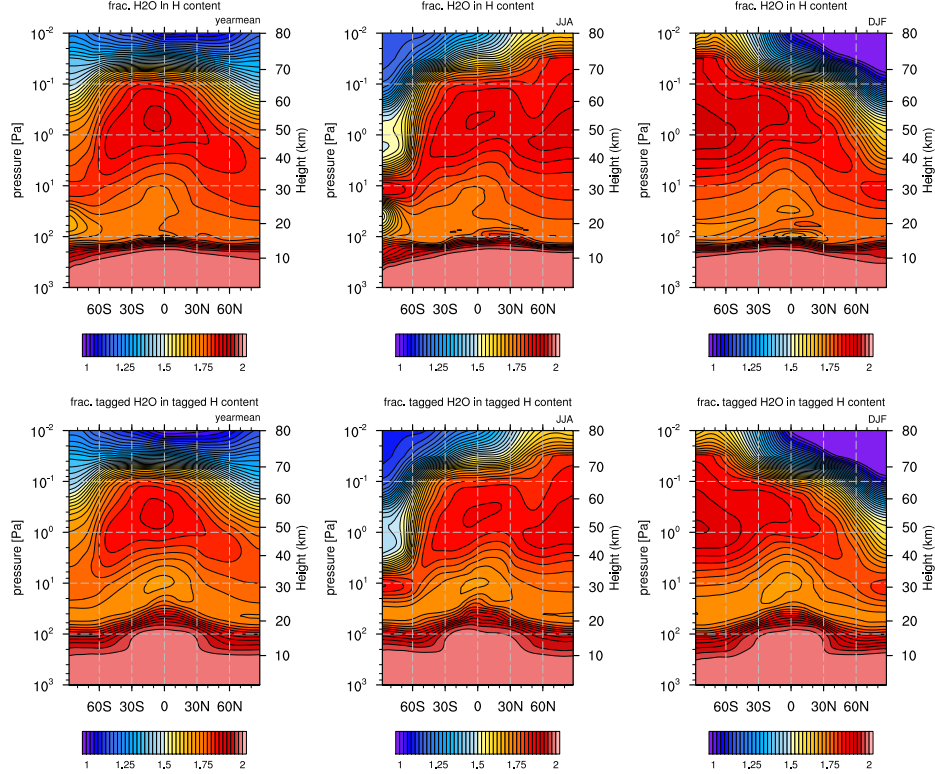


Figure S2. Zonal mean of un-tagged (upper panels) and tagged (lower panels) H portion in H_2O with respect to the un-tagged and tagged hydrogen content ($\text{H}+2\times\text{H}_2+2\times\text{H}_2\text{O}$) as annual climatology (left column), seasonal climatology of the months June, July and August (middle column) and of the months December, January and February (right column) respectively.

3 Results of the Box Model Simulations

3.1 Exp1

Table S1. Values for H2O in Exp1

pressure [hPa]	loss CH4 [nmol mol-1 yr-1]	prim. prod. H2O [nmol mol-1 yr-1]	prim. loss H2O [nmol mol-1 yr-1]	sec. prod. H2O [nmol mol-1 yr-1]	sec. loss H2O [nmol mol-1 yr-1]	direct yield [-]	effective yield [-]
0.01	1917.1093	1258.1943	819.6558	868.5772	565.0148	0.6563	0.3871
0.02	1920.4814	1378.9709	1243.0511	1985.6976	1789.7012	0.7180	0.1728
0.04	1567.9248	1536.7456	1460.5072	8215.1387	7807.8486	0.9801	0.3084
0.06	815.0206	898.4715	851.5042	7228.4312	6851.0942	1.1024	0.5206
0.08	330.9046	435.9221	411.6228	4326.1904	4085.3777	1.3174	0.8012
0.10	354.1445	509.4264	483.7607	6448.2222	6123.5918	1.4385	0.9891
0.20	248.4486	496.8959	461.8084	6529.9116	6068.1099	2.0000	2.0000
0.25	317.1020	634.2027	582.3067	7107.6855	6525.3833	2.0000	2.0000
0.50	647.9127	1295.8253	1041.9595	5317.7563	4275.7974	2.0000	2.0000
1.00	1117.6545	2235.3079	1468.8796	4284.1123	2815.2332	2.0000	2.0000
2.00	1175.4083	2350.8157	1317.5927	2997.7107	1680.1178	2.0000	2.0000
4.00	862.8663	1723.5771	871.0848	1761.1121	890.0270	1.9975	1.9975
5.00	738.7663	1464.9867	722.2376	1424.4871	702.2541	1.9830	1.9830
6.00	595.3466	1168.4746	561.6932	1081.6173	519.9347	1.9627	1.9627
8.00	432.5767	827.8423	386.2204	723.9407	337.7455	1.9137	1.9137
10.00	297.9835	554.7293	249.1120	452.0948	203.0224	1.8616	1.8615
15.00	193.2374	347.6617	149.0496	260.8025	111.8129	1.7991	1.7988
20.00	117.6032	206.2219	81.1034	133.5830	52.5370	1.7535	1.7531
30.00	79.9943	137.2668	47.5862	72.7755	25.2227	1.7160	1.7155
40.00	53.1989	90.2145	24.8173	34.1195	9.2971	1.6958	1.6959
50.00	44.6790	75.4166	18.1324	23.7102	5.5567	1.6880	1.6884
60.00	34.1557	58.2252	8.5872	9.9817	1.3638	1.7047	1.7056
80.00	31.2933	54.6421	3.1229	3.2992	0.1714	1.7461	1.7463
90.00	32.8238	57.6864	2.1720	2.2171	0.0774	1.7575	1.7565
100.00	35.8189	63.0893	1.5539	1.4907	0.0349	1.7613	1.7586
120.00	40.4032	69.8148	1.4292	1.2055	0.0224	1.7280	1.7219
140.00	38.8669	66.0524	1.8469	1.6469	0.0326	1.6995	1.6935
160.00	38.7104	65.6202	2.1579	2.0107	0.0418	1.6952	1.6903
180.00	37.8395	63.3394	2.2637	2.2041	0.0435	1.6739	1.6712
200.00	39.0952	64.8123	2.4269	2.3771	0.0476	1.6578	1.6553
250.00	50.4316	82.8999	3.1987	3.1354	0.0628	1.6438	1.6413
300.00	80.7958	135.6818	4.9048	4.8297	0.0894	1.6793	1.6773
400.00	176.0176	308.7615	10.0708	9.9343	0.1649	1.7542	1.7524
600.00	254.1102	390.7552	9.8457	7.8480	0.0998	1.5377	1.5295
1000.00	134.5239	164.2375	1.2036	0.7443	0.0027	1.2209	1.2209

Table S2. Values for H2 in Exp1

pressure	loss CH4	prim. prod. H2	prim. loss H2	sec. prod. H2	sec. loss H2	direct yield	effective yield
[hPa]	[nmol mol ⁻¹ yr ⁻¹]	[nmol mol ⁻¹ yr ⁻¹]	[nmol mol ⁻¹ yr ⁻¹]	[nmol mol ⁻¹ yr ⁻¹]	[nmol mol ⁻¹ yr ⁻¹]	[-]	[-]
0.01	32.8238	17.1165	8.7060	0.0084	0.0043	1.6142	1.6129
0.02	330.9046	432.4914	67.2743	37.2794	5.8004	1.8280	1.8272
0.04	432.5768	160.0545	122.7173	0.0412	0.0316	1.6988	1.6916
0.06	31.2933	16.5110	8.2205	0.0069	0.0034	1.5179	1.4794
0.08	815.0206	1237.0828	84.7577	57.3419	3.9294	1.3070	1.1988
0.10	595.3474	194.9620	172.7311	0.0361	0.0320	1.1948	1.0109
0.20	34.1557	18.3832	8.1400	0.0084	0.0037	0.3404	0.0000
0.25	254.1104	112.3087	37.9123	0.8334	0.2812	0.2548	0.0000
0.50	647.9126	83.9009	83.9001	1.1670	1.1669	0.1295	0.0000
1.00	738.7661	217.3730	204.8212	0.0306	0.0288	0.1237	0.0000
2.00	44.6790	24.0232	9.9814	0.0155	0.0064	0.1682	0.0000
4.00	1567.9249	2663.6274	65.5622	55.6063	1.3688	0.2580	0.0025
5.00	862.8660	222.6293	220.4723	0.0226	0.0224	0.2942	0.0170
6.00	53.1989	28.3828	12.1118	0.0246	0.0105	0.3275	0.0373
8.00	176.0175	73.7215	37.7322	0.6454	0.3300	0.3700	0.0863
10.00	79.9943	41.5943	18.7922	0.0425	0.0192	0.4141	0.1386
15.00	80.7957	38.1473	16.6900	0.2451	0.1070	0.4626	0.2013
20.00	1920.4814	3510.5625	18.4543	17.0534	0.0898	0.4986	0.2473
30.00	317.1024	80.7949	80.7896	10.3658	10.3647	0.5200	0.2853
40.00	50.4316	25.1512	10.0118	0.1088	0.0431	0.5335	0.3061
50.00	248.4489	84.5781	84.5716	16.2928	16.2910	0.5377	0.3145
60.00	1175.4092	197.6494	197.6482	0.0210	0.0210	0.5382	0.3000
80.00	117.6032	58.6404	29.5825	0.0542	0.0274	0.5276	0.2650
90.00	39.0952	19.9434	7.8514	0.0591	0.0231	0.5215	0.2564
100.00	1917.1086	3094.5813	6.4022	3.8562	0.0080	0.5130	0.2527
120.00	37.8396	19.4147	7.8198	0.0496	0.0199	0.5055	0.2735
140.00	38.7104	19.7894	8.2465	0.0377	0.0157	0.5106	0.2959
160.00	193.2375	89.3834	50.5064	0.0558	0.0315	0.5112	0.2988
180.00	38.8668	19.8472	8.3671	0.0329	0.0138	0.5131	0.3072
200.00	40.4032	20.4247	9.3857	0.0232	0.0107	0.5101	0.3102
250.00	354.1446	423.1427	104.5756	52.3713	12.9461	0.4987	0.3015
300.00	1117.6539	138.2324	138.2310	0.1722	0.1722	0.4721	0.2673
400.00	297.9837	123.3905	82.1122	0.0461	0.0307	0.4188	0.2063
600.00	35.8189	18.3753	9.3289	0.0116	0.0059	0.4420	0.2949
1000.00	134.5239	82.4899	4.2614	0.1497	0.0077	0.6132	0.6132

3.2 Ref

Table S3. Values for H2O in Ref

pressure	loss CH4	prim. prod. H2O	prim. loss H2O	sec. prod. H2O	sec. loss H2O	direct yield	effective yield
[hPa]	[nmol mol-1 yr-1]	[nmol mol-1 yr-1]	[nmol mol-1 yr-1]	[nmol mol-1 yr-1]	[nmol mol-1 yr-1]	[-]	[-]
0.01	1916.8042	1086.3535	1048.9749	1185.1133	1144.3433	0.5668	0.0408
0.02	1919.5883	1367.3448	1313.4905	2371.8792	2278.3296	0.7123	0.0768
0.04	1565.6472	1481.0541	1394.4912	5921.4658	5575.2847	0.9460	0.2764
0.06	808.8222	912.3744	876.5737	5038.4727	4841.4878	1.1280	0.2878
0.08	319.7195	447.2575	438.0138	2990.5637	2929.2996	1.3989	0.2205
0.10	341.1670	521.3764	508.8003	3623.2104	3536.2605	1.5282	0.2917
0.20	214.6349	429.2681	428.2884	2916.2593	2909.4502	2.0000	0.0363
0.25	279.8951	559.7884	558.3185	3872.8921	3862.5020	2.0000	0.0424
0.50	580.3633	1160.7261	1077.1849	4830.4058	4482.5776	2.0000	0.7433
1.00	1063.3245	2126.6477	1140.1077	2457.7378	1317.6302	2.0000	2.0000
2.00	1187.9875	2375.9729	576.9183	761.9608	185.0425	2.0000	2.0000
4.00	895.0134	1778.7972	292.5617	350.1597	57.5985	1.9875	1.9875
5.00	769.0637	1506.1696	203.6251	235.4593	31.8355	1.9584	1.9584
6.00	617.5189	1188.6660	140.1327	158.8602	18.7292	1.9249	1.9249
8.00	449.4256	844.3197	79.2058	87.4038	8.1997	1.8787	1.8787
10.00	307.7070	564.2828	54.7397	60.6180	5.8805	1.8338	1.8338
15.00	205.2432	366.9352	30.6975	33.4976	2.8024	1.7878	1.7878
20.00	125.0500	218.0648	19.1280	20.9642	1.8389	1.7438	1.7438
30.00	89.5452	153.6822	8.9137	9.4615	0.5488	1.7163	1.7162
40.00	61.5042	104.2324	4.1206	4.2904	0.1696	1.6947	1.6947
50.00	55.4957	94.0130	2.3572	2.4183	0.0606	1.6941	1.6941
60.00	41.5033	70.1394	1.2526	1.2761	0.0228	1.6900	1.6900
80.00	34.9607	59.4718	0.5952	0.5976	0.0060	1.7011	1.7010
90.00	36.3509	62.0817	0.4557	0.4476	0.0033	1.7078	1.7075
100.00	38.7497	66.3182	0.3711	0.3451	0.0019	1.7115	1.7107
120.00	45.8798	78.2013	0.5046	0.4107	0.0026	1.7045	1.7024
140.00	48.8163	82.8270	1.0747	0.9208	0.0112	1.6967	1.6933
160.00	52.2214	88.7913	1.5558	1.3972	0.0210	1.7003	1.6968
180.00	49.4261	83.2931	2.3941	2.3052	0.0421	1.6852	1.6826
200.00	49.6510	83.1572	2.7342	2.6752	0.0513	1.6748	1.6726
250.00	56.1950	93.3549	3.4830	3.4534	0.0684	1.6613	1.6595
300.00	70.8472	118.3622	4.2906	4.2769	0.0792	1.6707	1.6694
400.00	123.4280	210.8178	6.9562	6.9284	0.1154	1.7080	1.7069
600.00	270.5331	425.7514	10.7052	8.7467	0.1112	1.5737	1.5661
1000.00	389.8932	553.6271	4.0120	2.6731	0.0098	1.4199	1.4199

Table S4. Values for H2 in Ref

pressure [hPa]	loss CH4 [nmol mol-1 yr-1]	prim. prod. H2 [nmol mol-1 yr-1]	prim. loss H2 [nmol mol-1 yr-1]	sec. prod. H2 [nmol mol-1 yr-1]	sec. loss H2 [nmol mol-1 yr-1]	direct yield [-]	effective yield [-]
0.01	36.3509	18.4479	7.7105	0.0023	0.0009	1.9577	1.9592
0.02	319.7195	402.5815	118.5530	122.3434	36.0357	1.9200	1.9232
0.04	449.4256	163.7093	109.1757	0.0068	0.0045	1.7420	1.7236
0.06	34.9607	17.9573	7.4232	0.0017	0.0007	1.4651	1.4121
0.08	808.8222	1185.0426	162.1303	138.1292	18.9011	1.2592	1.1583
0.10	617.5189	197.1238	150.7504	0.0075	0.0057	1.1024	0.8573
0.20	41.5033	21.4047	8.5026	0.0016	0.0007	0.2795	0.0000
0.25	270.5331	111.7407	37.6832	0.8101	0.2731	0.2259	0.0000
0.50	580.3634	75.2228	75.2219	3.3326	3.3323	0.1296	0.0000
1.00	769.0637	215.7597	183.8005	0.0075	0.0064	0.1183	0.0000
2.00	55.4957	28.1749	11.1765	0.0024	0.0010	0.1550	0.0000
4.00	1565.6472	2727.3469	153.7818	132.4532	7.4700	0.2385	0.0125
5.00	895.0134	213.4234	202.1929	0.0064	0.0060	0.2805	0.0416
6.00	61.5042	31.3171	12.5238	0.0038	0.0015	0.3192	0.0751
8.00	123.4280	57.7362	24.6907	0.4303	0.1837	0.3643	0.1213
10.00	89.5452	44.3419	18.9230	0.0061	0.0026	0.4060	0.1662
15.00	70.8472	34.3793	13.1360	0.1665	0.0635	0.4444	0.2122
20.00	1919.5883	3685.5903	48.8383	55.7574	0.7396	0.4802	0.2563
30.00	279.8951	63.2418	63.2383	19.2653	19.2637	0.4952	0.2839
40.00	56.1950	27.1117	9.7868	0.0751	0.0270	0.5092	0.3056
50.00	214.6349	59.9931	59.9895	22.5709	22.5691	0.5077	0.3063
60.00	1187.9875	184.1197	184.1172	0.0052	0.0052	0.5157	0.3109
80.00	125.0500	60.0512	28.0084	0.0086	0.0040	0.5136	0.3013
90.00	49.6510	23.8813	8.5974	0.0393	0.0141	0.5075	0.2954
100.00	1916.8042	3752.4705	12.1424	15.1728	0.0492	0.4999	0.2922
120.00	49.4261	23.7615	8.7057	0.0324	0.0118	0.4856	0.2962
140.00	52.2214	24.8176	9.3376	0.0228	0.0086	0.4808	0.3014
160.00	205.2432	91.2163	47.6608	0.0079	0.0041	0.4752	0.2967
180.00	48.8163	23.4725	8.7713	0.0187	0.0070	0.4807	0.3050
200.00	45.8798	22.2784	8.6929	0.0101	0.0040	0.4810	0.3083
250.00	341.1670	376.0900	149.9699	110.3882	44.0293	0.4825	0.3092
300.00	1063.3245	125.7608	125.7594	0.0780	0.0780	0.4853	0.3013
400.00	307.7070	124.9258	73.7913	0.0072	0.0042	0.4678	0.2697
600.00	38.7497	19.3692	8.0468	0.0035	0.0014	0.4130	0.2757
1000.00	389.8932	177.3043	16.6462	0.3442	0.0323	0.4548	0.4548

3.3 SS01

Table S5. Values for H2O in SS01

pressure	loss CH4	prim. prod. H2O	prim. loss H2O	sec. prod. H2O	sec. loss H2O	direct yield	effective yield
[hPa]	[nmol mol ⁻¹ yr ⁻¹]	[nmol mol ⁻¹ yr ⁻¹]	[nmol mol ⁻¹ yr ⁻¹]	[nmol mol ⁻¹ yr ⁻¹]	[nmol mol ⁻¹ yr ⁻¹]	[-]	[-]
0.01	1916.4918	648.9949	646.4947	505.8346	503.8989	0.3386	0.0023
0.02	1918.7546	1274.8889	1268.1830	1362.7478	1355.5673	0.6644	0.0072
0.04	1561.7603	1498.7343	1481.7581	3727.7241	3685.8247	0.9596	0.0377
0.06	801.9331	907.6525	903.9208	1818.5702	1811.5344	1.1318	0.0134
0.08	310.8306	439.9582	439.7443	1030.1494	1029.9108	1.4154	0.0015
0.10	328.7188	501.1739	500.8932	1230.3495	1229.9161	1.5246	0.0022
0.20	190.9330	381.8643	381.9021	935.7492	935.8069	2.0000	-0.0005
0.25	246.9136	493.8255	493.8717	1260.8860	1260.9547	2.0000	-0.0005
0.50	501.2253	955.6842	955.7430	1931.9720	1932.0178	1.9067	-0.0002
1.00	886.6048	1700.8844	1630.4633	4364.6538	4183.8838	1.9184	0.2833
2.00	967.9517	1915.0850	1264.9290	2832.9390	1871.2062	1.9785	1.6653
4.00	728.7657	1412.1588	687.0246	1274.2139	619.9307	1.9377	1.8928
5.00	629.6415	1192.8501	484.8236	811.8930	329.9937	1.8945	1.8898
6.00	506.9423	942.5328	339.0827	529.5964	190.5278	1.8593	1.8592
8.00	370.8450	674.2853	197.3300	278.9563	81.6377	1.8182	1.8182
10.00	252.0401	446.6481	135.8468	195.2029	59.3701	1.7721	1.7721
15.00	165.1342	284.9094	74.6688	101.1696	26.5142	1.7253	1.7252
20.00	97.4300	163.8911	45.0675	62.1399	17.0873	1.6821	1.6820
30.00	66.8627	110.5772	19.7987	24.1113	4.3170	1.6538	1.6537
40.00	43.2429	70.6204	8.2790	9.3792	1.0995	1.6331	1.6331
50.00	37.5273	61.2516	4.3699	4.7070	0.3358	1.6322	1.6322
60.00	25.8492	42.2400	2.0657	2.1736	0.1063	1.6341	1.6342
80.00	19.5035	32.2898	0.8412	0.8624	0.0224	1.6556	1.6555
90.00	19.5982	32.6015	0.6030	0.6076	0.0112	1.6635	1.6632
100.00	20.3775	33.9462	0.4560	0.4450	0.0060	1.6659	1.6650
120.00	23.4725	38.7521	0.5404	0.4901	0.0066	1.6510	1.6485
140.00	24.7600	40.6171	0.9614	0.8990	0.0160	1.6404	1.6373
160.00	26.4438	43.4358	1.2347	1.1841	0.0228	1.6426	1.6398
180.00	24.9944	40.7031	1.4276	1.4160	0.0276	1.6285	1.6269
200.00	25.1002	40.5931	1.5208	1.5163	0.0303	1.6172	1.6159
250.00	28.3674	45.4227	1.7931	1.7892	0.0360	1.6012	1.5998
300.00	35.6866	57.4276	2.1333	2.1324	0.0398	1.6092	1.6081
400.00	62.0087	101.7611	3.3808	3.3708	0.0563	1.6411	1.6400
600.00	135.6708	197.0716	4.9929	3.9867	0.0508	1.4526	1.4448
1000.00	195.2386	250.3074	1.8298	1.1651	0.0043	1.2821	1.2821

Table S6. Values for H2 in SS01

pressure [hPa]	loss CH4 [nmol mol ⁻¹ yr ⁻¹]	prim. prod. H2 [nmol mol ⁻¹ yr ⁻¹]	prim. loss H2 [nmol mol ⁻¹ yr ⁻¹]	sec. prod. H2 [nmol mol ⁻¹ yr ⁻¹]	sec. loss H2 [nmol mol ⁻¹ yr ⁻¹]	direct yield [-]	effective yield [-]
0.01	19.5982	10.7282	4.0564	0.0010	0.0004	1.3848	1.3877
0.02	310.8306	303.0025	100.9256	45.4398	15.1415	1.4426	1.4527
0.04	370.8450	156.9617	89.9165	0.0126	0.0072	1.4294	1.4396
0.06	19.5035	10.7583	3.9832	0.0007	0.0003	1.1287	1.0983
0.08	801.9331	905.1032	136.1367	131.6170	19.8026	0.9748	0.7476
0.10	506.9423	191.8873	125.5017	0.0154	0.0101	0.8949	0.5877
0.20	25.8492	14.3603	4.8739	0.0009	0.0003	0.2053	0.0000
0.25	135.6708	69.2656	18.1339	0.4817	0.1260	0.1786	0.0000
0.50	501.2253	66.1055	66.1049	1.3790	1.3789	0.1319	0.0000
1.00	629.6414	213.4654	156.2828	0.0166	0.0122	0.1311	0.0000
2.00	37.5273	20.7090	6.8870	0.0018	0.0006	0.1833	0.0000
4.00	1561.7603	2232.4202	161.1999	190.8134	13.7811	0.2930	0.0475
5.00	728.7657	213.5024	178.8970	0.0169	0.0142	0.3390	0.0908
6.00	43.2429	23.9389	8.0543	0.0034	0.0012	0.3785	0.1310
8.00	62.0087	33.4408	12.4239	0.2475	0.0917	0.4233	0.1808
10.00	66.8627	36.3949	13.2295	0.0076	0.0028	0.4638	0.2276
15.00	35.6866	19.4946	6.4362	0.0898	0.0295	0.5007	0.2748
20.00	1918.7546	2767.8999	74.9014	97.0992	2.6284	0.5320	0.3181
30.00	246.9136	44.0994	44.0973	5.2300	5.2297	0.5443	0.3465
40.00	28.3674	15.3265	4.7423	0.0384	0.0118	0.5536	0.3674
50.00	190.9330	39.2001	39.1980	6.1183	6.1180	0.5518	0.3683
60.00	967.9515	177.3884	177.3862	0.0175	0.0175	0.5555	0.3670
80.00	97.4300	51.8297	20.8491	0.0137	0.0055	0.5516	0.3474
90.00	25.1002	13.4666	4.1603	0.0193	0.0059	0.5474	0.3405
100.00	1916.4918	2653.8635	19.5267	25.4585	0.1874	0.5422	0.3386
120.00	24.9944	13.3891	4.2216	0.0157	0.0049	0.5351	0.3512
140.00	26.4438	14.0311	4.5558	0.0110	0.0036	0.5340	0.3615
160.00	165.1342	82.6896	37.3158	0.0135	0.0061	0.5306	0.3586
180.00	24.7600	13.2226	4.2787	0.0089	0.0029	0.5357	0.3672
200.00	23.4725	12.5612	4.3206	0.0047	0.0016	0.5365	0.3713
250.00	328.7188	294.1756	122.5368	36.9261	15.3875	0.5403	0.3740
300.00	886.6049	116.2059	116.2046	0.3553	0.3553	0.5463	0.3676
400.00	252.0401	116.8858	59.5354	0.0134	0.0068	0.5393	0.3414
600.00	20.3775	11.0497	4.1502	0.0015	0.0006	0.5105	0.3795
1000.00	195.2386	107.2068	6.6770	0.2018	0.0126	0.5491	0.5491

3.4 SS02

Table S7. Values for H2O in SS02

pressure	loss CH4	prim. prod. H2O	prim. loss H2O	sec. prod. H2O	sec. loss H2O	direct yield	effective yield
[hPa]	[nmol mol ⁻¹ yr ⁻¹]	[nmol mol ⁻¹ yr ⁻¹]	[nmol mol ⁻¹ yr ⁻¹]	[nmol mol ⁻¹ yr ⁻¹]	[nmol mol ⁻¹ yr ⁻¹]	[-]	[-]
0.01	1916.2720	71.6682	71.6685	6.0385	6.0386	0.0374	-0.0000
0.02	1918.1202	140.5200	140.5212	26.9649	26.9655	0.0733	-0.0000
0.04	1558.6752	274.0238	274.0450	137.8101	137.8266	0.1758	-0.0000
0.06	796.4383	151.2874	151.3091	90.7788	90.7982	0.1900	-0.0001
0.08	303.7297	85.5789	85.5912	55.3986	55.4100	0.2818	-0.0001
0.10	318.7704	115.0628	115.0802	75.3997	75.4150	0.3610	-0.0001
0.20	171.9750	112.5759	112.5875	75.9244	75.9303	0.6546	-0.0001
0.25	220.5317	169.2188	169.2352	114.9273	114.9351	0.7673	-0.0001
0.50	437.9152	429.2071	429.2343	322.7821	322.7906	0.9801	-0.0001
1.00	745.2243	1015.9248	1015.9476	1369.2640	1369.2703	1.3632	-0.0000
2.00	791.9167	1266.1801	1266.2045	3017.6399	3017.6433	1.5989	-0.0000
4.00	595.7649	916.6845	916.6895	2269.1021	2269.0835	1.5387	0.0000
5.00	518.1020	774.7303	774.7334	1901.1782	1901.1635	1.4953	0.0000
6.00	418.4800	600.0106	600.0101	1434.5537	1434.5374	1.4338	0.0000
8.00	307.9801	425.0742	425.0761	1000.9892	1000.9828	1.3802	0.0000
10.00	207.5064	262.7709	262.7739	524.3085	524.3049	1.2663	0.0000
15.00	133.0469	157.0328	157.0344	273.2870	273.2207	1.1803	0.0005
20.00	75.3339	81.4447	81.4341	119.1172	117.8388	1.0811	0.0171
30.00	48.7168	56.8910	56.3587	89.5712	80.8718	1.1678	0.1895
40.00	28.6339	37.0780	32.3809	50.2396	32.2129	1.2949	0.7936
50.00	23.1527	32.4973	21.1383	33.1306	15.3641	1.4036	1.2580
60.00	13.3260	19.4221	6.7207	8.6247	1.9326	1.4575	1.4553
80.00	7.1377	10.8839	1.5133	1.6607	0.1417	1.5248	1.5256
90.00	6.1959	9.6328	0.9366	0.9998	0.0601	1.5547	1.5552
100.00	5.6798	8.9551	0.6117	0.6380	0.0272	1.5767	1.5765
120.00	5.5468	8.6794	0.4044	0.4093	0.0111	1.5648	1.5637
140.00	5.5150	8.5917	0.3578	0.3664	0.0080	1.5579	1.5580
160.00	5.8216	9.0815	0.3878	0.3997	0.0088	1.5600	1.5605
180.00	5.4489	8.4631	0.3441	0.3569	0.0072	1.5532	1.5542
200.00	5.4595	8.4193	0.3467	0.3580	0.0073	1.5421	1.5429
250.00	6.1053	9.3020	0.3811	0.3888	0.0079	1.5236	1.5236
300.00	7.5580	11.5624	0.4365	0.4453	0.0084	1.5298	1.5299
400.00	12.8731	19.9701	0.6713	0.6792	0.0114	1.5513	1.5510
600.00	27.7802	35.3341	0.8982	0.6934	0.0089	1.2719	1.2642
1000.00	39.5131	43.5487	0.3195	0.1916	0.0007	1.1021	1.1021

Table S8. Values for H2 in SS02

pressure [hPa]	loss CH4 [nmol mol-1 yr-1]	prim. prod. H2 [nmol mol-1 yr-1]	prim. loss H2 [nmol mol-1 yr-1]	sec. prod. H2 [nmol mol-1 yr-1]	sec. loss H2 [nmol mol-1 yr-1]	direct yield [-]	effective yield [-]
0.01	6.1959	3.6576	1.0579	0.0003	0.0001	0.9940	0.9606
0.02	303.7297	256.4054	78.9012	2.4025	0.7397	1.0017	0.9212
0.04	307.9801	153.9385	72.1560	0.1105	0.0518	1.0056	0.9410
0.06	7.1377	4.2297	1.1327	0.0002	0.0000	0.9568	0.8377
0.08	796.4383	762.0050	100.1964	6.1796	0.8129	0.8442	0.5899
0.10	418.4800	191.9428	101.1732	0.1076	0.0567	0.8028	0.5123
0.20	13.3260	7.9742	1.8073	0.0007	0.0001	0.1757	0.0000
0.25	27.7802	17.6233	2.5444	0.0938	0.0135	0.1613	0.0000
0.50	437.9151	59.8329	59.8324	0.0749	0.0749	0.1366	0.0000
1.00	518.1020	218.0794	127.5337	0.1044	0.0611	0.1432	0.0000
2.00	23.1527	13.8732	3.2202	0.0040	0.0008	0.2179	0.0003
4.00	1558.6752	1567.3640	114.1221	14.5478	1.0596	0.3710	0.1228
5.00	595.7649	221.0570	147.8984	0.0800	0.0535	0.4209	0.1748
6.00	28.6339	17.1913	4.2225	0.0130	0.0028	0.4587	0.2170
8.00	12.8731	7.9488	2.1490	0.0479	0.0129	0.4998	0.2657
10.00	48.7168	29.0460	8.3007	0.0431	0.0120	0.5335	0.3092
15.00	7.5580	4.6381	1.0647	0.0179	0.0041	0.5648	0.3539
20.00	1918.1202	1921.3562	167.9019	14.8349	1.2966	0.5869	0.3939
30.00	220.5317	35.5822	35.5805	0.2767	0.2767	0.5962	0.4265
40.00	6.1053	3.6890	0.7878	0.0079	0.0016	0.6004	0.4533
50.00	171.9750	30.2167	30.2149	0.3197	0.3197	0.5992	0.4603
60.00	791.9167	172.5675	172.3449	0.0210	0.0210	0.5984	0.4628
80.00	75.3339	44.2103	14.5768	0.0655	0.0215	0.5926	0.4339
90.00	5.4595	3.2631	0.7050	0.0040	0.0008	0.5903	0.4196
100.00	1916.2720	1904.8350	72.4220	8.6097	0.3274	0.5875	0.4132
120.00	5.4489	3.2465	0.7198	0.0032	0.0007	0.5884	0.4355
140.00	5.8216	3.4436	0.7876	0.0023	0.0005	0.5917	0.4557
160.00	133.0469	75.1441	28.1136	0.0936	0.0350	0.5915	0.4565
180.00	5.5150	3.2631	0.7514	0.0019	0.0004	0.5958	0.4642
200.00	5.5468	3.2639	0.8491	0.0011	0.0002	0.5977	0.4691
250.00	318.7704	255.9192	93.9760	2.1778	0.8001	0.6042	0.4762
300.00	745.2243	106.7504	106.7494	0.0294	0.0294	0.6137	0.4746
400.00	207.5064	110.7126	46.6048	0.0972	0.0409	0.6175	0.4533
600.00	5.6798	3.3371	0.9907	0.0004	0.0001	0.6344	0.5457
1000.00	39.5131	26.7624	0.5844	0.0343	0.0007	0.6773	0.6773

3.5 SS03

Table S9. Values for H2O in SS03

pressure	loss CH4	prim. prod. H2O	prim. loss H2O	sec. prod. H2O	sec. loss H2O	direct yield	effective yield
[hPa]	[nmol mol-1 yr-1]	[nmol mol-1 yr-1]	[nmol mol-1 yr-1]	[nmol mol-1 yr-1]	[nmol mol-1 yr-1]	[-]	[-]
0.01	1916.2512	57.2777	57.2778	1.8267	1.8267	0.0299	-0.0000
0.02	1918.0458	87.5657	87.5662	7.9537	7.9539	0.0457	-0.0000
0.04	1558.2920	123.4414	123.4480	36.1690	36.1730	0.0792	-0.0000
0.06	795.7528	71.7501	71.7554	27.3894	27.3944	0.0902	-0.0000
0.08	302.8428	39.3191	39.3219	17.7565	17.7599	0.1298	-0.0000
0.10	317.5275	53.4506	53.4551	25.2578	25.2627	0.1683	-0.0000
0.20	169.6055	64.5030	64.5095	32.6402	32.6428	0.3803	-0.0001
0.25	217.2341	104.5519	104.5620	53.1251	53.1287	0.4813	-0.0001
0.50	430.0014	335.0852	335.1062	213.0798	213.0844	0.7793	-0.0001
1.00	727.5515	941.6185	941.6392	1214.5675	1214.5709	1.2942	-0.0000
2.00	769.9118	1211.2266	1211.2478	2661.9041	2661.8967	1.5732	-0.0000
4.00	579.1397	825.4896	825.4860	1580.2598	1580.2368	1.4254	0.0000
5.00	504.1595	675.0144	675.0089	1244.2352	1244.2170	1.3389	0.0000
6.00	407.4222	512.9369	512.9288	925.4190	925.3988	1.2590	0.0001
8.00	300.1220	352.5341	352.5305	601.4781	601.4671	1.1746	0.0000
10.00	201.9397	213.1851	213.1843	307.6684	307.6629	1.0557	0.0000
15.00	129.0360	124.8427	124.8415	158.4200	158.4015	0.9675	0.0002
20.00	72.5719	66.9920	66.9815	78.9570	78.2788	0.9231	0.0095
30.00	46.4485	47.9700	47.5188	64.3708	58.4597	1.0328	0.1370
40.00	26.8078	32.0249	27.9635	39.6048	25.4780	1.1946	0.6785
50.00	21.3558	27.7330	20.9989	30.2864	15.2236	1.2986	1.0207
60.00	11.7606	16.1610	7.1338	9.1856	2.2850	1.3742	1.3543
80.00	5.5920	8.0734	1.3492	1.4911	0.1362	1.4437	1.4448
90.00	4.5206	6.6723	0.7857	0.8441	0.0545	1.4760	1.4768
100.00	3.8426	5.7989	0.4829	0.5077	0.0233	1.5091	1.5095
120.00	3.3060	5.0731	0.2696	0.2772	0.0078	1.5345	1.5344
140.00	3.1093	4.7770	0.2094	0.2183	0.0048	1.5363	1.5376
160.00	3.2439	4.9958	0.2214	0.2320	0.0051	1.5401	1.5418
180.00	3.0058	4.6256	0.1891	0.1993	0.0040	1.5389	1.5409
200.00	3.0044	4.5947	0.1898	0.1990	0.0041	1.5293	1.5310
250.00	3.3225	5.0194	0.2068	0.2140	0.0044	1.5107	1.5116
300.00	4.0419	6.1209	0.2329	0.2407	0.0045	1.5144	1.5152
400.00	6.7311	10.2797	0.3489	0.3567	0.0060	1.5272	1.5274
600.00	14.2938	17.7077	0.4518	0.3515	0.0045	1.2388	1.2315
1000.00	20.0473	21.4133	0.1571	0.0932	0.0003	1.0681	1.0681

Table S10. Values for H2 in SS03

pressure [hPa]	loss CH4 [nmol mol-1 yr-1]	prim. prod. H2 [nmol mol-1 yr-1]	prim. loss H2 [nmol mol-1 yr-1]	sec. prod. H2 [nmol mol-1 yr-1]	sec. loss H2 [nmol mol-1 yr-1]	direct yield [-]	effective yield [-]
0.01	4.5206	2.7055	0.6576	0.0002	0.0000	0.9759	0.9307
0.02	302.8428	254.2942	76.2837	0.7793	0.2339	0.9740	0.8822
0.04	300.1220	153.8022	69.7075	0.0881	0.0399	0.9838	0.9185
0.06	5.5920	3.3557	0.7478	0.0002	0.0000	0.9490	0.8316
0.08	795.7528	755.1970	95.2530	2.0687	0.2610	0.8397	0.5896
0.10	407.4222	192.4424	97.7455	0.0869	0.0441	0.8001	0.5161
0.20	11.7606	7.1185	1.3961	0.0007	0.0001	0.1752	0.0000
0.25	14.2938	9.4509	0.9724	0.0416	0.0043	0.1613	0.0000
0.50	430.0013	59.1531	59.1527	0.0253	0.0253	0.1376	0.0000
1.00	504.1595	219.4490	123.3854	0.0840	0.0472	0.1450	0.0000
2.00	21.3558	12.9492	2.7320	0.0042	0.0008	0.2235	0.0013
4.00	1558.2920	1533.0311	106.1287	4.6379	0.3212	0.3849	0.1377
5.00	579.1397	222.9308	143.2322	0.0659	0.0423	0.4353	0.1906
6.00	26.8078	16.2802	3.7144	0.0108	0.0022	0.4723	0.2325
8.00	6.7311	4.2638	0.9576	0.0238	0.0053	0.5125	0.2804
10.00	46.4485	28.0440	7.6498	0.0319	0.0085	0.5445	0.3225
15.00	4.0419	2.5446	0.4937	0.0101	0.0018	0.5744	0.3663
20.00	1918.0458	1868.2346	180.3870	4.8048	0.4640	0.5949	0.4058
30.00	217.2341	35.0426	35.0409	0.0849	0.0849	0.6038	0.4396
40.00	3.3225	2.0552	0.3780	0.0048	0.0007	0.6073	0.4691
50.00	169.6055	29.7069	29.7051	0.0977	0.0977	0.6064	0.4786
60.00	769.9118	172.1023	171.1051	0.0162	0.0161	0.6053	0.4866
80.00	72.5719	43.1702	13.7555	0.0483	0.0153	0.6001	0.4664
90.00	3.0044	1.8339	0.3460	0.0025	0.0004	0.5985	0.4530
100.00	1916.2512	1869.9966	88.8331	2.3706	0.1126	0.5962	0.4446
120.00	3.0058	1.8270	0.3537	0.0020	0.0003	0.5984	0.4618
140.00	3.2439	1.9560	0.3879	0.0014	0.0002	0.6025	0.4821
160.00	129.0360	74.1222	26.8961	0.0703	0.0255	0.6030	0.4838
180.00	3.1093	1.8733	0.3754	0.0011	0.0002	0.6078	0.4907
200.00	3.3060	1.9783	0.4522	0.0007	0.0001	0.6104	0.4960
250.00	317.5275	254.0694	90.6481	0.6981	0.2492	0.6186	0.5060
300.00	727.5515	105.5051	105.5040	0.0125	0.0125	0.6296	0.5095
400.00	201.9397	109.9502	44.8696	0.0760	0.0310	0.6334	0.4939
600.00	3.8426	2.2911	0.5828	0.0003	0.0000	0.6612	0.5958
1000.00	20.0473	13.9727	0.1841	0.0120	0.0002	0.6970	0.6970

3.6 SS04

Table S11. Values for H₂O in SS04

pressure	loss CH ₄	prim. prod. H ₂ O	prim. loss H ₂ O	sec. prod. H ₂ O	sec. loss H ₂ O	direct yield	effective yield
[hPa]	[nmol mol ⁻¹ yr ⁻¹]	[nmol mol ⁻¹ yr ⁻¹]	[nmol mol ⁻¹ yr ⁻¹]	[nmol mol ⁻¹ yr ⁻¹]	[nmol mol ⁻¹ yr ⁻¹]	[-]	[-]
0.01	1916.2366	48.3526	48.3526	0.2489	0.2489	0.0252	0.0000
0.02	1917.9882	53.1589	53.1590	0.9566	0.9566	0.0277	-0.0000
0.04	1557.9861	51.7857	51.7856	3.8459	3.8461	0.0332	-0.0000
0.06	795.2046	30.3480	30.3459	3.3050	3.3054	0.0382	0.0000
0.08	302.1334	13.8428	13.8409	2.2613	2.2616	0.0458	0.0000
0.10	316.5334	18.8425	18.8407	3.6429	3.6434	0.0595	0.0000
0.20	167.7099	29.3744	29.3772	7.2611	7.2616	0.1752	-0.0000
0.25	214.5961	54.8070	54.8120	14.0636	14.0643	0.2554	-0.0000
0.50	423.6704	263.3580	263.3736	123.9371	123.9378	0.6216	-0.0000
1.00	713.4132	773.1735	773.1869	852.8061	852.8029	1.0838	-0.0000
2.00	752.3080	1027.5138	1027.5266	1460.9475	1460.9363	1.3658	-0.0000
4.00	565.8395	631.4210	631.4160	662.0550	662.0446	1.1159	0.0000
5.00	493.0054	506.3616	506.3548	483.8403	483.8313	1.0271	0.0000
6.00	398.5758	376.5226	376.5156	341.3628	341.3551	0.9447	0.0000
8.00	293.8355	248.3343	248.3288	220.6348	220.6301	0.8451	0.0000
10.00	197.4863	147.3645	147.3624	120.3364	120.3341	0.7462	0.0000
15.00	125.8273	90.6617	90.6598	73.9790	73.9770	0.7205	0.0000
20.00	70.3623	55.0466	55.0421	51.1527	50.9635	0.7823	0.0028
30.00	44.6339	44.1734	43.8080	51.6834	48.5821	0.9897	0.0777
40.00	25.3469	30.3590	26.5857	36.8204	24.5355	1.1977	0.6335
50.00	19.9184	25.6550	19.4495	28.2637	14.2466	1.2880	1.0153
60.00	10.5083	14.1728	6.3425	8.1197	2.0370	1.3487	1.3240
80.00	4.3554	5.9845	1.0875	1.1993	0.1126	1.3740	1.3739
90.00	3.1804	4.3876	0.5694	0.6111	0.0406	1.3796	1.3799
100.00	2.3728	3.3100	0.3054	0.3207	0.0152	1.3950	1.3950
120.00	1.5135	2.2215	0.1260	0.1297	0.0037	1.4678	1.4678
140.00	1.1848	1.7510	0.0779	0.0812	0.0018	1.4779	1.4791
160.00	1.1817	1.7540	0.0779	0.0816	0.0018	1.4843	1.4860
180.00	1.0512	1.5710	0.0639	0.0676	0.0014	1.4945	1.4967
200.00	1.0404	1.5519	0.0639	0.0675	0.0014	1.4917	1.4939
250.00	1.0963	1.6259	0.0669	0.0704	0.0014	1.4831	1.4850
300.00	1.2291	1.8265	0.0697	0.0734	0.0014	1.4861	1.4880
400.00	1.8176	2.6961	0.0924	0.0960	0.0016	1.4834	1.4844
600.00	3.5047	4.3036	0.1106	0.0913	0.0012	1.2280	1.2221
1000.00	4.4746	4.7488	0.0348	0.0215	0.0001	1.0613	1.0613

Table S12. Values for H2 in SS04

pressure [hPa]	loss CH4 [nmol mol-1 yr-1]	prim. prod. H2 [nmol mol-1 yr-1]	prim. loss H2 [nmol mol-1 yr-1]	sec. prod. H2 [nmol mol-1 yr-1]	sec. loss H2 [nmol mol-1 yr-1]	direct yield [-]	effective yield [-]
0.01	3.1804	1.9315	0.3174	0.0001	0.0000	0.9630	0.9132
0.02	302.1334	253.3274	74.2472	0.1032	0.0303	0.9537	0.8597
0.04	293.8355	153.7450	67.7178	0.0668	0.0294	0.9737	0.9103
0.06	4.3554	2.6463	0.4220	0.0001	0.0000	0.9457	0.8313
0.08	795.2046	752.0619	91.2984	0.3236	0.0393	0.8385	0.5930
0.10	398.5758	192.9511	94.9457	0.0652	0.0321	0.8000	0.5220
0.20	10.5083	6.4240	1.0569	0.0004	0.0000	0.1753	0.0000
0.25	3.5047	2.5253	0.0906	0.0065	0.0002	0.1617	0.0000
0.50	423.6704	58.6296	58.6291	0.0041	0.0041	0.1384	0.0000
1.00	493.0054	220.7265	119.9782	0.0608	0.0331	0.1465	0.0000
2.00	19.9184	12.1983	2.3341	0.0025	0.0004	0.2283	0.0038
4.00	1557.9861	1517.0623	99.4865	0.7424	0.0487	0.3970	0.1507
5.00	565.8395	224.6447	139.3690	0.0447	0.0278	0.4477	0.2044
6.00	25.3469	15.5400	3.3024	0.0066	0.0013	0.4841	0.2460
8.00	1.8176	1.2351	0.1743	0.0082	0.0008	0.5232	0.2929
10.00	44.6339	27.2284	7.1241	0.0212	0.0054	0.5537	0.3338
15.00	1.2291	0.8340	0.1089	0.0049	0.0003	0.5825	0.3768
20.00	1917.9882	1829.2559	180.9671	0.6790	0.0672	0.6015	0.4158
30.00	214.5961	34.6965	34.6948	0.0094	0.0094	0.6100	0.4508
40.00	1.0963	0.7194	0.0925	0.0026	0.0002	0.6131	0.4830
50.00	167.7099	29.3994	29.3977	0.0103	0.0103	0.6124	0.4953
60.00	752.3079	171.7689	168.8842	0.0106	0.0104	0.6113	0.5108
80.00	70.3623	42.3230	13.0886	0.0336	0.0104	0.6076	0.5107
90.00	1.0404	0.6640	0.0888	0.0014	0.0001	0.6073	0.5075
100.00	1916.2366	1845.2938	95.5194	0.2271	0.0118	0.6065	0.5062
120.00	1.0512	0.6645	0.0905	0.0011	0.0001	0.6123	0.5205
140.00	1.1817	0.7356	0.1000	0.0007	0.0000	0.6202	0.5364
160.00	125.8273	73.2914	25.9123	0.0501	0.0177	0.6226	0.5384
180.00	1.1848	0.7348	0.0998	0.0005	0.0000	0.6321	0.5470
200.00	1.5135	0.9267	0.1393	0.0003	0.0000	0.6383	0.5542
250.00	316.5334	253.2272	88.0590	0.0901	0.0313	0.6562	0.5741
300.00	713.4131	104.5050	104.5040	0.0035	0.0035	0.6785	0.5936
400.00	197.4863	109.3427	43.4643	0.0566	0.0225	0.6795	0.5877
600.00	2.3728	1.4391	0.2381	0.0001	0.0000	0.7206	0.6965
1000.00	4.4746	3.1576	0.0118	0.0008	0.0000	0.7057	0.7057

3.7 SS05

Table S13. Values for H2O in SS05

pressure	loss CH4	prim. prod. H2O	prim. loss H2O	sec. prod. H2O	sec. loss H2O	direct yield	effective yield
[hPa]	[nmol mol ⁻¹ yr ⁻¹]	[nmol mol ⁻¹ yr ⁻¹]	[nmol mol ⁻¹ yr ⁻¹]	[nmol mol ⁻¹ yr ⁻¹]	[nmol mol ⁻¹ yr ⁻¹]	[-]	[-]
0.01	1917.4506	1152.0941	972.0172	1046.6910	882.7494	0.6008	0.1794
0.02	1921.2894	1354.5757	1070.4066	1406.5293	1111.1105	0.7050	0.3017
0.04	1573.4655	1532.7096	1091.6971	2516.4966	1792.7393	0.9741	0.7403
0.06	822.6463	926.9048	703.9893	2259.4878	1715.9041	1.1267	0.9317
0.08	337.5310	460.2191	366.2959	1504.2253	1197.1858	1.3635	1.1879
0.10	366.0978	546.7259	409.6069	1491.9966	1117.6855	1.4934	1.3970
0.20	262.0522	524.1026	392.2722	1558.7915	1166.5212	2.0000	2.0000
0.25	345.8707	691.7394	449.8824	1286.3845	836.5033	2.0000	2.0000
0.50	738.6408	1477.2809	599.7045	1009.5035	409.7992	2.0000	2.0000
1.00	1416.7443	2833.4866	463.3571	553.9648	90.6077	2.0000	2.0000
2.00	1628.0342	3256.0657	222.6417	238.9948	16.3530	2.0000	2.0000
4.00	1227.4987	2454.9949	125.3499	132.0970	6.7471	2.0000	2.0000
5.00	1047.9014	2088.6077	92.5751	96.8693	4.2943	1.9931	1.9931
6.00	838.6682	1656.2070	65.8576	68.5848	2.7274	1.9748	1.9748
8.00	606.5847	1176.4484	37.9511	39.2159	1.2651	1.9395	1.9395
10.00	419.0400	796.2705	26.2306	27.1237	0.8935	1.9002	1.9002
15.00	285.4608	530.5683	15.0735	15.5137	0.4407	1.8586	1.8586
20.00	180.2899	327.6204	9.6982	9.9933	0.2958	1.8172	1.8172
30.00	134.9099	241.5629	4.8993	5.0004	0.1014	1.7905	1.7905
40.00	98.0266	173.2125	2.5217	2.5591	0.0373	1.7670	1.7670
50.00	91.4322	161.4018	1.5766	1.5925	0.0156	1.7653	1.7653
60.00	72.8114	127.7538	0.9169	0.9238	0.0066	1.7546	1.7546
80.00	65.8750	115.8137	0.4866	0.4817	0.0020	1.7581	1.7580
90.00	69.8565	123.3021	0.3946	0.3754	0.0012	1.7651	1.7648
100.00	75.4939	133.6683	0.3474	0.2987	0.0008	1.7706	1.7699
120.00	90.6941	160.6455	0.5402	0.3680	0.0012	1.7713	1.7694
140.00	96.9287	171.2260	1.1373	0.8407	0.0056	1.7665	1.7634
160.00	103.7765	183.7637	1.6952	1.3575	0.0124	1.7708	1.7674
180.00	98.2895	172.5836	3.3991	3.1036	0.0481	1.7559	1.7524
200.00	98.7525	172.4551	4.3641	4.1283	0.0720	1.7463	1.7432
250.00	111.8500	194.1436	6.4359	6.3069	0.1205	1.7357	1.7335
300.00	141.1681	246.6561	8.4764	8.4087	0.1533	1.7473	1.7457
400.00	246.2659	440.9796	14.1163	14.0163	0.2313	1.7907	1.7893
600.00	540.2539	913.0054	22.3788	18.4960	0.2337	1.6900	1.6823
1000.00	779.1950	1225.6187	8.7068	6.0023	0.0220	1.5729	1.5729

Table S14. Values for H2 in SS05

pressure [hPa]	loss CH4 [nmol mol-1 yr-1]	prim. prod. H2 [nmol mol-1 yr-1]	prim. loss H2 [nmol mol-1 yr-1]	sec. prod. H2 [nmol mol-1 yr-1]	sec. loss H2 [nmol mol-1 yr-1]	direct yield [-]	effective yield [-]
0.01	69.8565	31.3075	14.7000	0.0054	0.0025	1.8209	1.8206
0.02	337.5310	331.6122	67.8352	12.9766	2.6554	1.7023	1.6983
0.04	606.5847	179.3811	142.6581	0.0056	0.0044	1.2973	1.2597
0.06	65.8750	30.0831	14.0082	0.0039	0.0018	1.1627	1.0682
0.08	822.6463	956.5209	97.6609	22.1988	2.2671	0.9825	0.8121
0.10	838.6682	210.9737	189.8433	0.0058	0.0052	0.8370	0.6030
0.20	72.8114	33.3041	15.3839	0.0034	0.0016	0.1999	0.0000
0.25	540.2539	161.3481	72.9615	1.1051	0.4996	0.1554	0.0000
0.50	738.6408	80.2659	80.2651	0.1661	0.1661	0.1087	0.0000
1.00	1047.9014	225.7224	218.5267	0.0052	0.0051	0.0992	0.0000
2.00	91.4322	40.7070	19.2181	0.0041	0.0019	0.1202	0.0000
4.00	1573.4655	2041.2762	82.7807	24.6621	1.0006	0.1793	0.0000
5.00	1227.4987	220.0991	220.0964	0.0038	0.0038	0.2154	0.0069
6.00	98.0266	43.7379	20.8770	0.0054	0.0026	0.2516	0.0252
8.00	246.2659	90.7785	46.9357	0.6335	0.3273	0.2957	0.0605
10.00	134.9099	57.7337	29.4662	0.0068	0.0035	0.3369	0.0998
15.00	141.1681	56.4971	25.7920	0.2668	0.1216	0.3743	0.1414
20.00	1921.2894	3270.6006	24.8572	17.3760	0.1323	0.4112	0.1829
30.00	345.8707	53.7350	53.7322	0.9706	0.9705	0.4279	0.2096
40.00	111.8500	45.0345	19.4756	0.1290	0.0557	0.4462	0.2332
50.00	262.0522	52.3847	52.3812	2.0913	2.0911	0.4452	0.2350
60.00	1628.0342	195.7267	195.7237	0.0036	0.0036	0.4574	0.2461
80.00	180.2899	74.1418	41.1766	0.0078	0.0043	0.4567	0.2441
90.00	98.7525	39.9971	17.1594	0.0717	0.0307	0.4482	0.2378
100.00	1917.4506	3491.3965	6.4972	5.9922	0.0112	0.4378	0.2326
120.00	98.2895	39.8660	17.3388	0.0602	0.0262	0.4163	0.2283
140.00	103.7765	41.5929	18.5125	0.0438	0.0195	0.4079	0.2286
160.00	285.4608	106.8388	66.4820	0.0067	0.0042	0.4008	0.2226
180.00	96.9287	39.5372	17.4011	0.0367	0.0161	0.4056	0.2295
200.00	90.6941	37.7576	17.0594	0.0212	0.0096	0.4050	0.2317
250.00	366.0978	306.4323	92.8673	10.3323	3.1323	0.4026	0.2292
300.00	1416.7443	140.6035	140.6018	0.0283	0.0283	0.4002	0.2185
400.00	419.0400	141.1785	99.3668	0.0059	0.0041	0.3686	0.1793
600.00	75.4939	33.0509	15.4928	0.0080	0.0037	0.2987	0.1647
1000.00	779.1950	265.8364	38.3675	0.5181	0.0748	0.3412	0.3412